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Foreword

This second volume of the Third International Mathematics and Science Study (TIMSS) 1999 Video Study Technical Report focuses on every aspect of the planning, implementation, processing, analysis, and reporting of the science components of the TIMSS 1999 Video Study. The report is intended to serve as a record of the actions and documentation of outcomes, to be used in interpreting the results and as a reference for future studies.

The TIMSS 1999 Video Study is a complex and ambitious study conducted under the aegis of the International Association for the Evaluation of Educational Achievement (IEA) and managed by the U.S. Department of Education's National Center for Education Statistics (NCES) in cooperation with its study partner, the National Science Foundation. The study researchers collected, transcribed, translated, coded, and analyzed hundreds of hours of videotapes of eighth-grade science lessons in the five participating countries. The design of the study built on the foundations established by the first TIMSS 1995 Video Study, but was improved and carried out through a collaborative process that involved individuals around the globe.

Each of the chapters of this report, and the appendices, focuses on critical steps taken in the planning and implementation of the study, from its initial design to how the data were analyzed. One of the more complex tasks of the study was the development of a coding system that addressed critical questions and was applicable to each country's unique education system. The resulting coding system for the science videos is discussed in detail in this report with the aim of making the system available for review, improvement, and possible application to future studies.

This report follows the release of data focusing on the eighth-grade science lessons made available to the public in April 2006. The report, *Teaching Science in Five Countries: Results From the TIMSS 1999 Video Study* (Roth et al. 2006a), and an executive summary of the findings, *Highlights From the TIMSS 1999 Video Study of Eighth-Grade Teaching Science* (Roth et al. 2006b) are available by going to the NCES web site at http://nces.ed.gov/timss.

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July 2011

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The TIMSS 1999 Video Study was conducted by LessonLab Research Institute (formerly LessonLab, Inc.) under contract to the National Center for Education Statistics, U.S. Department of Education. The U.S. National Science Foundation and the participating countries provided additional funding for the study.

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Chapter 1. Introduction

1.1 Introduction

The Third International Mathematics and Science Study (TIMSS) 1999 Video Study examined classroom teaching practices through in-depth analysis of videotapes of eighth-grade mathematics and science lessons. An update and expansion of the 1995 TIMSS Video Study, the TIMSS 1999 Video Study investigated nationally representative samples of classroom lessons from countries in which students demonstrated relatively high achievement on the TIMSS 1995 assessment (Peak 1996). The TIMSS Video Studies were designed to supplement the information obtained through the TIMSS 1995 and 1999 mathematics and science assessments.

The TIMSS 1999 Video Study was funded primarily by the National Center for Education Statistics (NCES) in the Institute of Education Sciences (IES) of the U.S. Department of Education, and the National Science Foundation (NSF). It was conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA), based in Amsterdam, the Netherlands. The IEA is the sponsoring organization that oversees the development and implementation of TIMSS. Support for the project also was provided by each participating country through the services of a collaborator who guided the sampling and recruiting of participating teachers. In addition, Australia contributed direct support for data collection and processing of its sample of lessons.

This report presents the technical aspects of collecting videotapes of science lessons for the TIMSS 1999 Video Study. A parallel technical report on the mathematics lessons, *Third International Mathematics and Science Study 1999 Video Study Technical Report Volume 1: Mathematics* (Jacobs et al. 2003), was released separately and is available on the NCES web site at http://nces.ed.gov/timss. Aspects of conducting the science component of the TIMSS 1999 Video Study are exactly the same as some aspects of the mathematics component of the study. To minimize duplication between the two TIMSS 1999 Video Study technical reports, the reader will be directed to chapters of the technical report for the mathematics component for detailed information. For example, the videotaping procedures used in classrooms were the same in both the mathematics and science components of the study. To learn about the videotaping procedures, the reader is therefore directed to chapter 4, section 3 of the mathematics technical report (Jacobs et al. 2003).

1.2 Goals

The broad goal of the science portion of the TIMSS 1999 Video Study was to describe and investigate teaching practices in eighth-grade science in a variety of countries including several countries with varying cultural traditions and with high science achievement among its students, as assessed through the TIMSS 1995 mathematics assessment (Peak 1996). The participating countries in the science component of the TIMSS 1999 Video Study were Australia, the Czech Republic, Japan, the Netherlands, and the United States. In addition to the broad goal of describing eighth-grade science teaching in these five countries, the TIMSS 1999 Video Study had the following research objectives:

- To develop objective, observational measures of classroom instruction to serve as appropriate quantitative indicators of teaching practices in each country;
- To compare teaching practices among countries and identify lesson features that are similar or different across countries; and
- To describe patterns of teaching practices within each country.

1.3 Design of the Study

The TIMSS 1999 Video Study was designed to describe eighth-grade mathematics and science teaching in each participating country. The method employed was the video survey (Stigler, Gallimore, and Hiebert 2000). Video surveys allow researchers to integrate the qualitative and quantitative study of classroom teaching across cultures, increasing the chances of capturing not only universal quantitative indicators but culturally-particular qualitative categories as well. Video surveys combine videotaping with national probability sampling. Qualitative analyses of video can be validated against a national sample of videos. Quantitative analyses are rendered more interpretable by being efficiently linked to specific video examples of the categories coded.

Some of the challenges of studying teaching using video include creating standardized camera procedures, minimizing observer effects, and maintaining acceptable levels of coding reliability. As this report will describe, a detailed data collection protocol was developed and tested (see chapter 3) and several questionnaire items assessed teachers' perceived degree of bias due to the video camera (see chapter 4).

Other challenges of video studies have to do with sampling strategies. To provide national-level pictures of teaching, the study videotaped each teacher once, conducting a single classroom lesson. It should be clear that taping only one lesson per teacher shapes the kinds of conclusions that can be drawn about instruction. Teaching involves more than constructing and implementing lessons. It also involves weaving together multiple lessons into units that stretch out over days and weeks. Inferences about the full range of teaching practices and dynamics that might appear in a unit cannot necessarily be made, even at the aggregate level, based on examining a single lesson per teacher. Consequently, the interpretive frame of the TIMSS 1999 Video Study is properly restricted to national-level descriptions and comparisons.

Another sampling issue concerns the way in which content is sampled. Eighth-grade science courses are composed of different topics, and teaching may look different for different topics. Decisions about how to sample depend, again, on the goal of the study. To get a nationally-representative picture of eighth-grade science teaching, the best procedure is to randomly select lessons across the school year. Different countries use different curricula and move through different sets of topics. The only reasonable way to deal with this variation is to sample steadily across the school year and to randomly select lessons at each point.

It might appear desirable to control for content by sampling the same topics in the curriculum in each country, but this turns out to be virtually impossible. Different curricula and different teachers across countries often define topics so uniquely that the resulting samples become less rather than more comparable. If the researchers' goal is to compare the teaching of particular topics, and if the topics are selected and defined so there is a shared understanding of the material to be taught, then controlling for topic is a reasonable approach. But such a study would have a different goal than the one reported here.

The fact that images of teachers and students appear on the tapes makes it more difficult than usual to protect the confidentiality of study participants. This continues to be a serious issue when the data set is used for secondary analyses. The question is what procedures to establish to allow continued access to video data by researchers interested in secondary analysis (Arafeh and McLaughlin 2002). One option is to disguise the participants by blurring their faces on the video. This can be accomplished with digital video editing tools, but it is expensive at present to do so for an entire data set. A more practical approach, and the one employed for this study, is to define special access procedures that will protect the confidentiality of participants while still making the videos available as part of a restricted-use data set.

1.4 Overview of the Technical Report

This report provides a full description of the methods used to conduct the TIMSS 1999 Video Study. In chapter 2 there is a full description of the sampling approach implemented in each country. Chapter 3 details how the data were collected, processed, and managed. Chapter 4 describes the questionnaires collected from the teachers in the videotaped lessons, including how they were developed and coded. Chapter 5 provides details about the codes applied to the video data by a team of international coders as well as several specialist groups. Chapter 6 describes procedures for coding the content and the classroom discourse of the video data by specialists. Lastly, in chapter 7, information is provided regarding the weights and variance estimates used in the data analyses. There are also numerous appendices to this report, including the questionnaires and manuals used for data collection, transcription, and coding. The list of research participants is provided in appendix A.

Chapter 2. Sampling

2.1 Introduction

The TIMSS 1999 Video Study was designed to provide comparable information about nationally-representative samples of mathematics and science lessons in participating countries. To make the comparisons valid, it was necessary to devise a sampling design for each country that called for uniformity in sampling procedures but also allowed participating countries to account for differences in educational systems, as well as implementation limitations. In general, the sampling plan for the TIMSS 1999 Video Study followed the standards and procedures agreed to and implemented for the TIMSS 1999 mathematics and science assessments (Martin, Gregory, and Stemler 2000). Most of the participating countries drew separate samples for the TIMSS 1999 Video Study than they did for the TIMSS 1999 mathematics and science assessments, however. For this reason, the TIMSS 1999 assessment data cannot be directly linked to the video database.

2.2 Selecting Countries to Participate in the Study

The TIMSS 1999 Video Study aimed to expand on the TIMSS 1995 Video Study by investigating science teaching. The TIMSS 1995 Video Study did not investigate science teaching and included only three countries. The selection of countries for inclusion in the TIMSS 1999 Video Study was based primarily on the results from the TIMSS 1995 mathematics assessment administered to eighth-grade students (Peak 1996) with the aim of including countries that outperformed the United States. Since it was not operationally or financially possible to include all nations that outperformed the United States in mathematics in TIMSS 1995, the sponsors of the study invited four nations from Europe and Asia—the Czech Republic, Hong Kong SAR, Japan, and the Netherlands—to participate, along with the United States. In addition, Switzerland and Australia joined the study partly at their own expense. Japan agreed to participate in the science portion of the study only; Hong Kong SAR and Switzerland agreed to participate in the mathematics portion of the study only.

Table 2.1 lists the countries analyzed as part of the TIMSS 1999 Video Study along with their scores on the TIMSS 1995, 1999, and 2003 science assessments. The TIMSS 1999 and 2003 science assessments were administered after the TIMSS 1999 Video Study was underway and played no role in the selection of countries for the Video Study.

On the TIMSS 1995 science assessment, eighth-grade students in Japan performed above students in the other four countries, on average. Students in the United States performed below students in all four of the other countries, on average in 1995 and 1999. Since that time, however, the U.S. experienced improvement in average science performance at grade 8. In 2003, U.S. students' average score in science was not measurably different from the average score in Australia, but remained below the average score of students in Japan and the Netherlands. The Czech Republic did not participate in TIMSS 2003.

Table 2.1. Average science scale scores of eighth-grade students, by country: 1995, 1999, and 2003

Country	1995 Average score	1995 Standard error	1999 Average score	1999 Standard error	2003 Average score	2003 Standard error
Australia[1]	527	4.0	540	4.4	527	3.8
Czech Republic	555	4.5	539	4.2	—	—
Japan	554	1.8	550	2.2	552	1.7
Netherlands[1]	541	6.0	545	6.9	536	3.1
United States[2]	513	5.6	515	4.6	527	3.1

— Not available.
[1]Nation did not meet international sampling and/or other guidelines in 1995. See Beaton et al. (1996) for details.
[2]Nation did not meet international sampling and/or other guidelines in 2003. See Gonzales et al. (2004) for details.
NOTE: Rescaled TIMSS 1995 science scores are reported here (Gonzales et al. 2000). The average for Australia in 2003 cannot be compared to the averages in 1995 and 1999 due to national level changes in the starting age/date for school. The 1995 and 1999 averages are those reported in Gonzales et al. 2000. The 2003 average is the one reported in Gonzales et al. 2004.
SOURCE: Gonzales, P., Calsyn, C., Jocelyn, L., Mak, K., Kastberg, D., Arafeh, S., Williams, T., and Tsen, W. (2000). *Pursuing Excellence: Comparisons of International Eighth-Grade Mathematics and Science Achievement from a U.S. Perspective, 1995 and 1999* (NCES 2001-028). U.S. Department of Education, National Center for Education Statistics, Washington, DC: U.S. Government Printing Office. Gonzales, P., Guzman, J.C., Partelow, L., Pahlke, E., Jocelyn, L., Kastberg, D., and Williams, T. (2004). *Highlights from the Trends in International Mathematics and Science Study (TIMSS) 2003* (NCES 2005-005). U.S. Department of Education, National Center for Education Statistics, Washington, DC: U.S. Government Printing Office.

2.3 International Sampling Specifications

In general, the sampling plan for the TIMSS 1999 Video Study followed the standards and procedures agreed to and implemented for the TIMSS 1999 mathematics and science assessments. The sampling plan proposed for the TIMSS 1999 Video Study internationally was a two-stage stratified cluster design. The first stage consisted of a stratified sample of schools, and the second stage consisted of a sample of mathematics and science lessons from the eighth-grade in the sampled schools. This relatively simple and cost-effective design was intended to produce national samples that would meet the analytical requirements necessary to allow estimates for classrooms and schools.

At a minimum, the sample design for each country had to provide a sampling precision at the lesson (or classroom) level equivalent to a simple random sample of 100 mathematics and 100 science eighth-grade lessons for Australia, the Czech Republic, the Netherlands, and the United States, and 100 science eighth-grade lessons for Japan. There was no minimum sample size established for the study. Rather, each country sample was carefully scrutinized to determine acceptability.

In addition, an attempt was made to collect data across the school year, and thus be representative of the teaching that eighth-grade students received over an academic year. In order to achieve this, an average of 12 to 15 lessons were videotaped per month in each country.

2.3.1 The School Sampling Stage

Under the international sample design, the first sampling stage was the sampling of schools. The school sampling frame in principle included all schools in the country that had eligible students in eighth grade, the target grade. The school sample was required to be a Probability Proportionate to Size (PPS) sample. A PPS sample assigns probabilities of selection to each school proportional to the number of eligible students in the eighth-grade in schools countrywide. Westat[1] strongly recommended systematic sampling, with implicit and explicit stratification, to each of the participating countries. Systematic sampling was recommended because of its good properties with regard to lower sampling variance (when the implicit stratification structure is chosen well), and its relative simplicity, allowing for use by individual countries. Whether or not systematic sampling was used, the sample was required to be a scientific probability sample, selected using the techniques and principles of this method.

Under the proposed systematic sampling approach, all schools within the explicit stratum were expected to be ordered by a set of school characteristics that become the implicit strata. The explicit strata were generally expected to be regions of the country or other similar subgroups for which an exact sample size was desired for each subgroup. The implicit strata were expected to be other school characteristics for which exact sample sizes within subgroups were not deemed necessary, but for which a small variability in sample size across subgroups was desired.

Once the final ordering of schools was determined, a sample was to be drawn for each explicit stratum by computing an aggregate measure of size (MOS) where the measures of size are proportional to the school selection probabilities for each school on the ordered list. The first school's aggregate MOS is equal to its measure of size, the second school's aggregate MOS is equal to the summation of the first and second schools' measures of size, and so on, with the final school's aggregate MOS equaling the total summation of all measures of size in the explicit stratum. A sampling interval was computed that is equal to the total MOS for the explicit stratum divided by the sample size for the stratum.

A random number was chosen for the explicit stratum between 0 and the sampling interval. The school with the smallest aggregate MOS greater than the random number would be selected. A stream of numbers was then generated by adding positive integer multiples of the sampling interval to the random number, until the total measure of size was exceeded. For each number in this stream, a school was to be selected by taking the school with the smallest aggregate measure of size greater than that number.

If originally selected schools declined to participate, in some countries replacement schools were selected using the same procedure described above. In general, the original and replacement schools had very similar probabilities of selection into the initial sample. More information on the number of replacement schools used in each country is presented in section 2.4 of this chapter. Additional details on the selection probabilities and weights assigned to the replacement schools in each country can be found in chapter 7.

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[1] Westat was contracted to guide the sampling and weighting procedures for the TIMSS 1999 Video Study.

2.3.2 The Classroom and Lesson Sampling Stage

The next stage following school selection was classroom selection within schools, and finally lesson selection. One mathematics and/or one science eighth-grade class per school was to be sampled, depending on the subject(s) to be studied in each country.[2] The classes were to be randomly selected from a list of eligible classes in each participating school. The classroom sampling design was to be an equal probability design with no subsampling of students in the classroom.

For schools in which both mathematics and science classes were to be videotaped, the mathematics classroom was selected first with each available mathematics classroom having an equal probability of being selected. However, science classes that were scheduled at the same time as the selected mathematics class were omitted, and the science classroom was then randomly selected from the remaining available classrooms.

One lesson from each selected mathematics and science classroom was then videotaped. The videotaping date was determined by the scheduler in each country, and was based on scheduling and operational convenience.

2.4 Selecting Samples Within Each Country

Within the guidelines specified above, each country developed its own sampling strategy. Although most countries used replacement schools, some did not. All of the TIMSS 1999 Video Study countries were required to include at least 100 schools in their initial selection of schools; however some countries chose to include more for various reasons. Furthermore, although all countries had to obtain a systematic PPS sample, they were allowed to define strata appropriate for their country.

In most countries, the school sample was selected by the national research coordinators. In the United States, Westat (a contracted research corporation) selected the school sample. In countries that used the same sample of schools as for the TIMSS 1999 mathematics and science assessments, school samples were selected and checked by Statistics Canada.[3] In all cases, countries provided the relevant sampling variables to Westat, so that they could appropriately weight the school samples.

The national research coordinators were responsible for selecting the classroom sample in their country. LessonLab was responsible for selecting the classroom sample in the United States. Westat received information about the number of classes in each country, so that the classroom stages of sampling could be weighted correctly. Additional information on the weighted participation rates in each country is provided in chapter 7.

In all the participating countries, the national research coordinator was responsible for securing and verifying that any consent required by law was obtained from teachers, students, and/or

[2] Australia, the Czech Republic, the Netherlands, and the United States also collected video data on eighth-grade mathematics lessons.
[3] Statistics Canada was contracted to guide the sampling procedures and produce the weights for the TIMSS 1999 assessment.

parents. In addition, the national research coordinator in each country determined the type of compensation that would be provided to participating teachers. In each country, teachers were provided locally appropriate monetary compensation, a book voucher, and/or a videotape of their lesson in return for participation.

The details of the sample selection in each country are provided below. For most countries, a table is provided describing the breakdown of the types of schools by school sector type and any other variables deemed pertinent by the national research coordinator. For more detailed information on the educational systems within each of the participating countries, see Robitaille (1997).

2.4.1 Australia Sample

Australian schools were sampled systematically from 13 explicit strata, which were defined by state/territory and metro/non-metro status. Within each stratum, the schools were sorted by sector (government, Catholic, and independent) and enrollment. A systematic PPS sample of 100 schools was selected from the ordered list. The measure of size (MOS) was the estimated number of mathematics and science classes in the school. Sixty-one of the 100 originally sampled schools agreed to participate and 26 replacement schools were used, yielding a final sample size of 87 schools. Mathematics and science lessons were filmed in all of the selected classrooms.

Table 2.2 shows the breakdown of schools in the Australian sample based on school sector type.

Table 2.2. Number and percentage distribution of the Australian school sample, by school sector type: 1999

School sector type	Number of schools in original sample	Number of originally sampled schools that participated	Number of eligible schools that participated	Percentage distribution of eligible schools that participated including replacements—unweighted
Total	**100**	**61**	**87**	**87**
Government	—	—	54	54
Catholic	—	—	16	16
Independent[1]	—	—	17	17

— Not available.
[1]Independent schools included Christian Community schools, non-Catholic religious schools, and others.
NOTE: Detail may not sum to totals because of rounding.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

2.4.2 The Czech Republic Sample

Schools in the Czech Republic were sampled systematically from two explicit strata: basic schools and *gymnasia* schools.[4] Within each stratum, the schools were sorted and a systematic PPS sample was selected from the ordered list. There were 100 schools included in the original sample of schools. However, after data collection, it was discovered that 12 of the lessons focused on economic and political geography content, topics included in the science curricula in the country. After consultation, it was decided to exclude these 12 lessons from the sample of eligible science lessons, reducing the sample size to 88 schools.

Consistent with the distribution in the population, 81 schools were selected from the basic school stratum and seven schools were selected from the *gymnasia* school stratum. The MOS was the number of students enrolled in the eighth grade. Seventy-eight out of 88 originally sampled schools agreed to participate and 10 replacement schools were used, yielding a final sample size of 88 schools. Mathematics and science lessons were filmed in all of the selected classrooms.

Table 2.3 shows the breakdown of schools in the sample for the Czech Republic based on school sector type, including source of funding as well as ability track.

[4] In the Czech Republic there is a two-tiered school system at the lower secondary level (grades 6-9). At the time of data collection, basic schools (the lower tier) were attended by approximately 90 percent of lower secondary students. Student attending *gymnasia* schools (the upper tier) were required to pass an entrance examination to gain entrance to the school.

Table 2.3. Number and percentage distribution of the Czech Republic school sample, by school sector type: 1999

School sector type	Number of schools in original sample	Number of originally sampled schools that participated	Number of eligible schools that participated	Percentage distribution of eligible schools that participated including replacements — unweighted
Total[1]	**100**	**78**	**88**	**100**
Funding				
State	—	—	86	98
Religious	—	—	1	1
Private	—	—	1	1
Ability track[2]				
Basic	—	—	81	92
Gymnasia	—	—	7	8

— Not available.

[1]Twelve of the lessons selected from the initial sample of 100 schools in the Czech Republic included only economic and political geography content and were excluded from the sample of eligible science lessons. Due to these exclusions, the number of schools in the initial sample was reduced to 88.

[2]In the Czech Republic there is a two-tiered school system at the lower secondary level (grades 6-9). At the time of data collection, basic schools (the lower tier) were attended by approximately 90 percent of lower secondary students. Students attending *gymnasia* schools (the upper tier) were required to pass an entrance examination to gain entrance to the school.

NOTE: Detail may not sum to totals because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

2.4.3 Japan Sample

For the Japanese sample of science lessons, schools were sampled systematically from strata defined by size of community and size of school. Within each stratum, the schools were sorted and a systematic PPS sample was selected from the ordered list. Ninety-five out of 100 originally sampled schools agreed to participate and no replacement schools were used, yielding a final sample size of 95 schools. Science lessons were filmed in all the selected schools. No mathematics lessons were videotaped.

Table 2.4 shows the breakdown of schools in the Japanese sample based on school sector type.

Table 2.4. Number and percentage distribution of the Japanese school sample, by school sector type: 1999

School sector type	Number of schools in original sample	Number of originally sampled schools that participated	Number of eligible schools that participated	Percentage distribution of eligible schools that participated including replacements - unweighted
Total	**100**	**95**	**95**	**95**
Funding[1]				
Public	—	—	88	93
National school	—	—	1	1
Private school	—	—	5	5
School attached to a university	—		4	4
Single gender school	—	—	1	1

— Not available.

[1]Funding information is from teacher questionnaire responses. In the questionnaire, teachers identified schools with as many categories as applied. The total percent of all categories is therefore greater than 95 percent, and the sample size by funding is greater than 95 schools.

NOTE: Detail may not sum to totals because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

2.4.4 The Netherlands Sample

Schools in the Netherlands were sampled systematically from seven implicit strata based on ability tracking at the school level. A systematic PPS sample of 175 schools was drawn from a list sorted on the stratum and number of eighth-grade students (MOS). The sample was selected at the same time as the TIMSS 1999 mathematics and science assessments sample. The same sampling interval was used for both samples, but the random selection number for the 1999 Video Study sample was the random selection number for the TIMSS 1999 mathematics and science assessments sample plus 0.5. This was done to reduce the overlap between the two samples. However, significant overlap occurred in spite of this procedure. Sixty-nine of the 175 originally sampled schools had already been selected to participate in the TIMSS 1999 mathematics and science assessments or were “first replacements” (the school following the sampled school on the sorted list for that study). Therefore, they were not considered eligible schools for the 1999 Video Study. An additional four schools were dropped randomly, and two other schools were ineligible, leaving 100 schools for the video sample. This constituted the number of schools considered to be in the original sample for the study.

Forty-nine originally sampled schools agreed to participate and 36 replacement schools were used, yielding a final sample size of 85 schools. Of the 36 replacement schools, in 27 cases the replacement was the initially designated first replacement school. The other nine replacements were chosen from unused substitutes for other schools, including one case of a school that had previously been dropped. Science lessons were filmed in 81 of the selected classrooms from only seven different schools.

Table 2.5 shows the breakdown of schools in the Netherlands sample based on school sector type, including source of funding as well as ability track.

Table 2.5. Number and percentage distribution of the Netherlands school sample, by school sector type: 1999

School sector type	Number of schools in original sample	Number of originally sampled schools that participated	Number of eligible schools that participated	Percentage distribution of eligible schools that participated including replacements—unweighted
Total	**98**	**49**	**81**	**83**
Funding[1]				
Public	—	—	26	32
Roman Catholic	—	—	26	32
Protestant-Christian	—	—	19	23
Non-denominational private	—	—	5	6
Not identified	—	—	2	2
Ability track[2]				
(i)vbo	—	—	5	6
mavo	—	—	4	5
(i)vbo/mavo	—	—	9	11
(i)vbo/mavo/havo	—	—	4	5
vwo	—	—	5	6
havo/vwo	—	—	8	10
mavo/havo/vwo	—	—	23	28
large (i)vbo/avo/vwo	—	—	20	25

— Not available.

[1]Funding information is from teacher questionnaire responses. In the questionnaire, teachers identified schools with as many categories as applied. The total percent of all categories is therefore greater than 83, and the sample size by funding and ability track is greater than 81 schools.

[2]Ability track information is from teacher questionnaire responses. (i)vbo = (individual) junior vocational education; mavo = junior general education; havo = senior general education; vwo = pre-university education; avo = mavo and/or havo. Large (i)vbo/avo/vwo schools are those that serve all ability tracks and include a large number of students in the eighth grade. Because these schools had a different selection probability from those that were smaller, they were placed in a separate stratum.

NOTE: Detail may not sum to totals because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

2.4.5 The United States Sample

To select schools in the United States, first a sample of 52 geographic Primary Sampling Units (PSUs) was selected from a frame of PSUs that represented the entire country. PSUs were defined to be counties or groups of counties. Ten of the PSUs, the ten largest Metropolitan Statistical Areas (MSAs), were included with certainty. Among the 12 next largest MSAs, a systematic random sample of six was selected. The remaining sample of PSUs consisted of a stratified sample of 36 other areas—18 MSAs, and 18 groups of counties from outside metropolitan areas. These 36 PSUs were stratified by geographic region, metropolitan/non-metro, and characteristics such as proportion of adults with college degrees and size of minority populations (the exact stratification characteristics varied by region and metro/non-metro status). The 36 PSUs were selected with probability proportional to population size as reported in the 1990 U.S. Population Census.

The PSU sample design is very similar to that used for the TIMSS 1995 Video Study, and is identical to that which was used for sampling schools for the TIMSS 1999 mathematics and science assessments. In the TIMSS 1999 United States sample, different schools were used for the achievement and video study and, except for the 16 large metro areas, the PSUs for the two study samples were different.

A systematic PPS sample of 110 schools was chosen from the 13,261 schools that taught grade 8 in the selected PSUs. The schools were selected from a list sorted by region, urban/rural status (and, in the case of the 16 largest PSUs, central city/suburban status), type of school (public/private), and school size. Approximately two schools were selected from each PSU, but larger metropolitan PSUs may have had more than two schools selected, while from other PSUs a single school was selected.

The primary purpose for including the PSU stage of selection was to ensure that the sample for the TIMSS 1999 Video Study was in different schools, and to a large extent in different school districts, from the TIMSS 1999 mathematics and science assessments sample, the IEA 1999 Civics Education Study sample, and the National Assessment of Educational Progress 1999 Long-Term Trend and 2000 Field Test samples. All of these studies were taking place in national samples of grade 8 schools across the nation during the 1998–99 school year.

Replacement schools were not used in the United States sample. Instead, an extra 10 schools were selected along with the 100 schools to increase the likelihood that 100 schools would participate in the study. It was likely that some selected schools would not be eligible. As it turned out, one school had ceased operations and another only had one student in the eighth-grade.

Eighty-nine out of the 108 eligible, originally sampled schools agreed to participate. Mathematics lessons were filmed in 83 of the selected classrooms and science lessons were filmed in 88 of the selected classrooms. Science lessons only were filmed in six schools.

Table 2.6 shows the breakdown of schools in the U.S. sample based on school sector type.

Table 2.6. Number and percentage distribution of the United States sample, by school sector type: 1999

School sector type	Number of schools in original sample	Number of originally sampled schools that participated	Number of eligible schools that participated	Percentage distribution of eligible schools that participated including replacements-unweighted
Total	**108**	**89**	**88**	**82**
Public	—	—	80	75
Private	—	—	8	7

— Not available.
NOTE: Detail may not sum to totals because of rounding.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

A classroom in the United States was required to have at least three students to be eligible for selection into the lesson sample. Classrooms with fewer than three students could not be combined with an adjacent classroom. Two sampled schools were identified as ineligible after data collection efforts began. One school was closed permanently and another had only one student in the grade 8 mathematics and science classes.

When the available classes included a combined mathematics and science lesson which was team taught, one mathematics class was randomly selected from all classes teaching mathematics, then a science class was selected following the procedures described above. In one case, the team-taught class was randomly selected and videotaped. This class fulfilled the requirement for one mathematics and one science lesson.

All participating teachers (and parents of the students in the class) were required to sign a consent form (see the report *Third International Mathematics and Science Study 1999 Video Study Technical Report Volume 1: Mathematics* (Jacobs et al. 2003) for a sample of the United States consent form). This consent/waiver released the usage of their lesson video for research purposes. In most instances, the school principal was relied upon to provide teachers with an introductory packet that described the study and invited them to participate. The consent/waiver form was contained in the packet, and was to be signed and returned to LessonLab prior to the videotaping.

Chapter 3. Data Collection and Processing

3.1 Data Collection

3.1.1 Nature of Data Collected

The primary focus of the data collection for this study was the videotaping of a full mathematics and/or science lesson in each sampled classroom. What counted as a lesson was determined by what was standard in each participating country.

Additional data were also collected to help understand the videotaped lesson more fully. This additional data included

- A teacher questionnaire;
- A student questionnaire;
- Photocopies of text pages, worksheets, overhead transparencies, and other materials used in the lesson;
- A log sheet that videographers completed after each taping session.

3.1.2 Data Collection Schedule

The National Research Coordinator (NRC) in each country was responsible for scheduling the videotaping and ensuring that taping was evenly distributed throughout the school year. LessonLab scheduled the videotaping of classrooms in the United States. As an added check, the receipt control system at LessonLab tracked the proportion of lessons that arrived from each country on a monthly basis, to ensure there was not a disproportionate number of tapes collected during any given month.

Most of the data collection took place in 1999. In some countries filming began in late-1998, and in other countries filming began in 1999. Data collection ended in either late-1999 or mid-2000 in order to sample lessons across the academic year in each country. Data collection in each country was also determined by the start and end of the academic year, which can differ between northern and southern hemisphere countries. Table 3.1 lists the start and end dates for data collection in the five participating countries.

Table 3.1. TIMSS 1999 Video Study data collection periods, by country: 1998–2000

Country	Data collection start date	Date collection end date
Australia	5/24/1999	12/3/1999
Czech Republic	11/26/1998	10/20/1999
Japan	5/11/1999	2/8/2000
Netherlands	12/8/1998	3/22/2000
United States	1/26/1999	5/18/2000

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

3.1.3 Number of Science Lessons Filmed

Detailed sampling procedures are described in chapter 2. Table 3.2 provides the final sample size of science lessons that were included in the study.

Table 3.2. Number of science lessons included in the study, by country: 1999

Country	Number of science lessons
Australia	87
Czech Republic	88
Japan	95
Netherlands	81
United States	88

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

In some countries, additional science lessons were filmed but not included as part of the final sample for various reasons. See chapter 2 for more details.

In the United States, one lesson was filmed but not used in the study because it was not from a sampled teacher. Another lesson was excluded from the database because the sound and visual quality were too poor to be coded. The class was re-filmed at a later date.

3.1.4 Number of Questionnaires Collected

Each videotaped teacher was given a questionnaire to complete after the videotaped lesson, as was each student in the class. Responses to only the TIMSS 1999 Video Study science teacher questionnaire were coded, analyzed, and reported. Response rates on the teacher questionnaire were between 95 and 100 percent, as shown in table 3.3. More complete information about the development and nature of the science teacher questionnaire is available in chapter 4.

Table 3.3. Science teacher questionnaire response rates, by country: 1999

Country	Number of teachers videotaped	Number of teacher questionnaires returned	Response rate-unweighted
Australia	87	87	100
Czech Republic[1]	88	88	100
Japan	95	95	100
Netherlands	81	79	98
United States	88	84	95

[1]Twelve lessons selected from the initial sample of 100 schools in the Czech Republic included only economic and political geography content and were excluded from the sample of eligible science lessons.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

Though background data on students were collected through a questionnaire, the data were neither coded nor analyzed for this study. It was determined after data collection that since the primary focus of the study was on the teaching of science, the most pertinent information would come from the teachers rather than the students.

3.2 Videotaping procedures, data receipt and processing, and construction of the multimedia database

The procedures for videotaping, data receipt and process, and construction of the multimedia database for the science component of the study are the same as those for the mathematics component. Complete details on these technical aspects are included in chapter 4 of the companion report, *Third International Mathematics and Science Study 1999 Video Study Technical Report Volume 1: Mathematics* (Jacobs et al. 2003), available at http://nces.ed.gov/timss.

Chapter 4. Teacher Questionnaire Data

4.1 Purpose of the Questionnaire

The purpose of the science teacher questionnaire was to elicit information that would provide important background for the analysis and interpretation of the videotapes. The information collected from teacher responses was used in two ways.

First, coders used the information from the questionnaire to make better judgments about what they saw on the videotapes. For instance, sometimes coders needed to know the teacher's goal for a lesson in order to make sense of the activities that constituted the lesson. As another example, when coders segmented the lessons into periods of review, new, and practicing/applying new material, it helped coders to refer to questionnaire items where the teacher identified what students had previously been taught and what they were expected to learn from this lesson.

In addition, information from several questionnaire items also was used to assess the typicality of the lesson captured on videotape. Although teachers were instructed not to prepare in any special way for this lesson, what transpired on the day of the taping was potentially not typical compared to what normally happens in a given classroom. An atypical lesson may have resulted from nervousness on the part of the teacher, excitement on the part of the students, or some special event not connected to the TIMSS 1999 Video Study. Furthermore, questionnaire responses might identify a sampling bias. For example, if teachers reported that the lessons were "stand-alone" lessons rather than part of a curricular series, this information could indicate an atypical lesson.

4.2 Constructing the Science Questionnaire

Constructing the science teacher questionnaire was a multi-step process that took place over several months. Two parallel versions of the teacher questionnaire were developed at the same time for the mathematics and science teachers participating in the TIMSS 1999 Video Study. The following section describes this process in detail for the science version.

<u>Step 1: Review of the TIMSS 1995 Video Study Questionnaire</u>
The TIMSS 1995 Video Study teacher questionnaire was reviewed by project staff. Items that were particularly useful were highlighted, and those that did not provide the anticipated information were examined more closely. In addition, project members involved with coding and reporting data in the 1995 Video Study identified those questions that had produced the most helpful information. They then discussed the limitations of other questions that were less successful. Two questions guided the item analysis: (1) Did this item measure an issue that was important to retain in the TIMSS 1999 Video Study questionnaire? (2) If yes, does the item need to be rewritten to achieve the intended purpose?

The TIMSS 1995 Video Study teacher questionnaire was modestly revised and used in the TIMSS 1999 Video Study field test (see chapter 2 of the *Third International Mathematics and Science Study 1999 Video Study Technical Report Volume 1: Mathematics*).

Step 2: Review of Teacher Questionnaires from Other Studies

The teacher questionnaires used in the TIMSS 1995 Achievement Study, as well as other then-recent education research projects, also were reviewed. Items that fit into the designated domains were considered for inclusion in the TIMSS 1999 Video Study questionnaire.

A set of decision-making guidelines emerged during this process. The guiding questions were:

- Does the item help to better understand the context of the videotaped lesson?
- Does the item help to make judgments about the relationship of the videotaped lesson to current thinking about science teaching?
- Could the question be answered simply by looking at the videotape?

Step 3: Drafting and Revising the Questionnaire

Information generated from the discussions mentioned above was used to draft new sample items for the TIMSS 1999 Video Study science teacher questionnaire. The new items were reviewed and a first draft of the revised teacher questionnaire was created. An additional guideline was added: Don’t change an item on the TIMSS 1999 Video Study teacher questionnaire unless a strong case can be made for the necessity of a change. This was done so that the science teacher questionnaire did not diverge substantially from the mathematics teacher questionnaire developed concurrently.

The questionnaire development team and additional project members (including the Project Director and the Chief Analyst) reviewed the draft. The questionnaire was electronically sent out for review to collaborators in each of the participating countries. They were asked to provide feedback to the development team by July 6, 1998.

Questionnaires from the teachers who participated in the TIMSS 1999 Video Study field study test were translated into English (when necessary) and reviewed.

Based on these reviews, the team revised the questionnaire and created the final international version.

Step 4: Creating and Translating the Final Version

A panel, consisting of NCES personnel and mathematics and science education experts, reviewed all items on the questionnaires for consistency, clarity, and utility. Suggested revisions from the National Research Coordinators, education experts, and NCES were incorporated into the final version of the science teacher questionnaire.

A panel at the Office of Management and Budget (OMB) also reviewed and approved the questionnaire. The OMB review panel suggested randomly sorting the teacher attitude items in question 57 and reversing the direction of several items in this question. Revisions were made and reported to OMB (see section 4.4).

Following the finalization of the international version of the science teacher questionnaire, national adaptations of the questionnaire were made, according to the requests of each participating country (see section 4.5).

4.3 Questionnaire Item Justification

The final version of the questionnaire asked science teachers to provide additional information about the videotaped lesson, their background and experience, attitudes, and professional development. A copy of the questionnaire provided to U.S. science teachers is included as appendix B. The questionnaire included the seven domains listed below. In this section, a rationale is provided for each domain. The seven domains are:

- the videotaped lesson;
- the larger unit or sequence of lessons;
- the typicality of the videotaped lesson;
- ideas that guide teaching;
- educational background, teaching background, and teaching load;
- school characteristics; and
- attitudes about teaching.

4.3.1 The Videotaped Lesson

This section of the questionnaire was designed to gather contextual information about the lesson recorded on videotape. Some information necessary for understanding the lesson might not have been evident from simply watching the videotape. These background items were collected in this section of the questionnaire.

<u>Content of the Lesson</u>
Item 1: Knowing the teacher's definition of the content of the lesson facilitates interpretation of the tape. This information is especially helpful when the teacher has content goals in mind that might not be immediately obvious to the coder.

Items 2 and 3: These questions elicit the sources of influence on the content of the videotaped lesson. Item 2 asks if there is an external document or textbook that played a major role in the teacher's decision to teach this content. Access to the relevant document could provide insight into how the teacher interpreted these materials and how they influenced the teaching of the lesson. Item 3 requests the name of such documents.

Item 4: This question elicits important information about the sources of influence on the teacher's lesson. These sources may influence the teacher's ways of understanding and representing the content as well as providing him/her with ideas about pedagogical strategies. In addition, the question (especially in combination with other questions) provides glimpses into the teacher's tendency to collaborate with colleagues and the teacher's ways of thinking about students.

Item 5: This question serves two purposes. First, it provides an outline of the content of the lesson from the teacher's perspective. Second, it clarifies which content is new to students and which is review. This is important in making coding decisions about the nature of the lesson activities (e.g., whether an activity contains new information).

Intended Student Learning

Items 6 and 7: Knowing the teacher's intended goal facilitates interpretation of the tape (item 6). The goal of the lesson also may explain differences in observed instruction. Item 7 provides teachers the opportunity to highlight portions of lessons they considered problematic and explain why. This item also allows teachers to say why they were satisfied with the lesson. Coders might use this information to understand the lesson.

Item 8: This question about the teacher's perception of resource limitations gives teachers a chance to express which additional resources would have improved the lesson. In addition, the item enables cross-national comparisons of perceived resource needs.

Teacher Planning

Item 9: This question helps assess typicality of planning for taped lesson. Although the teachers are instructed to plan and teach the lesson just as they would normally do, some teachers may put in extra time planning this lesson.

Items 10 to 14: The ability levels of the students will not be known from the videotape. Thus, items 10 and 11 help us learn whether the teacher put students in groups according to ability or other reasons. These items give a rough indication of the mix of students working together in the small groups. Also, because schools in different jurisdictions may or may not use "tracking" which we cannot infer from the tapes, questions 13 and 14 will help us identify such practices. Teaching techniques may differ according to ability level of the students; these questions alert coders to any special quality of this particular group of students and their abilities.

Items 15 to 18: These items will indicate what kinds of homework preparation students have had for the videotaped lesson. A classroom activity may serve a different purpose for students who are already familiar with materials used in the lesson than it would for students who are seeing the material for the first time.

Assessment

Items 19 and 20: Assessment tasks provide important windows into teacher thinking. In particular, assessment tasks reflect a great deal about the kind of learning that is valued by the teacher (factual, conceptual, procedural, etc.). The assessment also can help us evaluate the alignment among the teacher's goals, the teacher's instructional practices in the lesson, and the assessment.

4.3.2 The Larger Unit or Sequence of Lessons

The questions in this section asked the teacher to place the videotaped lesson in the context of a larger unit or sequence of lessons. These questions were important for three reasons: (1) standards documents in science education describe good teaching as connected and as developing student conceptual understanding across time; (2) the data could be used to make judgments about the teacher's views about teaching; and (3) in combination with the videotaped lesson, the data could enable the construction of a more complex view of teaching. Thus, teacher responses to these questions provided data on teaching that supplemented data provided by the videotape alone (without incurring the enormous cost of videotaping additional lessons).

Items 21 through 25: Placing the videotaped lesson in the context of a sequence of lessons helps clarify the teacher's goals and purposes before and beyond the videotaped lesson. Is the content development in this lesson closely linked to other lessons? How does the teacher think about content and the development of ideas over time? How long are the sequences?

Item 26: This item helps assess the typicality of the video lesson and places the video lesson in a broader context, and provides insights into the teacher's thinking about effective science teaching. Requesting teachers to describe the lesson in words commonly used in her/his nation provides information on cultural differences in types of lessons in each nation.

4.3.3 The Typicality of the Videotaped Lesson

This section of the questionnaire was designed to gather information about the typicality of the lesson that was videotaped.

Items 27 to 31: These questions address the important issue of whether the instruction recorded on the videotapes is judged as typical by the teacher. Typicality ratings are elicited for teaching methods and student participation. The teacher will also be asked to describe any aspects of the lesson that were not typical. Analysis will examine differences in judged typicality across countries. National portraits of what is marked as atypical will be used to moderate interpretation of findings.

Item 32: This item is designed to assess the effect that being videotaped had on the teacher.

4.3.4 Ideas That Guide Teaching

This section of the science teacher questionnaire was designed to provide insights into the teacher's knowledge and personal views of good science teaching.

Item 33: This item that identifies teachers' broadest instructional goals for the school year provides a measure of teacher's knowledge and attitudes toward current thinking about science, and her/his own teaching philosophies.

Items 34 to 37: These questions were designed to assess teachers' response to and awareness of current ideas about how to teach science in the classroom. The teacher's self-rating is complemented by information about how they acquired this information and their list of familiar documents.

Items 38 and 39: These items ask teachers to what extent they feel the videotaped lesson is consistent with current ideas about the teaching and learning of science and to describe one part of the videotaped lesson that they feel exemplifies these ideas and why.

Items 40 and 41: These questions serve as an indicator of the teacher's involvement in professional development activities that are consistent with peer collaboration and observation recommended in standards and reform documents.

4.3.5 Educational Background, Teaching Background, and Teaching Load

Items 42 to 51: These items inquire about the teacher's pre-service and subsequent preparation for teaching and for teaching specific subject matters.

Item 52: This item asks teachers to identify how much time is spent preparing to teach and doing other school-related work.

4.3.6 School Characteristics

Item 53 to 56: These questions ask for a basic description of the school including type, how students are admitted, number of teachers of science, and grade levels. Teacher responses indicate whether or not the school has any special status that might contribute to the nature of the observed teaching. For example, students at a magnet school might receive a different kind of science instruction or have access to more resources than a traditional school.

4.3.7 Attitudes About Teaching

This section provides information on the teacher's attitudes towards teaching science. The items suggest ways in which the teacher thinks about her/his work, the students, and science. It is important to examine the satisfaction of teachers since this factor might be associated with differences among teachers.

Items 57f, j, l, o, r, w: These items explore the teacher's satisfaction with teaching science and the teaching profession.

Items 57g and u: These items examine the teacher's sense of competence as a science teacher.

Items 57c, i, q: These items explore the teacher's preference for working with students of varying abilities.

Items 57b, k, n, p, t, v, y: These items probe the teacher's attitudes towards professional development and growth.

Items 57a, h, s, x: These items explore the teacher's feelings of satisfaction with aspects of the classroom and school environment.

Items 57d, m, z, aa: These items explore the teacher's feelings of being appreciated.

Items 57e and bb: These items examine teacher's feelings pertaining to gender issues in science.

4.4 Approval of Questionnaires

The first version of the TIMSS 1999 Video Study science teacher questionnaire was designed to provide an opportunity for individual countries to make modifications to some questions or response options in order to include the appropriate wording or options most consistent with their own national education systems. This version of the teacher questionnaire was approved by NCES and the OMB review panel on November 16, 1998. Each country revised the questionnaire as needed. The national adaptations of the questionnaire were reviewed by the national research coordinators and the country associates, and requested revisions were sent to NCES for approval. Data collection in a country did not begin until approval of that country's teacher questionnaire was received. The following table presents the dates final versions of the questionnaires were approved for the participating countries.

Table 4.1. Dates of approval for national versions of questionnaires, by country: 1998–1999

Country	Date of approval
Australia	4/12/1999
Czech Republic	11/16/1998
Japan	4/28/1999
Netherlands	11/16/1998
United States	11/16/1998

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

4.5 National Modifications of the Questionnaires

Most items in the teacher questionnaire were common to the questionnaires of all participating countries. Table 4.2 indicates the number of open- and closed-ended questions in each country's teacher questionnaire.

Table 4.2. Number of items in the science teacher questionnaire, by country: 1999

Country	Open-ended questions	Closed-ended questions
Australia	27	31
Czech Republic	25	32
Japan	23	32
Netherlands	23	32
United States	27	32

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

There were four general types of options for adapting the questionnaires to the purposes of each participating country. The first of these was a translation option in which countries were asked to translate terms and expressions into the local idiom if they thought it necessary. For the most part, these were minor wording changes to such things as the format for recording dates. Translations of the questionnaires were completed in each participating country.

The second type of option required that a country consider the nature of a concept defined internationally and then develop country-specific names for the items, or even country-specific indicators for a particular concept. The specification of the name of the national curriculum guide is an example of the first kind. Developing country-specific indicators for the multi-item measure of type of school exemplifies the second kind of translation task in this option category.

Another option that allowed for the inclusion of questions of national interest (national options) was encouraged but not obligatory. Finally, countries could eliminate a question if it was deemed to be irrelevant (e.g., the situation or item does not exist in the country) or dealt with subjects that were prohibited from being asked by law. Table 4.3 indicates the kinds of modifications and additions that countries made to items in the teacher questionnaire.

Table 4.3. Modifications and additions to science teacher questionnaire items, by country: 1999

Country	Translations or minor word changes	Modified with country-specific names	National options added	Questions not applicable nationally
Australia	8F, 8I	4L, 4M, 13, 14, 42, 51, 54, 55	57CC, 57DD	2B, 4N
Czech Republic	†	42, 54	†	44 to 47
Japan	†	2,42,43,54	50	†
Netherlands	†	54, 55	†	13, 14
United States	†	†	†	†

† Not applicable
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

4.6 Coding of Open-Ended Items in the Teacher Questionnaire

4.6.1 Code Development

The teacher questionnaires consisted of closed-ended (or forced-choice) and open-ended (or free-response) items. Open-ended questions were appropriate for this study because of its cross-cultural nature, which made it especially difficult to anticipate the possible range of teachers' responses. Teachers were expected to spend approximately 45–50 percent of the time for filling out the questionnaires responding to the open-ended questions.

The 27 open-ended items on the teacher questionnaire required development of quantitative codes to analyze the responses. A subset of open-ended questions, those that required extended responses, were coded and analyzed: teachers' goals for students for the videotaped lesson (TQ6) and for science for the year (TQ33), reasons teachers were satisfied or not satisfied with the videotaped lesson (TQ7), differences in students' behavior during the videotaped lesson (TQ30), major and minor areas of study (TQ44 through TQ47), and areas and grade levels of teaching certification (TQ43). Due to the length of the responses for these items, teachers' answers to these questions were first translated into English by coders who were bilingual in English and one of the other relevant languages. Coding of the data then was carried out using the English translations by a team headed by the Chief Analyst of the TIMSS 1999 Video Study.

All open-ended questions were partitioned into two types: short-answer questions and extended-response questions. Short-answer items required teachers to provide a brief response to a question. For example, "What materials are you aware of that describe current ideas about the teaching and learning of science?" Extended-response items required teachers to provide a more lengthy and detailed response to a question. For example, "What was the main thing you wanted students to learn from the videotaped lesson?"

Separate codes for the four extended response items describing teachers' goals for science (TQ6 and TQ33), teachers' satisfaction with the lesson (TQ7), and students' behavior during the lesson (TQ30) were developed using a four-phase process. First, before examining teachers’ responses, categories of anticipated responses were developed based on current research in science teaching and learning and advice from subject matter specialists. This part of the process helped the code developers (1) form a common interpretation of the question, (2) identify categories that may not be provided in the teachers’ responses, and (3) address culturally specific issues, such as the meanings of phrases used in the different countries.

Second, categories were further developed based on teachers’ responses. Teachers’ actual responses were used in the code development process because they allowed codes to reflect the variety of comments possible as well as teachers’ interpretations of the questions. The process of within country and then across country category development was selected so that the categories created would retain responses unique to a country.

Third, codes were created using the categories generated in the preceding two phases considering frequencies of responses, the cultural significance of a code, and the importance of a category in understanding teachers’ beliefs and goals. Comparing categories in this way ensured that the codes for the free-response items reflected the different educational systems of the study as well as current understandings of teaching and learning.

Fourth, the codes were checked for reliability. Using these results, the codes were further revised and then applied to the remainder of the questionnaires.

For the five extended-response items describing teachers’ educational backgrounds, each lesson was reviewed by the questionnaire coding team. This procedure ensured that each lesson would be reviewed and judged by a team member familiar with that country’s educational system. The teams were required to come to consensus on the codes for each lesson.

4.6.2 Reliability

Codes developed for the free-response items are described in detail in the TIMSS 1999 Video Study Science Teacher Questionnaire Code Book (see appendix C). Inter-rater reliability was established on all of the open-ended items that were coded using consensus of the questionnaire coding team. For each item, two coders independently coded 10 randomly selected lessons from each country. An 85 percent inter-rater reliability criterion was used. If an 85 percent level was not achieved initially, discrepancies were discussed and necessary modifications were made to the code definition. Reliability was then attempted on a different, randomly selected set of lessons. This procedure is similar to reliability procedures used in the TIMSS 1995 Achievement Study to code students’ responses to the open-ended assessment tasks (Mullis and Martin 1998).

Table 4.4 lists the reliability scores for each of the four extended-response questionnaire items that for which codes were developed (as discussed in section 4.6.1). In each case, reliability was calculated as the percentage of agreement between coders.

Table 4.4. Reliability estimates for eighth-grade science teacher questionnaire extended response codes, by teacher questionnaire item: 1999

Teacher questionnaire item	Item reliability (percent)
Main thing students should learn from the videotaped lesson (TQ6)	90
Main thing students should learn from science for the year (TQ33)	92
Reason teachers were satisfied or not satisfied with the videotaped lesson (TQ7)	98
Differences in students' behavior during the videotaped lesson (TQ30)	100

NOTE: Inter-rater agreement was calculated as the number of agreements divided by the sum of the number of agreements and disagreements.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

4.7 Questionnaire Analyses

As presented in the international report on the science results (Roth et al. 2006), teacher responses to the questionnaires were used in the following ways:

- *Computation of national-level univariate statistics.* Distributions by country provided information on the basic characteristics of the sample.
- *Help interpret observed classroom data.* Coders used qualitative analyses of selected questionnaire items to enhance interpretations of the videotape.

Most of the analyses of teacher responses to the questionnaire that are presented in *Teaching Science in Five Countries: Results from the TIMSS 1999 Video Study* (Roth et al. 2006) include comparisons of means or distributions across five countries for questionnaire data. In all cases, the lesson was the unit of analysis. Analyses were conducted in two stages. First, means or distributions were compared across all available countries using either one-way ANOVA or Pearson Chi-square procedures. Variables coded dichotomously were usually analyzed using ANOVA, with asymptotic approximations.

Next, for each analysis that was significant overall, pairwise comparisons were computed and significance determined by Bonferroni adjustment. The Bonferroni adjustment was made assuming all combinations of pairwise comparisons. For continuous variables, Student's t values were computed on each pairwise contrast. Student's t was computed as the difference between the two sample means divided by the standard error of the difference. Determination that a pairwise contrast was statistically significant with $p<.05$ was made consulting the Bonferroni t tables published by Bailey (1977). For categorical variables, the Bonferroni Chi-square tables published in Bailey (1977) were used.

A significance level criterion of .05 was used for all analyses. All differences discussed in *Teaching Science in Five Countries: Results from the TIMSS 1999 Video Study* (Roth et al. 2006) met at least this level of significance, unless otherwise stated. Terms such as "less," "more," "greater," "higher," or "lower," for example, are applied only to statistically significant comparisons.

All tests were two-tailed. Statistical tests were conducted using unrounded estimates and standard errors, which also were computed for each estimate. The analyses reported in *Teaching Science in Five Countries: Results from the TIMSS 1999 Video Study* (Roth et al. 2006) were conducted using data weighted with survey weights, which were calculated specifically for the classrooms in the TIMSS 1999 Video Study (see chapter 7 for a more detailed description of weighting procedures).

Chapter 5. Coding Video Data I: International Science Teams

This chapter describes the coding of the video data by the Science Code Development Team and the International Science Coding Team. The work of another specialist coding group—the Science Content Coding Team—is described in detail in chapter 6. First, background is provided on the personnel involved, including the Science Content Coding Team and the International Video Coding Team, advisory groups, and the coders. Next, details on the code development process are provided, along with information about each code. Methods used to train coders, measure reliability, and ensure quality control are also described.

5.1 Coding Personnel

5.1.1 International Science Teams

Various teams and expert groups were assembled to develop and apply codes to the TIMSS 1999 Video Study science data. The International Video Coding Team consisted of five country associates (bilingual representatives from each country) and was directed by a science educator. This team worked closely with two advisory groups: a group of National Research Coordinators representing each of the countries in the study, and a Steering Committee consisting of five North American science educators. In addition, code development and application teams had access to National Research Coordinators from each participating country as well as members of the Steering Committee. Refer to appendix A for a list of the various members who contributed to the development and application of the codes to the science video data.

5.1.1.1 Science Content Coding Team

Each country participating in the project was represented by a country associate, who was fluent in the language and well versed in the cultural background of the country. The country associates served as representatives for their countries, providing reminders of the diversity of instruction and challenging the coding system to account for them. Furthermore, the representatives provided an “insider’s” interpretation of events in the videotaped classrooms. Thus, the impressions of both cultural insiders and outsiders were considered when developing codes. Additionally, the country associates helped to hire and manage coders for their country, and could aid them in making coding decisions that might involve cultural or linguistic nuances.

The country associate team was headed by a science coordinator who directed the code development effort, analyses, and reporting of data.

As a group, the Science Content Coding Team was responsible for creating and overseeing the coding process. The team discussed coding ideas, created code definitions, wrote a coding manual, gathered examples and practice materials, designed a coder training program, trained coders and established reliability, organized quality control measures, consulted on difficult coding decisions, and managed the analyses and write-up of the data.

5.1.1.2 International Video Coding Team

Members of the International Video Coding Team represented all of the participating countries (see appendix A for team members). They were fluently bilingual so they could watch the lessons in their original language, and not rely heavily on the English-language transcripts. In almost all cases, coders were born and raised in the country whose lessons they coded.

Coders in the International Video Coding Team applied 174 codes in 11 coding dimensions to each of the videotaped lessons.

5.1.1.3 National Research Coordinators

A national research coordinator was designated for each of the participating countries. These coordinators were all from academic or research institutions in their own country, and were also involved in the TIMSS 1995 and/or TIMSS 1999 Achievement Studies. As national research coordinators of the 1999 Video Study they played several roles. On an operational level, they organized the data collection in their country (i.e., designing a sampling procedure tailored to their country, selecting schools, modifying the questionnaires for teachers and students in their country, contacting teachers, and scheduling videotaping). They served also as advisors throughout the study. Meetings including the science code development team and national research coordinators were held at least once each year throughout the project to discuss the progress made to date and to gather input on pertinent tasks such as developing research questions, defining specific codes, and reviewing the data.

Several national research coordinators made independent visits to LessonLab during the life of the project, and contributed to the ongoing code development process. Additionally, the coordinators served as hosts to country associates when the latter visited their "home" country for meetings with educators and teachers.

The coordinators also occasionally convened groups of experts in their country, to perform tasks requested by the code development team. These experts were individuals identified as being particularly knowledgeable about science and education in their country and as being interested in cross-cultural video research. For example, experts were asked to review particular code definitions.

5.1.1.4 Steering Committee

A Steering Committee was convened, composed of a diverse group of individuals who represented a cross-section of interests within the North American science education community. Though all members of the Steering Committee were based in the United States or Canada, the steering committee met with the Science Code Development Team yearly; these meetings sometimes overlapped with the National Research Coordinator annual meetings. Steering committee members reviewed and commented on research priorities, identified research questions, provided input on code definitions, and reviewed tables and drafts of the final report.

5.2 Code Development Process

5.2.1 Developing a Coding Scheme

The Science Code Development Team, with the aid of National Research Coordinators and the steering committee, developed a guiding set of research questions and a framework for constructing individual codes. Strategies for code development were sensitive to the twin goals conceived early in the project: to describe the nature of teaching within each country, and to compare teaching across all countries. Although code development strategies for achieving these goals were not conflicting, they required somewhat different approaches.

Both strategies outlined above were implemented by constructing individual codes that reliably captured important features and segments of lessons. To begin the process, the Science Code Development Team consulted instruments and coding protocols used in previous studies of teaching, including the mathematics portion of the TIMSS 1995 Video Study, and textbooks and curriculum materials from each participating country. Codes that would answer research questions regarding the nature of teaching within each country and/or the differences and similarities in teaching across countries were defined, piloted, and refined. As this work revealed new insights into teaching within and across countries, the set of research questions was revised and new codes were suggested.

To capture the nature of teaching within each country, the science code development team began with the conclusion of the TIMSS 1995 Video Study—that there are unique cultural patterns of teaching mathematics in each country. At the beginning of the TIMSS 1999 Video Study, cultural "insiders" (including the country associates, the national research coordinators, and science educators) developed hypotheses about specific instructional patterns that might be found in eighth-grade science classrooms in their country. These hypotheses were continually revisited to ensure that each country's perspective on teaching was considered as individual codes were constructed.

5.2.2 Developing hypotheses about country patterns of science instruction

In early 1998, at least four science field test lessons were collected in each country. These videotapes of eighth-grade science classrooms provided an initial opportunity to observe teaching in the different countries in the sample. An international group of representatives[5] met together for an entire summer, viewing and reflecting on these tapes. They followed a structured protocol throughout this period, with the intention of generating hypotheses that could later be tested by quantitative analyses of the full data set. More details on the field test study are presented in chapter 2 of the *Third International Mathematics and Science Study 1999 Video Study Technical Report Volume 1: Mathematics* (Jacobs et al. 2003).

These discussions yielded 11 dimensions that the representatives agreed framed classroom practice and were of interest across countries and lessons: lesson structure, classroom talk, social organization structure, activity structures, function structures, classroom environment, independent activities, content categories, science knowledge development, science content development, and practical assignments. The dimensions were then used to develop hypotheses

[5] Most of these representatives continued in the role of code developer.

about science instruction in collaboration with the national research coordinators, steering committee members, and other colleagues in each country, and refined over a period of several months.

The goal was to retain an "insider perspective," and faithfully represent the critical features of teaching in each country in the coding system for two purposes: first, to identify key, universal variables for quantitative coding and second, to describe a larger context that might be useful in interpreting the coding results.

5.2.3 Deciding What to Code

Classroom lessons are filled with many activities and human interactions, more than can be described even when analyzing only a few lessons. The challenge is compounded when 439 science lessons from five countries are to be analyzed. Decisions must be made to focus the analysis and reduce the complexity. The Science Code Development Team sharpened its focus by setting priorities among the 11 dimensions of classroom practice presented in the country models. Because this was a study of science teaching, not generic teaching, the content dimension emerged as a dimension of special interest. Research on teaching and learning, results gleaned from the TIMSS 1995 Video Study, the field test lesson reviews, the nature of teaching in different country, and the suggestions of the steering committee, all reinforced the initial focus on content.

5.2.4 Coverage and Occurrence Codes

The Science Code Development Team defined two kinds of codes that would be useful in analyzing science lessons: coverage codes and occurrence codes.

Coverage codes parsed the entire lesson, or a specified part of the lesson, into non-overlapping segments. Every moment of the lesson, or specified part, was "covered" by one of the mutually exclusive and exhaustive categories. For example, a science lesson could be segmented into periods of time when there was either: 1) no science work, 2) science organization or management, or 3) science work. Then, the science work time could be segmented into either working on practical or seatwork activities.

Occurrence codes were used to identify the occurrence of a particular event, either within the lesson or within a specified part of the lesson. For example, a science lesson might or might not have contained a goal statement. Similarly, practical work might or might not have been related to a real world context, or involved physical materials. Codes such as these were developed to describe how often events of interest occurred within lessons, type of work, and other such segments.

5.3 Applying the Coding Scheme

Applying codes requires paying close attention to specific details in a lesson. Often coders were asked to note when a certain activity began or ended, and then describe the activity as one of several possible types. In order to reduce information processing demands, enable high inter-coder reliability, and ensure continued high quality coding, the codes were separated into "dimensions," with only a subset of codes applied in each dimension. A dimension involved viewing the entire lesson (and re-viewing critical portions) and marking all relevant segments. Altogether, 174 codes were applied in 11 coding dimensions.

Most of the codes in the first few dimensions were coverage codes, and segmented the entire lesson into meaningful chunks that later could be studied in more detail. In Dimension 1, coders marked the beginning and end of the lesson, and then divided the lesson into periods of science instruction, science organization, and non-science. Dimension 2 involved identifying periods of time when public speech or conversational exchanges are intended for the whole class.

Dimension 3 involved dividing the lesson into periods of science instruction time when students work on assignments independently from the teacher in different social organization structures, such as pair/group work. Additionally, coders had to code a variety of characteristics of student work within the different social organization structures. Dimension 4 entailed dividing science instruction time into different types of activities in which students worked as a whole-class or independently on practical or seatwork activities.

In Dimension 5, coders divided each lesson into segments according to their pedagogical goals— reviewing previous content, developing new content, assigning homework, assessing student work, and administrative activities. Additionally, this dimension included occurrence codes for specific events that might occur during the lesson and contribute to the coherence of the lesson, such as, connecting lessons, goal and summary statements, students coming to the front of the classroom, types of homework assignment, students working at their own pace, and students checking their work.

Another set of codes in Dimension 6 explored different features of the learning environment, such as holding the classroom in a science lab or a science room, and whether particular resources were used during the lesson, such as answer books, computers, and audio or visual devices.

In the Dimension 7, numerous questions were asked about students actively 'doing' science within independent practical and independent seatwork activities.

Dimension 8 involved coding the science content of the lesson into a primary content category, subcategory, and subordinate category of science. In Dimensions 9 and 10, coverage codes identified the types of science knowledge that are publicly developed during the lesson, such as canonical knowledge, and occurrence codes identified science ideas supported with data, phenomena, and/or visual representations. Because Dimensions 8-10 focus primarily on the content of the science lessons, these dimension are described separately in chapter 6.

Finally, Dimension 11 involved a series of additional questions about the set-up of the practical activities, post-lab questions, the relatedness and coherence of the practical activity segments, features of the activities such as the students' role in designing the research question or procedures, and student inquiry behaviors related to the practical activities.

In the sections that follow, the codes in each dimension are described and defined. The code definitions provided in this chapter are simplified, partial definitions. Complete definitions of the codes, as applied to the video data, can be found in the TIMSS 1999 Video Study Science Coding Manual, included as appendix D. Examples and rationales are provided where appropriate.

5.3.1 Dimension 1: Lesson Length and Phase Structure

The first dimension contained two codes that describe the basic structure of the lesson: Lesson length (LSSN) and phase structure (PH). The definition of lesson length was intentionally generous, so that most borderline cases would likely be included in the lesson.

The length of a science lesson provides a measure of the total amount of time that students had the opportunity to learn science during formally scheduled school time. The lesson length involved marking the beginning and ending of each lesson, defined as the first and last public talk by the teacher that appeared to require all students' attention. The talk did not have to be about science, but it should have signaled the point when a good student would recognize the lesson as starting or finishing. The lesson length code (LSSN) was used to establish the duration of each science lesson, and it enabled the calculation of "percent of lesson" variables. Furthermore, all subsequent coding had to occur within the defined lesson boundaries.

The lesson then was broken down into different phases. The phase structure code (PS) is a coverage code developed to provide a broad overview of how the lesson is structured. Marking this code required coders to consider each moment of the lesson time and decide which of four mutually exclusive and exhaustive categories it best fit. The four categories were: 1) science instruction, 2) science organization, 3) non-science, and 4) technical difficulty. The first step was to identify the two basic phases, science work and non-science, within each lesson. The second step was to identify the two types of science work: science instruction and science organization. The former is the period when science teaching and learning take place, and the latter is when organizational talk and activities take place that were related to science. Non-science is a period of time when there are no science-related activities or discussions taking place, and, therefore, no opportunity for students to learn science. For example, comparing countries on the occasions when science instruction was interrupted is a way of assessing whether lessons maintained a continuous focus on science instruction or provided breaks from the science instruction focus. If there was a period within a lesson when sufficient audio and/or visual information was not available due to a technical problem, this segment was identified as technical difficulty. A minimum time requirement of 30 seconds applied to all of these phase structure categories.

5.3.2 Dimension 2: Public talk

Dimension 2 contained a single coverage code that is exclusive but not exhaustive: public talk (PUBL). Public talk describes classroom talk audible for the whole-class. Some exchanges that were addressed to particular individual(s), but intended for the whole class, were included in public talk as well. It is important to capture public talk because it provides evidence that all students have the opportunity to hear and potentially learn from the information that is publicly presented as opposed to private individual exchanges and silences that were not captured in this code. Public talk did not have to be related to science; any public comment was included in this code. The key criterion for coding public talk was whether the talk was intended, directly or indirectly, for the whole class to hear.

The verbal exchanges tended to be public during the time the whole class was working together with the teacher (e.g., lecture, demonstration, teacher-led experiment, whole-class discussion, etc). The verbal exchanges during the time when students worked independently of the teacher tended to be private. Sometimes teachers gave public instruction during independent working time. These public instructions were coded as public talk if there was strong evidence to suggest that the talk was intended for the whole class. The public talk code was identified whenever a speaker started to talk publicly and ended when there was a pause that is 15 seconds or longer. There was no minimum time requirement for a public talk segment.

5.3.3 Dimension 3: Social Organization Structure

Dimension 3 contained a single coverage code, social organization structure (S), with four mutually exclusive and exhaustive categories. Each independent practical and independent seatwork segment, as identified in dimension 4, was labeled as individual, pair, group or other social organization structure based on the primary social structure of the independent work segment. This code provided information on students' opportunities to actively be involved in making sense of assigned tasks in a social process with group members.

The observed structure was not determined solely by who talked and how much students talked with each other but by the level of collaboration among students. For example, students could work together without talking or they could talk a lot while working alone. The focus of this code was on what the students were doing.

A social structure that continued to change throughout the segment, such as when multiple tasks were assigned to students who kept moving around and interacting with other students, was coded as an 'other' social organization structure. When there was a mix of social structures, the structure with the majority of students was coded.

Additional questions were asked about the social organization structure. Some questions applied to all structures while others applied to only one particular structure. The coding categories for these questions were: physical arrangement of students, sharing materials, amount of talk among students, required collaboration among students, roles assigned to students, products made by students, gender composition of pairs or groups, and number of students in groups.

5.3.4 Dimension 4: Activity Structure

Dimension 4 was comprised of one coverage code, activity structure (AS) consisting of seven mutually exclusive and exhaustive categories within the science instruction phase. These categories include whole-class work activities (ASPDF), that can be coded as practical activities (ASPPD) or seatwork activities (AS:PD), as well as independent practical activities (AS:WP), independent seatwork activities (AS:WA), copying notes (AS:CN), silent reading (AS:IR), and divided class activities (AS:DC). Copying notes and silent reading are considered as specific types of independent seatwork activities.

This activity structure code provided information on issues of practical work and the receiving versus doing role which students played in the lesson. For example, these codes answered questions about the kinds of first-hand practical experiences students had to learn, content ideas, and whether the lesson was teacher-focused or student-focused. Were students primarily receiving science content information, either by listening, reading, copying notes, or watching a demonstration, or were they primarily doing science by acting upon the science content knowledge by performing experiments, completing written assignments, or interacting in small group discussions?

Segments of whole-class work were further divided in presentation segments, where students primarily received information, and discussion segments, where students primarily engaged in science work. These codes help identify when and how students are active contributors to classroom instruction. Discussion was the portion of whole-class work segments where the teacher and/or students publicly made statements to elicit responses and responded to those elicitation requests, and was characterized by back and forth dialogue. During presentation segments, the source of the information was usually the teacher but could also have been a video, a visiting speaker, the textbook read aloud, or a student in the class.

Segments of independent activities were coded for private teacher-student interactions. These private interactions were periods when the teacher provided assistance, guidance, or instruction to an individual student or group of students, or received information from them. The content of the talk was related to the task at hand, or about other science ideas or tasks.

Additional codes identified the occurrence in the lesson of student questions (SQ), student presentations (PST), and student reading aloud (PRE). The purpose of coding student questions was to identify only those occasions when students raised substantive, content-related questions demonstrating that they were paying attention and trying to understand or otherwise engage in the content of the lesson (e.g., “meaty” questions, “curiosity” questions, “trying to understand” questions). The student questions could be a science content-related request intended to elicit an immediate verbal response (from the teacher or another student), or a science content-related statement or comment that a student volunteers that succeeds in eliciting a content-related response from the teacher that provides some content information.

Student presentation (PST) is a period of time during which one student, or a group of students, publicly presented instructional material that they had prepared with the knowledge that they would be presenting this material to the rest of the students. The information was presented orally and/or with the use of visual materials or three-dimensional objects. The teacher was not actively involved in the presentation, but may have played a supporting role.

Reading aloud (PRE) is the period of time when instructional material was presented by the student(s) reading aloud to the whole class. The student read from a source that was prepared by someone else (e.g., the textbook, a teacher-prepared worksheet, an internet source, or an overhead transparency prepared by the teacher).

5.3.5 Dimension 5: Activity Function

The codes in Dimension 5 were developed to capture and identify patterns of time usage for the different pedagogical functions of the lesson, in other words, the instructional goals and purposes of classroom events. Dimension 5 includes a coverage code, Function Structure (F), divided into seven categories that are mutually exclusive, but not exhaustive. Lesson segments remained unidentified if none of the following pedagogical functions were applicable.

The function of the core instructional part of the lesson was identified as either reviewing previous content (F:RE) or developing new content (F:DE). When previously covered materials were repeated or reviewed in a lesson, the segment was coded as reviewing previous content. Developing new content was defined as a period of time when the goal of the instructional activity was to present, develop, elaborate, or apply scientific concepts, ideas, and/or procedures. In other words, this was when the teacher introduced new information to the students or elaborated on previously introduced information. The function of other parts of the lesson besides the core instruction could be homework related, assessment related, or managerial. When the teacher clearly assigned homework and expected all students to complete the homework, the pedagogical function was called assigning homework (F:HW1). Going over homework (F:HW2) on the other hand was a period of time set aside by the teacher to collect, check, correct, or go over students' homework after the students had worked on or completed the assignment at home. Going over homework was different from the core instructional part of the lesson. The students previously had worked on the material which was different from developing new content. Also, the results had not been shared or corrected in class which was different from reviewing previous content. The function of formal assessments, such as oral exams and written exams, was assessing student learning (F:AS1). When the teacher returned materials, the class shared answers, the teacher and students talked about grades, or went over the questions and/or answers from previously conducted tests, quizzes, or other assessment materials, the function of this classroom event was identified as going over assessment (F:AS2). Many of the Non-Science segments identified in Dimension 1 contain administrative (F:ADM) events such as ritual opening, roll taking, or announcements of future events. The administrative category was used when general information was provided by the teacher and administrative and housekeeping activities were carried out. Such information and activities were usually pre-planned by the teacher to take care of things not related to or indirectly related to science content of the lesson, but still a necessary part of the classroom management.

In addition to the coverage code, Dimension 5 included nine occurrence codes, three of which had no minimum time requirement: assigning homework (AHW), ritual opening and closing of the lesson (RIT), and outside interruptions (OUT). These occurrence codes also could have been coded as function structure coverage codes. Follow-up questions related to the coherence of the lesson led to six occurrence codes (connecting lesson [1], lesson goal statement [2], lesson summary statement [3], students coming to the front [SCF], homework worked on in class [5.1], and type of homework assignment [5.2]), and two lesson-level codes (students working at their own pace [6.1] and students independently checking their work [7.1]).

The occurrence code, connecting lesson (1), is a potential indicator of lesson coherence and characterized the way in which the lesson was connected to the previous lesson and to the next lesson. Coders used all available information to identify the type of connecting, such as, teacher and students' conversations and teacher questionnaire responses. Lessons could be connected by tests, by topic or activity, by homework and by connecting different aspects of practical work.

Teachers could make the content organization of the lesson more explicit for students and help deepen their understanding of the content of the lesson by providing goal and summary statements. A lesson goal statement (2) was the teacher's public statement(s) that described the overall goals/activities of the current lesson at the beginning of or just before the instruction. Present lesson goal statements described the whole lesson rather than only one section of the lesson. Goals could be stated in terms of science content (e.g., topics to be covered or key ideas to be learned), instructional activities (e.g. assignments to be carried out), or materials (e.g., chapters or pages in the textbook, computers, or videos). Next lesson goal statements were public statements that described the next lesson, often occurring near the end of the lesson or the public part of the lesson. A lesson summary statement (3) was the teacher's public statement(s) that normally occurred at or near the end of the lesson that include the key point(s) or event(s) that were covered during the lesson. The teacher could state the summary, elicit the summary from the students, or write the summary on the board and ask students to copy it in their notebooks.

Coders captured when a student or a group of students was called to the front of the room by the teacher to carry out science instructional tasks with an occurrence code (SCF). The tasks were defined as one of three types: (1) present results from a previously worked assignment; (2) work on a seatwork assignment; or (3) work on a practical assignment. This code was distinct from the Dimension 4 student presentation code (PST). For this code, the student at the front of the class had to be aware that her/his work was being made public to the whole class.

Teaching students strategies to be responsible for their own learning, for example, making decisions, setting their own goals, and monitoring their own progress, could enable them to become independent, self-directed learners. Because homework is one strategy that could help students develop these skills, instances of assigning homework and the kinds of homework assigned in the lesson were identified with two occurrence codes (5.1 and 5.2). Coders identified if the students were given an opportunity to work on the homework assignment in class. They also identified if the homework assignment was to review materials, study for a test, work on a written assignment or a set of question, read text, or another type of assignment such as bringing something to class.

Working on homework and self-pacing long-term assignments are both strategies to increase students' responsibility for learning outside of the class. In many classrooms, students are assigned homework for a particular day and the teacher expects students to have it completed by that day. In other classes, students are working at their own pace: they can work ahead and sometimes fall behind without getting into trouble. A lesson-level code (6.1) was developed to capture if students worked at their own pace. In such cases, students were given an assignment schedule or they were encouraged to work ahead. For this code, students had to be responsible for pacing their own work on science.

The final Dimension 5 code was at the lesson-level and identified if students independently check their work (7.1) before the lesson, during the lesson, or after the lesson, but their answers were not discussed publicly. The code included lessons in which students were encouraged to check their own work on assignments using an answer book or answer sheet, or students had answers available as they worked on the assignment. The students were either assigned to check their answers, or they simply chose to check their answers.

5.3.6 Dimension 6: Learning Environment

Dimension 6 codes identified the physical aspects of classroom environment in which students in different countries were situated during science lessons. These codes were used to describe the resources available to support science teaching, the way science was represented in the lesson, and the kinds of opportunities students had to complete science tasks.

All codes in this dimension were occurrence codes and included the following: Room types (L:RM), science-related commercial products and materials (L:CP), science-related natural objects (L:NP), books used by students (L:BK), organized science notebooks (L:NB), computers (L:C), overhead projectors (L:OH), visual technologies (L:TC), blackboards (L:CB), adult teaching assistants (L:TA), grading (L:GS), routine lesson openers (L:RO), and school uniforms (L:SU).

5.3.7 Dimension 7: Types of Independent Activities

The purpose of Dimension 7 was to describe student 'doing' during independent practical activity, independent seatwork activity, and discussion segments. The codes in this dimension provided information on the kinds of tasks students were expected to complete during independent practical and seatwork activities, and the kinds of questions they had the opportunity to consider and answer during discussions. The importance of these codes was to identify opportunities for students to take an active role in science learning and to describe the variety of learning activities they were engaged in.

The first code (RW) was an occurrence code that identified whether the independent practical activity was related to an independent seatwork activity in the lesson. Six additional codes described the nature of the independent activities within practical and seatwork segments as follows: an engaging, fun activity (FA), related to social issues or students' personal lives (SP), a writing task (LW), a mathematical calculations/operations assignment (MP), a drawing/diagram assignment (DD), a graph assignment (GR), or an assigned text reading assignment (RT).

5.3.8 Dimension 11: Features of Practical Activities

The purpose of Dimension 11 codes was to capture additional information on the types of practical activities provided for students. The importance of these activities is that they reflect the nature of work in the larger science community. Several sets of codes described features of the practical activity: preparation for the activity, summary of the activity, coherence of practical activity segments throughout the lesson, student role in the activity, and the nature of the activity.

Preparation for the practical activity included the following codes: set-up for the practical work (Q1), usually in the form of public talk directly related to the upcoming activity; and conceptual reason(s) that the students will learn from the activity (Q2), such as a big idea, concept, or theory. Descriptions of how teachers summarized the activity included: presenting/discussing results from the activity (Q5), such as observations or conclusions; generating new questions to investigate (Q6); and critiquing or evaluating methods used in the activity (Q7).

A third set of codes was used to assess the coherence or relatedness of the practical activity segments throughout the lesson: setting up for the next lesson (Q8); wrapping up from previous lesson (Q9); relating all activity segments by topic (Q10); linking primary and secondary practical activities (Q11); relating primary activity segments by topic (Q12); and helping students make links between primary activity segments (Q13).

Student roles during practical activities are another way to describe opportunities for students to actively engage in science. Coders marked whether students were involved in any of the following during the practical activity: generating the research question (Q15.1), designing procedures for investigations (Q15.2), working on independent practical activity related to real-life issues (Q16), working with quantitative and qualitative data (Q17), and collecting and recording data (Q18).

A final set of codes described the nature of the practical activity: types of practical activities (Q19), students made predictions (Q20), the teacher and/or students made predictions supported by theory or reasoning (Q22), the teacher and/or students linked predictions to results (Q23), students organized or manipulated collected data (Q24), students were expected to interpret the results (Q25), and the activities were engaging (ENG).

5.4 Coder Training

As described above, codes were developed, practiced, and applied in dimensions. Once definitions were completed for each code in a dimension, training materials were created and a reliability procedure was developed by the science code development team.

Training for each coding dimension involved three stages: introduction, practice, and reliability. First, coders were provided with the coding manual which contained carefully worded definitions for each code, as well as notes and examples. Coders and representatives from the science code development team met to introduce and discuss each code in the dimension, including the definitions and accompanying notes. For most codes, video examples were shown of each coding category. Coders frequently raised questions about the rationale and purpose behind the codes, or requested further clarification of the definitions. The country associates sometimes used the coders' input to make minor revisions to the coding manual.

After learning the definitions and watching examples from a particular coding dimension, coders were given the opportunity to practice applying the codes. In these practice sessions, coders were provided with a select set of lessons, or portions of lessons, usually representing all the countries in the sample. Coders were instructed to work individually to apply the codes, and then compare their coding to an answer key. To create these answer keys, each country associate individually coded the lessons. Then the science code development team met and reached consensus on the appropriate coding. Once they finished practicing, coders and country associates would meet again to discuss any problems or concerns that arose.[6]

Throughout the training process, coders were encouraged to make suggestions for improving the code definitions. In particular, coders and country associates formed subgroups to test code definitions, assemble practice materials, and train other coders.

Once coders and country associates felt comfortable with the codes, and confident that they could apply them reliably, coders took an initial reliability test. Details of the initial reliability procedure and calculations are discussed in section 5.5.1 below. After establishing reliability on the codes in a dimension, coders applied them to lessons from their country. Various additional quality control measures were put in place to ensure reliable and valid coding and data entry. For example, mid-point reliability was calculated for each code once coders completed at least half of their assigned lessons.

Coders also played a substantially active role in assisting the science code development team to refine code definitions for reliability purposes. Occasionally coders did not reach an acceptable level of initial reliability on some codes in a dimension (e.g., science instruction time and independent practical activities). In such cases, coding definitions were then modified by the code development team in close collaboration with the coders, coders were re-trained, and they established reliability using a new set of lessons. On other codes, such as teacher products and lesson framing, coders could not establish an acceptable level of reliability even after re-training and re-testing. Therefore, these codes were dropped.

Coders were each responsible for a particular number of lessons, and coding was done individually. However, collaboration among coders was encouraged, especially among coders from the same country. Also, country associates were available to help with questions and difficult lessons. When coders came across lessons that were particularly hard to code, the entire science code development team met to watch them and determine how to accurately apply the codes. These decisions were then explained in writing and distributed to all coders (see the TIMSS 1999 Video Study Science Coding Manual included as appendix D).

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[6] Lessons or portions of lessons that were coded by the country associates and then by coders as “practice” were considered coded. Therefore, the coders assigned to those particular lessons simply had to enter the coding into the appropriate software.

5.5 Reliability and Quality Control

Coders established initial reliability for all codes prior to their implementation. After they finished coding approximately half of their assigned set of lessons (in most cases about 40–50 lessons), coders established midpoint reliability. The minimum acceptable reliability score for each code was 85 percent (averaged across coders). Individual coders or coder pairs had to reach at least 80 percent reliability on each code.[7]

A variety of additional quality control measures were put in place to ensure accurate coding. These measures included: 1) discussing difficulties in coding reliability lessons with the science code development team and/or other coders, 2) checking the first two lessons coded by each coder, either by a code developer or by another coder, and 3) discussing hard-to-code lessons with code developers and/or other coders.

Initial reliability was computed as agreement between coders and a master document. Reliability statistics were calculated based on a "percent correct" approach (Bakeman and Gottman 1997). A master refers to a lesson or part of a lesson coded by consensus by the science code development team. To create a master, the country associates independently coded the same lesson and then met to compare their coding and discuss disagreements until consensus was achieved. Masters often were used to establish initial reliability, particularly in the early passes. The formula used to compute reliability was:

Number of Agreements ÷ (Number of Agreements + Number of Disagreements).

This formula was used regardless of whether reliability was established between coders and a master document, or as inter-rater agreement. What counted as an agreement or disagreement depended on the specific nature of each code, and is explained in detail in sections 5.5.1 and 5.5.2. Note that when codes required timing and categorization decisions, both were taken into account as either agreements or disagreements.

Table 5.1 lists the initial and midpoint reliability scores for each code, averaged across coders. Since the computation of reliability for codes differed somewhat, the specific procedures used to calculate initial and midpoint reliability for each code are presented in sections 5.5.1 and 5.5.2. Reliability scores for codes included in dimensions 8-10 are described in chapter 6.

[7] The minimum acceptable reliability score for all codes (across coders and countries) was 85 percent. For coders and countries, the minimum acceptable reliability score was 80 percent. That is, the reliability of an individual coder OR the average of all coders within a particular country was occasionally between 80–85 percent. In these cases clarification was provided as necessary, but re-testing for reliability was not deemed appropriate.

Table 5.1. Initial and midpoint reliability statistics, by code: 1999

Dimension	Code	Initial reliability[1] (percent)	Midpoint reliability[2] (percent)
1	Lesson structure		
	Lesson length (LSSN)	98	94
	Phase structure (PH)	92	96
	Classroom talk		
2	Public talk (PUBL)	99	98
4	Private teacher-student interaction (TSI)	93	94
3	Social organization		
	Social organization structure (S)	95	100
	Physical arrangement of students (PA)	95	100
	Sharing materials (M)	93	100
	Amount of talk among students (OI)	90	100
	Expected interaction (EI)	92	100
	Requiring collaboration (RC)	95	100
	Assigning roles to group members (R)	96	100
	Creating science group products (P)	90	100
	Working in mixed gender groups (G)	92	100
	Group size (N)	98	100
4	Activity structure		
	Activity structure (AS)	95	98
	Student questions (SQ)	88	85
	Discussion or presentation activity (PRES/DISC)	96	96
	Student presentation (PST)	97	88
	Reading aloud (PRE)	95	100
5	Activity function		
	Function structure (F)	94	97
	Ritual opening and closing (RIT)	100	100
	Outside interruptions (OUT)	87	89
	Assigning homework (AHW)	94	97
	Connecting lesson (1)	92	93
	Lesson goal statements (2)	89	97
	Lesson summary statements (3)	86	97
	Students coming to the front (SCF)	100	100
	Homework worked on in class (7.1)	87	91
	Type of homework assignment (7.2)	88	92
	Students work at their own pace on long term assignments (8.1)	88	89
	Students check their own work (9.1)	98	98

See notes at end of table.

Table 5.1. Initial and midpoint reliability statistics, by code: 1999—Continued

Dimension	Code	Initial reliability[1] (percent)	Midpoint reliability[2] (percent)
6	Learning environment		
	Room types (L:RM)	85	88
	Science-related commercial products and materials (L:CP)	98	99
	Science-related natural products (L:NP)	92	97
	Books used by students (L:BK)	87	85
	Organized science notebooks (L:NB)	86	87
	Computers (L:C)	85	98
	Overhead projectors (L:OH)	100	100
	Specialized visual technology (L:TC)	88	89
	Blackboards (L:CB)	98	100
	Adult teaching assistants (L:TA)	98	99
	Grading (L:GS)	90	92
	Routine lesson openers (L:RO)	98	100
	School uniform (L:SU)	100	100
7	Types of independent activities		
	Independent seatwork activity related to Independent practical activity (RW)	99	100
	Motivating activities (FA)	92	100
	Independent activities related to real-life issues (SP)	87	91
	Writing text during independent activities (LW)	86	96
	Mathematical calculations (MP)	93	100
	Diagrams (DD)	88	100
	Graphs (GR)	100	100
	Reading text during independent activities (RT)	94	100
11	Types of practical activities and motivating activities		
	Types of practical activities		
	Type A or B (TYPE)	100	100
	Set-up talk (Q1)	96	100
	Purpose of the practical activity before first segment (Q2)	91	100
	Relationship between multiple independent practical activity segments (Q3)	93	94
	Purpose of the practical activity before last segment (Q4)	89	100
	Discussion of results (Q5)	93	100
	New questions to investigate are discussed or mentioned (Q6)	93	100

See notes at end of table.

Table 5.1. Initial and midpoint reliability statistics, by code: 1999—Continued

Dimension	Code	Initial reliability[1] (percent)	Midpoint reliability[2] (percent)
11	Methods are critiqued or evaluated (Q7)	93	94
	Lab involves setting up for next lesson (Q8)	100	100
	Lab involves wrapping up from previous lesson (Q9)	100	100
	Lab segments related by topic (Q10)	100	100
	Link between primary and secondary labs (Q11)	100	100
	Primary lab segments related by topic (Q12)	100	100
	Teacher helps students make links between primary lab segments (Q13)	89	94
	Who generates the research question (Q15.1)	96	100
	Who designs procedures for investigations (Q15.2)	94	100
	Independent practical activity related to real-life issues (Q16)	96	100
	Students work with quantitative and qualitative data (Q17)	94	88
	Students collect and record data (Q18)	89	100
	Types of practical activity (Q19)	86	100
	Students make predictions (Q20)	100	100
	Where predictions occur (Q21)	96	100
	Prediction supported by theory (Q22)	98	100
	Prediction linked to results (Q23)	98	100
	Students organize or manipulate collected data (Q24)	97	85
	Students interpret results (Q25)	89	85
	Motivating whole-class activities (ENG)	97	100

[1]Initial reliability refers to reliability established on a designated set of lessons before coders began work on their assigned lessons. Initial reliability was established against a master document.
[2]Midpoint reliability refers to reliability established on a designated set of lessons after coders completed approximately half of their total assigned lessons.
NOTE: Inter-rater agreement was calculated as the number of agreements divided by the sum of the number of agreements and disagreements. Codes for categories of science content in the lesson were developed using consensus coding among the Science Content Coding Team.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

5.5.1 Initial Reliability

Initial reliability was determined by comparing coders' individual markings of lessons to masters of those lessons, as described above. This method is considered a rigorous and cost-effective alternative to inter-coder reliability (Bakeman and Gottman 1997).

A percent agreement reliability statistic was computed for each coder by dividing the number of agreements by the sum of agreements and disagreements (Bakeman and Gottman 1997). Then, average reliability was calculated across coders and across countries for each code. In cases where coders did not reach the set reliability standard, they were re-trained and re-tested using a new set of lessons. Codes were dropped if 85 percent reliability could not be achieved (or if individual coders could not reach at least 80 percent reliability; see section 5.4).

Some codes required coders to indicate a time. In these cases, coders' time markings had to fall within a predetermined margin of error. This margin of error varied depending on the nature of the code, ranging from 10 seconds to two minutes. Rationales for each code's margin of error are provided in the sections that follow.

Exact agreement was required for codes that had categorical coding options. In other words, if a code had four possible coding categories, coders had to select the same coding category as the master. In some cases, coders had to both mark a time (i.e., note the In- and/or Out-Point of a particular event) and designate a coding category. Reliability for the coding category was calculated only if coders marked the time within the given margin of error.

Reliability calculations differed somewhat depending on the nature of each code. A detailed explanation of how the initial reliability was computed for each code is provided below.

5.5.1.1 Initial Reliability for Lesson Length (Dimension 1: LSSN)

Coders watched five video lessons (one lesson from each of the participating countries) and marked the In- and Out-Point of the lesson (LSSN). Each In- and Out-point had to be within 30 seconds of the master to be considered as agreement. A 30-second margin of error was deemed appropriate and reasonable based on the notion that eighth-grade science lessons typically last about 35-55 minutes. Reliability was calculated as the number of agreements on In- and Out-Points divided by the total number of In- and Out-Points in all five lessons.

5.5.1.2 Initial Reliability for Phase Structure (Dimension 1: PH)

Within the same five video lessons, coders noted all shifts and categories for the phase-structure code. The shifts had to be within 15 seconds of the master to be considered as agreement. A 15-second margin of error was deemed appropriate and reasonable because the definition of phase structure required that these segments be at least 30 seconds long, but typically longer. Each categorization was required to be exactly the same as the master to be counted as agreement. Coders marking a shift incorrectly were counted as a disagreement. The shift reliability was calculated as the number of agreements on shifts divided by the total number of shifts in all five lessons. Coders then were told the correct shift time(s) and given the opportunity to adjust their categories. The categorization reliability then was calculated as the number of agreements on categories divided by the total number of categories in all five lessons.

5.5.1.3 Initial Reliability for Public Talk (Dimension 2: PUBL)

Coders marked In- and Out-Points for the public talk code in five video lessons (one lesson from each of the participating countries) that were selected for Dimension 2. There was no minimum time requirement for the public talk code. Reliability was calculated as the number of seconds the coders were in agreement with the masters divided by the total number of seconds in all five lessons.

5.5.1.4 Initial Reliability for Social Organization Structure (Dimension 3: S)

Dimension 3 consisted of a series of codes applied to previously identified activity structure segments categorized as either student seatwork activity (AS:WA) or student practical activity (AS:WP). Coders watched a total of 33 segments and applied 10 codes to those segments. For each code, an agreement was counted if the coder marked exactly the same coding category as the master, and a disagreement was counted if the coder marked a coding category different from the master. Time was not included in the reliability calculations for these codes because In- and Out-Points of each segment had previously been determined in Dimension 4.

5.5.1.5 Initial Reliability for Activity Structure (Dimension 4: AS)

Coders watched five video lessons (one lesson from each of the participating countries) and noted shifts and categories for the activity structure code. Each shift had to be within 15 seconds of the master to be considered as agreement. A 15-second margin of error was deemed appropriate and reasonable because the definition of phase structure required that these segments be at least 30 seconds long to be coded, but typically longer. Each categorization was required to be exactly the same as the master to be counted as agreement. Coders marking the shifts incorrectly were counted as a disagreement. The shift reliability was calculated as the number of agreements on shifts divided by the total number of shifts in all five lessons. Coders then were told the correct shift time(s) and given the opportunity to adjust their labels. The categorization reliability then was calculated as the number of agreements on categories divided by the total number of categories in all five lessons.

5.5.1.6 Initial Reliability for Private Teacher-Student Interaction (Dimension 4: TSI)

The teacher-student interaction code was applied to independent activity segments only (AS:WA and AS:WP). Coders viewed four minutes of independent work segments from 20 different video lessons (four per country) and marked In- and Out-Points of the TSI code. This means that the total duration of time coded for reliability purpose was 80 minutes. There was no minimum time requirement for this TSI code. Reliability was calculated as the number of seconds where the coder had the same coding as the master divided by the total number of seconds in all selected segments.

5.5.1.7 Initial Reliability for Discussion or Presentation Activity (Dimension 4: PRES/DISC)

Presentation/discussion coding applied only to whole-class work segments (AS:PD and ASPPD). To establish reliability 15 minutes of whole-class work were selected in 10 separate lessons (two lessons from each of the participating countries). This means that the total duration of time coded for reliability purpose was 150 minutes. Reliability was calculated as the number of seconds where the coders were in agreement with the master divided by the total number of seconds in all selected lesson segments.

5.5.1.8 Initial Reliability for Student Presentation and Reading Aloud (Dimension 4: PST, PRE)

Fourteen lesson segments were carefully selected. In these segments five student presentations and five whole-class readings occurred (one example of both codes in a video lesson from each participating country). Coders marked In- and Out-Points of the codes. Each In- and Out-Point had to be within 10 seconds of the master to be considered as agreement. A 10-second margin of error was deemed appropriate and reasonable because there were no time requirements for student presentations or whole-class reading. For both codes reliability was calculated separately as the number of agreements on In- and Out-Points divided by the total number of In- and Out-Points in all 14 lessons. In addition, reliability was calculated as the percentage of seconds that the coders were in agreement with the master.

5.5.1.9 Initial Reliability for Student Questions (Dimension 4: SQ)

Within the same 14 lesson segments, coders noted all student questions. Each question marked as SQ was evaluated against the master coding of the segment. The coding was considered as agreement if the same question was coded SQ on the master. Disagreements occurred when the coder missed a SQ that was marked on the master or if the coder coded any additional SQ's.

5.5.1.10 Initial Reliability for Function Structure (Dimension 5: F)

Coders watched five videos (one lesson from each of the participating countries). Coders marked In- and Out-Points for the function structure categories. Reliability was calculated as the number of seconds where the coder had the same coding as the master divided by the total number of seconds in the five lessons.

5.5.1.11 Initial Reliability for Outside Interruptions (Dimension 5: F:OUT)

In the same five video lessons coders marked only In-Points for outside interruptions. Each In-Point had to be within 10 seconds of the master to be considered as agreement. A 10-second margin of error was deemed appropriate and reasonable because there were no time requirements for student questions. For both codes, reliability was calculated separately as the number of agreements on In-Points divided by the total number of In-Points in all 14 lessons.

5.5.1.12 Initial Reliability for Different Functions of Pedagogical Features (Dimension 5: 1, 2, 3, 7, 8, 9)

Coders watched 15 video lessons (three lessons from each of the participating countries). Each code in this dimension was similar to a multiple choice question. Coders were in agreement with the master if they selected the correct answer to the coding question as defined by the master coding. Coders were reliable for an individual code if they coded 13 out of 15 lessons correctly for that particular code. Some coders were not reliable on a certain code. In that case, they began the coding process and documented the rationale for their coding on that particular question. Country associates checked their rationale and made the final (reliable) coding decision for each lesson for that code.

5.5.1.13 Initial Reliability for Learning Environment (Dimension 6: L)

Coders watched the same 15 video lessons as they did in the previous dimension. Also, the same reliability procedures were used to establish reliability. None of the coders were found unreliable on any code. Therefore, no additional coding procedures were necessary.

5.5.1.14 Initial Reliability for Types of Independent Activities (Dimension 7)

Three independent work segments were selected from each country. A total of 15 lesson segments were coded for all Dimension 7 codes. Agreement was counted when the coder made the exact same decision as the master for each question asked. Reliability was calculated for each question separately.

5.5.1.15 Initial Reliability for Types of Independent Activities and Motivating Activities (Dimension 11)

Coders watched five videos (one lesson from each of the participating countries) and coded all independent practical activities in these lessons for all 25 coding questions. Agreement was counted when the coder made the exact same decision as the master for each question asked. Reliability was calculated for each question separately.

5.5.2 Midpoint Reliability

Midpoint reliability for the code lesson duration (LSSN) was determined by comparing coders' marking of lessons to master lessons. For all other codes, midpoint reliability was determined by calculating the mean inter-rater agreement among pairs of coders. By halfway through the coding process, coders were considered to be more expert in the code definitions and applications than the science code development team. Therefore, in general, the most appropriate assessment of their reliability was a comparison with other coders.

Coder pairs always were randomly assigned according to the following conditions: 1) coders could not be from the same country, and 2) coders could not have the same partner for initial and midpoint reliability. Lessons were selected for each coder by randomly choosing from among their five most recently coded lessons. Coders reviewed their selected lessons and coded their partner's lessons. In the process, coders were instructed to consult the coding manual and keep notes regarding the “implicit” rules they applied. That way if disagreements arose, the coder pairs could support their decisions. After their reliability scores were calculated, coder pairs were encouraged to resolve such coding differences on their own, seeking help from other coders and country associates as needed.

Reliability calculations differed somewhat depending on the nature of each code. A detailed explanation of how the midpoint reliability was calculated for each code is provided in the sections that follow.

5.5.2.1 Midpoint Reliability for Dimension 1

After half the lessons were coded (approximately 20 lessons per coder), a coded lesson was randomly selected from each coder. The advantage of this approach was that coders did not know beforehand which lesson was to be checked. A master was created and the In- and Out-Points, shifts, and categories compared to the master. Midpoint reliability was calculated in the same manner as initial reliability.

5.5.2.2 Midpoint Reliability for Dimension 2

After approximately half the lessons were coded, one lesson was selected at random from each coder. This lesson was then coded again by another coder. An inter-rater agreement score was calculated for midpoint reliability.

5.5.2.3 Midpoint Reliability for Dimension 3

After approximately half the lessons were coded for the social structure, one lesson was randomly selected from each coder. A master for these lessons was created by a team made up of two additional coders and one members of the research team who led the development and training of the code. Midpoint reliability was calculated in the same manner as initial reliability.

5.5.2.4 Midpoint Reliability for Dimension 4

Two lessons were selected at random from each coder—one after approximately 40 percent of the data were coded and another after approximately 80 percent of the data were coded. A master for these lessons was created by a team made up of two additional coders and two members of the science code development team. Midpoint reliability was calculated in the same manner as initial reliability.

Midpoint reliability for private teacher-student interactions was conducted after approximately half of the data was coded. The same procedures as initial reliability were followed.

Midpoint reliability for the presentation/discussion, student questions, student presentation, and whole-class reading codes were established concurrently with the activity structure code. Midpoint reliability was calculated in the same manner as initial reliability based on five selected lessons that were not previously coded.

5.5.2.5 Midpoint Reliability for Dimension 5

After approximately half of the lessons were coded for function structure and outside interruptions, one lesson was randomly selected from each coder. A master for these lessons was created by a team made up of two additional coders and one members of the research team who led the development and training of the code. Midpoint reliability was calculated in the same manner as initial reliability.

After approximately half of the lessons were coded for different functions of pedagogical features, one lesson was randomly selected from each coder. A master for these lessons was created by one member of the research team who led the development and training of the code. Midpoint reliability was calculated in the same manner as initial reliability.

5.5.2.6 Midpoint Reliability for Dimension 6

After approximately half of the lessons were coded for the learning environment, one lesson was randomly selected from each coder. A master for these lessons was created by one member of the research team who led the development and training of the code. Midpoint reliability was calculated in the same manner as initial reliability.

5.5.2.7 Midpoint Reliability for Dimension 7

After 50 percent of all data was coded, two lessons were randomly selected from each coder. Four lessons were selected from coders that coded two countries (two lessons from each country). Next, another coder from a different country created a master in collaboration with a country associate. Midpoint reliability was calculated the same way as the initial reliability.

5.5.2.8 Midpoint Reliability for Dimension 11

After 50 percent of all data was coded, two lessons were randomly selected from each coder. Four lessons were selected from coders that coded two countries (two lessons from each country). Next, another coder from a different country created a master in collaboration with a country associate. Midpoint reliability was calculated the same way as the initial reliability.

5.5.3 Other Quality Control Measures

A variety of additional quality control measures were put in place to ensure accurate coding. These measures included: 1) discussing difficulties in coding lessons reliably with the science code development team and/or other coders, 2) checking the first two lessons coded by each coder, either by a country associate or by another coder, and 3) discussing hard-to-code lessons with country associates and/or other coders.

5.5.4 Data Entry, Cleaning, and Statistical Analyses

Most codes were entered directly into the multimedia database, so that the videotapes and English transcripts could be linked directly with specific codes. The data then were exported either in spreadsheet format for statistical analyses, or in table format for further study by specialist coding groups. In some cases, where the vPrism software was not conducive for particular types of coding, codes were entered into a Microsoft Excel spreadsheet.

Codes from Dimensions 1 through 7 were entered directly into a vPrism database. Codes from Dimension 11 were entered into an Excel database.

A data cleaning process was put in place for both the vPrism and Excel databases. For the vPrism data, coders first recorded their coding decisions in writing onto printed lesson transcripts. Then they entered this information into vPrism. Lastly, coders exported the vPrism data for each lesson and compared it to their markings on the transcripts. In this way, data entry errors were immediately noted and corrected. In addition, errors detected through preliminary data analyses were examined and corrected. For example, coding that was outside of a possible range was detected and extreme outliers on particular codes were studied.

For the Excel data, coders first recorded their coding decisions in writing onto a printed spreadsheet for each lesson. Then they entered this information into Excel. Every 10th lesson was checked for accuracy, and errors were corrected.

Once they were cleaned, all of the data were aggregated to the lesson level, with each coding dimension in a separate datafile. The full sample weight and replicate weights were then appended to each file. Finally, statistical analyses were run using the weighted data in WesVar (Westat 2000) and/or SPSS.

5.5.5 Other Quality Control Measures

After coders passed initial reliability for each dimension, coding for their first two or three lessons were checked by one or more members of the science code development team. Feedback on coding errors was provided to the coders where necessary.

Chapter 6. Coding Video Data II: Specialists

Most codes were applied to the video data by the International Science Coding Team, whose members were cultural insiders and fluent in the language of the lessons they coded (see chapter 5). However, not all of them were experts in science or teaching. Therefore, the Science Content Coding Team, a specialist coding team with different areas of expertise, was employed to create and apply codes regarding the science nature of the content, the types of science knowledge, the level of difficulty of the science content, the different modes of content development, and the classroom discourse. Dimensions 8-10 of the coding process covered these aspects of the study, and are described in detail in this chapter.

The Science Content Coding Team consisted of individuals with expertise in science and science education. The group was directed by Stephen Druker (LessonLab) and Catherine Chen (California State University, Long Beach), and included Ivonne Budianto, Constance Christensen, Patrick Lam, Angelica Mejia, Alvaro Mercado, Valdislav Mikulich, and Mark Valderrama (all of LessonLab). They developed and applied a series of codes to all of the scientific content in the videotaped lessons.

6.1 Dimension 8: Science Content

The Science Content Coding Team categorized the science content covered in eighth-grade in all participating countries using a comprehensive, detailed, and structured list of science content categories, subcategories, and subordinate subcategories identified in the 1997 *Guidebook to Examine School Curricula: TIMSS as a Starting Point to Examine Curricula* (McNeely 1997). The purpose of the content categories was to describe the science that students were encountering during each lesson. Three coders first identified the primary science content category, subcategory, and subordinate subcategory of a lesson from teachers' responses to the questionnaire. Then, they watched the videotaped lessons to confirm the codes and to provide additional information for the more detailed codes if necessary. If the content coded from the questionnaire did not agree with the content observed in the videotaped lesson, the final content code for the lesson would be based on the observed lesson.

The final science content code list consisted of 101 codes. The 8 broad categories of topic codes included earth science; life science; physical science; science, technology, and mathematics; history of science and technology; environmental and resource issues related to science; nature of science; and science and other disciplines. Within each of these categories, 27 subcategories were used to further classify science content at a more detailed level. The third, and most detailed level of content codes, included 66 additional subordinate subcategories.

Category 1. Earth science

This category includes 3 subcategories and 14 subordinate subcategories.

- Earth features
    - composition

  - land forms
  - bodies of water
  - atmosphere
  - rocks and soil
  - ice forms
- Earth processes
  - weather and climate
  - physical cycles
  - building and breaking
  - Earth's history
- Earth in the universe
  - Earth in the solar system
  - planets in the solar system
  - beyond the solar system
  - evolution of the universe

Category 2. Life science

This category includes 5 subcategories and 19 subordinate subcategories.

- Diversity, organization, and structure of living things
  - plants and fungi
  - animals
  - other organisms
  - organs and tissues
  - cells
- Life processes and systems enabling life functions
  - energy handling
  - sensing and responding
  - biochemical processes in cells
- Life spirals, genetic continuity, and diversity
  - life cycles
  - reproduction
  - variation and inheritance
  - evolution, speciation, and diversity
  - biochemistry of genes
- Interactions of living things
  - biomes and ecosystems
  - habitats and niches
  - interdependence of life
  - animal behavior
- Human biology and health
  - nutrition
  - disease

Category 3. Physical science

This category includes six subcategories and 30 subordinate subcategories.

- Matter
    - classification of matter
    - physical properties
    - chemical properties
- Structure of matter
    - atoms, ions, and molecules
    - macromolecules
    - crystals
    - subatomic particles
- Energy and physical properties
    - energy types, sources, and conversions
    - heat and temperature
    - wave phenomena
    - sound and vibration
    - light
    - electricity
    - magnetism
- Physical transformations
    - physical changes
    - explanations of physical changes
    - kinetic theory
    - quantum theory and fundamental particles
- Chemical transformations
    - chemical changes
    - explanations of chemical changes
    - rate of change and equilibria
    - energy and chemical change
    - organic and biochemical changes
    - nuclear chemistry
    - electrochemistry
- Forces and motion
    - types of forces
    - time, space, and motion
    - dynamics of motion
    - relativity theory
    - fluid behavior

Category 4. Science, technology, and mathematics

This category includes 3 subcategories and 4 subordinate subcategories.

- Nature or conceptions of technology
- Interactions of science, mathematics, and technology

    - influence of mathematics and technology on science and applications of science in mathematics and technology
- Interactions of science, technology, and society
    - influence of science and technology on society
    - influence of society on science and technology

Category 5. History of science and technology

This category does not include additional subcategories or subordinate subcategories.

Category 6. Environmental and resource issues related to science

This category includes six subcategories only:

- Pollution
- Conservation of land, water, and sea resources
- Conservation of material and energy resources
- World population
- Food production and storage
- Effects of natural disasters

Category 7. Nature of science

This category includes two subcategories only:

- Nature of scientific knowledge
- The scientific enterprise

Category 8. Science and other disciplines

This category includes two subcategories only:

- Science and mathematics
- Science and other disciplines

6.2 Dimension 9: Types of Knowledge

Dimension 9 directly addresses the content knowledge that was presented publicly in the lesson by any source, whether it was the teacher, a student or, for example, a publicly-presented information video. Describing the types of knowledge publicly presented provided important information about how the science community was represented and the kinds of opportunities students had to learn science. This dimension consists of one coverage code, Knowledge Types (T) that characterizes the types of science-related knowledge, or "knowledge development themes" that are publicly presented during the lesson. This coverage code is mutually exclusive and exhaustive, meaning that all public talk (see section 5.3.2 for a detailed description of public talk in Dimension 2) in the lessons is coded as one of the following categories without any time requirements.

Canonical knowledge (T:CAN) included any amount of public talk in which the content of the talk was about ideas or events designed to foster the development of scientific facts, concepts, ideas, processes, or theories. This is the type of knowledge commonly found in traditional science texts, sometimes referred to as "textbook" knowledge, and includes knowledge of scientific characteristics, labels, definitions, data, observations, experiences, laws, and theories.

Procedural and experimental knowledge (T:PRO) included public talk about how to do science related practices such as manipulating materials, performing experimental processes, or engaging in scientific thinking practices for the primary purpose of enabling student(s) to carry out a procedure or experimental practice at some point in the future. Procedural information that was not science-related was not captured in the code.

Real-life issues referred to public talk about how science knowledge was used, applied, or related to societal or social issues. When real-life issues were substantively linked to canonical knowledge, the segment was referred to as real-life issues used to develop canonical knowledge (T:CANS). In other words, the real-life issue was related to canonical knowledge beyond a topic level, the real-life issue helped clarify the canonical knowledge, or the canonical knowledge helped clarify the real-life issue. Without such a substantial link, real-life issues that were publicly-presented were coded as real-life issues not linked to canonical knowledge (T:SAS).

Classroom safety knowledge (T:SAF) was defined as any public talk about issues for the purpose of providing students safety-related information. The primary purpose of the information provided was safety, whether or not the issue is related to other types of knowledge.

Public talk that explicitly referred to how science is done, that is, the do’s and don’ts of practicing science and the rules of the scientific community, was captured in the category nature of science knowledge (T:NOS). Nature of science knowledge included information beyond specific science content. This type of knowledge did not include any information about the history of science.

The code meta-cognitive knowledge (T:MET) captured public talk about strategies of learning (learning how to learn) or reflection on one’s knowledge or learning as part of the learning process.

If none of these types of knowledge were applicable, then the public talk was coded as blank.

6.3 Dimension 10: Knowledge Development

Dimension 10 codes provided important information on how science content was developed and supported with evidence during the lesson. These codes applied only to lesson segments identified as developing new content and as going over homework (see section 5.3.5 for detailed definitions of these segments and chapter D10 in appendix D for more detailed information). Five sets of codes were developed to describe the number and nature of all canonical ideas and specifically the main science ideas, the evidence used to support those ideas, the difficulty and complexity of the science content, and the organization of the content development.

One occurrence code identified the density of publicly-presented canonical ideas (Q2). Canonical ideas were found only in segments of the lesson that were coded as canonical knowledge (T:CAN) and real-life issues linked to canonical knowledge (T:CANS) in Dimension 9. Canonical ideas are scientific facts, concepts, patterns in data, descriptions of natural processes, scientific models and laws, and theoretical explanations that are publicly-presented. First, coders identified and numbered each canonical idea found within these lesson segments and then categorized the lesson as dense with canonical ideas when they contained a large number of (at least 15) canonical ideas that were presented publicly. Coders disagreed more than 15 percent of the time on the exact number of publicly-presented canonical ideas in the lesson but were found to be 85 percent reliable on the density of ideas in the lesson.

Three occurrence codes identified the types of evidence used to support the science content: first-hand data (Q8.2), phenomena (Q17), and visual representations (Q11). First-hand data included specific things or events that could be observed or measured directly. First-hand data could have been presented as a single unit or one first-hand data point or a first-hand data set that included multiple first-hand data points. Phenomena were defined as change events of scientific interest that students had the opportunity to experience and that were connected to the intended science content of the lesson. Teachers could have provided these experiences either through first-hand observations or through vicarious experiences (e.g., watching a phenomenon occur on videotape). Visual representations were defined as visual images of real objects or processes that the teacher or students showed, created, or manipulated, such as drawings, 3D models, photographs, diagrams, tables, charts, concept maps, or other visual images that attempt to explain or describe science content.

A third set of occurrence codes identified each main idea about science in the lesson (Q1) and whether each main idea was supported with multiple links to evidence (Q5, Q7, Q10) or an isolated link to evidence (Q4a, Q6a, Q9a). A main idea was defined as a set of related knowledge outcomes or ideas, treated as a main idea of the lesson, and linked together. A main idea was required to be sufficiently developed by the teacher (not just a quick reference), to contain multiple ideas, and to link together the multiple ideas. It also was possible for a lesson to contain no main ideas. This could happen in a review lesson where many ideas were individually reviewed but not brought together into main ideas or in a lesson where students were engaged in activities independently without having those activities linked to any ideas.

The Science Content Coding Team also identified how challenging the science content of the lesson was using a fourth set of occurrence codes. These codes described the content as difficult and complex or simple and basic (Q20), the lesson as activity-focused or content-focused (Q18), and the inclusion of science ideas that are publicly-presented scientific laws and theories (Q3a). An activity-focused lesson typically focused students' attention primarily on an activity with students doing activities without the opportunity to learn science content. A content-focused lesson provided students with the opportunity to learn science content knowledge, whether through whole-class instruction or an independent activity. Not all lessons with activities were considered as activity-focused. Content-focused lessons also could have activities that helped develop some information, such as canonical knowledge.

A code to identify ideas specifically as publicly-presented scientific laws and theories was developed to capture a more theoretical nature of the science content. Scientific laws and theories express how nature acts under certain conditions and will predict what will happen as long as those conditions are met. Laws can predict across a large range of phenomena and/or contexts and are often abstract and presented as equations. Theories provide an explanation for these phenomena and natural patterns.

Finally, a fifth set of occurrence codes focused on the overall organization of the way teachers developed new science content in the lesson. Coders identified the coherence of the lesson content by the conceptual links between science ideas (Q21). A lesson was identified as learning content with weak conceptual links or no conceptual links, or learning content with strong conceptual links. The source of the content organization (Q19) could have been a textbook or workbook, a worksheet, the teacher, the students (i.e., students play a central role in the development of new ideas through their presentations, design of their own experiments, or independent research), and other sources such as a video. The primary way in which the content was developed (Q22) was identified as engaging the class in making connections among experiences, patterns, and/or explanations with inductive or deductive reasoning, or presenting facts, definitions, sequences, and/or problem solving procedures where reasoning is generally linear and information presented as pieces.

6.4 Classroom Discourse

The Science Content Coding Team used designated portions of the science lesson transcripts to conduct various discourse analyses. Derived from these analyses were descriptions of the opportunities students had to talk during whole-class discussions and during independent collaborative work, how that talk was structured, and how technical was the talk. The content experts made decisions about technical and non-technical science terms (single words, bigrams, and trigrams) derived from transcripts prepared by Bruce Lambert (University of Illinois at Chicago). The group employed computer software developed by Keith Cascio (University of California, Los Angeles) to conduct quantitative analyses of classroom talk during periods of public interaction. Word-based or lexical features were used to analyze the teacher and student (science) talk in the science lessons.

Because of resource limitations, computer-assisted analyses were applied to English translations of lesson transcripts. In the case of the Czech Republic, Japan, and the Netherlands all lessons were translated from the respective native languages.

Transcriber/translators were fluent in both English and their native language, educated at least through eighth grade in the country whose lessons they translated, and had completed two-weeks training in the procedures detailed in the TIMSS 1999 Video Study Transcription and Translation Manual (available as appendix A in Jacobs et al. 2003, *Third International Mathematics and Science Study 1999 Video Study Technical Report Volume 1: Mathematics*). A glossary of terms was developed to help standardize translation within each country.

The translation and transcription of lesson videos was organized and supervised by David Olsher (University of California, Los Angeles), Wendy Klein (University of California, Los Angeles), Lindsey Engle (University of California, Los Angeles), Don Favareau (University of California, Los Angeles), Susan Reese (LessonLab), and Petra Kohler (University of Dresden).

6.5 Reliability

6.5.1 Reliability for Dimension 8: Science Content

The Science Content Coding Team initially coded science content for each lesson from teacher responses to the questionnaire. This was done in teams of three coders including two content expert scientists. The teams were required to come to consensus on these initial content categories. This same process was used in the second stage of coding the science content from the videotaped lessons, again requiring consensus agreement among the group.

6.5.2 Reliability for Dimension 9: Types of Science Knowledge

The Science Content Coding Team established initial reliability for types of science knowledge prior to beginning their work on assigned lessons. After they finished coding approximately half of their assigned set of lessons (in most cases about 40–50 lessons), coders established midpoint reliability. The minimum acceptable reliability score for each code was 85 percent (averaged across coders). Individual coders or coder pairs had to reach at least 80 percent reliability on each code.[8]

A variety of additional quality control measures were put in place to ensure accurate coding. These measures included: 1) discussing difficulties in coding reliability lessons with the science content coding team, 2) checking the first two lessons coded by the science coding team, and 3) discussing hard-to-code lessons with the science coding team.

Procedures used to compute initial and midpoint reliability for types of knowledge were identical to those used for types of independent practical work (Dimension 11) and described in chapter 5, sections 5.5, 5.5.1.15, and 5.5.2.8. After coders passed initial reliability for each dimension, their coding for their first two or three lessons were checked by one or more members of the Science Code Development Team. Feedback was provided to the coder on coding errors where necessary.

Initial reliability averaged across the science content coders was 85 percent agreement. Midpoint reliability was estimated at 86 percent agreement.

6.5.3 Reliability for Dimension 10: Knowledge Development

After first identifying the science content of each lesson, the Science Content Coding Team then coded the ways in which this content was developed and supported with evidence. Since the five sets of codes developed in this dimension described the nature and development of the content, the coding required the expertise of the content specialists. The procedures used to code knowledge development were similar to those used to code the science content of the lesson.

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[8] The minimum acceptable reliability score for all codes (across coders and countries) was 85 percent. For coders and countries, the minimum acceptable reliability score was 80 percent. That is, the reliability of an individual coder OR the average of all coders within a particular country was occasionally between 80–85 percent. In these cases clarification was provided as necessary, but re-testing for reliability was not deemed appropriate.

The Science Content Coding Team initially coded the number and nature of science ideas, the evidence used to support those ideas, the difficulty and complexity of the science content, and the organization of the content development in teams of two content scientists whose expertise matched the content of the lesson. The teams were required to come to consensus on these codes. Hard-to-code lessons always were discussed with the entire Science Content Coding Team.

After approximately 40 to 50 lessons were coded, the Science Content Coding Team decided the complexity of the codes required each of the remaining lessons be reviewed and coded by the entire group using consensus coding.

6.5.4 Data Entry, Cleaning, and Statistical Analyses

Most codes were entered directly into the multimedia database, so that the videotapes and English transcripts could be linked directly with specific codes. The data then were exported either in spreadsheet format for statistical analyses, or in table format for further study by specialist coding groups. In some cases, where the vPrism software was not conducive for particular types of coding, codes were entered into an Excel spreadsheet.

Codes from Dimensions 9 and 10 were entered directly into a vPrism database. Codes from Dimension 8 (science content) and the classroom discourse analyses were entered into an Excel database.

The identical data cleaning process that was applied to Dimensions 1 through 7 and 11 (see section 5.5.4) was also applied to these codes for both the vPrism and Excel databases.

Once cleaned, all of the data were aggregated to the lesson level, with each coding dimension in a separate datafile. The full sample weight and replicate weights were then appended to each file. Finally, statistical analyses were run using the weighted data in Wesvar and/or SPSS.

Chapter 7. Weighting and Variance Estimation

7.1 Introduction

As described in chapter 3, the samples of classrooms for the study were selected using two-stage probability sampling methods. The first stage of selection was the sample of schools. For each subject area (mathematics and science) the second stage involved the random selection of one eighth-grade classroom. Some countries participated for only one subject area, so that one classroom was selected from the eighth-grade classes in that subject area.

To make valid inferences from the data, it was necessary to account for the features of the sample design in the analysis. There were two components to this process. The first was to incorporate into the analysis survey weights that reflected the selection mechanism (in particular the selection probabilities used to draw the samples) and also any nonresponse at the school or classroom level. These survey weights were added so that the estimates from the data would be unbiased as estimates of the relevant parameters in the full population of classes.

The second feature that needed to be accounted for was the effect of the design on the sampling variances of the estimates. Usually in a two-stage design, there is concern about the effects of clustering the data within first-stage sampling units. Because in the TIMSS 1999 Video Study only one classroom was selected from each school, per subject, the important feature that must be accounted for was the stratification employed as part of the school sampling process. For the United States it was also important to reflect the slight clustering of the school sample within the selected geographic primary sampling units (see chapter 3). This was achieved by using the jackknife procedure, which could be implemented in data analyses by utilizing a set of 50 jackknife replicate weights.

This chapter includes the following information:

- The procedure for applying base weights to the sampled classes, reflecting the probability of selection;
- The procedure for conducting nonresponse adjustments to the weights;
- The jackknife replication variance estimation procedure and how it was implemented;
- How the survey weights and replicate weights should be used for analyzing the data; and,
- The response rates for the study.

Flowcharts that describe the detailed steps for weighting the data for each country are included in appendix E. These charts show the order in which the various steps were implemented in each country and the number of records processed at each step. Although each country required a unique approach to weighting, common features applied. The output from the school sampling for each country was obtained from the country representative. This was used to create initial school weights, giving the reciprocal of the selection probability of the school, and also to establish the pattern for the jackknife replicate weights. Then these weights were adjusted for school nonresponse, where required. In most cases Westat proprietary SAS macros for creating jackknife replicate weights and carrying out nonresponse adjustments were used for this purpose, as is reflected in the flowcharts by reference to "REP_BWGT.MAC," "REP_PREP.MAC," and "COLL_ADJ.MAC."

The material in this chapter covers the weighting procedures for the TIMSS 1999 Video Study. The weighting procedures for the TIMSS 1995 Video Study, conducted in Germany, Japan, and the United States, are described in a separate report (Rizzo 1996).

7.2 Classroom Base Weights

Classroom base weights were calculated from two components: school selection probabilities and classroom selection probabilities. In all countries except the United States, the school selection probabilities were based on the probability of each school in the school sample. Classroom selection probabilities were based on the probability, within each school, of the selected classroom.

7.2.1 School Selection Probabilities

Classroom base weights were created by Westat, based on information about the school sampling process provided by the national research coordinators in each country. Such information either included the probability of selection of each school in the sample, or enough detail so that the probability could be readily determined. The selection probability for school was denoted as P_i.

In most countries replacement schools were used to replace selected schools that did not participate. When replacement schools were used, they were assigned the selection probability that was associated with the replacement school itself. That is, each school was assigned the probability that it would have been selected in the initial sample (although, of course, it was not selected initially). In most cases the original and replacements were very similar schools, and in particular they were similar in size. This meant that the original and replacement schools generally had very similar probabilities of selection to the initial sample.

For the United States the first stage of sample selection consisted of selecting 52 geographic primary sampling units (PSUs). These PSUs were selected with probabilities proportional to population size, with the ten largest metropolitan areas in the country selected with certainty. Then from an aggregate list of schools within the 52 PSUs, a sample of 110 schools was selected. The school selection probability of each of these 110 schools was, therefore, the product of two probabilities: 1) the PSU selection probability, and 2) the school within PSU selection probability.

The school within PSU probabilities were constructed such that when the two probability components are multiplied together, the school selection probability looks just as it would if the sample had been drawn directly from the entire list of schools in the country. Thus the introduction of this additional stage of sampling had no real impact on the base weights assigned to the schools. It did, however, affect the sampling variability of the study estimates. This was therefore reflected in the method of estimating sampling variances via the jackknife procedure, as described in section 7.4.

7.2.2 Classroom Selection Probabilities

One classroom (per subject area) was selected from each school. The classrooms within a school were each given an equal chance of selection. Thus if the number of classes for a subject area in school i was C_i, the classroom selection probability of the selected classroom was $\frac{1}{C_i}$.

7.2.3 Classroom Base Weights

The base weight for each classroom was the reciprocal of the product of the school selection and classroom selection probabilities. That is, for a classroom selected from school i, the base weight, BW_i, was calculated as:

$$BW_i = \frac{C_i}{P_i} .$$

The classroom base weights have the following property: had all schools participated (or been successfully replaced), then the sum of these weights across the entire sample within the country would give an unbiased estimate of the total number of classrooms in a country (or close to an unbiased estimate when replacement schools were used). This property also holds true for subpopulations within a country, such as those defined by type of school or geographic region.

Thus in the absence of nonresponse, these classroom base weights are a mechanism to provide valid generalizations from the sample to the national population. They correct any imbalance that may have arisen in the sample, either as the result of intentional oversampling of some kinds of schools or due to imperfections in the information about the size of a school available at the time of sampling.

In the Czech Republic, there was 100 percent response once replacement schools were taken into account. Therefore, the base weights have the property described above. In the other countries, however, nonresponse adjustments were needed to ensure that the results from data analyses would be close to unbiased.

7.3 Nonresponse Adjustments

This section describes the procedure for creating nonresponse adjustments to compensate for cases where a sampled school had one or more eligible classes but none was videotaped.

First, schools were grouped into cells. The principles in forming cells were that (1) schools within the same cell should be somewhat similar with respect to characteristics that might relate to the phenomena being studied, (2) there were at least six responding schools (i.e., the selected classroom was videotaped) in each cell, and (3) as many cells could be formed as were reasonable given constraints (1) and (2).

The idea behind nonresponse adjustments was to compensate for missing data from nonresponding schools by increasing the weights of similar responding schools. Principles (1) and (3) above were aimed at making the schools that receive such weight adjustments as similar to the nonresponding schools as possible. If such an effort were carried to too great an extreme, however, the beneficial effects of reducing nonresponse bias could be outweighed by the increase in sampling variance that results from assigning different weights to different classes. Principle (2) above addressed this concern.

The nonresponse cells were generally based on the sampling stratification variables. There were two reasons for this. The sampling strata were often chosen for the sample design because they were known or thought to be related to the study outcomes. Thus they also make good characteristics for forming nonresponse adjustment cells. The second reason was that the stratification variables were known for the nonresponding schools, but there was little other relevant information available about them. Table 7.1 presents the variables used to form nonresponse adjustment cells and the number of cells created for each country.

Table 7.1. Variables used to form nonresponse adjustment cells and the number of cells created, by country: 1999

Country	Variables used to define nonresponse adjustment cells	Number of nonresponse adjustment cells	Maximum nonresponse adjustment
Australia	Explicit sampling strata	8 (4 of these cells had no nonresponse)	1.57
Czech Republic	No nonresponse after replacement	†	†
Japan	Explicit sampling strata	4 (2 of these cells had no nonresponse)	1.31
Netherlands	Explicit sampling strata	7 (2 of these cells had no nonresponse)	1.42
United States	Urban/suburban/rural (derived from type of location)	3	1.34

† Not applicable
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

Within each nonresponse adjustment cell, a nonresponse adjustment factor was calculated as:

$$NRF = \frac{\sum_{i \in \left\{ \begin{array}{c} \text{eligible} \\ \text{sampled} \\ \text{schools} \end{array} \right\}} BW_i}{\sum_{i \in \left\{ \begin{array}{c} \text{responding} \\ \text{schools} \end{array} \right\}} BW_i}$$

The final weight for the classroom selected from school i $\left(FW_i\right)$ was given as the product of the classroom base weight, BW_i, and the nonresponse adjustment factor for the cell to which the school belonged, NRF_i. That is:

$$FW_i = BW_i \times NRF_i$$

Note that in the Netherlands and the United States, the nonresponse adjustments sometimes varied by subject area. This variation was due to the fact that in some schools in these countries the selected class was videotaped for one subject but not the other. In addition, in some schools in the United States the number of eighth-grade mathematics and science classes were not the same.

7.4 Variance Estimation using the Jackknife Technique

Sampling variances were computed for each country using the jackknife technique. This technique takes into account the design used to select the classroom samples as well as the effect on sampling variance due to the nonresponse adjustments. Nonresponse adjustments were computed to mitigate against any nonresponse bias. However, since these adjustments involved calculating ratios of sample estimates within cells and then applying these ratios to the weights, they also have an impact on the sampling variances of estimates derived from the study. The variance estimates obtained via the jackknife approach reflect this appropriately.

The general jackknife technique was implemented as follows: The selected schools were sorted in the order in which they were sampled. That is, they were sorted by explicit sample stratum and then within that sort they were arranged in the order that they were in prior to the systematic selection. Then successive schools were paired.

A single jackknife replicate was created by dropping one of the schools from the sample and doubling the contribution of the complementary pair member of the dropped school. Then the statistic of interest was re-estimated using the modified data set so created. This process was repeated by successively dropping one member (chosen at random) from each of the pairs of schools. For this study the typical design was to select 100 schools, giving rise to 50 pairs of schools. Thus in this way 50 replicate estimates could be derived corresponding to each estimate made from the full data set.

If in general *T* jackknife replicates are formed, numbered by t = 1,2, …., T, then the appropriate formula for the variance of an estimate, $\hat{X}$, is given by

$$\text{var}\left(\hat{X}\right) = \sum_{t=1}^{T} \left(\hat{X}_{(t)} - \hat{X}\right)^2$$

where the sum from $t = 1$ to *T* is over the replicate estimates, and $\hat{X}_{(t)}$ denotes the estimate of *X* derived from replicate *t*.

In practice the jackknife replication procedure is most straightforwardly implemented by creating a set of separate weight variables, one corresponding to each replicate. The weight variable was constructed by setting to zero the replicate weight of the school that was dropped for the replicate in question and giving its complementary school a replicate weight that was double its base weight. All the other schools got a replicate weight for that particular replicate that was the same as its base weight. Thus if 50 replicates were formed, a given school would have 49 of its replicate weights equal to the base weight with the fiftieth being either zero or twice the base weight.

Once these replicate weights have been created from the base weights, the nonresponse adjustment procedures are applied to the full set of replicate weights, just as for the full sample base weight. Thus the final replicate weights for each school may vary somewhat from being equal to the school's full sample weight, or double that weight, or zero, because of different nonresponse adjustment factors calculated for each replicate.

For example, the full sample nonresponse adjustment that applies to a particular school might have a value of 1.1. When the nonresponse adjustment is recalculated for a given replicate (the first, say), the nonresponse adjustment calculated for that school for that replicate might be 1.09, for example. Thus once the nonresponse adjustments are applied to the base weights, for the full sample and each replicate, the pattern of replicate weights will no longer follow the simple relationship to the full sample weight (that applied to the replicate base weights) whereby each replicate weight was either equal to its full sample weight, double that weight, or zero. In this way the replicate weights are able to reflect the impact of the nonresponse adjustments on sampling variance.

Some countries did not have 50 pairs of schools. In those cases replicate pairs were formed as described above, and the unused replicate weights were filled out with values equal to the full sample weight. It can be seen from the above formula that one can add an arbitrary number of additional replicate weights, all equal to the full sample weight, without changing the variance estimate. This was done so that all countries would have the same number of replicate weights on the file. This was needed to make analyses that involved multiple countries practical to carry out.

In the United States a modified approach was needed to reflect the use of the PSU stage of sample selection. For schools from within the ten certainty PSUs, the procedure was as described above. For schools in the other 42 PSUs, 21 replicates were formed by pairing the selected PSUs, again by considering the stratification and sample selection ordering. This resulted in 36 pairs within the United States—21 pairs of PSUs and 15 pairs of schools from within the 10 certainty PSUs. The replicate for a pair of PSUs was formed by deleting all the sampled schools from one of the PSUs and doubling the base weights of all the classes from its paired PSU. Then a final set of an additional 14 replicate weights were created by giving each class the full sample weight for each.

The jackknife technique is described in detail in Wolter (1985) and summarized in Rust (1985), and Rust and Rao (1996). Theoretical properties are summarized in Shao (1996). This jackknife approach is essentially the same as that used in 1994–95 TIMSS, the TIMSS 1995 Video Study, and TIMSS 1999.

7.5 Using the Weights in Data Analyses

As mentioned earlier, valid population inference using the TIMSS 1999 Video Study data required the use of the full sample weights for parameter estimation and the replicate weights for sampling variance estimation.

For estimating parameters, each variable value from a classroom in the data file should be associated with its full sample weight for all statistics. Thus, to estimate the population mean of variable, *X*, measured for each classroom in the sample, the appropriate formula is:

$$\hat{\bar{X}} = \left(\sum_i FW_i \times X_i\right) \Big/ \left(\sum_i FW_i\right),$$

where X_i is the value of *X* for school *i*.

If estimating the median (or other quartiles), it is the median of the empirical distribution where each class contributes to the distribution in proportion to its value of FW_i. When complex analysis, such as linear regression, are carried out, again each unit should be weighted by FW_i to carry out the analysis.

To obtain appropriate estimates of sampling error, as measured by the estimated standard error of a parameter estimate, the 50 jackknife replicate weights included with the data should be used following the approach described in Section 7.4.

Both the weighting and variance estimation can be carried out using standard statistical software (such as SAS or STATA), or specialized statistical software such as WesVar (Westat 2000) or SUDAAN (version 8 only) (Research Triangle Institute 2001). These specialized programs read in the full sample weights and the 50 replicate weights and automatically apply the approaches to parameter estimation and jackknife replicated variance estimation that are described here.

Most general statistical software can readily apply the full sample weights to arrive at unbiased parameter estimates. However, appropriate standard error estimates cannot be routinely obtained by such software. One must write specific routines to carry out the calculations described in Section 7.4. Because the formula for the jackknife variance estimator takes the same form no matter what the parameter estimator looks like, this is feasible. However, most analysts are likely to find that they can more readily and surely derive appropriate standard error estimates using WesVar or SUDAAN.

The use of the replicate design based on paired schools means that statistical tests on the data should be conducted assuming that the degrees of freedom available for variance estimation is equal to half the number of classrooms in the data. This compares to the standard situation where the number of classrooms would be used as the number of degrees of freedom.

When data from several countries are combined, 50 degrees of freedom should be assumed in any analyses. This is because there are only 50 replicate weights on the file no matter how many countries' data are being combined for the analysis.

When conducting analyses that combine data from several countries, it is important to note that, in the absence of any special steps to the contrary, the countries contribute to the combined estimate in proportion to the number of grade 8 classes in the county. Thus, the United States will dominate any combined mean, for example.

For a detailed discussion of appropriate methods for applying weights to TIMSS datasets, see Rutkowski et al. (2010).

7.6 Weighted Participation Rates

This section describes the procedures used to calculate the TIMSS 1999 Video Study's weighted participation rates. A participation rate reflects the proportion of total sampled eligible cases from which data were obtained. In the TIMSS 1999 Video Study, the participation rate indicates the percentage of sampled schools for which videotapes were completed. These rates are presented by country and with the rate components in tables 7.2 and 7.3.

Unweighted participation rates, computed using the actual numbers of schools, reflect the success of the operational aspects of the study (i.e., getting schools to participate). Participation rates weighted to reflect the probability of being selected into the sample describe the success of the study in terms of the population of schools to be represented.

Participation rates were computed both before and after replacement. The participation rate before replacement identifies the proportion of originally sampled schools that participated; the participation rates after replacement gives the percentage of all schools sampled (including original and replacement schools) that participated.

Table 7.2. Science participation rates before replacement, by country: 1999

Country	Weighted school participation, before replacement (percentage)	Weighted numerator, before replacement[1]	Weighted denominator, before replacement[2]	Unweighted school participation, before replacement (percentage)	Unweighted numerator, before replacement[3]	Unweighted denominator, before replacement[4]
Australia	60.9	5,839.3	9,586.0	59.0	59	100
Czech Republic	83.2	91,174.7	109,633.0	88.6	78	88
Japan	95.1	1,327,181.5	1,395,806.0	95.0	95	100
Netherlands	46.6	50,543.3	108,501.1	46.9	46	98
United States	81.2	2,238,667.0	2,755,605.0	81.5	88	108

[1]The weighted numerator is the sum of the sampling weights of all the participating schools in the sample.
[2]The weighted denominator is the sum of the sampling weights of all the eligible schools in the sample.
[3]The unweighted numerator is the number of participating schools in the sample.
[4]The unweighted denominator is the number of eligible schools in the sample.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999

Table 7.3. Science participation rates after replacement, by country: 1999

Country	Weighted school participation, after replacement (percentage)	Weighted numerator, after replacement[1]	Weighted denominator, after replacement[2]	Unweighted school participation, after replacement (percentage)	Unweighted numerator, after replacement[3]	Unweighted denominator, after replacement[4]
Australia	84.8	8,127.4	9,586.0	87.0	87	100
Czech Republic	100.0	109,633.0	109,633.0	100.0	88	88
Japan	95.1	1,327,181.5	1,395,806.0	95.0	95	100
Netherlands	80.6	87,501.7	108,501.1	82.7	81	98
United States	81.2	2,238,667.0	2,755,605.0	81.5	88	108

[1]The weighted numerator is the sum of the sampling weights of all the participating schools in the sample.
[2]The weighted denominator is the sum of the sampling weights of all the eligible schools in the sample.
[3]The unweighted numerator is the number of participating schools in the sample.
[4]The unweighted denominator is the number of eligible schools in the sample.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

7.6.1 General procedure for weighted participation rate calculations

In general each country's weighted school participation rate was the sum of base weight times the MOS for all eligible participating sampled schools divided by the combined sum of the base weight times the MOS of both the eligible participating schools and the eligible refusing schools. Ineligible and excluded schools were not included in the calculations. The basic formulae are:

$$\text{Weighted response rate, before replacement} = 100 \times \frac{\sum_{i \in \left\{\begin{array}{c}\text{responding}\\ \text{original}\\ \text{schools}\end{array}\right\}} MOS_i / P_i}{\sum_{i \in \left\{\begin{array}{c}\text{eligible}\\ \text{original}\\ \text{schools}\end{array}\right\}} MOS_i / P_i}$$

$$\text{Weighted response rate, after replacement} = 100 \times \frac{\sum_{i \in \left\{\begin{array}{c}\text{all}\\ \text{responding}\\ \text{schools}\end{array}\right\}} MOS_i / P_i}{\sum_{i \in \left\{\begin{array}{c}\text{responding schools}\\ \text{+ refusing originals}\\ \text{not replaced}\end{array}\right\}} MOS_i / P_i}$$

The base weights used in the participation rate calculations were those derived directly from the sampling probabilities, prior to any adjustments for school refusals. They were not the final weights delivered to LessonLab but were contained within them, as those final weights consisted of the base weights adjusted to compensate for patterns of nonresponse.

7.6.2 Country-specific procedures

Each country provided a unique MOS variable. Furthermore, there were possible sample design differences among countries which could potentially affect the way in which an eligible participating school was represented in the participation rate calculation. Therefore, the rate calculation methodology by country is provided for full disclosure and documentation completeness. Table 7.4 shows, by country, the name of the variable that was used to derive the MOS that was used, together with the school base weights, to derive the participation rates.

Table 7.4. Variables used for participation rate calculations, by country: 1999

Country	Measure of size (MOS)
Australia	Number of grade 8 classes
Czech Republic	Number of grade 8 students
Japan	Number of grade 8 students
Netherlands	Number of grade 8 students
United States	Number of grade 8 students

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

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Appendix A: Research Participants in the TIMSS 1999 Video Study of Science Teaching

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Appendix B: U.S. Science Teacher Questionnaire

SCIENCE TEACHER
Questionnaire
GRADE 8

VIDEOTAPE I.D. #: ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

TIMSS-R Videotape Study

James Stigler- Study Director
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According to the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information is __________. The time required to complete this information collection is estimated to average 50 minutes per response, including the time to review instructions, search existing data resources, gather the data needed, and complete and review the information collected. If you have any comments concerning the accuracy of the time estimate(s) or suggestions for improving this form, please write to U.S. Department of Education, Washington, D.C. 20202-4651. If you have comments or concerns regarding the status of your individual submission of this form, write directly to: National Center for Education Statistics, 555 New Jersey Avenue, N.W., Washington, D.C. 20208.

DIRECTIONS:

• Please fill out this questionnaire **as soon as possible after the videotaping is completed** preferably **on the same day as the videotaping**.

• Please include a copy of your lesson plan or notes for the videotaped lesson if available (**see Question 5)**

• Include a copy of your lesson or unit assessment (e. g., test, quiz, report or portfolio guidelines) with your questionnaire (**See Question 20).**

• Mail the completed questionnaire, your lesson plan (or notes), and your unit assessment in one of the envelopes provided as soon as possible.

• If you will not have a lesson or unit assessment ready until later, send the questionnaire NOW in one envelope, and send the assessment later in the second envelope.

• Your payment will be sent upon receipt of the materials.

ORGANIZATION OF THE QUESTIONNAIRE:
This questionnaire is divided into 7 sections, which ask about:

A. **THE VIDEOTAPED LESSON**: The lesson we videotaped and the students in this classroom
B. **THE LARGER UNIT:** How this lesson fits into a larger unit or sequence of lessons
C. **HOW TYPICAL?** How this lesson was typical or not of what usually happens in your classroom
D. **YOUR IDEAS ABOUT TEACHING:** The ideas that influence and guide your science teaching
E. **YOUR BACKGROUND:** Your teaching and educational background and teaching load
F. **YOUR SCHOOL:** Demographic data about your school
G. **ATTITUDES:** Your attitudes about science teaching

TIMSS-R

VIDEOTAPE CLASSROOM STUDY

Science Teacher

QUESTIONNAIRE
GRADE 8

Thank you for participating in this study. Both the videotape and the questionnaire will be used only for research purposes, unless you have signed an agreement that states otherwise. All persons with access to this information will be licensed to protect your privacy.

Thank you for your careful attention to this questionnaire. We appreciate the time you are taking to help us better understand science teaching.

Your name: ________________________________ ☐ Male ☐ Female

School's name: ______________________________ Date: ________________

Name of videotaped course: ____

City/State____

Number of times videotaped class meets each week ______________

For how long? ______________ minutes per meeting

Grade level(s) of students in videotaped class: ________; # of girls enrolled in class ____
# of boys enrolled in class ____

(Write zero if there are none for that sex)

Phone number where we can reach you should any questions arise (______)____-______

Best time of day to call you ____________________________AM / PM

E mail address _____________________________________

A. THE VIDEOTAPED LESSON

1. Please describe the subject matter content of the videotaped lesson. *Check as many as apply*.

NOTE: Use the lines to provide more detail about the subject matter content for this lesson.

☐ 1. Earth and Space Science:____

____

☐ 2. Life Science:____

____

☐ 3. Health: ____

____

☐ 4. Physical Science: ____

____

☐ 5. Nature of Science: (understanding about the scientific enterprise, how science works, scientists at work)____

____

☐ 6. Scientific Inquiry: (learning to do science inquiry, learning scientific habits of mind)

____

____

☐ 7. Technology: (understanding about technology, learning to do drafting? Graphics? work. Please be more specific.)____

____

☐ 8. History of Science and/or History of Technology: __________________________

____

☐ 9. Societal issues: (e. g., pollution, food and world population, genetic testing)

____

____

☐ 10. Integrated Science: (e. g., integration of chemistry and life sciences in a study of plants)____

____

☐ 11. Interdisciplinary Curriculum—Science and another discipline: (e. g., science and social studies, science and mathematics) __________________________________

____

☐ 12. Other: ____

____

2. Which of the following played a role in your <u>decision to teach this content</u>?
Please check one item in each row.

	No Role	Small Role	Major Role
a. National, State, District, or School curriculum guidelines	☐	☐	☐
b. External examinations or standardized tests	☐	☐	☐
c. Mandated textbook for your grade level	☐	☐	☐
d. Your comfort with or interest in the content	☐	☐	☐
e. Your personal assessment of the students' interests or needs	☐	☐	☐
f. Collaborative work with other teachers or consultants	☐	☐	☐

3. If you marked "Major role" for choice (a) in question 2 above, please list the curriculum

guidelines or documents that you use: ____

____

4. To what extent did you use the following when planning this lesson, (not necessarily materials you used during the lesson)…

	Not At All	A Little	Some	Quite A Lot	A Great Deal
a. a lesson plan that you had prepared and used before	☐	☐	☐	☐	☐
b. lesson or unit plans developed by other educators	☐	☐	☐	☐	☐
c. lesson you planned in collaboration with other teachers or science specialists	☐	☐	☐	☐	☐
d. student textbook	☐	☐	☐	☐	☐
e. Teacher's Guide version of textbook	☐	☐	☐	☐	☐
f. replacement unit teacher guides (e.g., kits, modules, activity manuals)	☐	☐	☐	☐	☐
g. resource books (e.g., trade books, reference books, other texts)	☐	☐	☐	☐	☐
h. multimedia resources (video, laser disc, TV, etc)	☐	☐	☐	☐	☐
i. the Internet	☐	☐	☐	☐	☐
j. ideas from a workshop	☐	☐	☐	☐	☐
k. knowledge about your students' interests, thinking, or difficulties	☐	☐	☐	☐	☐
l. local curriculum guidelines (e.g., school, district)	☐	☐	☐	☐	☐
m. state or national curriculum guidelines or standards	☐	☐	☐	☐	☐
n. external examinations or standardized tests	☐	☐	☐	☐	☐
o. other (please describe)____________________	☐	☐	☐	☐	☐

5. For us to understand the videotaped lesson, we need to know which ideas and skills had been previously taught to this class and which were new. For each idea or skill taught in the videotaped lesson, please indicate whether it was:

- mainly review
- mainly new

If you need more space, continue on the back of the paper. **Please Note:** If you have a written lesson plan or notes for the videotaped lesson, we would like a copy. Please enclose a copy in the envelope provided for return of the questionnaire.

Ideas and skills in videotaped lesson that were mainly review to students:

Ideas and skills in videotaped lesson that were mainly new to students:

6. What was the main thing you wanted students to learn from the videotaped lesson?

7. Are you satisfied that the videotaped lesson achieved that purpose? ☐ YES ☐ NO

Explain why you were or were not satisfied.

8. Think about how you taught <u>the videotaped lesson</u> compared to how you would <u>ideally like to teach this lesson</u>. To what extent did any of the following <u>limit you</u> from reaching your ideal in this lesson?

	Not At All	**A Little**	**Some**	**Quite A Lot**	**Great Deal**	**Does Not Apply**
a. Official curricular guidelines and/or standardized tests	☐	☐	☐	☐	☐	☐
b. Requirements to teach many topics	☐	☐	☐	☐	☐	☐
c. Insufficient student motivation or readiness to learn.	☐	☐	☐	☐	☐	☐
d. Class size (If a limitation please describe nature of limitation) ____	☐	☐	☐	☐	☐	☐
e. Insufficient time for lesson planning	☐	☐	☐	☐	☐	☐
f. Insufficient time to work with colleagues on lessons	☐	☐	☐	☐	☐	☐
g. Not enough books (textbooks, trade-books, reference books,etc.)	☐	☐	☐	☐	☐	☐
h. Insufficient class time to finish what I planned to teach	☐	☐	☐	☐	☐	☐
i. Lack of or obsolete computers	☐	☐	☐	☐	☐	☐
j. Lack of appropriate software for computers	☐	☐	☐	☐	☐	☐
k. Lack of needed instructional equipment (VCR, microscopes, overhead projection equipment, carts, etc.)	☐	☐	☐	☐	☐	☐
l. Lack of needed multimedia materials (videotapes, transparency sets, slides, laser disks)	☐	☐	☐	☐	☐	☐
m. Insufficient science teaching materials and supplies, hands-on materials n. (such as seeds, magnets, chemicals, flashlights, etc.)	☐	☐	☐	☐	☐	☐
o. Inadequate physical facilities (room size, room layout, furniture, preparation room, teacher office space, storage space, sinks, electrical outlets, gas jets, etc.)	☐	☐	☐	☐	☐	☐
p. Insufficient training or support for using new technologies in your classroom.	☐	☐	☐	☐	☐	☐
q. Presence of the video-camera and videographer	☐	☐	☐	☐	☐	☐

9. How long did you spend planning for <u>the videotaped lesson</u>? __________ minutes

9b. How long do you usually spend planning for this type of science lesson? _________minutes

10. Did your students work in groups for any part of the videotaped lesson?

☐ YES ☐ NO

11. If yes, please describe the basis by which students were assigned to groups (e.g., academic ability level, gender, student choice, other).

12. Think about the availability of the following items at your school. To what extent do you have sufficient access to these items for use in your science classroom?

	Enough	**Too few or little**	**Not at all**
Computers			
Computer Software			
Computers with internet connections			
A/V equipment (TV, VCR, overhead projectors)			
Teaching supplies/materials (e.g. chemicals, magnets, rulers)			
Microscopes			
Science laboratory			
Reference materials (books, journals, magazines)			

13. Do all students in the school take this course?

☐ YES (skip to 15) NO

14. If **no**, is curriculum in this course more challenging or less challenging than the typical 8th grade science course in this school? Mark one of the three choices below:

☐ More challenging A typical 8th grade curriculum Less challenging

15. Did you previously assign science homework that was due for the day of the videotaped lesson?

☐ YES NO (skip to 19)

16. Please describe <u>what students were expected to do</u> for this homework.

17. Was the assigned homework related to this lesson or to the prior lesson?

☐ The videotaped lesson Prior lesson Both

18. How long would it have taken the typical student in your class to complete this homework?

__________minutes.

19. Will students be formally evaluated on the material they studied in the videotaped lesson (e.g., a quiz, unit test, project, etc.)?

☐ YES NO

20. If yes, how will they be assessed? (Also, please enclose a copy of the assessment you will use for the lesson or unit. Enclose this assessment in the return envelope).

B. THE LARGER UNIT OR SEQUENCE OF LESSONS

21. Was the videotaped lesson planned as part of a larger **unit** or **sequence of related lessons**, or was it a stand-alone lesson?

☐ stand-alone lesson ☐ part of a unit or sequence
(If stand-alone, explain why in space below then skip to 26)

22. Describe the unit or sequence of lessons with a short phrase or title:

23. What is the main thing(s) you want students to learn from the whole unit or sequence of lessons?

24. Approximately how many lessons are in the entire sequence or unit? _____________

25. Where did the videotaped lesson fall in the sequence or unit
(e.g., number 3 out of 5)? ________

26. To help us understand what we will see on the videotape, please provide information about the videotaped lesson and about the 2 lessons before and 2 lessons after the videotaped lesson.

- Please describe the main thing you wanted students to learn from the lesson
- Please choose 1 or 2 words that most teachers in your country use to describe each type of lesson. (e. g. review lesson, introductory lesson, etc.)

	Main thing you wanted students to learn from the lesson	Type of lesson
2 lessons Before		
1 lesson Before		
Videotaped Lesson	**DO NOT FILL IN THIS BOX**	
1 lesson After		
2 lessons After		

C. HOW TYPICAL WAS THE VIDEOTAPED LESSON?

27. For this study, we are interested in capturing your typical science teaching. It is important for us to know in what ways the teaching in the videotaped lesson might not have been typical.

How often do you use the teaching methods that are in the videotaped lesson?

- ☐ seldom
- ☐ sometimes
- ☐ often
- ☐ almost always

28. What, if anything, was different in the videotaped lesson from how you normally teach?

29. How would you describe your students' behavior and participation during the videotaped lesson?

- ☐ better than usual
- ☐ about the same as usual
- ☐ worse than usual

30. What, if anything, was different about the nature of the students' behavior and the amount of student participation during the videotaped lesson? Briefly describe any differences.

31. Was the content of the videotaped lesson more difficult for your students than usual, about the same, or less difficult than usual?

- ☐ more difficult for students than most lessons
- ☐ about the same as most lessons
- ☐ less difficult for students than most lessons

32. Do you think that having the camera present caused you to teach a lesson that was better than usual, worse than usual, or about the same as usual?

- ☐ better than usual
- ☐ about the same as usual
- ☐ worse than usual

D. IDEAS THAT GUIDE YOUR TEACHING

33. List the three most important things you would like your students to learn from studying science **this year.**

1. ____

____

2. ____

____

3. ____

____

34. In general, I feel comfortable trying new techniques for teaching science in my classroom.

- ☐ I agree
- ☐ no opinion
- ☐ I disagree

35. In general, I feel I keep up with current ideas in science teaching and learning.

- ☐ I agree
- ☐ no opinion
- ☐ I disagree

36. How do you usually hear about current ideas about the teaching and learning of science?

37. What written materials are you aware of that describe current ideas about the teaching and learning of science? Please list up to three, and indicate whether you personally have read each one.

____ I have read:
- ☐ all of it
- ☐ most of it
- ☐ some of it
- ☐ none of it

____ I have read:
- ☐ all of it
- ☐ most of it
- ☐ some of it
- ☐ none of it

____ I have read:
- ☐ all of it
- ☐ most of it
- ☐ some of it
- ☐ none of it

38. To what extent do you feel that the videotaped lesson is in accord with current ideas about the teaching and learning of science?

- ☐ a lot
- ☐ a fair amount
- ☐ a little
- ☐ not at all (skip to 41)

39. Please describe one part of the videotaped lesson that you feel exemplifies current ideas about the teaching and learning of science and explain why you think it exemplifies these ideas.

40. As part of professional development activities, how often in the past year has a teacher colleague observed you teaching an entire science lesson? (**do not include observations made in team teaching situations or as part of a formal evaluation).**

Circle a, b, c, or d

a. never
b. once or twice
c. every other month
d. once a month or more

41. As part of professional development activities, how often in the past year have you observed a teacher colleague teaching an entire science lesson? **(do not include observations made in team teaching situations or as part of a formal evaluation)**.

Circle a, b, c, or d

a. never
b. once or twice
c. every other month
d. once a month or more

E. YOUR TEACHING BACKGROUND AND TEACHING LOAD

42. What was the highest level of formal education you have completed?

- ☐ Teacher training without completing High School
- ☐ High school
- ☐ High school with 1 or 2 years of teacher training
- ☐ High school with 3 or 4 years of teacher training
- ☐ BA or equivalent with no teacher training
- ☐ BA or equivalent with teacher training
- ☐ Masters or doctoral degree with no teacher training
- ☐ Masters or doctoral degree with teacher training

43. In what subject areas and grade levels are you certified to teach?

Subjects	**Grade level**

44. What was your undergraduate major field of study? ___________________________________

45. What was your undergraduate minor field of study (if any)? _____________________________

46. What was your major field of study in graduate school? ________________________________

47. What was your minor field of study in graduate school (if any) ? __________________

48. Counting this school year, how many years in total have you been teaching? (include part-time teaching, but not substitute teaching)
Please round to the nearest whole number. _____________years

49. Counting this year, how many years in total have you taught science? (include part-time teaching, but not substitute teaching)
Please round to the nearest whole number. _____________years

50. During the last two years, how many college or university courses have you taken in science or science education? (Circle one letter.)

A. none
B. one
C. two
D. three
E. four or more

51. During the last two years, have you participated in professional development activities or taken courses in any of the following? (Circle **all** letters that apply)

A. use of technology, such as computers
B. science instructional techniques
C. cooperative group instruction
D. interdisciplinary instruction
E. teaching higher-order thinking skills
F. teaching students from different cultural backgrounds
G. teaching limited English proficient students
H. teaching students with special needs (eg. visually impaired, gifted and talented)
I. standards-based teaching
J. classroom management and organization

K. other professional issues
L. none of the above

52. In a typical week, I spend:

a) ______Hours at school teaching science classes. Titles of science classes:__________________

____

____

b) ______ Hours at school teaching other classes. Titles of other classes: ____________________

____

____

c) ______ Hours at school meeting with other teachers to work on curriculum and planning issues.

d) ______ Hours at school doing work related to teaching science (e.g., lesson planning, grading papers, etc.).

e) ______ Hours at home doing work related to teaching science (e.g., lesson planning, grading papers, etc.).

f) ______ Hours at home or school doing other school-related activities.

F. QUESTIONS ABOUT YOUR SCHOOL.

53. List the grade levels that are taught in this school:__________________________________

54. **THIS QUESTION WILL VARY BY COUNTRY**: What type of school is this?

BELOW IS U.S. VERSION OF 54:
Identify any special status or purpose of your school: ***Check as many as apply***.

☐ Academic accelerated school
☐ Vocational school
☐ Magnet school (Describe type:_____________________________________)
☐ Charter school
☐ Partnership with a university (such as a professional development school)
☐ Laboratory School
☐ School within a school
☐ Religious or sectarian school
☐ Private (non-religious) school
☐ Single sex school
☐ Other (Please describe:____)

55. How are students admitted to this school? (e.g., neighborhood residence, entrance test, lottery, all who want to come, other)?

56. Approximately how many science teachers are in this school this year? ____________________

G. ATTITUDES ABOUT TEACHING.

57. Please respond to each statement.	strongly agree	some-what agree	some-what disagree	strongly disagree
a. I have adequate materials and facilities to support my teaching of science.	☐	☐	☐	☐
b. I actively pursue opportunities to learn how to improve my science teaching.	☐	☐	☐	☐
c. I especially prefer teaching low-ability students.	☐	☐	☐	☐
d. My work as a science teacher is appreciated by my teacher colleagues.	☐	☐	☐	☐
e. Girls in this school are not encouraged to develop a science interest.	☐	☐	☐	☐
f. If I had to choose I would become a teacher again.	☐	☐	☐	☐
g. I have a strong science background in the subject areas I teach.	☐	☐	☐	☐
h. I am often impressed with the quality of thinking my students can do.	☐	☐	☐	☐
i. I prefer to teach a class that has students of all different ability levels.	☐	☐	☐	☐
j. I am enthusiastic about teaching science.	☐	☐	☐	☐
k. I do not like to watch TV programs about new developments in science.	☐	☐	☐	☐
l. I enjoy students' questions about science even when I do not know the answer.	☐	☐	☐	☐
m. My work as a science teacher is appreciated by my students' parents.	☐	☐	☐	☐
n. I read journals and books about science teaching.	☐	☐	☐	☐
o. I enjoy teaching students of this age level.	☐	☐	☐	☐
p. I do not pursue science interests or issues in my personal life.	☐	☐	☐	☐
q. I especially prefer teaching high-ability students.	☐	☐	☐	☐
r. Teaching science is rewarding work.	☐	☐	☐	☐
s. The number of students in my class is not appropriate to support good science teaching and learning.	☐	☐	☐	☐
t. I do not have adequate opportunities during the school day to collaborate with colleagues about science.	☐	☐	☐	☐
u. I am proud of the quality of my teaching.	☐	☐	☐	☐
v. I enjoy working with colleagues about science curriculum and teaching, even if it means after-school meetings.	☐	☐	☐	☐
w. Teaching science is hard work.	☐	☐	☐	☐
x. I teach in an environment where I do not feel physically safe.	☐	☐	☐	☐
y. I enjoy attending science teacher conferences to learn about new ideas in science teaching.	☐	☐	☐	☐
z. My work as a science teacher is appreciated by my students.	☐	☐	☐	☐

	strongly agree	some-what agree	some-what disagree	strongly disagree
aa. My work as a science teacher is not appreciated by administrators.	☐	☐	☐	☐
bb. I work hard to get girls involved in science.	☐	☐	☐	☐

THANK YOU!!!
for your cooperation and thoughtfulness

Please put this questionnaire, your lesson plan or notes for the videotaped lesson, and your lesson or unit assessment in the mailing envelope and return it as soon as possible.

Appendix C: TIMSS 1999 Video Study Science Teacher Questionnaire Code Book

GRADE 8 SCIENCE TEACHER QUESTIONNAIRE CODE BOOK

LESSONID Alphanumeric lesson identification		
Code	**Example**	**Description or item option**
SAU001	Science, Australia, Lesson 001	Column 1 identifies subject. Columns 2 and 3 identify country. Columns 4 to 6 identify class.

CASEID Numeric lesson identification		
Code	**Example**	**Description or item option**
23001	Science, Australia, Lesson 001	Column 1 identifies subject (1=math; 2=science). Column 2 identifies country (AU=3, CZ=2, JP=5, NL=4, US=1). Columns 3 to 5 identify classroom.

CTYALPHA Country identification		
Code	**Country name**	**Description or item option**
10	Australia	
20	Czech Republic	
30	Hong Kong SAR	
40	Japan	
50	The Netherlands	
60	Switzerland	
70	United States	

SUBJECT Lesson subject		
Code	**Subject**	**Description or item option**
1	Mathematics	
2	Science	

TQSAMPLE Teacher questionnaire received for lesson		
Code	**Response**	**Description or item option**
1	Teacher questionnaire received	
Blank	Lesson videotaped but questionnaire not received	

DISCIPL5 Science discipline – five areas		
Code	**Response**	**Description or item option**
1	Chemistry	
2	Earth Science	
3	Life Science	
4	Physics	
5	Other	

DISCIPL4 Science discipline – four areas		
Code	**Response**	**Description or item option**
1	Earth Science	
2	Life Science	
3	Physics	
4	Other	

TGENDER Teacher gender		
Code	**Response**	**Description or item option**
1	Male	
2	Female	
Blank	Missing, not interpretable, or not applicable	

MEETINGS Number of times videotaped class meets each week ***(Code number of times class meets per week)***		
Code	**Response**	**Description or item option**
Blank	Missing, not interpretable, or not applicable	

HOWLONG For how long? (minutes per meeting) ***(Code number of minutes per meeting)***		
Code	**Response**	**Description or item option**
Blank	Missing, not interpretable, or not applicable	

MEETWEEK Total amount of time videotaped class meets each week ***(Code number of minutes per week multiplied by number of meetings per week)***		
Code	**Response**	**Description or item option**
Blank	Missing, not interpretable, or not applicable	

GRADE Grade level(s) of students in videotaped class ***(Codes for Australia, Czech Republic, and United States; code 'Blank' for Japan)***		
Code	**Response**	**Description or item option**
1	Grade 6	
2	Mix – Grades 6 and 7	
3	Grade 7	
4	Mix – Grades 7 and 8	
5	Grade 8	
6	Mix – Grades 7, 8, and 9	
7	Mix – Grades 8 and 9	
8	Mix – Grades 8, 9, and 10	
9	Grade 9	

Blank	Missing, not interpretable, or not applicable	***Code 'Blank' for Japan version; item not included.***

GRADE Grade level(s) of students in videotaped class
(Codes for Netherlands)

Code	Response	Description or item option
1	VWO	Includes VWO, Gymnasium, Atheneum.
2	HAVO	
3	MAVO	
4	VBO	Includes VBO, individual VBO, MBO (vocational secondary education)
5	VWO and HAVO	
6	MAVO and VBO	
7	MAVO and HAVO	
8	VBO, MAVO, and HAVO	Includes MHV (all three non-vocational tracks: MAVO, HAVO, and VWO)
9	MAVO, HAVO, and VWO	
10	VBO, MAVO, HAVO, and VWO	
Blank	Missing, not interpretable, or not applicable	

GIRLS Number of girls enrolled in class
(Code number of girls)

Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

BOYS Number of boys enrolled in class
(Code number of boys)

Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

GIRLBOY Total number of boys and girls enrolled in class
(Code number of girls plus boys)

Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

ALLGIRLS Lesson with all girls enrolled in class
(Code number of girls)

Code	Response	Description or item option
0	All boys or Mixed gender	

	class	
1	All girls class	
Blank	Missing, not interpretable, or not applicable	

ALLBOYS Lesson with all boys enrolled in class
(Code number of boys)

Code	Response	Description or item option
0	All girls or Mixed gender class	
1	All boys class	
Blank	Missing, not interpretable, or not applicable	

TQ1A Please describe the subject matter content of the videotaped lesson.
a. Earth and Space Science

Code	Response	Description or item option
0	No	
1	Yes	A
Blank	Missing, not interpretable, or not applicable	

TQ1B Please describe the subject matter content of the videotaped lesson.
b. Life Science

Code	Response	Description or item option
0	No	
1	Yes	B
Blank	Missing, not interpretable, or not applicable	

TQ1C Please describe the subject matter content of the videotaped lesson.
c. Health

Code	Response	Description or item option
0	No	
1	Yes	C
Blank	Missing, not interpretable, or not applicable	

TQ1D Please describe the subject matter content of the videotaped lesson.
d. Physical Science

Code	Response	Description or item option
0	No	
1	Yes	D
Blank	Missing, not interpretable,	

	or not applicable	

TQ1E Please describe the subject matter content of the videotaped lesson. e. Nature of Science		
Code	**Response**	**Description or item option**
0	No	
1	Yes	E
Blank	Missing, not interpretable, or not applicable	

TQ1F Please describe the subject matter content of the videotaped lesson. f. Scientific Inquiry		
Code	**Response**	**Description or item option**
0	No	
1	Yes	F
Blank	Missing, not interpretable, or not applicable	

TQ1G Please describe the subject matter content of the videotaped lesson. g. Technology		
Code	**Response**	**Description or item option**
0	No	
1	Yes	G
Blank	Missing, not interpretable, or not applicable	

TQ1H Please describe the subject matter content of the videotaped lesson. h. History of Science and/or History of Technology		
Code	**Response**	**Description or item option**
0	No	
1	Yes	H
Blank	Missing, not interpretable, or not applicable	

TQ1I Please describe the subject matter content of the videotaped lesson. i. Societal issues		
Code	**Response**	**Description or item option**
0	No	
1	Yes	I
Blank	Missing, not interpretable, or not applicable	

TQ1J Please describe the subject matter content of the videotaped lesson. j. Integrated Science		
Code	**Response**	**Description or item option**
0	No	
1	Yes	J
Blank	Missing, not interpretable, or not applicable	

TQ1K Please describe the subject matter content of the videotaped lesson. k. Interdisciplinary Curriculum – Science and another discipline		
Code	**Response**	**Description or item option**
0	No	
1	Yes	K
Blank	Missing, not interpretable, or not applicable	

TQ1L. Please describe the subject matter content of the videotaped lesson. l. Other		
Code	**Response**	**Description or item option**
0	No	
1	Yes	L
Blank	Missing, not interpretable, or not applicable	

TQ2A Which of the following played a role in your decision to teach this content? a. National, State, District, or School curriculum guidelines		
Code	**Response**	**Description or item option**
0	No role	A
1	Small Role	B
2	Major Role	C
Blank	Missing, not interpretable, or not applicable	

TQ2B Which of the following played a role in your decision to teach this content? b. External examinations or standardized tests ***(Codes for Czech Republic, Netherlands, and United States versions. Code 'Blank' for Australia; item not applicable.)*** Entrance examinations or standardized tests ***(Code for Japan)***		
Code	**Response**	**Description or item option**
0	No role	A
1	Small role	B
2	Major role	C
Blank	Missing, not interpretable,	***Code 'Blank' for Australia; item not applicable.***

	or not applicable	

TQ2C Which of the following played a role in your decision to teach this content?
c. Mandated textbook for your grade level

Code	Response	Description or item option
0	No role	A
1	Small Role	B
2	Major Role	C
Blank	Missing, not interpretable, or not applicable	

TQ2D Which of the following played a role in your decision to teach this content?
d. Your comfort with or interest in the content

Code	Response	Description or item option
0	No Role	A
1	Small Role	B
2	Major Role	C
Blank	Missing, not interpretable, or not applicable	

TQ2E Which of the following played a role in your decision to teach this content?
e. Your personal assessment of the students' interests or needs

Code	Response	Description or item option
0	No Role	A
1	Small Role	B
2	Major Role	C
Blank	Missing, not interpretable, or not applicable	

TQ2F Which of the following played a role in your decision to teach this content?
f. Collaborative work with other teachers or consultants

Code	Response	Description or item option
0	No Role	A
1	Small Role	B
2	Major Role	C
Blank	Missing, not interpretable, or not applicable	

TQ2ARC2 Which of the following played a role in your decision to teach this content?
a. National, State, District, or School curriculum guidelines

Code	Response	Description or item option
1	None or small role	A,B
2	Major role	C
Blank	Missing, not interpretable,	

	or not applicable	

TQ2BRC2 Which of the following played a role in your decision to teach this content? b. External examinations or standardized tests ***(Codes for Czech Republic, Japan, Netherlands, and United States versions. Code 'Blank' for Australia; item not applicable)***		
Code	**Response**	**Description or item option**
1	None or small role	A,B
2	Major role	C
Blank	Missing, not interpretable, or not applicable	***Code 'Blank' for Australia; item not applicable.***

TQ2CRC2 Which of the following played a role in your decision to teach this content? c. Mandated textbook for your grade level		
Code	**Response**	**Description or item option**
1	None or small role	A,B
2	Major role	C
Blank	Missing, not interpretable, or not applicable	

TQ2DRC2 Which of the following played a role in your decision to teach this content? d. Your comfort with or interest in the content		
Code	**Response**	**Description or item option**
1	None or small role	A,B
2	Major role	C
Blank	Missing, not interpretable, or not applicable	

TQ2ERC2 Which of the following played a role in your decision to teach this content? e. Your personal assessment of the students' interests or needs		
Code	**Response**	**Description or item option**
1	None or small role	A,B
2	Major role	C
Blank	Missing, not interpretable, or not applicable	

TQ2FRC2 Which of the following played a role in your decision to teach this content? f. Collaborative work with other teachers or consultants		
Code	**Response**	**Description or item option**
1	None or small role	A,B
2	Major role	C
Blank	Missing, not interpretable, or not applicable	

TQ2ABDF Difference in National, State, District, or School curriculum guidelines from External examinations or standardized tests ***(Code TQ2ARC2 minus TQ2BRC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2ACDF Difference in National, State, District, or School curriculum guidelines from Mandated textbook for your grade level ***(Code TQ2ARC2 minus TQ2CRC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2ADDF Difference in National, State, District, or School curriculum guidelines from Your comfort with or interest in the content ***(Code TQ2ARC2 minus TQ2DRC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2AEDF Difference in National, State, District, or School curriculum guidelines from Your personal assessment of the students' interests or needs ***(Code TQ2ARC2 minus TQ2ERC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2AFDF Difference in National, State, District, or School curriculum guidelines from Collaborative work with other teachers or consultants ***(Code TQ2ARC2 minus TQ2FRC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2BCDF Difference in External examinations or standardized tests from Mandated textbook for your grade level ***(Code TQ2BRC2 minus TQ2CRC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2BDDF Difference in External examinations or standardized tests from Your comfort with or interest in the content ***(Code TQ2BRC2 minus TQ2DRC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2BEDF Difference in External examinations or standardized tests from Your personal assessment of the students' interests or needs ***(Code TQ2BRC2 minus TQ2ERC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2BFDF Difference in External examinations or standardized tests from Collaborative work with other teachers or consultants ***(Code TQ2BRC2 minus TQ2FRC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2CDDF Difference in Mandated textbook for your grade level from Your comfort with or interest in the content ***(Code TQ2CRC2 minus TQ2DRC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2CEDF Difference in Mandated textbook for your grade level from Your personal assessment of the students' interests or needs ***(Code TQ2CRC2 minus TQ2ERC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2CFDF Difference in Mandated textbook for your grade level from Collaborative work with other teachers or consultants ***(Code TQ2CRC2 minus TQ2FRC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2DEDF Difference in Your comfort with or interest in the content from Your personal assessment of the students' interests or needs ***(Code TQ2DRC2 minus TQ2ERC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2DFDF Difference in Your comfort with or interest in the content from Collaborative work with other teachers or consultants ***(Code TQ2DRC2 minus TQ2FRC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ2EFDF Difference in Your personal assessment of the students' interests or needs from Collaborative work with other teachers or consultants ***(Code TQ2ERC2 minus TQ2FRC2)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ4A To what extent did you use the following when planning this lesson? a. A lesson plan that you had prepared and used before		
Code	**Response**	**Description or item option**
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ4B To what extent did you use the following when planning this lesson? b. Lesson or unit plans developed by other educators		
Code	**Response**	**Description or item option**
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ4C To what extent did you use the following when planning this lesson?
c. A lesson you planned in collaboration with other teachers or science specialists

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ4D To what extent did you use the following when planning this lesson?
d. Student textbook

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ4E To what extent did you use the following when planning this lesson?
e. Teacher's Guide version of textbook

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ4F To what extent did you use the following when planning this lesson?
f. Replacement unit teacher guides (e.g., kits, modules, activity manuals)
(Code 'Blank' for Netherlands; item not applicable)

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	***Code 'Blank' for Netherlands; item not applicable.***

TQ4G To what extent did you use the following when planning this lesson? g. Resource books (e.g., trade books, reference books, other texts)		
Code	**Response**	**Description or item option**
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ4H To what extent did you use the following when planning this lesson? h. Multimedia resources (e.g., video, laser disc, TV, etc.)		
Code	**Response**	**Description or item option**
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ4I To what extent did you use the following when planning this lesson? i. The Internet		
Code	**Response**	**Description or item option**
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ4J To what extent did you use the following when planning this lesson? j. Ideas from a workshop		
Code	**Response**	**Description or item option**
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ4K To what extent did you use the following when planning this lesson? k. Knowledge about your students' interests, thinking, or difficulties		
Code	**Response**	**Description or item option**
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ4L To what extent did you use the following when planning this lesson? l. Local curriculum guidelines (e.g., school, district) Your own school's curriculum guidelines ***(Australia version)***		
Code	**Response**	**Description or item option**
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ4M To what extent did you use the following when planning this lesson? m. State or national curriculum guidelines or standards ***(Czech Republic, Netherlands, United States versions)*** Your state's version of the *National Profiles* ***(Australia version)***		
Code	**Response**	**Description or item option**
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ4N To what extent did you use the following when planning this lesson? n. External examinations or standardized tests ***(Code 'Blank' for Australia; item not applicable)***		
Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E

Blank	Missing, not interpretable, or not applicable	***Code 'Blank' for Australia; item not applicable.***

TQ4O To what extent did you use the following when planning this lesson? o. Other		
Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	

TQ6IDE What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Understanding scientific ideas		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Understanding scientific ideas	Understand scientific ideas, including theories or explanations.
Blank	Missing, not interpretable, or not applicable	

TQ6TOP What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Knowing scientific definitions		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Knowing scientific definitions	Know definitions of topics (e.g., labels or phrases describing specific topics).
Blank	Missing, not interpretable, or not applicable	

TQ6GEN What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Knowing general information about science disciplines		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Knowing general information about science disciplines	Know information at the broad, general level (e.g., biology, chemistry, physics disciplines).
Blank	Missing, not interpretable, or not applicable	

TQ6ITI What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Knowing specific ideas or topics with specific inquiry skills		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Knowing specific ideas or topics with specific inquiry skills	Know specific ideas or topics with specific inquiry skills.
Blank	Missing, not interpretable, or not applicable	

TQ6COG What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Developing problem solving skills		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Developing problem solving skills	Learn how to think, problem solve, and apply knowledge.
Blank	Missing, not interpretable, or not applicable	

TQ6INQT What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Developing scientific thinking skills		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Developing scientific thinking skills	Develop science thinking, inquiry skills, and scientific habits of mind (e.g., "how to think scientifically").
Blank	Missing, not interpretable, or not applicable	

TQ6INQA What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Applying problem solving skills: apply scientific knowledge to solve problems, develop explanations, and make decisions		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Applying problem solving skills: apply scientific knowledge to solve problems, develop explanations, and make decisions	Apply knowledge to solve problems or applying knowledge in different contexts. Knowledge can be scientific knowledge and science inquiry, or general knowledge (e.g., "Application of atoms and molecules to chemistry;" "Ability to weigh conclusions based on the lessons that they've learned;" "To come up with a new idea based on acquired knowledge").
Blank	Missing, not interpretable, or not applicable	

TQ6INQ What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Applying problem solving skills: apply scientific knowledge and scientific thinking skills to solve problems, develop explanations, and make decisions		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Applying problem solving skills: apply scientific knowledge and scientific thinking skills to solve problems, develop explanations, and make decisions	Apply problem solving skills; apply scientific knowledge and scientific thinking skills to solve problems or applying knowledge in different contexts. Knowledge can be scientific knowledge and science inquiry, or general knowledge (e.g., "Application of atoms and molecules to chemistry", "Ability to weigh conclusions based on the lessons that they've learned", "To come up with a new idea based on acquired knowledge"). Includes TQ6INQT, TQ6INQA, and TQ6ITI.
Blank	Missing, not interpretable, or not applicable	

TQ6ACTP What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Completing a scientific project		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Completing a scientific project	Complete a scientific project (e.g., "build models of Newton's Laws", "write a report", "watch a video", "make constellation maps", "have a discussion about the lab results from yesterday").
Blank	Missing, not interpretable, or not applicable	

TQ6ACTE What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Investigating the natural world; conduct a scientific experiment		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Investigating the natural world; conduct a scientific experiment	Learn to investigate the natural world by conducting an experiment that involves collection of data (e.g., "do an experiment", "do a lab on acids", "do more practicals").
Blank	Missing, not interpretable, or not applicable	

TQ6ACT What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Complete a project or an experiment		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation -	Complete a scientific project (e.g., "build models of

	Complete a project or an experiment	Newton's Laws", "write a report", "watch a video", "make constellation maps", or investigate the natural world by conducting an experiment that involves collection of data such as "do an experiment", "do a lab on acids", or "do more practicals"). Includes TQ6ACTP and TQ6ACTE.
Blank	Missing, not interpretable, or not applicable	

TQ6LSK What is the main thing you wanted students to learn from the videotaped lesson?
Performance expectation - Using tools, routine procedures

Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Using tools, routine procedures	Learn laboratory or practical skills (e.g., using science tools or taking scientific measurements).
Blank	Missing, not interpretable, or not applicable	

TQ6COM What is the main thing you wanted students to learn from the videotaped lesson?
Performance expectation - Communicating

Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Communicating	Learn how to communicate science ideas, observations, and/or investigations in writing and orally.
Blank	Missing, not interpretable, or not applicable	

TQ6SAF What is the main thing you wanted students to learn from the videotaped lesson?
Perspective - Learning safety in the science environment

Code	Response	Description or item option
0	Not a goal	
1	Perspective - Learning safety in the science environment	Learn safety procedures in the science environment, including practical, in-the-classroom safety.
Blank	Missing, not interpretable, or not applicable	

TQ6SAS What is the main thing you wanted students to learn from the videotaped lesson?
Perspective - Develop awareness of the usefulness or need of science in life

Code	Response	Description or item option
0	Not a goal	
1	Perspective - Develop awareness of the usefulness or need of science in life	Promote awareness of the relevance of science to societal applications, real-world connections, students' personal lives, everyday life such as health, environmental issues, safety, careers, etc.

Blank	Missing, not interpretable, or not applicable	

TQ6SOC What is the main thing you wanted students to learn from the videotaped lesson? Perspective - Learn to work collaboratively in groups		
Code	Response	Description or item option
0	Not a goal	
1	Perspective - Learn to work collaboratively in groups	Promote working in social groups including learning how to work in groups and how to work collaboratively.
Blank	Missing, not interpretable, or not applicable	

TQ6IND What is the main thing you wanted students to learn from the videotaped lesson? Perspective - Learn to work independently		
Code	Response	Description or item option
0	Not a goal	
1	Perspective - Learn to work independently	Promote learning to work independently with responsibility and self-discipline.
Blank	Missing, not interpretable, or not applicable	

TQ6FUN What is the main thing you wanted students to learn from the videotaped lesson? Perspective - Develop positive attitude toward or interest in science		
Code	Response	Description or item option
0	Not a goal	
1	Perspective - Develop positive attitude toward or interest in science	Promote positive attitude toward or interest in science; learn that science is fun and exciting.
Blank	Missing, not interpretable, or not applicable	

TQ6CON What is the main thing you wanted students to learn from the videotaped lesson? Perspective - Develop confidence		
Code	Response	Description or item option
0	Not a goal	
1	Perspective - Develop confidence	Promote confidence in doing science.
Blank	Missing, not interpretable, or not applicable	

TQ6NOS What is the main thing you wanted students to learn from the videotaped lesson? Content - Nature of science		
Code	Response	Description or item option
0	Not a goal	

1	Content - Nature of science	Learn information involving the nature of science, how science works, scientific habits of mind and values/attitudes (e.g., "learning about the scientific method" or appreciate science and how it works).
Blank	Missing, not interpretable, or not applicable	

TQ6INT What is the main thing you wanted students to learn from the videotaped lesson? Content - Interdisciplinary curriculum		
Code	Response	Description or item option
0	Not a goal	
1	Content - Interdisciplinary curriculum	Learn science through the integration of science disciplines or science with non-science disciplines.
Blank	Missing, not interpretable, or not applicable	

TQ6TEC What is the main thing you wanted students to learn from the videotaped lesson? Content - Technology		
Code	Response	Description or item option
0	Not a goal	
1	Content - Technology	Learn information about the nature of technology, the role of technology in society, and the relationship between science and technology.
Blank	Missing, not interpretable, or not applicable	

TQ6MAT What is the main thing you wanted students to learn from the videotaped lesson? Content - Mathematics		
Code	Response	Description or item option
0	Not a goal	
1	Content - Mathematics	Learn explicit mathematics content and/or processes in the science discipline (e.g., calculations, mathematical estimates, graphs, and problem solving).
Blank	Missing, not interpretable, or not applicable	

TQ6OTH What is the main thing you wanted students to learn from the videotaped lesson? Other response		
Code	Response	Description or item option
0	Not a goal	
1	Other response	Any response not included in defined codes (e.g., teaching goals or religious goals).
Blank	Missing, not interpretable, or not applicable	

Q6GENTOP What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Knowing general information about science disciplines and knowing scientific definitions		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Knowing general information about science disciplines and knowing scientific definitions	Know information at the broad, general level such as biology, chemistry, physics disciplines, and know definitions of topics such as labels or phrases describing specific topics. Includes TQ6GEN and TQ6TOP.
Blank	Missing, not interpretable, or not applicable	

Q6INQAT What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Developing scientific thinking skills and Applying problem solving skills		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Developing scientific thinking skills and Applying problem solving skills- apply scientific knowledge to solve problems, develop explanations, and make decisions	Develop science thinking, inquiry skills, and scientific habits of mind (e.g., "how to think scientifically") and apply knowledge to solve problems or applying knowledge in different contexts. Includes TQ6INQA and TQ6INQT.
Blank	Missing, not interpretable, or not applicable	

Q6IDEITI What is the main thing you wanted students to learn from the videotaped lesson? Performance expectation - Understanding scientific ideas and Knowing specific ideas or topics with specific inquiry skills		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Understanding scientific ideas and Knowing specific ideas or topics with specific inquiry skills	Understand scientific ideas, including theories or explanations, and know specific ideas or topics with specific inquiry skills. Includes TQ6IDE and TQ6ITI.
Blank	Missing, not interpretable, or not applicable	

GENTOP6 Difference in goals for the videotaped lesson: Knowing general information about science disciplines from Knowing scientific definitions ***(Code TQ6GEN minus TQ6TOP)***		
Code	Response	Description or item option

Blank	Missing, not interpretable, or not applicable	

GENNOS6 Difference in goals for the videotaped lesson: Knowing general information about science disciplines from Nature of science content
(Code TQ6GEN minus TQ6NOS)

Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

GENIDE6 Difference in goals for the videotaped lesson: Knowing general information about science disciplines from Understanding scientific ideas
(Code TQ6GEN minus TQ6IDE)

Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TOPNOS6 Difference in goals for the videotaped lesson: Knowing scientific definitions from Nature of science content
(Code TQ6TOP minus TQ6NOS)

Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TOPIDE6 Difference in goals for the videotaped lesson: Knowing scientific definitions from Understanding scientific ideas
(Code TQ6TOP minus TQ6IDE)

Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

NOSIDE6 Difference in goals for the videotaped lesson: Nature of science content from Understanding scientific ideas
(Code TQ6NOS minus TQ6IDE)

Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

MATGEN6 Difference in goals for the videotaped lesson: Mathematics content from Knowing general information about science disciplines
(Code TQ6MAT minus TQ6GEN)

Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

MATTOP6 Difference in goals for the videotaped lesson: Mathematics content from Knowing scientific definitions ***(Code TQ6MAT minus TQ6TOP)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

MATNOS6 Difference in goals for the videotaped lesson: Mathematics content from Nature of science content ***(Code TQ6MAT minus TQ6NOS)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

MATIDE6 Difference in goals for the videotaped lesson: Mathematics content from Understanding scientific ideas ***(Code TQ6MAT minus TQ6IDE)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

INQACT6 Difference in goals for the videotaped lesson: Applying problem solving skills from Completing a project or an experiment ***(Code TQ6INQ minus TQ6ACT)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

INQLSK6 Difference in goals for the videotaped lesson: Applying problem solving skills from Using tools, routine procedures ***(Code TQ6INQ minus TQ6LSK)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

ACTLSK6 Difference in goals for the videotaped lesson: Completing a project or an experiment from Using tools, routine procedures ***(Code TQ6ACT minus TQ6LSK)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

GTNOS6 Difference in goals for the videotaped lesson: Knowing general information about science disciplines and knowing scientific definitions from Nature of science content ***(Code Q6GENTOP minus TQ6NOS)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

GTIDEI6 Difference in goals for the videotaped lesson: Knowing general information about science disciplines and knowing scientific definitions from Understanding scientific ideas and Knowing specific ideas or topics with specific inquiry skills ***(Code Q6GENTOP minus Q6IDEITI)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

IDEINOS6 Difference in goals for the videotaped lesson: Understanding scientific ideas and Knowing specific ideas or topics with specific inquiry skills from Nature of science content ***(Code Q6IDEITI minus TQ6NOS)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

INATCOG6 Difference in goals for the videotaped lesson: Developing scientific thinking skills and Applying problem solving skills from Developing problem solving skills ***(Code Q6INQAT minus TQ6COG)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

INATACT6 Difference in goals for the videotaped lesson: Developing scientific thinking skills and Applying problem solving skills from Complete a project or an experiment ***(Code Q6INQAT minus TQ6ACT)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

INATLSK6 Difference in goals for the videotaped lesson: Developing scientific thinking skills and Applying problem solving skills from Using tools, routine procedures ***(Code Q6INQAT minus TQ6LSK)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ7A Are you satisfied that the videotaped lesson achieved that purpose?		
Code	Response	Description or item option
0	No	B
1	Yes	A
2	Mixed	A,B
Blank	Missing, not interpretable, or not applicable	

TQ7ARC Are you satisfied that the videotaped lesson achieved that purpose?		
Code	Response	Description or item option
0	No	B
1	Yes or mixed	A, or A and B
Blank	Missing, not interpretable, or not applicable	

TQ7AnoRC Are you satisfied that the videotaped lesson achieved that purpose?		
Code	Response	Description or item option
0	Yes or mixed	A, or A and B
1	No	B
Blank	Missing, not interpretable, or not applicable	

TQ7BnoA Explain why you were or were not satisfied that the videotaped lesson achieved the main purpose - Students did not learn content covered		
Code	Response	Description or item option
0	Satisfied or other reason not satisfied	Teacher was either satisfied or identified other reason not satisfied.
1	Not satisfied – Students did not learn content covered	Teacher was not satisfied students learned content covered in videotaped lesson.
Blank	Missing, not interpretable, or not applicable	

TQ7BnoB Explain why you were or were not satisfied that the videotaped lesson achieved the main purpose - Students did not participate		
Code	Response	Description or item option
0	Satisfied or other reason not satisfied	Teacher was either satisfied or identified other reason not satisfied.
1	Not satisfied – Students did not participate	Students did not participate in lesson as they usually do (e.g., "Students were more passive than usual”).
Blank	Missing, not interpretable, or not applicable	

TQ7BnoC Explain why you were or were not satisfied that the videotaped lesson achieved the main purpose – Lesson plan not achieved		
Code	Response	Description or item option
0	Satisfied or other reason not satisfied	Teacher was either satisfied or identified other reason not satisfied.
1	Not satisfied – Lesson plan not achieved	Teacher was not satisfied lesson plan was achieved; not enough time to complete lesson plan or to complete experiment; experiment did not succeed as planned; lesson plan changed due to videotaping.
Blank	Missing, not interpretable, or not applicable	

TQ7ByesD Explain why you were or were not satisfied that the videotaped lesson achieved the main purpose – Student interest		
Code	Response	Description or item option
0	Not satisfied or other reason satisfied	Teacher was either not satisfied or identified other reason satisfied.
1	Satisfied – Student interest	Teacher was satisfied with lesson noting students' enjoyment of the lesson or the quality of student behavior (e.g., "I think most of the students were interested in the lesson").
Blank	Missing, not interpretable, or not applicable	

TQ7ByesE Explain why you were or were not satisfied that the videotaped lesson achieved the main purpose – Student learning		
Code	Response	Description or item option
0	Not satisfied or other reason satisfied	Teacher was either not satisfied or identified other reason satisfied.
1	Satisfied – Student learning	Teacher was satisfied students understood concepts and were able to demonstrate understanding; students successfully completed their own experiment.
Blank	Missing, not interpretable, or not applicable	

TQ7ByesF Explain why you were or were not satisfied that the videotaped lesson achieved the main purpose – Student participation		
Code	Response	Description or item option
0	Not satisfied or other reason satisfied	Teacher was either not satisfied or identified other reason satisfied.
1	Satisfied – Student participation	Teacher was satisfied with the quality or quantity of student participation (e.g., "students were able to follow the presentation" or "they asked a lot of questions").
Blank	Missing, not interpretable, or	

	not applicable	

TQ7ByesG Explain why you were or were not satisfied that the videotaped lesson achieved the main purpose – Lesson plan achieved		
Code	Response	Description or item option
0	Not satisfied or other reason satisfied	Teacher was either not satisfied or identified other reason satisfied.
1	Satisfied – Lesson plan achieved	Teacher was satisfied lesson plan was completed; goals were achieved; teacher successfully completed experiment.
Blank	Missing, not interpretable, or not applicable	

TQ7ByesH Explain why you were or were not satisfied that the videotaped lesson achieved the main purpose – No reason identified		
Code	Response	Description or item option
0	Not satisfied or specific reason satisfied was identified	Teacher was either not satisfied or identified specific reason satisfied.
1	Satisfied – No reason identified	Teacher was satisfied with lesson plan but did not identify a reason.
Blank	Missing, not interpretable, or not applicable	

TQ8A To what extent did any of the following limit you from reaching your ideal in this lesson? a. Official curricular guidelines and/or standardized tests ***(Czech Republic, Japan, Netherlands, and United States versions)*** Your state's version of the *National Profiles* ***(Australia version)***		
Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8B To what extent did any of the following limit you from reaching your ideal in this lesson? b. Requirements to teach many topics		
Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable,	F Item noted by teacher as not applicable.

	or not applicable	

TQ8C To what extent did any of the following limit you from reaching your ideal in this lesson? c. Insufficient student motivation or readiness to learn		
Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8D To what extent did any of the following limit you from reaching your ideal in this lesson? d. Class size		
Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8E To what extent did any of the following limit you from reaching your ideal in this lesson? e. Insufficient time for lesson planning		
Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8F To what extent did any of the following limit you from reaching your ideal in this lesson? f. Insufficient time to work with colleagues on lessons ***(Czech Republic, Japan, Netherlands, and United States versions)*** Insufficient time to collaborate with colleagues on lessons ***(Australia version)***		
Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E

Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8G To what extent did any of the following limit you from reaching your ideal in this lesson?
g. Not enough books (e.g., textbooks, trade books, reference books, etc.)

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8H To what extent did any of the following limit you from reaching your ideal in this lesson?
h. Insufficient class time to finish what I planned to teach

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8I To what extent did any of the following limit you from reaching your ideal in this lesson?
i. Lack of or obsolete computers
Lack of computers or obsolete computers ***(Australia version)***

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8J To what extent did any of the following limit you from reaching your ideal in this lesson?
j. Lack of appropriate software for computers

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D

4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8K To what extent did any of the following limit you from reaching your ideal in this lesson?
k. Lack of needed instructional equipment (e.g., VCR, microscopes, overhead projection equipment, carts, etc.)

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8L To what extent did any of the following limit you from reaching your ideal in this lesson?
l. Lack of needed multimedia materials (e.g., videotapes, transparency sets, slides, and laser discs)

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8M To what extent did any of the following limit you from reaching your ideal in this lesson?
m. Insufficient science teaching materials and supplies (e.g., hands-on materials, seeds, magnets, chemicals, flashlights, etc.)

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8N To what extent did any of the following limit you from reaching your ideal in this lesson?
n. Inadequate physical facilities (e.g., room size, room layout, furniture, preparation room, teacher office space, storage space, sinks, electrical outlets, gas jets, etc.)

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8O To what extent did any of the following limit you from reaching your ideal in this lesson?
o. Insufficient training or support for using new technologies in your classroom

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8P To what extent did any of the following limit you from reaching your ideal in this lesson?
p. Presence of the video-camera or videographer

Code	Response	Description or item option
0	Not at all	A
1	A little	B
2	Some	C
3	Quite a lot	D
4	A great deal	E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8ARC2 To what extent did any of the following limit you from reaching your ideal in this lesson?
a. Official curricular guidelines and/or standardized tests ***(Czech Republic, Japan, Netherlands, and United States versions)***
Your state's version of the *National Profiles* ***(Australia version)***

Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8BRC2 To what extent did any of the following limit you from reaching your ideal in this lesson? b. Requirements to teach many topics		
Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8CRC2 To what extent did any of the following limit you from reaching your ideal in this lesson? c. Insufficient student motivation or readiness to learn		
Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8DRC2 To what extent did any of the following limit you from reaching your ideal in this lesson? d. Class size		
Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8ERC2 To what extent did any of the following limit you from reaching your ideal in this lesson? e. Insufficient time for lesson planning		
Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8FRC2 To what extent did any of the following limit you from reaching your ideal in this lesson? f. Insufficient time to work with colleagues on lessons ***(Czech Republic, Japan, Netherlands, and United States versions*** Insufficient time to collaborate with colleagues on lessons ***(Australia version)***		
Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8GRC2 To what extent did any of the following limit you from reaching your ideal in this lesson? g. Not enough books (textbooks, trade books, reference books, etc.)		
Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8HRC2 To what extent did any of the following limit you from reaching your ideal in this lesson? h. Insufficient time to finish what I planned to teach		
Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8IRC2 To what extent did any of the following limit you from reaching your ideal in this lesson? i. Lack of or obsolete computers ***(Czech Republic, Japan, Netherlands, and United States versions)*** Lack of computers or obsolete computers ***(Australia version)***		
Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8JRC2 To what extent did any of the following limit you from reaching your ideal in this lesson?
j. Lack of appropriate software for computers

Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8KRC2 To what extent did any of the following limit you from reaching your ideal in this lesson?
k. Lack of needed instructional equipment (VCR, overhead projection equipment, etc.)

Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8LRC2 To what extent did any of the following limit you from reaching your ideal in this lesson?
l. Lack of needed multimedia materials (videotapes, transparency sets, slides, and laser discs)

Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8MRC2 To what extent did any of the following limit you from reaching your ideal in this lesson?
m. Insufficient science teaching materials and supplies (e.g. hands-on materials, seeds, magnets, chemicals, flashlights, etc..)

Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8NRC2 To what extent did any of the following limit you from reaching your ideal in this lesson? n. Inadequate physical facilities (room size or layout, furniture, etc.)		
Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ8PRC2 To what extent did any of the following limit you from reaching your ideal in this lesson? p. Presence of the video-camera or videographer		
Code	Response	Description or item option
0	Not at all or A little	A or B
1	Some, Quite a lot, or A great deal	C, D, or E
Blank	Missing, not interpretable, or not applicable	F Item noted by teacher as not applicable.

TQ9A How long did you spend planning the videotaped lesson? ***(Code number of minutes)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ9B How long do you usually spend planning for this type of science lesson? ***(Code number of minutes)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ9A9BDF Difference in time teacher spent planning for this type of science lesson from time spent planning for the videotaped lesson ***(Code number of minutes reported in TQ9A minus number of minutes reported in TQ9B)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ10 Did your students work in groups for any part of the videotaped lesson?		
Code	Response	Description or item option
0	No	
1	Yes	
2	Yes and No	

Blank	Missing, not interpretable, or not applicable	

TQ10RC Did your students work in groups for any part of the videotaped lesson?		
Code	Response	Description or item option
0	No	
1	Yes, or Yes and No	
Blank	Missing, not interpretable, or not applicable	

TQ11A If students worked in groups, please describe the basis by which students were assigned to groups - Student academic ability		
Code	Response	Description or item option
0	Other reason	Groups assigned for reasons other than student academic ability.
1	Student academic ability	Teacher uses student ability or academic performance to assign students to groups.
Blank	No groupwork or missing response	

TQ11B If students worked in groups, please describe the basis by which students were assigned to groups – Student choice		
Code	Response	Description or item option
0	Other reason	Groups assigned for reasons other than student ability.
1	Student choice	Students choose group formation.
Blank	No groupwork or missing response	

TQ11C If students worked in groups, please describe the basis by which students were assigned to groups – Student behavior		
Code	Response	Description or item option
0	Other reason	Groups assigned for reasons other than student ability.
1	Student behavior	Teacher uses student behavior to assign students to groups.
Blank	No groupwork or missing response	

TQ11D If students worked in groups, please describe the basis by which students were assigned to groups – Student gender		
Code	Response	Description or item option
0	Other reason	Groups assigned for reasons other than student gender.
1	Student gender	Teacher uses student gender to assign students to groups.
Blank	No groupwork or missing	

	response	

TQ11E If students worked in groups, please describe the basis by which students were assigned to groups – Seating arrangement		
Code	Response	Description or item option
0	Other reason	Groups assigned for reasons other than student arrangement.
1	Seating arrangement	Teacher uses classroom seating arrangement to assign students to groups.
Blank	No groupwork or missing response	

TQ11F If students worked in groups, please describe the basis by which students were assigned to groups – Pre-assigned list		
Code	Response	Description or item option
0	Other reason	Groups assigned for reasons other than pre-assigned list.
1	Pre-assigned list	Teacher uses pre-assigned list or roster to assign students to groups.
Blank	No groupwork or missing response	

TQ11G If students worked in groups, please describe the basis by which students were assigned to groups – Other reason		
Code	Response	Description or item option
0	Student ability, choice, behavior, gender, seating arrangement, or pre-assigned list	Groups assigned by student ability, choice, behavior, gender, seating arrangement, or pre-assigned list.
1	Other reason	Teacher uses basis other than those defined in this variable.
Blank	No groupwork or missing response	

TQ11H If students worked in groups, please describe the basis by which students were assigned to groups – No reason identified		
Code	Response	Description or item option
0	Student ability, choice, behavior, gender, seating arrangement, or pre-assigned list	Groups assigned by student ability, choice, behavior, gender, seating arrangement, pre-assigned list, or other reason.
1	No reason identified	Students assigned to groups but no reason identified.
Blank	No groupwork or missing response	

TQ12A To what extent do you have sufficient access to this item for use in your science classroom?
a. Computers

Code	Response	Description or item option
0	Not at all	C
1	Too few or little	B
2	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12B To what extent do you have sufficient access to this item for use in your science classroom?
b. Computer software

Code	Response	Description or item option
0	Not at all	C
1	Too few or little	B
2	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12C To what extent do you have sufficient access to this item for use in your science classroom?
c. Computers with Internet connections

Code	Response	Description or item option
0	Not at all	C
1	Too few or little	B
2	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12D To what extent do you have sufficient access to this item for use in your science classroom?
d. A/V equipment (e.g., TV, VCR, overhead projectors)

Code	Response	Description or item option
0	Not at all	C
1	Too few or little	B
2	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12E To what extent do you have sufficient access to this item for use in your science classroom? e. Teaching supplies/materials (e.g., chemicals, magnets, rulers)		
Code	Response	Description or item option
0	Not at all	C
1	Too few or little	B
2	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12F To what extent do you have sufficient access to this item for use in your science classroom? f. Microscopes		
Code	Response	Description or item option
0	Not at all	C
1	Too few or little	B
2	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12G To what extent do you have sufficient access to this item for use in your science classroom? g. Science laboratory		
Code	Response	Description or item option
0	Not at all	C
1	Too few or little	B
2	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12H To what extent do you have sufficient access to this item for use in your science classroom? h. Reference book materials (e.g., books, journals, magazines)		
Code	Response	Description or item option
0	Not at all	C
1	Too few or little	B
2	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12ARC To what extent do you have sufficient access to this item for use in your science classroom? a. Computers		
Code	Response	Description or item option
0	Too few or little or Not at	B,C

	all	
1	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12BRC To what extent do you have sufficient access to this item for use in your science classroom?
b. Computer software

Code	Response	Description or item option
0	Too few or little or Not at all	B,C
1	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12CRC To what extent do you have sufficient access to this item for use in your science classroom?
c. Computers with Internet connections

Code	Response	Description or item option
0	Too few or Not at all	B,C
1	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12DRC To what extent do you have sufficient access to this item for use in your science classroom?
d. A/V equipment (e.g., TV, VCR, overhead projectors)

Code	Response	Description or item option
0	Too few or Not at all	B,C
1	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12ERC To what extent do you have sufficient access to this item for use in your science classroom?
e. Teaching supplies/materials (e.g., chemicals, magnets, rulers)

Code	Response	Description or item option
0	Too few or Not at all	B,C
1	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12FRC To what extent do you have sufficient access to this item for use in your science classroom? f. Microscopes		
Code	Response	Description or item option
0	Too few or Not at all	B,C
1	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12GRC To what extent do you have sufficient access to this item for use in your science classroom? g. Science laboratory		
Code	Response	Description or item option
0	Too few or Not at all	B,C
1	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ12HRC To what extent do you have sufficient access to this item for use in your science classroom? h. Reference book materials (e.g., books, journals, magazines)		
Code	Response	Description or item option
0	Too few or Not at all	B,C
1	Enough	A
Blank	Missing, not interpretable, or not applicable	

TQ13 Do all students in the school take this course? ***(Czech Republic, Japan, and United States versions)*** Do all students at the year 8 level take this course of study/pathway? ***(Australia version)*** ***(Code '1' for Netherlands because all students must take this course)***		
Code	Response	Description or item option
0	No	B
1	Yes	A ***Code '1' for all Netherlands because all students must take this course.***
Blank	Missing, not interpretable, or not applicable	

TQ14 If **no**, is curriculum in this course more challenging or less challenging than the typical 8th grade science course in this school? Mark one of the three choices below ***(Australia, Japan, and United States versions)*** If **no**, is the curriculum on the same level as in other 8th-grade courses? ***(Czech Republic version)*** ***(Code '2' for Netherlands because all students must take this course***)		
Code	Response	Description or item option
1	Less challenging	C
2	A typical 8th grade curriculum	B 'Yes' on Question 13; all students take this course. ***Code '2' for Netherlands because all students must take this course.***
3	More challenging	A
Blank	Missing, not interpretable, or not applicable	

TQ14NO13 If **no**, is curriculum in this course more challenging or less challenging than the typical eighth grade science course in this school? Mark one of the three choices below ***(Australia, Japan, and United States versions)*** If **no**, is the curriculum on the same level as in other 8th-grade courses? ***(Czech Republic version)*** ***(Code 'Blank' for Netherlands because all students must take this course)***		
Code	Response	Description or item option
1	Less challenging	C
2	A typical 8th grade curriculum	B
3	More challenging	A
Blank	Missing, not interpretable, or not applicable	***Code 'Blank' for all 'Yes' responses on Question 13; Code 'Blank' for Netherlands because all students take this course.***

TQ15 Did you previously assign science homework that was due for the day of the videotaped lesson?		
Code	Response	Description or item option
0	No	
1	Yes	
Blank	Missing, not interpretable, or not applicable	

TQ16A Please describe what, if anything, students were expected to do for homework due the day of the videotaped lesson - Work on problems or exercises		
Code	Response	Description or item option
0	Other type of homework	Other type of homework assigned.

1	Work on problems or exercises	Teacher assigned tasks from text, worksheet, etc., including preparation or set-up for experiment.
Blank	No homework assigned or missing response	

TQ16B Please describe what, if anything, students were expected to do for homework due the day of the videotaped lesson – Solve application problems		
Code	Response	Description or item option
0	Other type of homework	Other type of homework assigned.
1	Solve application problems	Teacher made a note that students were expected to solve application problems.
Blank	No homework assigned or missing response	

TQ16C Please describe what, if anything, students were expected to do for homework due the day of the videotaped lesson – Review notes, questions, or problems		
Code	Response	Description or item option
0	Other type of homework	Other type of homework assigned.
1	Review notes, questions, or problems	Students were expected to review notes or problems from previous day or lesson; teacher assigned a cumulative review of questions or problems to prepare for a quiz or test (e.g., "Worksheet to review for test", "They were to do a practice test)".
Blank	No homework assigned or missing response	

TQ16D Please describe what, if anything, students were expected to do for homework due the day of the videotaped lesson - Reading		
Code	Response	Description or item option
0	Other type of homework	Other type of homework assigned.
1	Reading	Students were expected to read textbook or other materials (e.g., "students were expected to read ahead in Chapter 2"); students were expected to read and answer questions based on what they read.
Blank	No homework assigned or missing response	

TQ16E Please describe what, if anything, students were expected to do for homework due the day of the videotaped lesson - Project		
Code	Response	Description or item option
0	Other type of homework	Other type of homework assigned.
1	Project	Students were expected to complete a project (e.g., "Hand in a lab report and a performance based assessment sheet on an experiment", "The students had to hand in their learning-diaries").

Blank	No homework assigned or missing response	

TQ16F Please describe what, if anything, students were expected to do for homework due the day of the videotaped lesson – Homework assigned but not described		
Code	Response	Description or item option
0	Other type of homework	Other type of homework assigned.
1	Homework assigned but not described	Teacher assigned homework but did not provide description
Blank	No homework assigned or missing response	

TQ17 Was the assigned homework related to this lesson or the prior lesson? ***(Code '0' for all TQ15 = '0' responses)***		
Code	Response	Description or item option
0	No homework assigned	No homework assigned; or homework not from prior or videotaped lesson.
1	Prior lesson	B
2	Videotaped lesson	A
3	Both	C
Blank	Missing, not interpretable, or not applicable	

TQ18 How long would it have taken the typical student in your class to complete this homework? ***(Code number of minutes)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ19 Will students be formally evaluated on the material they studied in the videotaped lesson (e.g., a quiz, unit test, project, etc.)?		
Code	Response	Description or item option
0	No	B
1	Yes	A
Blank	Missing, not interpretable, or not applicable	

TQ21 Was the videotaped lesson part of a unit or sequence of related lessons, or was it standalone?		
Code	Response	Description or item option
1	Stand-alone lesson	A
2	Part of a larger unit or sequence of related lessons	B
Blank	Missing, not interpretable, or	

	not applicable	

TQ24 Approximately how many lessons are in the entire sequence or unit? ***(Code number of lessons in unit)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ25 Where did the videotaped lesson fall in the sequence or unit? ***(Code number of videotaped lesson in unit)***		
Code	Response	Description or item option
1	First lesson in unit	First lesson in unit, teacher notes lesson is not stand alone but only one lesson in unit, or stand-alone lesson.
2	Second lesson in unit	Example
3	Other	Later than 2nd unit in lesson sequence
Blank	Missing, not interpretable, or not applicable	

TQ27 For this study, we are interested in capturing your typical science teaching. It is important for us to know in what ways the teaching in the videotaped lesson might not have been typical. How often do you use the teaching methods that are in the videotaped lesson?		
Code	Response	Description or item option
1	Seldom	A
2	Sometimes	B
3	Often	C
4	Almost always	D
Blank	Missing, not interpretable, or not applicable	

TQ27C12 For this study, we are interested in capturing your typical science teaching. It is important for us to know in what ways the teaching in the videotaped lesson might not have been typical. How often do you use the teaching methods that are in the videotaped lesson?		
Code	Response	Description or item option
0	Almost always or often	C,D
1	Seldom or sometimes	A,B
Blank	Missing, not interpretable, or not applicable	

TQ27C3 For this study, we are interested in capturing your typical science teaching. It is important for us to know in what ways the teaching in the videotaped lesson might not have been typical. How often do you use the teaching methods that are in the videotaped lesson?		
Code	Response	Description or item option
0	Seldom, sometimes, or almost always	A,B,D

1	Often	C
Blank	Missing, not interpretable, or not applicable	

TQ27C4 For this study, we are interested in capturing your typical science teaching. It is important for us to know in what ways the teaching in the videotaped lesson might not have been typical. How often do you use the teaching methods that are in the videotaped lesson?

Code	Response	Description or item option
0	Seldom, sometimes, or often	A,B,C
1	Almost always	D
Blank	Missing, not interpretable, or not applicable	

TQ29 How would you describe your students' behavior and participation during the videotaped lesson?

Code	Response	Description or item option
1	Worse than usual	C
2	About the same as usual	B
3	Better than usual	A
4	Better and worse than usual	A,C or A,B,C
Blank	Missing, not interpretable, or not applicable	

TQ29C1 How would you describe your students' behavior and participation during the videotaped lesson?

Code	Response	Description or item option
0	About the same as usual, or Better than usual	A,B
1	Worse than usual	C
Blank	Missing, not interpretable, or not applicable	

TQ29C2 How would you describe your students' behavior and participation during the videotaped lesson?

Code	Response	Description or item option
0	Worse than usual, or better than usual	A,C
1	About the same as usual	B
Blank	Missing, not interpretable, or not applicable	

TQ29C3 How would you describe your students' behavior and participation during the videotaped lesson?		
Code	Response	Description or item option
0	Worse than usual, or about the same as usual	B,C
1	Better than usual	A
Blank	Missing, not interpretable, or not applicable	

TQ30C11 What, if anything, was different about the nature of the students' behavior and the amount of student participation during the videotaped lesson? Less active **(Applied only to the Czech lessons that described students' behavior as worse than usual in TQ29)**		
Code	Response	Description or item option
0	Worse than usual – other reason	
1	Worse than usual - less active	
Blank	Missing, not interpretable, or not applicable	

TQ30C12 What, if anything, was different about the nature of the students' behavior and the amount of student participation during the videotaped lesson? Shy and/or insecure **(Applied only to the Czech lessons that described students' behavior as worse than usual in TQ29)**		
Code	Response	Description or item option
0	Worse than usual – other reason	
1	Worse than usual – shy and/or insecure	
Blank	Missing, not interpretable, or not applicable	

TQ30C13 What, if anything, was different about the nature of the students' behavior and the amount of student participation during the videotaped lesson? Less focused **(Applied only to the Czech lessons that described students' behavior as worse than usual in TQ29)**		
Code	Response	Description or item option
0	Worse than usual – other reason	
1	Worse than usual - less focused	
Blank	Missing, not interpretable, or	

	not applicable	

TQ31 Was the content of the videotaped lesson more difficult for your students than usual, about the same, or less difficult than usual?		
Code	Response	Description or item option
1	Less difficult for students than most lessons	C
2	About the same as most lessons	B
3	More difficult for students than most lessons	A
Blank	Missing, not interpretable, or not applicable	

TQ31C1 Was the content of the videotaped lesson more difficult for your students than usual, about the same, or less difficult than usual?		
Code	Response	Description or item option
0	About the same as most lessons, or more difficult for students than most lessons	A,B
1	Less difficult for students than most lessons	C
Blank	Missing, not interpretable, or not applicable	

TQ31C2 Was the content of the videotaped lesson more difficult for your students than usual, about the same, or less difficult than usual?		
Code	Response	Description or item option
0	Less difficult, or more difficult for students than most lessons	A,C
1	About the same as most lessons	B
Blank	Missing, not interpretable, or not applicable	

TQ31C3 Was the content of the videotaped lesson more difficult for your students than usual, about the same, or less difficult than usual?		
Code	Response	Description or item option
0	Less difficult for students, or about the same as most lessons	B,C
1	More difficult for students than most lessons	A
Blank	Missing, not interpretable, or	

	not applicable	

TQ32 Do you think that having the camera present caused you to teach a lesson that was better than usual, worse than usual, or about the same as usual?		
Code	Response	Description or item option
1	Worse than usual	C
2	About the same as usual	B
3	Better than usual	A
4	Mixed	A and C, or A, B, and C
Blank	Missing, not interpretable, or not applicable	

TQ32C1 Do you think that having the camera present caused you to teach a lesson that was better than usual, worse than usual, or about the same as usual?		
Code	Response	Description or item option
0	About the same, or better than usual	A,B
1	Worse than usual	C
Blank	Missing, not interpretable, or not applicable	

TQ32C2 Do you think that having the camera present caused you to teach a lesson that was better than usual, worse than usual, or about the same as usual?		
Code	Response	Description or item option
0	Worse, or better than usual	A,C
1	About the same as usual	B
Blank	Missing, not interpretable, or not applicable	

TQ32C3 Do you think that having the camera present caused you to teach a lesson that was better than usual, worse than usual, or about the same as usual?		
Code	Response	Description or item option
0	Worse, or about the same as usual	B,C
1	Better than usual	A
Blank	Missing, not interpretable, or not applicable	

TQ33IDE List the three most important things you would like your students to learn from studying science this year. Performance expectation - Understanding scientific ideas		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation -	Understand scientific ideas, including theories or

	Understanding scientific ideas	explanations.
Blank	Missing, not interpretable, or not applicable	

TQ33TOP List the three most important things you would like your students to learn from studying science this year.
Performance expectation - Knowing scientific definitions

Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Knowing scientific definitions	Know definitions of topics (e.g., labels or phrases describing specific topics).
Blank	Missing, not interpretable, or not applicable	

TQ33GEN List the three most important things you would like your students to learn from studying science this year.
Performance expectation - Knowing general information about science disciplines

Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Knowing general information about science disciplines	Know information at the broad, general level (e.g., biology, chemistry, physics disciplines).
Blank	Missing, not interpretable, or not applicable	

TQ33ITI List the three most important things you would like your students to learn from studying science this year.
Performance expectation - Knowing specific ideas or topics with specific inquiry skills

Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Knowing specific ideas or topics with specific inquiry skills	Know specific ideas or topics with specific inquiry skills.
Blank	Missing, not interpretable, or not applicable	

TQ33COG List the three most important things you would like your students to learn from studying science this year.
Performance expectation - Developing problem solving skills

Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Developing problem solving skills	Learn how to think, problem solve, and apply knowledge.

Blank	Missing, not interpretable, or not applicable	

TQ33INQT List the three most important things you would like your students to learn from studying science this year.
Performance expectation - Developing scientific thinking skills

Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Developing scientific thinking skills	Develop science thinking, inquiry skills, and scientific habits of mind (e.g., “how to think scientifically").
Blank	Missing, not interpretable, or not applicable	

TQ33INQA List the three most important things you would like your students to learn from studying science this year.
Performance expectation - Applying problem solving skills: apply scientific knowledge to solve problems, develop explanations, and make decisions

Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Applying problem solving skills: apply scientific knowledge to solve problems, develop explanations, and make decisions	Apply knowledge to solve problems or applying knowledge in different contexts. Knowledge can be scientific knowledge and science inquiry, or general knowledge (e.g., “Application of atoms and molecules to chemistry”, “Ability to weigh conclusions based on the lessons that they've learned”, “To come up with a new idea based on acquired knowledge”).
Blank	Missing, not interpretable, or not applicable	

TQ33INQ List the three most important things you would like your students to learn from studying science this year.
Performance expectation - Applying problem solving skills: apply scientific knowledge and scientific thinking skills to solve problems, develop explanations, and make decisions

Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Applying problem solving skills: apply scientific knowledge and scientific thinking skills to solve problems, develop explanations, and make decisions	Apply problem solving skills; apply scientific knowledge and scientific thinking skills to solve problems or applying knowledge in different contexts. Knowledge can be scientific knowledge and science inquiry, or general knowledge (e.g., “Application of atoms and molecules to chemistry”, “Ability to weigh conclusions based on the lessons that they've learned”, “To come up with a new idea based on acquired knowledge”).

		Includes TQ33INQT, TQ33INQA, and TQ33ITI.
Blank	Missing, not interpretable, or not applicable	

TQ33ACTP List the three most important things you would like your students to learn from studying science this year. Performance expectation - Completing a scientific project		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Completing a scientific project	Complete a scientific project (e.g., “build models of Newton’s Laws”, “write a report”, “watch a video”, “make constellation maps", “have a discussion about the lab results from yesterday").
Blank	Missing, not interpretable, or not applicable	

TQ33ACTE List the three most important things you would like your students to learn from studying science this year. Performance expectation - Investigating the natural world; conduct a scientific experiment		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Investigating the natural world; conduct a scientific experiment	Learn to investigate the natural world by conducting an experiment that involves collection of data (e.g., “do an experiment”, “do a lab on acids”, “do more practicals").
Blank	Missing, not interpretable, or not applicable	

TQ33ACT List the three most important things you would like your students to learn from studying science this year. Performance expectation - Complete a project or an experiment		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Complete a project or an experiment	Complete a scientific project (e.g., “build models of Newton’s Laws”, “write a report”, “watch a video”, “make constellation maps", or investigate the natural world by conducting an experiment that involves collection of data such as “do an experiment”, “do a lab on acids”, “do more practicals"). Includes TQ33ACTP and TQ33ACTE.
Blank	Missing, not interpretable, or not applicable	

TQ33LSK List the three most important things you would like your students to learn from studying science this year. Performance expectation - Using tools, routine procedures		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Using tools, routine procedures	Learn laboratory or practical skills (e.g., using science tools or taking scientific measurements).
Blank	Missing, not interpretable, or not applicable	

TQ33COM List the three most important things you would like your students to learn from studying science this year. Performance expectation - Communicating		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Communicating	Learn how to communicate science ideas, observations, and/or investigations in writing and orally.
Blank	Missing, not interpretable, or not applicable	

TQ33SAF List the three most important things you would like your students to learn from studying science this year. Perspective - Learning safety in the science environment		
Code	Response	Description or item option
0	Not a goal	
1	Perspective - Learning safety in the science environment	Learn safety procedures in the science environment, including practical, in-the-classroom safety.
Blank	Missing, not interpretable, or not applicable	

TQ33SAS List the three most important things you would like your students to learn from studying science this year. Perspective - Develop awareness of the usefulness or need of science in life		
Code	Response	Description or item option
0	Not a goal	
1	Perspective - Develop awareness of the usefulness or need of science in life	Promote awareness of the relevance of science to societal applications, real-world connections, students' personal lives, everyday life such as health, environmental issues, safety, careers, etc.
Blank	Missing, not interpretable, or not applicable	

TQ33SOC List the three most important things you would like your students to learn from studying science this year. Perspective - Learn to work collaboratively in groups		
Code	Response	Description or item option
0	Not a goal	
1	Perspective - Learn to work collaboratively in groups	Promote working in social groups including learning how to work in groups and how to work collaboratively.
Blank	Missing, not interpretable, or not applicable	

TQ33IND List the three most important things you would like your students to learn from studying science this year. Perspective - Learn to work independently		
Code	Response	Description or item option
0	Not a goal	
1	Perspective - Learn to work independently	Promote learning to work independently with responsibility and self-discipline.
Blank	Missing, not interpretable, or not applicable	

TQ33FUN List the three most important things you would like your students to learn from studying science this year. Perspective - Develop positive attitude toward or interest in science		
Code	Response	Description or item option
0	Not a goal	
1	Perspective - Develop positive attitude toward or interest in science	Promote positive attitude toward or interest in science; learn that science is fun and exciting.
Blank	Missing, not interpretable, or not applicable	

TQ33CON List the three most important things you would like your students to learn from studying science this year. Perspective - Develop confidence		
Code	Response	Description or item option
0	Not a goal	
1	Perspective - Develop confidence	Promote confidence in doing science.
Blank	Missing, not interpretable, or not applicable	

TQ33NOS List the three most important things you would like your students to learn from studying science this year. Content - Nature of science		
Code	Response	Description or item option
0	Not a goal	
1	Content - Nature of science	Learn information involving the nature of science, how science works, scientific habits of mind and values/attitudes (e.g., "learning about the scientific method"), and appreciate science and how it works.
Blank	Missing, not interpretable, or not applicable	

TQ33INT List the three most important things you would like your students to learn from studying science this year. Content - Interdisciplinary curriculum		
Code	Response	Description or item option
0	Not a goal	
1	Content - Interdisciplinary curriculum	Learn science through the integration of science disciplines or science with non-science disciplines.
Blank	Missing, not interpretable, or not applicable	

TQ33TEC List the three most important things you would like your students to learn from studying science this year. Content - Technology		
Code	Response	Description or item option
0	Not a goal	
1	Content - Technology	Learn information about the nature of technology, the role of technology in society, and the relationship between science and technology.
Blank	Missing, not interpretable, or not applicable	

TQ33MAT List the three most important things you would like your students to learn from studying science this year. Content - Mathematics		
Code	Response	Description or item option
0	Not a goal	
1	Content - Mathematics	Learn explicit mathematics content and/or processes in the science discipline (e.g., calculations, mathematical estimates, graphs, and problem solving).
Blank	Missing, not interpretable, or not applicable	

TQ33OTH List the three most important things you would like your students to learn from studying science this year. Other response		
Code	Response	Description or item option
0	Not a goal	
1	Other response	Any response not included in defined codes (e.g., teaching goals or religious goals).
Blank	Missing, not interpretable, or not applicable	

Q33GNTOP List the three most important things you would like your students to learn from studying science this year. Performance expectation - Knowing general information about science disciplines and knowing scientific definitions		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Knowing general information about science disciplines and knowing scientific definitions	Know information at the broad, general level (e.g., biology, chemistry, physics disciplines) and know definitions of topics (e.g., labels or phrases describing specific topics). Includes TQ33GEN and TQ33TOP.
Blank	Missing, not interpretable, or not applicable	

Q33INQAT List the three most important things you would like your students to learn from studying science this year. Performance expectation - Developing scientific thinking skills, Applying problem solving skills, and Applying scientific knowledge to solve problems, develop explanations, and make decisions		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Developing scientific thinking skills, Applying problem solving skills and Applying scientific knowledge to solve problems, develop explanations, and make decisions	Develop science thinking, inquiry skills, and scientific habits of mind (e.g., “how to think scientifically") and apply knowledge to solve problems or applying knowledge in different contexts. Includes TQ33INQA and TQ33INQT.
Blank	Missing, not interpretable, or not applicable	

Q33IDITI List the three most important things you would like your students to learn from studying science this year. Performance expectation - Understanding scientific ideas and Knowing specific ideas or topics with specific inquiry skills		
Code	Response	Description or item option
0	Not a goal	
1	Performance expectation - Understanding scientific ideas and Knowing specific ideas or topics with specific inquiry skills	Understand scientific ideas, including theories or explanations, and know specific ideas or topics with specific inquiry skills. Includes T33IDE and TQ33ITI.
Blank	Missing, not interpretable, or not applicable	

GENTOP33 Difference in goals for science this year: Knowing general information about science disciplines from Knowing scientific definitions ***(Code TQ33GEN minus TQ33TOP)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

GENNOS33 Difference in goals for science this year: Knowing general information about science disciplines from Nature of science content ***(Code TQ33GEN minus TQ33NOS)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

GENIDE33 Difference in goals for science this year: Knowing general information about science disciplines from Understanding scientific ideas ***(Code TQ33GEN minus TQ33IDE)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TOPNOS33 Difference in goals for science this year: Knowing scientific definitions from Nature of science content ***(Code TQ33TOP minus TQ33NOS)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

COGINQ33 Difference in goals for science this year: Developing problem solving skills from Applying problem solving skills ***(Code TQ33COG minus TQ33INQ)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

COGACT33 Difference in goals for science this year: Developing problem solving skills from Completing a project or an experiment ***(Code TQ33COG minus TQ33ACT)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

COGLSK33 Difference in goals for science this year: Developing problem solving skills from Using tools, routine procedures ***(Code TQ33COG minus TQ33LSK)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

COGCOM33 Difference in goals for science this year: Developing problem solving skills from Communicating ***(Code TQ33COG minus TQ33COM)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

INQACT33 Difference in goals for science this year: Applying problem solving skills from Completing a project or an experiment ***(Code TQ33INQ minus TQ33ACT)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

INQLSK33 Difference in goals for science this year: Applying problem solving skills from Using tools, routine procedures ***(Code TQ33INQ minus TQ33LSK)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

INQCOM33 Difference in goals for science this year: Applying problem solving skills from Communicating ***(Code TQ33INQ minus TQ33COM)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

ACTLSK33 Difference in goals for science this year: Completing a project or an experiment from Using tools, routine procedures ***(Code TQ33ACT minus TQ33LSK)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

ACTCOM33 Difference in goals for science this year: Completing a project or an experiment from Communicating ***(Code TQ33ACT minus TQ33COM)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

LSKCOM33 Difference in goals for science this year: Using tools, routine procedures from Communicating ***(Code TQ33LSK minus TQ33COM)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

SASSOC33 Difference in goals for science this year: Developing awareness of the usefulness or need of science in life from Learning to work collaboratively in groups ***(Code TQ33SAS minus TQ33SOC)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

SASIND33 Difference in goals for science this year: Developing awareness of the usefulness or need of science in life from Learning to work independently ***(Code TQ33SAS minus TQ33IND)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

SASFUN33 Difference in goals for science this year: Developing awareness of the usefulness or need of science in life from Developing positive attitude toward or interest in science ***(Code TQ33SAS minus TQ33FUN)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

SASCON33 Difference in goals for science this year: Developing awareness of the usefulness or need of science in life from Developing confidence ***(Code TQ33SAS minus TQ33CON)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

SOCIND33 Difference in goals for science this year: Learning to work collaboratively in groups from Learning to work independently ***(Code TQ33SOC minus TQ33IND)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

SOCFUN33 Difference in goals for science this year: Learning to work collaboratively in groups from Developing positive attitude toward or interest in science ***(Code TQ33SOC minus TQ33FUN)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

SOCCON33 Difference in goals for science this year: Learning to work collaboratively in groups from Developing confidence ***(Code TQ33SOC minus TQ33CON)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

INDFUN33 Difference in goals for science this year: Learning to work independently from Developing positive attitude toward or interest in science ***(Code TQ33IND minus TQ33FUN)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

INDCON33 Difference in goals for science this year: Learning to work independently from Developing confidence ***(Code TQ33IND minus TQ33CON)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

FUNCON33 Difference in goals for science this year: Developing positive attitude toward or interest in science from Developing confidence ***(Code TQ33FUN minus TQ33CON)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

GTNOS33 Difference in goals for science this year: Knowing general information about science disciplines and knowing scientific definitions from Nature of science content ***(Code Q33GNTOP minus TQ33NOS)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

GTIDEI33 Difference in goals for science this year: Knowing general information about science disciplines and knowing scientific definitions from Understanding scientific ideas and Knowing specific ideas or topics with specific inquiry skills ***(Code Q33GNTOP minus Q33IDITI)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

IDINOS33 Difference in goals for science this year: Understanding scientific ideas and Knowing specific ideas or topics with specific inquiry skills from Nature of science content ***(Code Q33IDITI minus TQ33NOS)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

IATCOG33 Difference in goals for science this year: Developing scientific thinking skills and Applying problem solving skills from Developing problem solving skills ***(Code Q33INQAT minus TQ33COG)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

IATACT33 Difference in goals for science this year: Developing scientific thinking skills and Applying problem solving skills from Complete a project or an experiment ***(Code Q33INQAT minus TQ33ACT)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

IATLSK33 Difference in goals for science this year: Developing scientific thinking skills and Applying problem solving skills from Using tools, routine procedures ***(Code Q33INQAT minus TQ33LSK)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ34 In general, I feel comfortable trying new techniques for teaching science in my classroom		
Code	Response	Description or item option
1	I disagree	C
2	No opinion	B
3	I agree	A
Blank	Missing, not interpretable, or not applicable	

TQ35 In general, I feel I keep up with current ideas in science teaching and learning		
Code	Response	Description or item option
1	I disagree	C
2	No opinion	B
3	I agree	A
Blank	Missing, not interpretable, or not applicable	

TQ35C1 In general, I feel I keep up with current ideas in science teaching and learning		
Code	Response	Description or item option
0	No opinion or I agree	A,B
1	I disagree	C
Blank	Missing, not interpretable, or not applicable	

TQ35C2 In general, I feel I keep up with current ideas in science teaching and learning		
Code	Response	Description or item option
0	I disagree or I agree	A,C
1	No opinion	B
Blank	Missing, not interpretable, or not applicable	

TQ35C3 In general, I feel I keep up with current ideas in science teaching and learning		
Code	Response	Description or item option
0	I disagree or no opinion	B,C
1	I agree	A
Blank	Missing, not interpretable, or not applicable	

TQ37A What written materials are you aware of that describe current ideas about the teaching and learning of science? ***(Code number of written materials)***		
Code	Response	Description or item option
0	None	No written materials identified
1	One material	Teacher identified one written material
2	Two materials	Teacher identified two written materials
3	Three materials	Teacher identified three written materials
Blank	Missing, not interpretable, or not applicable	

What written materials are you aware of that describe current ideas about the teaching and learning science? Please list up to three, and indicate whether you have personally read each one. **TQ37B1** ***First mentioned written material*** **TQ37B2** ***Second mentioned written material*** **TQ37B3** ***Third mentioned written material***		
Code	Response	Description or item option
0	None of it	D
1	Some of it	C
2	Most of it	B
3	All of it	A
Blank	Missing, not interpretable, or not applicable	

TQ38 To what extent do you feel that the videotaped lesson is in accord with current ideas about the teaching and learning of science?		
Code	Response	Description or item option
0	Not at all	D
1	A little	C
2	A fair amount	B
3	A lot	A
Blank	Missing, not interpretable, or not applicable	

TQ38C0 To what extent do you feel that the videotaped lesson is in accord with current ideas about the teaching and learning of science?		
Code	Response	Description or item option
0	A little, a fair amount, or a lot	A,B,C
1	Not at all	D
Blank	Missing, not interpretable, or not applicable	

TQ38C1 To what extent do you feel that the videotaped lesson is in accord with current ideas about the teaching and learning of science?		
Code	Response	Description or item option
0	Not at all, a fair amount, or a lot	A,B,D
1	A little	C
Blank	Missing, not interpretable, or not applicable	

TQ38C23 To what extent do you feel that the videotaped lesson is in accord with current ideas about the teaching and learning of science?		
Code	Response	Description or item option
0	Not at all or a little	C,D
1	A fair amount or a lot	A,B
Blank	Missing, not interpretable, or not applicable	

TQ39 Please describe one part of the videotaped lesson that you feel exemplifies current ideas about the teaching and learning of science		
Code	Response	Description or item option
0	No current ideas in the lesson	
1	Current ideas in the lesson but none identified	
21	Work on practical activities	Students observe or manipulate 3-D objects (e.g., hands-on activities, experiments, and demonstrations). The focus is on the doing of experiments, demonstrations, hands-on, rather than on using these activities to develop content knowledge.
22	Develop critical thinking skills	Students do things with ideas rather than objects including solving problems, critical thinking, or reasoning, concept mapping, reflecting, higher level thinking (e.g., "Get them thinking", "Students need to figure things out"). Students are given challenging problems, problems that require higher level thinking, problems that require use of evidence. Students learn

		to use critical thinking skills and how to think scientifically. Students do competition problems.
23	Develop science ideas through practical work/experiments	Students do things with objects for the purpose of developing ideas, such as manipulating or observing. Teacher might describe students as discovering ideas from experiments, designing investigations to answer questions, using evidence to build explanations, using inquiry approaches to understand concepts, drawing conclusions from experiments, theorizing based on the experiment, analyzing results.
24	Develop communication skills	Students involved in discussions or other forms of talking, writing, or listening; includes peer teaching; students interact a lot.
25	Construct own knowledge	Students engaged in sharing their own ideas or experiences. Teacher checks for students' prior ideas and misconceptions and then helps them address and change these ideas, building on students' prior knowledge. Teacher responds to student learning styles. Students given choice of what to do.
26	Engage in real-world applications	Students engaged in doing real world problems, activities, or discussion. Teacher emphasizes that students are seeing the "real" thing.
27	Collaborate	Students work in groups or pairs, go over work together, help each other, collaborate, build a community of inquiry, and display group collaboration.
28	Work independently	Students take responsibility for their own learning, learn how to work independently, and are self-motivated.
31	Science content	Content is consistent with current ideas about science teaching (e.g., integrated curriculum or less is more).
32	Teacher role	Focus is on what the teacher does (e.g., teacher as facilitator). Teacher actions are emphasized (e.g., "Started with a review session and then presented new information"). General teaching philosophy or approach is given (e.g., "I move from general to concrete"). Source of information that the teacher uses is described (e.g., "I use the national standards to guide my planning").
33	Student interest	Teacher makes the lesson fun or interesting, motivating students.
34	Technology	Tools or technology include computers, video technology, specialized lab equipment, OHT, etc.
35	Variety of instructional methods	Variety of methods used, for example, combination of lecture, textbook, and/or video.
36	Classroom composition	Class membership includes diverse ability levels, diverse ethnically/racially, tracked, gifted, small class

		size, or multiage.
37	Other current idea	Science literacy; memory work; chunking and pacing, multi, preparation for high stakes tests
Blank	Missing, not interpretable, or not applicable	

TQ39RC1 Please describe one part of the videotaped lesson that you feel exemplifies current ideas about the teaching and learning of science - recode

Code	Response	Description or item option
0	No current ideas in the lesson	Code 0
1	Current ideas in the lesson but none identified	Code 1
2	Current ideas in the lesson – student 'doing' science	Codes 21 through 28
3	Current ideas in the lesson – other current idea	Codes 31 through 37
Blank	Missing, not interpretable, or not applicable	

TQ39C1 Please describe one part of the videotaped lesson that you feel exemplifies current ideas about the teaching and learning of science – No specific ideas identified

Code	Response	Description or item option
0	No current ideas in the lesson	
1	Current ideas in the lesson but not identified	Code 1
Blank	Missing, not interpretable, or not applicable	

TQ39C2 Please describe one part of the videotaped lesson that you feel exemplifies current ideas about the teaching and learning of science – Student 'doing' science

Code	Response	Description or item option
0	No current ideas in the lesson	
1	Current ideas in the lesson – student 'doing' science	Codes 21 through 28
Blank	Missing, not interpretable, or not applicable	

TQ39C3 Please describe one part of the videotaped lesson that you feel exemplifies current ideas about the teaching and learning of science – Other current idea

Code	Response	Description or item option
0	No current ideas in the lesson	

1	Current ideas in the lesson – other current idea	Codes 31 through 37
Blank	Missing, not interpretable, or not applicable	

TQ40 As part of professional development activities, how often in the past year has a teacher colleague observed you teaching an entire science lesson?		
Code	Response	Description or item option
0	Never	A
1	Once or twice	B
2	Every other month	C
3	Once a month or more	D
Blank	Missing, not interpretable, or not applicable	

TQ40RC As part of professional development activities, how often in the past year has a teacher colleague observed you teaching an entire science lesson?		
Code	Response	Description or item option
0	Never	A
1	One or more times	B,C,D
Blank	Missing, not interpretable, or not applicable	

TQ41 As part of professional development activities, how often in the past year have you observe teacher colleague teaching an entire science lesson?		
Code	Response	Description or item option
0	Never	A
1	Once or twice	B
2	Every other month	C
3	Once a month or more	D
Blank	Missing, not interpretable, or not applicable	

TQ41RC As part of professional development activities, how often in the past year have you observed a teacher colleague teaching an entire science lesson?		
Code	Response	Description or item option
0	Never	A
1	One or more times	B,C,D
Blank	Missing, not interpretable, or not applicable	

TQ42RC What was the highest level of formal education you have completed?		
Code	Response	Description or item option
0 1 2 3 Blank	High school not completed Completed high school Completed undergraduate college degree Completed graduate degree Missing, not interpretable, or not applicable	

TQ42HS What was the highest level of formal education you have completed? High school		
Code	Response	Description or item option
0	High school not completed, or completed undergraduate college and/or graduate degree	
1	Completed high school	
Blank	Missing, not interpretable, or not applicable	

TQ42BABS What was the highest level of formal education you have completed? Undergraduate college degree		
Code	Response	Description or item option
0	High school not completed, completed high school, or completed graduate degree	
1	Completed undergraduate college degree	
Blank	Missing, not interpretable, or not applicable	

TQ42MAPH What was the highest level of formal education you have completed? Graduate degree		
Code	Response	Description or item option
0	High school not completed, completed high school, or completed undergraduate degree	
1	Completed graduate degree	
Blank	Missing, not interpretable, or not applicable	

TQ42LIFE Life science field of study and level of education
Code using responses from:
TQ42 What was the highest level of formal education you have completed?
TQ44 What was your undergraduate major field of study?
TQ45 What was your undergraduate minor field of study?
TQ46 What was your graduate major field of study?
TQ47 What was your graduate minor field of study?

Code	Response	Description or item option
0	Non-science education	
1	Certification in Life science discipline	
2	Life science minor at undergraduate or graduate level of study	
3	Life science major at undergraduate level of study	
4	Life science major at graduate level of study	
Blank	Missing, not interpretable, or not applicable	

TQ42PHYS Physics field of study and level of education
Code using responses from:
TQ42 What was the highest level of formal education you have completed?
TQ44 What was your undergraduate major field of study?
TQ45 What was your undergraduate minor field of study?
TQ46 What was your graduate major field of study?
TQ47 What was your graduate minor field of study?

Code	Response	Description or item option
0	Non-science education	
1	Certification in Physics discipline	
2	Physics minor at undergraduate or graduate level of study	
3	Physics major at undergraduate level of study	
4	Physics major at graduate level of study	
Blank	Missing, not interpretable, or not applicable	

TQ42CHEM Chemistry field of study and level of education ***Code using responses from:*** TQ42 What was the highest level of formal education you have completed? TQ44 What was your undergraduate major field of study? TQ45 What was your undergraduate minor field of study? TQ46 What was your graduate major field of study? TQ47 What was your graduate minor field of study?		
Code	Response	Description or item option
0	Non-science education	
1	Certification in Chemistry discipline	
2	Chemistry minor at undergraduate or graduate level of study	
3	Chemistry major at undergraduate level of study	
4	Chemistry major at graduate level of study	
Blank	Missing, not interpretable, or not applicable	

TQ42EART Earth science field of study and level of education ***Code using responses from:*** TQ42 What was the highest level of formal education you have completed? TQ44 What was your undergraduate major field of study? TQ45 What was your undergraduate minor field of study? TQ46 What was your graduate major field of study? TQ47 What was your graduate minor field of study?		
Code	Response	Description or item option
0	Non-science education	
1	Certification in Earth science discipline	
2	Earth science minor at undergraduate or graduate level of study	
3	Earth science major at undergraduate level of study	
4	Earth science major at graduate level of study	
Blank	Missing, not interpretable, or not applicable	

TQ42GENL General science field of study and level of education
Code using responses from:
TQ42 What was the highest level of formal education you have completed?
TQ44 What was your undergraduate major field of study?
TQ45 What was your undergraduate minor field of study?
TQ46 What was your graduate major field of study?
TQ47 What was your graduate minor field of study?

Code	Response	Description or item option
0	Non-science education	
1	Certification in General science discipline	
2	General science minor at undergraduate or graduate level of study	
3	General science major at undergraduate level of study	
4	General science major at graduate level of study	
Blank	Missing, not interpretable, or not applicable	

TQ42PED Level of pedagogical knowledge
Code using responses from:
TQ42 What was the highest level of formal education you have completed?
TQ43 In what subject areas and grade levels are you certified to teach?
TQ44 What was your undergraduate major field of study?
TQ45 What was your undergraduate minor field of study?
TQ46 What was your major field of study in graduate school?
TQ47 What was your minor field of study in graduate school?

Code	Response	Description or item option
0	No pedagogical training	
1	Pedagogical training but no science specific pedagogical training	
2	Limited science specific pedagogical training	
3	Science specific pedagogical training	
Blank	Missing, not interpretable, or not applicable	

T42LIFRC Major field of graduate and/or undergraduate study – Life science ***Code using responses from:*** TQ44 What was your undergraduate major field of study? TQ46 What was your major field of study in graduate school?		
Code	Response	Description or item option
0	Not science, or science field other than Life science	
1	Life science major field of study	
Blank	Missing, not interpretable, or not applicable	

T42PHYRC Major field of graduate and/or undergraduate study – Physics ***Code using responses from:*** TQ44 What was your undergraduate major field of study? TQ46 What was your major field of study in graduate school?		
Code	Response	Description or item option
0	Not science, or science field other than Physics	
1	Physics major field of study	
Blank	Missing, not interpretable, or not applicable	

T42CHMRC Major field of graduate and/or undergraduate study – Chemistry ***Code using responses from:*** TQ44 What was your undergraduate major field of study? TQ46 What was your major field of study in graduate school?		
Code	Response	Description or item option
0	Not science, or science field other than Chemistry	
1	Chemistry major field of study	
Blank	Missing, not interpretable, or not applicable	

T42EARRC Major field of graduate and/or undergraduate study – Earth science ***Code using responses from:*** TQ44 What was your undergraduate major field of study? TQ46 What was your major field of study in graduate school?		
Code	Response	Description or item option
0	Not science, or science field other than Earth science	
1	Earth science major field of study	
Blank	Missing, not interpretable, or not applicable	

T42GENRC Major field of graduate and/or undergraduate study – General science
Code using responses from:
TQ44 What was your undergraduate major field of study?
TQ46 What was your major field of study in graduate school?

Code	Response	Description or item option
0	Not science, or science field other than General science	
1	General science major field of study	
Blank	Missing, not interpretable, or not applicable	

T42LIFR2 Major and/or minor field of graduate and/or undergraduate study – Life science
Code using responses from:
TQ44 What was your undergraduate major field of study?
TQ45 What was your undergraduate minor field of study?
TQ46 What was your major field of study in graduate school?
TQ47 What was your minor field of study in graduate school?

Code	Response	Description or item option
0	Not science, or science field other than Life science	
1	Life science major and/or minor field of study	
Blank	Missing, not interpretable, or not applicable	

T42PHYR2 Major and/or minor field of graduate and/or undergraduate study – Physics
Code using responses from:
TQ44 What was your undergraduate major field of study?
TQ45 What was your undergraduate minor field of study?
TQ46 What was your major field of study in graduate school?
TQ47 What was your minor field of study in graduate school?

Code	Response	Description or item option
0	Not science, or science field other than Physics	
1	Physics major and/or minor field of study	
Blank	Missing, not interpretable, or not applicable	

T42CHMR2 Major and/or minor field of graduate and/or undergraduate study – Chemistry ***Code using responses from:*** TQ44 What was your undergraduate major field of study? TQ45 What was your undergraduate minor field of study? TQ46 What was your major field of study in graduate school? TQ47 What was your minor field of study in graduate school?		
Code	Response	Description or item option
0	Not science, or science field other than Chemistry	
1	Chemistry major and/or minor field of study	
Blank	Missing, not interpretable, or not applicable	

T42EARR2 Major and/or minor field of graduate and/or undergraduate study – Earth science ***Code using responses from:*** TQ44 What was your undergraduate major field of study? TQ45 What was your undergraduate minor field of study? TQ46 What was your major field of study in graduate school? TQ47 What was your minor field of study in graduate school?		
Code	Response	Description or item option
0	Not science, or science field other than Earth science	
1	Earth science major and/or minor field of study	
Blank	Missing, not interpretable, or not applicable	

T42GENR2 Major and/or minor field of graduate and/or undergraduate study – General science ***Code using responses from:*** TQ44 What was your undergraduate major field of study? TQ45 What was your undergraduate minor field of study? TQ46 What was your major field of study in graduate school? TQ47 What was your minor field of study in graduate school?		
Code	Response	Description or item option
0	Not science, or science field other than General science	
1	General science major and/or minor field of study	
Blank	Missing, not interpretable, or not applicable	

TQ42LPDF Difference in major area of graduate and/or undergraduate study – Life science from Physics ***(Code T42LIFRC minus TQ42PHYRC)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ42LCDF Difference in major area of graduate and/or undergraduate study – Life science from Chemistry ***(Code T42LIFRC minus TQ42CHMRC)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ42LEDF Difference in major area of graduate and/or undergraduate study – Life science from Earth science ***(Code T42LIFRC minus TQ42EARRC)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ42LGDF Difference in major area of graduate and/or undergraduate study – Life science from General science ***(Code T42LIFRC minus TQ42GENRC)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ42PCDF Difference in major area of graduate and/or undergraduate study – Physics from Chemistry ***(Code T42PHYRC minus TQ42CHMRC)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ42PEDF Difference in major area of graduate and/or undergraduate study – Physics from Earth science ***(Code T42PHYRC minus TQ42EARRC)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ42PGDF Difference in major area of graduate and/or undergraduate study – Physics from General science ***(Code T42PHYRC minus TQ42GENRC)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ42CEDF Difference in major area of graduate and/or undergraduate study – Chemistry from Earth science ***(Code T42CHMRC minus TQ42EARRC)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ42CGDF Difference in major area of graduate and/or undergraduate study – Chemistry from General science ***(Code T42CHMRC minus TQ42GENRC)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ42EGDF Difference in major area of graduate and/or undergraduate study – Earth science from General science ***(Code T42EARRC minus TQ42GENRC)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ43 In what subject areas and grade levels are you certified to teach?		
Code	Response	Description or item option
0	Not certified to teach science or certified below grade 8	
1	Certified to teach science grade 8 and/or above	
Blank	Missing, not interpretable, or not applicable	

TQno43 In what subject areas and grade levels are you certified to teach?		
Code	Response	Description or item option
0	Certified to teach science at grade 8 level	
1	Not certified to teach science at grade 8 level	Certified to teach subject area other than science, certified to teach science below grade 8, or certified to teach science above grade 8.
Blank	Missing, not interpretable, or	

	not applicable	

TQ43GRD8 In what subject areas and grade levels are you certified to teach?		
Code	Response	Description or item option
0	Not certified to teach science in grades including grade 8	Certified to teach subject area other than science, certified to teach science below grade 8, or certified to teach science above grade 8.
1	Certified to teach science at grade 8 level	
Blank	Missing, not interpretable, or not applicable	

SCIMAJOR Science major field of study ***Code using responses from:*** TQ44 What was your undergraduate major field of study? TQ46 What was your major field of study in graduate school?		
Code	Response	Description or item option
0	Not science	
1	Science was major field of graduate or undergraduate study	
Blank	Missing, not interpretable, or not applicable	

SCMAJMN Science major and/or minor field of study ***Code using responses from:*** TQ44 What was your undergraduate major field of study? TQ45 What was your undergraduate minor field of study? TQ46 What was your major field of study in graduate school? TQ47 What was your minor field of study in graduate school?		
Code	Response	Description or item option
0	Not science	
1	Science was major and/or minor field of undergraduate study	
Blank	Missing, not interpretable, or not applicable	

NOSCIMAJ Non-science major field of study ***Code using responses from:*** TQ44 What was your undergraduate major field of study? TQ45 What was your undergraduate minor field of study? TQ46 What was your major field of study in graduate school? TQ47 What was your minor field of study in graduate school?		
Code	Response	Description or item option

0	Science was major field of study	
1	Science was not major field of study	
Blank	Missing, not interpretable, or not applicable	

NOSCMJMN Non-science major and/or minor field of study ***Code using responses from:*** TQ44 What was your undergraduate major field of study? TQ45 What was your undergraduate minor field of study? TQ46 What was your major field of study in graduate school? TQ47 What was your minor field of study in graduate school?		
Code	Response	Description or item option
0	Science was major and/or minor field of study	
1	Science was not major or minor field of study	
Blank	Missing, not interpretable, or not applicable	

TQ48 Counting this school year, how many years have you been teaching? ***(Code number of years)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ49 Counting this school year, how many years have you been teaching science? ***(Code number of years)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ50 During the last two years, how many college or university courses have you taken in science or science education? ***(Czech Republic, Netherlands, and United States versions)*** During the last two years, how many university courses have you taken in science or science education? ***(Australia version)*** During the last two years, how many university courses or education center courses have you taken in science or science education? ***(Japan version)***		
Code	Response	Description or item option
0	None	A
1	One course	B
2	Two courses	C
3	Three courses	D

4	Four or more courses	E
Blank	Missing, not interpretable, or not applicable	

TQ50RC During the last two years, how many college or university courses have you taken in science or science education?
(Czech Republic, Netherlands, and United States versions)
During the last two years, how many university courses have you taken in science or science education? ***(Australia version)***
During the last two years, how many university courses or education center courses have you taken in science or science education? ***(Japan version)***

Code	Response	Description or item option
0	None	A
1	One or more courses	B,C,D,E
Blank	Missing, not interpretable, or not applicable	

TQ51A Use of technology, such as computers
During the last two years, have you participated in professional development activities or taken courses in any of the following?

Code	Response	Description or item option
0	No	
1	Yes	A
Blank	Missing, not interpretable, or not applicable	

TQ51B Science instructional techniques
During the last two years, have you participated in professional development activities or taken courses in any of the following?

Code	Response	Description or item option
0	No	
1	Yes	B
Blank	Missing, not interpretable, or not applicable	

TQ51C Cooperative group instruction
During the last two years, have you participated in professional development activities or taken courses in any of the following?

Code	Response	Description or item option
0	No	
1	Yes	C
Blank	Missing, not interpretable, or not applicable	

TQ51D Interdisciplinary instruction During the last two years, have you participated in professional development activities or taken courses in any of the following?		
Code	Response	Description or item option
0	No	
1	Yes	D
Blank	Missing, not interpretable, or not applicable	

TQ51E Teaching higher-order thinking skills During the last two years, have you participated in professional development activities or taken courses in any of the following?		
Code	Response	Description or item option
0	No	
1	Yes	E
Blank	Missing, not interpretable, or not applicable	

TQ51F Teaching students from different cultural backgrounds During the last two years, have you participated in professional development activities or taken courses in any of the following?		
Code	Response	Description or item option
0	No	
1	Yes	F
Blank	Missing, not interpretable, or not applicable	

TQ51G Teaching limited English proficient students ***(Australia and United States versions)*** Teaching limited Czech proficient students ***(Czech Republic version)*** Teaching limited Dutch proficient students ***(Netherlands version)*** ***(Code 'Blank' for Japan version; not applicable)*** During the last two years, have you participated in professional development activities or taken courses in any of the following?		
Code	Response	Description or item option
0	No	
1	Yes	G
Blank	Missing, not interpretable, or not applicable	***Code 'Blank' for Japan version; item not applicable.***

TQ51H Teaching students with special needs (e.g., visually impaired, gifted and talented) During the last two years, have you participated in professional development activities or taken courses in any of the following?		
Code	Response	Description or item option
0	No	
1	Yes	H

Blank	Missing, not interpretable, or not applicable	

TQ51I Standards-based teaching ***(Japan, Netherlands, and United States versions)***
TQ51I Outcomes based teaching ***(Australia version)***
(Code 'Blank' for Czech Republic; item not applicable.)
During the last two years, have you participated in professional development activities or taken courses in any of the following?

Code	Response	Description or item option
0	No	
1	Yes	I
Blank	Missing, not interpretable, or not applicable	***Code 'Blank' for Czech Republic; item not applicable***.

TQ51J Classroom-management and organization
During the last two years, have you participated in professional development activities or taken courses in any of the following?

Code	Response	Description or item option
0	No	
1	Yes	J
Blank	Missing, not interpretable, or not applicable	

TQ51K Other professional issues
During the last two years, have you participated in professional development activities or taken courses in any of the following?

Code	Response	Description or item option
0	No	
1	Yes	K
Blank	Missing, not interpretable, or not applicable	

TQ51L Number of professional development activities
(Code number of activities)

Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ52A1 How many hours a week do you teach science?
(Code number of hours per week)

Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ52B1 How many hours a week do you teach classes other than science? ***(Code number of hours per week)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ52C How many hours a week do you meet with other teachers to work on curriculum and planning lessons? ***(Code number of hours per week)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ52D How many hours a week do you do work at school related to teaching science (e.g. lesson planning, grading papers, etc.)? ***(Code number of hours per week)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ52E How many hours a week do you do work at home related to teaching science (e.g. lesson planning, grading papers, etc.)? ***(Code number of hours per week)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ52F How many hours a week do you spend at home or at school doing other school related activities? ***(Code number of hours per week)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ52A1MD How many hours a week do you teach science? ***(Code number of hours per week; substitute ‘0’ for missing data)***		
Code	Response	Description or item option
0	No hours or missing	No hours ***Substitute ‘0’ hours for missing data.***

TQ52B1MD How many hours a week do you teach classes other than science? ***(Code number of hours per week; substitute ‘0’ for missing data)***		
Code	Response	Description or item option
0	No hours or missing	No hours

		Substitute '0' hours for missing data.

TQ52CMD How many hours a week do you meet with other teachers to work on curriculum and planning lessons? ***(Code number of hours per week; substitute '0' for missing data)***		
Code	Response	Description or item option
0	No hours or missing	No hours ***Substitute '0' hours for missing data.***

TQ52DMD How many hours a week do you do work at school related to teaching science (e.g. lesson planning, grading papers, etc.)? ***(Code number of hours per week; substitute '0' for missing data)***		
Code	Response	Description or item option
0	No hours or missing	No hours ***Substitute '0' hours for missing data.***

TQ52EMD How many hours a week do you do work at home related to teaching science (e.g. lesson planning, grading papers, etc.)? ***(Code number of hours per week; substitute '0' for missing data)***		
Code	Response	Description or item option
0	No hours or missing	No hours ***Substitute '0' hours for missing data.***

TQ52FMD How many hours a week do you spend at home or at school doing other school related activities? ***(Code number of hours per week; substitute '0' for missing data)***		
Code	Response	Description or item option
0	No hours or missing	No hours ***Substitute '0' hours for missing data.***

TQ52TOT Total hours a week teacher spends on activities ***(Code total number of hours per week; sum of TQ52A1MD through TQ52FM)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ53 List the grade levels taught in this school. ***(Codes for Australia, Czech Republic, and United States)***		
Code	Response	Description or item option
1	4-9 or intervals included	Entire interval must be within this interval; includes 4-8, 5-8, 6-8, 6 to 9, 7-8, 7-9, 8-9 (7-10 is not included in this code).
2	6 -13 or intervals included	For Australia, code includes 5-12 and 8-12. For the Czech Republic, code includes 6-12, 7-10, 7-12, and 7-13.

3	K-9 or intervals included	Includes K-7, K-8, K-9, 1-8, and 1-9.
4	K-13 or intervals included	In the Czech Republic, code includes K-10, K-12, and K-13.
Blank	Missing, not interpretable, or not applicable	

TQ53 List the grade levels taught in this school.
(Codes for Japan)

Code	Response	Description or item option
1	Grades 7, 8, 9	
2	Grades 7 to 12	
Blank	Missing, not interpretable, or not applicable	

TQ53 List the grade levels taught in this school.
(Codes for Netherlands)

Code	Response	Description or item option
1	VWO	D
2	HAVO	C
3	MAVO	B
4	VBO	A
5	VWO/HAVO	C,D
6	MAVO/VBO	A,B
7	MAVO/HAVO	B,C
8	VBO/MAVO/HAVO	A,B,C
9	MAVO/HAVO/VWO	B,C,D
10	VBO/MAVO/HAVO/VWO	A,B,C,D
Blank	Missing, not interpretable, or not applicable	

TQ54A1 What type of school is this?
a. Academic accelerated school (***Australia and United States versions)***
a. State school ***(Czech Republic version)***
a. Public school ***(Japan version)***
a. Openbaar ***(Netherlands version)***

Code	Response	Description or item option
0	No	
1	Yes	A
Blank	Missing, not interpretable, or not applicable	

TQ54A2 What type of school is this?
b. Vocational school ***(Australia and United States versions)***
b. State school with specialization **(*Czech Republic* version)**
b. National school ***(Japan version)***
b. Roman Catholic ***(Netherlands version)***

Code	Response	Description or item option
0	No	
1	Yes	B
Blank	Missing, not interpretable, or not applicable	

TQ54A3 What type of school is this?
c. Magnet school ***(United States versions)***
c. School with a special program ***(Australia version)***
c. Private school ***(Czech Republic version)***
c. Private school ***(Japan version)***
c. Protestant or Christian ***(Netherlands version)***

Code	Response	Description or item option
0	No	
1	Yes	C
Blank	Missing, not interpretable, or not applicable	

TQ54A4 What type of school is this?
d. Charter school ***(United States version)***
d. Private school with specialization ***(Czech Republic version)***
d. School attached to a university ***(Japan version)***
d. General school ***(Netherlands version)***

Code	Response	Description or item option
0	No	
1	Yes	D
Blank	Missing, not interpretable, or not applicable	

TQ54A5 What type of school is this?
e. Partnership with a university ***(Australia and United States versions)***
e. Religious or Christian school ***(Czech Republic version)***
e. Single sex school ***(Japan version)***

Code	Response	Description or item option
0	No	
1	Yes	E
Blank	Missing, not interpretable, or not applicable	

TQ54A6 What type of school is this? f. Laboratory school ***(Codes for United States)***		
Code	Response	Description or item option
0	No	
1	Yes	F
Blank	Missing, not interpretable, or not applicable	

TQ54A7 What type of school is this? g. School within a school ***(Codes for Australia and United States)***		
Code	Response	Description or item option
0	No	
1	Yes	G
Blank	Missing, not interpretable, or not applicable	

TQ54A8 What type of school is this? h. Religious or sectarian school ***(Codes for Australia and United States)***		
Code	Response	Description or item option
0	No	
1	Yes	H
Blank	Missing, not interpretable, or not applicable	

TQ54A9 What type of school is this? i. Private (non-religious) school ***(Codes for Australia and United States)***		
Code	Response	Description or item option
0	No	
1	Yes	I
Blank	Missing, not interpretable, or not applicable	

TQ54A10 What type of school is this? j. Single sex school ***(Codes for Australia and United States)***		
Code	Response	Description or item option
0	No	
1	Yes	J
Blank	Missing, not interpretable, or not applicable	

TQ54A11 What type of school is this? k. Other ***(Codes for Australia and United States)***		
Code	Response	Description or item option
0	No	
1	Yes	K
Blank	Missing, not interpretable, or not applicable	

TQ54A12 What type of school is this? l. Public school ***(Codes for Australia and United States)***		
Code	Response	Description or item option
0	No	
1	Yes	L
Blank	Missing, not interpretable, or not applicable	

TQ54B What type of school is this? m. Philosophy categories ***(Netherlands version)*** ***(Codes for Netherlands)***		
Code	Response	Description or item option
1	Montessori-onderwijs	A
2	Vrije School	B
3	Dalton- onderwijs	C
4	Freinet - onderwijs	D
5	Other	E
Blank	Missing, not interpretable, or not applicable	Code 'Blank' for all countries except Netherlands!

TQ56 Approximately how many science teachers are in this school this year? ***(Code number of teachers)***		
Code	Response	Description or item option
Blank	Missing, not interpretable, or not applicable	

TQ57A Attitudes about teaching. a. I have adequate materials and facilities to support my teaching of science		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57B Attitudes about teaching. b. I actively pursue opportunities to learn how to improve my science teaching		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57C Attitudes about teaching. c. I especially prefer teaching low-ability students.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57D Attitudes about teaching. d. My work as a science teacher is appreciated by my teacher colleagues.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57E Attitudes about teaching. e. Girls in this school are not encouraged to develop a science interest.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57F Attitudes about teaching. f. If I had to choose I would become a teacher again.		
Code	Response	Description or item option
1	Strongly disagree	D

2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57G Attitudes about teaching.
g. I have a strong science background in the subject areas I teach.

Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57H Attitudes about teaching.
h. I am often impressed with the quality of thinking my students can do.

Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57I Attitudes about teaching.
i. I prefer to teach a class that has students of all different ability levels.

Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57J Attitudes about teaching.
j. I am enthusiastic about teaching science.

Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57K Attitudes about teaching. k. I do not like to watch TV programs about new developments in science.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57L Attitudes about teaching. l. I enjoy students' questions about science even when I do not know the answer.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57M Attitudes about teaching. m. My work as a science teacher is appreciated by my students' parents.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57N Attitudes about teaching. n. I read journals and books about science teaching.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57O Attitudes about teaching. o. I enjoy teaching students of this age level.		
Code	Response	Description or item option
1	Strongly disagree	D

2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57P Attitudes about teaching.
p. I do not pursue science interests or issues in my personal life.

Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57Q Attitudes about teaching.
q. I especially prefer teaching high-ability students.

Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57R Attitudes about teaching.
r. Teaching science is rewarding work.

Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57S Attitudes about teaching.
s. The number of students in my class is not appropriate to support good science teaching and learning.

Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or	

	not applicable	

TQ57T Attitudes about teaching. t. I do not have adequate opportunities during the school day to collaborate with colleagues about science.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57U Attitudes about teaching. u. I am proud of the quality of my teaching.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57V Attitudes about teaching. v. I enjoy working with colleagues about science curriculum and teaching, even if it means after-school meetings.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57W Attitudes about teaching. w. Teaching science is hard work.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57X Attitudes about teaching. x. I teach in an environment where I do not feel physically safe.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57Y Attitudes about teaching. y. I enjoy attending science teacher conferences to learn about new ideas in science teaching.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57Z Attitudes about teaching. z. My work as a science teacher is appreciated by my students.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57AA Attitudes about teaching. aa. My work as a science teacher is not appreciated by administrators.		
Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57BB Attitudes about teaching. bb. I work hard to get girls involved in science.		
Code	Response	Description or item option
1	Strongly disagree	D

2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	

TQ57CC Attitudes about teaching.
cc. I work hard to get boys involved in science.***(Australia version)***
(Codes for Australia)

Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	***Code 'Blank' for Czech Republic, Japan, Netherlands, and United States; item not included in questionnaire.***

TQ57DD Attitudes about teaching.
dd. I think that I am an effective teacher, I am confident that my students learn nearly all of what I teach. ***(Australia version)***
(Codes for Australia)

Code	Response	Description or item option
1	Strongly disagree	D
2	Somewhat disagree	C
3	Somewhat agree	B
4	Strongly agree	A
Blank	Missing, not interpretable, or not applicable	***Code 'Blank' for Czech Republic, Japan, Netherlands, and United States; item not included in questionnaire.***

Appendix D: TIMSS 1999 Video Study Science Video Coding Manual

Chapter D1: Lesson and Phase Structure

D1.1 Lesson Structure

The first dimension in the coding scheme involves the basic structure of the framed period of time that we call the “lesson.” The lesson is the key unit of analysis. It is a period of time when the teacher intends class activities to take place. There is an official and scheduled time period for each lesson, nevertheless, teachers mark the beginning and end of their lessons so that their students know when they are obligated to participate in classroom activities.

Most of this lesson time is spent on subject-related activities. Teachers also need to take care of managerial business during the lesson, which may or may not be subject-related. In this project, the subject-related part of the lesson is called “Science Work” and the non-subject related part is “Non-Science.” The first step in the coding scheme is therefore to mark the beginning and end of the lesson and then to identify the two basic phases, “science work” and “non-science”, within each lesson. There are two types of Science Work: “Science Instruction” and “Science Organization.” The former is the period when science teaching and learning take place, and the latter is when organizational talk and activities take place. If there is a period within a lesson when sufficient audio and/or visual information is not available due to a technical problem, we will identify this segment as “technical difficulty".

Table D1.1 below provides an overview of the lesson structure.

Table D1.1. Lesson structure

	Phase Structure	
Lesson	Technical Difficulty	
	Non-Science	
	Science Work	Science Organization
		Science Instruction

In the remainder of this section we will provide the definitions and coding procedures for the lesson and the four possible phases.

D1.1.1 Lesson [LSSN]

To analyze videotaped classroom lessons, we must first identify clearly what we mean by “lesson” and when it begins and ends. Below are the definition, indicators, and the procedures to identify the beginning and the end of lesson.

Lesson [LSSN] is defined as a period of time that is intended and publicly framed by the teacher to designate class activities with students. Once the teacher signifies the beginning of the lesson, it continues until the teacher signifies the end.

Lesson is a period of time during which students are expected to be physically present in the classroom and to engage in the activities intended by the teacher. Lesson, therefore, includes the time spent on managerial activities such as disciplining or roll taking.

D1.1.1.1 Marking the Beginning of a Lesson

Table D1.2. Indicators to mark the beginning of the lesson

Teacher signals	Normally signals verbally her/his intention to begin class activity. The signal is audible to all students.
Classroom talk	Ignore any public talk prior to the teacher signal.
Student physical presence	All or most of students are in the room

Teacher signals. Normally, the teacher verbally signals her/his intention to begin class activities. For example, the teacher says to the class, "Okay everyone, take out your homework…" which indicates the beginning.

- In many cases an activity immediately follows the signal. In such cases, mark the beginning at the start of the signal.

- In some cases, there may be a gap between the signal and the actual start of an activity. For example, the students do not comply with the teacher's signal immediately. If the teacher continues to attempt to get students' attention (e.g., repeating the signal, waiting, disciplining some students) until the start of an activity, mark the beginning at the start of the signal.

- If, however, the teacher stops the attempt and engages in some other activity such as leaving the room, talking to a visitor, or organizing him/herself, wait for the next signal.

Classroom talk. The teacher may talk publicly to the class before the signal to begin the lesson. In such case, ignore any public talk before the signal.

Student physical presence. All or most of the students must be in the classroom to mark the beginning of lesson.

Special considerations

- Lesson begins with a routine activity without teacher signal. Sometimes a lesson starts with a routine activity without any explicit marker by the teacher. For example, the students come into the classroom and start working on some assignment or start correcting their homework answers. In cases like this, mark the beginning of lesson when all or most of the students are in the classroom, and the majority of them have started to do what they are supposed to do

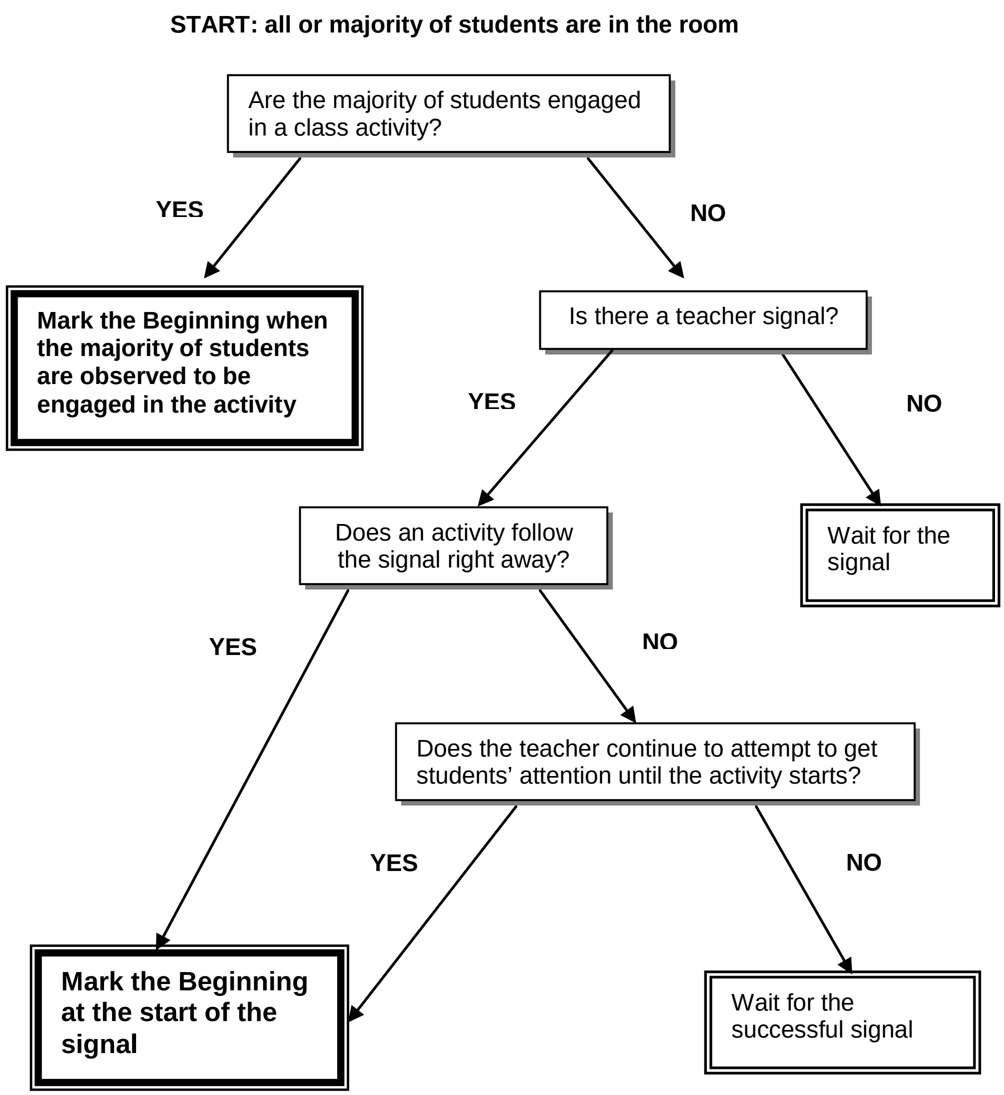
- Lesson apparently begins before video is turned on. If the lesson is already underway when the video begins, mark the beginning of the lesson at the first time code.

- <u>Class ritual greetings</u>. Sometimes the teacher and students participate together in a formal ritual greeting that signals the beginning of the lesson. The ritual may start with a verbal cue ("Stand now, please.") or with a physical cue (teacher stands in front of the class and all students rise and face the teacher). Mark the beginning of lesson when the teacher indicates (verbally or physically) the beginning of this class ritual.

  Note: If a class activity has already started before the ritual greeting, mark the beginning when the activity started.

Figure D1.1 below describes the coding decision process for marking the beginning of lesson.

Figure D1.1. The process of identifying the beginning of lesson



D1.1.1.2 Marking the End of a Lesson

Table D1.3. Indicators to mark the end of the lesson

Teacher signals	Normally signals verbally that the class is over and students may leave. All students can hear or see the signal. The signal may be formal or informal.
Student activity	Students begin packing up, leaving the room, or commencing another non-science subject.
Student physical presence	Indicates the end when the first student leaves the room.

Teacher signals. Like the beginning of the lesson, the teacher normally signals her/his intention to end instructional activities. The signal is usually verbal (e.g. “Okay let's end”). Signals could be formal (e.g,. bowing) or informal (e.g., “That's it for today”).

No public talk after the signal. When there is no public talk after the signal, mark the end after the signal.

- Students continue to engage in some activity. When no public talk follows the signal but the students continue to engage in some class activities after the signal, mark the end when the first student leaves the room. If no student leaves, apply “good student rule” (see the section under Good Student Rule below).

- Public talk after the signal. When the teacher talks publicly after the signal, mark the end when the first student leaves the room, or following the Good Student Rule, mark the end when you would think that you are allowed to leave the room

- Dismissing gradually. Sometimes the teacher does not dismiss all the students at once at the end of the lesson. For example, the students are packed up and waiting at their seats to be dismissed by the teacher. The teacher then tells the students sitting in the first row to leave first. In such cases, mark the end of the lesson when the teacher publicly allows the first student(s) to leave the classroom.

Student activity. A lesson may end gradually without teacher signals. For example, the students are conducting a lab project, and at the end of the lesson they start to leave the room as they finish the project. In this case mark the end of the lesson when the first student leaves the room, or apply the “good student rule.”

Student physical presence. Usually students must leave the room when the lesson ends. Mark the end according to the rules explained above. In some classrooms, however, the students do not have to leave the room for reasons such as it is their homeroom or their next lesson takes place in the same room. Sometimes the students may have to leave the room, but you do not see any student leaving the room in the video. In such cases apply the “good student rule” to mark the end (see the section on “good student rule” below).

Special considerations

- Dismissing a part of the class. When the teacher signals that a part of the class may leave but the other part must remain working on a task, mark the end of lesson when the teacher signals that the second group can finish the task and leave, and the first student in the second group leaves the room. Either part can consist of only one or few students.

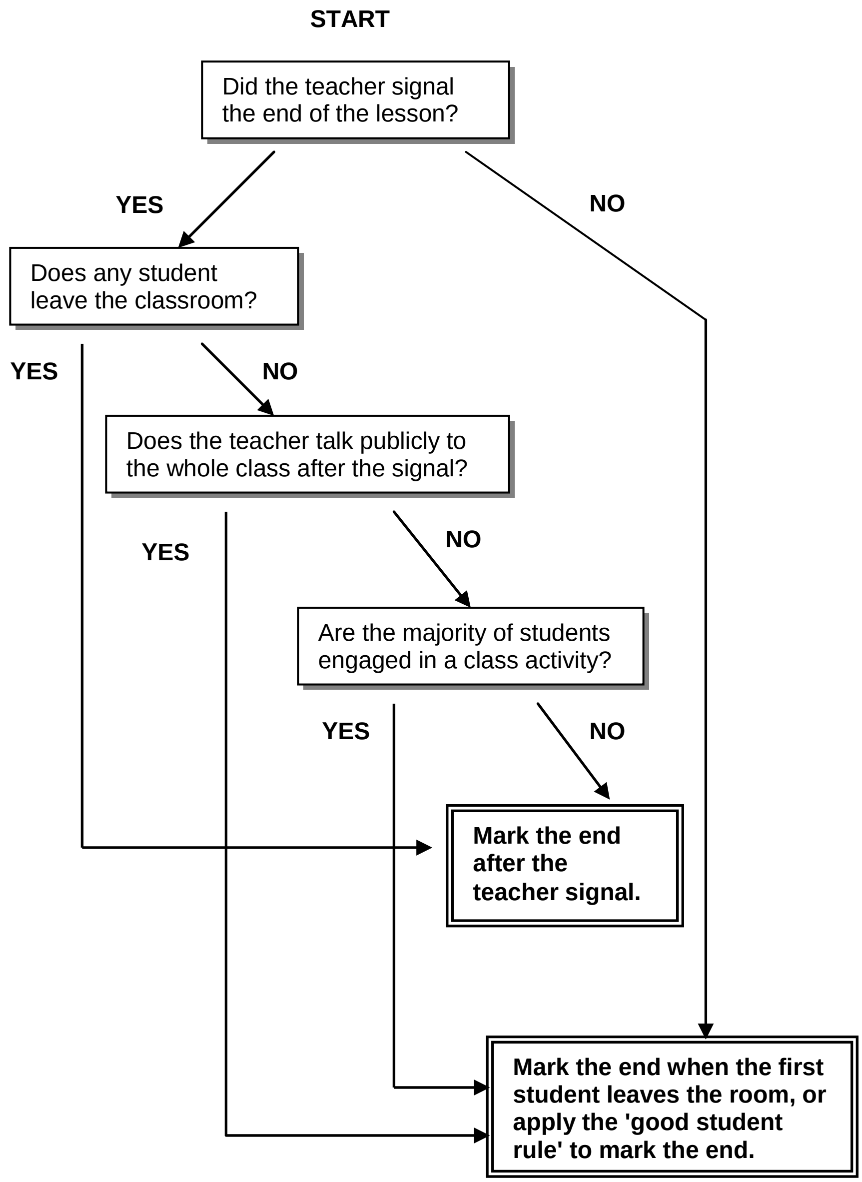
- Class ritual. Sometimes the teacher and students participate together in a formal ritual dismissal that signals the end of the lesson. The ritual may start with a verbal cue ("Stand now, please.") or with a physical cue (teacher stands in front of the class and all students rise and face the teacher). Mark the end of lesson at the end of the ritual.

- Good student rule. When it is not clear at which exact point the lesson begins and ends, use the "good student rule." That is, when do you think a good student is expected/not expected to engage in a class activity? Mark the beginning of the lesson at the point you think such a student would attend to the class activity and the end of the lesson at the point you think a good student is no longer expected to engage in the activity.

- Bell. Sometimes the bell signals the end of the lesson. For example, the students are working on an assigned task, and as soon as the bell rings, they stop working and start to leave the room. In this case, mark the end of the lesson at the bell.

Figure D1.2 describes the coding decision process to mark the end of lesson.

Figure D1.2. The process of marking the end of the lesson



D1.1.1.3 Examples

In this section we provide one typical practice examples for the beginning and end of a lesson. For the typical examples, the context, a transcript excerpt, and the coding rationale are provided.

The following codes have been developed to try to deal with the discourse of the classroom:

- **T =** Teacher
- **S =** Single student
- **SN =** Student-new**.** A single student whose identity differs from the last student to speak
- **S? =** When the identity of the student (whether the speaker is S or SN) is unclear
- **Ss =** Multiple students, but not the entire class
- **E =** Entire class (or sounds like the entire class); used to indicate choral responses
- **O =** Other; used to indicate speech by a non-member of the class, such as school personnel, office monitors, or talk from public address systems

In addition, several other codes are used to describe regularly-occuring aspects of the classroom:

- Bb = Blackboard
- HW = Homework

Exhibit 1.1. Beginning of a lesson: Example

Example 1	SUS003 – Lesson begins with the teacher's verbal signal.		
Context	The teacher is in the room, chatting with students informally; students walk into the room and settling down.		
Video	View the first minute of the video.		
Example	Time	Person	Transcript
	00:00:04	S	(What's that?)
	00:00:05	T	Microphone
	00:00:31	T	Shh.
	00:00:37	S	Mr. SHU, why is this squid (stuff) all over my chair!
	00:00:41	T	That's not squid, it's gum.
	00:00:43	S	That's- that's not gum, that's a water spot.
	00:00:46	T	Oh, water //spot.
	00:00:46	S	//That's not cool.
00:00:49	00:00:49	T	Good Morning.
	00:00:50	Ss	Morning
	00:00:51	T	All right, ... shh.
	00:00:53	T	Today we'll be dissecting the squid like I told you yesterday. ... Okay, it's uh ... it's going to take the whole period and, it goes by very fast.
Coding rationale	At 00:49 the teacher signals his intention to begin a class activity, which is to tell the students what they will be doing. The beginning of the lesson is marked at the teacher's verbal signal. Although there is a candidate signal		

	with the “shhh” at 00:31, the teacher stops this attempt and engages in conversation with a few students about whether it is squid juice on the chair. Therefore, wait for the next signal, which is “good morning” at 00:49. See Section 1.2.

Exhibit 1.2. End of a lesson: Example

Lesson ID	SAU060 – Lesson ends with the teacher's verbal signal		
Context	The teacher is in the room waiting for Ss to finish writing their homework in a special HW diary book. They are simply writing the details of the HW, not attempting to do it.		
Video	T begins to write details of the HW on the Bb at approximately 1:02:30		
Example	Time	Person	Transcript
	01:02:12	T	So could you write in your homework diary now? Complete table for activity eight point one. If you forget what to do it's written in eight point one. Is it written in your diary J.R.?
	01:02:28		Can you write on the board for us?
	01:02:29	T	Is it written in your diary J.R.?
	01:02:32	SN	Write it on the board Sir.
	01:02:33	SN	Sir? They can ( ).
	01:02:38	SN	What do we have to do Sir?
	01:03:05	T	Alright. I've been asked to let you know there'll be a little parade at the end of period three. So after period three,
	01:03:13	T	Please go straight to the space frame because there's too much rubbish in the (yard) area.
	01:03:26	T	I need to see Trent before he leaves, and Harry.
	01:03:32	SN	Can we go?
1:03:40	01:03:34	T	Everybody else, once it's written in your diary, you may leave. Thank you very much.
	01:03:49	T	See you later. Can you take the video out of the video recorder for me? You have to put the power on first.
	01:03:56	SN	( ).
	01:03:59	T	No.
	01:03:59	SN	( )?
	01:04:01	T	Space frame.
	01:04:12	T	No just push stop and eject. On the right. Yeah. Come on.
	01:04:24	T	Inappropriate behavior in the classroom.
Coding rationale	Ss are still engaged in Science (noting details of their HW), with some interruptions about non-science activities. Lesson ends after the sentence "Thank you very much," which is the verbal signal for the end of the lesson, and some students are seen to move towards the door.		

D1.2 Phase Structure [PH]

Within the lesson, there are four possible phase categories:

- Technical difficulty [PH:TD]
- Non-science [PH:NS]
- Science organization [PH:ORG]
- Science instruction [PH:SI]

Phase Structure codes are coverage codes. That is, they are mutually exclusive and exhaustive; and therefore, every part of a lesson must fall into one of the four categories. The first Phase Structure segment is marked when the lesson begins, and the last segment is marked when the lesson ends.

Science organization and science instruction together constitute the “science work” portion of a lesson. Every lesson contains a science instruction phase, but the other three phases may or may not occur.

Of the four phases, technical difficulty is probably most easily identified because it is the segment where you do not have sufficient visual or audio information. For the other three phases, the determining factor is the content, not the observable features, of activities. In order to identify whether the content is present in a segment you will usually follow the teacher talk. When there is no teacher talk that suggests the content of the activity, then you must attend to what the students are doing. Figure D1.1 (page D-3) provides the conceptual overview of the phase structure codes.

D1.2.1 Minimum Time Requirement

One of the goals of the phase structure dimension is to gain a broad overview of how the lesson is structured. We use a minimum time requirement for most phase structure segments to avoid splitting the lesson into a cluster of very small segments.

- As a general rule, the minimum time requirement for a phase structure segment is 30 seconds.
- If you identify a phase structure segment (or segments) that is less than 30 seconds, apply the rules in the following sections.

D1.2.1.1 Short Segment Rules

Rule 1: One short segment

- If a segment is shorter than 30 seconds, include it in the previous phase structure segment.

Last eligible segment Type X (at least 30 seconds)	Short segment Type A (10 sec)	Next eligible segment Type Y (at least 30 seconds)

< 30 seconds

↓

Type X	Type Y

- If it is the first segment of the lesson, include the segment in following phase structure segment.

Beginning of lesson →

Short segment Type A (10 sec)	Next eligible segment Type Y (at least 30 seconds)

< 30 seconds

↓

Type Y

- If the segment is preceded by technical difficulty segment, include the segment in following phase structure segment.

Last eligible segment Type X (at least 30 seconds)	Technical difficulty segment	Short segment Type A (10 sec)	Next eligible segment Type Y (at least 30 seconds)

< 30 seconds

↓

Type X	PH: TD	Type Y

Rule 2: Multiple short segments

On some occasions you may identify a series of short segments; two or more different phase structure segments that are less than 30 seconds, and are next to each other. In these cases use the following guidelines.

<u>Total less than 30 seconds</u>. If the total sum of the time of all segments in between two eligible segments (i.e., segments that are 30 seconds or more) is less than 30 seconds.

- include all segments in the preceding eligible segment (see the diagram below).

Last eligible segment Type X (at least 30 seconds)	Short segment Type A (10 sec)	Short segment Type B (12 sec)	Next eligible segment Type Y (at least 30 seconds)
< 30 seconds ↓			
Type X			Type Y

- If these segments are the first segments of the lesson include them in following phase structure segment.

- If these segments are after technical difficulty segment include them in following phase structure segment.

<u>Total greater or equal to 30 seconds</u>. If the total sum of the time of all segments in between the two eligible segments is greater or equal to 30 seconds

- include and code the whole sequence of short segments as a new segment (see the diagram below), and label the segment according the highest level code present in the following hierarchy:
    - Science instruction [PH:SI]
    - Science organization [PH:ORG]
    - Non-science [PH:NS]

Last eligible segment PH:ORG (at least 30 seconds)	Short segment PH:NS (19 sec)	Short segment PH:SI (15 sec)	Short segment PH:ORG (10 sec)	Next eligible segment PH:NS (at least 30 seconds)
	> 30 seconds			
PH:ORG	← PH:SI →			PH:NS

D1.2.1.2 Exceptions to Minimum Time Requirement

In some cases we would like to capture segments even if they do not meet the minimum time requirement of 30 seconds. These segments are usually very important to describe the overall structure of the lesson or indicate some problem with the video data. There are three types of exceptions to the minimum time requirement.

- Technical difficulty exceptions → No minimum time requirement. Technical difficulty segments are marked regardless of their length.

  IMPORTANT NOTE: Ignore any technical difficulty segments (short or longer ones) when determining how to label other short segments. If the short segment rules ask you to use an "eligible segment" to determine the label, use the next eligible segment after the technical difficulty. See Short Segment Rule #1 and #2.

- Science instruction exceptions → There are two exceptions to the 30 second rule for science instruction. They apply only to particular circumstances as described below:

  - The first and the last science instruction segment in the lesson → code the segments as PH:SI regardless of duration.

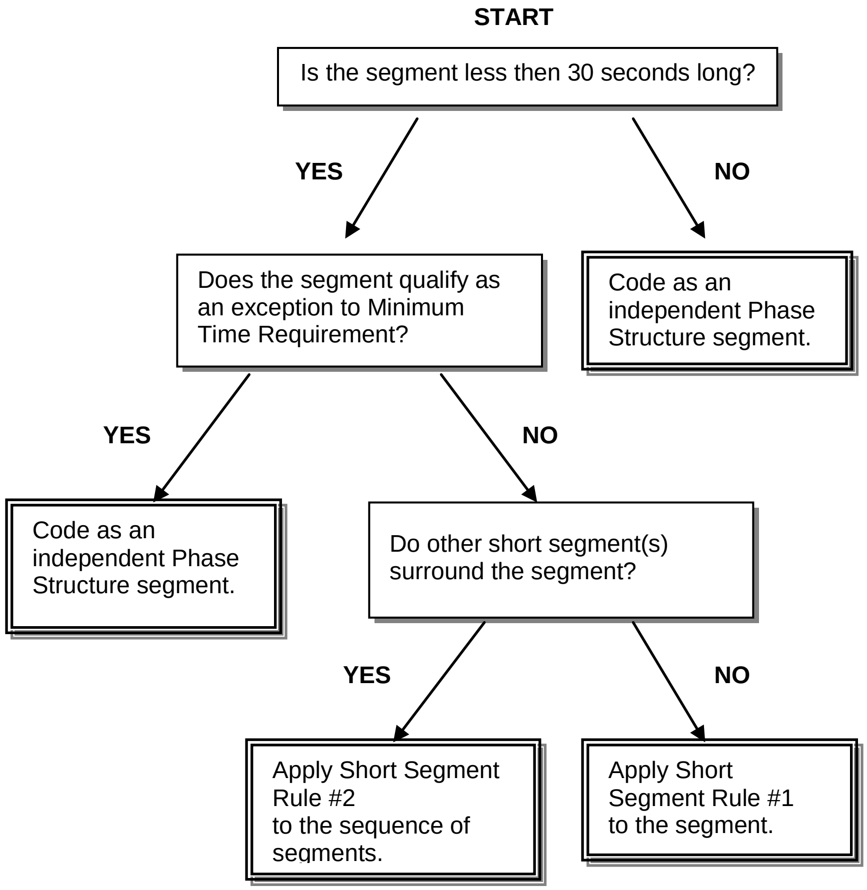
  - A short science instruction segment preceded by a set-up organizational segment → code the science instruction segment as PH:SI regardless of its duration.

  An example of such case is when the teacher tells the students to gather around the teacher so that they can see the teacher better. The teacher then conducts a demonstration that lasts only for ten seconds, and tells the students to go back to their seats. Note however, that the science instruction segment must be clearly framed by the teacher and the science organization segment must be clearly related to the short science instruction that follows. That is, the teacher explicitly indicates that the class needs to pay attention or to start working (see also section 1.2.5.1 Special considerations).

  IMPORTANT NOTE**:** Short segments of science instruction that meet one of the two criteria above should be coded and treated as if they meet the minimum time requirement of 30 seconds. That is, they can be considered as "eligible segments" when determining how to label other short segments. For example, if a short segment of non-science follows a science instruction exception segment, include it as part of the science instruction segment.

Figure D1.3 below describes the decision process for identifying when and which rule for short segments to apply.

Figure D1.3. Identifying when to apply short segment rules



D1.2.2 Technical Difficulty [PH:TD]

TECHNICAL DIFFICULTY [PH:TD] is defined as a period of time in the lesson where a technical problem with the video is observed, which prevents coding.

Examples of technical difficulty segments include lack of audio, unintelligible audio due to noise, lack of image, etc.

D1.2.2.1 Marking In-and Out-Points

The In- and Out-Points of this segment are marked at the exact points where the problem starts and ends. When the video starts with a technical difficulty, mark the beginning of the video as the In-Point of this segment.

Special considerations

- Lack of video/audio due to videotape change. When a lesson is longer than 60 minutes, the videographer changes the tapes. There is a slight gap between the two tapes, and you do not have any information during this gap. However, the videographer does not change the tapes for the teacher camera and the student camera at the same time; and therefore, between the two cameras you should have sufficient information to code the lesson. For this reason, we do not code technical difficulty when the videotapes are changed.

D1.2.2.2 Example

Exhibit 1.3. Marking In- and Out-Points for technical difficulty: Example

Lesson ID	SJP002 – *Not* technical difficulty		
Context	The teacher is presenting the information to the students. Her microphone falls off and teacher spends some time fixing it.		
Video			
Example	Time	Person	Transcript
	00:38:05	S	I'm macho.
	00:38:08	S	FUMI, hand me ( ) ... Behind you. Candy, candy. The orange one.
	00:38:22	T	What shall I do with this?
	00:38:26	S	Are you going to freeze that?
	00:38:27	Ss	***Ha ha.***
	00:38:33	S	You cannot do that.
	00:38:34	S	Next.
	00:38:36	S	Teacher, let's put some energy.
	00:38:38	T	Okay, this ... rubber-ball that KUBO brought in.
	00:38:44	Ss	Ss (//)
	00:38:47	T	//Rubber-ball.

	00:38:50	T	Here we go, we'll do this one. What do you think will happen? ... How about if I drop it? It will shatter?
Coding rationale	This segment *is not* coded as technical difficulty because even though the teacher was having a problem with her microphone, we are not missing audio/visual information that is necessary for coding.		

D1.2.3 Non-Science [PH:NS]

NON-SCIENCE [PH:NS] is defined as a period of time in the lesson when there are no science-related activities or discussions taking place, and therefore, there is no opportunity for students to learn science.

Minimum time requirement for the length of the segment: 30 seconds.

Examples of non-science phases include the teacher taking the roll, announcing school events, disciplining students, the lesson being interrupted by uncooperative student behavior or by outside sources such as a visitor who is not there to provide any instruction and whose presence stops the flow of the lesson.

Table D1.4. Indicators for marking non-science

Classroom talk	Not related to science.
Student involvement	Not doing or receiving science information. No opportunity to learn science.

<u>Classroom talk.</u> The talk is not directly or indirectly related to the science study. The talk does not contain any scientific content.

<u>Student involvement.</u> Students are not involved in any science tasks. They do not have an opportunity to learn science.

<u>D1.2.3.1 Marking In- and Out-Points</u>

The In-Point of a non-science segment is marked when the teacher verbally or physically expresses her/his intention of starting an activity that is not related to science or when an interruption begins.

The Out-Point is marked when a new phase structure segment begins or when the lesson ends.

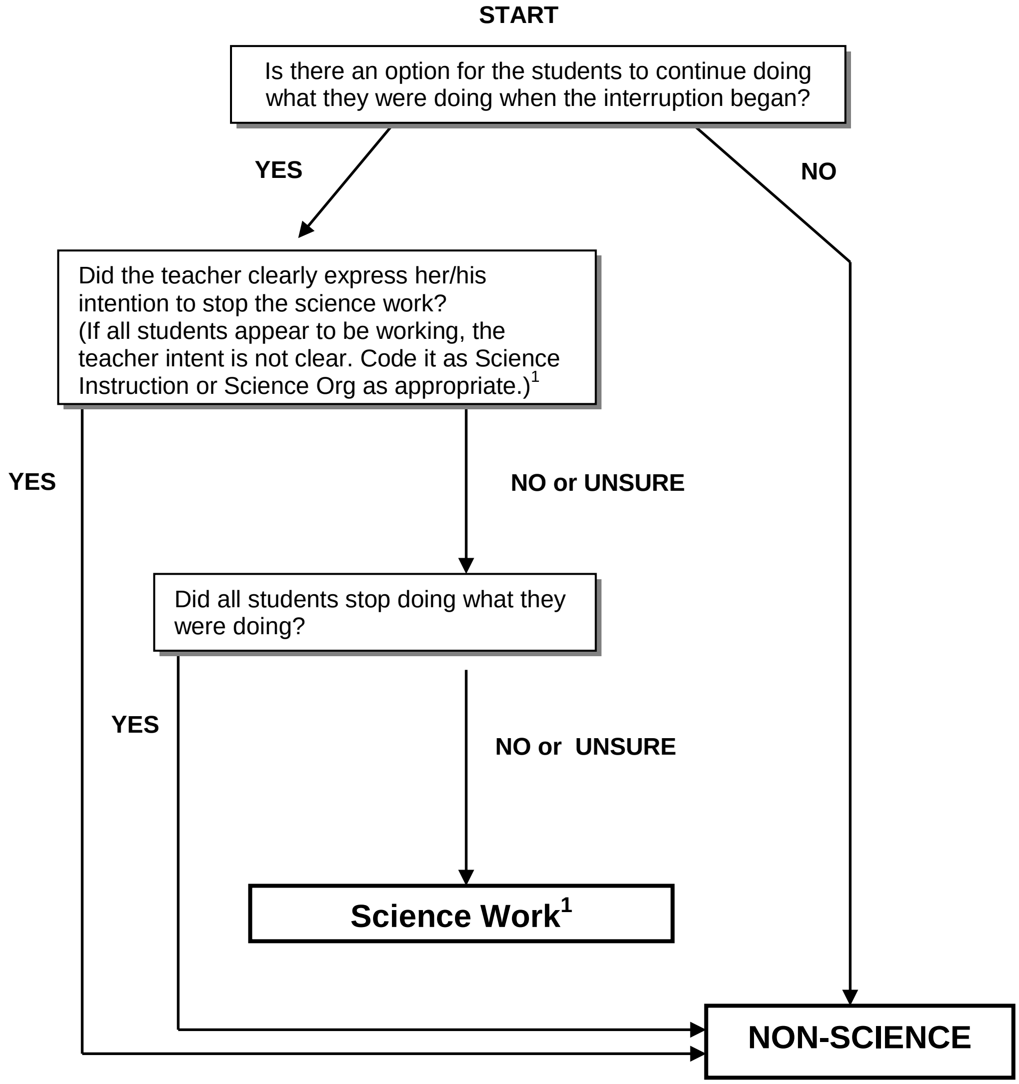
D1.2.3.2 What is an "Interruption"?

In deciding what constitute as "interruption," you must evaluate three things:

- whether the students have a choice to stay engaged in an ongoing science work;
- whether the teacher expresses her/his intention to stop the science work; and
- whether there is evidence in the video that students disengage from the science work.

Figure D1.4 below describes the decision making procedure.

Figure D1.4. Identifying "interruption" that is coded as non-science



[1]Science work will be coded into either SCIENCE ORGANIZATION or SCIENCE INSTRUCTION (see the definitions below).

D1.2.3.3 Example

Exhibit 1.4. Non-science phase: Example

Lesson ID	SJP002		
Context	The teacher walks into the classroom, greets the students, and checks the attendance.		
Video			
In / Out Point	06:01 - 07:11		
Example	Time	Person	Transcript
	00:05:34	S	Yes.
	00:05:36	T	A rubber?
	00:05:58	T	Did class start already? Did the bell ring? OK, we'll begin.
06:01	00:06:01	S	〈Stand up.
	00:06:12	T	I know it's hot, but we just have to bear it.
	00:06:22	T	Quiet
	00:06:31	S	Bow.
	00:06:31	T	Okay. Onegaishimasu.
PH:NS	00:06:32	Ss	Onegaishimasu.
	00:06:34	T	Do we have any absentees today? No absentees? No?
	00:06:39	S	Maybe.
	00:06:39	T	Maybe? Maybe.
	00:06:40	S	TSUCHIYA, TSUCHIYA is absent.
	00:07:04	T	OK, quiet down.
07:11	00:07:11	T	〈Okay, um ... we finally got the liquid nitrogen that you've all been longing for, so today we will do the experiment we talked about in a previous class where we had some unanswered questions.
Coding rationale	This segment is coded as PS: NS because no science instruction is conducted during this time, and therefore, the students do not have an opportunity to learn any scientific content. The non-science activities include the formal ritual greeting and the taking of attendance. The In-Point of the segment is marked at 6:01, which corresponds to the beginning of the lesson. This is thus the first segment in the lesson. The Out-Point of the segment is marked at 7:11 when the teacher starts science instruction. This is when a new segment PH:SI starts.		

D1.2.4 SCIENCE INSTRUCTION [PH:SI]

SCIENCE INSTRUCTION [PH:SI] is defined as a period of time in the lesson when the teacher and students are engaged in activities that provide opportunities for students to learn science.

Minimum time requirement for the length for the segment: 30 seconds with two exceptions (see special considerations under D1.2.4.1).

Science instruction phase is the main phase of a lesson and is probably the longest segment in most lessons. This phase contains science activities such as the class conducting and discussing experiments, the teacher explaining science concepts, or the students working on written assignments.

Table D1.5. Indicators for marking science instruction

Classroom talk	Primarily about science.
Student involvement	Primarily involved in science study; have opportunities to learn science.

Classroom talk. The talk is primarily related to the science content of the lesson.

Student involvement. Students are primarily involved in science study. They have opportunities to learn science (e.g., working on written assignments, carrying out experiments or other practical tasks, listening to the teacher's explanation).

D1.2.4.1 Marking In- and Out-Points

The In-Point of this segment is marked when the teacher verbally or physically expresses her/his intention to start an instructional activity that provides opportunities for students to learn science.

- Smooth transition. In most cases there is a smooth transition to science instruction. That is, instruction immediately follows the signal (e.g., “Okay. Now this experiment is about gravity…”). In such cases, mark the In-Point at the start of the signal.

- Somewhat smooth transition. At times it may not be clear to you whether the transition is smooth or not. For example, the signal may be followed by very brief attempt(s) by the teacher to get students’ attention before, or even after instruction starts (e.g., “Okay everyone, shhhh, on your lab today you will be …” ; “Okay obviously- John are you listening? Obviously you should always wear your goggles because these chemicals are dangerous …). In such cases, mark the In-Point at the start of the signal.

- Not smooth transition. In some cases, it will be clear that the transition to science instruction is not smooth. For example, the teacher may continue to attempt to get students’ attention for a period of time before starting instruction (e.g., repeating the signal, asking for attention, waiting, disciplining some students). In such cases the segment is considered as non-science. If it is less than 30 seconds, apply the short segment rule. Mark the In-Point of science instruction at the beginning of the next successful signal or when instruction actually starts (whichever happens first).

The Out-Point of this segment is marked when another Phase Structure segment begins or when the lesson ends.

Special considerations

- Exception to the 30 second rule. As mentioned in the section 1.2.3, there are two exceptions to this rule for science instruction phase. One of them is the first and the last science instruction segment of the lesson; and the other is the science instruction segment that is preceded by a related, set-up type of science organization segment. One example of the second case is when the whole class goes outside, the teacher demonstrates a short experiment, and the class comes back into the room. It takes several minutes for the class to move out and to move back in to the room while the experiment takes less than 30 seconds. It will be coded as science instruction, preceded and followed by a science organization segment.

D1.2.4.2 Example

Exhibit 1.5. Science instruction: Example

Lesson ID	SJP056		
Context	After the greeting with the students, the teacher begins to conduct the science instruction.		
Video			
In/Out Point	00:00:59 - 00:50:42		
Example	Time	Person	Transcript
	00:00:58		[Bell.]
00:59	00:00:59	T	〈Okay, stand up.
	00:01:00	Sn	Stand up.
	00:01:04	S	Stand straight.
	00:01:05	T	Okay face the front.
	00:01:07	S	Pease teach us well //.
	00:01:08	T	// Okay // please listen well.
	00:01:08	E	// Please teach us well.
	00:01:10	T	Sit down.
PH:SI	00:01:17	T	In our last class, the electric diagram, the symbols for the electric diagram, right?
	00:01:25	T	I explained that right? I'll explain the rest for you later. Okay? I think that you've probably forgotten it already. We'll be doing this today. What was this again? What is this called?
	00:01:35	T	Huh? What was it again?
	00:01:38	Ss	A voltmeter.
	00:50:28	T	*{{Lesson continues}}*
50:42	00:50:38	T	Okay. It's okay times up. Alright then for next time, since I wasn't able to get you guys to make a parallel circuit today I'm going to have to explain it to you again.
	00:50:49	T	But okay, I'm going to have you use the white board again and have you draw a circuit diagram. 〈Okay, well since I'm going to have you leave this, I want you to write your names on them.
	00:50:59		I want everyone to sign it. Okay? Write it. Write it okay? Okay, we will finish after you sign them.
			[Bell.]
	00:51:03	Sn	Is it okay if I write “student president?”
Coding rationale	The entire segment is coded as PH:SI because science content predominates during this time; the opportunities for the students to learn science content are available throughout; and no non-science or		

	science organization segments 30 seconds or longer are identified. The In Point of the segment is marked at 00:59 when the greeting starts. Greeting is non-science, but in this case it lasts only for 18 seconds, and therefore, it is included in the following PH:SI segment according to the short segment rule #1. The Out-Point is marked at 50:42 when the teacher starts to talk about administrative matter, which is coded as a beginning of a new segment.

D1.2.5 Science Organization [PH:ORG]

SCIENCE ORGANIZATION [PH:ORG] is defined as a period of time in the lesson that is *clearly set aside* by the teacher for administrative activities and discussions that are *related to science study*. During this time the students are either involved in the administrative activities or are expected to pay attention to administrative discussions. These activities and discussions are usually necessary to prepare for, to follow-up after, or to complete science instruction activities. No explicit science instruction is being conducted during this time.

Minimum time requirement for the length for the segment: 30 seconds.

A key aspect in identifying a lesson segment as science organization is its strictly administrative nature. These are periods of time when classroom activities are conducted exclusively to achieve the purposes shown below.

Students are involved in administrative activities such as

- arranging the classroom for an instructional activity;
- physically arranging themselves for instruction;
- cleaning up after an instructional activity; and
- gathering or receiving instructional materials.

Students pay attention to or participate in administrative discussions by

- talking about how to arrange the classroom;
- talking about how to arrange themselves;
- talking about how to clean up;
- talking about how to gather materials;
- talking about grades; and
- talking about homework and tests.

Activities and discussion that are not science organization

- Sometimes students must wait while teachers organize themselves for classroom purposes, such as erasing the board;
- walking from one side of the room to another;
- getting chalk or other materials;
- pausing between sentences; or
- setting up a video or an experiment.

In such instances students are not themselves engaged in the organizational task. These activities or discussions are therefore NOT considered as science organization, and therefore, do NOT shift to a new segment.

Table D1.6. Indicators for marking science organization

Classroom talk	Primarily organizational/administrative or absent
Student involvement	Not learning science content directly. Students are engaged in organizational activities or need to pay attention to administrative discussions.

Classroom talk. The talk is primarily organizational and/or administrative in nature. It is related to science study but does not directly address science content.

Student involvement. Students are primarily engaged in organizational activities or listening to the teacher talking about administrative and/or organizational matters. During this segment the students are not learning the science content directly.

Note that a science organization includes the time both the teacher and/or the students spend on organizational talk or activities. For example, the teacher talks for a few minutes about how to reorganize the students' desks and then gives the students some time to reorganize their desks. Both of these activities are included in a science organization segment.

D1.2.5.1 Marking In- and Out-Points

The In-Point of this segment is when the teacher verbally or physically marks her/his intention to begin an organizational activity for all students. The Out-Point of this segment is marked when another Phase Structure segment begins or the lesson ends.

Special considerations

- Co-occurrence of organizational and instructional activities. Sometimes an organizational activity occurs at the same time as science instruction. For example, the teacher presents scientific content as materials are being distributed. In such cases *do not* code the segment as science organization.

- Indistinguishable organizational and instructional activities. In other cases organizational activity may be indistinguishable from the start of science instruction. For example, students start working on an assignment as soon as it is handed to them, or the teacher tells the students to get the materials *and* start working.

  If the students have the opportunity to start working as soon as they receive (or gather) the necessary materials, the PH:ORG is indistinguishable from the PH:SI, and the segment is coded as PH:SI. The opportunity to start means that students have access to the needed materials and information to start the instructional task, and they know that they can start. The In-Point of PH:SI is marked when the teacher signals that students should start both organizational and instructional task.

All talk prior to the signal to start working on instructional task and organizational task is coded as either PH:ORG or PH:SI depending on the content.

If students do not have access to enough required materials needed to start working on the instructional task, then they *do not have the opportunity* to start working, and the In-Point of PH:SI is delayed until the first student has access to it.

For example, the teacher might withhold an *essential* part of the required materials and pass this around after students have started to gather the other materials. In this case, the In-Point of PH:SI is marked when the first student receives the essential material from the teacher. The gathering of materials prior to this point is coded as PH:ORG, since students cannot start to work until they have access to enough materials to start to work.

- <u>An activity containing both aspects</u>. There are also cases where one activity contains both organizational and instructional aspects (e.g., the teacher may review the science content of a test while assigning the date and chapters for students to study). In such cases *do not* code the segment as science organization.

- <u>Student(s) help teacher get organized.</u> Sometimes the teacher chooses one or two students to help him/her get organized while the rest of the class waits (e.g., students may set up equipment or cue a video). Treat such cases as teachers organizing themselves for classroom purposes, and *do not* code as science organization.

Exhibits 1.6-1.9 below contain examples of some typical classroom activities that may be considered as science organization or science instruction depending on their content.

Exhibit 1.6. Activities that can potentially be coded as science organization: Example

Physical Organization and Distribution of Materials		
Activity	Examples of science organization	Examples of science instruction
<u>Students physically arranging</u> Physically arranging students or the classroom space for instruction	Teacher tells students to rearrange their desks or themselves for an activity (e.g., "*get into your groups for the lab,*" "*everyone gather around me so you can see this demonstration,*" or "*we need to get organized for dismissal*"), and the clear majority of the students promptly[1] stop working and begin to rearrange furniture or themselves. Mark the In-Point at the start of the request. Teacher tells some students (i.e., students in the back of the classroom) to rearrange their desks or themselves for an activity, and those students promptly[1] begin to rearrange furniture or themselves while the majority of the rest are waiting or doing another non-science activity (that is, the clear majority of students are not engaged in an instructional activity). Mark the In-Point at the start of the request.	If the shift from PH:SI to PH:ORG or PH:ORG to PH:SI is indistinguishable, code the segment as PH:SI. If the rearranging by the majority does not occur promptly, code the segment as PH:SI until the majority of students start rearranging.
<u>Teacher distributing materials</u> e.g., - worksheets - test products	Teacher passes out worksheets, and the clear majority of students waits to start until they discuss how to do the assignment. Mark the In-Point when the teacher starts distributing the material.	If the students start working on the worksheet as they receive it, code the entire segment as PH:SI.

[1] "Promptly" means within 30 seconds after the end of the request.

Exhibit 1.7. List of activities that can potentially be coded as science organization: Example

Gathering and Putting Away Materials		
Activity	Examples of science organization	Examples of science instruction
<u>Students gathering materials</u> e.g., - objects for practical activities - worksheets, notebooks, textbooks	At the request of the teacher, the clear majority of students promptly[1] begins to gather materials for an instructional activity and *wait* before starting an instructional activity (that is, the clear majority of students do not engage in an instructional activity). Mark the In-Point at the start of the request.	If the students start working on the assignment as they gather materials, code the entire segment as PH:SI.
<u>Students putting away materials or cleaning up</u> e.g., - objects for practical activities	At the request of the teacher, a clear majority[1] of the students promptly[2] stops working on an instructional activity and start working on an organizational activity (e.g., putting away materials or cleaning up), or wait for another instructional activity to begin. Mark the In-Point at the start of the request.	If otherwise, code the segment as PH:SI.
<u>Selected group of students gather or put away materials</u>	At the request of the teacher, a selected group of students (e.g., one from each group) promptly[1] begins to gather or put away materials, while the majority of the rest of the class waits or does another non-science activity (that is, the clear majority of students are not engaged in an instructional activity). Mark the In-Point at the start of the request.	

See notes on following page.

NOTES

(a) Teacher gives a request to shift from PH:SI to PH:ORG for the purposes of gathering materials or clean up, and there is a response of the clear majority of the students but not promptly. If the teacher makes another signal, which leads to a prompt response, mark the In-Point at the start of the most recent request. If the teacher does not make further requests or no requests are successful, but at some point a shift to PH:ORG is observed, mark the In-Point when the clear majority of students start working on an organizational activity.

(b) If there is no request by the teacher to shift from PH:SI to PH:ORG, but at one point the clear majority of students does shift to PH:ORG, mark the In-Point to PH:ORG when the clear majority of students are observed to be engaged in an organizational activity.

[1] "Clear majority" rule for identifying science organization includes the number of students engaged in PH:ORG and PH:NS combined.

[2] "Promptly" means within 30 seconds after the end of the request.

Exhibit 1.8. List of activities that can potentially be coded as science organization: Example

Homework or assessment product NOT WORKED ON in the lesson		
Activity	Example of science organization	Example of science instruction
<u>Prior to the lesson</u> Returning or talking about homework, a test, other assessment product (e.g., worksheet, practical work product) that was done before the lesson Grading a performance that was done prior to the lesson	Homework, test, or other assessment product is returned with NO discussion, and NO time is set aside for (all)students to review the test[1] The teacher tells students their grades only, and the test, homework, or other assessment product (e.g., the test paper, worksheet, oral examination, practical work) is not available to students	Teacher discusses content of specific test or homework items with students Time is set aside for all students to review their tests or homework The teacher tells students the correct answer to each item while students have the assessment product or homework in front of them to look at The teacher assigns grades and/or evaluates the assessment product while students have the assessment product in front of them Teacher provides reasons for students grades that refer to specific aspects of their performance
<u>After the lesson</u> Talking or writing about homework or tests that will be done in the future	Providing date of the test Telling students the grade needed to pass the test (e.g., 85%) Telling students the numbers of the homework problems to be done Providing the chapters and/or page numbers of homework	Providing topics (e.g., heat, electricity, energy) and/or other content-related information to be covered in the test or homework[2] Reviewing concepts covered in the test or homework Asking or responding to students' content-related questions about the test or homework Students write down information that has some scientific content or examples

[1] Sometimes while the teacher is returning a test, students who receive their paper first may have time to review the test while the rest are being returned. If, however, the teacher begins a new activity once the last student receives the test, code the segment as science organization. The reason here is that this type of sequence suggests the teacher's primary intent was to return the tests, not for all students to review their tests.

[2] Statements such as: "Don't forget to study how population density influences mortality." and "Don't forget to review your notes on how to organize data clearly to answer your question." are more than just telling students topics. They provide content (i.e., the first statement implies that that population density influences mortality, the second statement implies that you should think about the research question to know how to organize data from an experiment.)

Exhibit 1.9. List of activities that can potentially be coded as science organization: Example

Homework, assessment product, or assignment worked on in the lesson		
Activity	Example of science organization	Example of science instruction
Present materials Returning homework, a test, or other assessment product (e.g., worksheet, practical work product) that was worked on during the lesson Grading a performance that was worked on during the lesson	Returning tests or homework with NO discussion, and NO time is set aside for the clear majority of students to review them[1]	Returning tests or homework when there is time set aside for all students to review them All talking or writing about homework, tests, or other assessment products (e.g. oral examination) that students worked on in this class is considered as Science Instruction regardless of content unless it has been previously described in this table.
Starting on future materials Talking or writing about an assignment, test, or homework that students will have opportunity to work on in class		All talking or writing about tests, assignments, or homework that students will work on in this class is considered as Science Instruction regardless of content unless it has been previously described in this table.

[1] Sometimes while the teacher is returning a test, students who receive their paper first may have time to review the test while the rest are being returned. If, however, the teacher begins a new activity once the last student receives the test, code the segment as science organization. The reason here is that this type of sequence suggests the teacher's primary intent was to return the tests, not for all students to review their test.

__D1.2.5.2 Example__

Exhibit 1.10. Science organization: Example

Lesson ID	SUS010			
Context	The teacher asks the students to collect their homework and she starts distributing the worksheet for an upcoming activity.			
Video				
In / Out Point	9:31 - 11:58			
Transcript	Time	Person	Transcript	
	00:09:18	Sn	One point five. I mean one point seven five.	
	00:09:21	T	One point seven five and make sure you put the units G, you're in grams. Any questions, everybody got it?	
	00:09:29	Sn	Yeah.	
9:31	00:09:31	T	〈 Okay, go ahead and pass in all your homework. I'm going to pass out the lab. So pass in your homework and then I'll pass the lab for you.	
	00:09:42	Sn	Pass ( )?	
PH:ORG	00:09:44	T	Yeah, pass in the questions. Remember Friday we had those questions on the overhead? Just pass that in with it.	
	00:10:01	T	Steve just had to get on TV. ( ). Okay.	
	00:10:11	Sn	I can't handle the pressure. I ain't- I ain't gon	
			{{activity continues}}	
	00:11:49	T	Hey.	
	00:11:52	Sn	( )	
	00:11:52	Ss	Ha ha ha.	
11:58	00:11:53	T	Enough. 〈Okay, I need your attention up here please. Shh... You need one per person. You can still work within your group but you're gonna have to fill out your own information.	
	00:12:11	T	Okay, if you look where it says problem it's to calculate the density of the objects. So what are the two things we need to know to calculate density?	
	00:12:18	Sn	Mass and volume.	
Coding rationale	This segment is coded as PH: SO because the students cannot start working on the assignment while the worksheets are being distributed. This is a Type 3 (distributing materials) Science Organization activity, Table 1.2-a, p. 36-a. The In-Point of the segment is marked at 9:31 when the teacher signals			

	that students should be collecting the homework and students comply. The Out-Point of the segment is marked at 11:58 when the teacher starts to instruct students, which marks the beginning of a new science instruction segment.

Chapter D2: Classroom Talk

During a lesson the participants in the class (teachers and students) engage in numerous conversational (verbal) exchanges. Some of these exchanges are addressed to and intended for the whole class, while others are addressed to and intended for particular individual(s). The former type can be considered as public and the latter as private. There are also some exchanges that are addressed to particular individual(s), but are intended for the whole class. When the speech or exchanges are intended for the whole class, we code it as public talk [PUBL]**.**

<u>Why code public talk?</u> Identifying public talk is important for two reasons: (1) it serves as a useful, and sometimes necessary, indicator for coding various other features of the lesson; and (2) it is a necessary first step for further discourse coding.

<u>What kind of code is it?</u> Public talk is an "occurrence" code with In- and Out-Points. It is NOT a coverage code as the codes in Phase Structure. Occurrence codes capture events whenever they occur or appear in a lesson, but they do not necessarily cover the entire lesson.

<u>When does it start and end?</u> Public talk code is identified whenever a speaker starts to talk publicly and ends when there is a pause that is 15 seconds or longer, or private speech follows (more details are provided in a later section).

<u>Is there a minimum time requirement?</u> There is no minimum time requirement for public talk segment. It can consist of one word uttered by one speaker or a series of phrases and sentences exchanged between multiple speakers for an extended amount of time.

<u>Do we code word by word?</u> You are coding discourse, not each word separately. A single word or a phrase could make up a segment on its own only if they contain a clear function on its own. For example, the word "Stop!" should be evaluated independently if it's uttered in between pauses, and it could constitute an independent public talk segment. On the other hand, the same word uttered in between other words (e.g., "Okay, everyone, can you *stop* for a moment?") would not be evaluated on its own. Always pay attention to an on-going discourse instead of trying to determine whether each word is public or not.

D2.1.1 Public Talk [PUBL]

PUBLIC TALK [PUBL] is defined as the conversational exchange(s) between any participant(s) in the classroom during a lesson when the intended audience is the whole class.

The key criterion for coding public talk is whether the talk is intended, directly or indirectly, for the whole class to hear (i.e., it is not whether the talk is addressed to the whole class). Below are common examples of public talk:

- The teacher talks to the whole class during whole-class-working time (e.g., explains lab procedures) → directly intended for the whole class.

- The teacher makes an announcement during independent working time (e.g., tells the class to start cleaning up a lab experiment) → directly intended for the whole class.

- The teacher talks to a student during whole-class-working time (e.g., calls on a student and asks a question or disciplines a student publicly) → indirectly intended for the whole class.

- A student talks to the teacher during whole-class-working time (e.g., responds to the teacher's question or asks a question to the teacher) → indirectly intended for the whole class.

- A student talks to another student during whole-class discussion (e.g., one asks a question or makes comments to another while the rest of the class including the teacher is the audience of discussion) → indirectly intended for the whole class.

Note that the above five examples are common examples of public talk in classrooms, but *they do not cover all public talk* in classrooms. There are other types of speech that are considered as public talk. The following section describes the indicators of public talk.

D2.1.1.1 Marking Public Talk

Determining the intended audience of talk is not always easy. What you need to do then is to make your judgments based on all available information in the video that indicates speakers' intentions. There are four main indicators that help you identify public talk.

Table D2.1. Indicators for marking public talk

Speaker's voice	Normally loud enough for the whole class to hear
Context of talk	Normally the whole class is working together with the teacher
Speaker's posture	Normally facing and looking at the whole class
Content of talk	Normally related to an on-going class activity and is relevant to all students

Speaker's voice. The volume of speaker's voice is often a helpful and a strong indicator of public talk. When the talk is clearly available for the whole class to hear, the talk is most likely coded as public talk. (Some exceptions are explained in Special Considerations section).

When you are not sure if the talk is loud enough for the whole class to hear, use other indicators to make your coding decision.

Note that the teachers' voices tend to sound louder than it actually is in the videos because of the wireless microphone they were wearing during videotaping. We strongly suggest that you listen to the audio from the student camera in judging whether the voice was loud enough for the whole class to hear.

Context of talk. The verbal exchanges tend to be public during the time the whole class is working together with the teacher (e.g., lecture, demonstration, teacher-led experiment, whole-class discussion, etc). During this time, code the talk as public *UNLESS* there is strong evidence that suggests otherwise.

Consider the following example: the teacher asks a question to the whole class and calls on one student to answer, and the student responds in a very soft voice, that you could barely hear in the video:

Teacher: *What's that word, Lori?*
Lori: *(Precipitate?)*
Teacher: *Precipitate. Has anyone heard that word before?*

This exchange will be coded as public talk because it took place while the whole class is working with the teacher.

During whole-class working time → when in doubt, code the talk as public.

The verbal exchanges during the time when students are working independently of the teacher tend to be private. During this time, *DO NOT* code the talk as public *UNLESS* there is strong evidence that the talk was intended for the whole class.

For example, the teacher sometimes makes public announcements during private working time. Consider the following scenario. The teacher walks around the room and assists different groups while they are working on an experiment.

[The teacher comes to the table of one of the groups and says,]

Teacher: *You guys already did that? Good.*

[Then she looks up to the whole class and says in a louder voice,]

Teacher: *Make sure you're still putting the masses back before you move on.*

The teacher's voice, posture, and the content of the talk strongly suggest that the first statement was intended for the group only, but they suggest that the second statement was intended for the whole class. Therefore, code the second statement as public talk even though the context is independent working time.

During independent working time → when in doubt, *do not* code the talk as public talk.

Speaker's posture. Speaker's posture is another helpful indicator. When talking publicly, the teacher tends to face the whole class. Students, on the other hand, tend to look directly at the teacher when talking publicly. Both teacher and students may sometimes talk publicly while facing the board. Again, it is important that you cross-evaluate all available indicators.

Content of talk. Normally, the content of public talk is related to an on-going class activity, but not always. For example, the teacher may tell students a joke or talk about some personal experience. In such cases, code the talk as public if the talk is available and intended for the whole class.

In some cases the talk is addressed to a particular student, and the content of the talk is not related to a class activity. For example, the teacher says to one student in the middle of lecture:

> Teacher: *Are you alright, Lori? You look pale.*
> Lori: *Yes I'm fine.*

Code this exchange as public talk only if it is *clearly available* for the whole class to hear.

If the content of the talk is neither related to a class activity nor relevant to the whole class, and there is no strong evidence that suggests that the talk was intended for the whole class to hear, *do not* code it as public talk.

In the next section, we provide more examples of public talk from actual lessons.

Special considerations

- Verbal information from various sources, such as
    - Audio/visual devices. Sometimes teachers use audio/visual devices such as videos, tape-recorders, or TV for class activities. Code the transcribed utterances from these devices as public talk if it is clear that the teacher intended the whole class to attend to the information coming from those devices.
    - Loudspeaker announcements. Sometimes there are public announcements that come from a loudspeaker during lessons. Code these as public talk.

Blackboard texts. Information presented on the blackboard is transcribed when the teacher does not read them aloud. Written information is not a part of classroom discourse, and it should not be coded as public talk; however, do not break public talk segments for blackboard information. Take a look at the excerpt below:

Time	Person	Transcript
00:28:33	T	When we heat them up, what do they do?
00:28:35	SN	They went white.
00:28:37	T	They burn in air…
00:28:40	B	Burn in air to form
00:28:46	T	To form a substance called, a new substance called an ?
00:28:49	Ss	Oxide.
00:28:50	T	An oxide. What have they reacted with? …
00:28:56	B	A new substance called an oxide.
00:29:04	T	Why- what have they reacted with to form an oxide?
00:29:06	Ss	Oxygen.

In this excerpt, the teacher is instructing the whole class, and as he instructs, he writes information on the chalkboard, which are transcribed along with the conversational exchanges. Although the two lines at 28:40 and 28:56 are not part of discourse, *do not* break the public talk segment at those two lines.

- Talk intended for a part of class. Sometimes the teacher divides the class and instructs part of the class while the rest of the students work independently from the teacher. Code the conversational exchanges led by the teacher as public talk *only if they are clearly available* for the entire class to hear.

- Talk intended for voluntary audience. Normally, all students are supposed to listen to the teacher when he/she talks publicly. In some cases, however, the teacher gives an option for students to listen to the public exchanges or to work independently. For example, the teacher publicly questions one student at the front of the class, while the rest of the class has an option to work independently on their own or to listen to the exchanges guided by the teacher. In such cases, code the exchanges guided by the teacher as public talk.

- Teacher-student exchanges during independent working time. It was mentioned earlier that teachers sometimes make public announcements during private working time, and they are coded as public talk. Teachers and students also engage in one-on-one conversational exchanges during independent working time. Normally these exchanges are not available for the whole class to hear, but in some cases they are. For example, a student asks a question to the teacher from the back of the room and the teacher responds from the front of the room. Code these exchanges as public talk if there is strong evidence that suggests the exchanges were intended for the whole class. If you are not sure, refer to the coding decision tree in the next section (Figure D2.1).

- Student-to-student exchanges during independent working time. Students also engage in conversational exchanges with other students during independent working time. Code this type of exchange as public talk if it is related to an on-going activity, and there is strong evidence that suggests that the talk was intended for the whole class.

If the talk is intended for the whole class but is not related to an on-going class activity, code the exchange as public talk only if the majority of the class responds to the talk verbally or non-verbally.

- <u>Unsolicited student utterances during whole-class working time.</u> Students may talk publicly without being solicited by the teacher. For example, while the teacher is demonstrating an experiment, some students may shout out their reactions to the experiment ("Wow, cool!", "Fire, fire!", or "Dangerous!"). These student utterances are included in the public talk segment because they are part of an on-going public discourse.

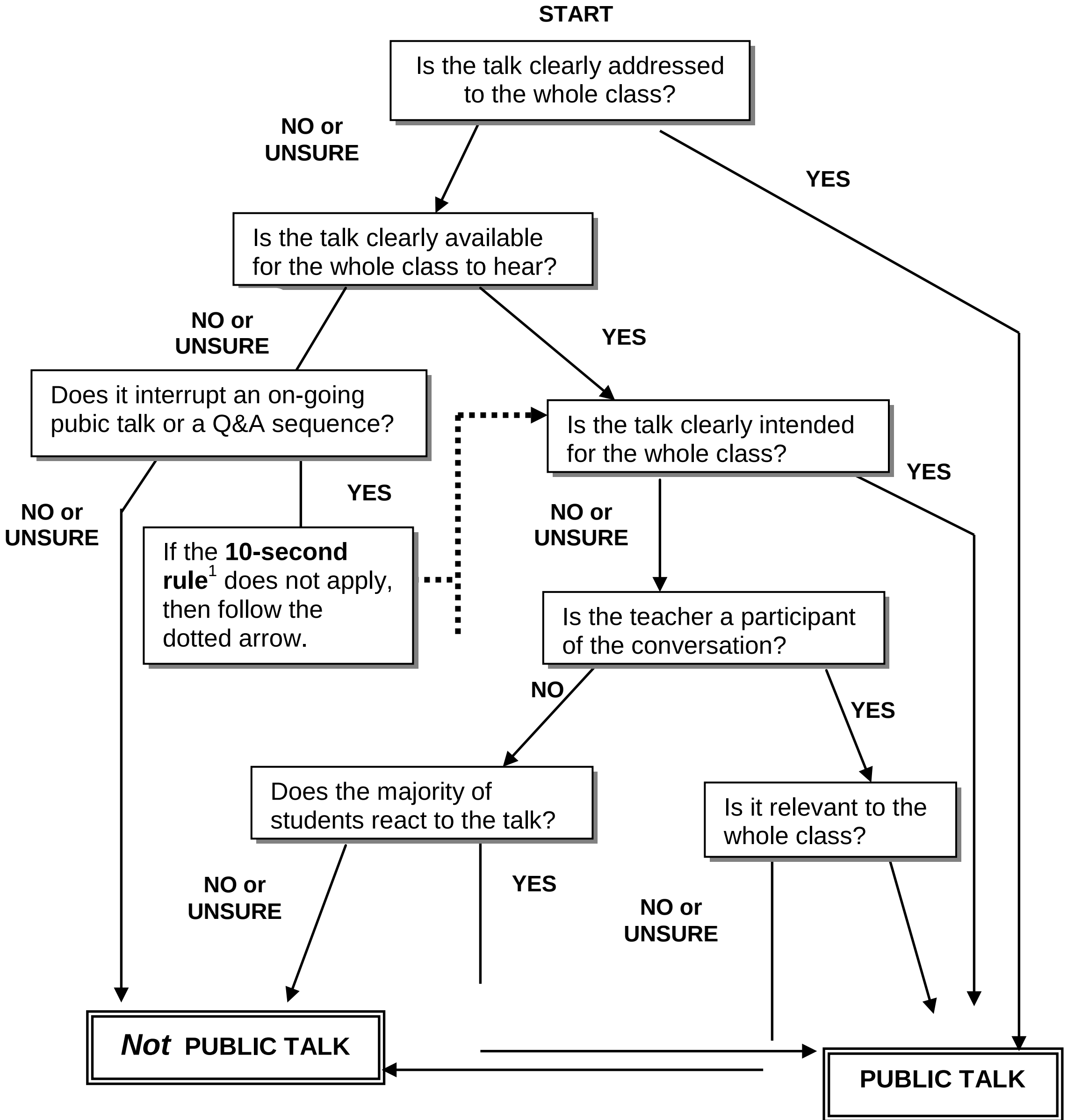
- The unsolicited utterances that are not intended for the whole class nor related to an on-going activity are normally considered as not public. However, include them in the public talk segment they last less than 10 seconds (i.e., do not make a shift out of public talk segment).

- <u>Teacher's private utterances in the middle of continuous public exchanges</u>. While the teacher is talking to the whole class (e.g., lecturing), he/she may briefly talk privately to an individual student. In such cases *do not* break the public talk segment if the private interaction lasts less than 10 seconds.

- <u>Teacher disciplining individual student(s).</u> Teachers sometimes discipline students during the lesson (e.g., "John, are you listening?"). Code disciplinary talk as public talk if it is *clearly available* to the whole class.

  The tree in the next page describes the decision making process for public talk coding for difficult cases.

Figure D2.1. The decision-making process for public talk



[1] See the section 2.4 on the next page.

D2.1.1.2 Marking In- and Out-Points

The In-Point of public talk segment is marked at the beginning of the statement. The Out-Point is marked when one of these two situations occurs:

- Non-public utterances are combined with pauses that last for 10 seconds or longer.
- A pause without any utterances lasts for 15 seconds or longer.

The excerpts below illustrate how to mark In- and Out-Points.

Public talk followed by non-public utterances

In the excerpt below, the teacher's public statement starts at 01:47 when she asks the class about homework. The students respond (01:51). Then the teacher goes to the door and talks to the people outside the room (02:00). Because the private exchanges started, the Out-Point of the segment is marked at 01:52 at the end of the students' statement. A new segment of public talk starts again at 02:29 when the teacher comes back to the room and talks to the class.

Time	Person	Transcript	Decision
00:01:47	T	Anybody's done with their homework sheet already?	The teacher talks to the class (= PUBLIC TALK).
00:01:51	Ss	Oh no.	
00:02:00	T	Do you have a TA? … Um. … There's no teacher in room seven.	The teacher goes to the door and talks to someone outside the class.
00:02:17	T	Oh, she showed up.	
00:01:29	T	Okay. One more minute to finish your homework sheet and then you should be on your general review.	The teacher comes back and talks to the class again (= PUBLIC TALK).

Public talk followed by a pause

In this second excerpt, the teacher makes a public statement (04:40) and waits for about 30 seconds before she starts the next public statement. Therefore, the Out-Point is marked at 04:42. A new segment starts at 05:10.

Time	Person	Transcript	Decision
00:04:40	T	One more minute.	The teacher talks to the whole class (= PUBLIC TALK) .
00:05:10	T	Okay, I'd like you to clear off your desks now except for Astronomy Assignment One and a clean sheet of paper. ... Which you will title Astronomy Assignment Two.	The teacher talks again to the whole class after 22 seconds (= PUBLIC TALK).
00:05:27	T	Astronomy Assignment One and a clean sheet of paper.	

<u>D2.1.1.3 Example</u>

In this section we provide one typical example of public talk.

Exhibit 2.1. Public talk: Example

Example 1	SJP056 -- Public statement during public working time.		
Context	The teacher is reminding the class about previous activities.		
Video			
Example	Time	Person	Transcript
			{{ The teacher has been talking to the class.}}
	01:17:18	T	In our last class, the electric diagram, the symbols for the electric diagram, right?
	01:25:14	T	I explained that right? I'll explain the rest for you later. Okay? I think that you've probably forgotten it already. We'll be doing this today. What was this again? What is this called?
			{{ The teacher continues to talk to the class.}}
Coding rationale	The teacher is standing in front of the room and facing the whole class; his voice is loud enough for everyone to hear; the content of speech is related to science instruction and is relevant to all students.		

Chapter D3: Social Organization Structure

D3.1 Types of Social Organization Structure

In Dimension 3 we identified the segments for which the students make the group assignments (AS:WA and AS:WP) independently from the teacher. In this Dimension, we will further classify and characterize the AS:WA and AS:WP segments based on the social organization structure. There are four mutually exclusive categories that will be assigned to each of the AS:WA and AS:WP segments.

	AS:WA	AS:WP
• Individual	[S: A1]	[S: P1]
• Pair	[S: A2]	[S: P2]
• Group	[S: A3]	[S: P3]
• Other	[S: A4	[S: P4]

What the first three codes mean should be self-explanatory: individual = students are working alone; pair = students are working in pairs; and group = students are working in small groups. In many cases it is indeed easy to assign these codes to the independent segments because the teacher specifies the social structure that he/she wants the students to be working in (e.g., the teacher says, “Work in your group,” or “Work with your neighbor…”).

Even when the teacher does not specify the social structure, often the nature of the task that the teacher assigns indicates the social structure (e.g., “Okay, think about the hypothesis for a moment, then write it down in your notebook,” or “Take out your homework, and check the answers.”)

When neither the teacher nor the task indicates social structures, you may be able to observe in the video if students are working mostly alone or in groups. In the next section we describe the indicators that can be used to make the coding decisions.

D3.1.1 Indicators of Social Organization Structures

D3.1.1.1 Presence of Strong Indicators

There are four primary indicators that help you code the Social Organization Structure as shown in the table below. In the table D3.1 below, we provided only the strong evidence for each category. If any of this evidence is observed, code for the category it applies to. For example, if two students are responsible for a common product, code the segment as pair.

Table D3.1. Indicators of social organization structure

	Individual	Pair	Group
Teacher specified structure	Individual	Pair	Group (three or more)
Task specified structure	Individual	Pair	Group
Objects & tools	--	Two students share	Group shares
Products	--	Pair product	Group product

<u>Teacher specified structure.</u> If the teacher explicitly assigns the social structure, code the segment according to what the teacher says. If the teacher gives an option for students to choose the structure that they work in, or if he does not specify a structure, then evaluate other indicators. For example, the teacher could say: *"you can work alone or with others…"*

<u>Task specified structure.</u> If the nature of the task requires students to work in a certain social structure, then code the segment for that structure. For example, the task such as "think" or "memorize," you cannot do it with others (=individual).

If the task does not specify any social structure, then evaluate other indicators.

<u>Objects and tools.</u> If most students are sharing objects or tools in pairs (i.e., not taking turns but using them together), then code the social structure of the segment as pair. Likewise, if most students are sharing objects or tools in groups, then the segment should be coded as group.

If there are no objects or tools used, or students are taking turns in using them, you still need to evaluate other indicators.

If other indicators do not suggest any of the three structures, and the only information you have is that students have their own objects and tools to work with, then code the segment as individual.

IMPORTANT NOTE: Include any objects and tools that students need to carry out the assignment (e.g., pens and papers to write). However, in deciding whether students are sharing those objects/tools, do not include the incidents that some students share pens or papers only because one of them forgot to bring it. The "sharing" has to be observed systematically (i.e., all or most pairs and groups).

<u>Products.</u> Include tools and objects, if the majority of students are responsible for a pair or group product, code the segment as pair or group.

If students are not responsible for any product, or if you cannot identify what product for which students are responsible, then evaluate other indicators.

If other indicators do not suggest any of the three structures, and the only information you have is that students are responsible for their own product, then code the segment as individual.

D3.1.1.2 Absence of the Strong Indicators

When you do not have any of the above-specified evidence, then base your decision on another indicator, which is "observed structure."

Table D3.2. Indicators of observed structure

	Individual	Pair	Group
Observed structure	Most students work alone most of the time	Most students work in pairs most of the time	Most students work in groups most of the time

Observed structure. Observed structure is not determined simply by who and how much students are talking with each other. It is about the level of collaboration among students. Students can work together without talking (e.g., pairs of students construct something quietly), and they can also talk with each other a lot while working alone (e.g., students go over their test and continuously chat with their neighbors. Focus on what the students are doing rather than how much they are talking with each other.

If you see a mix of the two or three of these three structures, then code for the higher (i.e., use this hierarchy of codes: group > pair > individual).

D3.1.1.3 When Do You Code the Segment as Other?

Sometimes you cannot make your coding decision not because of the lack of information but because the social structure keeps changing throughout the segment. For example, there are multiple tasks assigned to the students, and students keeps moving around, interacting with different students at different times, and you cannot tell who is working with who on what task. In such cases, code the segment as other. Also, when there is a mix of individual, pair, and group without a majority for either structure, code the segment as other (see 3.1.1.5).

D3.1.1.4 When the Teacher Gives an Option

In some cases the teacher tells the students that they can work alone or together. In such cases, code the segment based on the observed structure. For example, the teacher says, "You can work with your partner if you want." If you actually see most students working (again, not just talking) with their partners, then code the segment as PAIR.

D3.1.1.5 When there is a mix of INDIVIDUAL, PAIR and GROUP

When students are working independently, it is possible that there is a mix of social structures (e.g., some students work alone and some work with partners). Below is a list of possible types of mixed structures and suggested coding decisions for each type.

- Individual and pair → Code for the majority (more than half of the total number of students in the class).
- Individual and group → Code for the majority.
- Pair and group → Code group if there are at least two groups. Otherwise, code as pair.
- Individual, pair, and group → Code for the structure with the majority (i.e., more than half of the class). If there is no majority, code as other.

D3.1.1.6 When there is a shift in Social Organization Structure.

In some cases, there is a shift in Social Organization structures within the same segment. The two possible cases are

- Potential gradual shift. For example, students move from working on a hands-on activity in groups to writing about the task individually at their desks.
- Two AS:WA or AS:WP segments with short ASPDF in between. For example, students work on a written task individually first, then the teacher tells them to discuss the result of the task in groups, but the ASPDF segment (=when the teacher is directing) is less than 30 seconds, and the two AS:WA segments are coded as one continuous segment.

In both cases, code for the structure in which students spend more time.

D3.1.1.7 Examples

Structure	Lesson	Time	Description
Individual	SJP070	12:07-14:10	
	SNL035	32:13-33:28	
Pair	SNL026	07:15-17:40	Materials are per table, which seats two. TQ also confirms "they work in pairs."
	SNL077	07:53-30:25	T says "Work in pairs." Only the last student who does not have partner works in a group of three
Group	SUS062	55:40-01:20	
	SAU004	11:59-12:50	
	SJP074	13:59-43:39	

D3.2 Questions about Social Organization Structure

Previously, you decided on the codes for Social Organization Structure. Because the questions are broad, we are asking additional questions to describe these Social Organization types.

Certain questions are interesting to ask for each Social Organization Structure, other questions apply only to one particular structure. If the question does not apply, we will code ‘55’. This code has no real meaning, other than the question does not apply.

The table below shows which questions are asked of each type:

Table D3.3. Questions about types of social organization structures

Questions	Individual	Pair	Group
1. Physical Arrangement of Students	Yes	Yes	Yes
2. Sharing Materials	Yes	Yes	Yes
3. Amount of Talk among Students	Yes	Yes	Yes
4. Expected interaction	Yes		
5. Required Collaboration among Students		Yes	Yes
6. Roles Assigned to Students		Yes	Yes
7. Products Made by Students		Yes	Yes
8. Gender Composition of Pairs or Groups		Yes	Yes
9. Number of Students in Groups		Yes	Yes

For individual: answer question 1,2,3,4, and 5. Code ‘55’ for all other questions.

For pair and group: answer question 1,2,3,5,6,7,8, and 9. Code ‘55’ for all other questions.

In the following sections we will describe the nine questions, the answers to the questions, and how to make decisions regarding your answers for each AS:WA and AS:WP segments.

D3.2.1 Questions That Apply to All Three Types of Social Organization Structures

- Physical arrangement of students [PA]
- Sharing materials [M]
- Amount of talk among students [OI]

<u>D3.2.1.1 Physical Arrangement of Students [PA]</u>

Physical arrangements may vary across classrooms and Social Organization segments. Physical arrangement describes the student's position during the private work – are they sitting/standing at individual desks? Are there two students at one table?

This question does *not* ask how many students *work* together! Students can be arranged to sit two at a table, while they work alone.

Code for the majority of the students' physical arrangements during the Independent segments.

Code one of the following if the physical arrangement of students is such that

- PA = 1 One student per desk (sitting or standing).
- PA = 2 Two students per desk (sitting or standing), or two desks are joined without barrier or space.
- PA = 3 Three or more students per desk, or three desks are joined without barrier or space.
- PA = 99 Other desk arrangements, or no majority for any arrangement. E.g. Students are not at desks, walk around between lab stations, or walk around in the library.

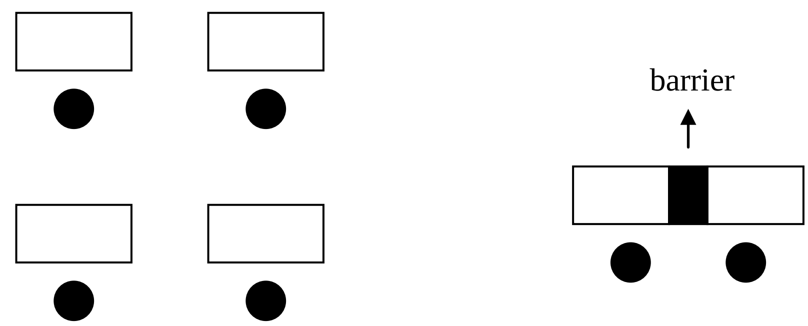
A diagram of these arrangements is included below.

IMPORTANT NOTE: We code for the physical location of the students while they work on the assignment. If the students are at lab stations away from their normal desks, we will code for the arrangement at the lab stations.

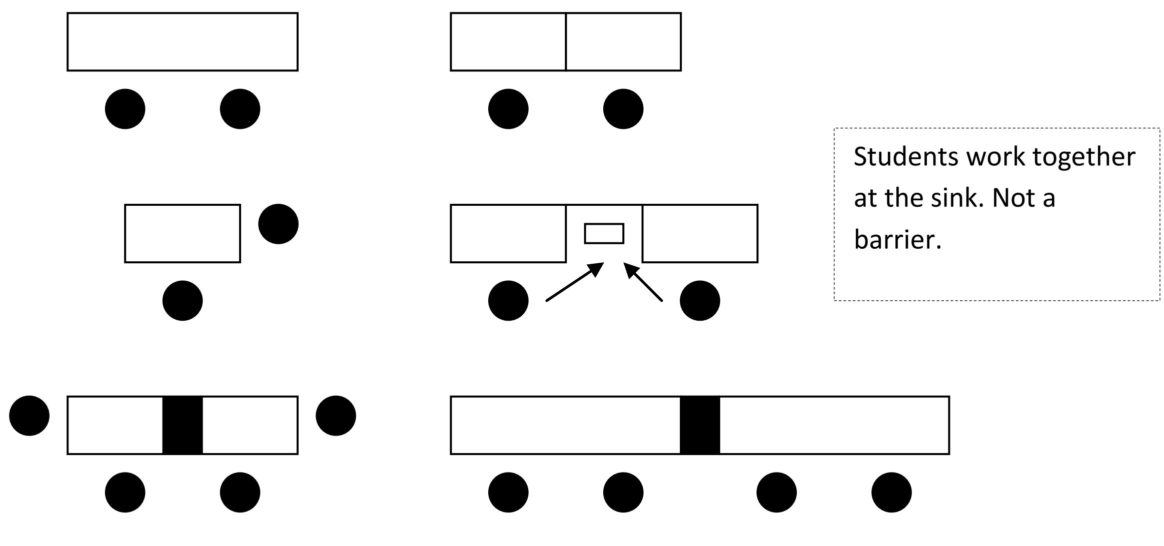
Examples

Code	Lesson	Time	Description
PA = 1			
PA = 2	SCZ020	9 :07-15 :25	
PA = 3	SJP069	17 :27-39 :06	
	SJP074	13 :58-43 :39	
	SAU004	11:59-12 :50	The sink is not a barrier.
PA = 99	SUS075	3:38-44 :35	
PA = 99	SCZ048	22 :48-26.19	The sink is a barrier!

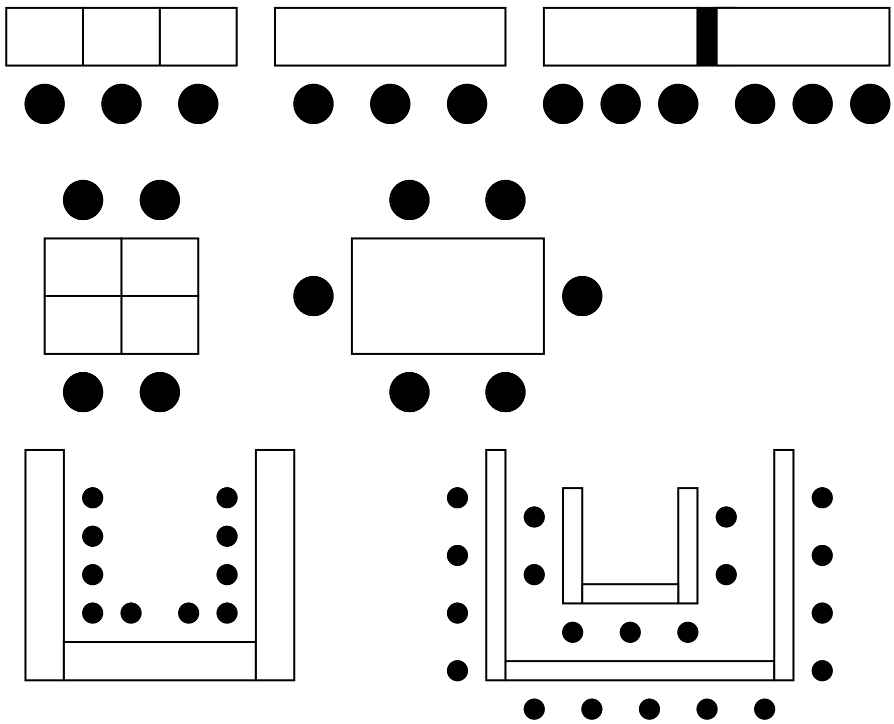
Physical Arrangement = 1: Example



Examples of Physical Arrangement = 2: Example

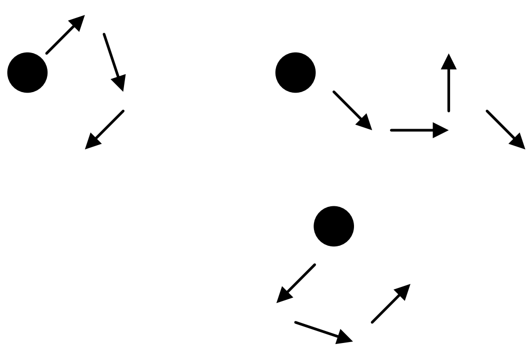


Physical Arrangement = 3: Example



Examples of Physical Arrangement = 99: Examples

Students move from station to station
Students are working on the floor, no desks
Students are walking around, in the library or outside



D3.2.1.2 Sharing Materials [M]

Some tasks require certain sharing materials specific to that task. For instance, most chemistry lab experiments require lab equipment and chemicals. We are interested in finding out whether students have their own sets of materials, or if they share within a group.

We are looking at the materials that are specific and necessary for the assigned task, but *excluding paper to write on, worksheets, pens, overhead paper and textbooks*.

Usually, the teacher provides and indicates the materials during the lesson, but they could also be pre-installed in the lab.

In rare cases, students are asked to provide the special materials. We include these *if* it is clear that the teacher had asked students to bring them for this occasion only. For example, the teacher may have asked each student to bring in a sample of tap water from home, and this water is used for the hands-on activity. We will code this as M=1 or M=3. We do not include materials that students carry with them regularly, such as calculators and rulers.

Examples of special materials are: chemicals, burners, and other lab equipment, rocks for identification, animals, plants, organs, globes, and construction tools (e.g., scissors, glue, rulers). We will include special paper and pens only if they are brought specifically for this task, for example, construction paper, special colored markers, etc. Worksheets never count (they are considered as the product).

Code one of the following if

- M = 0 no special materials are used;
- M = 1 each student has her/his own materials to work with;
- M = 2 each student rotates in using materials (see the definition of rotating below), or the whole class shares materials (e.g., the students observe the object that the teacher shows at the front of the classroom); or
- M = 3 students share materials in pairs/groups.

Sharing vs. rotating

<u>Sharing materials</u>. Students use materials within the group (e.g., one bunsen burner per four kids). Students work together with the materials, even if one student is manipulating. Not all students have to do each action, the person who manipulates does it for the whole group (i.e., one student can light the burner for all four). If students share materials in a group, it is considered as group work.

<u>Rotating materials</u>. Each student has to use the same materials individually, but they take turns. This can be done by having students rotate from station to station or by sending the material from students to student. Students work individually when rotating.

Special considerations

- When answering this question for the Individual Social Structure, you *cannot* choose option M=3. If you think M=3 is the only right option, you must change the social structure to group or pair.

- Books and magazines. Books other than the student textbooks and magazines count as a material if used specially for the task.

- Materials used by few students. We are coding for the materials specified for to the task by the teacher. If, for example, two students are observed sharing a protractor, we will not consider this as a special material. If it was specific and necessary for the task, more students would be using it.

- Rotate but share within the group or pair. For example, if groups or pairs take turns using the materials but the students share them within the group or pair, code M=3 (sharing).

- Sharing some but not all materials. When there are several different materials, and students share some but not all the materials, code for the shared material. For example, students each have a test tube, but they share a burner for the experiment. In this case code M=3 (sharing).

- Not all students have to use the same materials. If different groups are given different materials, determine whether students have to share within the group. For example: In group 1, each student gets a plant, in group 2 each student gets a rock. Group 1 only works with the plant, group 2 only works with the rock. Although the materials in group 1 and 2 are different, students do not share materials. (This does not mean you should change your Social Organization from group to individual, the teacher may have clearly stated that the students are working in groups.)

- Materials present but not used. We are looking whether the materials are used during *the* AS:WA or AS:WP segment. If a AS:WA follows a AS:WP segment, even if the objects used in WP are still present, you have already determined that students are not using those objects anymore. Otherwise, you would have coded AS:WP. Unless there are other objects that students are sharing, you should not code M=3.

- Shift in tasks within the segment. In some cases students move from one task to another in one AS:WA or AS:WP segment, and in one task they share materials, but in the other they do not. Code the highest observed (from high to low: 3>2>1>0).

Examples

Code	Lesson	Time
M = 0	SNL035	32:13-33:28
M = 1		
M = 2		
M = 3	SUS062	55:40-1:20:15
	SCZ020	42:29-45:30
	SAU033	

D3.2.1.3 Amount of Talk among Students (for all three types of Social Organization Structures) [OI]

When students are working on an assignment, we can observe interaction (talk) between students. Observed interaction is the amount of talking between the students while they work on the task that you see and hear in the video. It is not the same thing as the volume level, because students can talk a lot very quietly. We want to know how much students really work together, regardless whether the teacher frames the assignment as individual, pair, or group work.

The talking can be about the task, or it can be off-topic.

Code one of the following if

- OI = 1 no or very little talking is observed. A few students may talk or interact occasionally, but overall they work silently; or

- OI = 2 some or a lot of talking is observed. There is constant talking by few, many, or most students.

Special considerations

- When the amount of talk changes during the segment. The students may talk louder and more in the beginning of the segment as the teacher distributes materials, or at the end as they are finishing up the assignment. When the level of interaction changes along with the progression of the assignment, code for the period when students are actually working on the assignment, not when they are starting it or finishing it up. We are interested in how the students interact when they are working on the task.

  If the amount of talk changes during the working phase, then code OI = 2. OI=1 should be reserved for the cases where there is no period of some or high level of interaction while students are engaged in student assignments.

Examples

Code	Lesson	Time
OI = 1	SCZ035	21 :18-23 :23
	SAU034	7 :16-9 :00
	SJP030	18 :18-19 :34
	SCZ048	22 :10-26 :19
	SNL033	32 :37-38 :49
OI = 2	SNL034	7 :07-46 :26
	SAU011	14 :49-37 :57

D3.2.2 The Question That Applies to Individual Structure: Expected Degree of Interaction (Indicated by the Teacher) [EI]

The teacher often indicates the level of interaction that is expected or allowed for the students to carry on the assigned task.

When the teacher assigns group work, it is obvious that he intends for students to interact, but it is not true that for individual tasks, teachers always expect students to work completely alone. We can often observe students interacting and co-operating during individual work. In fact, this type of collaboration may even be explicitly encouraged.

In other cases, it is clearly stated that students are not allowed to talk or interact.

We look for explicit statements by the teacher. An explicit statement is any statement that makes it absolutely clear to the students whether they are allowed to talk or not. In many cases, the teacher does not make any statement about talk because the classroom pattern is known to all students. However, we cannot make assumptions about this pattern.

Code one of the following if

- EI = 0 teacher indicates there should be *no* interaction;
- EI = 1 teacher indicates students have an *option* to interact;
- EI = 99 cannot tell; or teacher does not indicate whether students should or should not interact with each other.; or
- EI = 55 code does not apply because pair or group was coded.

IMPORTANT NOTE: if the teacher makes it absolutely clear that students *must* interact, you should have coded Social Organization as group. For example, if the teacher says, *“I am not hearing enough discussion, you are supposed to talk it over”*, the segment probably should have been coded as pair or group structure.

Special considerations

- Teacher's statements during the segment. When the teacher does not indicate her/his intention initially, you may seek for the teacher's statements during the segment to infer the teacher's intention. This statement does not have to be public. Note, however, that these statements only apply to the segment in which it occurs.

  Examples of these statements are

  - "*Be quiet, no talking*" (code as '0').
  - "*It's ok to help your neighbor, but do it quietly*" (code as '1').

- When students are taking a test. If the teacher makes it clear that students are working individually on a (formal) test, we consider that the teacher has indicated there should be no interaction; therefore, code EI=0. But be careful, sometimes the teacher may use the word "test" or "quiz" without intending a formal evaluation where students are not supposed to talk.

D3.2.3 The Questions That Apply to Pair and Group Structures

- Required/necessary collaboration among students (task based) [RC]
- Roles assigned to students [R]
- Product [P]
- Gender within group [G]
- Group size [N]

D3.2.3.1 Required/Necessary Collaboration Among Students (Task Based) [RC]

Assigning students to work in groups does not guarantee that the students automatically learn collaborative skills. Many of these pair- or group tasks may easily be done by one student, and the rest of the students simply wait or chat with each other.

There are, however, tasks that cannot be completed unless the group members work together because the task is designed in such a way that each student contributes a vital part of the process or the end product of the task.

We are interested in capturing differing degrees of required collaboration among students due to the *nature of the task*. That is, this question is not about the teacher's intent, but about the task. It is already clear that the teacher expects students to interact- either through his instructions, or because they are sharing materials. That is why is we coded the segment as PAIR or GROUP structure.

The main question is, is the task designed in such a way that students must work together, or can one student carry out the task alone?

We have the following three codes to capture this distinction:

- RC = 0 No collaboration is required.
- RC = 1 Collaboration is required.
- RC = 99 It is unclear whether collaboration is required (the task is unknown).
- RC = 55 The code does not apply because the segment has been coded as individual.

Code RC = 0 when the following are both observed:

- The task can easily be carried out by one person.
- The teacher does not stress the need for building consensus.

The teacher may allow or encourage students to collaborate by using the language such as "talk it over in your group" or "compare your answer with your neighbor," but in general, these tasks are more 'product' oriented. The teacher's ultimate goal is to get the right answer, even though he/she may want students to work together.

Code RC = 1 when at least one of the following is observed:

- The task cannot be carried out by one person because it requires more than two hands and/or two minds (e.g. one student has to throw a ball, another student who is 5 yards away catches it, while a third student measure the time the ball spent in the air, or students have to interview their neighbors and keep statistics).

- The task is physically very difficult for one person to carry out (i.e., the experiment requires multiple simultaneous actions. For example, students have to read temperature of several liquids at exactly the same time).

- The task is designed such that each student or each group has different information that must be shared in order to complete the task as designed.

  In general, these tasks are still ‘product’ oriented, but individual students do not have all the information or the physical skills to do it.

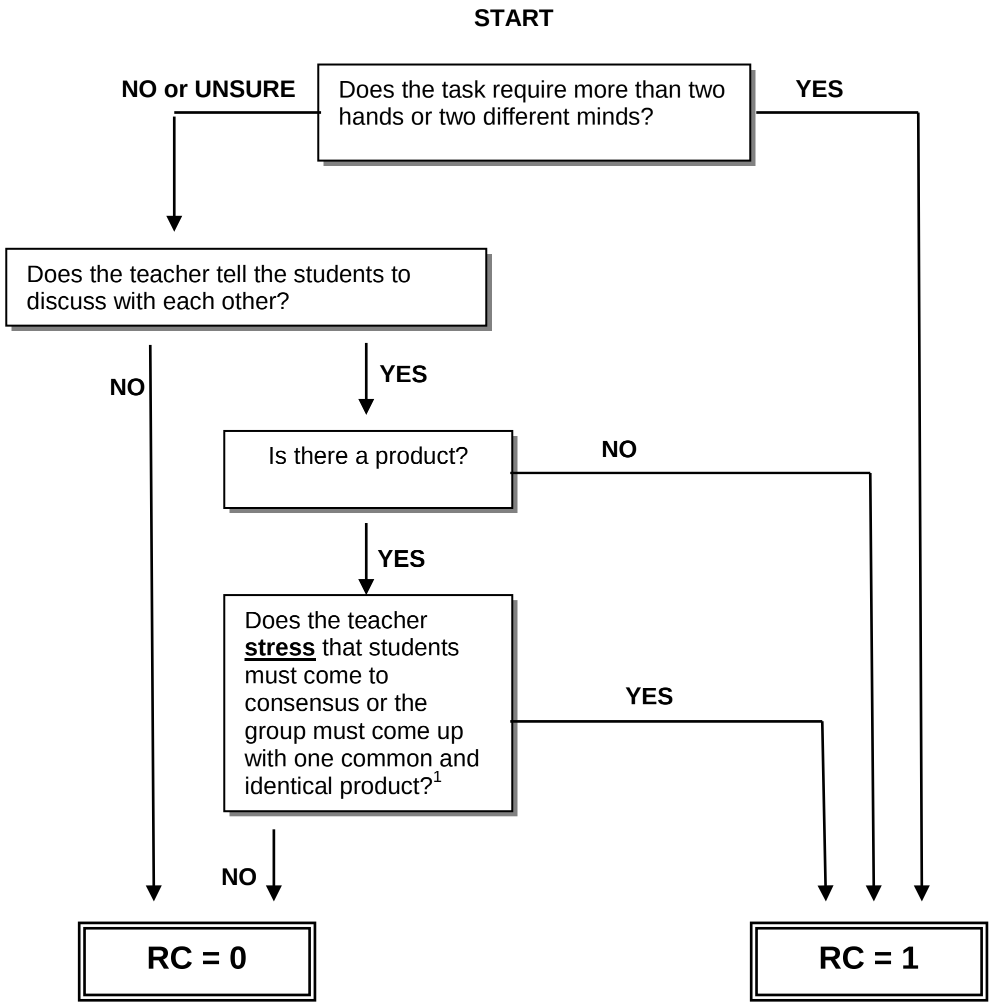
- The main goal of the task is to interact, such as exchanging ideas or opinions, or building a group consensus about something (e.g., formulate a group hypothesis or prepare for a group presentation).

  In general, these tasks are more ‘process’ oriented. The teacher’s ultimate goal is to get the students to work together, likely towards a group product, but the process is ultimately the goal.

- The task is to discuss and/or share ideas or opinions, but no written product is required.

Figure D3.1 describes the process of making coding decisions.

Figure D3.1. How to make a coding decision for difficult situations



[1] When the task has a clear right or wrong answer such as computation or identification of names of objects, it is likely that the task alone does not require students to collaborate. In such cases we will code as RC = 1 *only if* the teacher emphasizes that the students must discuss and agree on the product.

When the expected product is more or less open-ended such as writing a summary of an experiment together, it is more likely that the students will actually collaborate, but still it is possible that one student does all the work and the others simply copy. Again, we will code RC = 1 for such cases *only if* the teacher emphasizes that the students must discuss, come to an agreement, and generate a common and identical product within the group or pair.

Special considerations

- Multiple tasks with differing degrees of required collaboration among students. When students have multiple tasks to accomplish, we will code RC = 1 if collaboration is required for any of the tasks during the segment (only if the segment is coded as pair/group). We do not evaluate the length of time during which students are required to collaborate.

Examples

Code	Lesson	Time
RI = 0	SUS062	55:40-1:20 :00
RI = 1	SJP077	19:48-35:49
	SNL014	9:37-50:26
RI = 99		

D3.2.3.2 Roles Assigned to Students [R]

The teacher may assign different roles to different members in the group. For example, one person can be the discussion leader, or one person writes the results of the task for the whole group. We are interested in identifying whether the teacher specifies and assigns different roles to different members within each group.

Code one of the following:

- R = 0 Students within pairs or groups decide who will carry out different roles.
- R = 1 The teacher designates the specific person(s) within the pair or group who will take on a particular role(s).
- R = 2 Students in pairs or groups are not required to take on different roles.
- R = 55 Code does not apply because individual was coded.

Special considerations

The following will not be counted as assigning student roles:

- The teacher asks one person to get the materials for the whole group (we are looking for roles during the independent phase).
- The teacher asks one student to help another student to catch up.
- The teacher assigns roles to one group due to behavior problems.
- The students have the option to work in groups or individually, even if the teacher assigns roles to those who choose to work in groups.

The roles that carry over across segments. Sometimes the roles that the teacher assigns to the students carry over across AS:WA and AS:WP segments because the task continues. For example, one student from each group is assigned to record the data for a lab experiment, and the experiment happens to be coded as two separate AS:WP segments with a ASPDF in between. In such cases we code R = 1 as long as the task continues and the students know that they are supposed to keep the role. The key is that the students know they have that role.

If the task associated with the assigned role has clearly ended, we will not carry over that role to the next segment.

What is not a formal role? We are coding for roles that clearly defines who does what. If the teacher simply says, *"One of you, pick up the beaker and pour water in it"*, we do not consider this as a formal role. It is obvious that only one person should pick up a beaker, but it could be any student.

If, however, the teacher specifies multiple actions that should take place simultaneously, we will code as R = 1 or R = 2. For example, if the teacher says *"One person will hold the timer and announce when 2 minutes are up, the other person will hold the thermometer and read it at exactly two minutes"*, we will code it as R=1. In the second case, the teacher defines multiple roles.

Examples

Code	Lesson	Time	Explanation
R = 0	SAU004	15:07-25:14	There are no roles. The initial task, "One of the group comes here to get the material", does not count.
R = 1	SUS008	5:38-8:41	
	SJP077	19:48-35:49	

D3.2.3.3 Products made by Students [P]

When students are working together, they may have to work on a group/pair product (e.g., there is one worksheet per group). The other possibility is that they work together, but each student still has to complete her/his own worksheet.

The product is the target outcome of the task. Product here must be tangible such as *written work* or *constructed objects*. The following guidelines are used for AS:WP segments:

- When data collection is involved, we count the *written data* as the product.
- When the students have to answer questions or do calculations based on the collected data, the *written answers* are the product.
- Observation- type tasks, where students manipulate objects to observe a phenomenon do not have a product *unless* the data/observations are recorded. The observable materials left after an experiment are *not* a product.

- Dissection tasks may have a tangible product, if the result of the dissection is an observable finished product. If on the other hand, the dissection is used as a process to arrive at certain answers on a worksheet and the dissected material is discarded before the teacher looks at it, we don't consider it a product.

- Construction task generally involve designing and/or building an object, e.g. design a hovercraft. It generally involves putting several pieces together into a whole.

The following guidelines are used for AS:WA segments:

- Any task that is 'oral' or 'mental' only *does not* have a product. For example, 'have a discussion in your group', 'memorize this', 'look over your test.'

Code one of the following during the segment of AS:WA and AS:WP, if students are responsible for:

- P = 0 No product was produced.

- P = 1 Students worked on individual products.

- P = 2 Students worked on a group product.

- P = 55 Code does not apply because individual was coded.

IMPORTANT NOTE: We are looking for the students' responsibility *during* this segment.

For example: Students collect data in a AS:WP. They do not write anything down. After the conclusion of the AS:WP, the teacher assigns a group task, to write a conclusion regarding this data. In this case, there is a *no* product for the first AS:WP segment because students are not expected to do this group task during the first AS:WP.

<u>Individual and group product occurring simultaneously</u>. In some cases students may work both on an individual and group product during the same AS:WP, or the teacher may give the option to create an individual or group product. In these cases, we will code P = 2.

Exception: the teacher designed an individual task with individual product, but one student is allowed to join another because this student has to catch up. In this case, ignore this student and code P = 1.

<u>Setting up a tool or apparatus that will be used later for an experiment</u>. In some cases, the teacher may set aside time for the students to set up equipment that will be used later. This set-up may involve the construction of an object. We will code this as a product *if* it is the only task assigned. For example, the teacher may ask students to set up a burner, light it and then stop.

If the students are asked to set it up and continue with an experiment, the burner is not the product.

Examples

Code	Lesson	Time	Description
P = 0			
P = 1	SNL038	7:45-39:49	
	SAU004	15:05-25:14	
P = 2	SAU010	14:38-27:20	Kidney dissection
	SAU075	0:01-44:07	Construction of a bridge
P = 99			

D3.2.3.4 Gender Composition of Pairs or Groups [G]

Are there boys and girls in one group or are they separated?

Code one of the following if there are

- G = 0 all groups with single gender;
- G = 1 1 group with mixed gender;
- G = 2 2 or more groups with mixed gender;
- G = 3 all groups with mixed gender; or
- G = 55 code does not apply because individual was coded.

Special considerations

- The groups you cannot see well in the video. We will only consider the students that are close enough to the camera for you to make a judgment. If there is a group that is at the far end of the room, and the camera never comes close to them, simply disregard these students. For all other students, use your best judgment.
- Teacher questionnaire. For this question, it may be helpful to read the teacher questionnaire (Question #11). On the first page, there is a question about the number of girls and boys in the class. If the class is 100% boys, there can be no mixed groups. Sometimes, the teacher indicates that boys and girls are separated on purpose.
- Group gender changes during the segment. If the groups change during the segment, code the 'highest' code observed during either the practical or the writing task. Use the hierarchy (from high to low): 3>2>1>0.

Example: If you see two mixed gender groups at one point, but later the groups have changed and girls work with only with girls, than still code '2'.

- <u>When unsure of the gender of one student</u>. If you are unsure about one student, and this one student becomes the deciding factor, make your judgment based on the student's partner(s) in the same group, and also how other pairs/groups are arranged.

  For example, if all students are separate gender groups (boys with boys, girls with girls), and there is one student that you are not sure of the gender. If this student is sitting with the boys' group, then consider him a boy.

  Rule: when in doubt, look at its partner(s).

  Examples

Code	Lesson	Time
G = 0	SJP069	17:27-39:06
G = 1	SAU004	15:07-25:14
G = 2	SUS062	55:40-1:20:15
G = 3	SJP074	13:58-43:39

<u>*D3.2.3.5 Number of Students in Groups [N]*</u>

When students work in groups, it is usually clear how many students are in the group. In many cases, the teacher will specify the group size. In other cases, it is clear by the arrangement of the desks how many students there are in a group.

- N = 2 The students work in PAIRS.
- N = 3 The students work in groups of 3.
- N = 4 The students work in groups of 4.
- N = 5 The students work in groups of 5.
- N = 6 The students work in groups of 6.
- N = 7 (etc) The students work in groups of 7 or more.
- N = 99 Can't tell.
- N = 55 Code does not apply because individual was coded.

If you are considering the answer N = 2, it should be pair work.

Special considerations

- <u>When the groups are not the same size</u>. It is possible that not all groups are the same size. To code for the main structure, we coded GROUP if there are at least two groups of three or more. Similarly, if the group size varies, we will code the higher number observed, provided there are at least *two* groups of that number.

Examples

- 2 Groups of 4, 2 Groups of 5, 1 Group of 6 → Code N=5.
- 16 pairs, 2 groups of 3, 1 group of 4 → N=3.
- 7 groups of 3, 1 group of 4→ N=3.

Examples

Code	Lesson	Time
N = 3		
N = 4	SJP077	19:48 - 35:49
	SUS062	55:40 - 1:20:15
N = 5	SJP074	13:58 - 43:39
N = 00		

Exhibit: Coding Sheet

<u>Codes</u>	<u>AS:WA</u>	<u>AS:WP</u>
Individual	[S: A1]	[S: P1]
Pair	[S: A2]	[S: P2]
Group	[S: A3]	[S: P3]
Other	[S: A4]	[S: P4]

	Individual	Pair	Group
1. Physical Arrangement of Students	Yes	Yes	Yes
2. Sharing Materials	Yes	Yes	Yes
3. Amount of Talk among Students	Yes	Yes	Yes
4. Expected interaction	Yes		
5. Required Collaboration among Students		Yes	Yes
6. Roles Assigned to Students		Yes	Yes
7. Products Made by Students		Yes	Yes
8. Gender Composition of Pairs or Groups		Yes	Yes
9. Number of Students in Groups		Yes	Yes

<u>Physical arrangement of students</u>

PA = 1 One student per desk (sitting or standing)

PA = 2 Two students per desk (sitting or standing), or two desks are joined without barrier or space.

PA = 3 Three or more students per desk, or three desks are joined without barrier or space.

PA = 99 Other desk arrangements, or no majority for any arrangement. E.g. Students are not at desks, walk around between lab stations, or walk around in the library.

Sharing materials

M = 0 No special materials are used
M = 1 Each student has her/his own materials to work with
M = 2 Each student rotates in using materials, or the whole class shares materials
M = 3 Students share materials in pairs/groups

Amount of talk among students

OI = 1 No talking or very little talking is observed
OI = 2 Some or a lot of talking is observed

Expected level of interaction among students

EI = 0 Teacher indicates no talking during individual work
EI = 1 Teacher indicates an option of talking during individual work
EI = 99 Undetermined what teacher indicates
EI = 55 Code does not apply because the segment has been coded as pair or group.

Required collaboration among students

RC = 0 No required collaboration
RC = 1 Required collaboration
RC = 99 Cannot tell (the task is unknown).
RC = 55 Code does not apply because the segment has been coded as individual.

Roles assigned to students

R = 0 Students within pairs or groups decide who will carry out different roles.
R = 1 The teacher designates the specific person(s) within the pair or group who will take on a particular role(s).
R = 2 Students in pairs or groups are not required to take on different roles.
R = 55 Code does not apply because individual was coded.

Products made by students

P = 0 No product
P = 1 Individual product
P = 2 Group product
P = 55 Code does not apply because individual was coded.

Gender composition of pairs or groups

G = 0 No mixed gender groups
G = 1 1 mixed gender groups
G = 2 2 or more mixed gender groups
G = 3 All mixed gender groups
G = 55 Code does not apply because individual was coded

Number of students in groups

N = 2	Students work in PAIRS
N = 3	Students work in groups of 3
N = 4	Students work in groups of 4
N = 5	Students work in groups of 5
N = 6	Students work in groups of 6
N = n	Students work in groups of n
N = 99	Can’t tell.
N = 55,	Code does not apply because individual was coded

Chapter D4: Activity Structures

The activity structures dimension captures observable instructional practices during the science instruction phase. This dimension includes the following eight codes:

- whole-class work [ASPDF];
    - whole-class seatwork activities [AS:PD];
    - whole-class practical activities [ASPPD];
- independent practical activities [AS:WP];
- independent seatwork activities [AS:WA];
- copying notes [AS:CN];
- silent reading [AS:IR] and
- divided class [AS:DC].

The activity structures codes are coverage codes. That is, the event types are mutually exclusive and exhaustive within the science instruction phase.

The two main research questions for this dimension are focused on the issues of practical work and the receiving vs. doing roles that students play:

- What kinds of first-hand practical experiences do students have to learn content ideas?
- Is the lesson teacher-focused or student-focused? Do students play an active or passive role?

Table D4.1 provides an overview of the Activity Structures codes based on:

- the presence of practical work (practical or seatwork);
- the social organization of interaction (whole-class or independent); and
- student involvement (receiving or doing).

Table D4.1. Activity structure conceptual overview

	Whole class (students work with the teacher)	Independent (students work individually or in groups)	Mixed (Both whole-class and independent structures observed at the same time)
Practical (work with objects, materials, 3-D models, organisms)			
<u>Receiving</u> Students primarily receiving information (e.g., watching, listening, reading, copying)	ASPPD		AS:WP (Teacher-led)
<u>Doing</u> Students primarily doing science work (e.g., presenting, discussing, experimenting)		AS:WP	
Seatwork (no use of objects, materials, 3-D models, organisms)			
<u>Receiving</u> Students primarily receiving information (e.g., watching, listening, reading, copying)	AS:PD	AS:CN AS:IR	
<u>Doing</u> Students primarily doing science work (e.g., writing, discussing)		AS:WA	

- Practical work vs. Seatwork
  - <u>Practical work.</u> The students and/or the teacher interact with objects, materials, 3-D models, or organisms for purposes such as: generating and or gathering data; observing or modeling objects or phenomena; or practicing a skill that involves manipulation.
  - <u>Seatwork.</u> No such interaction with objects, materials, 3-D models, or organisms.
- Whole-class vs. Independent

<u>Whole-class.</u> Social organization in which the teacher works with the entire group of students. During this period all students are expected to engage in and pay attention to the class activity guided by the teacher.

- o Independent. Social organization in which students are required, explicitly encouraged, or expected by the teacher to work on an assignment alone or in partnership with one or more classmates.

- Receiving vs. Doing

    - o Receiving. Students are primarily receiving science content information, either by listening, reading, copying notes, or watching a demonstration.

    - o Doing. Students are primarily doing science; that is, they are acting upon the science content knowledge by performing experiments, completing written assignments, interacting in small group discussions, etc.

D4.1 Whole-Class Work Codes [ASPDF]

Whole-class work codes are designed to identify parts of the lesson that involve the whole class working together while science information is presented and/or discussed. The students are primarily "receiving" information and respond to the teacher's questions. These types of activity structures are very different from independent work activity structures (AS:WP and AS:WA), where the majority of the class is primarily "doing" science work independently (e.g., experimenting, writing, on their own etc.).

We divide the segments of the lesson where students are involved in whole-class work into two main types:

- whole-class seatwork activities [AS:PD]; and

- whole-class practical activities [ASPPD].

ASPPD will refer to the moments during AS:PD (consisting of whole-class presentations and discussion) when the teacher uses an object (or objects) to augment the presentation or discussion of the science content (e.g., demonstrations).

These two codes often appear together in lessons, sometimes in a long series of short, alternating AS:PD and ASPPD segments. To avoid complex short segment rules and to improve coding accuracy, we designed a special set of rules, which will be applied to these codes only.

D4.1.1 Conceptual Overview

ASPPD is a special type of AS:PD that involves the use of objects. Sometimes, a lesson may include a long sequence of AS:PD and ASPPD segments.

For example, the teacher may strum a note on a guitar to demonstrate a property of sound (ASPPD), put down the guitar, talk (AS:PD), and then pick up another musical instrument to demonstrate how it produces sound (ASPPD). He may repeat this sequence several times. In this case, the actual time during which he is acting upon each instrument may be a few seconds, but the entire period of time during which he is acting upon and talking about the instruments and their sounds may be much longer.

Conceptually, the above-described sequence of AS:PD and ASPPD can be thought of as one AS:PD family segment; the teacher presents information and/or leads a discussion throughout the entire segment. However, part of the time the teacher uses objects (musical instruments) to assist with the Whole-class activities.

The AS:PD family (ASPDF) in this example is made up of a sequence of smaller segments of AS:PD and ASPPD that occur one right after another, with no other activity structure included in the sequence.

	ASPDF							
AS:WP	AS:PD	ASPPD	AS:PD	ASPPD	AS:PD	ASPPD	AS:PD	AS:WA
2 min	16s	25s	46s	2s	5s	45s	40s	2 min

In our coding, we will identify both the larger ASPDF segments and the smaller AS:PD and ASPPD segments within the ASPDF.

This concept of whole-class work that is made up of smaller AS:PD and ASPPD segments will be reflected in the coding procedures. That is, you will code In- and Out-Points for both the larger ASPDF segments and the smaller AS:PD and ASPPD segments. See the two options described below. You can decide which order you prefer in coding these segments.

Option 1: Smaller segments → larger segments

AS:PD	AS:WA	AS:PD	ASPPD	AS:PD	ASPPD	AS:PD	AS:WA	AS:PD
ASPDF		ASPDF						ASPDF

Step 1. Identify all segments of AS:PD and ASPPD activity structure regardless of length. Mark the In- and Out-Points for each.

Step 2. Identify the larger AS:PD FAMILY segment[9]– a sequence of one or more segments of AS:PD or ASPPD that are not interrupted by a segment of any other activity type. The AS:PD FAMILY segment must be equal to or greater than 30 seconds. If the ASPDF segment is less than 30 seconds, see short ASPDF segment rules (see 4.1.2).

Option 2: Larger segments → smaller segments

ASPDF	AS:WA	ASPDF					AS:WA	ASPDF
AS:PD		AS:PD	ASPPD	AS:PD	ASPPD	AS:PD		AS:PD

Step 1. Identify the long segments of ASPDF. Each ASPDF segment must be equal to or greater than 30 seconds. If there is an ASPDF segment that is less than 30 seconds, see short ASPDF segment rules (see 4.1.2). Mark the In- and Out-Points for each ASPDF segment.

Step 2. Within each ASPDF segment, identify each of the AS:PD and ASPPD segments, regardless of length. Mark the In- and Out-Points for each AS:PD and ASPPD segment.

[9] The In-Point for whole-class work occurs where the first segment of the AS:PD/ASPPD sequence begins. The Out-Point for whole-class work is at the end of the last segment of the sequence of AS:PD and ASPPD.

IMPORTANT NOTE: An ASPDF segment can consist of only one segment of AS:PD or one segment of ASPPD. This means that each single segment of AS:PD or ASPPD will be coded twice, that is, first as whole-class work and then as one of the labels of AS:PD or ASPPD.

D4.1.2 Short ASPDF Segments

If the total sum of the ASPDF is less than 30 seconds, apply any of the general short segment rules as necessary (see section D4.4.9). Treat the ASPDF segment according to the hierarchy. Below are two example scenarios of short ASPDF segments.

Examples

Students are working on an independent practical activity. The teacher calls for students' attention and briefly talks and shows them a new tool they should use. The students then continue to work on the practical assignment.

<table>
<tr><td></td><td colspan="2">ASPDF
< 30 sec</td><td></td></tr>
<tr><td>AS:WP</td><td>AS:PD</td><td>ASPPD</td><td>AS:WP</td></tr>
<tr><td>Eligible segment</td><td>15 sec</td><td>10 sec</td><td>Eligible Segment</td></tr>
<tr><td colspan="4">AS:WP</td></tr>
</table>

Students are working on an independent practical activity. The teacher calls for students' attention and then shows them a new tool they should use. She then asks them to silently read the next step in the directions. Then she gives the signal for them to start on the next step of the practical assignment.

<table>
<tr><td></td><td colspan="2">ASPDF
27 sec</td><td></td><td></td></tr>
<tr><td>AS:WP</td><td>AS:PD
15 sec</td><td>ASPPD
12 sec</td><td>AS:IR
25 sec</td><td>AS:WP</td></tr>
<tr><td>Eligible segment</td><td colspan="3"></td><td>Eligible Segment</td></tr>
<tr><td>AS:WP</td><td colspan="3">ASPDF</td><td>AS:WP</td></tr>
</table>

D4.1.3 Whole-Class Seatwork Activities [AS:PD]

Whole-class seatwork activities [AS:PD] is a period of time during which instructionally-related information is provided and/or talked about in a whole-class context, primarily through oral and/or visual means. All students are expected to pay attention to the discussion/presentation. During this time, the students and teacher are not engaged in any practical activity (which involves the use of objects, materials, or organisms).

AS:PD segment must be 30 seconds or longer if it is surrounded only by AS:WP, AS:WA, AS:CN, AS:IR, or an AS:DC segments.

AS:PD segment can be less than 30 seconds if it appears in partnership with other ASPPD and AS:PD segments, and together they add up to 30 seconds or greater.

D4.1.3.1 Helpful Indicators

Table D4.2. Indicators for marking whole-class seatwork activities

Classroom talk	Primarily public
Social organization	Whole class working together.
Student involvement	Primarily receiving or providing information orally.
Teacher actions	Primarily presenting information, posing questions, leading discussion.
Physical objects	No 3-D objects are used.
Content of discussion	Any content that fits within science instruction.

Classroom talk. When the teacher is instructing the whole class, the talk is predominantly public. Although some student contributions to the discussion may be inaudible on the tape, the teacher is listening and expecting the other students to be listening.

Social organization. The social structure is whole-class. The teacher is working with the students. During this period all students are expected to engage in and pay attention to the class activity guided by the teacher. This includes listening to other students' responses to teacher questions.

Student involvement. Students are not engaged in practical activities. During this time the majority of the class is listening while one person (the teacher or a student) is speaking or providing information through visual means. The students might respond to teacher (or student) questions or initiate discussion. Students may be taking notes while listening.

Teacher actions. The teacher is primarily presenting information, posing questions to students, or leading a discussion.

Physical objects. No 3-D objects are used. Flat representations (diagrams, photos, videos, etc.) might be used.

Content of discussion. Remember that this code refers to the activity structure, not the content of the discussion. Therefore, as long as the discussion fits within the science instruction phase, it will be coded as AS:PD.

Special considerations

Sources of information. AS:PD is not limited to the segments when information is presented by the teacher. Other sources may be providing information. Examples of other sources are

- another person (e.g., student, visitor); and
- audio/visual source (e.g., videos, audio tapes).

Teacher/student writing. Sometimes while the teacher is speaking to the whole class, he/she may write some notes on the board. Students may also write some notes in their notebooks. Code these as AS:PD unless it is clear that the time is explicitly set aside ONLY for taking notes (see later definition of AS:CN).

Students' waiting time during AS:PD structure. There may be instances during an AS:PD segment when the teacher is not instructing the students (or leaves the room temporarily), and the students are just waiting for the teacher to resume instruction. In such cases do not shift the activity structure (keep as AS:PD).

Students' waiting time during teacher one-by-one interactions. If the teacher interacts with students in a one-by-one manner (the same task repeated with each student one-by-one) without any use of objects, AND the rest of the class is simply waiting (not expected to watch what the teacher is doing with each student), code as AS:PD.

Student(s) working in different activity structures. The teacher might ask one or more students to work on a separate task in a different activity structure while the rest of the class is in an AS:PD mode.

For example, the teacher tells one student to go to the front of the room to do an experiment (independent practical activities) *or* the teacher tells one student to make up a written quiz (independent seatwork activities). While the one student works on a practical activity or a written assignment (seatwork activity), the teacher works in a whole-class mode with the rest of the class. The student working on an independent practical activity or the student are working on an independent seatwork activity is carrying out a very different task from the rest of the class.

- If there is only one student working on a different task in a different activity structure, ignore that student, and code according to what the teacher is doing with the rest of the class (in this case, AS:PD).

- If there are two or more students who are working in a different activity structure (e.g., on a practical assignment or on a written assignment), refer to the section about divided class and code as AS:DC if the situation meets the criteria.

Dictating. If the teacher orally dictates information that students are expected to write down, consider the following:

- Is the material to be copied also written down for students to see? If it is written down, consider whether the time following the oral dictation qualifies as **AS:CN** (e.g., teacher is silent or only facilitating students' copying for 30 seconds or more while students copy).

- Are students expected to copy exactly what the teacher is dictating, or is there an option for students to use their own words, to work at their own pace, to start to work on the writing before the teacher begins to dictate, etc?

If students are expected to copy *word-for-word what is orally dictated (and not written down for students to copy)*, this will be coded as ASPDF**.** This is treated the same as note-taking during a presentation. Usually the pauses between the teacher's dictating and the students' writing will be brief (less than 30 seconds).

If students have the *option to use their own words*, to work at their own pace, or to start to work before the teacher dictates *and* they have 30 seconds or longer to do this, this will be coded as AS:WA *even if* the teacher at some point dictates an answer that students can simply copy down.

D4.1.3.2 Marking In- and Out-Points of AS:PD

An AS:PD segment typically begins when the speaker (usually the teacher) indicates an immediate need for the attention of all students (through verbal or physical signals), and the students comply. Mark the In-Point at the beginning of a successful bid for public interaction.

Mark the Out-Point when another Activity structure segment is identified.

Special considerations for In-Point of AS:PD

Delayed student compliance. In some cases, students may not immediately comply with the request for attention. We will use the notion of "smooth transition" previously used in Dimension 1. Code the In-Point of AS:PD according to the following rules:

- Smooth transition. In most cases there is a smooth transition to AS:PD. That is, instruction immediately follows the signal (e.g., "Okay. Now this experiment is about gravity…"). Mark the In-Point with the teacher's bid for attention or at the beginning of the signal.

- Somewhat smooth transition. There are two types of "somewhat smooth" transitions:

    - Teacher may keep talking despite lack of student compliance. In other cases, the transition may be questionable because the teacher's talk transitions smoothly into AS:PD (the teacher bids for attention and keeps on talking), but the students do not immediately comply.

      For example, students may be chitchatting while the teacher talks or students might continue to work silently on the previous activity while the teacher talks. The teacher continues to talk publicly despite students' off-task behavior or their continued work on the previous task . If the teacher continues to talk after the signal for attention, consider this a somewhat smooth transition to AS:PD.

Mark the In-Point at the start of the signal.

- The teacher's signal for attention may be followed by brief attempts by the teacher to get students' attention before instruction starts. In these cases, the teacher does not pause and wait for students to finish working on something else, but moves "somewhat smoothly" into the AS:PD structure.

  For example, the teacher says, "Okay everyone, shhhh. Debbie, listen up now. On your lab today you will be …" ; <u>or</u> "Okay obviously- John are you listening? I need everyone's attention now. Ok, obviously you should always wear your goggles because these chemicals are dangerous …).

  Mark the In-Point at the start of the signal.

- <u>Not smooth transition</u>. In some cases, it will be clear that the transition to AS:PD is not smooth. There are two types of "not smooth" transitions:

  - The teacher continues to attempt to get students' attention repeatedly for a period of time (repeating the signal, asking for attention, disciplining some students). In these cases, mark the In-Point of AS:PD when the instructional talk starts.

  - The teacher signals for attention, or begins to signal for attention, but then stops and waits for students to get quiet or finish working on a previous activity. The teacher waits silently. If the silent pause lasts less than 5 seconds, mark the In-Point at the beginning of the initial signal for attention. If the silent pause lasts 5 seconds or longer, wait and mark the In-Point at the beginning of the instructional talk.

In-Point of AS:PD following Teacher-Led AS:WP

(See definition of teacher-led independent practical activities on pp.18-19).

If the practical activity is teacher-led, there may not be a clear bid for attention marking the end of the practical activity and the beginning of an AS:PD segment.

For example, the teacher has been talking continuously to the class, directing their practical work, and at some point the teacher talk shifts away from the practical activity (the observations, manipulations, and talk about how to do the observations and manipulations) and into the presentation of new information.

Mark the In-Point when the teacher's talk shifts away from "step-by-step" directions of what to do or from direct talk about the observations and manipulations being made. The teacher is shifting students' attention away from the *observation* and/or *manipulation of* the objects to the consideration of the *ideas about* the objects (such as: drawing conclusions, discussing the 111results or the observations, introducing new terms, making predictions, writing down notes, etc.), or to a new topic or new activity. At this point most of the students will attend to the teacher and stop manipulating the objects (however, this may be a gradual process).

In-Point of AS:PD following ASPPD

It is sometimes difficult to decide where an AS:PD segment begins when it follows an ASPPD segment. To find the In-Point for an AS:PD following ASPPD, first consider whether or not there is a *physical* and/or *verbal signal* that the teacher is no longer calling students' attention to the objects:

- Physical signals to stop attending to the objects include setting the object down, walking away from the object, standing in front of the object, lowering the object, etc.

- Verbal signals to stop attending to the objects are words that indicate that students should no longer be observing the objects (e.g., "Now we are done with these." Or "Now we will look at something else.").

The In-Point of AS:PD segment occurs at one of the three possible points:

- the moment of a physical signal to stop attending to the objects;

- after a verbal signal to stop attending to the objects; or

- when a shift from the talk about the objects and observations of the objects to the talk about ideas related to the objects or to a new task or topic occurs.

The rules on the next page will tell you how to choose among these three possible In-Points. However, there is one important point to keep in mind for all three scenarios:

- The teacher (or students) makes a direct comment or question about the objects and/or observations immediately after a physical or verbal signal to stop looking at the objects. In such cases wait to start the AS:PD until the talk shifts away from the objects towards the talk about ideas related to the objects or to a new topic or task.

    For example: The teacher puts down the objects and asks a question about what color the solution turned. Mark the In-Point of AS:PD after the immediate answer to this question.

Exhibit 4.1. Guidelines for marking the In-Point of AS:PD following ASPPD

Mark at physical signal →	a) Physical signal only. If there is verbal signal only to stop attending to the objects, mark the **In-Point** of **AS:PD** at the moment when the physical signal to stop attending to the objects is observed (e.g., when the teacher sets the object down).
Mark at end of verbal signal →	b) Both physical and verbal signal. If there are both physical and verbal signals to stop attending to the objects, mark the **In-Point** of **AS:PD** at the end of the verbal signal.
Mark at end of verbal signal →	c) Verbal signal only. If there is a verbal signal but no physical signal to stop attending to the objects (e.g., "Okay, we don't need these test tubes anymore." Or "Now we will set these aside."), mark the **In-Point** of **AS:PD** at the end of the verbal signal to stop attending to the objects.
Mark at shift in talk →	d) Shift in the talk with no physical signal. If there is no physical signal to stop attending to the objects but there is a shift from talk (by teacher or students) about the specific objects and observations of the objects to talk about ideas related to the objects or to a new topic or task, mark the **In-Point** of **AS:PD** at the beginning of the sentence where the talk makes such a shift.

REMINDER: Students might be the ones talking about the objects (e.g., the teacher asks them a question about the object and students respond. If the teacher references the objects during the question, include the student response(s) to the question as part of the ASPPD segment.

When in doubt, err on the side of ASPPD.

Teacher organizing self, students wait. Sometimes the teacher calls for attention of the whole class, and the students comply, but the teacher delays or interrupts the start of a new activity structure by spending time getting organized. Include this teacher-organizing-self time in AS:PD, and mark the In-Point at the beginning of teacher signal for attention.

The teacher may also interrupt or stop in the middle of an AS:PD segment to organize him or herself. The students are waiting while the teacher gets organized, and the teacher is not talking to the whole class about science content. Keep the teacher-organizing-time in AS:PD.

If the teacher is organizing materials for an upcoming demonstration without talking about science content, AND students can see the teacher's manipulations of the objects, code this as ASPPD.

D4.1.4 Whole-Class Practical Activities [ASPPD]

Whole-Class Practical Activities [ASPPD] is a period of time when the science content is presented/discussed with the use of objects (e.g., science equipment, 3-D models, organisms etc.), and all students have the opportunity to observe the objects in one of two ways. (1) The whole class observes the teacher or another student(s) manipulate or show objects, materials, 3-D models, or organisms. There is one set of objects for the whole class to observe, and the objects are usually placed in front of the class. The purposes include observing and/or identifying objects or phenomena, generating and/or gathering data, or practicing/modeling a skill that involves manipulation. (2) Each student or group of students has their own set of objects to observe. Students do not have the opportunity to manipulate the objects. Students' observation is accompanied by public teacher talk guiding their observations. The purpose is to observe and/or identify the objects.

ASPPD segment must be 30 seconds or longer if it is surrounded only by AS:WP, AS:WA, AS:CN, AS:IR, or AS:DC segments.

ASPPD segment can be less than 30 seconds if it appears in partnership with other AS:PD and/or ASPPD segments, and if together they add up to 30 seconds or greater.

D4.1.4.1 Helpful Indicators

Table D4.3. Indicators for marking whole-class practical activities

Physical objects	Objects are present and observed by all students. If the objects are manipulated, it is the teacher or a small group of students who demonstrate to the rest of the class.
Classroom talk	Primarily PUBLIC.
Social organization	Whole class working together.
Student involvement	Primarily observing someone else doing the practical activity. Participating mainly through observation and discussion (e.g., responding to teacher questions orally).
Teacher actions	Manipulating objects and/or talking about the objects
Physical arrangement of class	Students arranged so they can see the objects. Objects may be at the front of whole class or in front of each student or group of students.
Content of discussion	Any content that fits within science instruction.

Physical objects. The use of objects is a key indicator for this code. Objects, materials, 3-D models, or organisms can be seen by the whole class. If the objects are manipulated, it is the teacher or a small group of students who demonstrate to the rest of the class. Objects, materials, and/or organisms may *be shown and/or manipulated* by the presenter. (See the next sections, 4.1.4.2 and 4.1.4.3, for the details about objects that qualify or do not qualify for ASPPD).

Classroom talk. When the teacher is instructing the whole class, the talk is predominantly public. Although some student contributions to the discussion may be inaudible on the tape, the teacher is listening to the students and expecting other students to be listening.

Social organization. The social structure is whole class. The teacher is working with all of the students. During this period all students are expected to engage in and pay attention to the class activity guided by the teacher. This includes listening to other students' responses to teacher questions.

Student involvement. Students engage in the activity primarily through observation and/or discussion (not by using the objects). Students do not participate in the manipulation of the objects or in the recording of observations about manipulations. Instead they watch the teacher or other selected student(s) do the practical task.

Teacher actions. The teacher (or other instructor) is usually manipulating and/or talking about the objects. The teacher might ask questions while referring to the objects (asking students to make observations, for example). Sometimes a few students will also be called to participate in or even lead the activity while the teacher watches on.

Physical arrangement of class. Sometimes there is one set of objects for the whole class to observe; other times each student or group of students has their own objects placed in front of them. The students are arranged so that they can see the objects. Sometimes the teacher explicitly tells the students to rearrange their seating (e.g., gather around the teacher's desk) so that they can observe the objects more easily.

Content of discussion. Remember that the whole-class practical work refers to the activity structure, not the content of the discussion. As long as the discussion fits within the science instruction phase, it will be coded as ASPPD.

D4.1.4.2 Objects that Qualify as ASPPD

There are four basic types of objects that qualify as ASPPD.

3-D science-related objects. Any 3-D objects related to science instruction that are shown or manipulated by a presenter to the rest of the class qualify the segment as ASPPD.

Flat representations that are manipulated to become 3-D**.** Typically, the teacher's use of flat representations (diagrams, photos, posters, concept maps, videos, etc.) in a presentation to the whole class are NOT coded as ASPPD (they are coded as AS:PD).

There are *two cases* when a flat representation could be considered as ASPPD:

- The teacher (or other presenter) manipulates a flat representation of an object or process, such as pictures, cut-outs, or symbolic materials (e.g., symbols for chemical elements or compounds), *to create a 3-D object or model*. Code as ASPPD.

- The teacher (or other presenter) *acts upon the flat representation in three dimensions*. For example, a classic activity used to represent natural selection involves dropping light and dark pieces of confetti on different colored background paper. The student or teacher then has a certain amount of time to pick up the pieces of confetti. Although this activity involves the use of a representation that is made only of pieces of paper (flat materials), the presenter (teacher or one or a few students) is acting upon the flat representation in three dimensions (dropping and picking up the confetti). Code as ASPPD.

<u>Computer simulations.</u> Sometimes the teacher uses a computer simulation to give the students a vicarious experience of observing and/or manipulating objects, materials, or organisms. Include these as ASPPD only if

- The teacher (or other presenter) uses the computer to show the class the results of a first-hand event that takes place in the classroom (e.g., showing the sound waves of a high-pitched whistle that the teacher used, or graphing the rise in temperature of a beaker of boiling water that is hooked to the computer via a temperature probe).

- The teacher (or other presenter) shows a computer simulation to provide the whole class with a vicarious experience of observing or handling/manipulating objects, materials, or organisms. The simulation involves the presenter in manipulating or acting upon the simulation (e.g , presenter manipulates variables, moves objects around, etc.).

<u>Students' and teacher's bodies or body parts as "objects."</u> Sometimes the teacher may use her/his body or body parts or students' bodies or body parts to represent objects, processes, or phenomena in different ways:

- The whole body of the teacher and/or students is used to create a human 3-D model that represents an object, process, or phenomena. For example, the teacher may act as the sun and have selected students act as the earth rotating and revolving around him/her. In this case the teacher is using bodies to represent 3-D models of objects and phenomena.

- A body part of the teacher or student is used to create a natural phenomenon that students can observe (e.g., the teacher uses vocal cords to demonstrate sound). For example, the teacher might use his body or body parts to create a natural phenomena for students to observe, such as "buzzing" his lips to talk about sound or jumping up in the air to talk gravity.

- A body part of the teacher or student is the object that is being observed. For example, the teacher might point to his elbow as an example of a joint. In this case the teacher is using a body part as the object under observation.

For a body part to be included as an object for ASPPD, the following conditions must be met:

- The teacher must be physically signaling a body part that can be observed by students (e.g., a chin or elbow or eye can be seen but the esophagus or brain cannot).

- The body part is specifically mentioned verbally by the teacher (e.g., points at the jaw and speaks about "the jaw").

In all of these cases, the rest of the class is supposed to observe, and the segment is coded as ASPPD.

EXCEPTION**:** Do not include cases where the teacher uses body parts to create a 3-D model.

For example, the teacher uses one fist to represent the sun and another fist to represent the earth moving around the sun. Or the teacher uses his arm to imitate wave action. These cases will not be considered as ASPPD.

D4.1.4.3 Objects that Do Not Qualify as ASPPD

The teacher may show or manipulate certain objects that do NOT qualify as ASPPD, such as:

- Everyday classroom tools. In general, everyday classroom tools, such as pencils, paper, calculators, computers, and drawing instruments, do not indicate a practical presentation task. For example, if the teacher uses a ruler to help draw a diagram on the board or uses a calculator to solve a mathematical problem being worked on publicly, do not code this as ASPPD. When these tools are used to accomplish a first-hand practical task (such as the use of the ruler for measuring an object or for demonstrating sound vibrations), then code this as ASPPD.

- Flat representations that are not manipulated. With two exceptions (see above), the use of flat representations (diagrams, photos, posters, concept maps, videos, etc.) in a presentation to the whole class is NOT coded as ASPPD (it is coded as AS:PD).

- Objects used only as markers or prizes. Sometimes the teacher may use objects only as markers or prizes. For example, the teacher uses magnets on the blackboard to mark the points on a graph. Alternatively, the teacher shows the students prizes that will be awarded to the winner of an upcoming science game or contest. The use of such markers and prizes should NOT be coded as ASPPD.

- Computer demonstration. Demonstrations with a computer shown to the entire class are *not* included as ASPPD if:
  - The computer is strictly used as a writing tool. For example, the teacher displays and creates notes on a PowerPoint program.
  - The computer is used as a "digital library of information." For example, the teacher demonstrates how to search the Internet to find some science-related information.
  - The computer is used only for visual purposes. For example, the teacher uses the computer to show students a videotaped program.

Special Considerations

- Observation via five senses. Most often students are required to use their vision for observing the practical activity, but they may also observe by hearing, smelling, touching, or tasting the presented objects. Code these as ASPPD.

- Limitations of observation. Sometimes, due to the nature of the task, not all students are able to see all aspects of the practical work at all times. Some students' view may be blocked by other students, or the details of the object might be too small for students to observe from a distance. When objects are small, the teacher might ask one or two students to make the observations and report the results to the whole class. Alternatively, the teacher might simply hold up objects that are too small to be observed by many students. However, it is clear that the teacher intends to direct students' attention to the object. Code all these situations as ASPPD.

- Students help with demonstration, rest of class waits. Sometimes the teacher will ask one or a few students to help with the demonstration. At this point, the rest of the students may not be able to see the objects**.** However, there is usually public discussion of the actions and/or results of the actions being carried out by the selected students either while they are helping or when they are finished. Code this as ASPPD as long as there is no independent task assigned to the rest of the class.

- Showing objects to students one-by-one. If the teacher shows students an object(s) in a one-by-one manner (the same object is shown to each student individually, one after another) AND the rest of the class is simply waiting, code as ASPPD. If the rest of the class is working on another task while the teacher shows objects one-by-one, consider whether the situation meets all the criteria for divided class.

- Talking about objects that will be used later. Talking about objects students will use later in the lesson does not count as ASPPD unless the teacher makes objects available for the majority of the students to see and talks about them.

  For example, the teacher pointing to the objects placed in different parts of the classroom and indicating the work stations will not count as ASPPD. However, if the teacher holds up an ammeter so that everyone can see it and points to the ammeter while explaining how the students will use the ammeter during the practical activity, this would be coded as ASPPD.

- Student(s) working in different activity structures. The teacher might ask one or more students to work on a separate task in a different activity structure while the rest of the class is in an ASPPD mode.

  For example, the teacher tells one student to make up a written quiz (independent seatwork activities). While the one student works on the quiz, the teacher works in an ASPPD mode with the rest of the class. The student working on the quiz is carrying out a very different task from the rest of the class and is working in a different activity structure (independent seatwork activities).

If there is only one student working on a different task in a different activity structure, ignore that student, and code according to what the teacher is doing with the rest of the class (in this case, ASPPD).

However, if there are two or more students who are working in a different activity structure (for example, on a written assignment), refer to the section about divided class and code as AS:DC if the situation meets the criteria.

D4.1.4.4 Marking In- and Out-Points of ASPPD

Mark the In-Point of ASPPD *only when* two conditions are met:

- The object(s) is visible to the class. "Visible" means that most students have a viewline that enables them to see the object. It does not mean that all students can see the details of the object. Sometimes teachers hold up objects that are too small for students to see in detail from a distance or motions toward an object sitting on a table or desk. Err on the side of ASPPD if it is clear that the teacher intends to draw students' attention to the object.

- The person who is leading the practical presentation (usually the teacher) directs students' attention to the object(s) with

  - a physical signal (pointing to the objects, manipulating the objects, lifting the objects up to be seen); and/or

  - a verbal signal to look (using words to direct students' attention to the specific objects being observed, such as "look at this rock here"). A verbal signal to look tells students to attend to or observe the objects. Sometimes the teacher precedes a signal to look with talk about ideas related to the objects. Such statements are not considered a signal to look at the objects.

For example: "The human heart has 4 chambers. You can see the four chambers in this model of a human heart." In this case, the words, "in this model of a human heart," are the signal that directs students' attention to the model. The comment that the heart contains 4 chambers is an idea about the heart, but it does not direct students' attention to look at the model. Therefore, the statement about the heart having 4 chambers is not part of the signal to attend to the objects.

Once these two conditions are met, identify whether there is a

- physical signal *only*;
- verbal signal *only*; or
- *both* a physical and a verbal signal.

Physical signal only. If the object is visible to the students and the teacher directs their attention to it with only a physical signal (pointing, lifting up, manipulating), mark the In-Point at the moment the teacher begins the physical signal (e.g., the moment he/she points to the object that will be used in the demonstration).

Questionable physical signals. Sometimes the teacher uses a questionable physical signal. For example, instead of a definite pointing at the object, the teacher waves his arms vaguely in the direction of the objects. If the signal is questionable, look for a clear verbal reference to the particular object while the physical motioning occurs. If the signal is questionable but there is a clear verbal reference to the object accompanying the physical signal, code as ASPPD. However, if the physical signal is questionable and there is no specific verbal reference to the object being used, do NOT code as ASPPD.

When in doubt, err on the side of ASPPD.

Verbal signal only. If the object is visible to the students and the teacher directs their attention to it with only a verbal signal ("look at the model on my desk, please"), mark the In-Point at the beginning of the sentence in which the verbal signal occurs.

Both physical and verbal signal. If the object is visible to the students, and the teacher directs their attention to it with BOTH a physical and a verbal signal to look, mark the In-Point at the moment the teacher begins the physical signal (e.g., the moment he/she points to the object that will be used in the demonstration).

Exception: If the verbal signal is given well in advance of the physical signal (more than 10 seconds before the physical signal), mark the In-Point at the beginning of the verbal signal.

Reminder: The verbal signal must be specifically about the objects being observed. (e.g, "This rock is only one type of rock" versus "There are many types of rocks").

Mark the Out-Point of ASPPD at the beginning of the next activity structure. Usually the Out-Point of ASPPD (and the beginning of the next activity structure) will occur with a physical signal to stop attending to the objects.

IMPORTANT NOTE: Use the special consideration "In-Point of AS:PD following ASPPD" (pp. 8-9) of the manual, (section 4.2.5) to identify when the teacher directs the attention away from the objects. This may not correspond to the new activity structure segment. If there is a pause after the teacher gives a physical or verbal signal to stop attending to the objects, and students are simply waiting, wait to shift until the *new eligible activity structure begins*.

Special considerations for In- and Out-Points of ASPPD

Teacher and/or students still talking about the objects. If the teacher references the objects while asking a question, include the question and the student(s) response to the question a part of the ASPPD segment (even if the object has at this point been set aside).

Mark the Out-Point after the talk about the objects is finished (when there is a shift in the talk away from talk about the objects to talk about ideas related to the objects or to a new topic or task (See special considerations for the In-Point of AS:PD following an ASPPD, p. 8).

Teacher organizing for ASPPD, students wait. Sometimes the teacher may interrupt or stop an AS:PD segment to begin silently setting up materials for a demonstration or to help one or a few students prepare for an upcoming demonstration. The students are waiting while the teacher gets organized. The teacher is not talking to the whole class about science content. In these cases the teacher is directing all students' attention to the objects by manipulating them and making her/his physical manipulation visible to the class.

In these cases code the segment as ASPPD, and mark the In-Point when the objects are visible to the students and the teacher first calls attention to the objects in a physical way. If the teacher later turns away from the materials and returns to lecturing the students, shift back to AS:PD.

When students have objects in front of them on their desks.When students have the objects in front of them on their desks, mark the In-Point at the beginning of the signal to attend to the object. That is when the person who is leading the practical presentation (usually the teacher) directs students' attention to the object(s) and talks in such a way that it is clear that students should be observing the objects.

Mark the Out-Point when the teacher's talk shifts students' attention away from the *observation of* the objects and towards the *consideration of the ideas about* the objects or any other instruction (such as: writing names of objects, discussing other observations, describing next step etc.)

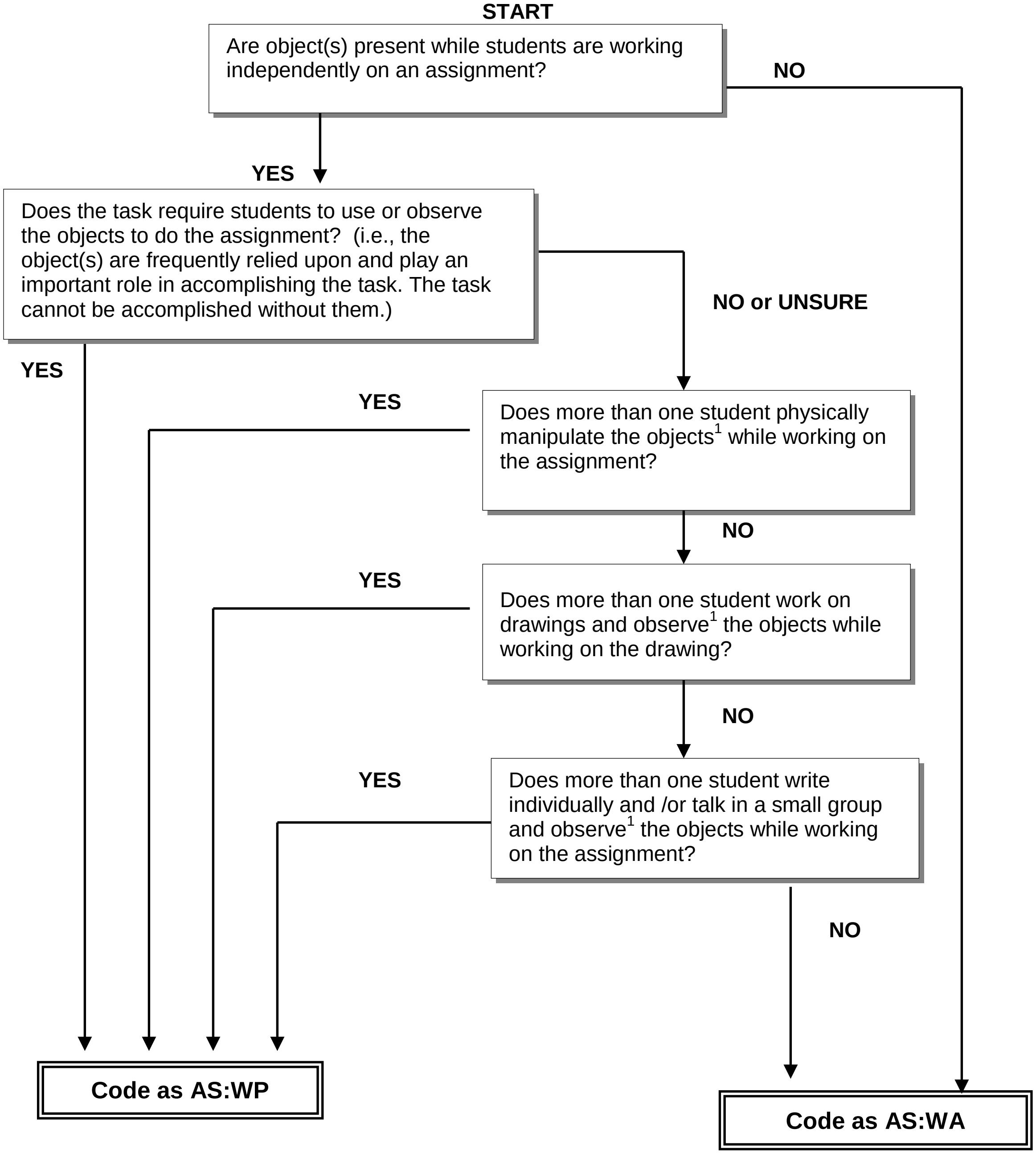
D4.2 Independent Work Codes

Independent work codes are designed to identify parts of the lesson that are set aside for students to actively work on assignments or tasks. For the purpose of activity structure codes, we define independent seatwork activities and tasks in a broad sense to include any activity where students are primarily doing science work independently (e.g., presenting, discussing, experimenting, and/or writing). These types of activity structures are very different from AS:PD and ASPPD activity structures where the students are primarily receiving science information in a whole-class social organization (e.g., when the teacher presents or demonstrates to the entire class).

We divide the segments of the lesson where students are working on science assignments into two main types: Independent practical activities (AS:WP) and Independent seatwork activities (AS:WA). The main distinction between these two activity structures is that when students are engaged in AS:WP tasks they are making use of objects, materials, models, and/or organisms.

Sometimes objects are present but not being used by students to work on an assignment independently. For example, objects might be sitting on students' desks but have nothing to do with the assignment that students are working on independently. In this case, we would not want to code the assignment as AS:WP. Figure 4.1 on the next page presents a conceptual overview of how to distinguish between practical (AS:WP, ASPPD) and seatwork (AS:WA) activity structures in which objects are present.

Figure D4.1. Conceptual overview of how to distinguish between seatwork and practical activity structures when students are independently working



[1] You have to make a reasonable judgment about the behavior of the students while they are accomplishing the task. If the majority of the students are looking at or manipulating the objects while working on the task, this is clear evidence that students are observing or manipulating the object(s). However, if you see at least two students who are observing or manipulating the objects periodically (more than once) while working on the task, this counts as evidence as well.

D4.2.1 Independent Practical Activities [AS:WP]

Independent Practical Activities [AS:WP] is a period of time when students are provided the opportunity to observe, handle, or manipulate objects, materials, 3-D models, or organisms with purposes such as: generating and/or gathering data, observing or modeling objects or phenomena, creating or manipulating models/diagrams or practicing a skill that involves manipulation.

Minimum time requirement for the length of this segment: 30 seconds.

D4.2.1.1 Patterns of AS:WP

There are many different ways that practical assignments can be carried out in the classroom. There are three patterns that are important to recognize.

Pattern 1: Student-directed working-on time

In this pattern, the students are given an entire set of directions (perhaps with several different tasks or steps involved) and then are set off to work on the practical tasks independently. The students work continuously for a long block of time, directing the pace of their own work, without being stopped by the teacher, for a long block of time.

Lesson		
AS: PD	AS: WP	AS: PD

Pattern 2: Teacher-segmented working-on time

In this pattern, the teacher structures the students' independent working-on time into discrete segments. The students are initially given directions for how to carry out the first steps of a practical assignment. They then carry out these steps independently. Then the teacher stops their practical work to talk about the steps just completed and/or to give directions for the next steps in the practical work. The teacher then sends students off to work independently again for another segment of working-on of time. This pattern could be repeated many times.

Thus, the students' working-on phase is interrupted by segments of AS:PD that last longer than 30 seconds. In this case you will code each segment where students are physically doing the task as separate AS:WPs and the segments where the teacher is discussing the results with the whole class as AS:PD.

Lesson				
AS: PD	AS:WP	AS: PD	AS:WP	AS: PD

Pattern 3. Teacher-led independent practical activity time

For coding purposes, it is necessary to identify one particular pattern of AS:WP: the Teacher-Led pattern. Although this pattern is not common, we need to identify it because it *requires the use of special In- and Out-Points rules.*

Teacher-led Practical Assignments are a special type of practical assignment. As in all practical assignments, students are provided the opportunity to observe, handle, or manipulate objects, materials, models, or organisms with purposes such as: generating and/or gathering data, observing or modeling objects or phenomena, creating or manipulating models/diagrams, or practicing a skill that involves manipulation.

What makes these Teacher-led assignments different is that the teacher is publicly giving each step of the directions, and students carry out each step as soon as they hear the particular step described. Thus, all students are working at the same pace, as directed by the teacher. Students are dependent on this information from the teacher; that is, without this information students would not be able to accomplish the task. Typically students do not have handouts that specify the procedures, and they have not studied the procedures in advance.

The social organization of the Teacher-led AS:WP pattern is mixed, including elements of both whole-class and independent work. The teacher is directing the whole class what to do (everyone needs to listen to the teacher at the same moment), so this qualifies it as a whole-class activity. However, students are carrying out the manipulations by themselves or in small groups, which qualifies the work as independent.

IMPORTANT NOTE: *Just because you hear the teacher talking publicly during a independent work phase does not mean that there is a Teacher-led AS:WP pattern*. The teacher talk must be of a particular type, for example, telling students what to do in a series of steps, with students completing each step at the moment the teacher directs them to do so. Sometimes, teachers talk publicly while students work on a practical assignment, but the students are still pacing their own work. In this case, the teacher comments are more like helpful suggestions or cautions that students can consider as they are pacing their own work.

To qualify as Teacher-led AS:WP, all the following criteria must be met:

- each student or group of students has own materials;
- teacher talks publicly while students work;
- teacher talk is pretty much continuous *and* tells students what to do in a detailed, step-by-step manner;
- all students complete the steps at the same pace, as guided by the teacher; they complete each step as they hear that particular direction from the teacher; and
- students must listen to the teacher while working on the practical activity in order to know how to complete the task.

D4.2.1.2 Helpful Indicators

Table D4.4. Indicators for marking independent practical activities

Physical objects	3-D objects are observed and/or handled by students.
Classroom talk	Primarily private except in the Teacher-led Practical Activities pattern.
Social organization	Usually independent (students work individually or in small groups). Can be mixed during Teacher-Led Practical Activities.
Student involvement	Students primarily doing: generating and/or gathering data, manipulating objects, observing, drawing observations, or practicing a skill.
Teacher actions	Monitoring, guiding, assisting, or directing students' actions.
Content	Any content that fits within science instruction.

Physical objects. Objects, materials, and/or organisms are not just shown by the teacher; they are used by the students to accomplish the task at hand. There are four basic types of objects: (See the next sections, 4.4.3.1 and 4.4.3.2 for the details about objects that qualify or do not qualify for AS:WP).

Classroom talk. Talk is primarily private except for brief public announcements (usually from the teacher) that do not stop students from working. There is one exception. In the Teacher-led practical assignment, the teacher talks publicly continuously, guiding the students' work step by step. Students might talk privately while the teacher talks publicly.

Social organization. Students are usually working independentlyeither individually or in small groups. During Teacher-Led Practical Assignments, however, the social organization is *mixed* (teacher leads whole class in a step-by-step manner, but students carry out the tasks individually or in small groups).

Student involvement. Students are primarily doing the practical assignments independently. That is, they are observing or manipulating objects, materials, 3-D models, and/or organisms on their own to generate and/or gather data, observe, or practice a skill. *Typically, students have the materials at their desks or tables, so that each student or small group of students has their own set of materials.* However, sometimes the whole class may observe and work independently with the same object. For example, the teacher may send students outside to observe and describe a particular tree or river on the school grounds. Or the teacher may place some large object in front of the class, and then have students work in small groups or individually in describing or otherwise using that object. In these cases, code as AS:WP.

Reminder: If the students are all observing an object(s) under the teacher's direction in a whole-class setting, this will be coded as ASPPD.

Teacher actions. Usually the teacher is monitoring, guiding, or directing students' actions. For example, two common teacher roles during AS:WP segments are

- Monitoring the students' work by doing such things as: circulating and observing students as they work; or providing assistance privately to individuals or groups or publicly to the whole class while students continue to work on the practical assignment.

- Publicly directing the practical assignments in a step-by-step fashion while students are working (teacher-led practical assignment).

Content. Remember that the AS:WP code refers to the activity structure, not the content of the assignment. As long as the assignment fits within the SCIENCE INSTRUCTION phase, it will be coded as AS:WP.

D4.2.1.3 Objects that Qualify as AS:WP

There are three basic types of objects that qualify as AS:WP.

3-D science-related objects. Typically, practical activities involve the use of 3-D objects used to learn about science in one of the following ways (also see decision tree, Figure 4.1, p.18):

- Task involves students in physically handling or manipulating[2] objects while working independently–any time an object is being manipulated, code as AS:WP.

- Task involves students in *drawing objects based on observations* (objects not manipulated)–The object, model, material, or organism is present while students are working independently. The students' interaction with the object involves viewing/observing the object (no manipulation) AND drawing the object based on observations. Code as AS:WP.

- Task involves students in *writing individually or writing/talking* in a small group based on observations of the objects (objects not manipulated). If the object, material, or organism, is *only* observed and talked about or written about (not touched in any way), consider whether the students are observing the object independently or under the guidance of the teacher (See definition of Independent Social Organization on p. D-88).

    - If students observe the objects independently, code as AS:WP.

    - If students observe the objects under the whole-class guidance of the teacher, code as ASPPD.

Flat representations. Typically, the use of flat representations (diagrams, photos, posters, concept maps, videos, etc.) by students is coded as AS:WA. There are *two cases* when a flat representation could be considered as AS:WP:

[2] Handling or manipulating means that the students are involved in touching the objects, and moving them so that they can be better observed or so that the objects are changed in some way (taken apart, opened up, weighed, etc.). Handling or manipulation means more than just carrying the object to the table.

- The students manipulate flat representations of an object or process, such as pictures, cut-outs, or symbolic materials (e.g., symbols for chemical elements or compounds), *to create a 3-D object or model*. Code as AS:WP.

- The students *act upon the flat representation in three dimensions*.

- For example, a classic activity that is used to represent natural selection involves students in dropping light and dark pieces of confetti on different colored background paper. The students then have a certain amount of time to pick up the pieces of confetti. Although this activity involves the use of a representation that is made only of pieces of paper (flat materials), the students are acting upon the flat representation in three dimensions (dropping and picking up the confetti). Code as AS:WP.

<u>Computer simulations</u>. Sometimes the students use a computer simulation that gives them a vicarious experience of observing and/or manipulating objects, materials, or organisms. Include these as AS:WP only if the following two conditions are met:

- The students use the computer to show the class the results of a first-hand event that takes place in the classroom (e.g., showing the sound waves of a high-pitched whistle that the teacher used, or graphing the rise in temperature of a beaker of boiling water that is hooked to the computer via a temperature probe).

- The computer simulation is manipulated (acted upon) by the students (e.g., students manipulate variables, move objects around, etc.).

<u>D4.2.1.4 Objects That Do Not Qualify as AS:WP</u>

The students may observe or manipulate certain objects that do NOT qualify as AS:WP, such as:

- <u>Everyday classroom tools.</u> In general, everyday classroom tools, such as pencils, writing paper, calculators, computers, and drawing instruments, do not indicate a practical task. For example, if the students are using a ruler only to underline main ideas in the text, *do not* code this as AS:WP. If students are using calculators to solve mathematical problems on a worksheet, *do not* code this as AS:WP. When these tools are used to accomplish a first-hand practical task (such as measuring an object), then *code* this as AS:WP.

- <u>Flat representations that are not manipulated</u>. With two exceptions (see above section) the use or creation of flat representations (diagrams, photos, posters, concept maps, videos, etc.) during a working-on period is *not* coded as AS:WP (it is coded as AS:WA).

- <u>Objects used only as markers or prizes</u>. Sometimes students may be using objects only as markers.

    - For example, students may use pennies to keep track of their answers on a bingo game card. Alternatively, students may receive objects as rewards, or prizes, for good behavior or good performance (e.g., candy).

The use of such markers and prizes should *not* be coded as AS:WP.

Use of computer**.** Student work with a computer is *not* included as AS:WP *if*

- the computer is strictly used as a writing tool. For example, students create notes on a PowerPoint program.
- the computer is used as a “digital library of information.” For example, students search the Internet to find some science-related information.
- the computer is used only for visual purposes. For example, students watch a videotaped program.

Special considerations

- Public speech. Public speech while the students are working on a practical activity does not necessarily indicate a shift to AS:PD.

  Do not shift to AS:PD unless students are required to stop working and pay attention to a whole-class activity (for at least 30 seconds).

- Non-Science or Science Organizational talk during AS:WP. In Dimension 1, we coded science instruction if students were working independently on n instructional task while the teacher engaged in science organization (PH:ORG) or non-science (PH:NS) talk. Because of this, you might hear the teacher engaging in no-science or science organization talk while students are copying. If the students have the opportunity to continue to copy *and* at least one student continues to copy, we will ignore this non-science or science organizational talk *unless* the teacher explicitly tells students to stop working in order to listen to the PH:NS or PH:ORG talk.

  Do not shift out of AS:WP when you encounter such talk during AS:WP. However, if the teacher tells the students to stop working, and then engages in PH:NS or PH:ORG talk, use the short segment rules regarding PH:SO and PH:NS segments to decided on the appropriate coding decision. It may be considered a short segment of AS:PD if it is “talk only” PH:ORG or PH:NS (see section D1.2.1.1).

  Note about outside announcements: Consider any announcements from outside the classroom that occur while students are working in dependently on AS:WP as PH:NS talk and continue the AS:WP segment UNLESS the teacher in the classroom tells students to stop working and listen to the announcements (this would be AS:PD).

- Written work. The presence of writing in itself is not a determining factor in distinguishing between AS:WP and AS:WA.

For example, students are often observed doing written work during a practical assignment that uses objects (e.g., they may be answering questions, recording data, drawing representations of an object). In such cases where students use or observe objects while writing or drawing, code the segment as AS:WP (see Figure 4.1 and Figure 4.2).

The written work that qualify for AS:WP includes the following:

- creating drawings of object(s) that require, or can be facilitated by, the use of the objects at the time the drawing is being done;
- recording descriptions based on observations of the object(s); and
- recording data that is being generated by the objects.

- <u>Objects present but not used.</u> If objects are present but not used or observed by the students while working on the assignment, *do not code as* AS:WP (See Figure 4.1). Following are some examples of cases that *do not qualify as* AS:WP:
    - Students are doing an assignment that has nothing to do with the objects that are present.
    - Students are doing an assignment that is related to previous activities that used the objects, but the objects are no longer used at the time the assignment is being done. For example
        - manipulating previously recorded data (e.g., graphing, making tables, or calculating);
        - discussing or producing written descriptions of procedures that have already been done;
        - interpreting previously collected data; and
        - recording or discussing observations based on previously generated data.
- <u>Students casually handling objects</u>. Sometimes students are handling or looking at objects while the teacher is talking to the class. When these cases are observed, code as AS:WP *only* if it is apparent that the teacher's intention is for students to observe or interact with the objects in front of them.

<u>Students handle objects one-by-one</u>. If the teacher involves students in manipulating object(s) or collecting data with use of objects in a one-by-one manner (the same task repeated with each student one-by-one), AND the rest of the class is simply waiting, code as AS:WP. Remember that to qualify as a "one-by-one" activity, the teacher must work with at least 2 students in a row or 2 small groups of students in a row.

- Teacher assigns students to work on different practical assignments. The teacher divides the class into groups and gives each group a different practical assignment. All students are working independently in an AS:WP. Although there are different tasks, there is only one activity structure. Code the activity structure observed (AS:WP).

- Student(s) working in different activity structures. Without any indication to the other students to stop or to keep working, the teacher might ask one or more students to work on a separate task in a different activity structure while the rest of the class is in an AS:WP mode.

    For example, the teacher tells one student to go to the board and the teacher starts publicly interacting with the student at the board (AS:PD) or the teacher tells one student to make up a written quiz (AS:WA). While the one student works with the teacher at the board or on the quiz, the rest of the students are engaged in an AS:WP mode. The student working at the board or on the quiz is carrying out a very different task from the rest of the class and is working in a different activity structure.

    If there is only one student working on a different task in a different activity structure, ignore that student, and code according to what the teacher is doing with the rest of the class (in this case, AS:WP).

    However, *if there are two or more students* who are working in a different activity structure (for example, on a written assignment), refer to the section about divided class and code as AS:DC if the situation meets the criteria.

- Teacher assisting individual students or small groups. This teacher assistance during the time students work independently on assignments will always be considered as AS:WP if students are independent practical activities. Do not consider these interactions as AS:PD. The whole segment while students are independent seatwork activities and receiving teacher assistance with that assignment will be considered as AS:WP.

- Public talk during AS:WP segment. In general, public talk (such as teacher announcements or reminders from the teacher) that occurs while students are working independently on a practical assignment are included as part of the AS:WP. The *exception* would be if the teacher stops the students from working and talks with the whole class for > 30 seconds; this would be coded as an AS:PD segment.

    For guidelines about what counts as "stopping students from working" when there is *a clear bid for attention* from the teacher, see the note about delayed student compliance and smooth, somewhat smooth, and not smooth transitions into AS:PD, p. 7.Guidelines about what counts as "stopping students from working" when there is not a clear bid for attention from the teacher (e.g., the teacher starts talking publicly without clarifying whether or not students should stop working" are listed below:

    - Teacher starts talking, students stop working: Without a clear bid for attention, the teacher starts publicly talking, and *all* students *eventually* stop working after the teacher's public talk begins. Mark the In-Point of ASPDF at the beginning of the teacher's public talk.

- o Teacher starts talking, students keep working. Without a clear bid for attention, the teacher starts publicly talking, but at least one student continues to work throughout the teacher's public talk. In this case, consider whether there is a shift in the content of the teacher's talk.

If the content of the teacher's talk is not about the specific task the students are doing (e.g., it is new information for students to attend to), consider this as a signal for students to stop working and to pay attention to the new information. That is, the teacher's talk is drawing students' attention away from the task at hand. Mark the In-Point of ASPDF at the beginning of the teacher's public talk.

However, if the teacher's talk is *only* about the specific task at hand, and there is not a clear signal for students to stop working (you have the sense that the AS:WP is continuing), do not shift to ASPDF. Note that if the teacher's talk contains new information, consider making a shift to ASPDF regardless of the amount of new information.

- Series of short practical assignments. Sometimes students may be involved in a series of short practical assignments. For example, the teacher might read or dictate a series of short practical tasks, pausing between each one to allow time for students to observe independently. The teacher might point to a particular bone in the skeleton model and ask students to observe it and write down the name of the bone. Then she points to another bone and poses the same task. In these cases you will find back-and-forth sequences of short segments of AS:PD (when the teacher is calling for attention or assigning the task), ASPPD (when the teacher is calling attention to objects to be observed independently), and AS:WP (when students are independently observing, manipulating). Apply the multiple short segments rule, and code the entire segment of short segments as AS:WP.

Refer to the next section for marking In-Point.

IMPORTANT NOTE*:* Sometimes when the teacher is assigning the practical task, she may repeat the task more than one time. If that happens, end the segment of AS:PD or ASPPD after the teacher states the task the *first time*. At that point, students have the necessary information and can begin working independently.

- Students finish up one activity structure while paying attention to the next activity structure. Sometimes the teacher expects students to pay attention to two activities at the same time.

For example, the teacher tells students to pay attention to the teacher talk (ASPDF) while they finish up a practical activity. Everyone is now paying attention to the teacher (in AS:PD), but some students finish up work on the practical assignment (in AS:WP) at the same time. In this case, there is a common activity structure that all students are supposed to attend to at the same time (AS:PD).

Do not consider this as a case of divided class. *Code according to the common activity structure for all students*.

D4.2.1.5 Marking In- and Out-Points for AS:WP

When marking the In-Point of AS:WP, use one of the following hierarchy (i.e., if number 1 applies, use it and ignore all other options):

- There is an explicit signal to start, and most students comply within 30 seconds (“whoosh”).

    If there is an explicit signal to start the AS:WP assignment followed by most students complying within 30 seconds, mark the In-Point at the conclusion of the signal.

    Definition of explicit signal to start and most students comply: An explicit signal to start is a statement or action that “sets students off to work” on the task, and is followed by most students’ action within 30 seconds. In these cases if you see a few students working prior to the signal, ignore them.

    An explicit signal to start is *not* a statement of the task. An explicit signal to start is usually followed by a pause that indicates students should start off to work.

    Examples of explicit signals: “You can begin now.” “Get your things and start now.” “Make this now.” These signals are followed by most students starting to work.

    Notes: (1) If there is more than one explicit signal, select the signal that is followed by the most students starting to work (usually the later signal). (2) The signal should be regarded as a unit of talk that ends with the “sending students off to work” phrase. Mark the In-Point at the end of the entire unit of talk (as indicated by the “/” mark in the examples below).

    - Example 1: “I want you to do steps 1-4 of this lab activity. *You can start now*./”

    - Example 2: “Okay, write it here. Write your values where it says “experiment one” and we do number two. Okay, *you can begin now***./”**

    - Example 3: “I want you to measure and write down your measurements for I1 and I2. Got it? [there is a pause but no one starts to work]. Okay, if there are no more questions, *you can begin now***./**”

    - Example 4: “Make this, and… are you ready? [waits for a few students to attend]. It will be fine if you just write it on the white board, and I’d like you to measure these out. Got it? [pause but no one starts to work]. I’ll be making my rounds so if you don’t understand it, please ask me. Okay? *Alright then, begin***./”**

- There is an *intermediate* signal to start, and *most students comply* within 30 seconds (“whoosh”).

If there is an intermediate signal to start the AS:WP assignment followed by most students complying within 30 seconds, mark the In-Point at the conclusion of the signal.

Definition of intermediate signal to start and most students comply: An intermediate signal to start is a statement or action that serves the function of "setting students off to work" on the task without actually saying something explicit like "begin now." It is followed by most students complying within 30 seconds. In these cases if you see a few students working prior to the signal, ignore them.

There are two common types of intermediate signals to start:

- Type 1: Teacher says "okay" or "alright" or a similar word or phrase in a tone of voice (usually followed by at least a brief pause) indicating that students should start to work. Example: "I want you to measure and write down your measurements for I2 and I2. Got it? /" (followed by pause and most students start to work).

- Type 2: The statement of the task serves the function as the signal to start, if it is followed by most students starting to work (and usually at least a brief pause). Example: "Make this circuit." (followed by at least a brief pause, and most students start to work).

Notes: (1) If there is *more than one intermediate signal*, select the signal that is followed by the most students starting to work (usually the later signal). (2) The signal should be regarded as a *unit of talk* that ends with the "sending students off to work" phrase. Mark the In-Point at the end of the entire unit of talk.

- There is an *explicit* signal to start, but *most students do not comply* within 30 seconds (or most students have already started to work).

If there is *no signal to start*, mark the In-Point of this segment when students have enough information to start working and at least one student actually starts working on the practical assignment.

Definition of explicit signal to start, but most students do not comply: An explicit signal to start is a statement or action that "sets students off to work" on the task, but in this case it is *not* followed by most students' action within 30 seconds (or most students have already started working before the explicit signal).

In this case, mark the In-Point when the students have enough information to start, and at least one student actually starts working on the practical assignment.

IMPORTANT NOTE: an explicit signal to start is *not* a statement of the task. An explicit signal to start is usually followed by a pause that indicates students should start off to work.

Examples of explicit signals not followed by most students' compliance: "You can begin now." "Get your things and start now." "Make this now." After this type of signal most students do not comply within 30 seconds.

- There is an *intermediate* signal to start, but *most students do not comply* within 30 seconds (or most students have already started to work).

  Definition of intermediate signal to start, but most students do not comply: An intermediate signal to start is a statement that serves the function of setting students off to work without actually saying something explicit like "begin now." But in this case, the intermediate signal is not followed by most students complying within 30 seconds (or most students have already started working before the intermediate signal). In this case, mark the In-Point when the students have enough information to start working and at least one student actually starts working on the practical assignment.

- There is no explicit or intermediate signal to start, but students start working.

  In the rare case where there is no signal to start but students start working, mark the In-Point when students have enough information to start working and at least one student actually starts working on the practical assignment.

  Mark the Out-Point of AS:WP when the teacher begins the new activity structure. This is usually after the teacher signals to stop working and to attend to another activity structure.

Special considerations for In- and Out-Points of AS:WP

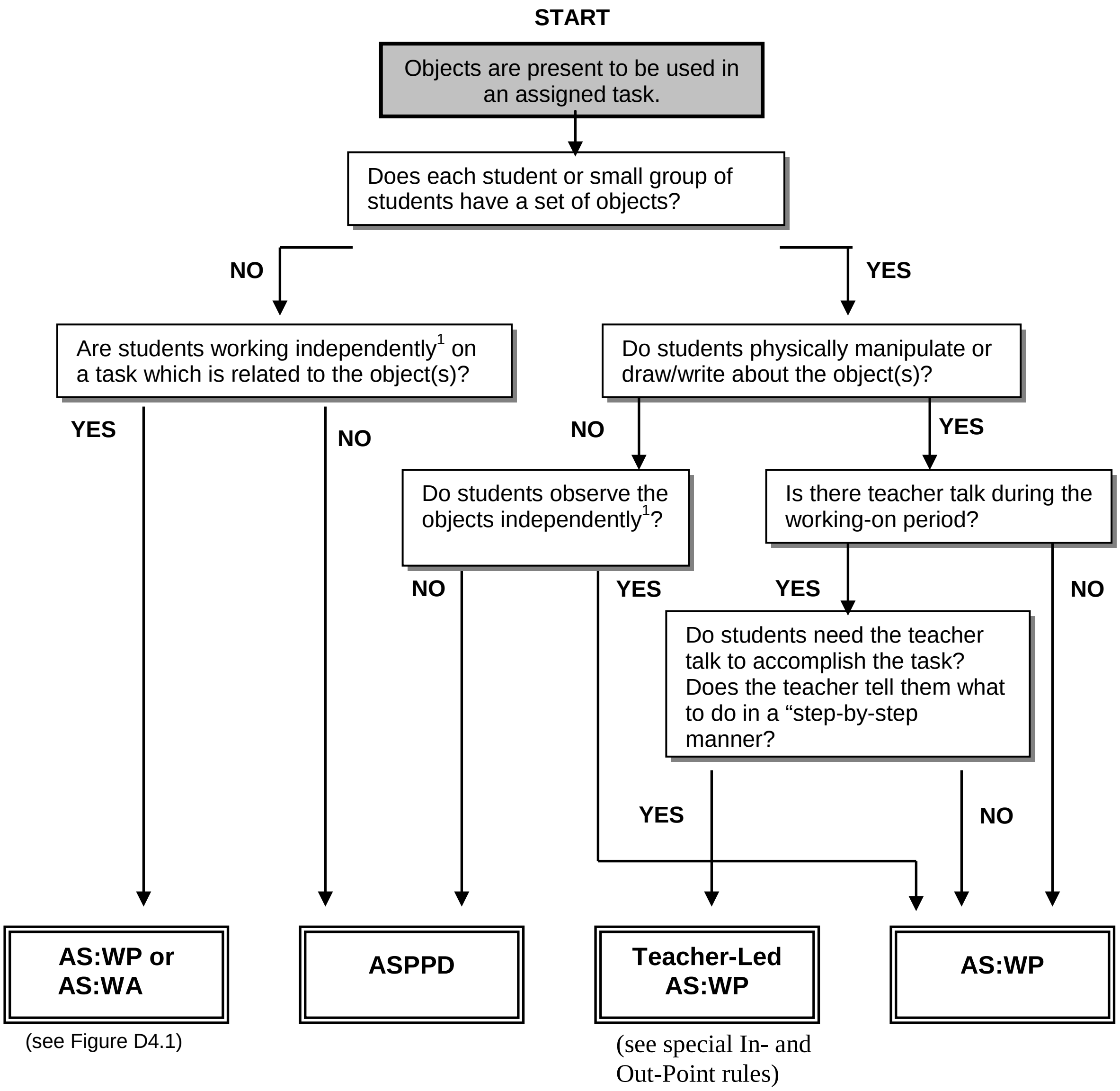
- <u>Marking In and Out-Points for TEACHER-LED AS:WP only</u>. Mark the In-Point of Teacher-Led AS:WP at the *beginning* of the teacher's first statement that directs students to start to work on one step of the practical assignment (if at least one student is seen to begin to work after this statement). Although we usually mark the In-Point of AS:WP at the *end* of the teacher signal to start to work, the Teacher-led AS:WP segments often lack clear verbal signals to begin. The teacher's statement is typically the first in a series of statements that tells students what to do with the objects; the students begin to work as soon as they hear the first statement.

  Mark the Out-Point of Teacher-Led AS:WP when the teacher's talk shifts away from "step by step" directions of what to do. The teacher is shifting students' attention away from the *manipulation of* the objects to the consideration of the *ideas about* the objects (such as: drawing conclusions, discussing the results or the observations, introducing new terms, making predictions, writing down notes, etc.). At this point most of the students will attend to the teacher and stop manipulating the objects (however this may be a gradual process).

- <u>Gradual shift from AS:WA/AS:CN/AS:IR to AS:WP</u>. In some cases the teacher announces that students will be working on two different activities. First, they will work on an assignment (AS:WA), copy notes (AS:CN), or read independently (AS:IR), and when they are done they will start to work on a practical assignment (AS:WP). See the rules for marking In- and Out-Points for gradual shifts in Appendix E.

- <u>Gradual shift from AS:WP to AS:WA/AS:CN/AS:IR</u>. Sometimes the students are expected to work on a seatwork assignment such as a worksheet, crossword puzzle, or homework (AS:WA), to copy notes (AS:CN), or to read independently (AS:IR) after they finish working on a practical assignment. Or students may be asked to do an assignment that contains first-hand practical work followed by writing related to the practical activity that occurs after the use of objects is finished. These are both cases of a gradual shift from AS:WP to AS:WA/AS:CN/AS:IR, and the activity structure will gradually change until all students eventually start working on a seatwork task (AS:WA/AS:CN/AS:IR). See the rules for marking In- and Out-Points for gradual shifts in section 4.2.7.

Figure D4.2. Conceptual overview of how to distinguish among 3 types of practical work: ASPPD, AS:WP and Teacher-Led AS:WP



[1] Independent in this case means that during the students' observation time, the teacher DOES NOT talk continuously in order to pace students' work and DOES NOT provide a full description of the objects that are being observed. Instead the teacher's talk is of one or more of the following types

- The teacher is mostly silent, OR
- The teacher interacts privately with students, either individually or in small groups (NON-PUBLIC), OR
  - The teacher minimally directs the observation in a PUBLIC manner. For example, intermittent public announcements are made to guide students' work (reminders, cautions, etc.). These announcements are helpful for all students to hear, but students can proceed with their work without attending to them

Table D4.5. Summary of differences between ASPPD, AS:WP, and Teacher-Led AS:WP

	ASPPD	AS:WP	Teacher-Led AS:WP
What kinds of objects?	3-D objects including models, organisms, etc.	Same as for ASPPD	Same as for ASPPD
Who has the objects?	Usually the teacher (or a student leader) has the objects (but objects might be placed with each student or group of students)	Usually the students have the objects (but there might be only one set of objects in front of the whole class)	The students have the objects
Social organization	Whole-class	Independent	Mixed
Student involvement	Observing/talking only	Observing, manipulating, drawing/writing	Observing, manipulating, drawing/writing
Classroom talk	PUBLIC	Usually non-public; can be some public announcements	Primarily PUBLIC with some non-public communication among students possible
Teacher Actions	Continuously presenting and/or leading discussion	Facilitating students' independent work; guiding students individually or in groups	Continuously guiding students' work in a step-by-step fashion

D4.2.2 Independent Seatwork Activities [AS:WA]

Independent Seatwork Activities [AS:WA] is a period of time when students are provided opportunities to carry out an assignment independently, and the assignment *does not* involve opportunities to interact with or manipulate objects, materials, models, or organisms.

Minimum time requirement for the length for the segment: 30 seconds.

D4.2.2.1 Helpful Indicators

Table D4.6. Indicators of independent seatwork activities

Physical objects	Objects are not used to do the task.
Assignments	Seatwork, written or oral, usually explicitly assigned by teacher.
Classroom talk	Primarily private.
Social organization	Independent.
Student involvement	All or most students are primarily doing.
Teacher actions	Usually gives an explicit assignment, then monitors, guides, assists, or directs students' actions.
Content	Any content that fits within science instruction.

Physical objects. No objects are used by the teacher or students except for everyday classroom tools and materials.

Assignments. Seatwork assignments, written or oral, usually explicitly assigned (Exception: reviewing graded tests, see p.30). Below are some examples of seatwork assignments:

- textbooks/worksheets (e.g., fill-in-the-blank problems, reading comprehension questions, computation problems, or homework problems);
- written assignments (e.g., journal writing, essay composition, written tests and quizzes, or writing the protocols or results of the practical assignment without using objects);
- using or creating flat representations of objects or processes such as drawing pictures or diagrams, coloring in or labeling diagrams or maps, creating concept maps, etc.(NOTE: If students use flat materials to create 3-D objects or models or to act upon them in three dimensions, code this as AS:WP, see p. 23);
- oral assignments that are carried out by the students in small groups (the teacher's public oral questioning of the whole class is NOT AS:WA; code this as AS:PD;
- computer projects (e.g., creating PowerPoint presentations, research completed on the web, or using a CD ROM);

- use of computers for writing tasks, internet searches for information, etc. NOTE: If computers are used to simulate firsthand experiences with objects or processes, code as AS:WP (see p. 23);

- games/puzzles (e.g., crossword puzzles, word searches, games played in small groups, and group games in which all students are involved in carrying out a task);

- role playing, skits (e.g., students individually or in groups use their bodies and words to represent some phenomenon or object);

- students are given back graded tests followed immediately by time to review them; and

- other projects (e.g., library research).

Classroom talk. Primarily private. The teacher may talk publicly to all students during this segment, but students keep working on the assignment and the teacher DOES NOT continuously direct the activities of all students as they work.

Social organization. The social organization of interaction during this time is independent. During this time students are required, explicitly encouraged, or expected by the teacher to work on an assigned task alone or in partnership with one or more classmates.

Student involvement. Students are primarily independent seatwork activities. They are generating information, producing the answers. It is not just copying answers from the board or writing down what the teacher dictates. The assignment involves all or most students in doing an activity, not just one or a few students.

Teacher actions. The teacher usually explicitly gives an assignment for students to do. Then the teacher typically monitors the students or assists individuals or groups privately.

Content. Remember that the independent seatwork activities code refers to the activity structure, not the content of the assignment. As long as the assignment fits within the science instruction phase, it will be coded as AS:WA.

Special considerations

- Series of short assignments. Sometimes students may be involved in a series of short assignments. For example, the teacher might read or dictate a series of questions, pausing between each one to allow time for students to write down the answers independently. In these cases you will find back-and-forth sequences of short segments of AS:PD (when the teacher is reading the question) and short segments of AS:WA (when students are writing their responses).

    Apply the multiple short segments rule, and code the entire segment of short segments as AS:WA. Mark the In-Point at the end of the teacher statement that gives students enough information to start working.

IMPORTANT NOTE: Sometimes when the teacher is reading the question for students to answer, she may repeat the question more than one time. If that happens, end the segment of AS:PD after the teacher states the question the first time. At that point, students have the necessary information and can begin working independently.

- Seatwork or science organizational talk during AS:WA. In Dimension 1, we coded science instruction if students were working independently on an instructional task while the teacher engaged in science organization (PH:ORG) or non-science (PH:NS) talk. Because of this, you might hear the teacher engaging in non-science or science organization talk while students are copying. If the students have the opportunity to continue to copy *and* at least one student continues to copy, we will ignore this non-science or science organizational talk *unless* the teacher explicitly tells students to stop working in order to listen to the PH:NS or PH:ORG talk.

  Do not shift out of AS:WA when you encounter such talk during AS:WA. However, if the teacher tells the students to stop working, and then engages in PH:NS or PH:ORG talk, use the short segment rules regarding PH:ORG and PH:NS segments to decide on the appropriate coding decision. It may be considered a short segment of AS:PD if it is "talk only" PH:ORG or PH:NS (see section D1.2.1.1).

  Note about outside announcements: Consider any announcements from outside the classroom that occur while students are working in dependently on AS:WA as PH:NS talk and continue the AS:WA segment UNLESS the teacher in the classroom tells students to stop working and listen to the announcements (this would be AS:PD).

- Note taking. Note taking is not considered as an assignment.

- Written work. The presence of writing in itself is not a determining factor in distinguishing between AS:WP and AS:WA. For example, students will often be observed doing written work during a practical assignment that uses objects (e.g., they may be answering questions, recording data, drawing representations of an object).

  In such cases where the writing requires or can be facilitated by the objects, code the segment as AS:WP (see Figure D4.1). This would include the following types of writing:

  - creating drawings of object(s) that require, or can be facilitated by, the use of the objects at the time the drawing is being done;

  - recording descriptions based on observations of the object(s) at the time descriptions are being written; and

  - recording data that is being generated by the objects.

- <u>Objects present but not used</u> [See Figures 4.1]. If objects are present but are not used by students to do the assignment, code the segment as AS:WA. In some cases this will be obvious.

  For example, sometimes students are doing an assignment that has nothing to do with the objects that are present. In other cases, students may be doing an assignment that is related to a previous activity in which students used the objects; however, the objects are no longer being used at the time the assignment is being done. In such cases code the segment as AS:WA. Such cases would include

  - manipulating previously recorded data (e.g., graphing, making tables, calculating);
  - discussing or producing written descriptions of procedures;
  - interpreting previously collected data; and
  - recording or discussing observations based on previously generated data.

- <u>Preparation for independent seatwork activities</u>. Sometimes students spend more than 30 seconds preparing to do an assignment by numbering their papers or putting a title on their papers. If students later use this paper to complete an assignment, code this preparation work as AS:WA. Similarly, if students are preparing for the assignment by copying questions before answering them, code this as AS:WA if students move gradually from copying to answering the questions (e.g., the beginning point of AS:WA is not distinguishable). If there is a clear segment of time set aside *only* for copying the questions (not answering them), code this segment as AS:CN if it fits the requirements of AS:CN (otherwise, code it as AS:WA).

  Reminder: If students are writing name and date only this should be considered PH:ORG.

- <u>Use of computer(s)</u>. If the computer is used to accomplish the task, and it is used mainly as a writing tool, code the segment as AS:WA.

- <u>Reviewing graded tests</u>. We have said that usually the teacher gives students an explicit direction to do an assignment. However, when the teacher returns graded tests to the students and gives students time to review them without any explicit direction to do so, we coded this as PH:SI in Dimension 1, assuming that the implicit assignment was to look over the tests.

  Therefore, if the teacher passes back a graded test to students, and this is *followed immediately* by 30 seconds or more of time when the teacher is not directing the whole class, we will assume that the implied assignment is to look over the test. In this case, code the time during which the tests are passed back (i.e., beginning from the time the first student receives her/his paper) and the time students have *immediately afterwards* to review the tests as AS:WA.

In any other situation where students have returned tests in front of them (and the opportunity to review them), code as AS:WA *only* if the teacher gives an explicit direction to review the tests.

- Public talk mixed with AS:WA activity. Sometimes there is a mix of public talk and students working on an assignment. The following clarifies what to do in situations where you encounter a mix of public talk and students working on an assignment:

  - teacher public announcements or ongoing public talk during AS:WA segment. In general, public talk (such as announcements or reminders from the teacher) that occurs while students are working independently on an assignment are included as part of the AS:WA.

    The *exception* would be if the teacher stops the students from working and talks with the whole class for > 30 seconds; this would be coded as an AS:PD segment.

    For guidelines about what counts as "stopping students from working", see the note about delayed student compliance and smooth, somewhat smooth, and not smooth transitions into AS:PD, p. 7.

    Guidelines about what counts as "stopping students from working" when there is not a clear bid for attention from the teacher (e.g., the teacher starts talking publicly without clarifying whether or not students should stop working" are listed below:

  - teacher starts talking, students stop working. Without a clear bid for attention, the teacher starts publicly talking, and *all* students *eventually* stop working after the teacher's public talk begins. Mark the In-Point of ASPDF at the beginning of the teacher's public talk.

  - teacher starts talking, students keep working. Without a clear bid for attention, the teacher starts publicly talking, but at least one student continues to work throughout the teacher's public talk. In this case, consider whether there is a shift in the content of the teacher's talk.

    If the content of the teacher's talk is not about the specific task the students are doing (e.g., it is new information for students to attend to), consider this as a signal for students to stop working and to pay attention to the new information. That is, the teacher's talk is drawing students' attention away from the task at hand. Mark the In-Point of ASPDF at the beginning of the teacher's public talk.

    However, if the teacher's talk is about the specific task at hand, and there is not a clear signal for students to stop working (you have the sense that the AS:WP is continuing), do not shift to ASPDF.

  - public discussion of an assignment. When the class is publicly working through a series of questions (i.e., homework from last night, answers to test etc.), this is not AS:WA because students are not working *independently* on generating the answers. Code this segment as AS:PD.

- answering written questions during a video. If students are answering worksheet questions while watching a video or listening to an audio presentation, *do not* code as [AS:WA]. In these cases students are primarily listening to the source in order to answer the questions, so it is coded as AS:PD.

- public checking of the results of assignment. Sometimes after the assignment is finished, the teacher may check on the results of the assignment. If this action stops students from working on the assignment, code the segment as AS:PD.

  Even if the checking is done privately with one or two students, if the rest of the class is simply waiting for this checking process to be finished (they are *not* still working on the assignment), code it as AS:PD.

  However, if the teacher does the checking privately with one or a few students, and the rest of the class continues to work on the assignment, code as AS:WA. For example, the class is playing a game, like Bingo. After one student calls out "Bingo", the game (which is coded as AS:WA) stops while the teacher checks to make sure the student who called Bingo had the correct answers. The teacher might check the student's answers publicly or only in interaction with the one student. In both cases, it is coded as AS:PD, because the students cannot and are not continuing to work.

  In another scenario, the students have been working on a written quiz. One student finishes early, and the teacher checks that student's answers in a one-on-one conversation. The rest of the students are still working on the quiz. Code as AS:WA because the teacher's checking of the results is done privately, and the rest of the students are continuing to work on the assignment.

- <u>Students begin working independently without a signal from the teacher to do so</u>. Sometimes students will begin working independently without being directed to do so. If this happens at the beginning of the lesson and appears to be a routine class activity and/or the directions are publicly posted (e.g., the segment was coded as PH:SI in Dimension 1), code it as AS:WA, regardless of the teacher's public talk (unless the teacher stops the students from working and starts a new activity structure).

  This could also happen during the lesson. For example, towards the end of the lesson the teacher passes out a worksheet for students to do as homework. The teacher then talks publicly about an upcoming test and reviews the content that the students need to study. However, some students are busily working on the homework worksheet. If there is NO indication from the teacher that she expects the students to be working on the assignment, code this as AS:PD.

  However, be sure to watch the entire segment for evidence that the teacher at some point indicates that she intends that the students should be working independently on a seatwork activity. If she later on says something like, "OK, I see many of you have started, that's good, keep working," then code the entire segment (starting when students know what to do and at least one has started to work) as AS:WA. If she later on says something like, "Okay, now you can start working on the homework," (without acknowledging that it was OK for them to have started earlier), mark the In-Point at this signal.

There are other scenarios where the students might start working independently without a signal from the teacher to do so. In general, look for evidence that the teacher intends (or does not intend) for students to work on the assignment.

For example, sometimes the teacher might pass out a worksheet without explicitly directing students to work on the worksheet. Students can be seen working on the worksheet after they receive it.

In this case, the teacher's silence while students begin to work and the fact that she does not stop them from working suggest that she intended for students to work on the worksheet. Code this as AS:WA.

- Teacher assigns students to work on different worksheets. The teacher divides the class into groups and gives each group a different worksheet. All students are working independently in an AS:WA segment. Although there are different tasks, there is only one activity structure. Code the activity structure observed (AS:WA).

- Students working independently but with the option to discuss the particular task with the teacher in a small group. The teacher states that the next assignment is a worksheet (AS:WA). He states that he will be doing one of the problems on the worksheet publicly for those who need more help. Students have a choice to participate in either group. We observe the public interaction between the teacher and some students (AS:PD) while other students work independently on the assignment (AS:WA). Because the teacher is doing publicly one of the same problems that the students are completing independently, it is not a different task. Code for the activity structure observed for the rest of the students (AS:WA), unless all students choose the option to work with the teacher in an AS:PD mode.

- Student(s) working in different activity structures. Without any indication to the other students to stop or to keep working, the teacher might ask one or more students to work on a separate task in a different activity structure while the rest of the class is in an AS:WA mode.

  For example, the teacher tells one student to go to the board and the teacher starts publicly interacting with the student at the board (AS:PD). Or the teacher tells one student to go to the front of the room to set up a distillation apparatus (AS:WP). While the one student works with the teacher at the board or on the practical activity, the rest of the students are engaged in an AS:WA mode. The student working at the board or on the practical activity is carrying out a very different task from the rest of the class and is working in a different activity structure.

If there is only one student working on a different task in a different activity structure, ignore that student, and code according to what the teacher is doing with the rest of the class (in this case, AS:WA).

However, *if there are two or more students* who are working in a different activity structure, refer to the section about divided class and code as AS:DC if the situation meets the criteria.

Teacher assisting individual students during the time they work independently on their assignment will be always considered as AS:WA if the rest of the students are working on a seatwork assignment (this is even if the teacher chooses to use an object to assist some students privately). The whole segment while students are working on the assignment will be considered as AS:WA.

- Students finish up one activity structure while paying attention to the next activity structure. Sometimes the teacher expects students to pay attention to two activities at the same time.

  For example, the teacher tells students to pay attention to the teacher talk (ASPDF) while they finish up a practical activity. Everyone is now paying attention to the teacher (in AS:PD), but some students finish up work on the practical assignment (in AS:WP) at the same time. In this case, there is a common activity structure that all students are supposed to attend to at the same time (AS:PD).

  Do not consider this as a case of divided class. Code according to the common activity structure for all students.

- Dictating. If the teacher orally dictates information that students are expected to write down, consider the following three things:

  - Is the material to be copied also written down for students to see? If it is written down, consider whether the time following the oral dictation qualifies as AS:CN (e.g., teacher is silent or only facilitating students' copying for 30 seconds or more while students copy).

  - Are students expected to copy exactly what the teacher is dictating, or is there an option for students to use their own words, to work at their own pace, to start to work on the writing before the teacher begins to dictate, etc?

  If students are expected to copy *word-for-word what is orally dictated (and not written down for students to copy)*, this will be coded as ASPDF. This is treated the same as note-taking during a presentation. Usually the pauses between the teacher's dictating and the students' writing will be brief (less than 30 seconds).

  If students have the *option to use their own words*, to work at their own pace, or to start to work before the teacher dictates *and* they have 30 seconds or longer to do this, this will be coded as AS:WA *even if* the teacher at some point dictates an answer that students can simply copy down.

<u>D4.2.2.2 Marking In and Out-Points for AS:WA</u>

When marking the In-Point of AS:WA, use one of the following hierarchy (i.e., if number 1 applies, use it and ignore all other options):

- There is an explicit signal to start, and most students comply within 30 seconds ("whoosh").

  If there is an explicit signal to start the AS:WA assignment followed by most students complying within 30 seconds, mark the In-Point at the conclusion of the signal.

  Definition of explicit signal to start and most students comply. An explicit signal to start is a statement or action that "sets students off to work" on the task, and is followed by most students' action within 30 seconds. In these cases if you see a few students working prior to the signal, ignore them. An explicit signal to start is *not* a statement of the task. An explicit signal to start is usually followed by a pause that indicates students should start off to work.

  Examples of explicit signals: "You can begin now." "Get your things and start now." "Make this now." These signals are followed by most students starting to work.

  Notes: (1) If there is more than one explicit signal, select the signal that is followed by the most students starting to work (usually the later signal). (2) The signal should be regarded as a unit of talk that ends with the "sending students off to work" phrase. Mark the In-Point at the end of the entire unit of talk (as indicated by the "/" mark in the examples below).

  Example 1: "I want you to do steps 1-4 of page 34. *You can start now*.**/**"

  Example 2: "Okay, write it here. Write it here on your worksheet. You need to use complete sentences. Okay, *you can begin now./*"

  Example 3:"I want you to write down your explanation for what we observed in the experiment. Got it? [there is a pause but no one starts to work]. Okay, if there are no more questions, *you can begin now***./**"

  Example 4: "Okay, do the first 10 definitions, and… are you ready? [waits for a few students to attend]. And it will be fine if you just write it on your worksheet. Got it? [pause but no one starts to work]. I'll be making my rounds so if you don't understand it, please ask me. Okay? *Alright then, begin.***/"**

- There is an *intermediate* signal to start, and *most students comply* within 30 seconds ("whoosh").

  If there is an intermediate signal to start the AS:WA assignment followed by most students complying within 30 seconds, mark the In-Point at the conclusion of the signal.

Definition of intermediate signal to start and most students comply: An intermediate signal to start is a statement or action that serves the function of "setting students off to work" on the task without actually saying something explicit like "begin now." It is followed by most students complying within 30 seconds. In these cases if you see a few students working prior to the signal, ignore them.

There are two common types of intermediate signals to start:

- Teacher says "okay" or "alright" or a similar word or phrase in a tone of voice (usually followed by at least a brief pause) indicating that students should start to work.

  Example 1: "I want you to discuss your hypotheses with your group members. *Got it?* **/"** (followed by pause and most students start to work).

  Example 2: "Okay, write it here. Write your values where it says "experiment one" and we do number two. *Okay***./"**

- The statement of the task serves the function as the signal to start, if it is followed by most students starting to work (and usually at least a brief pause).

  Example: "Write down your explanation./" (followed by at least a brief pause, and most students start to work).

  Notes: (1) If there is *more than one intermediate signal*, select the signal that is followed by the most students starting to work (usually the later signal). (2) The signal should be regarded as a unit of talk that ends with the "sending students off to work" phrase. Mark the In-Point at the end of the entire unit of talk.

- There is an *explicit* signal to start, but *most students do not comply* within 30 seconds (or most students have already started to work).

  If there is no signal to start, mark the In-Point of this segment when students have enough information to start working and at least one student actually starts working on the practical assignment.

  Definition of explicit signal to start, but most students do not comply: An explicit signal to start is a statement or action that "sets students off to work" on the task, but in this case it is *not* followed by most students' action within 30 seconds (or most students have already started working before the explicit signal).

  In this case, mark the In-Point when the students have enough information to start, and at least one student actually starts working on the practical assignment.

  IMPORTANT NOTE: an explicit signal to start is *not* a statement of the task. An explicit signal to start is usually followed by a pause that indicates students should start off to work.

Examples of explicit signals not followed by most students' compliance: "You can begin now." "Open your notebook and start now." After this type of signal most students do not comply within 30 seconds.

- There is an *intermediate* signal to start, but *most students do not comply* within 30 seconds (or most students have already started to work).

  Definition of intermediate signal to start, but most students do not comply: An intermediate signal to start is a statement that serves the function of setting students off to work without actually saying something explicit like "begin now." But in this case, the intermediate signal is not followed by most students complying within 30 seconds (or most students have already started working before the intermediate signal).

  In this case, mark the In-Point when the students have enough information to start working and at least one student actually starts working on the assignment.

- There is *no explicit or intermediate* signal to start, but students *start working*.

  In the rare case where there is no signal to start but students start working, mark the In-Point when students have enough information to start working and at least one student actually starts working on the assignment.

Gradual shift

If this segment follows an AS:WP segment, and if the shift between the two segments is gradual, mark the In-Point when the last student finished the practical task and starts working on the assignment (see Gradual Shifts Rules, section 4.2.7).

Mark the Out-Point of AS:WA when the teacher begins the new activity structure. This is usually after the teacher signals to stop working and to attend to another activity structure.

Special considerations for In- and Out-Points for AS:WA

- <u>Gradual shift from AS:CN or AS:IR to AS:WA</u>. In some cases the teacher announces that students will be working on two different activities. First, they will copy notes (AS:CN) or read independently, and when they are done they will start to work on an assignment (AS:WA), such as homework. See the rules for marking gradual shifts in Appendix E. Code the whole segment as AS:WA unless you can identify a clear period of time that was set aside *only* for copying notes or *only* for silent reading.

- <u>Gradual shift from AS:WA to AS:WP</u>. In some cases the teacher announces that students will be working on two different activities. First, they will work on an assignment (AS:WA), and when they are done they will start to work on a practical assignment (AS:WP). See the rules for marking gradual shifts in Appendix E.

- <u>Gradual shift from AS:WP to AS:WA</u>. Sometimes the students are expected to work on a seatwork assignment (e.g., a worksheet, crossword puzzle, homework) after they finish working on a practical assignment. Or students may be asked to do an assignment that contains first-hand practical work followed by writing related to the practical activity that occurs after the use of objects is finished. These are both cases of a gradual shift from AS:WA to AS:WP, and the activity structure will gradually change until all students eventually start working on a seatwork task (AS:WA). See the rules for marking gradual shifts in section 4.2.7.

D4.2.3 Copying Notes [AS:CN]

Copying Notes [AS:CN] is a period of time that is set aside exclusively for students to copy any written or drawn information that is presented to them. During this time students are working independently.

Minimum time requirement for the length for the segment: 30 seconds.

D4.2.3.1 Helpful Indicators

Table D4.7. Indicators for copying notes

Classroom talk	Absent or minimal.
Social organization	Independent (usually students work individually).
Student involvement	Primarily receiving, copying presented information.
Teacher actions	Usually waits silently or writes on the board or overhead.
Physical objects	No 3-D objects are used.
Source of information	External, written, or drawn.
Content	Any content that fits within science instruction.

Classroom talk. Talk is usually absent or minimal. If there is talking, it is only to facilitate student copying. If the teacher reads out loud the material that is being copied, or if the teacher publicly mentions new information while students are copying, shift to AS:PD.

Social organization. Usually students are working individually to copy the notes.

Student involvement. Students are not generating any new information on their own. They are simply copying the information received from external sources.

Teacher actions. The teacher usually reserves time for students to take the notes and waits until students are finished. The teacher may walk around the class and provide minimal individual assistance.

Physical objects. No 3-D objects are used.

Source of information. The source may be the blackboard, overhead, video, textbook, or any other written or drawn material. Dictation does not fall into this category, because dictation is an oral presentation of information and would thus be coded as Whole-class seatwork activities.

Content. Remember that the AS:CN code refers to the activity structure, not the content of the notes. As long as the notes fit within the science instruction phase, it will be coded as AS:CN.

Special considerations

Facilitating talk during copying. While students are copying notes, the teacher is either silent or talking to facilitate students' copying. The teacher's facilitating talk includes the monitoring of the copying work (pacing the work, telling individual students to write neatly, etc.), clarifying what is to be copied, helping students get arranged so they can see the material to be copied, giving directions or advice about how to copy ("be sure to copy all of this"), etc. Talk that involves reading aloud the material to be copied, science content, or new information not related to the copying that the students need to attend to is NOT included as facilitating talk.

Non-science or science organizational talk during AS:CN. In Dimension 1, we coded science instruction if students were working independently on an instructional task while the teacher engaged in science organization (PH:ORG) or non-science (PH:NS) talk. Because of this, you might hear the teacher engaging in non-science or science organization talk while students are copying. If the students have the opportunity to continue to copy *and* at least one student continues to copy, we will ignore this non-science or science organizational talk *unless* the teacher explicitly tells students to stop working in order to listen to the PH:NS or PH:ORG talk.

Do not shift out of AS:CN when you encounter such talk during AS:CN. However, if the teacher tells the students to stop working, and then engages in PH:NS or PH:ORG talk, use the short segment rules regarding PH:ORG and PH:NS segments to decided on the appropriate coding decision. It may be considered a short segment of AS:PD if it is "talk only" PH:ORG or PH:NS (see section D1.2.1.1).

Note about outside announcements: Consider any announcements from outside the classroom that occur while students are working in dependently on AS:CN as PH:NS talk and continue the AS:CN segment UNLESS the teacher in the classroom tells students to stop working and listen to the announcements (this would be AS:PD).

Note taking during other activities. You may notice students taking notes while the teacher lectures, while they are watching a video or demonstration, or during the course of practical activities. Do not code these instances as copying notes because this time is not set aside exclusively to copy notes.

Copying diagrams, drawings, etc. Copying notes includes students copying diagrams, graphs, maps, and pictures as long as the nature of the task does not require students to think and produce some additional information.

For example, copying down the picture of the human body and adding labels of the parts does not count as copying notes, because students have to use their own knowledge or resources to name the parts.

Dictating. If the teacher orally dictates information that students are expected to write down, consider the following two things:

- Is the material to be copied also written down for students to see? If it is written down, consider whether the time following the oral dictation qualifies as AS:CN (e.g., teacher is silent or only facilitating students' copying for 30 seconds or more while students copy).

- Are students expected to copy exactly what the teacher is dictating, or is there an option for students to use their own words, to work at their own pace, to start to work on the writing before the teacher begins to dictate, etc?

  If students are expected to copy *word-for-word what is orally dictated (and not written down for students to copy)*, this will be coded as ASPDF**.** This is treated the same as note-taking during a presentation. Usually the pauses between the teacher's dictating and the students' writing will be brief (less than 30 seconds).

  If students have the *option to use their own words*, to work at their own pace, or to start to work before the teacher dictates *and* they have 30 seconds or longer to do this, this will be coded as AS:WA *even if* the teacher at some point dictates an answer that students can simply copy down.

Students copying without clear signal to do so. Sometimes the teacher may interrupt an AS:PD segment to write on the board or overhead. The students are not working on any assignment at the time. As the teacher writes, some students start to copy the notes on the board in their notebooks (without any teacher signal to do so). In these cases

- Code the segment as AS:CN if it is clear that the teacher intended for students to write down the notes AND most students are copying notes.

  Teacher intent may be explicitly expressed at some point (e.g., "Please hurry and get these copied.") Or teacher intent may be inferred from the teacher's behaviors, such as waiting and watching the students while they are copying and not moving on with instruction until all students are done. The teacher may also at some point make statements that suggest the intent for students to be copying (e.g., "Everyone almost finished?").

  Use students' behavior as an additional indicator to determine whether to code these kinds of segments as AS:CN or to continue the previous activity structure: Watch the student camera for evidence that students are looking back and forth between the source of the information and their own papers/notebooks.

- If it is not clear that students were expected to write down the notes, do not code the segment as AS:CN. If students seem to be simply waiting for the teacher to resume instruction (only a few students can be seen copying the notes, code the segment as AS:PD).

Student(s) working in different activity structures. All students are copying notes. Without any indication to the other students to stop or to keep working, the teacher involves one student in another activity structure. *Ignore this student and code this as AS:CN.*

However, *if there are two or more students* who are involved in different activity structure while the rest of the class is in an AS:CN mode, refer to the section about divided class and code as AS:DC if the situation meets the criteria.

Gradual shift between AS:CN and another independent activity structure. In some cases the teacher announces that students will be working on two different independent tasks, one of which is AS:CN.

For example, they will first copy notes (AS:CN), and when they are done they will start to work on an assignment (AS:WA), such as homework. Or perhaps they will first work on an assignment and then copy notes from the board. In these cases, students will probably gradually shift (each at her/his own pace) from one activity to the other.

See the rules for marking gradual shifts in section 4.2.7.

D4.2.3.2 Marking In- and Out-Points for AS:CN

Mark the In-Point of the copying notes segment when the teacher has indicated that the students should start to copy, at least one student begins to copy, and the teacher is not reading the material aloud or orally providing new information (teacher talk is limited to facilitating student copying of notes).

If there is no explicit teacher signal to copy notes, mark the In-Point after the following three conditions are met:

- There is something for students to copy.
- At least one student has started to copy.
- The teacher is not reading the material aloud or orally providing new information (teacher talk is limited to facilitating student copying of notes).

Mark the Out-Point of the AS:CN segment when another activity structure segment is identified.

D4.2.4 Silent Reading [AS:IR]

Silent Reading [AS:IR] is a period of time set aside exclusively for students to read. During this time students are working independently.

Minimum time requirement for the length for the segment: 30 seconds.

D4.2.4.1 Helpful Indicators

Table D4.8. Indicators of silent reading

Classroom talk	Absent or minimal.
Social organization	Independent (usually students work individually).
Student involvement	Primarily receiving; reading presented information with emphasis simply on decoding and basic comprehension.
Teacher actions	Usually waits silently.
Physical objects	No 3-D objects are used.
Source of information	External, written, or drawn.
Content	Any content that fits within science instruction (do not include seatwork reading material).

Classroom talk. Talk is usually absent or minimal. If there is talking it is only to facilitate student reading.

Social organization. Usually students are working individually while reading.

Student involvement. Students are not generating any new information on their own. They are simply reading the information received from external sources. There is no other task other than basic comprehension of the material being read. For example, the students are not reading to edit each other’s writing, or to interpret graphs, or to answer guiding questions, or to check their own writing for errors.

Teacher actions. The teacher usually reserves time for students to read and waits until students are finished. The teacher may walk around the class and provide minimal individual assistance.

Physical objects. No 3-D objects are used.

Source of information. The source is external and may include texts, the blackboard, overhead, or any other written or drawn material.

Content. Remember that the AS:IR code refers to the activity structure, not the content of the reading. As long as the content of the reading fits within the science instruction phase, it will be coded as AS:IR.

Special considerations

Facilitating talk during silent reading. While students are reading independently, the teacher is either silent or talking to facilitate students' reading. The teacher's facilitating talk includes monitoring of the reading (pacing the work, helping individual students find the appropriate page to be reading, etc.), clarifying what is to be read, giving directions or advice about how to read ("be sure to pay attention to the information in the sidebars"), etc. Talk that involves reading aloud the material that students are reading, science content, or new information not related to the reading assignment that the students need to attend to is *not* included as facilitating talk.

Non-science or science organizational talk during AS:IR. In Dimension 1, we coded science instruction if students were working independently on an instructional task while the teacher engaged in science organization (PH:ORG) or non-science (PH:NS) talk. Because of this, you might hear the teacher engaging in non-science or science organization talk while students are reading. If the students have the opportunity to continue to read *and* at least one student continues to read, we will ignore this non-science or science organizational talk *unless* the teacher explicitly tells students to stop working in order to listen to the PH:NS or PH:ORG talk.

Do not shift out of AS:IR when you encounter such talk during AS:IR. However, if the teacher tells the students to stop working, and then engages in PH:NS or PH:ORG talk, use the short segment rules regarding PH:ORG and PH:NS segments to decided on the appropriate coding decision. It may be considered a short segment of AS:PD if it is "talk only" PH:ORG or PH:NS (see section D1.2.1.1).

Note about outside announcements: Consider any announcements from outside the classroom that occur while students are working in dependently on AS:IR as PH:NS talk and continue the AS:IR segment *unless* the teacher in the classroom tells students to stop working and listen to the announcements (this would be AS:PD).

A student reads aloud. If one student reads aloud to the whole class, code this as AS:PD. Do not code it as AS:IR because this time is not set aside exclusively to read independently.

Student(s) working in different activity structures. All students are independently reading. Without any indication to the other students to stop or to keep working, the teacher involves one student in another activity structure. *Ignore this student and code this as AS:IR.*

However, *if there are two or more students* who are involved in different activity structure while the rest of the class is in an AS:IR mode, refer to the section about divided class and code as AS:DC if the situation meets the criteria.

Gradual shift between AS:IR and another independent activity structure. In some cases the teacher announces that students will be working on two different independent tasks, one of which is AS:IR.

For example, they will first read some material (AS:IR) and when they are done they will start to work on an assignment (AS:WA), such as homework. Or perhaps they will first work copy some notes (AS:CN) and then do some reading (AS:IR).

In these cases, students will probably gradually shift (each at her/his own pace) from one activity to the other. See the rules for marking gradual shifts in Appendix E.

D4.2.4.2 Marking In and Out-Points for AS:IR

Mark the In-Point of the segment when the teacher has indicated that the students should start to read, and at least one student has started to read.

If there is no explicit teacher signal to read, mark the In-Point after the following conditions are met: there is something for students to read, the teacher has directed students' attention to the reading material (e.g., "look at the first paragraph on p. 133"), at least one student has started to read, and the teacher is not reading the material aloud or orally providing new information (teacher talk is absent or limited to facilitating students' reading).

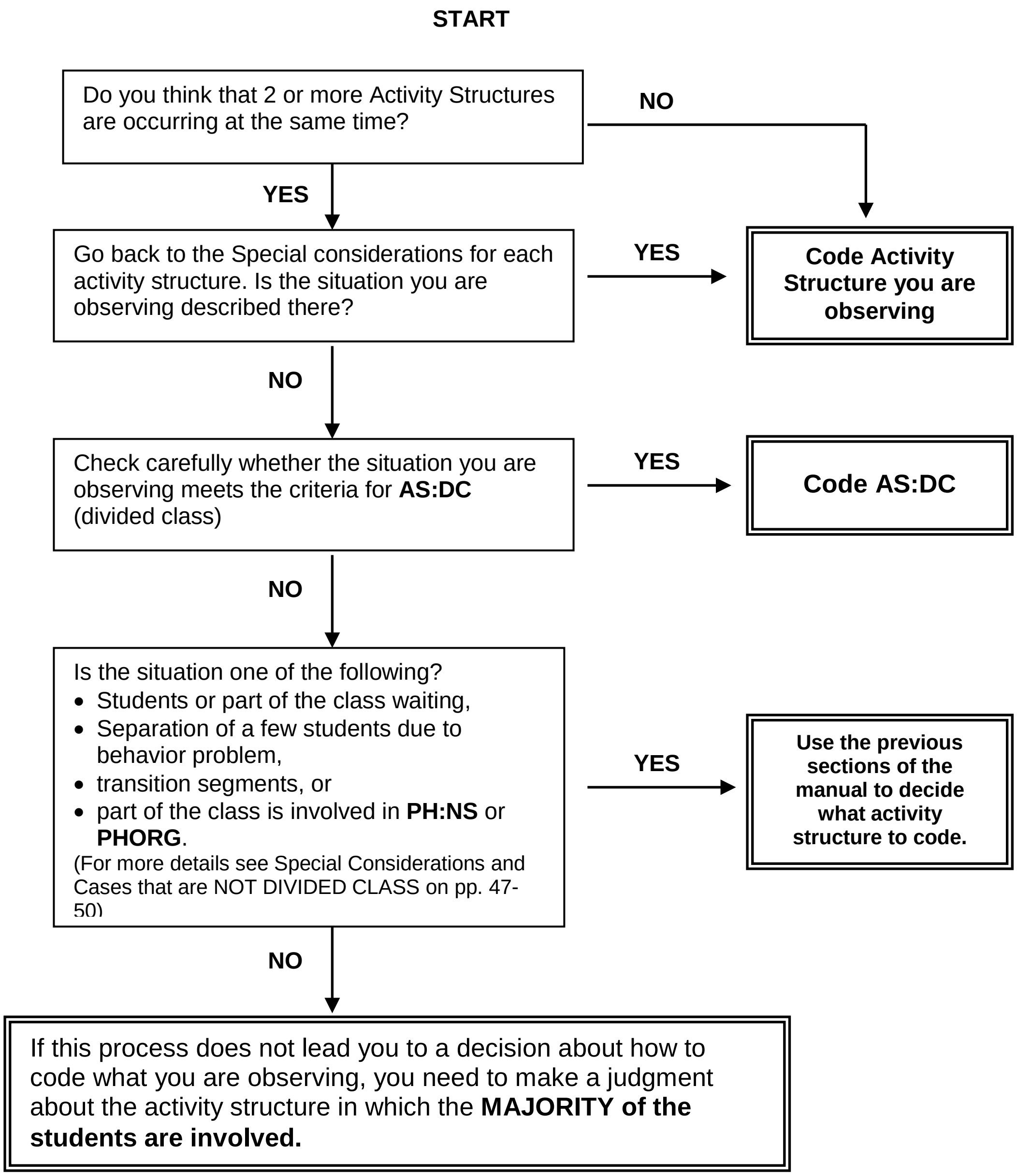
Mark the Out-Point of the segment when another activity structure segment is identified.

D4.2.5 What to Do When it is Hard to Code One Activity Structure

When coding for activity structures you may find occasions where multiple activities can be observed, and it is difficult to select only one activity structure. We designed a code (divided class, see section 4.9 of the manual) to capture some particular instances when the teacher divides the class and assigns students to work in two different activity structures. In other cases, the Special Considerations for each activity structure code will help you decide how to code the segment.

Before you make any decision whether the activity should be coded as divided class or not, please follow the figure 4.3 to orient yourself where to look for the answers.

Figure D4.3. Conceptual overview of how to proceed when more than one activity structure seems to be occurring in the classroom



D4.2.6 Divided Class [AS:DC]

Divided Class [AS:DC] is a period of time when there is no single common activity structure or assignment for the whole class at the same time. The teacher explicitly divides the class in at least two different groups, and at least two groups are expected to work in different activity structures on a different assignment.

Minimum time requirement for the length for the segment: 30 seconds.

Five conditions that must be present to qualify as Divided Class:

- There is no activity structure or assignment that all students must attend to at the same time;
- The teacher must explicitly divide[4] the class into 2 or more groups (this means that all students know what each group will be doing);
- At least two observable activity structures occurring simultaneously;
- The groups must be working on different tasks; and
- There are at least two students involved in each activity structure (more than one student works on each of the different tasks) *or* students work in "one by one" fashion (see special consideration, Section 4.9.3).

Examples

- The teacher divides the class into two groups, and he assigns two different assignments: one group will be working on a practical assignment (doing an experiment) while the other completes a worksheet that contains problems. In this case, the two activity structures would be AS:WP and AS:WA. Code as AS:DC.
- The teacher divides the class into two groups. One group works on an assignment individually (practical or seatwork) while the other group works publicly with the teacher on a new, different topic. The two activity structures in this case would be AS:WA (or AS:WP) and AS:PD. Code as AS:DC.
- Student option is presented by the teacher who tells the class that they are going to do an oral, whole-class review for a test, but that the students who did not finish the worksheet from yesterday may choose to finish the worksheet instead of participating in the oral, whole-class review. Most of the class chooses to participate in the whole-class review (AS:PD), while five students work on the worksheet with different task/topic (AS:WA). Code as AS:DC.

D4.2.6.1 Helpful Indicators

Table D4.9. Indicators of divided class

Teacher actions	The teacher divides the class explicitly.
Activity structure	No common single activity structure for the whole class.
Tasks/assignments	Different groups are assigned different tasks or assignments.
Social organization	At least one of the groups of students is working independently (individually or in pairs or small groups).
Student involvement	Two or more students work on each task in the group.
Content	Any content that fits within science instruction.

Teacher actions. The teacher divides the class and assigns a different task to each group. The teacher does not instruct or assist the whole class at the same time.

Activity structure. The class is divided into groups. Each group is involved in a different activity structure (e.g., AS:PD, ASPPD, AS:WA, AS:WP, etc.), and these activity structures are occurring simultaneously. For example, half the class works with the teacher in an AS:PD structure, while at the same time the others work independently on an assignment. Or half of the class works on a practical activity while the other half works on a written assignment.

Tasks/assignments. The groups must be working on different assignments. “Different assignments” means a different set of problems/questions, different worksheet, different experiment, etc. Practical and seatwork assignments are by definition different assignments, even if the topic of the assignment is quite similar. For example, if some students are doing a hands-on dissection of a frog while other students color in a diagram of the frog’s anatomy, these are different assignments because one is practical and the other is seatwork.

If the teacher or one student does one of the problems from the set on the board while the other students continue to work independently on the same set of problems, it is *not* a different assignment (all students are working on the same set of problems).

Social organization. The social organization can be independent or it can be a combination of independent and whole-class. It can be independent when all students are either working individually or in small groups. For example, half the class works individually on a quiz, while the other half works in small groups using the microscopes. It can be a combination of independent and whole-class when the teacher works with part of the class in a ‘whole-class’ interaction, while the rest of the class works independently.

Student involvement. Two and more students work on each assigned task.

Content. Remember that the AS:DC code refers to the activity structure, not the content of the activities. As long as the content of the activities fits within the science instruction phase, it will be coded as AS:DC.

Special considerations

- Teacher working with students in a "one-by-one" manner, while the rest of the students are working on another task. This is a special type of structuring of the activities in the classroom. This will be coded as AS:DC only if all of the following are observed:

    - The students are *all* engaged in PH:SI, and they are all assigned a task (copying notes, independent seatwork activities). Students are not sitting and waiting.

    - While the students are working on the assigned task, the teacher works sequentially with individual students (one after another) or groups of students (one after another) on a *different task* in *a different activity structure*. The teacher works with each student/group systematically one-by-one and engages them in the task.

    - The teacher explicitly divides the class; that is, and all students know what the teacher is doing with those students.

    - The teacher performs this second, one-by-one task with at least 2 students (one after another) or at least two different groups of students (one after another).

    In these cases consider the whole block of time as one activity structure. Mark the In-Point when the first student or group of students begins to move toward the area where they will be working with the teacher. If the students remain seated, and the teacher comes to the students, mark the In-Point when the teacher starts to work with the first student/group. Mark the Out-Point when the teacher finishes working with the last student.

    The time the teacher spends preparing between the two (or more) students/groups or reorganizing to call up the next group will be considered as part of the whole activity. However, do not include the time spent organizing before working with the first student or after working with the last student.

    If there is a mix of PH:ORG (or PH:NS) and PH:SI talk during a one-by-one segment, consider the whole segment as PH:SI, and code the entire time during which the one-by-one interaction is going on simultaneously with another activity structure as AS:DC.

    However, if the one-by-one talk is *all* PH:ORG or PH:NS, then this is not an AS:DC case. Code according to what the rest of the class is doing.

    The interaction with the students one-by-one should be considered

    - AS:PD if the teacher's interaction with individual students/groups of students is verbal only. Teacher talks to the student or group;

- ASPPD if teacher provides an opportunity for the student or small group to observe a phenomenon or an object (models, tools);

- AS:WA if the teacher involves the student or group in a seatwork, usually written, assignment;

- AS:WP if the teacher involves the student in manipulating the objects.

IMPORTANT NOTE: When making a judgment about the activity structure of the individual one-by-one interactions, consider how you would code the same activity if it had been happening with all of the students in the class at once. Your judgment should be same.

D4.2.6.2 Cases That are NOT Coded as AS:DC

Gradual shift or transition segments. The AS:DC does not apply to the gradual shift or transition segments when students are shifting from one activity structure to another one.

For example, as students finish doing some practical work, they are told to start copying notes from the board. Students gradually shift from an AS:WP activity structure to an AS:CN activity structure. This is not AS:DC because *each student is expected do both assignments in the same order (some are just working faster than others).*

Use the rules for gradual shifts in section 4.2.7 to decide when to mark the change from one activity structure to another.

Some student(s) separated from the rest of the class due to behavior problem. DC does not include segments of the lesson during which one student or a small group of the students is assigned to work on a different task due to some behavior problem. Disciplinary actions of the teacher may result in the separation of a small group of students when the teacher tells those students to work on different task. Code according to what the rest of the class is doing.

Part of the class involved in PH:NS or PH:ORG while rest of the class works on PH:SI. Do *not* consider coding AS:DC when you feel that class is "divided" between PH:NS/PH:ORG and one of the activity structures. *Code according to what the portion of the class involved in PH:SI is doing*. This is regardless of whether the group involved in PH:ORG or PH:NS is led by teacher, instructed by the teacher OR it is the teacher himself.

Example: A selected group of students works on an instructional task while other students are cleaning up.

Students finish up one activity structure while paying attention to the next activity structure. Sometimes the teacher expects students to pay attention to two activities at the same time.

For example, the teacher tells students to pay attention to the teacher talk (ASPDF) while they finish up a practical activity. Everyone is now paying attention to the teacher (in AS:PD), but some students finish up work on the practical assignment (in AS:WP) at the same time. In this case, there is a common activity structure that all students are supposed to attend to at the same time (AS:PD).

Do not consider this as a case of divided class. *Code according to the common activity structure for all students*.

<u>Some student(s) separated from the rest of the class due to the TIMSS-R video study</u>. Sometimes not all the students returned permission slips granting permission for them to be videotaped in the TIMSS-R Video Study. In this case the teacher might have asked those students to leave the classroom or to work in a separate part of the classroom so that they will not be in the video. These students may be assigned a different task to work on during the class hour. Normally you do not see those students in the video, but if you do, ignore these students and do not code as divided class. *Code according to what the rest of the class is doing.*

<u>When you cannot tell what one group is doing</u>. If the class is divided, but there is *no* indication about the activity structure type of one of the tasks (e.g., some students are sent to work in a different room), do not code as DIVIDED CLASS. Ignore the students who left the classroom and *code according to what the rest of the students are doing*.

<u>Teacher working with one or few student(s) on ASPPD while rest of the class waits</u>. The teacher may select one (or few) student to help him/her during a demonstration (e.g., taking some measurements), and the rest of the class is waiting, do not code this as divided class. Continue the segment as ASPPD until the teacher is no longer using objects in a whole-class setting.

<u>D4.2.6.3 Marking In and Out-Points of AS:DC</u>

Mark the In- Point of an AS:DC segment when you first observe two activity structures occurring at the same time. This may or may not correspond to the time when the first group starts to work on their task.

Mark the Out-Point of the AS:DC segment at the moment when only one activity structure is observed.

If the teacher is working with some students one-by-one, mark the In-Point at the teacher's interaction with the first student. Mark the Out-Point at the end of the teacher's interaction with the last student.

D4.2.7 Rules for Gradual Shifts from One Activity Structure to Another

D4.2.7.1 General Definition of Gradual Shifts

Movement from one activity structure to another does not always occur promptly after a signal from the teacher. This is especially true when students are moving from one independent activity structure to another (AS:WP, AS:WA, AS:CN, and AS:IR are the activity structures that usually involve students in independent work).

For example, the teacher will sometimes tell students to work on a laboratory activity (AS:WP) first and to begin working on their homework (AS:WA) when they are finished with the lab activity. Students gradually shift from the WP activity structure to the WA activity structure.

In such cases it is difficult to identify an **Out-Point** for the WP activity structure and an **In-Point** for the WA activity structure.

When the students are shifting from one independent activity structure to another (WP, WA, CN, IR), there is usually a transition period as students gradually shift from one activity structure to another. We will define such transition periods as cases of a gradual shift. A gradual shift occurs when we observe all three of the following conditions:

- All students are expected to eventually shift from one independent activity structure to another.
- All students start in the same independent activity structure, and they all shift eventually to the same activity structure as each other.
- The students make the shift at different points in time (they shift as they finish, rather than all shifting together shortly after a signal from the teacher).

D4.2.7.2 Gradual Shift from AS:WP to AS:WA/CN/IR

Sometimes the students are expected to work on a non-practical assignment (e.g., a worksheet, crossword puzzle, homework) (WA), to copy notes (CN), or to read independently (IR) after they finish working on a practical assignment. Or students may be asked to do an assignment that contains first-hand practical work followed by writing related to the practical activity that occurs after the use of objects is finished. These are both cases of a gradual shift from WP to WA, CN, or IR, and the activity structure will gradually change until all students eventually start working on a non-practical task (WA/CN/IR).

Definition of gradual shift from AS:WP to AS:WA/CN/IR. A gradual shift in this case means that all students eventually change from WP to WA/CN/IR, but the students make the shift at different times. There is NOT a prompt shift (within 30 seconds) of the whole class from one activity structure to another. All students shift from WP to WA/CN/IR, AND the students are making the shift at different points in time.

Marking the shift. When there is such a gradual shift from WA/CN/IR to WP, identify the point when you can no longer see any students using, or interacting with the objects (this includes manipulating the objects in readiness for packing them up or setting them aside). **Err on the side of WP.** Look for clear evidence that no student has the opportunity to observe and manipulate objects as part of the practical task. Students no longer have the opportunity to observe and manipulate objects if

- All students have finished working with the objects, and the objects have been set aside (e.g., on a tray or in a box that is sitting on their table), removed from the students' tables, or are no longer usable.

- All students have left the practical work area and returned to their seats where there are no objects.

- The nature of the task makes it clear that the students are no longer able to observe and manipulate the objects (e.g., the task requires heating of substances and all students have turned off their bunsen burners, or the task involves rolling cars down a ramp and all students have returned the cars to the front of the classroom and simply have the ramp in front of them).

Mark the **Out-Point** of WP when the last objects leave the table or are set aside (at "lift off") or when the last student begins to leave the laboratory area. In the case where some objects are still available, but they are no longer usable for the practical assignment, mark the **Out-Point** when the last student becomes unable to use the materials.

NOTE: Students may all stop using the objects at one point but later return to using the objects. In this case, continue the AS:WP code until you see the very last student using the objects for the last time.

REMINDER: **Err on side of WP**. If you are unsure whether students are using the objects or not, err on the side of AS:WP. For example, if you notice that students are still working at a lab station but you cannot actually see them using objects, assume they are manipulating objects and code as AS:WP.

<u>NOTE:</u> If the teacher stops all students from working on a WP and tells them to start working on a WA, CN, or IR activity, and the students comply within 30 seconds, this is **NOT** a case of a gradual shift. In this case, code the segment as AS:WA at the end of the teacher signal. However, if some students have already shifted from WP to WA, CN, or IR before the teacher signal, this **IS** a case of a gradual shift (students do not all make the shift at the same time). In this case, mark the In-Point of WA, CN, or IR after the last student has set aside the materials (NOT at the teacher signal).

<u>D4.2.7.3 Gradual Shift from AS:WA/CN/IR to AS:WP</u>

In some cases the teacher announces that students will be working on two different activities. First, they will work on an assignment (WA), copy notes (CN), or read independently (IR), and when they are done they will start to work on a practical assignment (WP).

Definition of gradual shift from AS:WA/CN/IR to AS:WP. A gradual shift in this case means that all students eventually change from a WA, CN, or IR activity structure to a WP activity structure, but the students make the shift at different times. There is NOT a prompt shift (within 30 seconds) of the whole class from one activity structure to another. All students shift from WA, CN, or IR to WP, AND the students are making the shift at different points in time.

Marking the shift. When there is such a gradual shift from WA/CN/IR to WP, mark the shift when the first student starts working on the practical task.

NOTE: If the teacher stops the whole group of students from working in one of these activity structures (WA, CN, or IR) and signals that they should now start on the new activity structure (WP), and most students comply within 30 seconds, this is NOT a gradual shift. In this case, code the segment as WP at the end of the teacher signal. However, if some students had already made the shift prior to the signal, this IS a gradual shift case (not all students make the shift at the same time), and you mark the In-Point of WP when the first students starts working on the practical assignment (e.g., before the signal).

D4.2.7.4 Gradual Shift from AS:WA to AS:CN/IR or from AS:CN /IR to AS:WA

In some cases the teacher announces that students will be working on two different activities, neither of which is practical. For example, the students might be asked to copy notes and then begin work on their homework, or they may be asked to read independently and then answer questions in the book. If there is a gradual shift from WA/CN/IR to WA/CN/IR, code the whole segment as WA unless you can identify a clear period of time that was set aside ONLY for copying notes or ONLY for independent reading.

Mark the **In-Point** of the AS:WA segment at the end of the teacher signal to start to work on the two consecutive tasks. If there is no signal to start, mark the **In-Point** when at least one student has received necessary materials and information for both tasks and starts working on the first assignment.

D4.2.7.5 Gradual Shift from AS:CN to AS:IR or from AS:IR to AS:CN

It is possible that students might be asked to work on two tasks consecutively, one of which is an independent reading task and the other of which is a copying notes task.

If there is a gradual shift as students move from CN to IR, code the entire segment as AS:CN. Mark the **In-Point** when the teacher has indicated that the students should start to copy, at least one student begins to copy, and the teacher is not reading the material aloud or orally providing new information (teacher talk is limited to facilitating student copying of notes).

If there is no explicit signal to copy notes and then read independently, mark the **In-Point** after the following three conditions are met:

- There is something for students to copy and later to read.
- At least one student has started to copy.

- The teacher is not reading the material aloud or orally providing new information (teacher talk is limited to facilitating copying and reading).

If there is a gradual shift as students move from IR to CN, code the entire segment as AS:IR. Mark the **In-Point** when the teacher has indicated that the students should start to read and later copy notes, and at least one student has started to read.

If there is no explicit signal to start reading, mark the **In-Point** after the following four conditions are met:

- There is something for students to read and later to copy.

- The teacher has directed students' attention to the reading material.

- At least one student has started to read.

- The teacher is not reading the material aloud or orally providing new information (teacher talk is absent or limited to facilitating students' reading).

D4.3 Teacher-Student Interactions (Dimension 4 Follow-Up)

During the time students are working independently on a practical or seatwork task (AS:WA or AS:WP), the teacher often moves from student to student or from group to group to provide assistance or guidance to those who need it. The teacher may also interact with a student/group in other ways. This assistance may be in one or more of the following forms: Telling, showing, clarifying, hinting, encouraging, evaluating, confirming, or advising. The teacher may also receive information from students. The teacher's conversation may be positive or negative in nature.

D4.3.1 Teacher-Student Interaction [TSI]

Teacher-Student Interaction [TSI] is a period during independent working segments (AS:WP and AS:WA only) when the teacher provides assistance, guidance, or instruction to an individual or group, or receives information from them. Either the teacher or a student/group may initiate the assistance. The content of the talk must be related to the task at hand, or must be about other science ideas or tasks.

Time Requirements: There is no minimum time requirement for TSI (with one exception, see 4.1.6 d, Interruptions).

<u>D4.3.1.1 Helpful Indicators</u>

Table D4.10. Indicators of teacher-student interaction

Teacher Talk	Private or public about science content
Student Talk	Mostly private or contained within the group
Content	Related to the science task
Teacher's Demeanor	Interacting directly with the student/group

<u>Teacher talk</u>. There must be evidence of verbal interaction. If the teacher simply points or nods his head or offers similar non-verbal cues, do not code as TSI. The talk will be mainly private, but public talk will be included if it satisfies the criteria. There must be science content or talk that relates to the science task(s) at hand. Disregard any private or public talk that has no science content, unless it occurs in the middle of the interaction.

IMPORTANT NOTE: In Dimension 2, some parts of the transcript were coded as PUBL but were actually very short segments of private talk between eligible PUBL periods. These segments need to be examined carefully to see whether or not they might be now coded as part of an eligible TSI.

<u>Student talk</u>. Directed at the teacher or other student(s). The talk will be mainly private though there may be times when the student speaks publicly (e.g., calling out to the teacher). There must be science content in the interaction. The talk can involve receiving or giving information.

<u>Content.</u> The content of the interaction between the teacher and student(s) will generally be about the task(s) being undertaken by the whole class, but may include other areas of science or science learning tasks.

<u>Teacher’s demeanor</u>. The teacher will usually place himself or herself in close proximity to the student/group, face the student/group and talk directly to the student/group. In conjunction with verbal cues, the teacher will usually use body language, such as gestures, shrugs, facial expressions, but these alone do not count as **TSI**. In some cases, the teacher may interact while at a distance from the student/group. This will be included as TSI if it meets the criteria in other ways.

<u>D4.3.1.2 Deciding What Counts</u>

When coding Teacher-Student Interaction (TSI) during independent work segments we are primarily interested in capturing segments where the teacher is

- exchanging information with students about ideas or procedures;
- helping students develop ideas or procedures; or
- evaluating students’ ideas or procedures.

Included in these types of TSI's are interactions where the teacher guides, or tells students, something about

- how to do something (e.g., how to manipulate materials while they are doing a practical activity or how to solve a written problem);
- how to work together or who to work together;
- what something is (e.g., definitions, identifications, descriptions); and
- why something is (e.g., explaining a scientific fact, concept, or theory).

Evaluative comments. Evaluative comments about the task at hand or about other science work done elsewhere will generally be coded as TSI. It should be clear that the teacher is commenting about the quality of the student's work, as in: "*That's a much better result than you got last time*", "*I'm only giving you a B for your test",* or "'*Sir, how am I doing with my graph?' 'Good, keep it up'*." If the remark appears ambiguous (could be evaluative or could be a comment about progress in the task at hand or it could be an encouragement remark), do not begin a new TSI. We do not include teacher statements like 'good job' or 'this looks good' as TSI. We do however code for TSI when the teacher explicitly points out *what* is being evaluated (e.g., "that graph looks good" or "you haven't looked at the results yet") and/or when the teacher specifies how the student should *proceed* (e.g., "you should do this one again"). If the teacher hands assessed work back to students and tells them their grade, this will be regarded as Evaluation. But encouragement remarks only will not be coded as TSI's. "Here, you got 9" = TSI; "I gave you a B" = TSI; "Good work, Kathy" = not a TSI; "Good work, Kathy - an 8" = TSI.

Task related comments**.** Assigning a new task, clarifying a previously assigned task, and telling how to do a task are all included as TSI. There is no need to make the distinctions between statements of "what to do" and statements of "how to do." Included in TSI's are interactions where the teacher is

- clarifying the current task (e.g., S: How many are we supposed to do? T: Five each.);

- restating the current task (e.g., S: What are we suppose to do? T: Didn't you listen? You're supposed to read p.11 and then answer question 1-5);

- assigning a new task (e.g., S: What do I do when I am finished T: Here is a new worksheet you can do); or

- making a statement about the task that could be 'how' or 'what' (e.g., T: did you read this yet? S: Not yet).

D4.3.1.3 Deciding What Does Not Count

There are many other types of interaction between teachers and students that do not fit into one of the categories above. Among these are occasions during which the teacher is only

- checking progress (e.g., the teacher circulates and comments on who is done and who is not done);

- managing time (e.g., the teacher reminds students of how much time they have left to complete the task);

- distributing, collecting or putting away materials (e.g., the teacher interacts with students while passing out or collecting materials or organizing students to put equipment away but does not tell them how to use the materials, or discuss any science ideas);

- interacting about non-science related issues (e.g., polite interactions, granting permission to leave the room for various reasons);

- giving short reward or encouragement statements (e.g., “well done”, “good” or “keep it up”, when the context is clearly not about evaluating work; and

- behavioral management (e.g. ‘be quiet, Johnny’, ‘I told you not to take the kidney out of the tray, and you are doing it anyway!’).

If the teacher-student interaction involves only these types of issues, *do not code as TSI.*

<u>D4.3.1.4 A Mixture of Types from 4.1.1 and 4.1.2</u>

If the discussion involves a mixture of the types of issues mentioned in 4.1.1 and information of the <u>how</u>, <u>what</u>, <u>who</u>, or <u>why</u> types described earlier, code as TSI (see Example 4.1.7).

<u>D4.3.1.5 Marking the In- and Out-Points</u>

Mark the In-Point at the time when either the teacher or the student/group initiates the verbal assistance, for example

- “Have you noticed the trick with number six?” (teacher initiated, mark the In-Point at the start of “Have”);

- “If you've finished, start work on the conclusions. Make sure you write them in point form only.” (private interaction to one group initiated by the teacher, mark the In-Point at the start of “If”);

- “Sir, I can't get my weight to sit on the balance properly.” (student initiated, mark the In-Point at the start of “Sir”).

Mark the Out-Point after the last eligible verbal interaction with the same group.

Special considerations

- <u>Difficult to see and/or hear</u>. Sometimes the camera is focused on a part of the room and it is very difficult or impossible to see the teacher and to detect if a new TSI has begun.

    The following are special considerations when a TSI has already started and the sound and images are not well captured by the camera.

- Use the view and/or sound from the second camera to try to make a decision.
- If the view from the second camera is not sufficient to allow a clear decision, try listening to the sound only and try to determine if a change in voice, context or content indicates an end of the current TSI or a new one begins.
- If the transcript is not complete, but you can hear evidence of the TSI, fix the transcript. Do not have to use empty parenthesis to fix the transcript. If only part of the TSI is audible, code for TSI only if the audible part of the utterance contains some content. However, if the audible part of the utterance does not contain any content information do not code as TSI.
- If there are empty parentheses in the transcript we can start the TSI if it is clear that the empty parenthesis is the beginning of an eligible TSI. Do not include the empty parenthesis if it does not seem to be part of the TSI.
- If it is still too difficult to decide, *do not shift out of the existing eligible TSI*.
- If no TSI is open, see 1 and 2 above to decide if a TSI should begin. If you cannot determine that the teacher is assisting a student/group with the science task, do not open a TSI.

- <u>Public talk</u>. If the segment is marked as public, it still can be a TSI if
  - the segment is marked public, but it is a short private interaction embedded within the public talk;
  - the segment is marked public because it was relevant to the whole class, but it is clearly addressed/intended for one student/group;
  - the segment is marked public, and the statement is clearly intended for the whole class, do not code a TSI. This includes cases where the student asks a question and the teacher's reply is intended for the whole class; or
  - the segment it marked incorrectly as public, talk to the original coder and consider changing the code.
- <u>Non-science talk.</u> We will exclude lengthy non-science discussions at the beginning and end of a TSI. Short non-science comments will be included if they are used to initiate a TSI or to end one. Use the following guidelines to decide what is lengthy.
  - Is there a break before the teacher continues with PH:NS? A longer break makes it is easier to separate the TSI and PH:NS.
  - How long is the non-science talk?

- How long is the PH:NS talk in relation to the length of the 'real' TSI? If the non-science is 8 seconds, and the rest of the TSI is only 2, we would not include the PH:NS if it were possible to break it up.

  Examples

- "Before I forget, did you people pay your money for the concert on Friday? No? Well do it today please. How are you going with the worksheet?" Mark the In-Point at the start of "How."
- "You've been away Kathy. Do you need any help with the worksheet?" Mark the In-Point at the start of "You've."
- "…then measure the last mass, and Susan, I have your keys up front." Mark the Out-Point at the end of "front."

- Interruptions. Sometimes the teacher is assisting a student/group in an eligible TSI when there is an interruption, but the teacher resumes interaction with the same student/group after the interruption.

  Where the actual interruption itself lasts less than 10 seconds followed by the teacher resuming the TSI with the same student/group, do not shift out of the TSI**.**

  IMPORTANT NOTE: In general there is no minimum time requirement for TSIs (see 4.1.0). However, TSIs that interrupt another TSI for less than 10 seconds will not be coded as separate TSIs.

  Where actual interruption itself lasts for 10 seconds or more followed by the teacher resuming the TSI with the same student/group, code according to one of the following:

Table D4.11. Coding TSI segments with interruptions

Type of Interruption	If the actual interruption itself lasts for 10 seconds or more:
Teacher discusses a non-science matter with the current student/group or stays silent, but *remains* with the student/group and generally attends to them.	Do not shift out.
The teacher attends to another TSI that lasts for 10 seconds or more.	Mark the Out-Point of the current TSI at the last eligible verbal interaction; mark the In-Point of the new TSI at the start of its first eligible verbal interaction. When the teacher returns to the first group, mark it as a new TSI (at the first verbal interaction).
The teacher: • stops attending to the student/group to focus on a non-science matter privately with another student/group. S/he may or may not remain with the first student/group, • talks publicly about science or non-science issues to the whole class, • remains and waits quietly, but the student/group or part of the group leave(s) and return(s), • leaves the student/group for any reason, whether it is relevant to the TSI or not, *or* • attends to an outside interruption.	Mark the Out-Point of the TSI at the last verbal interaction with the student/group. Mark a new TSI at the first eligible verbal interaction.

- Groups. When the teacher is standing near a table with several students, it is sometimes difficult to decide if he/she is talking to two students simultaneously, or if he/she addresses two students sequentially. In general, we will consider students sitting near each other as a group, except in two cases:
    - It is clear students are working individually and it is clear the teacher is dealing with the students one at the time. (e.g., SUS014).
    - The students are in working in groups, but several groups are at a table and it is possible to distinguish separate TSIs with the different groups. (e.g., SUS053 or SUS083).

In both cases, use the position of the teacher, the involvement of the ‘other’ student(s), and the content of the interaction to decide who is involved in the TSI. The Social Organization label (Dimension 3) can sometimes be helpful, but it should be not a deciding factor in this dimension.

D4.3.1.6 Examples

IMPORTANT NOTE: We will use { and } together with the In-Point and the Out-Point to denote an eligible TSI. The “|” is only used *here* to show ineligible ones. These latter marks will not be used in practice.

Example: SAU039

Time	Person	Transcript
00:31:51	SN	{Sir?
00:31:58	T	Yeah, yeah. See that's going to have so many, and so's that person, and the two of 'em just add together to either out weigh dad, or not.
00:32:07	S	( ).
00:32:08	T	Well you gotta add 'em together. You work out that one, it's moment, clockwise moment, that one, add 'em, there you go.}

The teacher is providing information about how to do the problem. Code as TSI.

Example: SAU039

Time	Person	Transcript
00:33:31	T	|You got it finished,| |you're doing okay|. |Gelson needs to go to the toilet.|

There are three separate short interactions in this segment. None are coded as TSI. The first “you got it finished” interaction is clearly a progress checking type statement. The second "you're doing okay" could be judged either as evaluative or as progress checking. Because it is ambiguous we *do not* code it as TSI. The third interaction "Gelson needs to go to the toilet" is clearly non-science related.

Example: SAU039

Time	Person	Transcript
00:50:51	T	|Alright, you're going to need that. And two, like, okay?| |Grab that Karl.|

Here are two separate short interactions in this segment. None are coded as TSI. In both segments the teacher is simply distributing materials (pieces of string) without telling students how to use the materials.

Example: SAU039

Time	Person	Transcript
00:51:10	T	{String, you got string? Hold that. Grab on to it. Oh, well you got to make up to two hundred,
00:51:21	T	Two hundred looks to be about maximum, so -
00:51:24	T	It is or isn't?
00:51:26	S	I think that it is- it's not balanced.
00:51:28	T	Oh, we'll see what happens. Try that little bit of difference, is going to effect things, but see what happens. Give it a go, and see what goes.} |Who needs string?|

This interaction starts off with the teacher distributing materials (cutting off lengths of string from a roll) but then the teacher continues to provide students with information about *how* to do the task. The result is a mixture of types. Code as TSI.

Example: SAU010

Time	Person	Transcript
00:15:41	SN	SN {Sir, can I sit with Beryl and help do her dissection?
00:15:43	T	Yes
00:15:44	S	Can Rondah and I ( )
00:15:46	T	Yes, for today only.}

The teacher is discussing with whom the student might sit. Code as TSI.

D4.3.1.7 Clarification

When statements. When statements are statements that begin with 'when' always excluded of TSI? No because it depends on whether the teacher is telling students what to do or how to work, or simply managing time. Non-science statements about time are always excluded.

Exclude as TSI: If the teacher is telling students how much longer they have, it is considered managing time and therefore not coded as a TSI. Setting a deadline (e.g., due date) or statements that deal with a timeline (e.g., "next week we will work some more on this") are also considered managing time and not coded as TSI. *Examples include "When is it due? Tomorrow." ; "When will we have a test on sound sir? Next week. "; "You can stop now, we will finish tomorrow"; "If you haven't finished the graph yet, you can hand it in tomorrow"; "If you haven't finished the graph yet, you can do it as homework": "If you haven't finished the graph yet, we will have more time in the next lesson".*

When-statements that deal with *non-science topic* are not TSI. *Example of a non-science "when" statement: 'When are we going skiing?*

Include as TSI: If the teacher combines telling students when to do a task in this lesson with a statement/clarification of the task, it is now considered a TSI because he/she is assigning/clarifying a task. *Examples of combining "when" with statement of the task: 'When you are finished, you can start on a new task'; "What are we supposed to do when you are finished? T: Nothing, just wait."; "Teacher, I don't understand this problem. T: Oh, you don't have to do that one, we will do it tomorrow."*

<u>Hinting statements</u>. Teacher guiding/hinting students where to find information they need coded as TSI's (e.g., "I don't understand how to proceed. What do you do? You have a book!")

<u>Collecting distribution materials</u>. What talk is excluded when the teacher is distributing, collection materials, or telling students to clean-up? *Limit* what is excluded according to the table.

<u>Collecting distribution materials</u>**.** If the teacher is checking whether students have done their homework, is it TSI? No, if the talk is limited to checking whether students have done it or not, it is not TSI.

Exclude as TSI: The following example is considered 'checking progress' and will not be coded as TSI. *Have you done your homework?*

Include as TSI: If the discussion turns to content, it would be considered a TSI because it is a mixture of progress checking and discussing content. (e.g., T: "Have you done your homework?" S: "No, I didn't understand it. I can't do these calculations.")

<u>Behavioral management.</u> Behavioral Management Urging students to get started, sit down, keep quiet, etc. is not coded as TSI because these statements do not contain any details about the task or about science ideas. We will consider them as behavioral management.

Exclude as TSI: Telling students to modify their behavior so that they can complete their work effectively and/or efficiently. (e.g., "Get to work"; "You should have started by now"; "Sit down"; "sit down and get on with your work"; "You should be working quietly."

Include as TSI: However, a remark like those above combined with information about the task will count as a TSI**.** (e.g. "Get to work - you should be reading"**;** "Stop dreaming and write."

<u>Collecting</u>. Teacher is asking the Student for an object. If the teacher asks a student to pass/give an object without adding any reason for this or any other information about the intended use, this should be treated like an example of the teacher collecting material.

Exclude as TSI: T "Can I borrow your calculator for a minute, sweetie?" SN "sure" = not a TSI.

Include as TSI: If the teacher had added "I want to check this result" or similar (an explanation of why s/he wanted the object) then it would become a TSI.

Progress checking. Teacher is asking the students about progress or checking for comprehension? If the teacher asks a student about progress in a very general way so that it is ambiguous whether s/he is checking for progress or for comprehension, do not code a TSI.

Exclude as TSI: T: You're already finished? Everything worked out? Good. It is not clear if the T is asking simply about progress (completing the task and checking the answers) or about the S's ability to do the tasks or the S's understanding. Do not code TSI. *T: Is it (going) a little better with this chapter?* Could refer to progress or to comprehension. Not a TSI

Include as TSI: T: Then you're almost finished with your homework already?
SN: Yes that's nice, right? T: So you understand it well? T is asking about progress *and* comprehension. Code as TSI.

Teacher statements while distributing, collecting, putting away materials**.** The manual states that statements made by the teacher while he is distributing, collecting or putting away materials does not count unless the teacher tells them how to use the materials. See table 4.1.2 for a clarification on what is excluded. If the context is ‘distribution, collecting and telling students to get materials’ try to fit the statement in either column.

Table D4.12. Coding teacher statements while distributing, collecting, putting away material

Activity	Exclude	Include
Distributing and collecting	“Here it is” theme: Give that to me. Pass this back. Thank you (for passing something). Here you are. Here is the worksheet. Here is a worksheet for the lab. Here is a worksheet about sound. Here’s the scissors (passing out). Got string? You need two of these. (passing out materials) Use two (passing out materials). Did you get all the materials yet? (disciplinary context) Hold this string while I cut it (passing out string context) Here’s the paper. What color do you want? Teacher passing out materials. S: I don’t have any string yet. T: Here you go. S: How many of these do I need? (while teacher is passing out materials) T: You need two.	“Do this with it” theme: Put that in your notebook. Put that in your notebook in Section V. Put that in your notebook in the section on Sound. Exchange these with your neighbor when you’re done. Hold your pins so they don’t roll away. Hold this in your hands (passing out pins context). Stick that in your notebook rather than just popping it in. T: What color do you want? Make sure you’re writing down what color you’re using.
Putting away, Clean up	“Do it” theme Clean up. You need to clean up. Clean up now. Why aren’t you cleaning up yet? Put your materials away.	“How to clean, where to put things” theme Put the beaker back in the cupboard next to the acids. You need to wash off the tables and put everything away. You need to clean up. Make sure you put the stuff in envelopes. Make sure you wash out the test tubes before you put them away. As soon as you’ve cleaned up, sit down. What do I do with these tongs, sir? Put them in the bin. Your table is still dirty. Wash it off.

D4.4 Discussion vs. Presentation (Dimension 4 Follow-Up 2)

In Dimension 4, we divided the lesson into activity structures. A central research question for this dimension is: Is the lesson teacher-focused or student-focused? In other words, do students play a more active or a more passive role? In our conceptual overview for Dimension 4, we divided activities according to whether the students were primarily receiving information (passive role) or doing science work (active role). Our overview for Dimension 4 acknowledged that ASPDF segments could involve students in either receiving information or actively doing science work.

With this follow-up, we will divide the ASPDF segments to identify presentation segments, where students are primarily receiving information, and discussion segments, where students are primarily doing science work. Although discussion segments typically involve only one or a few students speaking at a time while the rest of the class listens, it is still a period of time where students are expected to be active contributors to classroom instruction. Therefore, discussion segments are better indicators that students are actively doing science work.

How do we identify discussion and presentation segments?

To identify discussion and presentation segments, we will first mark all elicitations posed by the teacher or the students and all responses given by the students or the teacher during ASPDF segments. These will be used to identify places where there are back-and-forth questions and responses that last longer than 20 seconds, which will be called discussion segments. Once all discussion segments are identified, we will label all remaining ASPDF time as presentation, with the exception of special situations that will be resolved by using short segment rules. The discussion and presentation codes will be mutually exclusive coverage codes within the ASPDF segments. After identifying discussion and presentation segments, we will identify the source of each presentation segment: student(s) or student reading textbook or other source aloud.

Codes for ASPDF segmentation

Transcripts will be marked to identify the following (but these will not be coded in vPrism):

- teacher elicitation [Q];
- student response [R]; and
- teacher response [TR].

The following codes will be marked on the transcript and in vPrism:

- student elicitation [SQ] In- point only;
- discussion [DISC] In- and Out-Points;
- presentation [PRES] In- and Out-Points;

- student presentation [PST] In- and Out-Points; and
- reading aloud [PRE] In- and Out-Points.

There is no minimum time requirement for Q, R, SQ, and TR codes.

The minimum time requirement for each discussion and presentation segment is 20 seconds.

Coding process for DISC vs. PRES segmentation

The coding process will occur in two steps. First, we will mark transcripts for each teacher elicitation (Q), student response (R), student elicitation (SQ), and teacher response (TR). During this process, In-Points for student elicitations will be coded.

These markings of the transcript will then be used to code first for discussion segments and then for presentation segments.

D4.4.1 Marking Transcripts for Teacher Elicitation [Q]

During ASPDF segments, teachers frequently ask students questions or otherwise elicit student responses to guide the development of content ideas, to assess or evaluate students' understanding, to review ideas and procedures studied earlier, or to give students practice using new ideas. These questions and elicitations are designed to get students thinking and involved in the lesson – doing science work.

Teacher Elicitation [Q]: Is defined as an utterance that is intended to elicit an immediate verbal (oral) response from students. It is posed *publicly* by the teacher or other non-student, and it occurs during ASPDF segments. A Teacher Elicitation must be followed by either a Student Response, a pause of at least 2 seconds, or a repetition or rephrasing of the elicitation. It may be stated in the form of a question or in the form of a statement or direction.

Time Requirement: There is no time requirement for Teacher Elicitation. Teacher Elicitation will be marked on transcripts only!

D4.4.1.1 Helpful Indicators

Table D4.13. Indicators of teacher elicitation

Classroom talk	Public
Teacher talk	Makes a request for an immediate verbal response from one or more students. The request may be in the form of a question or a statement/directive.
Source of Teacher Elicitation	Usually the teacher. Can also be non-student source such as a teacher assistant or a text question that is read aloud.
Content of Teacher Elicitation	Related to the science task.
Student talk	Usually a verbal statement (or raising of hands to communicate a response) by one or more students immediately following the Teacher Elicitation. If there is no student response, there is at least a 2-second pause or a teacher repetition, rephrasing (including hints about how to answer) of the elicitation.

Teacher talk. The teacher (or other source) makes a public request for a verbal response from one or more students. If the teacher expects only a physical response (e.g., looking, listening, moving, nodding, etc.), do not code as a Teacher Elicitation unless the question asks students to raise their hands (or otherwise use body signals) to indicate a communicative response (e.g., “How many of you predict that this set-up of a circuit will work?”).

Source of teacher elicitation. Although the teacher usually poses the question, it can also be posed by another source. For example, a teacher assistant or a classroom visitor may pose a question to students. Students can be the source of the Teacher Elicitation if they are reading aloud a question that came from the textbook, a worksheet, or some other teacher-supplied source. In these cases, the questions really come from the teacher so they are coded as Teacher Elicitation.

Content of teacher elicitation. There must be science content or talk about the science task(s) that are immediately relevant to the class. Disregard any non-science questions including behavior management questions (e.g., “John, are you ready to start?” “Amy, why are you late?”), even if there is a student response.

Student talk. Usually one or more students will talk publicly in response to the Teacher Elicitation, giving a response to the Teacher Elicitation. Sometimes the students may raise their hands to respond to the teacher elicitation (“How many of you think that the pH is acidic?”) If there is no verbal or hand raising response, consider whether the teacher pauses after posing a question (for 2 seconds or longer) or if the teacher repeats, rephrases, or gives hints about the answer to the question. The teacher pause, repetition of the question, or hints are indications that a student response was expected – mark the teacher utterance as a Teacher

Elicitation even though no student responds. See Figure 4.2.1 for a decision tree to guide your coding.

D4.4.1.2 What to Include as Teacher Elicitation

When coding for Teacher Elicitation during ASPDF segments, we are primarily interested in capturing segments where the teacher is either providing information about ideas or procedures, or helping students develop ideas or procedures.

- Include science content-related questions that elicit a student response or are followed by a 2-second pause or a repetition/rephrasing of the elicitation.

  We are primarily interested in questions that ask students something about

  - what or why something is (e.g., describing or explaining a scientific fact, concept, theory, or procedure);
  - how to do something (e.g., how to manipulate materials while they are doing a practical activity, how to solve a problem, how to do an assignment or homework task); and
  - how to work together or who to work with (e.g., reviewing the directions for how students should work such as "Let's check to make sure you understand. How many people will be getting materials? Who will be doing the recording of data?"; asking about how to divide up tasks in group work such as "Would the recorders for each group raise their hands?"; or asking about how to act during group work such as "Who can tell me one suggestion for how to make things go smoothly in our group work today?").

- Include elicitation in the form of statements

  Teacher Elicitation may be presented in the form of statements or directions. The statement may or may not include the raising of the voice at the end of the sentence, indicating that it is intended as a question. For example: "I need someone to tell me the difference between three bulbs in series and three bulbs in parallel" or "Elements are composed of?" (voice goes up at end of statement).

  - If the statement is clearly intended to elicit a verbal student response and it either gets a response or is followed by at least a 2-second pause, mark it as a Teacher Elicitation.

    Example

Person	Transcript
T	Notice the brightness and tell me why.

    Mark this as a Teacher Elicitation if there is a verbal or hand-raising type of response or if there is a 2-second or longer pause after the question.

- If the statement is not clearly an elicitation but it successfully elicits a verbal response from a student, code it as a Teacher Elicitation.

  Example

Person	Transcript
T	I wonder whether this set up of a circuit will work.
S	I don't think it will.

  Mark this as a Teacher Elicitation.

- Include some requests that simply call on a student.

  Sometimes the teacher calling on a student can be marked as a Teacher Elicitation:

  - If the teacher asks for volunteers, mark each request for volunteers as a Teacher Elicitation if the students know what the task/question is before volunteering and if there is a student response, a 2-second or longer pause, or the request is repeated.

    Examples

    - "Who can answer this?"
    - "Who wants to try?"
    - "Do I have any volunteers to work this problem on the board?"
    - "Which group will volunteer to do their presentation first?"

  - If the teacher calls on a student to answer a previously posed question, include this as a Teacher Elicitation. Essentially, the teacher is repeating the original question by calling on another student.

  Example

Person	Transcript	Decision
T	What is the name of this compound?	Mark as Q
S	Sodium.	Mark as R
T	That's not enough. Tara?	Mark as Q

  Note: If the teacher is calling on a student to read aloud from a written source, do NOT include it as a Teacher Elicitation.

  Example: Teacher: Phillip, could you read the first paragraph on p. 252?   Do NOT mark as Q.

Include repetitions of the question.

- If the teacher repeats or rephrases the question or gives students hints about the answer to the question, mark each repetition, reformulation, or hint[10] as a new Teacher Elicitation, even if the first utterance of the elicitation does not get a response or a 2-second pause.Include requests for clarification, elaboration, or repetition of a student response.

  Include elicitations in which the teacher asks a student to clarify a response (So you would agree with Ella?"), elaborate a response ("Use a full sentence." "What unit?"), or repeat a response ("Say it again, Sam, louder this time")

- Include requests that asks students to read aloud from a textbook or other source.

  If students read aloud questions from a textbook, worksheet, overhead transparency, or other teacher-supplied source, mark these as Teacher Elicitations if students respond to them or if there is at least a 2-second pause after the reading of the question.

- Include requests that ask students to go to the front of the room to show or tell something to the class.

  Include them *only if* students have not had time to prepare for this task ahead of time. If they have prepared ahead of time, it is a Student Presentation, and we will not count the teacher's statement of the task as a Teacher Elicitation (see bullet under 1.4.3 What to Exclude).

<u>D4.4.1.3 What to Exclude as Teacher Elicitation</u>

- Exclude the non-content-related elicitation types listed below *even if* they elicit a verbal or hand-raising type of student response or are followed by a 2-second pause or a repetition/rephrasing of the question.

  There are many questions posed by teachers that ask students for a verbal response, but that do not fit into one of the above categories. Among these are requests in which the teacher is only

  - checking progress or pacing instruction ("Are you finished?" "How far have you gotten?" "Doing ok?" "What page should we be on?" "Did you finish your homework?" "How many of you finished your homework?" "Can you see?" "Do you have your textbook?" "Do you have your notebooks out?");
  - managing time ("How many of you need more time?");
  - asking students to distribute, collect, or locate materials ("John, can you pass out the worksheets?" "Mary, did you put the masses back?" "Who's got the scissors?" "Where is your homework?");

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[10]A hint is usually a short bit of additional information intended to help the student successfully answer the question. The tone of voice indicates that teacher is still looking for a student response (rather than lecturing).

- interacting with students about non-science issues (“Did you get a haircut, Jamie?” “Who did not bring in their permission slips?” “Why are you late?”);
- managing student behavior (“Get quiet, Maria.” “Are you listening, Josh?”, “You with me, Fred?”, “Paying attention, Joanne?”);
- asking a student to read aloud (“Can you read the first paragraph, Martin?”); and
- talking to himself or herself (“Oh my, where did I put those worksheets?”, “What was I going to do next?” “Where’s my chalk?”).

If request for a response involves the above types of issues, then DO NOT mark as Teacher Elicitation, *even if students do actually respond verbally or by raising their hands and even if there is a pause of 2 seconds or a repetition of the elicitation*.

- Exclude requests that are checking for understanding or asking for acknowledgement that the listener is following the presentation (“Okay?“, “Righto?”, “Alright?”, “Not a problem?”, Are you ok with that?” “Are you with me?”, “Is that fair?” “Do you understand?” “Any questions?” “Got it?”) *unless* students respond verbally or by communicative hand raising. In other words, this is marked as a Teacher Elicitation *only* if there is a student response (a 2-second pause or repetition of the question does not qualify it as a Teacher Elicitation).

- Exclude teacher statements of the task that are followed promptly (within 20 seconds?) by either:

  - A Student Presentation of something that was prepared ahead of time (e.g., student report read aloud to the class, students sharing a demonstration they have prepared), or
  - An AS:WA or AS:WP segment.

  Examples to EXCLUDE as teacher elicitation

  - “Ok, John and Joella, you can present your demonstration of Newton’s first law now.” (followed by student presentation of a demonstration prepared earlier in the lesson).
  - “Get to work now on the 10 questions about electricity.” (followed by AS:WA)

- “Remember to find out the mass and volume of the objects first, then calculate the densities. Ok, get started.” (followed by AS:WP) Exclude physical-response-only requests.

  Do not code requests that ask only for a physical response (to look, listen, touch, nod, etc.) as Teacher Elicitation (e.g., “Everyone look up here now.” or “I’d like you to notice the brightness.” or “Listen and notice if you can hear the alarm clock in the vacuum chamber.”)

There are three *exceptions* (see below). Do *not* code requests for physical responses as Teacher Elicitation *unless*

- The request for a physical action *also calls* for a verbal response ("Look at this line on the graph and tell me how long you think it is" (and there is a student response or a 2-second pause or a repetition of the question).

- The request for a *physical* action succeeds in eliciting a *verbal* response from one or more students and the verbal response is clearly related to the content of the teacher request ("Come and observe the meter." Student looks at the meter and responds, "It's 4.5.").

- The request is for students to raise their hands or to give other physical signals (e.g., thumbs up, thumbs down; holding up cards with written words that indicate their answers) to communicate a response to a teacher elicitation related to the science content and/or task ("Raise your hands if you think that the ammeter should be placed here."). In other words, include it as a Q if the answer to the question could be answered by students raising their hands. These are usually "How many of you…" and "Who thinks" types of questions.

Note: Sometimes no hands will be raised, but this apparent lack of response is still communicating something to the teacher (e.g., "Raise your hand if you understand this"). Therefore, consider the teacher request for a hand-raising response as a Teacher Elicitation even if no hands are raised.

Example

Person	Transcript
T	Raise your hand if you can hear this sound. Mark as Teacher Elicitation. (the sound is inaudible to human ears)

<u>What to do with statements describing assignments of AS:WA or AS:WP tasks.</u> Before sending students off to work on an AS:WA or AS:WP task, teachers often make statements that describe the assignment that students will be doing during the AS:WA or AS:WP. If these statements are followed by students going off to work on the assignment independently, do not mark the teacher statements as Teacher Elicitation.

<u>What to do with requests that students will respond to in the future.</u> This occurs when the teacher is not asking for an immediate response. Sometimes the teacher will utter a question that students will be expected to respond to in the future. Since the teacher is not asking for an immediate response, this is NOT coded as a Teacher Elicitation.

Example *to exclude*: “At the end of class, I am going to ask you about this question: How do you think a series circuit is different from a parallel circuit? So be thinking about that while you are working today.”

Do *not* mark this as a Teacher Elicitation (until the question is actually discussed later in the lesson).

Special considerations

- What to do with Teacher Elicitations that ask for a short written response that occurs during ASPDF? Sometimes you will encounter Teacher Elicitation during an ASPDF segment that ask students to respond in writing (this might have been coded as AS:WA if it had lasted longer than 30 seconds or this might be one student writing publicly to share with the rest of the class). If these questions meet the criteria for Teacher Elicitation and the student writing occurs during an ASPDF segment, code them as Teacher Elicitation. [*If this writing lasts longer than 30 seconds, it will be coded as AS:WA, and this would NOT be marked as a Teacher Elicitation (see exclusion 1.4.5).]* If the elicitation are about non-science tasks, do not code them as Teacher Elicitation.

    Exception: If the students are being asked only to copy something or to write down something that the teacher is dictating, no not code as Teacher Elicitation.

    Note: Student responses that are in written form will NOT be marked as Student Responses.

    Example that is a Teacher Elicitation:

Person	Transcript
T	What is the definition of transparent? Write it down on your worksheet now. (lasts less than 30 seconds)

    Mark this as Teacher Elicitation.

    Examples that are *not* Teacher Elicitations:

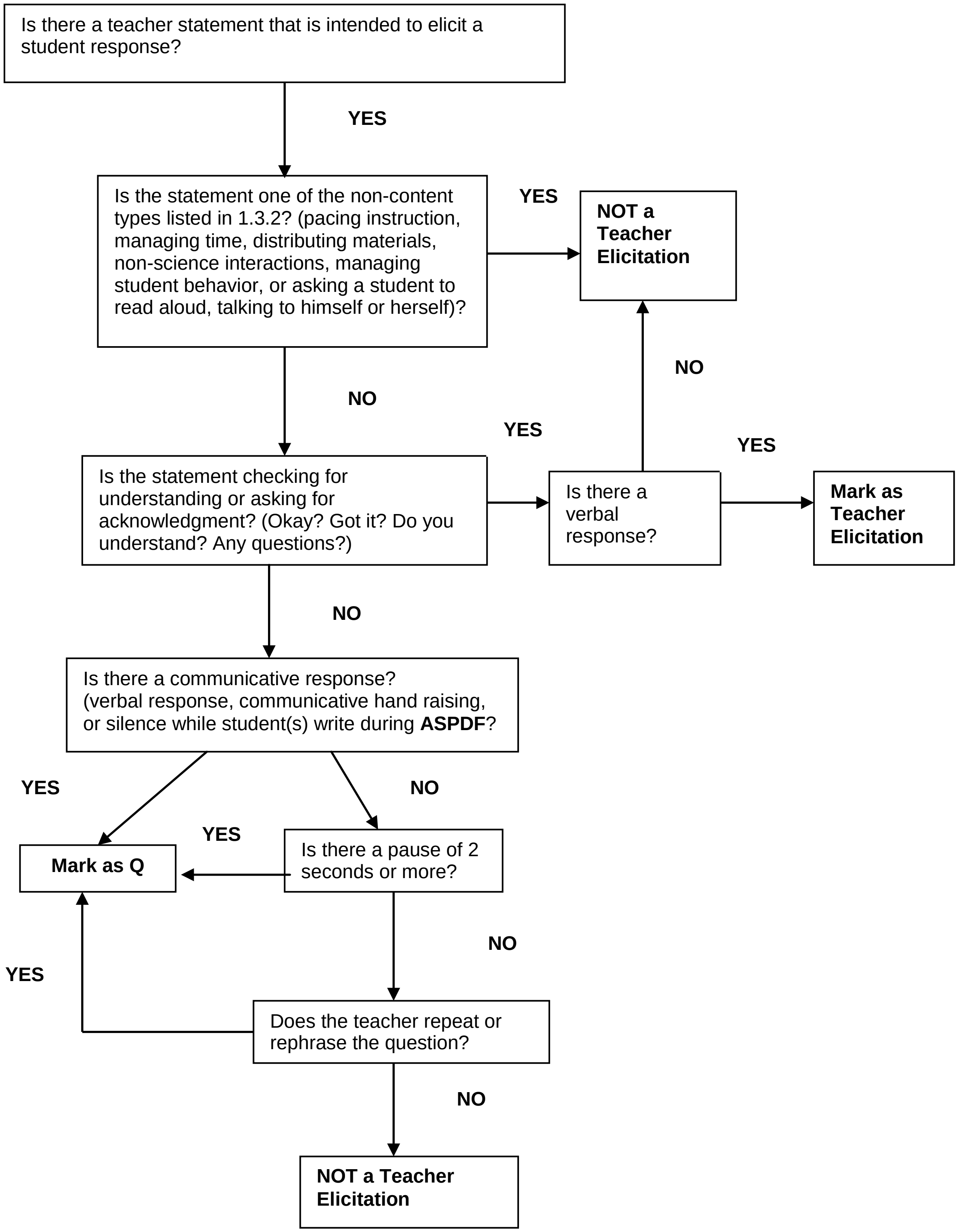
Person	Transcript
T	Write down your name and the date at the top of your paper.

    Since this is not about the science task or the science content – *do not* mark this as a Teacher Elicitation.

Person	Transcript
T	Write down these questions, which you will answer for your homework. Number 1, what happened in our experiment?

    Students are only being asked to copy down words dictated by the teacher. *Do not* mark this as a Teacher Elicitation.

Figure D4.4. Decision-making process for identifying teacher elicitations [Q]



D4.4.2 Student Response [R]

Student Response [R] is defined as a student's public answer in response to any elicitation (request for response) posed by the teacher, another student, or another source. The Student Response is usually verbal. The only nonverbal action that can be marked as a student response is when students are asked to respond to a question by raising their hands or using a similar body motion to communicate an answer (e.g., a thumbs up, thumbs down signal, or holding up a card with an answer written on it).

Time Requirement: There is no time minimum requirement for student responses. Student Responses will be marked on the transcript only!

D4.4.2.1 Helpful Indicators

Table D4.14. Indicators of student response

Classroom talk	Public
Student talk	Responds verbally or by communicative hand raising to a Teacher Elicitation. The student utterance appears to be responsive to the teacher request.
Audibility of student talk	Student voice is not always completely audible.
Transcription of student talk	A student's response to a Teacher Elicitation may or may not be transcribed.

<u>Student talk.</u> The student responds verbally to a teacher request, and the content of the student's talk indicates an attempt to respond to the teacher's question. The student verbal response can be extremely brief (yes, no, uh-huh, ok, I don't know) and can even include an "ummmm" type of utterance, indicating that the student has heard the question and is thinking about a response. However, do not include laughter, grunts, groans, etc. as verbal responses. The only nonverbal action that will count as a Student Response is student hand raising (or similar body action) to communicate an answer to a Teacher Elicitation (e.g., "Thumbs up if you agree with David's prediction, thumbs down if you disagree" or "Each group hold up your white board with your answer on it" or "How many of you think that Riley's rocket will go higher than Mackenzie's?").

Note: If the teacher asks students to raise their hands to answer a "How many of you think….?" type of question, then the lack of raised hands will also be considered as student response; the students who do not raise their hands are answering in the negative.

<u>Audibility of student response.</u> Although the response occurs during a public interaction, the student's response may or may not be completely audible. If you can hear enough of the utterance or the tone of the utterance to determine that it is most likely a response to the Teacher Elicitation, code it as a Student Response. Sometimes you can tell from the teacher's next statement what the student probably said. Use this information to make inferences about whether or not the inaudible student statement was responsive to the elicitation.

Transcription of Student Response - The student responses are often times not transcribed. Please add audible student responses to the transcript and mark them as Student Responses.

D4.4.2.2 What is included as a Student Response?

Include response to the question. The response must give some indication (by tone of voice or by words) that it is a response to the question that was posed.

Include constructed responses, not reactive. We are interested in constructed student responses rather than reactive student responses. Therefore, we do not mark laughter, grunts and groans, ohs and ahs, “wow”, “cool”, “yuk”, “gross,” and other similar “utterances” as attempts to construct an answer to a Teacher Elicitation.

Include any audible response. Code any indication that the student has heard the question and is attempting a response (even if the student only says, “uh”). *It does not have to be transcribed* to count.

Include delayed student responses. Sometimes the teacher asks for a response but the student response is delayed because of the nature of the question. Mark the Student Responses even though they are not immediate.

Include multiple responses to one question. Mark each audible response to the same Teacher Elicitation as an individual student response.

Include raising of hands or signs with answers written on them when these communicate a response to a teacher elicitation.

Include teacher reading student responses out loud. SJP056 28:03: Students hold up white boards with their responses written on them. Teacher reads each student answer out loud. Mark each student answer read out loud by the teacher as a Student Response.

Include public written student responses. Sometimes a student(s) writes a response on the board or on the overhead transparency publicly. Mark this as a Student Response.

D4.4.2.3 What is excluded as a Student Response?

Exclude non-responsive utterances. Exclude student comments that have nothing to do with the content of the teacher request for a response. The responses might be non-responsive because they are related to non-science matters or because they are not related to the content of the elicitation.

Example: The teacher asks the students to explain photosynthesis, and he calls on Robert. Robert responds, “It’s time for lunch, Sir.” He then calls on Gina, who says, ”Mr. Meyer, William is kicking my chair.” Both student utterances are non-responsive and are not coded as Student Responses.

Note: What do you do about utterances that are connected to the question that was posed but are not directly responsive? In these cases, err on the side of considering the student utterance responsive.

Example: The teacher is burning a piece of magnesium and asks students to tell whether or not they think a chemical reaction is taking place. Students are calling out their observations of the magnesium but are not talking about the chemical reaction question:

- "It is so bright!"
- "Can we try this again?"
- "It hurts my eyes."
- "It's burning fast."

All four of these student responses are relevant to the science task even though they are not directly responsive to the teacher's question. Include them as Student Responses.

<u>Exclude reactive, rather than constructive responses</u>. Exclude student utterances that are simply reactions to something they are hearing or seeing, rather than attempts to construct an answer to a question. Student laughter, grunts, groans, oohs, ahs, "cool", "wow", "gross", "yuk", etc. are examples of a reactive responses.

Example: The teacher burns a piece of magnesium. Students laugh and call out: "Wow! That's neat! Cool!" These are reactive responses, rather than constructed responses to a Teacher Elicitation.

<u>Exclude student responses that are questions</u>. If the student response to a Teacher Elicitation is phrased as a question, it will be coded as a Student Elicitation. NOTE: A student response might take on a questioning tone when the student is not sure he/she is right and is looking for confirmation from the teacher. When the student voice goes up at the end of a response, this does not automatically qualify it as a Student Elicitation.

Example 1: Student response is voiced as a question

Person	Transcript
T	What is the definition of transparent?
S	When you can see through it?

Mark this as a Student Response.

Example 2: Student response is a question

Person	Transcript
T	What is the definition of transparent?
S	How come some glass can be transparent and some isn't ? What makes some glass foggy?

Mark this as a Student Elicitation.

<u>Exclude responses that indicate the student did not hear the elicitation</u>.

Examples

- "I didn't hear the question, Sir."
- "Could you repeat the question?"

<u>Exclude private/independent student written responses</u>. Sometimes the teacher asks students to respond in writing independently (this would have qualified as AS:WA if it had lasted longer than 30 seconds). Do not include any written responses as a Student Response. However, this time will most likely fall into DISC segments if the teacher is silent while students write. Note: Student writing that is done publicly (e.g., on the board) is included as a student response.

D4.4.3 Student Elicitation [SQ]

Students often ask questions in science class, but most of the questions they ask are simply procedural: When is this due? Where are the tongs? What do we do next? How many pages does it have to be? What was my grade on this? The purpose of this code is to identify only those occasions when students raise substantive, content-related questions that demonstrate that they are paying attention and trying to understand or otherwise engage in the content of the lesson (e.g., "meaty" questions, "curiosity" questions, or "trying to understand" questions).

Student Elicitation [SQ] is defined as a public utterance initiated by a student that is either: (1) a science content-related request intended to elicit an immediate verbal response (from the teacher or another student), OR (2) a science content-related statement or comment that a student volunteers that succeeds in eliciting a content-related Teacher Response that provides some content information (more than simple acknowledgment of the comment).

Time Requirement: There is no time minimum requirement for student elicitations. In-Points only will be marked for student elicitations.

D4.4.3.1 Helpful Indicators

Table D4.15. Indicators of student elicitation

Classroom talk	Public
Student talk	A student initiates (without teacher prompt, not in response to a Teacher Elicitation) a public statement that is: a) related to the science content or the science task and b) either a request for an immediate verbal response (from the teacher or another student) or a statement that results in a content-related Teacher Response. The request may be in the form of a question or a statement/directive.
Content	Related to any science content or to the science task at hand.
Transcription of student talk	A student's question may or may not be transcribed.

Student talk. The student initiates (without teacher prompt) a science content-related public request for a verbal response from the teacher or another student. OR the student initiates (without teacher prompt) a science content-related public statement that the teacher picks up on and responds to (the student did not necessarily intend to elicit a Teacher Response). In this latter case, the Teacher Response must be more than a simple acknowledgement of the student contribution – there must be some elaboration of the response beyond "good", "yeah, good point."

Content of student elicitation. There must be science content or talk about the science task(s) that are immediately relevant to the class. The science content may be connected to the lesson, or it may be about science content that does not appear to be connected to the lesson. But there must be a link to some science content and/or some science task. Disregard any non-science questions ("Ms. Telori, may I go to the bathroom?").

Teacher talk. The teacher will usually respond verbally to the student's elicitation. However, there does not need to be a teacher response (except when the student makes a statement rather than a request or when the student requests a physical response only).

When coding for student elicitation during ASPDF segments, we are interested in capturing only segments where the student is asking content-related questions.

D4.4.3.2 What to Include as Student Elicitation?

Include science content-related elicitations. We are primarily interested in questions that students ask publicly about

- what or why something is (e.g., describing or explaining a scientific fact, concept, theory, or procedure);

Examples

- “How do they know that 1-celled plants existed long ago – they couldn’t find fossils of ‘em, could they?”
- “What does “pulverize” mean?”
- “Why do people hiccup? Does it have something to do with digestion?”
- “Why do you have to put the ammeter there?”

- how to do something that is content-related (e.g., how to solve a problem, how to represent data in a graph, how to do a measurement accurately, etc.);

Examples

- “How do you make the slides so there aren’t so many air bubbles?”
- “I don’t understand how you knew to put the time along the x axis and the distance along the y axis.”
- “Can you go over how to use the triple beam balance? I forget how to do it.”

<u>Include elicitations addressed to other students as well as the teacher</u>.

<u>Include elicitations that come in response to a teacher request for student questions.</u> Usually, we are looking for student elicitations that are initiated by students, without any prompting by the teacher. However, if the teacher specifically asks students to ask content-related questions, include any student questions that are posed as a result of this request as student elicitations.

Example

Person	Transcript
T	If you are having trouble understanding this, you need to ask me questions.
S	Well, I don’t understand why plants have to change sun energy into food energy. Why can’t they just use the sun energy?

Code this as a student elicitation.

<u>Include inaudible or partially audible student requests for a response</u> if you can infer the student question based on the teacher response.

<u>Include elicitations in the form of statements</u>. Student elicitations may be presented in the form of statements.

- If the statement is clearly intended to elicit a verbal teacher response (or response from another student), code it as student elicitation.

  Example: “Ms. Jones, I don’t understand how you did that.” Code this as student elicitation.

- If the statement is not intended to elicit a verbal teacher response (or response from another student) but successfully elicits a public verbal response from the teacher (or from another student), first consider whether it is a response to a previously-posed Teacher Elicitation. If it is related to a previously-posed Teacher Elicitation, mark it as a Student Response even if it does not directly address the teacher’s question.

  Example

Person	Transcript
T	This one smells the worst. What is it called?
S	( ) Rotten ( ) gas.
T	It doesn’t make rotten egg gas, it forms sulfur dioxide.

The teacher picks up on the student comment about rotten gas, but the rotten gas comment came in response to the teacher question, What is it called? Although this answer is not directly responsive to the teacher question, it is still considered a Student Response.

If the student statement is not related to a previously-posed Teacher Elicitation but instead raises a new issue or topic, code it as a student elicitation. For example, if the teacher picks up on the statement beyond simple acknowledgement of the student comment.

Person	Transcript
T	There are many different kinds of metals. Today we will be looking at how these metals are all similar and how they are different.
S	Sir, I’ve noticed that not all metals are magnetic.
T	Excellent observation, Marcus. That is one of the things we will be exploring in our lab today.

In this case, the student statement was not a response to a teacher question. Since it is also content-related and since the teacher picks up on this statement beyond simple acknowledgement, it is coded as a student elicitation.

D4.4.3.3 What to Exclude in a Student Elicitation?

Exclude any requests that are not science content-related. The requests for information must be content-related and/or about science tasks. If a student elicits information from the teacher or another student that relates to non-science matters (attendance, school events or announcements, social activities, disciplinary matters, etc.), do not include these as student elicitation.

Examples

- “Where is Eugene today?”
- “What is the videocamera here for?
- “Did you go to the game last night?”
- “Should I erase the board?

If a student elicits organizational information from the teacher, do *not* include these as student elicitations even if content words are mentioned.

Examples

- “How many points is this worth?”
- “How come you took off two points for my definition of parallel circuit?”
- “Can I work with Annie?”
- “Where do I write my answer?”
- “Where do we put the materials when we’re done?”
- “How much time will we be given to finish this?”
- “What do after we finish measuring the objects?”
- “What pages should we read?”
- “What was the homework for today?”
- “Teacher, you forgot to go over #3.”
- “Should I count it correct if she didn’t include the units in her answer?”
- “Did you grade our molecules tests yet?”
- “Will there be any questions about the parts of the atom on the test?”

Exclude questions read aloud by students from a textbook or other source. If students read aloud questions from a textbook, worksheet, overhead transparency, or other teacher-supplied source, code these as Teacher Elicitations if students are expected to answer them. They are *not student elicitation*, because the questions came from a teacher-supplied source.

Exclude inaudible student elicitations if you are unable to infer the student question based on the teacher response.

Exclude requests for the teacher to repeat something.

- “Could you repeat the definition of “metamorphic”?

Exclude student presenter asking other students for questions.

Example

During a Student Presentation, the student presenter asks, “Does anyone have any questions?”

Exclude students’ repetitions of the same question when the teacher didn’t hear the question the first time; if the student rephrases the question then mark each as a separate question.

Examples

- “What is metamorphic?”
- “I didn’t hear you, what did you say?”
- “What is metamorphic?”

Code the first audible student question only

Special considerations for student elicitation

- If a student elicitation asks for only a physical response (looking, listening, moving, etc.), do not code as a student elicitation unless the teacher picks up on it with a verbal response that goes beyond simple acknowledgement.

Examples:

Person	Transcript	Decision
S	Mrs. Jones, look at my pig heart.	Code as student elicitation.
T	What are you noticing about your pig heart?	

Person	Transcript	Decision
S	Mr. Meyers, could you hold this for me?	*Code as student elicitation.*
T	Sure. Be sure to tie this on carefully now.	

Person	Transcript	Decision
S	Mr. Wright, you left the burner on.	*Do not code as student elicitation.*
T	(T says nothing, goes over and turns off the burner)	

D4.4.3.4 Marking In-Points for Student Elicitation

Mark the In-Point at the beginning of the student elicitation utterance. Do not mark Out-Points for student elicitation.

D4.4.4 Teacher Response [TR]

Teacher Response [TR] is defined as a teacher's public verbal answer to any elicitation posed by a student. It is a public statement made during an **ASPDF** segment. It includes any audible response to a student's question – any indication that the teacher is responding to the student's elicitation. A Teacher Response can also come in response to a student statement that the teacher picks up on and responds to beyond simple acknowledgement.

Time Requirement: There is no time minimum requirement for Teacher Responses. Teacher Reponses will be marked on the transcripts only!

D4.4.4.1 Helpful Indicators

Table D4.16. Indicators of teacher response

Classroom talk	Public
Teacher talk	Responds to a student request or a student statement. The content of the teacher talk is responsive to the student request or statement.

Teacher talk. The teacher responds verbally to a student-initiated request, and the content of the teacher's talk indicates an attempt to respond to the student's elicitation. The teacher verbal response can be extremely brief (yes, no, uh-huh, ok, I don't know) and can even include an "ummmm" type of utterance, indicating that the teacher has heard the question and is thinking about a response.

The teacher may also pick up on and respond to a student-initiated statement (not a response to a Teacher Elicitation) that was not a request for a response. If the student statement was initiated by the student (not in response to a Teacher Elicitation), mark the teacher comments about the student statement as a Teacher Response.

D4.4.4.2 What is Included as a Teacher Response?

Include only statements that are responsive to the elicitation. The response must give some indication (by tone of voice or by words) that it is a response to the elicitation that was posed.

Include delayed teacher responses. Sometimes the student asks for a response but the teacher response is delayed because of an interruption.

Example

> Student: But why? I don't understand why you have to do it like that?
>
> Teacher: Just a minute on that, I want to finish working through this problem and then I'll get to your question.
>
> Teacher finishes the problem and then responds to the student's question.

Mark the Teacher Response twice – the immediate "delaying" response and the eventual substantive response.

Include when the teacher picks up on a student statement that qualifies as a student elicitation. Sometimes the student volunteers a statement that is not a response to a Teacher Elicitation and is not posed as a request for a response. If the statement qualifies as a student elicitation (e.g., content-related) and the teacher picks up on such a statement and responds to it beyond simple acknowledgement ("Good point."), mark the teacher's comments as a Teacher Response.

D4.4.4.3 What is Excluded as a Teacher Response?

Exclude non-responsive utterances. Exclude teacher comments that have nothing to do with the content of the student request for a response.

> The responses might be non-responsive because they are related to non-science matters or because they are not related to the content of the question.
>
> Example: The student asks, "Can I dissect that other one?" The teacher speaks to this student, saying, "What are you doing out of your seat?" This teacher statement is non-responsive to the elicitation and is *not* coded as a Teacher Response.
>
> Note: What do you do about utterances that are connected to the question that was posed but are not directly responsive? In these cases, err on the side of considering the teacher utterance as responsive.
>
> Example: The student asks, "Can I dissect that other one?" The teacher responds, "You worked carelessly today." Although this teacher response is not directly responsive to the student's question, mark it as a Teacher Response.

Exclude when the teacher response is a question. If the teacher response to a Student Elicitation is phrased as a question (and it meets the definition of a Teacher Elicitation), it will be marked as a teacher elicitation.

Exclude responses that indicate the teacher did not hear the elicitation. I didn't hear you, Alan. Can you say it again? Do *not* mark as a Teacher Response or a Teacher Elicitation.

Exclude a teacher's response to her/his own question.

Exclude the teacher's repetition of a student response as a Teacher Elicitation. We are only capturing teacher responses to student elicitation.

D4.4.4.4 Marking In- and Out-Points and Identifying the Beginning and End of Q, R, SQ, and TR Utterances

Do not mark In- and Out-Points for Q, R, and TR. Mark In-Points only for SQ at the beginning of each utterance that qualifies as an SQ.

D4.4.5 Identifying Discussion and Presentation Segments

Discussion and presentation are mutually exclusive coverage codes within the ASPDF segments.

- Discussion [DISC]
- Presentation [PRES]

To identify discussion and presentation segments, we will use previously marked Teacher Elicitations, Student Responses, student elicitations, and Teacher Responses. First we will use those marked utterances to identify all discussion segments. The rest of the ASPDF time will then be marked as presentation, with the exception of a few short segment rules.

D4.4.5.1 General Coding Guidelines

Look for "back-and-forth" vs "telling". In general, we are looking for "back-and-forth" dialogue segments to be marked as discussion and teacher telling talk to be marked a presentation. In difficult coding situations, ask yourself if the segment seems more like "back-and-forth dialogue or more like "telling."

> There might be times that the pattern seems to be back and forth, but the rules tell you to code Presentation. This may be because the students initiate a non-science interaction. In this case, still code presentation. It is also possible that there is a true discussion, without questions. For guidelines, see below.

Look for students "doing" science work. We are going to use the discussion code as an indication of students "doing" science work, whereas during presentation students are less involved in actively "doing" science work. In difficult coding situations, ask yourself if students need to be thinking about a response to a question or whether they are simply listening, waiting. If they should be thinking about a response to a question, then included it in discussion.

Be on the lookout for "True Discussions." If you see something that looks like discussion, but the coding rules tell you to code as presentation, consider whether this might be an example of a "true discussion" or a "real world discussion" and ask a Dimension Leader to review it. Classroom discussions are usually organized around questions and answers, and so our coding system uses questions and answers to identify discussion segments. But discussions in the real world often have a different structure. They are often back and forth commentaries, with each person building on what another person says without asking and answering questions. If this pattern occurs in our lessons, we want to capture it as discussion. In fact, we are especially interested in finding this type of discussion.

D4.4.6 Discussion [DISC]

Discussion [DISC] is the portion of ASPDF segments where the teacher and/or students publicly make statements to elicit responses and respond to those elicitation requests. Discussion segments are characterized by alternating public utterances between the teacher and students or among different students. No one speaker keeps the floor without interruption. Discussion segments are characterized by back and forth dialogue. Discussion segments typically consist of a series of requests for a response, or questions, and responses. Discussion segments always include one or more utterances that have been marked as Q, R, SQ, or TR.

Time requirement: In general, discussion segments must be at least 20 seconds in length. However, there are two exceptions to this 20-second requirement:

- when an eligible PH:SI/ASPDF segment is less than 20 seconds; or
- when the previously coded activity segment was short due to exception rules.

D4.4.6.1 Helpful Indicators

Table D4.17. Indicators of discussion

Teacher Talk	Utterances marked as Q, TR
Student Talk	Utterances marked as R, SQ

Teacher talk. The teacher asks questions to elicit student responses, or the teacher responds to questions or statements posed by students.

Student talk. By individual turns, students publicly share their responses to questions posed by the teacher, by another source, or by other students. They may also publicly ask questions of the teacher or other students.

D4.4.6.2 Marking In- and Out-Points for Discussion

The In-Point of a discussion segment is marked at the beginning of a previously identified Q, R, SQ, or TR utterance.

The Out-Point of a discussion segment is marked at the end of the utterance of Q, R, SQ, or TR after which there is 20 seconds or more of time when there are no Q, R, SQ, or TR marked utterances. That is, once a discussion segment begins, do not shift out to presentation until there is at least 20 seconds that contain no marked Q, R, SQ, or TR utterances. See decision tree in Figure 4.5.

Special considerations for In- and Out-Points of discussion

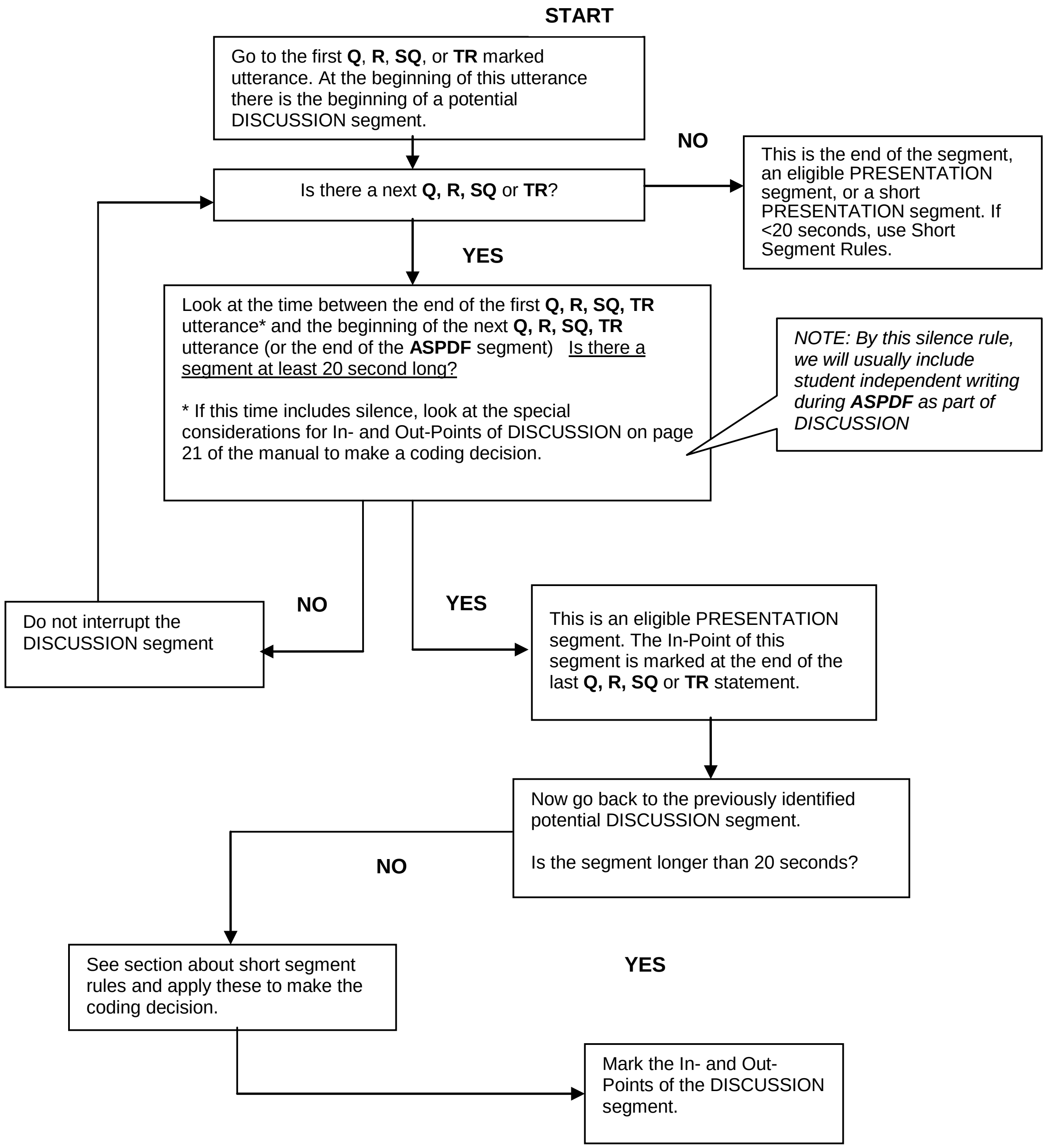
- Silences
    - If the teacher (or other speaker) is making telling statements (e.g., the teacher is making a statement that is *not* marked as Q or TR) and then stops talking for any reason (to write on the board, to set up for an ASPPD, to wait for students, to

organize him or herself, to turn off the video, to pass back papers, etc.), code these silences as presentation.

- If the teacher asks a question and this is followed by 2 seconds or more of silence (teacher is waiting for a response), include the entire silence in discussion *if* it is clear that the teacher is waiting for a response. Indicators that the teacher is waiting for a response include: the silence is followed by teacher giving hints or prompts about how to answer the question, the teacher calling on students to answer the question, the teacher repeating the question, or a student answering the question. If during the silence the teacher starts writing the answer to the question or writing new information on the board, or if the teacher starts talking about new information, shift out to PRES.

Figure 4.5. will give you a general procedure for identifying the In- and Out-Points of discussion segments.

Figure D4.5. Procedure for identifying discussion segments



D4.4.7 Identifying the Beginning and End of Q, R, SQ, and TR

In general, Q, R, SQ, or TR utterances are not treated as separate code and will not be marked in V-prism. However, you will need to know when Q, R, SQ, or TR utterances begin and end in order to make decisions about In- and Out-Points of discussion and presentation segments. For instance, you need to measure the time between the last words of a response and the In-Point of the next question.

To help you find In- and Out-Points for DISC and PRES, use the following rules to identify the beginning and end of each Q, R, SQ, or TR utterance.

Consider the beginning of each Q, R, SQ, or TR utterance to be the beginning of the individual utterance[5]. Systematically the end of each Q, R, SQ, or TR utterance will be end of the individual utterance. There is no time requirement for the length of this utterance.

It is important to remember that *transcribed turns do not equal to utterances*. Each student or teacher turn of transcribed text may include more than one utterance.

In the examples below, each Teacher Elicitation utterance is underlined, each Student Response utterance is marked in bold, and "other" types of utterances are in italics.

Example 1

Person	Transcript
T	*Monatomic*. <u>In these ones here there are?</u>
Ss	**Two. Two**.
T	*Two atoms inside the molecule*, <u>and these ones are referred to as being?/</u>

Example 2

Person	Transcript
T	<u>This line here indicates the?</u>
S	**Bond.**
T	*The chemical bond*. <u>And what exists between this molecule here and this molecule here? Some kind of?</u>

D4.4.7.1 Teacher Elicitations

Information that is needed in order to answer the question

A Teacher Elicitation begins when the teacher begins the statement to which students will be expected to respond. In general, include the information students will need to know in order to respond.

Examples (in these examples Teacher Elicitations are underlined)

- "Okay, the first problem: the sides are 12 cm and 15 cm long. What is the area?"
- "What are the names of the four chambers of the heart?"
- "Right, we said there are three main types of rocks. Who can name the three types?"
- "The chemical bond. And what exists between this molecule here and this molecule here? Some kind of?"
- "We said yesterday that these elements here…these elements over here are the?"
- "All these ones over here are shiny, and these ones over here are the?"
- "Then we will…if you are very quiet, and if you no longer hear it raise your hand."
- "Yes, okay, Suzanne. We got a difficult word here. Articulate, what does that mean?"
- "You read, for example, that a signal can be given at a railroad crossing when there is a train coming. Mention another example of a signal."
- " So the first question is. Write down the definition of acids."
- "I have taken the chip of this metal in the pair of pincers and when I put it in the flame it burnt with a dazzling flame that grew bigger. It was dazzling, so do we already know the name of the metal?"

Elaborated teacher elicitations

Hints and rephrasing. Sometimes the teacher will begin a question and get no response and then elaborate the question by rephrasing it or by giving hints to help students answer the question. Mark each rephrasing of the question and each hint as a separate Teacher Elicitation.

Example

Person	Transcript	Code
T	So what is the name of this metal?	Q
S	[NO RESPONSE]	
T	It is the metal that burns very brightly….	Q (hint)
S	[NO RESPONSE]	
T	It starts with an M…	Q (hint)
S	[NO RESPONSE]	
T	Kara, tell me the name of it. (rephrasing)	Q

<u>Content telling mixed in with the question</u>. Other times the teacher will state the question and then elaborate some content before finishing the statement of the question. In these cases, consider at what point the students would realize that they will be required to respond to the question. Consider the beginning of the Teacher Elicitation to be the statement that makes it clear that a question that will require a student response is coming. Include any content that follows as part of the Teacher Elicitation.

Example: SNL008

Time	Person	Transcript
17:17	T	Janneke, how come you hear me, and you hear a siren or a police car in the street? We said: something must vibrate. Well, this is vibrating, but there is no sound. What's wrong here? Do you know that?

Mark in the In-Point at 17:17, because it is clear that Janneke knows after that utterance that she will be expected to respond. Include the content statements as part of a long statement of the question.

<u>End of Teacher Elicitations when silence follows.</u> Sometimes the Teacher Elicitation is followed by a silence longer than 2 seconds (wait time) and no response is ever given. The teacher then starts talking again. Mark the end of the Teacher Elicitation at the end of the silence.

Example 1

Person	Transcript
T	Who knows the equation for photosynthesis? [Silence for 5 seconds.//*end of Teacher Elicitation is marked after the silence*.]
T	You should know this. The equation for photosynthesis begins like this, glucose plus ….

Example 2

Person	Transcript
T	How should I continue this sentence? Huh? In a series circuit? What should I say? Who knows? [Long wait time// *Mark the end of the Teacher Elicitation after the silence*]
T	This is difficult. In a series circuit.
T	In a series circuit, the electric current is equal anywhere, okay?

D4.4.7.2 Student Responses

Beginning of the Student Responses. A Student Response usually begins with the first verbal utterance made by a student after a Teacher Elicitation.

Examples

Person	Transcript
T	What is formed during the reaction, how will we call these substances
S	Those are reaction products.
T	You have there a little bottle with a label HCl. Hence, what kind of acid is it?
S	hydrochloric acid
T	There is a little box with a blue paper inside. What is it?
S	Litmus paper.
T	Some of you can read it, some of you don't have the label.
S	It is a litmus paper.
T	What will it be used for, this blue litmus paper, Frank?
S	To determine acidity.
T	That is not enough. You have to give everything you know about the paper.
S	That it changes the color according to acidity.
T	Okay.
T	Because we will carry out the reaction with HCl, so we, the next reactant will be?
S	Mmmmm

End of student verbal responses. Usually student responses are quite short and the response ends at the end of the student turn for talking (the floor). We will usually mark the end of the student response at the end of the student turn that follows the Teacher Elicitation. However sometimes the teacher may asks the student to expand the response (see example bellow). In these cases mark the student's elaboration as another Student Response.

Example

Person	Transcript	Code
T	Jana, what is the symbol for hydrochloric acid?	Q
S	HCl	R
T	In a sentence, please.	Q
S	The symbol for hydrochloric acid is HCl.	R

<u>IMPORTANT NOTE about Teacher Uptakes</u>: After a student gives a response to a teacher elicitation, the teacher will often comment on the student's response. This teacher move is called a teacher uptake. Do NOT include teacher uptakes as part of the Student Response to a Teacher Elicitation.

Example

Person	Transcript	Description
T	All molecules are?	END of Student Response
S	The same.	Teacher Elicitation
T	Are the same.	Teacher Uptake (not marked as **Q, R, SQ, TR**)

<u>Beginning and End of student hand-raising responses</u>. When the teacher makes an elicitation that calls for hand-raising to communicate a response, the students usually raise their hands all at once and then quickly all put them down at about the same time. In these cases, mark the beginning of the student response when you see the first student start to raise a hand to respond to this question. Mark the end of the student response when the last student puts his hand down. *If no student raises a hand, mark no student responses*[6] Occasionally, the students may raise their hands over a period of time in a one-by-one fashion (for example, to indicate when they can no longer hear a certain sound). In these cases mark each student hand raising as an individual response.

<u>End of the student's written public responses</u>. When the student(s) are responding to teacher elicitation publicly in written form we will mark the end of such a response when the last student stops writing or when the teacher starts publicly talk to the whole class whichever comes first.

<u>D4.4.7.3 Teacher Responses</u>

<u>Beginning of the Teacher Response.</u> A Teacher Response usually begins with the first verbal utterance made by the teacher after a student elicitation.

Example

Person	Transcript	Code
S	Does it work in a flame?	SQ
T	Oh yes, I will demonstrate with the candle.	TR
S	So if it's torn?	SQ
T	No, when it is torn it won't work, it's broken.	TR

<u>End of Teacher Responses</u>. The end of teacher responses to student elicitations is tricky to identify, because the teacher will often respond to the student at and then continue talking about something else. It may be difficult to decide whether the continued talk is a continuation of the response to the student or a new utterance. Other times the teacher response is quite lengthy and sounds more like "teacher telling" than teacher responding in a discussion format.

To simplify the process of identifying the end of teacher responses, we will mark either of the following, whichever comes first:

- The teacher shifts the content of the talk from answering the student elicitation to some other content.

Example

Person	Transcript
S	Do you have to divide the mass by the volume or the volume by the mass?
T	The mass by the volume, Ok? Got it? Now let's look at another problem that involves density… (Mark the end of the TR after 'Got it?')

- The end of the teacher's first transcribed turn after the student elicitation.

Example

Person	Transcript
S	Sir, does it work in flame?
T	That's why I lit the candle. I just, actually, before you came in, I just lit the candle and I took a glass, held up above this and made it smoke, like this. (Mark end of Teacher Response here, at the end of the teacher's first transcribed turn).
T	Yes, so I have that prepared here, ready for use. Now, this tuning fork, that's a very large tuning fork. And this tuning fork has a small point, like a kind of ball point, like a …

D4.4.8 Presentation [PRES]

Presentation [PRES] is the portion of ASPDF segments where there is no discussion occurring. Usually someone is giving out information during a presentation segment, but it could also be a period of silence or non-science talk. The source of the information is usually the teacher but could also be a video, a visiting speaker, the textbook read aloud, or a student in the class. For example, a student could present a report about information that is new to the rest of the students, or the students could read aloud from the textbook. During presentation segments, the speaker keeps the floor – there is no (or minimal) back and forth dialogue. Presentation segments are identified by an *absence* of Teacher Elicitation, Student Response, Student Elicitation, Teacher Response utterances.

Time requirement: Presentation segments must be at least 20 seconds in length. There are two exceptions to this 20-second requirement:

- when an eligible PH:SI/ASPDF segment is less than 20 seconds; or
- when the previously coded activity structure segment was short due to exception rules.

D4.4.8.1 Helpful Indicators

Table D4.18. Indicators of presentation

Teacher talk	Teacher is not eliciting responses or responding to student elicitations.
Student actions	Students are not responding to elicitations or posing questions.

Teacher talk. The teacher is not eliciting responses or responding to student elicitations. The teacher talk is usually related to Science Instruction, but Science Organization and Non-Science statements in an ASPDF segment are also included as Presentation.

Student actions. Students are not responding to teacher elicitations or posing questions to the teacher or other students. Instead, they are primarily listening, receiving information. They may take notes. Sometimes, a student is the one delivering the information statements.

Special considerations

- Silences. If the teacher (or other speaker) is making telling statements (e.g., the teacher utterances are *not* marked as Teacher Elicitation or Teacher Response) and then stops talking for any reason (to write on the board, to set up for an ASPPD, to wait for students, to organize him or herself, to turn off the video, to pass back papers, etc.), code the silence as presentation.

    Because of our rules for Q, R, SQ, TR, the following will usually be coded as presentation:

- Q, SQ, R, or TR utterances or sequences of utterances that last less than 20 seconds;
- teacher asks questions to check progress or pace instruction;
- teacher asks questions to check status of the listener, ask for acknowledgement that the listener is following the presentation;
- teacher asks students to distribute, collect, or locate materials;
- teacher asks questions about non-science issues;
- teacher asks a student to read aloud; and
- teacher asks questions to manage student behavior.

D4.4.8.2 The In- and Out-Points of Presentation

The In-Point of presentation will be marked at the end-point of the last DISC segment or at the beginning of the ASPDF segment, if it is the first eligible segment of the ASPDF.

The Out-Point of presentation will be marked at the beginning of the next eligible DISC segment, or at the end of the ASPDF segment, if it is the last eligible segment of the ASPDF.

D4.4.9 Short Segment Rules

Rule 1: One short segment of PRES or DISC at the beginning or end of an eligible ASPDF segment

- There is one short segment of presentation (or discussion) at the beginning of the ASPDF segment that is followed by an eligible discussion (or presentation) segment. In this case the short segment will be lumped with the following eligible discussion (or presentation) segment.

AS:WP	ASPDF	
AS:WP	PRES < 20 sec	DISC > 20 sec
AS:WP	DISC	

- There is one short segment of presentation at the end of the ASPDF segment that is preceded by an eligible discussion segment. In this case the short segment will be lumped with the preceding eligible discussion segment.

Rule 2: Multiple short segments surrounded by non-ASPDF (e.g., AS:WA, AS:WP, PH:ORG, PH:NS, etc.)

Sometimes there are two (or more) short segments of DISC and PRES next to each other (later referred to as a sequence of short segments) that are surrounded by non-ASPDF segments. Thus, there is no eligible presentation or discussion segment around these segments. For example:

AS:WP >30	PRES 15 sec	DISC 18 sec	AS:WP >30 sec

AS:WP >30	PRES 11 sec	DISC 3 sec	PRES 10 sec	AS:WP >30 sec

In this situation only, do *not* lump PRES segments that follow DISC segments into discussion. Instead, consider the total *actual time spent* in DISC and PRES. Then, treat the sequence of segments as one segment, labeling it according to the following:

- If the time spent in presentation is greater than the time spent on discussion within the sequence, code the segment as presentation.
- If the time spent in discussion is greater than the time spent on presentation within the sequence, code the segment as discussion.
- If the time spent in presentation is equal to the time spent on discussion within the sequence, code segment as presentation.

For example

<table>
<tr><td>AS:WP
>30</td><td colspan="3">PRES
15 sec</td><td colspan="2">DISC
18 sec</td><td>AS:WP
>30 sec</td></tr>
<tr><td>AS:WP</td><td colspan="5">DISC</td><td>AS:WP</td></tr>
<tr><td>AS:WP
>30</td><td>PRES
11 sec</td><td>DISC
3 sec</td><td colspan="2">PRES
10 sec</td><td colspan="2">AS:WP
>30 sec</td></tr>
<tr><td>AS:WP</td><td colspan="4">PRES</td><td colspan="2">AS:WP</td></tr>
</table>

Rule 3: Multiple short segments at the beginning or end of an ASPDF segment

Sometimes a sequence of short segments can be identified preceding or following an eligible segment of presentation or discussion at the beginning or end of an eligible ASPDF segment. If you identify all of the following, code the sequence as presentation, regardless of the total time spent on presentation within the sequence:

- The sequence of short segments appears at the beginning or at the end of an eligible ASPDF segment.
- The sequence begins with a short presentation segment if it is at the beginning of the ASPDF segment, or it ends with a short presentation segment if it is at the end of the

ASPDF segment.

- The first eligible segment after the sequence of short segments is presentation segment (at the beginning of ASPDF) OR the last eligible segment before the sequence of short segments is presentation (at the end of the ASPDF).

  Examples

  - Short segments at the beginning of an eligible ASPDF segment

Presentation	Discussion	Presentation
5 seconds	15 seconds	40 seconds
Presentation		

  - Short segments at the end of an eligible ASPDF segment

Presentation	Discussion	Presentation
40 seconds	11 seconds	10 seconds
Presentation		

D4.5 What is the Source of Presentation Segments?

The teacher usually delivers presentations of information. However, some presentations are made by a source other than the teacher. We are interested in capturing the following sources of a presentation: a student or group of students, a video, or written material that is read out loud (textbook, worksheet, etc.) by a student.

- Student presentation [PRST]

- Reading aloud [PRE]

For each ASPDF segment, you will respond to the following question: Is there a student(s) presenting the information to the rest of the class? [PST]

For each PRES segment, you will respond to the following question: Is the information presented by a student reading aloud the information? [PRE]

These are all occurrence codes, which will be marked with In- and Out-Points. The Student presentation (PST) can occur within Discussion or Presentation, the others can *only* occur in Presentation.

D4.5.1 Student(s) Presentation [PST]

Student Presentation [PST] is a period of time during which one student, or a group of students, publicly presents instructional material *that they have prepared* with the knowledge that they will be presenting this material to the rest of the students. The information is presently orally and/or with the use of visual materials or 3-D objects. The teacher is not actively involved in the presentation, but may play a supporting role.

Conceptual background

With this code, we want to capture only those presentations that students have prepared with the knowledge that they will be presenting this information to the class. That is, the material they present was designed by students for the purpose of presenting it to the rest of the students. Students have the opportunity to spend time preparing for these presentations (during the lesson or at home). The presentations might be a demonstration with objects, an explanation of a visual representation that a student(s) has prepared, an essay that is read aloud to the class, a statement of a hypothesis that a student or group of students has prepared, an explanation of an idea or process, etc. When the material was prepared at home (usually by one student), it is easier to make the decision that we are seeing an eligible student presentation. If the presentation was prepared *during the lesson*, it should meet all the following criteria:

- The presentation will be preceded at some point in the lesson by an eligible AS:WA or AS:WP.

- The outcome of the task worked on during the AS:WA or AS:WP is the actual material that is presented.

- It is clear to students (usually from statements made by the teacher) at some point at the lesson, that the purpose of the AS:WA or AS:WP task is to work on something that will be presented to the class. For example: :"You will select somebody from your group to present your ideas", "Be prepared to share your ideas with the class."

- The presentation involves more than simply reporting the results of a measurement.

We do *not* want this code to capture presentations that occur "on the spot", spontaneously during the lesson. For example, students often complete homework problems and are called on by the teacher to "present" their solution methods. Students may even go to the front of the room and write on the board as they make this "presentation." However, the students did not know ahead of time that they would be making such a presentation to the class about this work. They solved the problem initially for the purpose of getting an answer, not for the purpose of preparing to share their solution method with the rest of the class. These informal "presentations" will not be captured with this code.

NOTE: We will be capturing with another code all those times that students go to the front of the classroom for an instructional purpose.

Time requirement: There is no time requirement for student presentation.

<u>D4.5.1.1 Helpful Indicators</u>

Table D4.19. Indicators for student presentation

Students who are presenting	Student(s) present information that they have prepared to the rest of the class. The student(s) may stand up or stand in front of the class (this is usually a good indicator it is PST and not simply a student responding to a Teacher Elicitation). Students presenting the information are leading the presentation and seem to play "role of the teacher".
Students who are not presenting	The rest of the students pay attention to the presentation. They may be asking questions or they may be taking notes.
Teacher actions	The teacher is not actively involved in the presentation. He/she may play more passive role (e.g., act as another student or call another student to come to present).
Material that is being presented	The student or students who are presenting have usually prepared whatever they are presenting (rather than doing as they are directed by the teacher). Material was usually prepared at home or during the lesson for the specific purpose of the presentation.

Special considerations for Student Presentations [PST]

- <u>Students help with demonstration</u>. Do not include demonstrations where the student is simply helping the teacher do the demonstration, or the student is performing the demonstration but the teacher is describing what the student is doing.

- <u>Questions from the presenter</u>. Sometimes during the student presentation, students in the class may be asked to answer questions posed by the student presenter. In general, these will be included as part of the PST segment because they are part of student presentations. These parts are likely to be coded as discussion.

- <u>Questions to the presenter</u>. Sometimes during the student presentation students and/or the teacher may ask questions that are *directly related* to the presentation. These questions are addressed to the presenter and the student(s) who is presenting usually answers these questions (e.g.: Did you design the experiment on your own? What did you learn when researching?). In general, these will be included as part of the PST segment because they are part of student presentations. These parts are likely to be coded as discussion.

- Public testing of students. Sometimes the teacher will call on a student(s) to stand and/or to come to the front of the classroom to be tested and graded on their knowledge. The teacher might ask the selected student(s) to demonstrate their knowledge using objects or by talking about their understanding of particular ideas/topics. Even though students know that they need to study ahead of time and that they can be called upon at any time for this type of quizzing, do not count these testing events as student presentations. They will be captured with another code (formal assessment).

- Teacher assisting students who are presenters. In general we will not interrupt the PST segment if the teacher is publicly/privately assisting the students who are presenting. This help is usually intended to help the presenters to "keep the presentation going" rather than to take over. If the teacher interrupts a group presentation with a comment or a question and the group then resumes their presentation, do not interrupt the PST segment unless the teacher interrupts for 20 seconds or longer.

- One-by-one student presentation. Sometimes the teacher calls on students one-by-one to make presentations. Each individual (or small group) presentation may be very short – sharing a hypothesis, for example. Mark In- and Out-Points for each individual student/group presentation, regardless of length.

D4.5.1.2 Marking the In- and Out-Points of PST

Mark the In-Point at the beginning of the first verbal OR visual clue (whichever comes first) that indicates that the presentation started. At this moment all students are expected to pay attention. Do not include time that students spend organizing themselves to start the presentation.

Mark the Out-Point at the moment when another source (usually the teacher) takes over the presentation OR when another activity structure segment starts. (Remember: Interrupt the PST segment is the teacher talks to the whole class for 20 seconds or longer).

D4.5.1.3 Student Presentation (PST) Follow-up

Rational for this code. We want to be able to report *how many different students or student groups make presentations*, in addition to reporting the length of time spent on student presentations. To describe the number of different student presenters, we will use the event notes for each PST to describe who is doing the presentation.

Procedure. Each new student group who make a presentation will be indicated with a new number: The first student or group of students who makes a presentation will be P1, the second student or group of students who makes a presentation will be P2, the third student/group will be P3, etc. Students that present as a group will be coded as one PST, therefore they will have one number.

Sometimes a student/group presentation gets interrupted for some reason (e.g., teacher takes over for a while or there is an outside interruption). If the same student/group continues the presentation after the interruption, we want to capture that this is the same student/group and not a new student/group. Therefore, use the original number assigned to this group (e.g., P2) with the words SAME STUDENT(S) written next to it. This allows us to add up the total time for this group.

Examples: You have coded 5 PST's

- Case 1: There are 5 uninterrupted student presentations. Put P1, P2, P3, P4, and P5 in the event notes, respectively.

- Case 2: There are 5 student presentations, but the third one is interrupted by the teacher for more than 30 sec. (see clarification #10). The third group continues after the teacher's talk. Put P1, P2, P3, P3-same students, and P4. Although there are five student presentation segments, there are only 4 different students/groups involved in giving the presentations.

- Case 3: There are 5 student presentations. The teacher asks Student 1 to resume her presentation after Student 3 finishes. Put P1, P2, P3, P1-same student, and P4.

IMPORTANT NOTE: If it *ever* occurs that a group returns to their presentation after an interruption, but the group is not exactly the same (a student has left - or joint - the group), then you present this as a difficult case to the dimension leader.

D4.5.2 Reading Aloud [PRE]

Reading Aloud [PRE] is the period of time when instructional material is presented by the student(s) reading aloud to the whole class. The student is reading from a source that was prepared by someone else (e.g., the textbook, a teacher-prepared worksheet, an internet source, or an overhead transparency prepared by the teacher).

Time requirement: There is minimum 20 seconds time requirement.

Special considerations

- <u>Students reading their own essays</u>. Do not code as PRE if the students are reading aloud essays or reports that they have prepared. In this case, the written material was previously prepared by students for the purpose of this presentation. Code this as PST.

- <u>Students reading in one-by-one fashion</u>. Students may be asked to read the textbook aloud in a one-by-one pattern. For example, Alan is asked to read the first paragraph and then Jan reads the second paragraph. In these cases do not interrupt the student reading segment *unless* there is 20 seconds or more of teacher talk or discussion between the student reading turns. This also applies if the individual students are asked to read during a student presentation.

D4.5.2.1 Marking the In- and Out-Points of PRE

Mark the In-Point of the PRE at the beginning of the first utterance that is being read by the student.

Mark the Out-Point of the PRE at the end of the last utterance that is read by the student (or by the last student in a series of one-by-one readers).

Chapter D5: Function Structure

In Dimension 1, the lesson was coded into segments based on the presence of science content during different events. In Dimension 4 the Science Instruction portion of the lesson was further coded into segments based on the observable behaviors of the teacher and students. In this dimension, we will segment the lesson based on the teacher's purposes. In other words, we will try to capture what it is that the teacher tries to accomplish out of the planned activities and events.

Teachers plan and organize a variety of class activities during a lesson for different instructional goals (what to achieve) and purposes (for what reasons). Knowing these goals and purposes helps us understand and learn from the videotaped lessons; however, we do not have access to the teachers' goals and purposes in our data. In this dimension we attempt to characterize the pedagogical functions of particular events observed in the videos based on the behaviors of the teacher and students (what they say and do) and the nature of the science work that they are engaged in.

To capture the pedagogical functions of classroom events, we will employ two different types of coding: segmenting the lesson with mutually exclusive codes and identifying events with occurrence codes.

The codes used for lesson segmentation are

- core instructional part;
    - reviewing previous content [F:RE]
    - developing new content [F:DE]
- homework related;
    - assigning homework [F:HW1]
    - going over homework [F:HW2]
- assessment related; and
    - assessing student learning [F:AS1]
    - going over assessment [F:AS2]
- managerial
    - administrative [F:ADM]

These seven codes are mutually exclusive *but not* exhaustive. That is, the codes do not overlap with each other, but *not* all parts in the lesson need to be covered with these codes. If there is a section in the lesson that does not apply to the definition of any of these codes, then that section is simply left blank. In other words, you do not need to force-fit a code to every part of the lesson.

The minimum time requirement for Function Structure segments is 30 seconds.

There are three occurrence codes in Dimension 5:

- assigning homework [AHW];
- ritual opening and closing [RIT]; and
- outside interruption [OUT].

These occurrence codes will be explained in a later section in this chapter.

In the next section, we will describe the first step in coding for Function Structure, which is to segment the lessons with the seven mutually exclusive codes.

D5.1 Segmenting Lessons with Coverage Codes

This section explains the definition, helpful indicators, special considerations, and additional questions about each of the seven codes. There is a separate sub-section at the end that explains the general rules for marking In- and Out-Points of each segment.

D5.1.1 Reviewing Previous Content [F:RE]

Teachers commonly repeat or review instructional materials that were covered in previous lessons. The function of these activities may be to refresh students' memories, to consolidate their knowledge, or to build new knowledge on top of the old knowledge. When previously covered materials are repeated or reviewed in a lesson, we code the segment as reviewing previous content.

Reviewing Previous Content [F:RE] is defined as a period of time set aside during the lesson to repeat or review materials that were previously presented to the students. No new science content information is provided during this time except for simple referencing.

What is "simple referencing"?

Below is an example of simple referencing. Here the he teacher is leading the students to revisit the previous lesson. He mentions briefly what they will be doing (the shaded sentence) without going to a detail. This is considered as "simple referencing," and we will not shift out of reviewing previous content for this statement.

Person	Transcript
T	I explained that, right? I'll explain it again for you later. Okay? I think you've probably forgotten it already. We'll be doing this today. What was this again? What is this called?

The following cases are *not* coded as reviewing previous content:

- when the materials introduced in the present lesson are reviewed at the end of the lesson;
- when the materials might have been introduced to some students previously but not to all or most of the students in the class;
- when you are not sure if the information is more than a repetition (i.e., elaborated);
- when the teacher goes back and forth between old and new information (see 5.1.3); and
- when the event is treated as something else such as sharing homework, assessment, or sharing assessment (see 5.1.3).

D5.1.1.1 Helpful Indicators

Table D5.1. Indicators of reviewing previous content

Teacher announcement	The teacher states explicitly that the materials have been introduced previously.
Student task	Students are supposed to know how to do the task because they have done it before.
Tense of teacher talk	Often uses past tense for both statements and questions.
Teacher questioning	Often uses recitation type questioning technique.
Teacher questionnaire	See question #5 in the teacher questionnaire.

Teacher announcement. Teachers explicitly tell the students that they are going to review previous materials so that the students will know that they are supposed to recall information rather than to generate ideas. The following are some examples of teacher announcements:

- Vocabulary. The clearest case is when the teacher uses the words such as “review”, “revise”, “repeat”, “remember”, or “go over” when starting a revisiting segment. Example: “So first we will review what acids are.”
- Another clear marker is the teacher’s use of words such as “yesterday” or “last time”, which also indicate the time when the materials to be discussed in a moment were introduced. Examples: “Okay, let’s go back over yesterday”; “Yesterday we talked about…”
- Announcing the agenda. In some cases, the teacher announces to the class at the beginning of the lesson that they will be revisiting at some point in the lesson. This also helps you identify revisiting segments. Example: “Okay guys, today we are going to review the chapter on sound, but first let’s check your homework.”

Student task. Students are supposed to know how to do reviewing tasks because they have done it already in a previous lesson. If the task requires generating ideas or methods, it is probably not reviewing previous content.

Tense of teacher talk. When reviewing previously introduced materials, the teacher tends to use past tense for both statements and questions. Examples: “I explained the symbols for electric diagrams, right? What was the name of this?”

Teacher questioning. Teachers often use recitation technique to review previously covered materials to see if students remember them. When the teacher asks a series of questions that request immediate answers from the students, the activity is most likely coded as reviewing previous content if it lasts for 30 seconds or longer.

Teacher questionnaire. In question #5 in the teacher questionnaire, teachers describe the materials that were review to the students. Teachers’ responses to this question can help you confirm or identify reviewing previous content segments.

Special considerations

- Indistinguishable old and new materials. In some cases the teacher goes back and forth between old and new materials in her/his talk or the students work on a written assignment, but you cannot identify whether the content of the assignment is old or new. Do not code the segment as reviewing previous content if old and new materials are indistinguishable or unidentifiable and the new material is more than simple referencing.

- Review in the form of homework-sharing or assessment. Many instructional activities contain the function of review, such as going over homework assignment or quizzes. Code the segment as reviewing previous content only if other Function codes (e.g., F:HW or F:AS) do not apply.

- Practicing or applying the knowledge from previous lessons. Sometimes students are given an assignment at the beginning (or close to the beginning) of the lesson to practice or apply what they had learned in the previous lesson(s). Code segment as reviewing previous content if the teacher assigns a practice or application task for students to work independently before presenting new materials. Note that the teacher gives no or minimal explanation or instruction about the task; this is an indication that students are supposed to know how to do the task.

- Practicing or applying the knowledge from the present lesson. After instructional materials are introduced, the teacher may give some practice or application assignments to the students. Code as developing new content if students are practicing what they have learned in the present lesson.

- When the source of information is not the teacher. When the source of information is not the teacher, it is difficult to judge if the students have already been presented the same information because you cannot use the past tense indicator. For example, if the teacher shows a video to the students, you do not know whether it is entirely a repetition for the students or there is some new information in it. In such cases, code the event as reviewing previous content *only if* the teacher explicitly states it as a repetition.

D5.1.1.2 Marking In- and Out-Points

Use the general rules described in Section D5.1.8 for marking In- and Out-Points.

D5.1.2 Developing New Content [F:DE]

Most lessons contain at least one segment during which the teacher introduces new information to the students or elaborates previously introduced information. When this is observed, the segment is coded as developing new content. This segment is the main part of the lesson and tends to be, although is not necessarily, the longest segment.

Developing New Content [F:DE] is defined as a period of time when the main instructional activity of the lesson takes place. The goal of the instructional activity is to present, develop, elaborate, or apply scientific concepts, ideas, and/or procedures.

Developing new content segments do not include the segment when the teacher and students talk about future or past events and activities (e.g., field trips, projects, and tests that took place in the past or will take place in the future).

Developing new content segments include organizational activities, such as gathering or distributing materials, physically moving, or cleaning up, if they are a necessary part of the main instructional activity taking place (e.g., after conducting an experiment, students may need to clean up the tools and materials that they used).

D5.1.2.1 Helpful Indicators

Table D5.2. Indicators of developing new content

Teacher announcement	The teacher states explicitly what the main thing he/she planned for the students for the day.
Teacher questionnaire	See question #6 in the questionnaire.
Location and length of segment	The segment starts during the first half of the lesson and tends to be the longest segment.

Teacher announcement. Teachers often announce to the class the main instructional activity or material that is planned for the lesson. Such an announcement may or may not be followed immediately by the actual activity, but at least it suggests what you should look for in identifying the main instructional segment of the lesson.

Teacher questionnaire. Question #6 in the teacher questionnaire asks: “What was the main things you wanted students to learn from the videotaped lesson?” The teacher’s response to this question will assist you in identifying the segment that is to be coded as developing new content.

Location and length of segment. Normally (but not always) developing new content segment takes up the majority of lesson time.

D5.1.2.2 Marking In- and Out Points

See Section D5.1.8 for general rules.

When an organizational activity precedes or follows a developing new content segment (e.g., passing out worksheets or cleaning up materials), try to judge if the activity is necessary for the developing new content segment. For example, if the developing new content activity is a lab experiment and requires the students to gather and clean up materials before and after the actual experiment, include this type of PH:ORG activities in the developing new content segment.

Special considerations

- Identifying a shift between reviewing previous content and developing new content. A developing new content segment often follows a reviewing previous content segment, but the shift is not always clear. The following describes different types of shifts and how to mark the Out-Point of reviewing previous content and the In-Point of developing new content segment:

    - The shift is marked by the teacher. The clearest case is when the teacher explicitly marks the end of reviewing and announces the start of the new materials. For example, the teacher says, “So we did that yesterday. Now, I want you to take out your notebook and write today’s date and the topic which is …” In this case, the Out-Point of reviewing previous content, which is the In-Point of developing new content, will be marked between “yesterday” and “Now.”

    - The shift is indicated by the change in activities. Sometimes the instructional activities for reviewing previous content and developing new content are clearly different. For example, the teacher begins a lesson by asking a series of questions to the students to review the previous materials. Then, he/she may move on to showing a video to the students that introduces a new topic. In such cases, mark the Out-Point reviewing previous content, which is the In-Point of developing new content, when the activity shifts from one function to another.

    - The shift is in content only. Sometimes the teacher starts talking about the previous materials and then continues on to talk about the new materials. The shift between the old and new materials is, therefore, not marked by the teacher or by the activity. In such cases, mark the In-Point developing new content, which is the Out-Point of reviewing previous content, when the new content is mentioned.

    - Unidentifiable shift. If the content gradually shifts from old materials to new materials but you cannot identify exactly what is new and what is old, code the entire segment as developing new content.

- Indistinguishable old and new materials. In some cases, the teacher goes back and forth between old and new materials in her/his talk, or the students work on a written assignment, but you cannot identify whether the content of the assignment is old or new. In such cases code the entire segment as developing new content.

D5.1.3 Assigning Homework [F:HW1]

Assigning Homework [F:HW1] is defined as a period of time the teacher sets aside to assign homework and for related activities to take place. Examples of these activities include the teacher announcing or writing on the board what the homework assignment is, students copying the homework assignment down, the teacher distributing materials that will be used for the homework, or the teacher explaining the procedure and/or the due date for the homework.

In order to code a segment as assigning homework, the following must be observed:

- The assignment is clearly defined (i.e., students know what to do by when).
- The teacher expects all students that apply to complete the assignment.

For example, a segment in which the teacher says, "You'd better study for the test" does not count as assigning homework, but a segment in which the teacher says, "Make sure you copy these in your notebook and review them tonight because I will ask you questions tomorrow" would be coded as assigning homework.

See section 5.3.4 for special cases that count or do not count as assigning homework.

D5.1.3.1 Helpful Indicators

Table D5.3. Indicators of assigning homework

Teacher announcement	The teacher indicates explicitly that the assignment is homework.
Information on the board	The teacher writes the homework assignment on the chalkboard or overhead projector without announcing it.

Teacher announcement. The teacher explicitly indicates that the assignment is homework when he/she assigns it (e.g., "Okay, here is your homework for tomorrow"). This announcement may be followed by the teacher explaining when it is due, how to do it, or guiding the students to work on a part of the assignment so that they know how to do it at home.

The teacher may make the announcement at the end of the lesson but not at the time he/she is assigning homework. For example, the teacher says, "Okay, that's it for today. Don't forget your homework for tomorrow!" when the students are leaving the classroom. In such cases, go back to the segment when the teacher was assigning the task and code it as F:HW1 if the segment lasts for 30 seconds or longer.

Information on the board. In some cases, the teacher simply writes the homework assignments on the chalkboard without announcing anything. In such cases, code the segment as F:HW1 if there is strong evidence that it is a homework assignment.

D5.1.3.2 Marking In- and Out-Points

See Section D5.1.8 for general rules.

Special considerations

- Finishing up class work at home. In some cases, the teacher tells the students to finish the assignment that they started in class at home. For example, the students carried out an experiment in class and started to write a summary of it, but because they do not have enough time to finish, the teacher says, "Those of you who are not done, make sure you have it done by tomorrow."

- In such cases, *do not* code the entire segment of working on the assignment to write a summary as F:HW1,because it was assigned originally as class work. The potential F:HW1 segment in this case begins when the teacher starts to mention that the students should finish the work at home.

  Note: *Do not* code a segment as F:HW1 if you are not sure whether the teacher expects the students to complete the assignment at home or the students will continue to work on it in the next lesson.

- Classwork assigned as "homework". In some cases, the teacher assigns homework and tells the students to start working on it in class either individually or in groups. In most cases, the students do not get to finish the assignment in class and they will complete the remainder at home.

  In such cases, *do not* code as F:HW1 the part of the lesson when the teacher is talking about the assignment that the students might do in class and the part of the lesson when students are actually working on the assignment in class. If the teacher talks about the part of the assignment that students will work on only at home, and if it lasts 30 seconds or longer, code that segment as F:HW1. Otherwise, it should be coded as an occurrence code for assigning homework.

- Studying for a future test. Sometimes the teacher tells the students to study for an upcoming test. Normally, the teacher clearly defines what the students are to study (e.g., "I want you to go over your text book from page 23 to 30 and the handouts #3 and 4. Because you are going to have a test on Monday"). In some other cases, the work is vaguely defined (e.g., "Remember you have a test next week. Make sure you review what we have covered so far"). Do not code as assigning homework if what the teacher wants the students to study at home is not clearly defined.

D5.1.4 Going Over Homework [F:HW2]

Going Over Homework [F:HW2] is defined as the period of time set aside by the teacher to collect, check, correct, or go over students' homework *after* they have worked on or completed the assignment at home. Examples of these activities include, but are not limited to, the teacher and students going over questions and answers together, students correcting the answers individually, the teacher checking that students finished homework, or the students turning in homework to the teacher.

D5.1.4.1 Helpful Indicators

Table D5.4. Indicators of going over homework

Teacher announcement	The teacher indicates explicitly that they are going to collect or share the previously assigned homework.
Teacher questionnaire	See the response to questions #15 and #16 in the teacher questionnaire.
Student activity	Students may start checking or correcting the homework assignment without being directed by the teacher.

Teacher announcement. When assigning homework, teachers tend to announce explicitly that they are going to check, collect, or go over homework. They may or may not use the exact word 'homework' (e.g., "Have you finished the report?" or "Okay, can I have five people to write the answers on the board?").

When you are not sure if the shared material was worked on in a previous lesson or at home, use the next indicator, the teacher questionnaire, to review the teacher's description of the homework.

Teacher questionnaire. Question #15 in the teacher questionnaire asks whether homework assigned to the students was due for the videotaped lesson. If the response for #15 is yes, then #16 asks for a description of the assignment. The teacher's response to these questions should help you code for this category if observable indicators are weak.

Student activity. Sometimes it is a routine activity for the students start correcting or going over their homework as they come into the classroom. Pay close attention to what the students are doing especially when the teacher does not make a clear announcement about homework.

D5.1.4.2 Marking In- and Out-Points

See Section D5.1.8 for general rules.

Special considerations

- Homework that was NOT assigned to the whole class. In some cases, the class shares the homework that was assigned to an individual student or a group of students. For example, a student had been assigned the preparation or presentation of a science topic and gives the presentation to the whole class. Code the segment as going over homework only when the homework was assigned to all or most of the students in the class.

- The assignment was started in the previous class and completed at home. If the students started working on the assignment in a previous class and completed at home, code the segment as going over homework when the class is sharing the assignment unless the activity is framed otherwise by the teacher.

- Distinguishing going over homework and reviewing previous content. One of the key differences between these two codes is that the materials covered during the reviewing previous content segment became shared knowledge in class in a previous lesson and, therefore, the students are expected to know the materials. On the other hand, the materials covered during the going over homework segment have been worked on by the students, but the results have not been shared or corrected in class.

- New information during going over homework. The teacher and/or students discuss new science information or work on science materials that involves more than simply sharing the problems and answers for the homework.

  If you are sure that the information presented or discussed is beyond the homework assignment, break off the going over homework segment if it lasts 30 seconds or longer. If you are not sure, then do not break off the segment.

D5.1.5 Assessing Student Learning[F:AS1]

Assessing Student Learning [F:AS1] is defined as the period of time set aside by the teacher to *formally* assess and/or grade students' work individually, as a group, or as a whole class either orally (e.g., oral examination or oral grading) or in writing (e.g., oral questions and written answers, or written questions and answers).

This code applies to the lesson segment during which

- The students work on the formal assessment tasks (e.g., answering written questions, answering oral questions, making a presentation, or doing a demonstration).

- The teacher distributes or collects test materials.

- The students turn in test materials after the test.

- The teacher explains the procedures for the test that takes place immediately or soon after the explanation. If the test takes place after the present lesson, do not include this in F:AS1.

D5.1.5.1 Helpful Indicators

Table D5.5. Indicators of assessing student learning

Teacher announcement	The teacher indicates explicitly that it is a formal/official assessment.
Students' access to external input	Students are not supposed to talk to each other or to look in their textbooks or notebooks.
Students' knowledge	The students are assessed on the knowledge they have acquired already.

Teacher announcement. Teachers tell the students that they are going to conduct a test when it is formal and official. They may also tell the students that the results will be graded and recorded.

Students' access to external input. The teacher announces that the students are not expected to talk to each other, work together on the questions or problems, or use their textbooks or notebooks to answer the questions.

Students' knowledge. The students are tested on the materials that they have already learned in class. If there is evidence or strong indication that the students have not learned the material, consider coding as developing new content (see 5.5.4 B).

D5.1.5.2 Marking In- and Out-Points

See Section D5.1.8 for general rules.

Note that this code does not include the time when the students carry out a task on which they will be tested later and they do not yet know the exact test questions or criteria. For example, the teacher tells the students that they will watch a video and after that they will be presented with written questions about the content of the video. In such cases, the In-Point of assessing student learning is marked when the teacher starts to give questions.

Special considerations

- Student presentation that is graded. Sometimes one or several students give a presentation to the class and the teacher assigns a grade or score at the end of the presentation. In such cases, consider coding assessing student learning for the presenters and coding developing new content for the rest of the class because they are receiving new information. Apply the "overlapping structure rule" (section 5.13).

- Class work that is graded. Sometimes the students carry out an assignment during the lesson and the teacher assigns a grade or score to them based on the quality of the work or product. If students have access to their books or notebooks and can talk to each other or to the teacher while they work on the assignment, do not code the entire segment as assessing student learning. Such a segment would be coded reviewing previous content or developing new content based on whether the content of the assignment was new or old.

D5.1.5.3 Question about Assessing Student Learning

For each assessing student learning segment, we will ask the question: How many students were assessed, and what is the Activity Structure? The answer should be selected from the following four choices:

1 = One student is assessed, and the Activity Structure is ASPDF (i.e., the rest of the class is just watching);

2 = One student is assessed, and the Activity Structure is AS:WA or AS:WP (i.e., the rest of the class is working on a different assignment);

3 = Two or more, but not all, students are assessed, and the Activity Structure is AS:DC; or

99 = Other.

This question will be answered after you finish coding the entire lesson with the coverage codes. The answer to the question is recorded in the event note section on vPrism at the start of the F:AS1 segment. The answer should be specified as 1, 2, 3, or 99.

D5.1.6 Going Over Assessment [F:AS2]

Going Over Assessment [F:AS2] is defined as a period of time when the activities related to previously conducted tests, quizzes, or other assessment materials take place. These activities include: the teacher returning materials, the class sharing answers, the teacher and students talking about grades, or going over the questions and/or answers.

D5.1.6.1 Helpful Indicators

Table D5.6. Indicators of going over assessment

Teacher announcement	The teacher indicates explicitly that they will be handling previously taken tests, quizzes, or other assessment materials.
Student actions	The students listen to the teacher who presents answers or grades, check their answers or the assigned points, or negotiate points and grades with the teacher.

D5.1.6.2 Marking In- and Out-Points

See Section D5.1.8 for general rules.

If the going over assessment takes place immediately after assessing student learning, mark the shift when the class starts to go over the test or the teacher starts to grade the tests.

The time when students are turning in or the teacher collecting the test materials is included in the assessing student learning.

D5.1.7 Administrative [F:ADM]

Many of the Non-Science segments identified in Dimension 1 contain administrative activities such as ritual greetings, roll-taking, or announcements of future events. Some Science Organization segments also contain administrative activities such as collecting money for an upcoming science field trip. Science Instruction segments, on rare occasions, also may contain administrative activities carried out by the teacher while some students continue working on a science assignment. With the administrative code, we try to identify the activities conducted by the teacher for administrative and housekeeping purposed.

Administrative [F:ADM] is defined as a period of time set aside by the teacher to provide information or to carry out administrative and housekeeping activities. These are usually pre-planned by the teacher to take care of information and activities that are not related to or indirectly related to science content of the lesson, but they are a necessary part of the classroom management. Administrative segments may be identified during PH:NS, PH:ORG, or PH:SI segments.

D5.1.7.1 Helpful Indicators

Table D5.7. Indicators of administration

Teacher announcement	The teacher announces intention to carry out an administrative task that is relevant to the whole class.
Student activity	Students adopt a mainly passive role, submitting information when asked or physically helping the teacher in some way.

Teacher announcement. The teacher usually announces an intention to commence the administrative activity. If the activity concerns organizing a future event, it may not be formally announced. The teacher instead simply begins to discuss it or to ask questions. The talk should be related to a matter that affects all or most of the students. If the teacher is simply organizing him/herself, or is distracted, do not code as F:ADM.

Student activity. Most students are passive although some may be contributing information or asking questions for clarification.

Special considerations

- Talking about videotaping. Include teacher announcements to the class about videotaping. Do not include in F:ADM when the teacher and students are informally talking about or talking to the videographer.

- Upcoming events. Include making announcements about or conducting things related to future events such as field trip, school events, or tests *if* science content information is not being provided.

- Correcting behaviors. Do not include correcting behaviors in F:ADM if the main purpose of managerial talk is to correct students' behaviors (e.g., the teacher telling the students what they are supposed to do because some or all of them failed to do so).

D5.1.7.2 Marking In- and Out-Points

See Section D5.1.8 for general rules.

Do not break off an ongoing F:ADM segment when the teacher and students are just waiting *if* that waiting is a necessary part of the F:ADM activity.

D5.1.8 General Rules for Segmenting Lesson with Function Structure Codes

D5.1.8.1 Marking In- and Out-Points

In-Points

- In general, mark the In-Point of the segment at the beginning of the teacher's statement that marks the start of the event if the event immediately follows.

- If there is a gap between the teacher's first marker and the time that the event actually starts (i.e., similar to "not smooth transition" cases), mark the In-Point when the event actually starts.

- If there is no signal by the teacher, mark the In-Point when the event actually starts.

Out-Points

- If one Function Structure segment is followed immediately by another Function Structure segment, the Out-Point of the first segment coincides with the In-Point of the next segment.

- If the teacher signals the end of a segment but a new segment does not follow immediately and students are just waiting or organizing themselves, mark the Out-Point at the start of the teacher's signal.

- If the teacher signals the end of the segment and students gradually finish working on their task, mark the Out-Point when a new Activity Structure or Phase Structure segment starts.

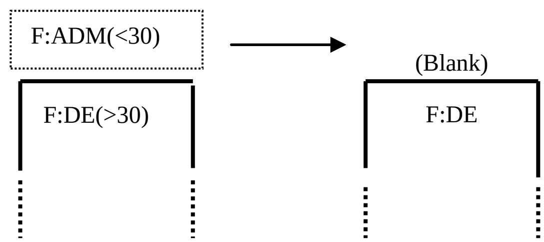
- If a segment is interrupted by an event that does not fit any Function Structure type (e.g., teacher disciplining students) or by a period of no activity (e.g., the teacher is not instructing students and the students are just waiting), and if the event lasts 30 seconds or longer, mark the Out-Point at the start of the interrupting event or at the end of previous public talk.

When none of the above is observed, keep the segment going.

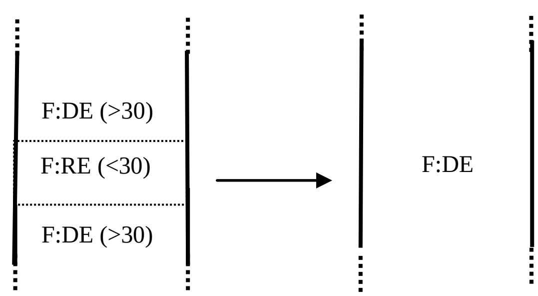
<u>D5.1.8.2 Short Segments</u>

In general, a segment that falls into one of the Function Structure types but is less than 30 seconds is not coded as a function. If the segment occurs in the middle of an on-going legitimate Function Structure segment, then keep the on-going segment (i.e., do not break off).

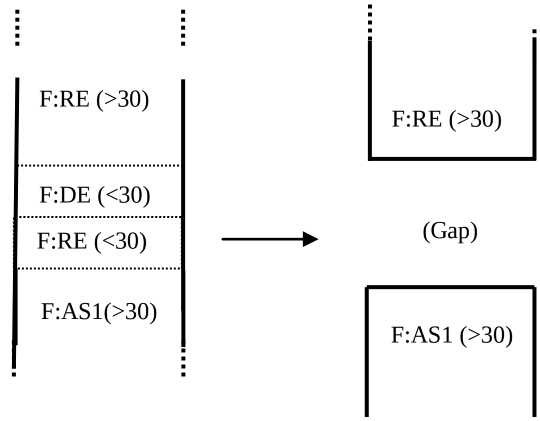
Example 1: A short ADMINISTRATIVE segment at the beginning of the lesson.



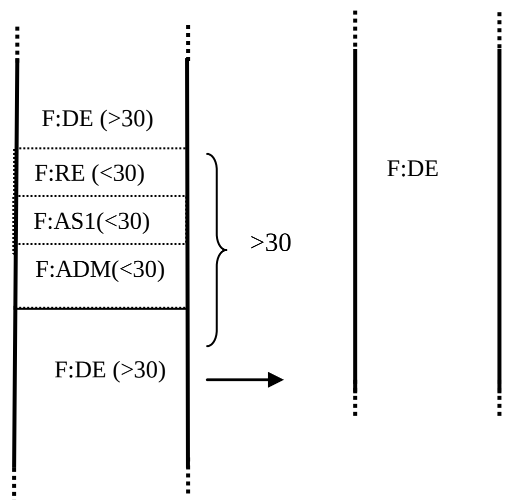
Example 2: A short REVIEWING PREVIOUS CONTENT segment in the middle of on-going DEVELOPING NEW CONTENT.



Example 3: Multiple short segments in between legitimate segments.



Example 4: Multiple short segments that add up to more than 30 seconds in the middle of an ongoing segment.



D5.1.8.3 Period of No Instruction

Sometimes there is a period of time in the lesson where no instruction is going on. Leave the period as blank if

- The teacher is organizing himself (not for students) and students are just waiting (30 seconds or longer if it is in the middle of an on-going Function segment).
- No teacher or student is doing anything (30 seconds or longer if it is in the middle of an on-going Function segment).
- The teacher breaks off the instruction and publicly disciplines some students, and most students are not working on an assigned task (30 seconds or longer if it is in the middle of an on-going Function segment).

There are also periods of time during which the teacher and students are engaged in some classroom activity, but none of the Function Structure codes applies (e.g., playing a game that is not related to the science content of the lesson). If such incidents last 30 seconds or longer, leave that part as blank.

D5.1.8.4 Gradual Shifts

In some cases, students are asked to start working on one activity as soon as they finish another. For example, they are asked to correct their homework on their own (F:HW2) and then start working on an review materials presented on the board (F:RE). Students all start with one activity and gradually shift to another activity.

When a teacher's signal (or some other signals) prompts the majority of the class to shift to a new activity, mark the In-Point at the end of the signal.

If there is no such signal, then follow the steps described below:

- Identify the first evidence of some student(s) starting on the second activity.
- Identify the last evidence of some student(s) working on the first activity.
- Take the mid-point between these two points which is the shift between the two segments.

If you cannot identify either or both points, then do not make a shift to a new Function Structure segment.

D5.1.8.5 Teacher and Students Engaged in Different Activities

Sometimes the teacher is engaged in an activity that has a different function than the one in which students are engaged. For example, the teacher walks around the classroom and checks homework (F:HW2) while students are working on a bell-ringer assignment with some review problems (F:RE).

When this type of overlap is observed (i.e., different activities for the teacher and for all students), base the code for the segment on what the teacher is doing if the teacher is working publicly with the whole class. Otherwise, base the code on what the students are doing.

D5.1.8.6 Overlapping Structures

Sometimes students are engaged in two different Function Structures. For example, one part of the class is assigned to review a previously conducted test while the other part of the class is assigned to start reading a new chapter in the textbook.

If one group (one or more students) is working publicly and/or formally with the teacher, then code the segment based on that group. Working "publicly or formally" means that the teacher has expressed to the whole class what he/she and one group of student(s) will be doing while the other group is doing something else.

If both groups are working independently (i.e., not working with the teacher), then code the segment based on the larger group.

If one of the following situations is encountered, then determine the code based on the hierarchy shown below:

- The groups are a similar size.
- It is not clear whether the teacher and one group are working publicly.
- There is any other situation to which none of the previously specified rules apply.

Hierarchy of Function Structure codes

Developing new content > Assessing student learning > Going over assessment > Assigning homework > Going over homework > Reviewing previous content > Administrative

D5.2 Identifying Occurrence Codes

Occurrence codes have an In-Point only. We are more interested in the fact that there is an occurrence of one or more of these events rather than the precise length of it. The In-Point will serve as an approximate marker for any person wishing to find out more about it in later analysis.

There are no minimum time requirements for the occurrence codes.

There are three occurrence codes in this dimension that are marked with In-Point only.

- Assigning homework [AHW]
- Ritual opening and closing [RIT]
- Outside interruption [OUT]

Note: Occurrence codes may or may not be part of eligible Function Structure coverage codes.

D5.2.1 Assigning Homework [AHW]

Assigning Homework [AHW] is identified when the teacher assigns a task to the students to be completed at home. The teacher may explicitly state that the assignment is homework or he/she may implicitly indicate, without using the term "homework," that the students are expected to work on the assignment by a certain date. The assignment may be started in class.

Code the instance of assigning homework only when it lasts less than 30 seconds.

Do not code AHW if it is part of the coverage code of Assigning Homework (F:HW1).

If multiple incidents of assigning homework are observed during the lesson, do not code AHW more than once if it is about the same homework assignment. For example, the teacher assigns homework in the middle of the lesson, and says to the students at the end of the lesson, "Do not forget your homework for tomorrow!" In this case, do not code AHW for the latter incident. If, however, the teacher assigns a different homework, then code it as AHW.

D5.2.2 Ritual Opening and Closing [RIT]

Ritual Opening and Closing [RIT] is identified when the lesson opens and/or closes with some ritualized activity such as whole class greeting formally, bowing, praying, pledging, etc. It may be signaled by the teacher or by a student, but the key criterion is that the whole class is engaged in the opening and closing together and publicly.

If the event of ritual opening and/or closing lasts for 30 seconds or longer, or if it preceded or followed other administrative event, it would have been coded as administrative. Note that this code is identified whether it is part of administrative or not.

- RIT = 1 Ritual opening
- RIT = 2 Ritual closing

Do not code each RIT type more than once in the same lesson.

D5.2.3 Outside Interruption [OUT]

In Dimension 1, we coded some outside interruptions as non-science. Recall that other outside interruptions were not coded as non-science because some students had an option to continue working, the teacher did not clearly express her/his intention to stop the science work, and/or at least one student appeared to be working. In this dimension, we will code outside interruptions regardless whether the teacher and/or students react to them.

Outside Interruption [OUT] is identified when an outside source interrupts class activities or interactions partially or totally. Examples of such interruptions are announcements over the intercom, fire drills, and a visitor from outside requiring the teacher's attention.

Code outside interruption each time it occurs. For example, if there is an intercom announcement at the beginning and also at the end of the lesson, code both incidents as OUT.

D5.3 Functions of Different Pedagogical Features (Dimension 5 Follow-Up)

In Dimension 5, we identified segments of the lessons that contained different pedagogical goals. In this chapter we will focus on different pedagogical features of the lessons that may contribute to coherence of the lesson.

1. *Connecting lessons (lesson-level codes)*

    1.1 Teacher questionnaire: is the lesson connected?

    1.2 Test: Is the lesson connected to the previous?

    1.3 Test: Is the lesson connected to the next?

    1.4 Big problem, topic, or activity: is the current lesson connected to the previous lesson?

    1.5 Big problem, topic, or activity: is the current lesson connected to the next lesson?

    1.6 Homework: is the current lesson connected to the previous lesson?

    1.7 Homework: is the current lesson connected to the next lesson?

    1.8 Practical work: is the current lesson connected to the previous lesson?

    1.9 Practical work: is the current lesson connected to the next lesson?

2. *Lesson goal statements (lesson-level codes)*

2.1/2.3 Present/Next Lesson Goal Content

Types

[0] = No goal statement or topic not indicated
[1] = Page number or Chapter number only
[2] = Students know the topic(s) only
[3] = Students know the topic(s) and at least one 'unknown'
[4] = Students know the topic and one knowledge outcome
[5] = A combination of [3] and [4] apply

2.2/2.4 Present/Next Lesson Goal Activity

Types

[0] = No goal statement or no activity stated
[1] = At least one activity is known

3. *Lesson summary statement (lesson-level codes)*

3.1 Lesson Summary Content
3.2 Lesson Summary Activity
Types: See Lesson Goal Statement Types

4. *Students coming to the front (occurrence code)*

SCF Students coming to the front

Types:

[1] = To present results from previously worked assignment
[2] = To work on a seatwork assignment
[3] = To work on a practical assignment

5. Types of homework assignment (answer for F:HW1 and F:AHW)

5.1 Homework started in class

Types:

[0] = No evidence that homework was started in class
[1] = There is evidence that homework was started in class

5.2 What type of assignment is the homework?

(Mark all that apply)

Types:

[1] = Study, review, learn but NOT for a test
[2] = Study, etc., for a test
[3] = Written assignment similar to AS:WA
[4] = Read material (e.g., new section or chapter)
[5] = Other (e.g., Bring certain objects)
[99] = Unknown/not sure/can't tell

6. *Do students work at their own pace? (lesson-level code)*

6.1 Students work at their own pace

Types:

[0] = No evidence that students work at their own pace
[1] = There is evidence that students work at their own pace

7. *Independent checking (lesson-level code)*

7.1 Independent checking

Types:

[0] = No evidence of independent checking
[1] = There is evidence of independent checking

D5.3.1 How are Lessons Connected? (lesson-level code)

Connecting characterizes the way in which the lesson is connected to the previous lesson and to the next lesson. The type of connecting is determined based on *any* available information (e.g., teacher and students' conversation, including private talk and teacher questionnaire responses). Lessons can be connected in different ways: by tests, by topic or activity, by homework, and by connecting different aspects of practical work.

Previous lesson:	The lesson before the videotaped lesson
Current lesson:	The videotaped lesson
Next lesson:	The lesson after the current lesson

The first code reflects what the teacher questionnaire says about connections. In the remaining codes, we will ask about 4 different types of connecting lessons on two levels: between the *previous lesson to the current lesson* and between *the current lesson to the next lesson*.

<u>D5.3.1.1 Is the Lesson Connected According to the Teacher Questionnaire? [1.1]</u>

If the lesson is a stand-alone lesson, the first in the sequence, or the last in the sequence, we do not have to look for a certain connection nor can we 'penalize' a lesson for not having a connection.

For each lesson, mark one of the following:

1.1 = 1 The lesson is a standalone lesson

1.1 = 2 The lesson is the first in the sequence

1.1 = 3 The lesson is the last in the sequence

1.1 = 4 The lesson is elsewhere in the sequence

1.1 = 98 Can't tell [teacher questionnaire not available]

Explanation of the codes

1. The teacher indicated in question 21, option A that the lesson is a standalone lesson.

2. The lesson is the first in a sequence. This information can come from information in question 24/25 and/or 26 OR from the teacher's words. There has to be evidence that the chapter is about a new topic.

   Example

   - *Yesterday, we finished the chapter, today we start a new chapter. That chapter is about digestion"* [current lesson has to have a different topic]

3. The lesson is the last in the sequence. This information can come from information in question 24/25 and/or 26 *or* from the teacher's words.

   Example

   - "*We will finish the chapter today and start a next topic tomorrow*"

4. The lesson is elsewhere in the sequence. This information can come from question 24/25 and/or 26 *or* from the teacher's words.

98. If no questionnaire is available or the teacher does not indicate anything.

D5.3.1.2 TEST: Is the Lesson Connected to the Previous Lesson by a Test? [1.2]

A test is a formal written assessment that *all* students take. A quiz is also a test, but an oral examination of one student is not.

For each lesson, mark one of the following: (current lesson is underlined)

1.2 = 0 A test is involved, but option 1 and 2 do not apply

1.2 = 1 The lessons are connected by "review for test->take test"

1.2 = 2 The lessons are connected by "taking test->go over test"

1.2 = 99 No tests involved

Explanation of the codes

1. A test occurred in the current or previous lesson (or both), but it is not used to connect the lessons. There is no evidence that a review was done in the previous (option 1) or if the test was taken in the previous lesson, the answers of the test are not discussed.

2. The previous lesson was a review for a test that is taken in this lesson.

3. A test was taken in the previous lesson and the test is worked on in this lesson either during an **ASPDF** or independently by students. The code does not include returning test papers without discussion or giving out grades.

99. No tests were included in the current or previous lesson.

D5.3.1.3 TEST: Is the Lesson Connected to the Next Lesson by a Test? [1.3]

For each lesson, mark one of the following: (current lesson is underlined)

1.3 = 0 A test is involved, but option 1 and 2 do not apply

1.3 = 1 The lessons are connected by "review for test->take test"

1.3 = 2 The lessons are connected by “ <u>taking test</u>->go over test”

1.3 = 99 No tests involvedExplanation of the codes

0. A test occurred in the current or next lesson, but it is not used to connect the lessons.

1. There is no evidence that a review was done in the current lesson for a test that occurs in the next lesson (option 1) or, if the test was taken in the current lesson, there is no evidence that the answers of the test will be discussed.

2. The current lesson contains a <u>review</u> for a test that will be taken in the next lesson. A teacher saying “This will be on your test” is not an indicator for “review for test.”

3. A test is taken in the current lesson and the test will be <u>worked on</u> in the next lesson either during an ASPDF or independently by students.

99. No tests were included in the current or next lesson.

<u>D5.3.1.4 Big Problem, Topic, or Activity: Is the Current Lesson Connected to the Previous Lesson? [1.4]</u>

For each lesson, mark one of the following:

1.4 = 0 The lesson has no connection to the previous lesson or can’t tell.

1.4 = 1 The current lesson is related to the previous lesson by topic only.

1.4 = 2 The current lesson is related to the previous lesson by an on-going student activity.

1.4 = 3 A big problem or question was raised in the previous lesson and the current lesson works on this big question/idea.

1.4 = 99 The current lesson is a standalone lesson or the first in the sequence; no connection is possible.

Note: If more than one option applies, code the higher option according to the hierarchy: 3>2>1>0 and 99.

Explanation of the codes:

0. There is no apparent connection between the lessons.

1. Lessons that are in a sequence are often connected by topic. The next lesson is a continuation that builds upon knowledge gained in the previous lesson.

   Question 22 on the teacher questionnaire can help identify whether the topics are related. This question should give the title of the sequence of lessons; if both lessons have the same topic, we call the lessons topic related.

2. The students continue independently with a task they started in the previous lesson. For instance "*continue working on the project you started yesterday*" Question 26 on the questionnaire can be helpful.

3. A big question or idea is a special way of introducing a new topic. Rather than giving the information as facts or as a future topic, students are encouraged to think about a question/problem.

   Example

- "*Last time we looked how electricity flows in a series circuit, and I asked you to think whether it would be the same in a parallel circuit?*"

   We will only know if a big problem or question was posed in the previous lesson if the teacher repeats it in the current lesson.

99. No connection is possible if either option [1] or [2] was marked in 1.1 above.

<u>D5.3.1.5 Big Problem, Topic, or Activity:Is the Current Lesson Connected to the Next Lesson? [1.5]</u>

For each lesson, mark one of the following:

1.5 = 0 The lesson has no connection to the next lesson or can't tell.

1.5 = 1 The current lesson is related to the next lesson by topic.

1.5 = 2 The current lesson is related to the next lesson by an on-going student activity

1.5 = 3 In the current lesson a big question/problem is raised, the next lesson addresses this big question/idea.

1.5 = 99 he current lesson is a standalone lesson or the last in the sequence so no connection is possible.

Note: If more than one option applies, code the higher option according to the hierarchy: 3>2>1>0 and 99.

Explanation of the codes:

0. The lesson has no connection to the next lesson. Apply this code when none of the other codes are appropriate.

1. For this option, question 26 on the teacher questionnaire may be helpful. Most teachers indicate the topics for both the current and the next lesson. Question 22 can help identify whether the topics are related. This question should give the title of the sequence of lessons; if both lessons are related to this topic, we call it topic related.

2. When students keep working on an activity started in the current lesson, we will apply code [2]. Question 26 on the questionnaire may be helpful, or the teacher might indicate that the lesson will continue.

   Example

   "*For the next activity, you will have two hours. This lesson and the next….*"

3. A big problem or question is a special way of introducing a new topic. Rather than giving the information as facts or as a future topic, students are encouraged to think about a question or idea.

   Example

   "*Today we saw how electricity flows in a series circuit, I wonder how it will be in a parallel circuit? We will find out tomorrow.*"

   Although we do not know if the next lesson was about that topic, we will apply code [3] if we have evidence of the big question or idea in <u>this</u> lesson if the teacher indicates that this is the topic for the next lesson.

99. Use this code if either option [1] or [3] was coded in 1.1 above

<u>D5.3.1.6 Homework: Is the Current Lesson Connected to the Previous Lesson? [1.6]</u>

For each lesson, mark one of the following:

1.6 = 0 Homework was assigned and/or started in the previous lesson, but the homework is not used to connect the previous lesson to the current lesson, or can't tell how it was connected.

1.6 = 1 Homework was assigned and/or started in the previous lesson. In the current lesson, homework content from the previous lesson is discussed and/or worked on.

1.6 = 99 No homework was assigned for the current lesson (i.e., the teacher indicated 'no' in question 15 of the teacher questionnaire).

Explanation of the codes

0. The teacher indicates homework was assigned (see teacher questionnaire #15), but it is not connected to this lesson. This can include lessons in which the teacher collects the homework or checks whether students have completed it ('stamping it'). Assume the homework was assigned in the previous lesson unless we have positive evidence that the homework was assigned before the previous lesson.

1. Homework was assigned and/or started in the previous lesson and lesson homework content is discussed or worked on in the current. Question 15 on the questionnaire

indicates whether homework was assigned. If option A is marked, consider whether it was discussed or worked on in this lesson. The code F:HW2 is an indicator of but is not essential for applying this code. It is possible that the teacher connects the content of the homework in another manner.

99. No homework was assigned for the current lesson (i.e., the teacher indicated 'no' in teacher questionnaire #15).

    We use question #15 of the teacher questionnaire to determine whether homework was assigned. If it is assigned, the coding manual states that we will code '1' if the content is discussed or worked on in the current lesson. It also states that F:HW2 in the current lesson is an indicator, but it is possible that the teacher connects the content of the homework in another manner.

The following are examples of homework 'worked on' and how homework can be used to connect lessons:

- The teacher goes over the answers publicly [F:HW2 is coded].

- The students check the answers independently.

- The teacher asks the students where they had problems with the homework. A student indicates what was difficult and the teacher explains or provides an example problem for the students [even if it is a slightly different problem]. In this case, F:HW2 may not have been coded.

- Students are given more time to continue the homework.

- The product of the homework is used in this lesson (e.g., the students had to create a bingo card for the current lesson and in the current lesson this card is used to play a game].

- The teacher goes over the content but it was too brief to be coded as a F:HW2. This does not make each brief reference to the homework a connection because the content has to be discussed.

- When the teacher assigns homework to *review* (i.e., learn, study, or memorize) a certain topic, it may be difficult to see a connection to the current lesson, but we can mark a connection in the following cases:

    - Teacher questionnaire item #16 states that the homework was a review *and* in the current lesson there is a reviewing previous content segment where the teacher is doing a question-and-answer review publicly. This review must be at least topically related to what students are supposed to review (e.g., SCZ006).

    - The homework assignment is to review for a certain topic, and one or more students are publicly quizzed on the content of the homework.

- The homework assignment is to review for a test, and the current lesson has a test on that topic. In this case, an assessment segment has been coded and the assessment contains questions related to the review.

D5.3.1.7 Homework: Is the Current Lesson Connected to the Next Lesson? [1.7]

For each lesson, mark one of the following:

1.7 = 0 Homework is assigned and/or started for the current lesson but the homework is not used to connect to the next lesson, or can't tell how it was connected.

1.7 = 1 Homework is assigned and/or started in current lesson and will be discussed or worked on in the next lesson.

1.7 = 99 There is no evidence of a homework assignment for the next lesson; no homework is assigned and no evidence of assignment schedule.

If homework is assigned for the next lesson, it may be difficult to determine what will be done with the homework in the next lesson. The teacher must mention in the current lesson what will be done with the homework, or what will be done with the homework must be clear from the additional materials.

D5.3.1.8 Practical Work: Is the Current Lesson Connected to the Previous Lesson? [1.8]

For each lesson, mark one of the following (the current lesson is underlined).

Note: These options are hierarchical

1.8 = 0 AS:WP occurs in either lesson or both the previous and current lessons, but is not used to connect the lessons, or can't tell.

1.8 = 1 The connection is 'lecture' -> <u>related AS:WP.</u>

1.8 = 2 The connection is 'set-up' -> <u>related AS:WP.</u>

1.8 = 3 The connection is AS:WP -> <u>results are 'worked on'.</u>

1.8 = 4 The connection is AS:WP -> related <u>AS:WP.</u>

1.8 = 5 Both [3] and [4] apply: AS:WP -> <u>results worked on and related AS:WP.</u>

1.8 = 98 No AS:WP in either lesson.

1.8 = 99 he current lesson is a standalone or the first lesson in a sequence.

Explanation of the codes

0. There was an AS:WP in either the current or previous lesson (or both), but the AS:WP's are not topically related. The AS:WP is not used to connect the lessons.

1. Information was presented in the previous lesson and the current lesson contains topically-related AS:WP.
2. In the previous lesson, there is some evidence that the teacher went over the plan for the AS:WP or the students designed their own procedure; in the current lesson the AS:WP occurs.
3. The AS:WP occurred in the previous lesson; in the current lesson the results are discussed, worked on, or critiqued.
4. There was an AS:WP is the previous lesson and an AS:WP in the current lesson; the AS:WPs are related, continued, or repeated.
5. Option [3] and [4] both apply. An AS:WP in the previous lesson is discussed in the current lesson, there is a related AS:WP in the current lesson, AND results of the previous lab are worked on.

98. There was no AS:WP in either lesson.
99. The current lesson is a standalone or the first lesson in the sequence; therefore, no connection is possible (either option [1] or [2] was marked in 1.1 above).

Note:

- The following hierarchy applies to the codes: 99 > 98 > 5 > (4 and 3) > 2 > 1> 0.
- Sometimes the teacher may use the word ‘practice’, either in the teacher questionnaire or in the lesson. This does not necessarily mean ‘practical work’ as we defined it in Dimension 4.
- If there are segments of AS:WP in both lessons but they are not connected, it is still possible that either AS:WP has a connection of type 1, 2, or 3.

D5.3.1.9 Practical Work: Is the Current Lesson Connected to the Next Lesson?[1.9]

For each lesson, mark one of the following (the current lesson is underlined):

1.9 = 0	AS:WP occurs in either lesson or both the previous and current lessons, but is not used to connect the lessons, or can’t tell.
1.9 = 1	The connection is ‘lecture’ -> related AS:WP.
1.9 = 2	The connection is ‘set-up’ -> related AS:WP.
1.9 = 3	The connection is AS:WP -> results are ‘worked on’.
1.9 = 4	The connection is AS:WP -> related AS:WP.
1.9 = 5	The connection is both [3] and [4].
1.9 = 98	No AS:WP in either the previous or current lesson.

1.9 = 99   The lesson is a standalone or the last lesson in the sequence.

Explanation of the codes

0. There was an AS:WP in either the current or next lesson (or both), but the lessons are not connected by any AS:WP.

1. Information was presented in the current lesson; the next lesson will contain a related AS:WP.

2. In the current lesson, the teacher reviewed the plan for the AS:WP or students designed their own procedure; in the next lesson, the AS:WP occurs.

3. The AS:WP occurred in the current lesson; in the next lesson, the results are discussed, worked on, or critiqued.

4. There was an AS:WP in the current lesson and in the next lesson; the AS:WPs are related, continued or repeated.

5. Options [3] and [4] both apply. There is an AS:WP in the current lesson, the results will be discussed in the next lesson AND there will be another related AS:WP in the next lesson.

98. There was no AS:WP in either lesson.

99. The current lesson is a standalone lesson or the last in the sequence, therefore no connection is possible [question 1.1 option [1] or [3] is marked].

Note: The following hierarchy applies to the codes: 99 > 98 > 5 > (4 and 3) > 2 > 1> 0.

D5.3.2. Do Teachers State Lesson Goals?

A **Lesson Goal Statement** is defined as the teacher's public statement(s) that describe the overall goals of the current lesson, normally in general terms, at the beginning of the instruction or before he/she presents the actual details of instruction. Present Lesson Goal statements describe the whole lesson, at least the main parts and not just one section of the lesson. Goals may be stated in terms of science content (e.g., topics to be covered or key ideas to be learned), instructional activities (e.g. assignments to be carried out), or materials (e.g., chapters or pages in the textbook, computers, or videos).

Next Lesson Goal Statements are public statements that describe the next lesson (or a portion of the lesson). These statements often occur towards the end of the lesson or near the end of the public part of the lesson. *Next Lesson Goal Statements do not have to describe the whole next lesson*; if the teacher describes one part of the next lesson, this is sufficient for applying the code. (NOTE: This is a different standard then for Present Lesson Goal.)

Important guidelines

- For Present Lesson Goal Statements, look at the beginning of the lesson *through all sections preceding the Development Phase and through the first three minutes of the Development Phase*.

- If a goal statement is written on the board (or similar presentation) *and* the teacher refers publicly to this information, use the information on the board [e.g., *"the goal of the lesson is listed on the board…"]*.

- The teacher can state more than one goal statement. Use the goal statement that results in the 'highest' code.

- Lesson Goal codes are marked on a lesson level, that is, they do not need to be coded with an In-Point.

  If the teacher only mentions the first activity of the lesson, this is not necessarily a lesson goal. If only the first lesson activity is introduced which begins starts right away, it is not a goal statement.

  Example: "*Let's do a quick review'. John, what is an example of a metal?"*

- Lessons are coded for *current lesson goals* and *next lesson goals* as well as for *topic* and *activity.* Some lessons may contain a goal statement about a topic only; other lessons may contain a goal statement at the activity level only; and some lessons may have goals statement both for topics and activities.

Each lesson will be coded for the following 4 codes:

- current lesson-topic [options described in code 2.1];
- current lesson-activity [options described in code 2.2];

- next lesson-topic [options described in code 2.1]; and
- next lesson- activity [options described in code 2.2].

Before coding for topic and activity, *first make sure there is a goal statement* which is a statement that describes the overall plan for all of today's lesson or part of the plan for the next lesson. The purpose of this code is to capture goal statements for the whole lesson, not just any topic or activity statements. Do NOT count "activity statements" as goal statements unless they are embedded within a goal statement ("Today we will be doing a review and then a lab activity" is a goal statement; "Let's get started with a quick review" is not a goal statement.

One exception to this last guideline: If the teacher describes a lab activity ("So this is what we will find out in the lab we are doing next") and the lab takes the whole lesson (or most of it), this will count as a goal statement. If the lab only is a small part of the lesson, however, the statement is not a lesson goal because it covers about one part of the lesson.

D5.3.2.1 Lesson Goal Statement: Topic or Content [2.1 present lesson; 2.3 next lesson]

Does the lesson contain a goal statement? What does the goal statement indicate about the topic of the lesson and/or any activities to be carried out during the lesson?

For each lesson, mark one of the following:

2.1 = 0 or 2.3 = 0 No goal statement is given or the goal statement does not indicate the topic.

Current lesson: *"Alright guys, sit down. Does anybody have any questions about the homework?"*

(Teacher starts right away with the first activity without giving a goal for the lesson, and no other goal statement is issued).

"We have a lot to cover today, so sit down.

Next lesson: "*We will finish this tomorrow* ."

2.1 = 1 or 2.3 = 1 Students know a page number only, nothing is said about the topic.

Current lesson: "*We are going to do chapter 5."*

(Students may know what chapter 5 is about, but they have to open the book to find out.)

Next lesson: *"Tomorrow, we will start on chapter 5."*

2.1 = 2 or 2.3 = 2 Students know what the lesson is about on a topic level.

Current lesson: "*We are going to talk about sound." "We are going to do reactions with metals."*

Next lesson: *"We will start with the chapter on sound tomorrow."*

2.1 = 3 or 2.3 = 3 Students know what they will learn/found out in the lesson.

This means students know the topic and at least one 'unknown' about this topic.

Current lesson: "*We are going to learn how sound travels in a vacuum."*

Next lesson: *"Tomorrow, we will look how sound travels in a vacuum."*

In some cases, the teacher may not phrase the goal statement as an unknown exactly, but a reasonable student would know what they will learn:

Current lesson: *"We are going to do reactions with metals and hydrochloric acid."*

(Students know they are going to investigate how metals react with hydrochloric acid.)

2.3 = 4 or 2.3 = 4 Students know at least one knowledge outcome from the goal statement.

Current lesson: "*We will see that sound does not travel in a vacuum."*

Next lesson: *"Next time, I will show that sound does not travel in a vacuum."*

2.1 = 5 or 2.3 = 5 Both [3] and [4] apply.

Students know at least one knowledge outcome, but there is still an unknown stated in the lesson goal.

Current lesson: - *"Reactions can be either chemical or not chemical. Today, we will learn to distinguish between the chemical reactions and other reactions."*

<u>D5.3.2.2 Lesson Goal: Activity [2.2 present lesson; 2.4 next lesson]</u>

Does the lesson contain a goal statement? If so, what does the goal statement indicate about the activities of the lesson?

Examples of activities that can be stated in a goal include 'a review', 'a lab', 'an assignment', 'watching video', 'a test', 'go over homework', 'talking about metals", etc. The statement 'you will learn about sound' is not considered an activity because there are many ways you can learn about sound.

For each lesson, mark one of the following:

2.2 = 0 or 2.4 = 0 There is no goal statement or the goal statement does not indicate an activity.

Current lesson: “*Today’s lesson is about sound. Open your books.”*

Next lesson: “*I will see you tomorrow!* “

2.2 = 1 or 2.4 = 1 Statement indicates at least one activity that will occur in the lesson.

Current lesson: *“We are going to do a lab today.” “Today’s lesson is on sound, and we will do a review first.” “In the lab today, we are going to boil some water with metals to learn about specific heat.”*

Examples of Current Lesson Goals

Transcript	Topic	Activity
“Today, we will look at sound, I will do a demonstration and than you will do it on your own in the lab.”	Topic: 2	Activity: 1
“Today, we will do a lab, so go to your lab stations.”	Topic: 0	Activity: 1
“The goal of the lesson is ‘how sound travels’ . I will do a demonstration to answer the question: does sound travel in a vacuum?”	Topic: 3	Activity: 1
“ Does sound travel in a vacuum? That is the topic for today’s lesson.”	Topic: 3	Activity: 0
“We are going to work on your projects the entire hour.”	Topic: 0	Activity: 1
“Reactions can be chemical or not chemical. How do we distinguish between the two? That’s the topic for today?”	Topic: 5	Activity: 0

Examples of Next Lesson Goals

Transcript	Topic	Activity
"Tomorrow, we will continue with acids and bases, you will do a practical application."	Topic: 2	Activity: 1
"In the lab tomorrow, you will do reactions with metals."	Topic: 2	Activity: 1
"We will do this tomorrow, but I wonder how current flows in a parallel circuit?"	Topic: 3	Activity: 0
"Tomorrow, I will do a demonstration to prove that sound does not travel in a vacuum."	Topic: 4	Activity: 1
"Turn in your homework tomorrow." [Note: this not an activity!]	Topic: 0	Activity: 0
"We'll discuss the results of the lab tomorrow."	Topic: 0	Activity: 1

D5.3.3 Do Teachers Give a Lesson Summary Statement? (Lesson-level code)

A **Lesson Summary Statement** is defined as the teacher's statements that normally occur at or near the end of the lesson that describe the key point(s) or event(s) that were covered during the lesson. The teacher may state the summary, may elicit it from the students, or may write on the board and ask students to copy it in their notebooks. Note that a Summary Statement must be stated publicly in the lesson.

D5.3.3.1 Lesson Summary Statement: Topic or Content [3.1]

Guidelines

- Similar to lesson goals, summary statements are coded separately for topic and activity.
- These are lesson-level codes; for each lesson we code one type of Lesson Summary Content and one type of Lesson Summary Activity. We are not marking In-Points.

For each lesson, mark one of the following:

0. No summary statements occur or the summary is about activity only.
1. Teacher refers to a page number but not to a topic. "*Today, we finished chapter 5.*"
2. Teacher refers to a topic. "*Today, we learned about sound.*"
3. Teacher restates what students have learned without repeating the knowledge outcome. "*Today, we learned how to recognize chemical reactions.*"

4. Teacher summarizes the lesson with a specific knowledge outcome.*"Today, we learned that electric current is equal anywhere in a series circuit."*

5. [3] and [4] both apply. *Today, we learned that electric current is equal anywhere in a series circuit and we learned how to build a parallel circuit."*

<u>D5.3.3.2 Lesson Summary: Activity [3.2]</u>

Does the lesson contain a summary statement? What does the summary statement indicate about the activities of the lesson?

Examples of activities that can be stated in a summary: include 'a review' 'a lab', 'an assignment', 'watching video', 'a test', 'go over homework', etc. A statement like 'you learned about sound' is not considered an activity because there are many ways you can learn about sound.

For each lesson, mark one of the following:

0. There is no summary statement or the summary statement does not indicate an activity. "We learned about sound today."

1. Statement indicates at least one activity occurred in the lesson. "*Okay, in our lab today we learned about finding mass of round objects." "We have demonstrated that sound does not travel in a vacuum."*

Special considerations

- <u>Lab conclusion and lesson summaries.</u> In many lessons with a practical assignment, the teacher publicly discusses the findings, results, or main conclusion of the lab, often near the end of the lesson. Such a discussion is not necessarily a lesson summary. We will use the following guideline: If the teacher only reports the 'answers' or results without drawing a main conclusion, do not code this as a lesson summary. If the teacher somehow draws the results of the lab together into a 'main concluding statement ***and*** the lab was a main part of the lesson, code this as a lesson summary.

  The following examples will help illustrate how to code lesson summaries:

  For most of the lesson, students work a lab about specific heat. Students have two test tubes: one with water and one with water and copper. Students measure how long it takes for the temperature in each test tube to increase by 10 degrees.

  - Scenario A

    After the lab, the teacher asks about each tube how long the task took. [Tube A it look 2 minutes, tube B it took 2.5 minutes] When the results are written down, he does not summarize.

- Scenario B

  After the results are on the board, the teacher concludes: "*Which one was the fastest?* [copper] *This means that copper has a lower specific heat than water.*"

This last statement is the main outcome of the lab; therefore, we will call this statement a lesson summary.

D5.3.4 Do Teachers Call Students to the Front of the Room to Carry Out Tasks? (occurrence code)

STUDENT COMING TO THE FRONT [SCF] is identified when a student or a group of students is called to the front of the room by the teacher to carry out science instructional tasks. The tasks must be one of the following three types: (1) present results from a previously worked assignment; (2) work on a seatwork assignment; or (3) work on a practical assignment.

Note:

- This code is not applied to the incidents that have been coded as Student Presentation.
- There is no minimum time requirement for the duration of students being at the front.
- Mark occurrences of SCF with In-Points only.
- This code is not applied to the cases when student(s) is doing organizational or non-science activities at the front (e.g., cleaning the board, turning in papers, etc).
- The "front" of the classroom is the area of the room students generally face. This could be the back or side of the room. A student standing at her/his desk does not qualify. The student must move from her/his seat to an area of the room where the rest of the students are facing.
- We are looking for times when the student at the front is aware that her/his work is being made public to the whole class. That is, the student up front is aware that others can see and judge the quality of her/his work. In general, this event occurs during public interactions. However, there are occasions when the rest of the class is working independently while one student (or more) works at the board which will be coded as SCF because the student(s) at the front knows that the students at their seats can watch and judge the quality of their work.

For each occurrence within the lesson, mark one of the following:

1. Present results from a previously worked assignment.
2. Work on a seatwork assignment.
3. Work on a practical assignment.

Explanation of the codes

1. Present results/answers

   A student or a group of students is called to the front of the room to present the results of practical or seatwork assignment(s) that they have worked on independently.

   The results may be presented orally or written on the board.

   The students may have worked on the assignment(s) in class or at home.

   The rest of the class is expected to attend to the presented results either at the time of or after the presentation.

2. Work on a seatwork assignment

   A student or a group of students is called to the front of the room to answer questions orally or work on seatwork assignments on the board.

   The student(s) has not worked on the assignment before coming to the front.

   The rest of the class is expected to attend to the teacher and the student(s) at the front unless they are assigned to work on a task independently.

3. Work on a practical assignment

   A student or a group of students is called to the front of the room to carry out a practical assignment.

   The rest of the class is expected to attend to the teacher and the student(s) at the front unless they are assigned to work on a task independently.

   The student is called up front to assist and be involved in manipulating or observing the teacher with an ASPPD.

D5.3.4.1 Examples of Marking the In-Point

In general, mark the In-Point at the start of the teacher's instruction or signal that prompts a student or students to come to the front. Each occurrence is marked with an In-Point.

- The same student is called to the front more than once. When a student is called to the front repeatedly, mark a new In-Point only if he/she is assigned a new task. In other words, if the student comes to the front again to simply add or change something on the original task, do not mark a new In-Point.

- Multiple students are called 'simultaneously'. If multiple students are at the front at about the same time and work together (with different roles), treat it as one event and mark the In-Point at the start of the teacher's instruction or signal that prompts the students to come to the front.

  If multiple students are at the front at about the same time, but work separately, treat it as one event if the students are all presenting answers to problems previously worked on (Type 1). Code as separate events if students are working separately on a new seatwork or practical assignment (Types 2 or 3).

- Multiple students are called 'one by one'. Each occurrence of a student coming to the front will be marked with an In-Point. If all or most are called to the front, consider the following:

- All or most students come to the board at some point. If all or most students in the class at some point come to the front (e.g., to enter data in a class data table), this usually will *not qualify as* SCF since it is unlikely that each student's work will be open to scrutiny by the rest of the class. In this case, the contributions of each student up front will likely be made so quickly that the rest of the class does not have time to judge how well or poorly any individual student performed. If you judge that each student called up front will likely feel "watched" or "on the spot" and that the rest of the students have time to judge the quality of her/his work up front, then code this event as SCF and code an In-Point for each student called up front to work.

D5.3.5 What Kinds of Homework do Teachers Assign? (occurrence code)

In Dimension 5, we coded instances of assigning homework (F:HW1 and F:AHW). We will now examine what kinds of homework were assigned and when students work on the assignment.

Each occurrence of F:HW1 and F:AHW will be coded for the following two questions.

D5.3.5.1 Homework Worked on in Class? [5.1]

For each lesson, mark one of the following:

1. Homework is not worked on in class.

2. Homework is worked on in class.

D5.3.5.2 What Kind of Assignment is It?[5.2]

For each F:HW1 or F:AHW, indicate the kind of assignment the homework (more than one type can apply):

1. Students are asked to review, study, or learn materials, but not to study for a test. This does not include assignments where the review consists of a set of questions to be answered.

2. Students are asked to study for a test.

3. Students are asked to work on a written assignment or a set of questions or problems [all other assignments that would be AS:WA if it occurred in this lesson]

4. Students are asked to read a section, read an article, etc.

5. Other assignment (e.g., student are asked to 'bring' something to class or students are asked to copy).

99. Unknown. Students are assigned something but the assignment is unknown to us.

98. No F:HW1 or F:AHW.

Examples

- *"For tomorrow's quiz, study section 4 and 5."* [type 2]
- *"For tomorrow, review what we discussed today."* [type 1]
- *"As a review, I made this cross word puzzle. Do this for homework.'* [type 3]
- *"For tomorrow, do section 5, question 1-10 and read section 6."* [types 3 and 4]
- "*Make sure you bring a calculator*." [type 5]
- "*The homework is on the board."* (the board is not visible to us) [type 99]

D5.3.6 Do Students Work at their Own Pace Across Lessons? [Lesson-level code]

In many classrooms, students are assigned homework for a particular day and the teacher expects students to have it completed by that day. In other classrooms, students are working at their own pace; they can work ahead and sometimes fall behind without getting into trouble.

For each lesson we will determine whether students work at their own pace *from lesson to lesson*. We will look for *any* evidence that students have been given an assignment schedule or are encouraged to work ahead. The teacher may mention the assignment schedule or assign homework for the next two weeks, or we can observe private interactions that indicate students can work at their own pace. Students working on a project that continues across three lessons is a case of working at their own pace (e.g., they are working on library or internet research for a report, work on it in today's lesson, continue with this work in tomorrow's lesson, and the assignment is due the lesson after that). A good indicator of 'working at own pace' is that students are working on an ongoing activity.

General Rule: Students must be responsible for pacing their own work over at least a three-lesson period (e.g., today's lesson, next lesson, and lesson after that).

Note that the coding completed in Dimension 5 (F:HW1 and F:AHW) does not determine the answer to this question. *That is, the lesson may not contain an event of assigning homework, but the students may have assignment schedule.*

D5.3.6.1. Students Work at their Own Pace? [6.1]

Assign one of the following:

0. No, there is no indication that students can work at their own pace.
1. Yes, there is evidence that students can work at their own pace.

Explanation of the codes

0. There is no indication that students can work ahead or have a assignment schedule.

1. There is evidence or indication that the teacher and students use an assignment schedule during or outside the lesson, or that students work ahead. Evidence and indicators include:

   The teacher and/or students use an assignment schedule during the lesson;

   The teacher or students mention an assignment schedule, study guide, etc.;

   A copy of assignment schedule is included in additional materials;

   The teacher announces that students can 'keep going' or 'know what to do'; or

   The teacher and student discuss the progress of the student and the discussion indicates the student has a certain degree of freedom in setting his own pace.

Special considerations

- We are coding for the provision for students' to set their own pace across lessons. Obviously within each independent work segment, most students work at their own pace. This would not be enough to apply code [1].

- Sometimes the teacher passes out an additional assignment for students who are finished, or the teacher tells students they can start on the homework when they are finished. This is not necessarily working ahead across lessons but rather the teacher is keeping the faster students busy and NOT allowing them to move ahead to the next chapter.

  Examples

  - "*When you are finished you can do this cross word puzzle.*" -> code [0].
  - "*When you are finished, I wrote the homework on the board.*" -> code [0].
  - "*The homework assignments for the next three lessons are on the board.*" -> code [1]

- Students have to work ahead on *science*. If they are given permission to work on another subject, do not code [1].

- In general, one student given permission to work ahead is enough evidence to apply code [1]. However, if 2 students are given conflicting information (one student is given permission to work ahead but the second student is explicitly forbidden to work ahead), we may have to look for other information. Submit this as a difficult case.

D5.3.7 Independent Checking of Assignment? (Lesson-level code)

In some classrooms, students are encouraged to check their own work on assignments using an answer book or answer sheet, or students have answers available as they are working on the assignment. For this code, we will examine whether students check their own answers (before the lesson, during the lesson, or after the lesson) and whether these answers are discussed publicly. The checking must be independent (i.e., student-directed); students are either assigned to check their answers or they simply choose to check their answers.

The following teacher-directed activities do *not* count:

- The teacher writes answers on the board and tells students to check their work.
- The teacher writes answers down and reviews the answer publicly.
- The teacher discusses all answers.
- Students check each other's work.

<u>D5.3.7.1 Do Students Independently Check their Own Work? [7.1]</u>

Code one of the following:

0. No, there is no evidence of independent checking.
1. Yes, there is evidence of independent checking.

Explanation of codes

0. There is no evidence or indication that answers are available (e.g., no visual evidence, not mentioned, or answers are corrected publicly).

1. There is evidence of independent checking:

    - If an answer book is coded in Dimension 6,

    - If an answer was not coded in Dimension 6 but there is evidence that students have used it in the past or will use it in the future, or

    - If there is evidence that students are correcting their answers in the back of the book and these answers are *not* discussed publicly.

Chapter D6: Learning Environment

In this dimension, we are looking at physical aspects of classroom environment in which students in different countries are situated during science lessons.

Lesson-level occurrence codes, that is, one of the code types, is applied to characterize the entire lesson. The In-Point is marked at the start of the lesson (i.e., mark the code on the front sheet of the transcript at the top).

The questions below require you to identify your *best* choice that best applies to the entire lesson.

D6.1 General Research Question and Codes

What is the physical learning environment for the students?

- Room types [L:RM]
- Science-related commercial products and materials [L:CP]
- Science-related natural objects [L:NP]
- Books used by students [L:BK]
- Organized science notebooks [L:NB]
- Computers [L:C]
- Overhead projectors [L:OH]
- Specialized visual technologies [L:TC]
- Blackboards [L:CB]
- Adult teaching assistant [L:TA]
- Grading [L:GS]
- Routine lesson openers [L:RO]
- School uniform [L:SU]

D6.1.1 What is the Room Type? [L:RM]

L:RM = 1 Regular classroom

Indicators:

- Movable desks/tables that could be adapted easily for other purposes besides science.
- Little or no science equipment observable in the room (in comparison to other indicators below).
- No extra large fixed desk/demonstration area that has ample water, power, or gas; the teacher uses an ordinary moveable table or desk.
- None or very limited access to water, power, or gas within the room.

L:RM = 2 Science Room – A room that has a few more science facilities in it but is not equipped to allow students to do a full range of practical work.

Indicators:

- Extra large teacher’s bench or desk at front of the classroom, with power, water and/or gas, that is typically fixed and higher than normal to allow students to clearly see demonstrations.
- Movable desks and/or tables.
- Limited access to water and power at side work benches or at the back of the room, and unlikely to have gas outlets.
- Science equipment is more observable than in a regular classroom but limited to what is needed for one or two disciplines (e.g., Physics or Earth Science).

L:RM = 3 Science Lab – A room that includes at least three of the following four indicators.

Indicators:

- Extra large teacher's fixed bench or desk at front of classroom, with power, water and/or gas, that is typically higher than normal to allow for clear demonstrations.
- Students have access to water, power, and/or gas at fixed benches or tables or share such facilities between a group of benches and/or tables.
- A large amount of science equipment is present in or on cupboards at the back of the room, floor, etc.
- If desks and/or tables are moveable, then there may be separate side benches or work areas with full power, water, and/or gas in the room.

L:RM = 99 Other or Can't tell/Not sure

Indicator:

- Includes other rooms such as a computer lab, library, outside, etc.

D6.1.2 Are There Any Science-Related Commercial Products or Materials Displayed on the Walls or in the Cabinets? [L:CP]

L:CP = 1 Yes, science-related commercial products or materials are displayed

L:CP = 99 No or Can't tell/Not sure

D6.1.3 Are There Any Science-Related Natural Products (e.g., living or non-living animals, birds, fish, and insects, plants, rocks, sea shells, etc) Displayed in the Room? [L:NP]

L:NP = 1 Yes, science-related natural products are displayed in the room

L:NP = 99 No or Can’t tell/Not sure

D6.1.4 Are the Science Textbooks or Other Books (e.g., workbooks, answer books, or study guide) Used by the Students During the Lesson? [L:BK]

L:BK = 1 Textbooks or workbooks are used by the students

L:BK = 2 Answer books, answer sheets, or assignment schedule, etc are used by the students (specify the kind of material used)

L:BK = 99 No or Can’t tell

Textbooks are pre-printed materials that are designed to provide science information rather than to provide space for writing.

Workbooks are pre-printed materials that contain space for students to write in their notes, answer questions, record data, draw diagrams and or graphs, etc.

Answer books/sheets contain answers to the problems in the textbooks and/or workbooks. They are different than textbooks that may have the answers attached in the back of the textbook.

Assignment Schedule/Study Guide/Syllabus contain information about the assignments and due dates that the students are responsible for completing on their own. These are usually prepared by the teacher to guide the students in their planning for their classes, and are not homework diaries or schedules or similar material.

To code as L:BK = 1 or L:BK = 2, there must be evidence that students are using the *same* book for the same purpose instructed by the teacher. For example, the teacher publicly announces to the students that they use the book (e.g., “take out your textbook…,” “Open page 30 of your workbook…,” “read page 10 and answer the questions…”) or the teacher instructs the class to carry out a task for which students know they must use a certain book (e.g., “Okay, check the answers and ask me questions if you don’t understand).

For this question, code all that apply.

D6.1.5 Do Students Keep Individual Notes (e.g., completed worksheets, graphs, etc.) in Some Organized Way (e.g., in a special notebook or binder)? [L:NB]

L:NB = 1 Yes, students keep individual notes

L:NB = 99 No or Can't tell/Not sure

L:NB = 99 Includes a) students do not take notes and b) students take notes but not in an organized or structured manner. To code L:NB=1, there must be evidence of at least one clear instance, either observed in the video or stated by the teacher, when notes are recorded in a special notebook or are kept in a special binder.

D6.1.6 Is a Computer Used During the Lesson? [L:C]

L:C = 1 Computers are available in the classroom but are not used

L:C = 2 Computers are used (describe who uses the computers)

L:C = 99 No or Can't tell/Not sure.

For a computer to be used, L:C=2, students must be publicly directed to look at it, to use the keyboard in some organized way, or to check some work on it. If a computer is obviously turned on, but the teacher never directs students to at least look at the screen, code this as L:C=2.

D6.1.7 How is the Overhead Projector Used in the Lesson? [L:OH]

L:OH = 1 Overhead projector used mainly to display texts and diagrams

L:OH = 2 Overhead projector used mainly for other purpose(s) (describe projector use)

L:OH = 99 No or Can’t tell/Not sure

If both L:OH=1 and L:OH=2 apply, code for the main use and describe in the note section.

D6.1.8 Does the Teacher Use Any Specialized Visual Technology to Enhance Visibility of Instructional Materials (e.g., texts or objects) Presented to the Students During the Lesson (other than computers or overhead projectors above)? [L:TC]

L:TC = 1 A video cassette recorder and monitor is used

L:TC = 2 Other specialized visual technology is used (describe what is used) (e.g., closed circuit television or microscope connected to a television)

L:TC = 99 No or Can’t tell/Not sure.

The teacher must direct the students to look at the apparatus being used.

If both L:TC=1 and L:TC=2 are observed in the lesson, code the option that indicates which type of technology is used the most during the lesson, but note that both types were used.

D6.1.9 Is the Blackboard Used During the Lesson? If So, How? [L:CB]

L:CB = 1 Blackboard used mainly for writing texts, drawing diagrams, etc.

L:CB = 2 Blackboard used mainly for other purposes

L:CB = 99 No or Can’t tell/Not sure

For text or other sources of information (e.g., displays) displayed on the blackboard before the lesson begins, do not code L:CB=1 or L:CB=2 unless the teacher draws students’ attention to them during the lesson.

If the blackboard is used for both L:CB=1 and L:CB=2, code for the main use and indicate that there were two uses for the blackboard in the note section.

D6.1.10 Is There Another Adult Teaching Assistant or Co-Teacher Actively Present During the Lesson? [L:TA]

L:TA = 1 Yes, another teaching assistant or co-teacher is actively present

L:TA = 99 No or Can't tell/Not sure.

An assistant must be taking an active role in the lesson by helping or interacting with the teacher and/or student(s). For example, an assistant includes an adult person helping the teacher setting up/cleaning up materials or helping a student with a disability.

D6.1.11 Are Individual/Small Group Grades or Scores Resulting from Formal Assessments Reported or Returned to the Students? [L:GS]

L:GS = 1 Yes, formal assessments are privately returned

For example, papers with grades on them are returned to students, but the teacher does not publicly state their grades.

L:GS = 2 Yes, formal assessments are publicly reported

For example, the teacher makes public statements about individual student grades (even just one student); students can hear the grade(s) of other student(s).

L:GS = 99 No or Can't tell/Not sure

D6.1.12 Does the Teacher Use Routine Lesson Openers (i.e., an independent work that students know that they are supposed to start working on it because it is a routine practice)? [L:RO]

L:RO = 1 Yes, the teacher uses a routine lesson opener

L:RO = 99 No or Can't tell/Not sure

To code for L:RO=1, there should be evidence that the students know what to do or how to do the task without being instructed by the teacher. The teacher may signal the students to start working on the task as they come in to the room, but he/she does not give detailed instruction about how to do the task.

If you see students are working or have already started to work independently at the beginning of the lesson, but the teacher officially gives instruction to the whole class on what to do and how to do the task and this instruction is more than a simple signal or a brief direction requesting the students to get started, code L:RO=99 for this lesson.

D6.1.13 Do Students Wear School Uniform? [L:SU]

L:SU = 1 Yes, all or most students wear uniforms

L:SU = 99 No or Can’t tell/Not sure

The code L:SU=1 includes variations of uniforms, such as physical exercise uniforms.

Exhibit 6.1. Learning Environment

Coded by: ____________________ Lesson ID:

Please check one of the boxes for each code.

CODES	TYPES	NOTES
Room	☐ L:RM=1 Regular room ☐ L:RM=2 Science room ☐ L:RM=3 Science lab ☐ L:RM=99 Other or can’t tell/not sure	*If 99, describe the type (e.g., computer lab)
Commercial products	☐ L:CP=1 Yes ☐ L:CP=99 No/can’t tell/not sure	
Natural products	☐ L:NP=1 Yes ☐ L:NP=99 No/can’t tell/not sure	*If 1 or 99, then describe the product briefly
Textbook	☐ L:TB=1 Yes ☐ L:TB=99 No/can’t tell/not sure	*If 1, describe “for what purpose?” and indicate the In-Point
Notebook	☐ L:NB=1 Yes ☐ L:NB=99 No/can’t tell/not sure	
Computer	☐ L:C=1 Computer available ☐ L:C=2 Computer used ☐ L:C=99 No/can’t tell/not sure	*If 2, describe who uses the computer and indicate the In-Point
Overhead Projector	☐ L:OH=1 Projector used for text ☐ L:OH=2 Projector used for other purpose ☐ L:OH=99 No/can’t tell/not sure	*If used, indicate the In-Point
Technology (visual aid)	☐ L:TC=1 VCR is used ☐ L:TC=2 Other equipment is used ☐ L:TC=99 No/can’t tell/not sure	*If 2, describe briefly
Blackboard	☐ L:CB=1 Yes, for notes, diagrams ☐ L:CB=2 Yes, for other purpose ☐ L:CB=99 No/can’t tell/not sure	
Teaching assistant	☐ L:TA=1 Yes ☐ L:TA=99 No/can’t tell/not sure	
Grades/scores	☐ L:GS=1 Yes, privately ☐ L:GS=2 Yes, publicly ☐ L:GS=99 No/can’t tell/not sure	*If 1 or 2, indicate the In-Point
Routine lesson opener	☐ L:RO=1 Yes ☐ L:RO=99 No/can’t tell/not sure	*If 1, describe lesson opener briefly
Student uniforms	☐ L:SU=1 Yes ☐ L:SU=99 No/can’t tell/not sure	

Chapter D7: Types of Independent Activities

We previously identified three activity structures that involve students in actively 'doing' science: Independent seatwork activities (AS:WA), Independent practical activities (AS:WP), and Discussion (DISC). The purpose of Dimension 7 is to describe student 'doing' science during AS:WA, AS:WP, and Discussion segments. What kinds of tasks are students expected to complete during independent seatwork activities and independent practical activities? What kinds of questions do students have the opportunity to consider and answer during Discussion segments?

D7.1 Types of Independent Seatwork Activities

The codes in this section of Dimension 7 describe Independent seatwork activities segments of the lesson: What is the nature of the AS:WA activities? What are students <u>doing</u> during AS:WA segments? The kinds of tasks assigned to students during AS:WP segments will be coded in another dimension.

The questions and codes in this dimension include the following

- Is the AS:WA related to an AS:WP in this lesson, or in a previous or future lesson? [RW]
- Is the AS:WA a motivating activity? [FA]
- Is the AS:WA related to real-life issues? [SP]
- Does the AS:WA involve writing text? [LW]
- Does the AS:WA contain mathematical calculations? [MP]
- Does the AS:WA involve making diagrams? [DD]
- Does the AS:WA involve making graphs? [GR]
- Does the AS:WA require reading text? [RT]

D7.1.1 Is the AS:WA Related to an AS:WP in this Lesson or in a Previous or Future Lesson? [RW]

We are interested in the relationship between AS:WA and AS:WP, in particular, whether the AS:WA is preparation for an AS:WP or follow-up after an AS:WP. The relationship has to be more than just topically related.

If students work on an AS:WP with reactions with acids after which they fill in a crossword puzzle with the different acids, the activities are topically related only. If students write down their hypothesis to be tested during an AS:WA, this event is a preparation for the AS:WP.

Mark all that apply:

RW = 0 The AS:WA is not related to any AS:WP (none of the other options apply).

RW = 1 The AS:WA is a preparation for an AS:WP that occurs in this lesson.

Example

Students are writing down their hypothesis to be tested.

RW = 2 The AS:WA is a follow up of an AS:WP that occurred in this lesson.

Examples

Students are writing down their conclusions.

Students are organizing or using the data that they collected in an AS:WP (in a previous lesson).

Students do calculations, further analysis, follow up questions.

Students repeat or finish steps of the AS:WP.

RW = 3 The AS:WA is preparation for an AS:WP that occurs in a future lesson.

Example

Students are writing down their hypothesis which will be tested in an AS:WP; the AS:WP is in some future lesson.

RW = 4 The AS:WA is a follow up of an AS:WP that occurred in a previous lesson.

Examples:

Students are writing down their conclusions.

Students are organizing or using the data that they collected in an AS:WP (in a previous lesson).

Students do calculations, further analysis, follow up questions.

Students repeat or finish steps of the AS:WP.

RW = 98 Cannot tell.

D7.1.2 Is the AS:WA a Motivating Activity? [FA]

Science inquiry activities, such as gathering data, are often motivating for students or at least the teacher intended the activity as more motivating than traditional school tasks, such as reading text books, answering questions from the textbook, etc.

For this code, we are looking for activities that teachers intended as motivating and activities are *not* what scientists would describe as traditional science inquiry.

We are looking for the overall focus of the AS:WA. For example, if the students answer 10 questions and one of them is a motivating activity, don't code the AS:WA as motivating.

Examples of motivating activities include

- creating a travel brochure to a planet;
- drawing a model of a space garbage collector without using any technical knowledge
- games;
- puzzles (not simple matching or similar puzzles);
- role playing or designing skits;
- creative writing related to science writing, such as poems or songs about science content;
- telling interesting stories, either real life or made up;
- simulation activities, with or without a computer (e.g., "Imagine you are stranded on an island", "what would you pack to a trip to space", or "you are going to be in an earthquake, what emergency materials do you need?");
- creating a story book for children about household trash or other topic;
- color, cut, and paste activities (e.g., a continental drift puzzle);
- designing, drawings, plans, and building 'fun' objects/models, such as rockets, hovercrafts, or bridges;
- crime solving activities;
- peer tutoring;
- interviewing peers or experts;
- activities that involve competition, prizes, challenge, or surprise (e.g., "work with a partner to design a plan for a structure made out of paper that will hold the most textbooks, brainstorm as many kinds of plants as you can, let's see who can come up with the longest list");
- activities that involve planning for or following up on motivating AS:WP activities;
- writing essays or letters expressing personal opinions;
- some computer tasks (e.g., answering 'timed' questions on the computer);
- music plays while the students work;
- working with cards (e.g., sorting cards, using magnetic cards on the board, rearranging cards, flash cards, etc.); and
- decorating notebooks, projects, book covers, graphs.

The following AS:WA activities would *not* qualify as motivating beyond science inquiry:

- creating or labeling diagrams or concepts maps (note: if students also are coloring or cutting and pasting, this is a motivating activity);
- brainstorming what is known about a topic (note: if there is a competition/challenge aspect to the brainstorming, this is a motivating activity);
- doing science inquiry activities (e.g., brainstorming hypotheses, graphing data, etc.);
- students presenting information about topics they have researched; and

- designing or drawing plans for building ‘serious’ objects or models (e.g., a model of a molecule or a model of one of Newton’s laws).

Mark one of the following:

FA = 0 The AS:WA is not a motivating activity.

FA = 1 The AS:WA is a motivating activity.

FA = 98 Cannot tell.

Special considerations

- <u>Coloring, pasting, and cutting activities</u>. When coding this dimension, we are looking for the *focus* of the activity. By focus we mean the emphasis that the teacher places on the coloring, and/or the majority of time the students spend on the coloring, pasting or cutting (e.g., if the task is to “*write a title page, and then decorate the page nicely*”, this activity would be coded as a motivating activity).

- <u>When does ‘personal life’ stuff become a motivating activity?</u> Some tasks are coded as real-life issue, SP, because the students are asked to come up with examples from real life. If students are asked to come up with stories or scenarios, hypothetical or real, code both SP and FA. However, if students are simply listing examples from real life, it would not be coded as FA (e.g., “List all the electrical appliances in your home” would not be coded as FA).

D7.1.3 Is the AS:WA Related to Real-life Issues? [SP]

Does the AS:WA relate to how science knowledge is used, applied, or relates to societal or social issues, or relate especially the personal experience of students? That is, does the AS:WA address the usefulness of science related knowledge in real life?

We are looking for the overall focus of the AS:WA. If the students answer 10 questions and only one short question relates to real-life issues, don’t code the AS:WA as SP. If the focus of the set of questions relates to real-life issues, then can code the AS:WA as SP .

Examples of SP include

- Students discussing whether or not they would want to be an organ donor.
- Students write down what they need to have available in case of an earthquake.
- Students share a story about their personal experiences with a disease.
- Students write about real life problem scenarios.

Mark one of the following:

SP = 0 The AS:WA is not related to real-life issues.

SP = 1 Yes, the AS:WA is related to real-life issues.

SP = 98 Cannot tell.

Special considerations

- When do ‘real-life’ issues become a motivating activity? Some tasks are coded as SP because the students are asked to come up with examples from real life. If students are asked to come up with stories or scenarios (hypothetical or real), we will code both SP and FA.

D7.1.4 Does the AS:WA Involve Writing Text? [LW]

Although most AS:WA’s involve students' writing, the length of writing can vary. In some cases, students have to fill in one word in a sentence; in other cases, the students write a paragraph. For each AS:WA, we will evaluate the length of writing if it occurs. Although we can observe how much students are writing, the focus of this question is more on the intention of the teacher.

Note

- The amount of writing is not necessarily related to the difficulty of the task.

- ‘Writing’ is defined as written words and numbers (not diagrams, graphs, charts, or lines written to organize the pages).

Mark one of the following:

LW = 0 The AS:WA does not involve any writing.

LW = 1 Simple copying or writing down what was stated by the teacher, regardless of length. Students are writing down words or sentences that the teacher stated. The students are not generating their own response.

LW = 2 Filling in blanks or labeling. Students are writing only a few words but are not writing sentences.

Examples

- multiple choice;
- one- or two-word written responses;
- true/false questions;
- crossword puzzles;
- fill-in words in a table;
- answer to a simple math question without writing the calculation;
- matching activities (e.g., connecting two shapes or words by drawing lines); and
- underlining text only if student selects what to underline.

LW = 3 Writing answers to a question or a sequence of questions. Each question requires students to write at least a phrase or a one-sentence response, but not to write a paragraph in a text.

Examples

- giving definitions;
- answering textbook, worksheet, or publicly-stated questions;
- answering questions that guide a practical activity; or
- writing down and performing calculations to a math problem.

LW = 4 Creating or brainstorming multiple ideas or a list. Students are generating a list of ideas, words, or short sentences.

Examples

- writing down everything the students know about bacteria;
- writing down everything the students would need in case of an earthquake.

LW = 5 Essay, report, or project work. Students are required to work on a written task using their own words that is more than a paragraph. The task is an essay or report writing that requires more than finding answers to questions.

Examples

- writing a lab report or summary of a chapter;
- writing a report about a famous scientist;
- doing library research and writing a report;
- creating plans for a lab, including procedures involving several steps, hypothesis, etc.;
- writing stories that require more than one paragraph.

LW = 98 Cannot tell.

Code according to the following hierarchy of codes: 5>4>3>2>1>0.

Special considerations

- Labeling diagrams. Code [2] if the *teacher provides the graph/diagram* and the task is to label it. Ignore labels that go with a diagram or graph that students are *creating*; such labels are used to code students making diagrams (see code [1] in section 7.6 on Diagrams below).

- Multiple codes apply. Code according to the hierarchy of codes: 5>4>3>2>1>0. For example, if a worksheet contains 10 questions and one of them requires students to brainstorm a list while the others are fill-in-the-blank, we will code [4]. If you know there is a worksheet with 10 questions but you do not know what the questions are, try to observe students' writing. Otherwise, code a [3].

- Computer use when working on an AS:WA task. In some cases, the students may use a computer to accomplish an AS:WA task. Consider the type of writing on the computer: if students are writing an essay on a computer, code a [5]; if students are using the computer to indicate the answer of choice, which is similar to multiple choice, code a [2].

- A written lab report. Students writing a lab report will count as a code [5] only when the teacher has not provided a set of questions to guide the report writing, and students are expected to write a complete lab report (e.g., aim, procedures, and conclusion).

- A complete lab report. Sometimes it is not clear if students are expected to write a complete lab report, such as when the teacher says "write the summary." In these cases, evaluate the worksheet, the length of writing that students do (observe the video), and the length of time student are given to complete the task.

- An option to write. If a teacher tells students that they have an option to write something down or that it is a good idea to write it down, consider this as a writing task.

- Unable to identify the length of writing to distinguish between codes [2] and [3]: Sometimes it may not be clear whether the question or task requires longer written answers or short one-word answers. In such cases, look at the following indicators:

    - Teacher's explicit statement asking for a whole sentence response, either in the preceding ASPDF during the AS:WA or on the worksheet;

    - Evidence of students writing sentences from the videotape; and

    - Students answering in sentences during the ASPDF following the AS:WA, when the teacher checks the answers publicly.

    If you find evidence of one of these indicators, code a [3].

    If none of these indicators is present, make a judgment based on the question or task by itself.

D7.1.5 Does the AS:WA Contain Mathematical Calculations? [MP]

Does the AS:WA require students to perform mathematical operations such as addition, subtraction, multiplication, or simplification of two or more numerical values? For example, students are asked to solve physics problems by calculating density, force, or pressure.

Do not include

- counting;
- identifying based on numerical value (e.g., “How many electrons are in one atom of Cu?”, “What is the temperature of the water now?”); or
- simple comparisons that students could do without doing a math operation, such as stating that things are equal ($x_1=x_2=x_3$) or stating that one outcome is bigger than another (e.g., "*F_1=10, and F_2=20. Therefore which one is larger*?").

Mark one of the following:

MP = 0 The AS:WA does not involve mathematical calculations or operations.

MP = 1 The AS:WA contains mathematical calculations or operations.

MP = 98 Cannot tell.

Special considerations

- Balancing chemical equations. This task would be considered a mathematical calculation if the question explicitly asks students to do so. It must be evident that the teacher wants students to carry out the process of the balancing (which requires simple mathematical operations). Just asking the students “Did you balance your equation?” does not count as a mathematical calculation.

- Formulas without mathematical operations. Numerical calculations must be involved when applying a mathematical operation. Stating formulas or deriving formulas without using numbers does not count as a mathematical calculation.

- Estimating involving mathematical operations. Evaluate what students are estimating and how they are estimating. If students use calculations, code [1].

  Examples

  - “*Estimate how tall I am? You look about 5’6*” would not be coded as a mathematical calculation.

  - *“Estimate the density of this object. The volume is probably 5, the mass is 10, therefore, the density would be?”* would be coded [1] for calculation.

D7.1.6 Does the AS:WA Involve Making Diagrams? [DD]

A diagram or drawing is a pictorial representation of an object or process. Do not include graphs or charts as diagrams or drawings. For this code, students must *create* a diagram or drawing, not just copy from a 2-Dimensional source or modify a diagram that the teacher, textbook, or worksheet provided for *this* task.

The teacher must state, either before, during, or after the AS:WA, that a diagram or drawing is necessary or recommended. Seeing a student making a diagram without such a reference would not be coded as making a diagram or drawing.

Examples of diagrams or drawings: Drawing an eye, a map of continents, a circuit diagram, or a sketch for a word problem.

Do not include

- coloring, cutting, pasting, or drawing arrows in a picture; or
- copying and using a diagram that the teacher has drawn on the blackboard or provided in the book or worksheet for *this* task.

Mark one of the following:

DD = 0 The AS:WA does not have an assigned diagram or drawing.

DD = 1 The AS:WA includes an assigned diagram or drawing.

DD = 98 Cannot tell.

Special considerations

- If the teacher provides a ‘frame’ for a drawing, but the students still have to draw the most important item in that frame, code this task as making a diagram, ‘1’.

D7.1.7 Does the AS:WA Involve Making Graphs? [GR]

A graph, which is different from a drawing, involves numerical data that is represented to demonstrate a relationship between variables or to indicate proportions (e.g., to demonstrate a relationship between time and temperature). Graphs can include line graphs, bar graphs, pie charts, histograms, etc.

A table that shows information in an organized manner is *not* a graph.

Students must *create* the graphs. If some details of the graph are provided, the students then have to *plot the data* into the graph. Students copying the graph from a source is not coded as making graphs.

Mark one of the following:

GR = 0 The AS:WA does not involve making a graph

GR = 1 The AS:WA involves making a graph.

GR = 98 Cannot tell

D7.1.8 Does the AS:WA Involve Reading Text? [RT]

To apply this code, students must read text that is *beyond reading the question to be answered*. By text, we mean at least a paragraph of a book, magazine, or other source.

If there is a phrase or sentence of text between questions, this will not be coded as reading text. If the text between questions is at least a paragraph, then the segment will be coded as reading text.

In general, the assignment should make it clear if students are required to read (e.g., the teacher says "*Read this section and then answer the question'').*

Assignments which are likely to involve reading

- independent research projects;
- reading and then writing a summary;
- reading a section of the textbook and answering questions; and
- reading another student's essay and giving them feedback.

Mark one of the following:

RT = 0 The AS:WA does not require reading text.

RT = 1 The AS:WA involves reading text.

RT = 98 Cannot tell.

Special considerations

- If the teacher tells students to read and answer question 10, do not code as reading text.

- If the teacher tells students to read the instructions for the lab, code the assignment as reading text.

- If the teacher tells students to read question 10 but not to answer it yet, do not code as reading text.

- An assignment to 'copy' something will not be coded as reading text because copying typically involves some reading but the intent of the reading assignment is not necessarily for understanding.

- If the teacher tells students to 'write up' the lab, identify what students are supposed to do.

If students copy the procedures from the book, do not code as reading text. If students read a substantial amount of text and then write up a procedure or research question, for example, then that task is a reading assignment and is coded as reading text.

- Some assignments may involve reading if there is text beyond the questions, and should be coded as reading text (e.g., "Work on section 6.1").

- If students are expected to correct a set of answers to problems (e.g., correct their own or other students' work, or compare their answers to other students' or an answer sheet), do not code this task as reading text.

- If the teacher directs students to use their textbooks to help them answer questions, code this segment as reading text based on the assumption that students need to read the text in such cases.

D7.2 Types of Independent Practical Activities

We previously identified three activity structures that involve students in actively 'doing' science: Independent seatwork activities (AS:WA), Independent practical activities (AS:WP), and Discussion (DISC). The purpose of the codes in this section of Dimension 7 is to describe student 'doing' during AS:WP. What kinds of tasks are students expected to complete during work on independent practical assignments?

The codes in this section on Independent practical activities segments of the lesson address the following questions: What is the nature of the AS:WP activities? What are students *doing during* AS:WP segments?

The questions and codes in this dimension include

- Is the AS:WP a motivating activity? [FA]
- Does the AS:WP involve writing text? [LW]
- Does the AS:WP contain mathematical calculations? [MP]
- Does the AS:WP involve making diagrams? [DD]
- Does the AS:WP involve making graphs? [GR]
- Does the AS:WP require reading text? [RT]

These codes for AS:WP activities are conceptually the same as the codes for AS:WA activities. Because some tasks may be undertaken in different ways in AS:WP, carefully read the following manual for coding guidelines.

The examples for 'motivating AS:WP' differ from all of the 'motivating AS:WA' examples. In the remaining codes, there are minor additions that apply to independent practical activities.

For all codes for independent practical activities:

These codes focus on the task that is part of the practical work, such as report writing, data collection, questions about the lab work, and conclusions. Ignore any additional writing tasks that students are assigned 'when they are done' with the AS:WP, including secondary tasks for students who are fast and tasks unrelated to the AS:WP.

Examples

- *"Do the lab, and when you are done, there is a cross word puzzle"* → ignore the crossword puzzle
- *"Do the lab, and then do this (unrelated) review sheet"* → ignore the review sheet.

D7.2.1 Is the AS:WP a Motivating Activity? [FA]

Science inquiry activities, such as gathering data, often are motivating for students or at least the teacher intended the activity as more motivating than traditional school tasks, such as reading text books and answering questions from the textbook.

For this code, look for types of motivating activities that the teacher intended as motivating and those activities are NOT what scientists would describe as traditional science inquiry. Also, look for the overall focus of the AS:WP. If the students are working on 10 experiments but only one would qualify as motivating, do not code the segment as motivating activity.

Consider AS:WP activities as motivating beyond scientific inquiry if they include any of the following elements:

<u>Surprising, exciting, or dramatic phenomena:</u> Things that appear magical (e.g., erupting volcano models, simulated pumping heart, screeching sounds that hurt the ear, optical illusions, making battery out of citrus fruits, racing cars, or shooting off rockets).

<u>Activities framed with a surprising, exciting, or dramatic expectation/question</u>: "Can fire burn under water?"; "You will be amazed when you see this. Watch carefully!"; "Here are five mystery powders you will explore"; or "Can you lift the teacher?".

<u>Activities framed as a simulation or scenario (with or without computer)</u>: "Imagine you are on a deserted island and all you have are these materials."

<u>Activities that appeal to students' fascination with the grotesque, gross things, death, and evil</u>: Crime labs or exploring "yukky" materials such as "goop"

<u>Open-ended explorations with motivating materials</u>: Students are given interesting materials to explore and freedom to observe and manipulate the materials (e.g., "Here are bunch of materials, play around with them and come up with your own classification for them "; "See if you can use them to build a platform that will hold three textbooks"; or "See if you can use these materials to build a parachute that will keep an egg from breaking when it is dropped from the top of the stairs").

Competition and prizes: Students try to make the best hot dog cooker, a rocket that will go the highest, a platform that will hold the most, or a hovercraft that will travel the farthest.

Game, puzzle, or role play format for the AS:WP.

Going outside of the classroom: Going outside to collect rocks, observe clouds, or run up and down the stairs to get timed for speed.

Model building activities: Building motivating objects and models with interesting materials (e.g., building a bridge with spaghetti, or building a rocket with paper or tubes).

Mark one of the following:

FA = 0 The AS:WP is not a motivating activity.

FA = 1 The AS:WP is a motivating activity.

FA = 98 Cannot tell.

Special considerations

- Coloring, pasting, and cutting activities. When coding this dimension, we are looking for the focus of the activity. By focus we mean the emphasis that the teacher places on the coloring, and/or the majority of time the students spend on the coloring, pasting or cutting (e.g., if the task is to "*write a title page, and then decorate the page nicely*", this activity would be coded as a motivating activity).

- When does 'personal life' stuff become a motivating activity? Some tasks are coded as real-life issue, SP, because the students are asked to come up with examples from real life. If students are asked to come up with stories or scenarios, hypothetical or real, code as FA. However, if students are simply listing examples from real life, it would not be coded as FA (e.g., "List all the electrical appliances in your home" would not be coded as FA). In Biology, students often check their own body functions (e.g., pulse, lung capacity, speed, strength, and vision). If students are gathering data about their own bodies, code this activity as motivating.

- Dissections. Many students find dissections interesting and "gross". However, do not code dissections as "motivating" because they represent typical inquiry activities that scientists undertake.

D7.2.2 Does the AS:WP Involve Writing Text? [LW]

Although most AS:WPs involve students in writing, the length of writing can vary. In some cases, students have to fill in one word in a sentence; in other cases, the students write a paragraph. For each AS:WP, evaluate the length of writing that is assigned (if any). Although how much students are actually writing can be observed, the focus of this question is on the intention of the teacher.

We are looking for the writing task that is part of the practical work, such as report writing, data collection, questions about the lab work, and conclusions. Ignore any additional writing tasks students are assigned for 'when they are done' for AS:WP. For example, if the students are working on an AS:WP and the teacher passes out a crossword puzzle for fast students, ignore this task.

In addition, ignore any AS:WP tasks that occur <u>during</u> the AS:WP segment but are not related to the AS:WP. In this way, the writing that will occur and be coded during the AS:WP will be related to the AS:WP.

Note

- The amount of writing is not necessarily related to the difficulty of the task.
- 'Writing' is defined as written words and numbers (not diagrams, graphs, charts, or lines written to organize the pages).

Mark one of the following:

LW = 0 The AS:WP does not involve any writing.

LW = 1 Simple copying or writing down what was stated by the teacher, regardless of length. Students are writing down words/sentences that the teacher has already stated. The students are not generating their own responses.

LW = 2 Filling in blanks/labeling. Students are writing only a few words but do not write a sentence.

Examples

- multiple choice;
- one- or two-word written responses;
- true/false questions;
- crossword puzzles;
- fill-in words in a table;
- answer to a simple math question without writing the calculation;
- matching activities (e.g., connecting two shapes or words by drawing lines);
- underlining text only if student selects what to underline;
- data collection (e.g., students write down numerical values on a worksheet or in a notebook but not sentences);
- lab report (i.e., a set of fill-in-the-blank questions).

LW = 3 Writing answers to a question or a sequence of questions. Each question requires students to write at least a phrase or a one-sentence response, but not to write a paragraph in a text.

Examples

- giving definitions;
- answering textbook, worksheet, or publicly-stated questions;
- answering questions that guide a practical activity;
- writing down and performing calculations to a math problem;
- collecting descriptive data and writing sentences to accurately describe the data (e.g., "Observe this fish tank and write down what you see");
- completing a lab report with a set of questions that guide students through the work.

LW = 4 Creating, brainstorming multiple ideas or a list. Students are generating a list of ideas, words, or short sentences.

Examples

- writing down everything the students think they will observe when they mix two chemicals;
- observing these materials and brainstorming a list of questions to be investigated;
- making a list of everything students observed during the reaction;
- writing down everything the students would need in case of an earthquake.

LW = 5 Essay, report, or project work. Students are required to work on a written task using their own words that is more than a paragraph. The task is an essay or report writing that requires more than finding answers to questions.

Examples

- writing a lab report or summary of a chapter;
- writing a report about a famous scientist;
- doing library research and writing a report;
- creating plans for a lab, including procedures involving several steps, hypothesis, etc.;
- writing stories that require more than one paragraph such as a lab report; the lab report is not guided by a set of questions and the students must generate the report from the beginning.

LW = 98 Cannot tell.

Code according to the hierarchy 5>4>3>2>1>0

Special considerations

- <u>Labeling diagrams</u>. Code [2] if the <u>teacher provides the graph/diagram</u> and the task is to label it. Ignore labels that go with a diagram or graph that students are <u>creating</u>; such labels are used to code students making diagrams (see code [1] in section 7.6 on Diagrams below).

- Multiple codes apply. Code according to the hierarchy of codes: 5>4>3>2>1>0. For example, if a worksheet contains 10 questions and one of them requires students to brainstorm a list while the others are fill-in-the-blank, we will code [4]. If you know there is a worksheet with 10 questions but you do not know what the questions are, try to observe students' writing. Otherwise, code a [3].

- Computer use when working on an AS:WP task. In some cases, the students may use a computer to accomplish an AS:WP task. Consider the type of writing on the computer: if students are writing an essay on a computer, code a [5]; if students are using the computer to indicate the answer of choice, which is similar to multiple choice, code a [2].

- A written lab report. Students writing a lab report will count as a code [5] only when the teacher has not provided a set of questions to guide the report writing, and students are expected to write a complete lab report (e.g., aim, procedures, and conclusion).

- A complete lab report. Sometimes it is not clear if students are expected to write a complete lab report, such as when the teacher says "write the summary." In these cases, evaluate the worksheet, the length of writing that students do (observe the video), and the length of time student are given to complete the task.

- An option to write. If a teacher tells students that they have an option to write something down or that it is a good idea to write it down, consider this as a writing task.

- Unable to identify the length of writing to distinguish between codes [2] and [3]: Sometimes it may not be clear whether the question or task requires longer written answers or short one-word answers. In such cases, look at the following indicators:

    - Teacher's explicit statement asking for a whole sentence response, either in the preceding ASPDF during the AS:WP or on the worksheet;
    - Evidence of students writing sentences from the videotape; and
    - Students answering in sentences during the ASPDF following the AS:WP, when the teacher checks the answers publicly.

  If you find evidence of one of these indicators, code a [3].

  If none of these indicators is present, make a judgment based on the question or task by itself.

D7.2.3 Does the AS:WP Contain Mathematical Calculations? [MP]

Does the AS:WP require students to perform mathematical operations such as addition, subtraction, multiplication, simplification, etc. of two or more numerical values? For example, students are asked to solve physics problems by calculating density, force, or pressure.

Do not include

- counting;
- Iidentifying based on numerical value (e.g., "How many electrons are in one atom of Cu?"; "What is the temperature of the water now?"); or
- simple comparisons that students could do without doing a math operation, such as stating that things are equal ($x_1=x_2=x_3$) or stating that one outcome is bigger than another (e.g., "*F_1=10, and F_2=20. Therefore which one is larger*?").

Mark one of the following:

MP = 0 The AS:WP does not involve mathematical calculations or operations.

MP = 1 The AS:WP does involve mathematical calculations or operations.

MP = 98 Cannot tell.

Special considerations

- <u>Balancing chemical equations</u>. This task would be considered a mathematical calculation if the question explicitly asks students to do so. It must be evident that the teacher wants students to carry out the process of the balancing (which requires simple mathematical operations). Just asking the students "Did you balance your equation?" does not count as a mathematical calculation.

- <u>Formulas without mathematical operations</u>. Numerical calculations must be involved when applying a mathematical operation. Stating formulas or deriving formulas without using numbers does not count as a mathematical calculation.

- <u>Estimating involving mathematical operations</u>. Evaluate what students are estimating and how they are estimating. If students use calculations, code [1].

  Examples

  - "*Estimate how tall I am? You look about 5'6"* would not be coded as a mathematical calculation.

  - "*Estimate the density of this object. The volume is probably 5, the mass is 10, therefore, the density would be?"* would be coded [1] for calculation.

D7.2.4 Does the AS:WP Involve Making Diagrams? [DD]

A diagram or drawing is a pictorial representation of an object or process. Do not include graphs or charts as diagrams or drawings. For this code, students must *create* a diagram or drawing, not just copy from a 2-Dimensional source or modify a diagram that the teacher, textbook, or worksheet provided for *this* task.

The teacher must state, either before, during, or after the AS:WP, that a diagram or drawing is necessary or recommended. Seeing a student making a diagram without such a reference would not be coded as making a diagram or drawing.

Examples of diagrams or drawings: Drawing an eye, a map of continents, a circuit diagram, or a sketch for a word problem.

Do not include

- coloring, cutting, pasting, or drawing arrows in a picture; or
- copying and using a diagram that the teacher has drawn on the blackboard or provided in the book or worksheet for *this* task.

Mark one of the following:

DD = 0 The AS:WP does not have an assigned diagram or drawing.

DD = 1 The AS:WP includes an assigned diagram or drawing.

DD = 98 Cannot tell.

Special considerations

- If the teacher provides a ‘frame’ for a drawing, but the students still have to draw the most important item in that frame, code this task as making a diagram, ‘1’.

  Examples

  - The worksheet presents a window in which students are expected to draw the positions of the constellations in the sky at different times of year.
  - The worksheet provides four boxes marked “summer”, “fall”, “winter”, and “spring” in which students are expected to draw the relationships between the sun and earth.

D7.2.5 Does the AS:WP Involve Making Graphs? [GR]

A graph, which is different from a drawing, involves numerical data that is represented to demonstrate a relationship between variables or to indicate proportions (e.g., to demonstrate a relationship between time and temperature). Graphs can include line graphs, bar graphs, pie charts, histograms, etc.

A table that shows information in an organized manner is *not* a graph.

Students must *create* the graphs. If some details of the graph are provided, the students then have to *plot the data* into the graph. Students copying the graph from a source is not coded as making graphs.

Mark one of the following:

GR = 0 The AS:WP does not involve making a graph.

GR = 1 The AS:WP involves making a graph.

GR = 9 Cannot tell.

D7.2.6 Does the AS:WP Involve Reading Text? [RT]

To apply this code, students must read text that is *beyond reading the question to be answered*. By text, we mean at least a paragraph of a book, magazine, or other source.

If there is a phrase or sentence of text between questions, this will not be coded as reading text. If the text between questions is at least a paragraph, then the segment will be coded as reading text.

In general, the assignment should make it clear if students are required to read (e.g., the teacher says "*Read this section and then answer the question'').*

Reading instructions for a lab will *not* be coded as reading text. An AS:WP can still include a reading task but the teacher make explicit to the class that

- students have to read text beyond the instructions; and
- the text has to be related to the AS:WP.

Assignments which are likely to involve reading

- independent research projects;
- reading and then writing a summary;
- reading a section of the textbook and answering questions; and
- reading another student's essay and giving them feedback.

Mark one of the following:

RT = 0	The AS:WP does not require reading text.
RT = 1	The AS:WP does involve reading text.
RT = 98	Cannot tell.

Special considerations

- If a worksheet has written text beyond the instructions (e.g., an introductory paragraph), an explicit statement requiring students to read this text must be present to code as reading text.
- If the teacher tells students to read and answer question 10, do not code as reading text.
- If the teacher tells students to read question 10 but not to answer it yet, do not code as reading text.
- An assignment to 'copy' something will not be coded as reading text because copying typically involves some reading but the intent of the reading assignment is not necessarily for understanding.
- If the teacher tells students to 'write up' the lab, identify what students are supposed to do. If students copy the procedures from the book, do not code as reading text. If students read a substantial amount of text and then write up a procedure or research question, for example, then that task is a reading assignment and is coded as reading text.
- Some assignments may involve reading if there is text beyond the questions, and should be coded as reading text (e.g., "Work on section 6.1").
- If students are expected to correct a set of answers to problems (e.g., correct their own or other students' work, or compare their answers to other students' or an answer sheet), do not code this task as reading text.
- If the teacher directs students to use their textbooks to help them answer questions, code this segment as reading text based on the assumption that students need to read the text in such cases.

Chapter D8: Content Categories

As a means for identifying the science content in each of the lessons, we will review the teacher questionnaires and the video lessons. We will restrict our review of the Teacher Questionnaire responses to Question #1 (subject matter content of the videotaped lesson) and Question #6 (main thing the teacher wanted students to learn from the videotaped lesson) as a way to focus our analysis. We understand that, although teachers may provide information about scientific skills or attitudes in their responses in the teacher questionnaires, we limit our coding to only the science content mentioned. We use the science content categories, subcategories, and subordinate subcategories identified in the *Guidebook to Examine School Curricula: TIMSS as a Starting Point to Examine Curricula (McNeely 1997)* as our science codes. After we code for the TIMSS content categories using the Teacher Questionnaire, we will watch the video lessons and decide whether we agree with the original coding based on the video content.

D8.1 Guidelines for Coding Content in Teacher Questionnaires

Code each lesson for the *primary* content category, subcategory, and subordinate subcategory as listed in the *Guidebook to Examine School Curricula: TIMSS as a Starting Point to Examine Curricula (McNeely 1997)*. Use Question #1 and Question #6 from the teacher questionnaires. If more than one content category is represented, code the category with the most information provided by the teacher. This would count as primary content. If both content categories provide an equal amount of written information from the teacher, code the category that is mentioned first.

Apply one of the following codes to the lesson for each science content category, subcategory, and subordinate subcategory listed in section D8.4:

[0] This type of science content is not the primary content presented in the lesson.
[1] This type of science content is the primary content presented in the lesson.

Example: SUS058

<u>Question #1:</u> "Integrated Science: The students are expected to distinguish between inherited traits & other characteristics that result from interactions with the environment."

<u>Question #6:</u> "I wanted students to know how to use a monohybrid cross to predict offspring of two parents."

<u>Decision:</u>
1.2 Life Sciences *(category)*
1.2.3 Life spirals, genetic continuity, and diversity *(subcategory)*
1.2.3.3 Variation and inheritance *(subordinate subcategory)*

Example: SUS001

Question #1:
"Earth and Space Science: Faulting and folding of the Earth's crust for mountain building." "Scientific Inquiry." "Interdisciplinary Curriculum: science, art."

Question #6: "Manipulate the types of stress and faults in the earth's crust." "Demonstrate the formation and shapes of folded mountains." "On a lateral or transform boundary no mountains form."

Decision:
1.1 Earth Sciences *(category)*
1.1.2 Earth processes *(subcategory)*
1.1.1.3 Building and breaking *(subordinate subcategory)*

Code the lessons based on teacher responses in Question #1 and Question #6. If Question #1 and Question #6 do not provide sufficient information to code for the primary science content, you may refer to other responses in the teacher questionnaire. However, you must limit your judgment to the *content of the videotaped lesson*. Helpful questions to refer to may include Questions #5a, #5b, and #21-#26.

Example: SAU020

Question #1: (BLANK)

Question #6: "Confidence of using practical applications; Following a prac; Revision of earlier learned concepts."

Since the responses in Question #1 and Question #6 do not aid in the coding of the content categories, look at other responses in the teacher questionnaire. Here, Question #20 provides helpful information by asking how students will be assessed with the material they studied in the videotaped lesson. The teacher's response in this lesson is:

"Draw a labeled diagram of the equipment we set up to make soap. (Include where we put the oil, methylated spirits and sodium hydroxide) I'll collect homework -must be complete."

Decision:
1.3 Physical Sciences *(category)*
1.3.5 Chemical transformations *(subcategory)*
1.3.5.1 Chemical changes *(subordinate subcategory)*

In lessons where the primary science content is Nature of Science, consider two subcategories in the following manner:

- Nature of scientific knowledge: This subcategory will include descriptions about how science knowledge is established, including references to the scientific method or inquiry skills involved in science. This also includes the tentative nature of scientific knowledge which is tested over time.

Example: SNL032

Question #1: “Physical sciences: Doing research, the subject was free choice.”

Question #6: “//Compare objectively//measure precisely// VL.”

Decision:
1.7. Nature of science *(category)*
1.7.1 Nature of scientific knowledge *(subcategory)*

- The scientific enterprise: This subcategory describes the culture of the scientific community. This may include descriptions of what scientists do (e.g., collaborate with one another, conduct research, present findings at conferences, or use standards for measurement).

  Example: SNL059

  Question #1: “Scientific inquiry: Concept standard measure (introduction).”

  Question #6: “Learn to read what is stated, using new concepts.”

  Decision:
  1.7. Nature of science *(category)*
  1.7.2 The scientific enterprise *(subcategory)*

Code lessons as blank only when there is not enough information in the teacher questionnaire to make a judgment about the content categories.

Code lessons as missing TQ if the teacher questionnaire is not available.

We will code the Teacher Questionnaire in teams of three coders including 2 content expert scientists. The teams have to come to consensus on the TIMSS content categories at the Teacher Questionnaire level. Be prepared to present your suggested coding and with a rationale that can be supported by using information in the teacher questionnaire only. Also, be prepared to evaluate your partner’s work in this same light.

D8.2 Guidelines for Coding Video Content

Watch the video lesson and decide (individually) whether you agree with the original content category.

Now that you have seen the videotaped lesson, do you agree with the original coding from the teacher questionnaire responses?

[1] Agree

[2] Disagree

D8.3 Follow-up to the TIMSS Content Categories

If one person in your group of three answered “2” for the previous question or if the content category was coded “Blank” or “Missing TQ” at a teacher questionnaire level, we will follow up the coding of the content categories by coming to consensus as a group and deciding what content should be coded for this lesson based on the video content?

1 – Category: ____

2 – Subcategory: ____

3 – Subordinate subcategory: ____

D8.4 Science Content Codes

The following science content categories, subcategories, and subordinate subcategories are listed in the *Guidebook to Examine School Curricula: TIMSS as a Starting Point to Examine Curricula (McNeely 1997)*.

1.1 Earth Sciences [VT11EART]

- 1.1.1 Earth Features [VT111]
  - 1.1.1.1 Composition
  - 1.1.1.2 Land forms
  - 1.1.1.3 Bodies of water
  - 1.1.1.4 Atmosphere
  - 1.1.1.5 Rocks, soil [VT1115]
  - 1.1.1.6 Ice forms

- 1.1.2 Earth Processes [VT112]
  - 1.1.2.1 Weather and climate [VT1121]
  - 1.1.2.2 Physical cycles
  - 1.1.2.3 Building and breaking [VT1123]
  - 1.1.2.4 Earth's history

- 1.1.3 Earth in the Universe [VT113]
  - 1.1.3.1 Earth in the solar system
  - 1.1.3.2 Planets in the solar system [VT1132]
  - 1.1.3.3 Beyond the solar system
  - 1.1.3.4 Evolution of the universe

1.2 Life Sciences [VT12LIFE]

- 1.2.1 Diversity, Organization, and Structure of Living Things [VT121]

1.2.1.1 Plants, fungi [VT1211]
1.2.1.2 Animals [VT1212]
1.2.1.3 Other organisms
1.2.1.4 Organs, tissues [VT1214]
1.2.1.5 Cells

1.2.2 Life Processes and Systems Enabling Life Functions [VT122]
1.2.2.1 Energy handling
1.2.2.2 Sensing and responding [VT1222]
1.2.2.3 Biochemical processes in cells

1.2.3 Life Spirals, Genetic Continuity, and Diversity [VT123]
1.2.3.1 Life cycles
1.2.3.2 Reproduction [VT1232]
1.2.3.3 Variation and inheritance [VT1233]
1.2.3.4 Evolution, speciation, and diversity
1.2.3.5 Biochemistry of genetics [VT1234]

1.2.4 Interactions of Living Things [VT124]
1.2.4.1 Biomes and ecosystems
1.2.4.2 Habitats and niches
1.2.4.3 Interdependence of life
1.2.4.4 Animal behavior

1.2.5 Human Biology and Health [VT125]
1.2.5.1 Nutrition
1.2.5.2 Disease [VT1252]

1.3 Physical Sciences [VT33PHYS, VT23CHEM]

1.3.1 Matter [VT131]
1.3.1.1 Classification of matter
1.3.1.2 Physical properties [VT1312]
1.3.1.3 Chemical properties

1.3.2 Structure of Matter [VT132]
1.3.2.1 Atoms, ions, and molecules
1.3.2.2 Macromolecules, crystals
1.3.2.3 Subatomic particles

1.3.3 Energy and Physical Properties [VT133]
1.3.3.1 Energy types, sources, conversions [VT1331]
1.3.3.2 Heat and temperature [VT1332]
1.3.3.3 Wave phenomena
1.3.3.4 Sound and vibration [VT1334]
1.3.3.5 Light [VT1335]
1.3.3.6 Electricity [VT1336]
1.3.3.7 Magnetism [VT1337]

1.3.4 Physical Transformations [VT134]
- 1.3.4.1 Physical changes [VT1341]
- 1.3.4.2 Explanations of physical changes
- 1.3.4.3 Kinetic theory
- 1.3.4.4 Quantum theory and fundamental particles

1.3.5 Chemical Transformations [VT135]
- 1.3.5.1 Chemical changes [VT1351]
- 1.3.5.2 Explanations of chemical changes
- 1.3.5.3 Rate of change and equilibria
- 1.3.5.4 Energy and chemical change
- 1.3.5.5 Organic and biochemical changes
- 1.3.5.6 Nuclear chemistry
- 1.3.5.7 Electrochemistry

1.3.6 Forces and Motion [VT136]
- 1.3.6.1 Types of forces [VT1361]
- 1.3.6.2 Time, space, and motion
- 1.3.6.3 Dynamics of motion
- 1.3.6.4 Relativity theory
- 1.3.6.5 Fluid behavior [VT1365]

1.4 through 1.8 Other Sciences and Other Disciplines [VT14OSCI]

1.4 Science, Technology, and Mathematics [VT14TECH]

1.4.1 Nature or Conceptions of Technology

1.4.2 Interactions of Science, Mathematics, and Technology
- 1.4.2.1 Influence of mathematics and technology on science
- 1.4.2.2 Applications of science in mathematics and technology

1.4.3 Interactions of Science, Technology, and Society [VT143]
- 1.4.3.1 Influence of science and technology on society
- 1.4.3.2 Influence of society on science and technology

1.5 History of Science and Technology [VT15HIST]

1.6 Environmental and Resource Issues Related to Science [VT16ENVI]

1.6.1 Pollution

1.6.2 Conservation of Land, Water, and Sea Resources

1.6.3 Conservation of Material and Energy Resources

1.6.4 World Population

1.6.5 Food Production and Storage

1.6.6 Effects of Natural Disasters

1.7 Nature of Science [VT17NOS]

1.7.1 Nature of Scientific Knowledge [VT171]

1.7.2 The Scientific Enterprise

1.8 Science and Other Disciplines [VT18OTHR]

1.8.1 Science and Mathematics [VT181]

1.8.2 Science and Other Disciplines

Chapter D9: Classroom Science Knowledge Development

Previous dimensions have described the types of “structures” and “functions” that are used in the classroom to develop science knowledge (e.g., types of activity structures, types of pedagogical functions). In Dimension 9, we directly address the content that is being developed. The Dimension 9 codes characterize the types of science-related knowledge, or "knowledge development themes", which are publicly developed during the lesson.

D9.1 How Do We Code Science Knowledge Development?

The science knowledge development codes are designed to characterize, in a broad manner, the science-related substance of the knowledge that is being constructed or provided to students during the lesson. Knowledge development is a coverage code. That is, all points in the lesson must be coded as one of the following, mutually exclusive categories:

- canonical knowledge [T:CAN]
- real-life issues [T:SAS]
- real-life issues used to develop canonical knowledge [T:CANS]
- procedural and experimental knowledge [T:PRO]
- classroom safety knowledge [T:SAF]
- nature of science knowledge [T:NOS]
- *meta-cognitive knowledge [T:MET]*
- *blank [TBLNK]*

Table D9.1. Indicators of knowledge development themes

Classroom talk	Public communication.
Teacher talk	Usually dominated or guided by the teacher.
Student talk	Usually structured by the teacher, often in the form of responses to teacher questions.

<u>Classroom talk </u>.When coding development themes, consider only discourse that is publicly available to students. Such talk likely has been coded as public in Dimension 2 (Public Talk [PUBL]).

<u>Teacher talk </u>. Generally, the discourse marked by the different knowledge development themes will be predominately teacher talk. Teachers will either be dominating the discussion (as in a Presentation) or engage in some back and forth discourse between the themselves and students, most often in the form of a question-and-answer sequence.

Note that although classroom presentations and discussions are coded only in presentation/discussion segments, knowledge development themes are coded wherever they apply during public talk. For example, if the teacher publicly addresses the class during a segment of independent practical work and that public talk contains canonical knowledge, that segment should be coded as developing canonical knowledge.

Occasionally, knowledge development themes may be delivered by a technological source, such as a video. For example, if a video shows how two particular molecules combine in a chemical reaction, the narration describing this process would be publicly available to students. Therefore, the segment of the lesson that included a presentation with a video would be coded as developing canonical knowledge.

Student Talk – Student participation in classroom talk usually will be structured by the teacher. Such events mostly occur in the form of responses to teacher questions (e.g., in a Discussion mode). Occasionally, the students may be observed dominating the discourse, such as when a student leads a presentation or discussion.

D9.1.1 Canonical Knowledge [T:CAN]

The example below is an illustration of the canonical knowledge category. It may help to think of this type of knowledge as the "what" and "why" of science, or the knowledge that science produces.

Example: SPJ056

Time	Person	Transcript
0:45:34	T	In a series circuit, the electric current is equal anywhere. Okay?
0:45:39	T	This means that the electric current that flows through a series circuit is equal anywhere. In a series circuit the electric current is equal anywhere.

Canonical knowledge is associated with the information found in traditional science texts, sometimes referred to as "textbook" knowledge. This information includes scientific facts, concepts, ideas, processes, and theories (e.g., a force is a push or a pull; plants make their own food through a process called ‘photosynthesis’; electric current produces a magnetic field; water is recycled in the water cycle).

Teachers can help students develop this knowledge in many ways. For example, the teacher may begin by presenting students with some data, either by producing a phenomenon or by asking students to observe an object, and then provide a scientific explanation for the data. Alternatively, the teacher may start with the scientific explanation and then present some data which demonstrate the theory. Yet another teacher may present only scientific definitions and explanations without the use of examples or phenomena. Regardless of the way knowledge is developed in the classroom, when there is public discussion about topics related to commonly understood, current state of scientific knowledge about the issue, we will consider it as canonical knowledge.

Canonical Knowledge [T:CAN] is defined as a period of time when the teacher and students publicly talk about or present ideas or events designed to foster the development of scientific facts, concepts, ideas, processes, or theories.

Time Requirement: There is no time requirement for Canonical Knowledge Development.

D9.1.1.1 Helpful Indicators

Content of talk. The key indicator for canonical knowledge is the content of the talk which may belong to one or more types: (a) scientific conventions, characteristics, labels, and definitions, (b) patterns in scientific data, observations, and experience, or (c) scientific laws and theoretical explanations. The following descriptions provide descriptions of the types of content that are included in the canonical knowledge category.

- Scientific characteristics, labels, and definitions. Includes scientific knowledge that is limited to characteristics, labels, or definitions. Canonical ideas in this category are generally concrete and do not involve a high level of abstraction. For example, a scientific characteristic would be, "Sulfur is a yellow powder." An example of a label would be, "This bone is called a 'femur.'" A scientific definition, for example, would be, "Hertz is the number of vibrations per second."

- Patterns in scientific data, observations, and experience.- Includes ideas that describe consistent patterns in experience and data. There is only limited generalization from data, observations, or experiences. An example of an idea that describes a pattern in data would be demonstrating that water with copper in it boils faster than water alone. A scientific idea based on prior observations would be that some trees lose their leaves in autumn or that sound travels at different speeds through different media.

- Scientific laws and theories. This type of canonical knowledge includes generalized laws or theoretical ideas that explain patterns of data and events in the real world. An idea in this category might be expressed as a scientific "law" with highly abstract descriptions of a class of patterns often represented in symbols and equations (e.g. the equation D=M/V, Newton's first law of motion that object at rest tends to stay at rest unless acted upon by a new force). An example of a theoretical explanation would be the idea that sound is caused by the vibration of molecules.

Special considerations

- Scientific conventions. For the purposes of the knowledge development code, consider scientific conventions as canonical knowledge. Scientific conventions are pieces of information based on tradition, convenience, or historical precedence that is not related strictly to scientific practice to be proven true or false (e.g., "that's just the way it is"; "that's the way its always been done"; "that's what it is called"). Examples include names and meanings of symbols (e.g., "This circle is a molecule"; "This line is a bond"; "Eureka is represented by the orange line on the graph") and units (e.g., "The unit that atmospheric pressure is measured in is called Pascal's").

- What is *not* considered canonical knowledge. Knowledge that is culturally defined is *not* canonical knowledge because it can be specific to the particular culture and not general to science. For example, "gold is very expensive" is a culturally defined statement and would not be coded as canonical knowledge, unless it was explicitly linked to canonical knowledge. Content information that fits into one of the other categories (e.g., procedural and experimental knowledge about how to use litmus paper to test the pH of substances) is not considered canonical knowledge.

- Knowledge about scientific ways of knowing and general scientific process (e.g., the importance of controlling variables, care in measurement, reasons for scientific practices that are not based in subject-matter knowledge) also will not be considered canonical knowledge. Such information would be coded procedural and experimental knowledge or nature of science knowledge depending on the context of the presentation (see sections below).

- <u>Correctness of information</u>. Our goal at this stage of coding is not to code for the correctness of the science but simply to mark the areas where this kind of information is being talked about. Do not restrict marking canonical segments only to places where scientific information is presented correctly. For example, if a statement is (1) deemed as being canonical knowledge not dependent on culture, then (2) consider that statement AS canonical knowledge even if it is incorrect scientifically (e.g., “Gold is not a metal”).

  Examples

“Gold is very expensive” (culturally defined statement; do not code as canonical knowledge);

“Gold is a metal” (scientifically accurate statement; code as canonical knowledge);

“Gold is not a metal” (scientifically inaccurate; code as canonical knowledge).

9.1.2 Procedural and Experimental Knowledge [T:PRO]

Canonical knowledge may be thought of as the "what" of science, and procedural and experimental knowledge as the "how" of science. Put another way, procedural and experimental knowledge is knowledge that enables the production of canonical knowledge. Procedural and experimental knowledge includes information about how to do something, or about how something is being done, so that students can do the procedures themselves at some point in time. The example below is an illustration of the procedural and experimental knowledge category.

Example: SUS047

Time	Person	Transcript
1:00:45	T	go ahead and take the light bulb and connect them like this: one light bulb
1:00:51	T	after the other; connect it to the battery.

Examples

- How to do some science-related manipulation (e.g., "Connect the circuit to the terminals of the ammeter in this order. Five amps, five hundred, fifty"),

- How to plan a manipulation (e.g., "When designing your experiment remember to only change one variable at a time."),
- How to manipulate formulas or mathematical operations (now plug your quantities into the formula and do the calculation),
- How to observe something (e.g., look at the brightness of the bulb in the circuit),
- How to interpret results of manipulations (e.g., "Deviations occur when you don't do your procedures carefully"),
- What scientific manipulations will be done in class (e.g., "Today you will be doing chemical reactions with hydrochloric acid."), and
- When to apply or engage in a scientific thinking practice (e.g., inferring relationships in data--"Look at the planet's distance from the sun and temperature and see if there is a relationship.").

Procedural and Experimental Knowledge [T:PRO] is the period of time when the teacher and students publicly talk about how to do science-related practices such as: manipulating materials, performing experimental processes, or engaging in scientific thinking practices for the primary purpose of enabling student(s) to engage in these practices.

Time Requirement: There is no time requirement for Procedural Knowledge Development, with the exception of those directive statements that enable, direct, or ask students to engage in scientific thinking processes. In such cases, students must have the opportunity to engage in the process for at least 5 seconds (see "Special Considerations" below for further information).

D9.1.2.1 Helpful Indicators

Purpose of information**.** Determining the purpose of the information is a key test in deciding whether it should be coded as procedural and experimental knowledge or another type of knowledge. The purpose of procedural and experimental knowledge is to enable students to carry out a procedure or experimental practice at some point in the future (e.g., in the current lesson, a future lesson, or at some unknown time in the future). For example, the segment below would be considered procedural and experimental knowledge because the teacher is telling students how to manipulate materials during a lab.

Example: SCZ028

Time	Person	Transcript
00:24:13	T	So, please, now I will tell you the procedure and after that you will do it. Mm-hm, you will light it above the asbestos tray. Hence take the cloth away from there, the reagent paper, the skewer.
00:24:29	T	Leave there only acid somewhere on the edge and the test tubes somewhere in front.
00:24:36	T	One of you will pour acid- I will tell you how much- and the other- as soon as he learns that the reaction is being carried out- lights the skewer and softly puts it inside.
00:24:46	T	So, please, pour around two centimeters of hydrochloric acid to magnesium, do it.

Not all procedural and experimental information is provided for the purpose of enabling students to perform the procedures. Teachers may provide procedural and experimental information to help students understand some other type of knowledge (e.g., canonical knowledge or real-life issues). The information serves to develop another type of knowledge. In these cases, code the information according to the theme the teacher uses to develop the knowledge. For example, the teacher may describe how something is being done in front of the class so that the students will be able to better comprehend the canonical idea behind the demonstration (not necessarily so that students will be able to repeat the same procedures). In the segment below, the teacher is demonstrating the difference between parallel and series circuits.

Example: SAU056

Time	Person	Transcript
00:11:03	T	In second circuit here ... I'm connecting all of them.
00:11:25	T	They're parallel to each other here. And I will use the same power source.

This segment is coded as canonical knowledge because the teacher is providing information to help students better understand what variables he is changing (the configuration of the circuit from series to parallel) and what he is not changing (the power source and the number of bulbs) so that they can understand a canonical idea: the difference between parallel and series circuits. The teacher is not providing the information to help students make the circuits on their own.

To determine if statements made during such activities are procedural and experimental knowledge, consider the reason the teacher is providing the information. If the immediate or primary instructional goal is to enable students to make similar set-ups, then this is a good indicator that the statement is procedural and experimental knowledge. If the instructional goal is to describe how something is set up so that students will be better able to understand another type of knowledge, code the segment as the type of knowledge it is being used to develop. If the teacher talks about procedural and experimental issues to help students perform these procedures although not necessarily in the present lesson, code the procedural and experimental part of the information, even if the information is provided so that students can perform the procedure in a future lesson.

Alternatively, a teacher may introduce canonical knowledge to explain why manipulations should be done a certain way. If the teacher provides canonical knowledge in the course of such an explanation, code the canonical part of the information. For example, the teacher tells students how to connect an ammeter in a circuit and then provides a reason for doing this such as "because the electricity flows from positive to negative". Code the instructions on how to connect the ammeter as T:PRO, and code the teacher's reason for the procedure as T:CAN because it provides a canonical justification (the direction of electricity flow) for the procedure.

Teachers may provide reasons for procedures that are based in scientific ways of knowing that are not linked to subject matter (e.g., “Remember to only change one variable when you design your experiment”). These types of segments will be coded as T:PRO or T:NOS as appropriate (see special consideration below) but not as T:CAN.

Public talk that enables, directs, or asks students to engage in scientific thinking will also be coded as T:PRO. However, the process students are being asked to engage in must involve more than mere recall, and students must have the opportunity to engage in the process for at least 5 seconds (see below for more details).

Special considerations

- Information about scientific ways of knowing**.** Discussions of scientific practices, such as experimental procedures and the reasons for such procedures (e.g., “Remember when you're designing your experiment to try to control all the variables except the temperature”), will be coded as procedural and experimental knowledge. For example, suppose the teacher tells students that the reason they need to carefully control dependant variables in their experiment is so that they attribute results to the variable they are studying. Although this knowledge is attributable to science on the whole, it is being related to how science is being done rather than a product of the scientific endeavor. Code such statements as procedural and experimental knowledge. If the teacher is commenting on the way science is done in a general sense (rather than telling students about a specific instance or guiding students through a specific task), code the segment as T:NOS. For example, the statement, "In science, when we design an experiment we always try to change only one variable so we can tell what is causing the result", is general enough to be considered as T:NOS.

- Directions to students helping the teacher with a demonstration. When the teacher provides procedural instructions to student(s) who are helping with a demonstration, code the segment as T:PRO even though the teacher may not expect the rest of the class to repeat the manipulations during the demonstration.

- Identification and talking about materials, instruments, and/or tools. Discussions about *how to use* materials, tools, or instruments students will be using in a practical activity (e.g., how they work, how to manipulate them or what they will used for) will be coded as T:PRO. If the talk focuses on identifying and naming the materials, tools, or their component parts (e.g., "This is hydrochloric acid"; "This is an ammeter") or if the talk focuses on telling students *why* the materials or tools work (e.g., "This mirror will bounce the light up into the microscope and to your eyes"), code the talk as canonical knowledge.

  - Statements that introduce or frame procedures**.** Lesson framing statements at the beginning of a lesson (e.g., "Today we will do reactions of metals with hydrochloric acid") provide students information about specific materials and activities and would be coded as T:PRO. Teacher statements describing what will happen or has happened in class (e.g., "Now we're going to carry out the reaction") are not coded as procedural and experimental knowledge unless the teacher names the *specific materials and activities* that make up these activities.

    Examples of T:PRO

    - "We're going to use hydrochloric acid to do the reaction."
    - "Now we're going to use the next metal to do a reaction (students know that the next metal is magnesium)."

    Examples of TBLNK (if time requirement is met)

    - "We're going to do a reaction."
    - "We're going to use hydrochloric acid for an experiment."
    - "Today we will do an experiment."

  - Definitions**.** In certain contexts, teachers may provide definitions that are about procedures. For example, the teacher statement, "The mass will be the measurement you obtain when you weigh the object on this scale", is phrased as a definition that tells students how to determine the mass of the object. This segment will be coded as T:PRO.

  - Showing students how to do calculations. Providing students with examples on how to do a calculation would be coded as T:PRO regardless of canonical information present in the intermediate outcomes of the equation or calculation. The primary function of working through such an example is to show students how to do it themselves. The final result, output, or goal of the calculation would be coded for T:CAN. Consider shifting to T:CAN if the teacher goes into more substantive canonical issues that are less directly related to the calculations.

  - Directive statements**.** The time requirement is five seconds. That is, students should be given the opportunity to engage in the procedure or experimental practice for at least five seconds after the directive statement before the results of the procedure, or experimental practice, are provided. If the results are provided (e.g., the teacher tells the students what they should be observing; the teacher provides the hypothesis), code the segment according the type of knowledge contained in the result (usually T:CAN). If the teacher requests the results from the students in less than 5 seconds, consider the segment as a question-and-answer sequence and code according to the category of the answer. More detailed descriptions of how to code various kinds of directive statements are provided in Table D9.1 below.

Table D9.2. Guidelines for coding directions to students

Type of directing	Code	Examples
Telling students to look, or telling students where to look, in a way that does not involve making a scientific observation	Blank [TBLNK] if it meets time requirement; otherwise, code with ongoing category	<u>Seatwork activities</u> "Open your books to p. 35." "Look at the picture on p. 61." "Look at the graph on your handout." "Look up here." "Turn to the section of your book on ecosystems."
Telling students to make a scientific observation	Procedural and experimental knowledge [T:PRO]	<u>Practical activities</u> "Carefully observe the reaction."
Telling students how to observe something *without* revealing what they should see	Procedural and experimental knowledge [T:PRO]	<u>Practical activities</u> "Look to see if bubbles are forming or not." "You need to get at eye level with the top of the liquid." "Look closely at this because it is going to happen quickly." "Look to see if a product was formed." "Look to see what color the litmus paper has changed." "Notice whether the reaction is still occurring."
Telling students what they should see *before* the data is available	Procedural and experimental knowledge [T:PRO]	<u>Practical activities</u> "When you dip the pH paper in the acid, notice that it will turn blue."
Calling students' attention to the results, telling them what they should be seeing	Canonical knowledge [T:CAN]	<u>Practical</u> "Notice that a product is formed." "Look at the bubbles that are forming." "Bubbles are formed."
Question and answer sequences that involve presentation of data, evidence, or what was observed, but that provide only minimal time for students to make the observation (i.e., less than 5 seconds) before an answer or a request for an answer.	Canonical knowledge [T:CAN]	<u>Practical</u> T: "Look to see if a product is formed." T: "Johnny?" S: "Yes, it's hot." *Note*: If this question was asked without being followed with an answer or the teacher allowed at least 5 seconds for students to engage in the observation, it would be coded as procedural and experimental knowledge up until the point the answer was provided.

- Directions to write something down or create a representation. Information or directions for students to write or copy (e.g., "Copy down these notes"; "Write down the metals we will use today"), create representations (e.g., "Draw the diagram in your book"), or make a data recording format (e.g., "Make a table to record your data in") would be coded as procedural and experimental knowledge. To determine whether or not to code such information or directive statements as T:PRO**,** first decide whether or not the thing that the student is being asked to construct or reproduce is related to a scientific practice.

  Examples

  - Representations such as diagrams, charts, and figures of scientific objects or phenomena;
  - Data recording or representation formats such as tables and graphs;
  - Writing that is more than copying or reproducing knowledge and requires students to engage in some scientific thinking processes (e.g., "Record your hypothesis"; "Write down what the relationship is between these variables"); and
  - Questions that will be answered in the present or a future lesson *if* the questions require students to engage in a scientific thinking practice beyond simple recall, and are publicly shared (i.e., presented on the blackboard or dictated).

- Directions to start a task that do not include a description of the task. Sometimes teachers will simply direct students to start a task (e.g., "OK, you can get started now." "You may begin to work now."). The guidelines in table D9.2 identify how to code directive statements like these.

Table D9.3. Guidelines for coding directions to start a task

Step	Question	Decision	
		Yes	No
1	Is the task practical?	Go to step 2	Go to step 3
2	Do students know enough about the materials and procedures to start, and do they start a practical task after the direction?	Code as T:PRO	It is probably not a direction to start. Code as TBLNK (if 15+ sec.) or determine if it fits another theme.
3	It the task a seatwork task?	Go to step 4	Decide what type of task it is.
4	Have the problems, exercise, or task details been made publicly available?	Go to step 5	TBLNK (if 15+ sec.)
5	Does the task fit the definition of T:PRO?	Code as T:PRO	TBLNK (if 15+ sec.)

- T:PRO segments that contain canonical knowledge. Segments that are marked as T:PRO also may contain canonical knowledge ideas in two situations:

    - examples teachers use to show students how to do calculations; and
    - information related to how to use science-related materials, tools, and instruments that will be used by students (e.g., when the pH paper is blue that mean the substance is an acid). If the talk is about why these things work, consider categorizing as T:CAN.

- Question and answer sequences**.** Question and answer sequences may be simply about getting the answer or may ask students to engage in some scientific process. To make this distinction, use the amount of time the teacher provides as one indicator. In general, if the teacher provides at least 5 seconds for the students to engage in some scientific thinking process after the question is asked, code the question as T:PRO. The answer will then be coded according to theme. If teacher begins to request an answer, or an answer is provided in less than 5 seconds, the question and answer will be grouped and coded together according to the theme of the answer. Do not automatically assume that if there is 5 seconds or more pause between the question and answer that the question is T:PRO and the answer is T:CAN. The coding will depend on your judgments of the intent of the teacher and the content of the question and answer.

- Directions to engage in scientific thinking practices. Scientific thinking practices refer to ways of reasoning that are characteristic of 'doing' science (e.g., interpreting evidence, inferring a pattern from data, looking for relationships, or hypothesizing what the outcome of an experiment would be based on prior data and concepts). Code directions to engage in such practices as T:PRO if the knowledge that is the result of the practice is not contained in the direction, and students are given at least 5 seconds to engage in the task. See guidelines in Table D9.3 below.

Table D9.4. Guidelines for coding directions to students to engage in scientific thinking practices

Type of directing	Code	Examples
Asking students to engage in a scientific thinking practice	Procedural and experimental knowledge T:PRO	"Look at the graph and think about the relation between distance from the equator and average temperature." "Look at the data and see if the hypothesis holds true." Note: the statement of the hypothesis would be canonical knowledge but the request to look at the data in relation to the hypothesis is procedural and experimental knowledge.
Providing results of scientific thinking practices	Canonical T:CAN	"The column in the picture indicates the amount of radiation that is in space that can be generated by machines." "So, given what we know about ice we might predict it would melt faster on a hotter day." "If the reaction is still occurring, that means that the metal is not all used up."

- Directions to do practical work**.** Code directions to begin practical work as T:PRO if students already know what materials to use and what activity to do. For example, if the teacher has already explained to students how to manipulate the materials, code a direction, such as "Okay, you can get started on your experiments", as T:PRO. Guidelines on coding practical activities are presented in Table D9.4 below.

Table D9.5. Guidelines for coding practical activities

Practice	Description	Examples	Theme
Manipulating and Planning Manipulation	T directs students how to manipulate the materials. Ss follow directions	"Now pour the acid into the test tube."	T:PRO
	T directs students to use the materials in front of them to answer a question or solve a problem (Ss decide how to do it themselves).	"Use the materials you have in front of you to design an experiment to determine the relationship between water temperature and the respiration of the fish."	T:PRO
Making Observations	T asks for students' attention or to look at something.	"Everyone pay attention, I want you to look at this model of the heart."	TBLNK (not considered a scientific observation)
	T tells students what to observe when data is available to them.	"Look at the bubbles forming."	T:CAN (considered as reporting evidence)
	T tells students what to observe before data is available to observe.	"When you do the reaction later make sure to notice the bubbles forming."	T:PRO
	T tells students how to observe something without telling them what to observe.	"Look to see whether or not bubbles are forming.	T:PRO
	T tells students to make an open ended scientific observation.	"Observe carefully what happens when I drop these two objects from the same height."	T:PRO

Table D9.5. Guidelines for coding practical activities—Continued

Practice	Description		Examples	Theme
Writing, Copying, Making Representations	Writing	Notetaking: T directs students to copy down notes from the board or book (notes may include words, numbers, and formulas, but NOT pictures, diagrams, figures, or data tables)	"Write down the materials we will be using in today's experiment." "Copy this formula down." "Copy down the steps to this procedure."	TBLNK (too general an activity to be considered a scientific practice)
		Writing as scientific practice: T directs students to do some writing on their own that involves a scientific thinking practice.	"Write down what you think will happen to the plant when we put it in the drawer without light." (hypothesizing)	T:PRO (see section on Scientific Thinking Practices)
	Diagramming	T directs students to copy a scientific diagram or figure from the board.		T:PRO
		T directs students to make a diagram or figure of something . Students are told, or know , diagramming conventions beforehand they know what elements should be in the diagram.		T:PRO
		T directs students to diagram something. Students decide what to include in the diagram and/or what conventions to use.		T:PRO
	Making data recording formats	T directs students to copy data table or chart from board. Format and data are provided.		T:PRO
		T directs students to copy data table or chart format from board. Students will fill in the table or chart themselves.		T:PRO
		T directs students to create a data table or chart. General format of data or chart are provided verbally.		T:PRO
		T directs students to make a data table or chart. Students determine format .		T:PRO

Table D9.5. Guidelines for coding practical activities—Continued

	Description	Examples	Theme
Scientific Thinking Practices	T asks students to engage in (by writing, talking about, or thinking independently) some Scientific Thinking Practice such as: making a hypothesis, designing an experiment, collecting and recording data, looking for patterns in data, drawing inferences based on data, developing conclusions, etc. (Students should be given at least 5 seconds to engage in the practice).	"Think for a minute about how you would design an experiment to test your prediction." "Describe the relationship between force and motion based on the data." "Write a summary of what you learned today from your experiment."	T:PRO
Question and Answer Sequences	Question and answer sequences which provide only minimal time (<5 seconds) for students to actually engage in the process required by the question.	T: "Is the reaction still occurring Mary?" S: "Yes, its still bubbling."	Code Q and A according to theme of answer given; in this case, code T:CAN
	Question and answer sequences which ask students to engage in a scientific practice *and* provide at least 5 seconds for students to do so.	T: "Can you find a relationship between the two variables." (>5 sec.) T: "John, what do you think?" S: "As temperature rises the fish breaths faster."	Code question as T:PRO; code request for answer and answer according to theme.

- Information about how to work on school assignments that is not related to science. Teachers often provide students information about how to do school assignments (practical or not) that is non-science related. For example, the teacher may tell students, "First do problems A through C, then D through F". Or the teacher may direct students to “go get your materials.” Do not code this type of information as procedural and experimental knowledge. It will be left blank if it meets the time requirements for blank sections described later.

D9.1.3 Real-Life Issues [T:SAS] and Real-Life Issues Used to Develop Canonical Knowledge [T:CANS]

Real-life issues and real-life issues that are used to develop canonical knowledge are two types of information about how science knowledge is used, applied, or relates to societal issues. The real life issues categories include:

- Personal experiences related to science issues,
- Usefulness of science-related knowledge in everyday life,
- Interest and motivational issues related to science,
- Relating scientific terms to their everyday meanings, and
- Everyday examples or illustrations.

When talk about these issues is substantively linked to canonical knowledge, we will code the segment as real-life issues used to develop canonical knowledge (T:CANS) to indicate the linking of the two types of knowledge. When real-life issues are not substantively linked to canonical knowledge we will code the section as T:SAS. The first example below (SUS047) illustrates the code T:SAS; the second example (SNL064) illustrates the code T:CANST:CANS.

Example of T:SAS: SUS047

Time	Person	Transcript
0:28:51	T	Um, so, um is electronics only for men?
0:28:57	SN	No.
0:28:58	T	Oh boy, things have really changed, let me tell you. Nowadays there's more and more- well there's different kinds of electronics people.

Example of T:CANS: SNL064

Time	Person	Transcript
00:18:20	T	Yes. What is the difference, Renee, what is the difference between an ordinary photo and an x-ray photo? Who can say something about that? Yes?
00:18:32	SN	In an regular photo you see the outside ( ).
00:18:36	T	With a regular photo you only see the outside, and with an x-ray you see the inside. And, ... and the difference is -
00:18:54	T	That with an ordinary photo, the rays don't go through you, but are bounced back by your body. And with an x-ray, the rays pass through your body.
00:19:10	T	So they go through your tissue, and they go through, uhm, through your muscles, they go through your bones.

Real Life Issues [T:SAS] and Real Life Issues Used to Develop Canonical Knowledge [T:CANS] are defined as a periods of time when the teacher and students publicly talk about how science knowledge is used, applied, or relates to societal or social issues.

Time Requirement: There is no time requirement for T:SAS or T:CANS Development.

<u>D9.1.3.1 Helpful Indicators for Coding T:SAS and T:CANS</u>

Information's relation to science content – The codes T:SAS and T:CANS capture information provided to students that relates to science content but that information is not canonical or procedural and experimental. Categorizing a segments as T:SAS or T:CANS does not simply mean that there is not science-related content being developed; that is, talk about a football game or a school dance would not be coded as T:SAS or T:CANS unless the talk was related to science issues. For example, discussions of difference types of jobs available to a person with a chemistry degree would be coded as T:SAS since it is important information that may enable students to see the practical applications of science knowledge or to see themselves as future scientists.

<u>D9.1.3.2 Helpful Indicators for Distinguishing Between T:SAS and T:CANS</u>

The key to distinguishing between the codes T:SAS and T:CANS is to consider the information's relation to other canonical knowledge in the lesson. A segment is considered T:CANS if the

- real life issue is related to the canonical knowledge beyond the topic level;
- real life issue helps clarify the canonical knowledge; or
- canonical knowledge helps clarify the real life issue.

To determine if the segment should be coded as T:SAS or T:CANS**,** first determine if the information is substantively linked to canonical knowledge, that is, the information is related to canonical knowledge beyond the topic level. In the first example presented at the beginning of this section, the teacher is talking about people who have jobs where they use knowledge of electricity. While this example is generally related to the topic of electricity, it is not substantively linked to canonical knowledge of electricity beyond the topic level. The segment is coded as T:SAS. In the second example presented at the beginning of this section, the teacher is explaining the differences between an x-ray image and a regular photograph by describing the physical properties of x-rays. In this case, the real life issue is linked to canonical knowledge beyond the topic level and is coded as T:CANS.

A more complex coding decision can occur in a segment where the teacher starts talking about everyday examples related to a topic. For example, a teacher might tell his students that they are going to talk about electricity in class today and then ask students to come up with names of things they find in their households that use electricity. After this, the teacher may go on to teach students about electricity in simple circuits (e.g., a circuit must be complete for electricity to flow and electricity is shared differently in series and parallel circuits) without linking this canonical knowledge about electricity to the household items the students mentioned. Although the household items are related to the topic of electricity, the information would not be considered as *substantively* linked. The section about household items would be coded as T:SAS, not T:CANS. Alternatively, suppose a teacher showed her students a flashlight from home and then proceeded to talk about how the batteries, bulb, and wires in the flashlight form a simple series circuit. The knowledge is substantively linked to canonical knowledge about series circuits and would be coded as T:CANS.

Substantive links between real-life issues and canonical knowledge can occur when

- the real life issue is used to clarify a science idea; or
- the science content is used to explain, or clarify, a real life issue or example.

Examples of T:CANS in which canonical knowledge is used to explain or clarify a real-life issue or example include the following:

- "Wisdom teeth often grow in and push out other teeth. They make it easy for food to get stuck. So it's important to brush behind them." *(Note: the canonical knowledge about how wisdom teeth grow in is used to support the real-life issue about the need to brush well behind them.)*

- "Copper is a metal that easily heats up so it is often used in cooking pots." (*Note: the canonical knowledge that copper is a good conductor of heat is used to explain the real life issue of why copper is often used in cooking pots.)*

Examples of T:CANS in which real-life issues supporting canonical knowledge:

- "Last night I made soup and noticed the fat floated on top of the water. You can also notice that the oil in salad dressing separates out and floats on top. So fat always floats on top of water." (*Note: the real-life information provides examples to help build a canonical idea.)*

- "A flashlight is an electronic device. If you look inside at the batteries and wires you can see how they are connected and make a complete circuit when you turn the switch on."

(Note: the real-life example of the flashlight is used to demonstrate an instance of canonical knowledge about the concept of a circuit).

The following table provides some guidelines to help you decide whether real-life issues are linked to canonical knowledge:

Table D9.6 Guidelines for coding real-life issues and real-life issues used to develop canonical knowledge

Type of real-life issue	T:SAS (real-life issue not linked to canonical knowledge)	T:CANS (real-life issue linked to canonical knowledge)
Usefulness of science-related knowledge	General discussions of the usefulness of science knowledge for things such as gaining employment opportunities or consumer awareness. Examples: "So, if you know about electricity you can tell if the man at the shop fixing your radio is trying to cheat you or not." "Biology will help you if you want to get a job in a medical field."	Discussions of the usefulness of science knowledge that substantively link to canonical ideas beyond the topic level. Example: "An electrician can find out the problem with your radio by checking to see if a circuit is broken with an ammeter." (T goes on to explain how the ammeter works).
Interest, motivational issues, and personal experiences	General discussions to motivate or foster interest in science-related issues. Examples: "How many of you are interested in electricity already? Go ahead and raise your hands." "Learning about molecules is fun; it's not hard." "You are an excellent biologist!" "The other day my radio broke and I couldn't fix it because I didn't know about electricity."	Discussions that link issues of interest and motivation to canonical ideas beyond the topic level. Example: "The other day when I wanted to make a quick bowl of soup I used a pot with a copper bottom because copper heats up quickly."
Relating scientific terms to their meaning in other contexts	The ordinary definition of a term is discussed but not related to its scientific meaning. Example: "We're going to talk about parallel circuits today. Who has heard the word parallel and can tell me how they have used it?" (T never relates common usage to science meaning).	The ordinary definition of a term is discussed and related to its scientific meaning. Example: "So, John said parallel means side-by-side. Notice now how the bulbs in a parallel circuit are connected sort of side-by-side, but in a series circuit they are all in a line."

Table D9.6. Guidelines for Coding Real-Life Issues and Real-Life Issues Used to Develop Canonical Knowledge—Continued

Type of real-life issue	T:SAS (real-life issue not linked to canonical knowledge)	T:CANS (real-life issue linked to canonical knowledge)
Everyday examples or Illustrations	Listing examples without using the examples to build a scientific idea or pattern. Examples: "Vinegar is an example of an acid." "Toy cars have electronic components in them." "Where have you heard the word calorie before?" (Students name places in everyday life where they have heard the word "calories." The students' examples such as diet foods are not used to further the definition of calories as energy). "The menu at Denny's lists calories." (This example is not used to elaborate the definition of calories.) "Do you know what a hot water bag is? Have you ever used one?" (This part of the discussion about a hot water bag is not used to support the development of a science idea, definition, explanation, or pattern).	Examples are used to develop, clarify, or elaborate larger science idea, definition, explanation or pattern. Examples: "Vinegar is an acid but it is a very weak acid which we can tell by comparing its pH to the pH of hydrochloric acid." (Here the example that is used to elaborate the definition of acid, not just to name an example of an acid). "Think of calories as the gas bill you would have to pay for gas, the more energy you use the more you have to pay." (The everyday example is used to clarify or illustrate the definition of calorie as energy). "We use hot water in the hot water bag because water is a substance that is extremely difficult to cool off." (The hot water bag example is being used to support the idea about water being slow to heat up and cool off).

Special Considerations for T:CANS

- <u>Materials or phenomena found in the classroom</u>. Teachers often refer to common materials, events, or phenomena found in the classroom in the course of a lesson. Although these may not have been bought into the classroom for the purpose of making a link to students' everyday lives, they may be used to serve this purpose. To decide whether or not to code as T:CANS or simply T:CAN, consider the following:
    - Is the material or phenomena used to provide a link to students' everyday lives? If yes, code as T:CANS. For example, the teacher refers to a light in the classroom and talks about how light rays travel from common light bulbs in general. The teacher is using an object found in the classroom to make a link to students'

everyday lives and would be coded as T:CANS. The teacher using common bulbs and batteries to teach electricity by making circuits would not be linking the object to its everyday context and would be coded as T:CAN.

- Is the material or phenomena in the classroom or outside the classroom? If yes, code as T:CANS. For example, the teacher referring to a group of trees seen outside the classroom window in the course of talking about photosynthesis would be coded as T:CANS. The teacher talking about how light travels from the sun through the window of the classroom would also be coded as T:CANS. Talking about how sound travels through the medium of air in the classroom would be coded as T:CAN only.

<u>D9.1.3.3 How to code T:CANS</u>

When a real life issue is linked to canonical content, identify and mark the real life issue and the related canonical knowledge as T:CANS. Include only the part of the real life issue that is actually linked to canonical knowledge in the segment. Do not include contextual information that leads up to the link or canonical knowledge that is no longer specifically linked to the real-life issue. See Table D9.6 for examples of a segments with T:SAS and T:CANS.

Table D9.7 Examples of T:SAS and T:CANS

Example	Code
"You've all watched your mother or father cook something, right? Maybe you've seen them use a pot to cook rice, or soup, or even boil water for pasta. What's you favorite food? Mine is pasta. I love to make pasta." "Next time you see someone using a pot to cook, notice if the pot is coated with copper on the bottom. People often make pots with copper because it is a good conductor of heat."	T:SAS This is contextual information. The T:SAS content that will be linked (the use of *copper* in pots) has not yet been mentioned. T:CANS The link between the use of copper pots and the canonical knowledge is made.
"Your refrigerator is an electronic device."	T:SAS This is an example only.
"A computer is an electronic device."	T:SAS This is an example only.
"A flashlight is an electronic device. If you look inside at the batteries and wires, you can see ho they are connected and make complete circuit when you turn the switch on."	T:CANS The example is linked to canonical knowledge.

Links are usually explicitly made and carried out in proximity to each other. However, sometimes they may be implicit and spread out in time. In these cases, the link should be very clear. To make this judgment, consider the following questions:

- Is the teacher actually trying to make a link (as opposed to presenting information that we as outside observers think could be linked)?
- Would a "good student" be able to make the connection the teacher is trying to make?

If the answer is yes to either of these questions, consider the segment as being linked.

Example

Person	Transcript
T	So what I'm trying to say is that like an oden restaurants, copper is commonly used for cooking. Okay? So check on the pot that oden restaurants use okay?

In this example, the canonical knowledge that links to this real life example was stated earlier: "Copper is very easy to heat up and cool down. I want you to remember this. It's important, okay?" Although this canonical knowledge is not explicitly stated in close proximity to the statement about the copper pots in restaurants, the teacher intends this link to be made and that a good student would be able to make the link. Code as T:CANS.

Example: SNL057

In the first section of the illustration below, the class is talking about the role of wisdom teeth and there are three areas where real life issues are linked to canonical content. At 5:37, the teacher states that wisdom teeth often need to be pulled as soon as they appear. If this information occurred alone, it would be considered T:SAS because it is a social issue. However, this knowledge is linked to canonical knowledge that provides the reason why these teeth have to be pulled (i.e., the jaws are too small, the wisdom teeth can push other teeth away making food get stuck more often and increasing chances of decay). The entire section is coded as T:CANS. A similar section is found at 6:05 when the teacher links the canonical knowledge about wisdom teeth to the real life issue about the need to brush behind your teeth. At 6:14, the student mentions their personal experience with additional teeth which the teacher links to canonical knowledge by talking about what kind of teeth they are and when they usually appear. At 6:41, the teacher begins teaching students more about how to brush but this information is not substantively linked to any canonical content beyond the topic level. It is coded as T:SAS.

Table D9.8 Guidelines for coding T:SAS and T:CANS

Time	Person	Transcript	Code
0:05:26	T	**[**The wisdom teeth are many times too small to be able to chew food well.**]**	T:CAN
		[Often it also happens that they don't	T:CANS
0:05:37	T	appear at all or that as soon as they do appear, that they need to be pulled. Does anyone have any idea why they have to be pulled out fast? Yes, Marloes?	
0:05:44	SN	The jaws are usually too small.	
0:05:44	T	The jaws are usually too small. Yes, uh, is it also that they can decay much faster? Or damaged faster?	
0:05:51	SN	Yes, ( )	
0:05:52	T	What, but what would be the reason that it gets damaged much faster?	
0:05:55	SN	That, um ...	
0:05:56	T	Yes?	
0:05:56	S	Damages the other teeth.	
0:05:57	T	What did you say?	
0:05:58	S	That will damages the other teeth, right? But I thought that pushes the other teeth away.	
0:06:02	T	It pushes them away and it gets stuck more often, yes.	
0:06:04	S	You can' t reach it.	
0:06:05	T	You can' t reach it very well with brushing. So keep that in mind if you get wisdom, wisdom teeth, yes. That you also try to brush behind your teeth, in the back of your teeth, yes.	
0:06:14	SN	Yes, but if you're at this age, I have, I got four additional teeth. I had that.	
0:06:20	T	Yes.	
0:06:21	S	But those were not wisdom teeth.	
0:06:22	T	No, those were regular teeth.	
0:06:22	T	Some people, let me say, get, get that already at, at a fairly young age and some others are a little later. There're also//	
0:06:31	S	//But now there's no space anymore.	
0:06:32	T	No, very well, but uh, uh, those wisdom teeth will - if they give you problems, that they have to be pulled out.	

		They will already start to press in the back against the other teeth. And then many	
0:06:41	T	times in the jaw itself.	
0:06:41	T	Yes? Okay ... Wisdom teeth can be damaged much faster**.]**	
0:06:41	T	**[**Um, one of the things in which too little attention is given to is, and that does not necessarily have to be	T:SAS
0:06:53	T	with Biology, maybe a little more in (home welfare class), is that the wisdom - that the brushing is very important. Not everyone, but many people also brush too hard.	
0:07:02	T	Some people actually brush the enamel um, off their teeth.	
0:07:02	T	So it is not really the intent when you are brushing your teeth to push that hard. With a hard brush that is not necessary either.	
0:07:15	T	With a medium or a soft brush, the most gentle way to brush is the most important so that it doesn't ( ). You should just remove the plaque and not or the plaque or at least remove the	

D9.1.4 Room Safety Knowledge [T:SAF]

Classroom Safety Knowledge [T:SAF] is defined as a period of time when the teacher and students publicly talk about issues for the purpose of providing students safety-related information.

Time Requirement: There is no time requirement for T:SAF Development

D9.1.4.1 Helpful Indicators

Information's purpose. The primary purpose of the information is to convey information related to safety in the classroom. Safety issues will be coded separately whether or not they are connected to other types of knowledge. Safety segments can include other themes that will not be marked at this time but T:SAF sections will be reviewed later to code any canonical science ideas where they are present. The key determinant of T:SAF is whether the primary purpose of the information is to give students safety-related information or to teach students some canonical knowledge or other type of knowledge.

Examples

- "A capacitor is a dangerous thing."
- "You have to know about capacitors for your own safety."
- "These things (the electronic components being passed out) are dangerous."

- “Be careful when using the burner.”

Special consideration

Safety and health issues outside the classroom. Discussions of health and safety which do not apply to classroom activities or materials (e.g., a discussion of the harmful effects of the sun's rays or how to prevent disease) will be coded as T:SAS.

D9.1.5 Nature of science Knowledge [T:NOS]

NATURE OF SCIENCE KNOWLEDGE [T:NOS] is defined as a period of time when the teacher and students publicly talk about issues about how science is done.

Time Requirement: There is no time requirement for T:NOS Development.

D9.1.5.1 Helpful Indicator

Explicit reference to the Nature of Science. Nature of science knowledge includes talk about how science is practiced: definitions of science or technology, the values of science and science dispositions (e.g., open-mindedness, skepticism, and objectivity), and scientific methods. Nature of science also includes talk about the scientific enterprise, how scientists work and communicate, the sociology of science, ethics in science, politics of science, and philosophy of science.

To be coded as T:NOS, the talk must explicitly refer to the nature of science in general terms. The information should go beyond the particular content being talked about. For example, "In science we try to only change one variable" would be coded as T:NOS because it makes explicit a certain view of science that goes beyond the particular activity or content being discussed. The teacher statement “In the experiment your doing today make sure to only change one variable” would be coded as T:PRO, but not T:NOS, because the talk is about how to do a particular experiment.

Special consideration

History of science. Talk about the history of science will not coded as T:NOS since it is included in canonical knowledge.

D9.1.6 Meta-Cognitive Knowledge

Meta-Cognitive Knowledge [T:MET] is defined as a period of time when the teacher and students publicly talk about strategies for learning (i.e., learning how to learn) or the importance of reflecting on one’s knowledge and learning as part of the learning process. The talk may be of a general nature, related to canonical knowledge, or related to procedural and experimental knowledge.

Time Requirement: There is no time requirement for T:MET Development.

D9.1.6.1 Helpful Indicators

Learning how to learn**.** Sometimes teachers try to help students “learn how to learn”, that is, to make students more aware of their own learning process and strategies for learning or point out to students how to improve their learning. They might guide students’ thinking processes, especially by pointing out difficulties in understanding a particular idea or skill or by guiding students’ use of helpful strategies to understand difficult ideas or skills. Sometimes the teacher’s statements sound more like motivational statements, encouraging students to keep working to understand difficult ideas, but such statements include some information that a student could learn about the process of learning science.

For this code, the learning goal is focused on strategies for thinking, studying, problem solving, synthesizing, or reflecting on what students know rather than gaining knowledge of specific science content ideas or procedures.

Examples

- “One strategy you might use to make sense of this text is to first preview it and make some predictions about what it is about.”
- “Who will write down the conclusions? You will write down the conclusions but that will help you learn better. It won’t help you learn if I tell you the conclusions.”
- “This part is pretty difficult, okay? This part is today’s big problem because it’s really difficult, okay?”
- “If you don’t do your homework, you’re only hurting yourself. These assignments are to support your learning and if you don’t do them you’re only hurting yourself and your own learning.”
- “Use mnemonics to remember things.”

Revealing thinking processes**.** The teacher’s and the students’ thinking processes are made more visible to the class when the teacher models thinking processes or asks students to reveal their thinking processes. The focus of the talk is on how an answer was obtained or how a particular problem was solved, but not simply on the answer to the problem.

Examples

- “Let me show you how I would think my way through this problem.”
- “Tell me what is confusing you, Derek.”
- “Help me understand how you are trying to solve this problem. Talk it through, Serena.”
- “Explain how you figured that out, Claire.”

Reflecting on learning**.** Students and/or the teacher publicly reflect on what they have learned and how they learned it.

Examples

- “Tell me how your ideas have changed.”
- “What convinced you to change your ideas?”
- “What are the big ideas that you learned today?”

Providing rationales or reasons for learning that ask students to take a "step back" from the learning process itself**.** Students and/or the teacher provide a reason for doing something that allows students to step back and reflect on the learning process in some way.

Examples

- “So tell me why we are learning this today?”
- “It's good for you to write things down. You learn better that way.”

D9.1.7 Blanks [TBLNK]

Blank [TBLNK] is defined as a period of time when no science-related knowledge is being publicly developed.

Time Requirement: There is a 15-second time requirement for the blank category. Any blanks that are less than 15 seconds will be grouped with the ongoing theme (e.g., if T:CAN was coded prior to the blank, keep T:CAN going during the potential blank segment that is less than 15 seconds). If there is no science-related knowledge theme being publicly developed (i.e., you are already in a blank section), continue coding as blank until the next theme begins. If there are pauses between a segment that is coded according to a theme and a segment that should be blank, include the pause in the blank.

D9.1.7.1 Helpful Indicators

No public talk. When coding knowledge development, only coding discourse that is publicly available to students. Except in special cases, the areas of the lesson that are not coded as Public Talk will be categorized as TBLNK to indicate that there is no science knowledge that is being publicly developed.

Non-instructional talk. Blanks that include talk but that talk is “non-instructional” talk occurs when no science-related knowledge (e.g., science-related claims, ideas, or data) is being discussed. Such talk would include classroom greetings, idle conversation, or interruptions to the lesson. Blanks may also be talk that facilitates the smooth flow of the lesson (e.g., transitions from one topic to another, directions to turn to a page, or instruction to take materials or books out).

Mentions of content at the topic or activity level. Talk that is more closely related to the science content but limited to a mention of content at the topic or activity level would be coded as TBLNK. These mentions of content primarily facilitate transitions in the lesson or move lessons along rather than present a content idea that students should learn (e.g., “Now get out your density problems that you did for homework”; “First we will go over the homework about atoms and then we will carry out an experiment”). The talk does not provide a direct opportunity for students to learn science-related content.

D9.1.7.2 Examples (if they meet the time requirement)

Transitions and topic shifts: When to categorize as TBLNK. When transitioning between activities and/or topics, teachers often talk about what they will be doing next. If this talk does not go beyond the topic or activity level to contain statements that could be considered science-related information that can be learned by students, leave the section blank until the teacher begins the next activity or topic. In the example below, the teacher is delivering science content that is coded as T:SAS. The teacher begins a transition to the next part of the lesson at 41:56. In the transition section topics and activities are mentioned, but the content itself is not yet being discussed. The new part of the lesson actually begins when the teacher asks for volunteers at 42:14. This section also is not coded because the teacher is organizing for the instructional activity (see section on asking for volunteers below). Canonical knowledge development begins around 42:27 when the teacher asks a content-related question. Note that framing statements that are only at the topic level will be left blank (e.g., “Today we will study about calories and specific heat”).

Example: SUS047

Time	Person	Transcript	Code
0:41:39	T	**[**There are so many, so many electrical- a beater you know for beating eggs you know. And so many. The hair dryer that you use.	T:SAS
0:41:46	SN	I don't use a hair dryer.	
0:41:47	T	Oh, some people use. So many electrical things and it's- and- and all you got to do is be able to follow the instructions on the circuit. **]**	
0:41:56	T	**[**So let me show you how to build, how to draw a simple circuit and how to connect it. Maybe I should talk a little bit about what's electricity before I do that?	TBLNK
0:42:09	SN	//No.	
0:42:09	SN	Yeah.//	
0:42:09	T	All right, just a little bit and then- and then we'll go on and go ahead and put together a little circuit.	
0:42:13	SN	Just a little.	
0:42:14	T	Not a lot just a little bit.	
0:42:14	T	Okay, uh, I need some actors and actresses, some volunteers. Oh, I have a lot of volunteers, what a surprise.	
0:42:22	T	Okay, um, okay, um, here's the thing. I'd like to ask you first a question.**]**	
0:42:27	T	**[**What's the difference between this kind of battery, somebody raise your hand, and this kind of battery?	T:CAN

Transition

Asking for volunteers

<u>Transitions and topic shifts: When to code a type of knowledge development</u>. When a transition or topic shift goes beyond the topic or activity level code according to the type of knowledge that is being developed. The main question is whether the teacher is simply transitioning or whether there is also some content being presented in the transition. In making a transition, the teacher might make a statement about the content from which students could learn a science idea. The transition would be coded according to the type of knowledge it relates to. In the following example, students could learn from the transition statements that evaporation and condensation are involved in the formation of clouds and dew. The segment would be coded as T:CAN.

Example: “We’ve just been talking about how evaporation and condensation are involved in the formation of clouds. Now we will look at how evaporation and condensation are involved in the formation of dew.”

<u>Directions to observe</u>. Directing students’ attention to look at or listen to something often are left blank if they meet the time requirement. In certain cases, these statements may be grouped

with procedural and experimental knowledge or another category. Use the guidelines above to determine what knowledge type to code such statements.

Orienting to locations: When to code TBLNK. When the teacher talks about where to look or where to find something, categorize the segment as TBLNK (e.g., showing students what page to look at or where to look for materials).

Examples

- “Turn to page 65.”
- “Turn to the section on global warming.”
- “You can see there a picture. Figure fifty-one.”

Orienting to locations: When to code a type of knowledge development. When the teacher talks about the content on a particular page in the book in a way that goes beyond the topic level, the segment would be coded according to the appropriate knowledge theme.

Example: “In the graph on page 34 the green line represents the temperature.”

Social organization issues: When to code TBLNK. Teachers’ organizational or directing statements, telling students how to organize materials or themselves for something related to the science lesson, should be coded as TBLNK.

Examples

- assignments or tests at the topic level only (e.g., “For homework, define these words: translucent, transparent, opaque”; “For tomorrow, do numbers 1-5 on p. 56”),
- distribution of materials;
- directions on how to pass out, collect, or organize papers, materials, and books;
- announcing grades, due dates, or schedules;
- organizing materials;
- permission slips for a field trip; and
- instructions on how to form groups.

If the direction is to do some sort of manipulation, and the students already know enough to do the manipulation, code as T:PRO (e.g., “You can start your experiment now”). If the direction does not involve manipulation (e.g., “You can get started on your homework now”), leave these statements blank (as in example "a" below). These kinds of statements are often very brief and interjected in the middle of delivering content that fits into one of the development themes; if less than 15 seconds, include them with the ongoing theme (as in example "b" below).

Example: SCZ006

Teacher is guiding a student who is setting a videotape in the correct position

Time	Person	Transcript	Code
0:03:05	T	So we will ask John. Is everything prepared, closed?	TBLNK
0:03:24	T	If you couldn't hear it well, then- John, forward it a bit. You turned it too early, acids.	
0:03:35		( )	
0:03:37	T	It doesn't matter. You had it but then you moved it a bit so, we'll wait a bit.	
0:03:43	T	Uh, there should be one, three, four, John, I think. You shouldn't have more there.	

Example

Time	Person	Transcript	Code	Note
1:43:35	T	Now, everybody, connect the batteries in parallel.	T:PRO	Whole segment is coded T:PRO
1:43:41	SN	Like that?	T:PRO	
1:43:43	T	Take a look, like this.	(directing)	
1:43:43	T	Two batteries,	T:PRO	
1:43:43	T	okay um, Merideth, go ahead and sit down.	(behavioral)	
1:43:43	T	Two batteries, the wires come out-	T:PRO	
1:43:43	T	Excuse me, sh sh sh sh sh. Take a look. Jessica? Jennifer? Fernando?	(behavioral)	
1:43:59	T	The wires come out of the positive end and join together. The wires come out of the negative end and join together.	T:PRO	

Social organization issues: When to code a type of knowledge development. If the information in a segment about social organization is explicitly connected to content, according to that knowledge theme. In talking about homework or practical assignments, the teacher might mention content beyond the topic level. In this case, the students could learning something from the teacher's statement and the talk about the assignment would be coded according to the related knowledge theme. In the example below, students could learn that the sun's energy plays an important role in creating the weather. The segment would be coded as T:CAN.

Example: "On number one on your test, you should have emphasized the importance of the sun's energy in creating the weather."

Behavioral Management: When to code TBLNK. Managing behavioral issues will generally be categorized blank unless connected to content that could be considered as one of the other knowledge development themes.

Calling on students: When to code TBLNK. When the teacher calls on students to come up to the blackboard or volunteer in an activity leave the segment blank if it meets the time requirement. This includes occasions when the teacher asks students to volunteer to participate in some science task or demonstration. Include the time when the teacher is calling on them and the time they are arranging themselves as blank unless some canonical knowledge is being provided at that time.

Calling on students: When to code a type of knowledge development. When the teacher calls on a student to answer a question or contribute to the classroom discussion, code according to the theme of the talk surrounding it. Do not code as blank. This includes occasions when the teacher asks students to raise their hands or calls on students to answer a question. Include the time when students are raising their hands and the teacher is calling on them as the appropriate theme.

Motivation/Interest: When to code TBLNK. If the teacher makes motivational comments that do not mention content, even topic level, code as TBLNK.

Example: "You should come to study group after school because it will help you do better on the test. I can help you review for the test and we can have fun quizzing each other."

Motivation/Interest: When to categorize a type of knowledge development. If the teacher makes motivational statements that include a content link at the topic level, code as T:SAS (e.g., "Electricity is a very interesting topic. How many of you are interested in electricity?"). If the motivational comments include a content link beyond the topic level, categorize with appropriate theme (e.g., "Isn't it fascinating that no matter how many bulbs I add in this circuit the brightness remains the same").

Personal experiences: When to categorize as TBLNK. Discussions of personal experience that are NOT connected to science content development should be considered as blanks. If the teacher or a student talks about a personal experience without linking it to science-related content, categorize as TBLNK.

Personal experiences: When to categorize according to a type of knowledge development. Personal experiences are categorized according to the theme they are related to if they are linked to one of the science content development themes.

Jokes: When to categorize as TBLNK. Jokes that are *not* closely linked to canonical knowledge should be considered as blank.

Example: "Well, yes, I do tell some lies occasionally, but there's no way I would lie today, right? Yes, normally I only tell the truth two times out of five but I won't lie today, okay?"

Jokes: When to categorize according to a type of knowledge development. If a joke is told in a way that is closely linked to the canonical knowledge, categorize as T:CAN.

Spelling: When to categorize as TBLNK**.** When the teacher gives directions concerning how to spell something without linking it to content consider as blank.

Examples

"Sir, I cannot read your handwriting. How do you spell "photosynthesis"?"
"This letter is supposed to be a "p". There, is that clearer? Can you read it now?"

Spelling: When to categorize according to a type of knowledge development. When the spelling of a word helps to define the word or to clarify something about the meaning of the word, categorize according to the appropriate theme.

Example: "The symbol for copper is Cu, but the word copper is spelled with an "o".

Dictating or writing: When to categorize as TBLNK -- Any direction to write something down that involves dictation or copy down notes from the board or book, such as words, numbers, and formulas but not pictures, diagrams, figures, or data tables, will be left blank if the direction does not mention content, or mentions content only at the topic (e.g., "Write your name on the paper"; "Copy this down"; "Write down the names of metals on your paper") Categorize as TBLNK any talk that guides students while they write or copy if it does not provide content information or information about scientific procedures or practices (e.g., "Be sure to write legibly"; "Be sure to copy everything with correct spelling and to skip lines").

When the teacher asks students to write down a question, or series of questions, categorize as TBLNK if the questions being written down are not shared publicly, or the questions being written down do not ask students to engage in some scientific practice.

Silence while the teacher is drawing or writing science information on the board will be coded as TBLNK until the drawing or writing is referenced if the teacher has not indicated to students that they need to attend to the information being written or drawn.

Dictating or writing: When to categorize according to a type of knowledge development. When the direction to write down expresses a content idea categorize according to the theme (e.g., "Don't forget to write down that the liquid was fizzing during the reaction").

If the teacher announces she is going to write on the board something related to content, categorize according to knowledge theme. When there is no discourse or only non-science discourse and the teacher calls students' attention to the information about to be written or drawn, categorize according to the knowledge theme.

If the answer to the question is shared before, or while, students are writing down the question, categorize the question and its answer (not the act of independent writing) according to theme.

If the teacher asks students to write down a question, or series of questions, categorize the direction to write and answer the question as T:PRO only if the questions are made public (i.e., either dictated verbally or written on the board) *and* answering the question entails engaging in some scientific procedure or thinking practice (e.g., "Write down the conclusions of your experiment.").

Table D9.9. Guidelines for coding segments with dictation or writing

Situation	Decision
Teacher tells students to copy down notes, and the direction to copy includes knowledge beyond the topic level. (dictating notes) ("Write down that the symbol for magnesium is Mg.")	Categorize according to theme (in this case T:CAN).
Teacher asks students to write down a question	Categorize direction as T:PRO if question is publicly shared and entails engaging in a scientific practice of some kind.
Teacher says she is going to write something down. ("I'm going to write down the symbol for magnesium.")	Categorize according to theme of what she is going to write down.
Teacher is writing/drawing on the board but there is no discourse, or non-science discourse. There has been no indication from the teacher that students should be paying attention to the information.	Categorize as TBLNK until writing or drawing is referenced.
Teacher is writing/drawing on the board but there is no discourse, or non-science discourse. The teacher has indicated that students should be paying attention to the information.	Categorize according to theme of what is being written or drawn.

<u>Referencing Statements: When to categorize as TBLNK</u>. Teachers often refer to something that was done earlier such as telling students they have done this activity before, or telling them they will be learning more about this later (e.g., "We studied that last week"; "We did this experiment yesterday"). If the statement is not connected to any theme consider as blank if the time requirement is met. The following example is coded as TBLNK because the referencing statement is not yet connected to any theme, is in the middle of a blank area, and does not go beyond the topic level.

Example: "This is the experiment we did. Do you remember this?"

<u>Referencing Statements: When to categorize according to a type of knowledge development</u>. If the teacher's referencing statements can be connected to one of the development themes, then categorize according to that theme. In the example below, the experiment and drawing being referred to are canonical knowledge so the referencing statements should also be categorized as T:CAN.

Example: "I drew this one last time."

Highlighting Statements: When to categorize as TBLNK. Teachers might highlight certain ideas as being important (e.g.,"This is very important"; "Be sure you remember this"; "Don't forget to memorize this"). If these statements cannot be connected to any knowledge theme, consider coding as blank if the time requirement is met.

Highlighting Statements: When to categorize according to a type of knowledge development. When highlighting statements can be connected to one of the themes, that is, you know the theme of the information being highlighted, categorize these highlighting statements according to the related knowledge theme.

Teachers' evaluative or guiding statements: When to categorize as TBLNK. Teachers often follow-up a student response to a question with a comment about the students' response. These comments might be evaluative in nature (e.g., "Good"; "You're on the right track") or guiding in nature (e.g., "State that in a sentence, please"; "How did you come to that conclusion?"). Usually, a theme will be associated with the teachers' initial question and student's response. If there is no theme associated, code as blank.

Teachers' evaluative or guiding statements: When to categorize according to a type of knowledge development. Teacher's comments about students' responses that are associated with one of the development themes should be categorized according to the theme that characterizes the student response.

Checking for understanding**.** When teachers check to make sure if students understand content before moving on, they leave open the possibility for questions and clarifications to that content. Categorize such checking statements according to the theme they are referring to.

Public talk during independent work. If the teacher talks publicly while students are working individually or in groups during independent work (AS:WP, AS:WA, AS:CN, AS:IR), code as blank if the talk does not contain any information that is related to a theme. If the talk contains one of the other types of knowledge development, categorize according to that theme ONLY when the talk is directed toward the whole class and not toward an individual or group of individuals. If the talk is directed toward an individual or group, code the segment as blank.

Data are being generated but there is no talk that can be considered as public and intended for the whole class. Sometimes data are being generated in the classroom without any accompanying public discourse. For example, the teacher may be conducting a classroom demonstration and direct students' attention to a phenomenon that is being produced. During such demonstrations, there may be no public talk. Since coding focuses on the public talk intended for the whole class, leave these segments TBLNK if they meet the time requirement. The data that are being generated will be captured in the Dimension 4 coding as ASPPD and/or in Dimension 10 coding as a phenomenon.

D9.1.8 Marking In-and Out-Points for Knowledge Development Categories

Although you should refer to previous codings when coding Dimension 9, you should print out a new transcript for marking. Use brackets (i.e., **[ ]**) to mark In- and Out-Points within the text. Use horizontal lines to the left of the speaker column to indicate shift times and themes. See examples provided previously in the manual for more details.

D9.1.9 Additional Clarifications for Knowledge Development Types

Coding knowledge types in divided class (AS:DC) segments. Divided Class segments must contain at least 2 different tasks and two different activity structures (e.g., AS:WA + AS:WP, ASPDF + AS:WA, ASPDF + AS:WP). When coding AS:DC segments for themes use the following guidelines:

- Sometimes the teacher breaks the class into groups and assigns each group a different task. In such cases the teacher may talk with each group privately to relate the instructions of the task to them. In these cases code the initial instructions to each group according to theme. However, after students know what to do and are working the teacher may continue to provide assistance to different groups. Consider these interactions as TBLNK.

- Sometimes the teacher may call students up to the board to work on a problem while the rest of the students work at their desks. In these cases the teachers' interaction with the student or students is available to the rest of the class. In essence they have the option to participate through observation. We will consider these interactions as public (even though they may not be marked as such) and code according to theme.

Coding knowledge types as T:SAS, T:CANS, or T:CAN when the teacher uses an object to teach science**.** To identify the appropriate knowledge type, first determine whether or not the teacher is using the object to help students make a connection between science knowledge and their own experiences. To do this, two factors must be considered: (1) the "everydayness" of the object being used, and (2) how the object is being used inside the classroom. The more "everyday" the object appears, the less evidence is needed about how it is being used. The "everydayness" is the evidence of the teacher's intent to make a connection to student's lives outside the classroom. In such cases, it would take very strong evidence about how the object is being used to code its use as T:CAN. The less "everyday" the object appears, the more important it is to consider evidence about how the teacher is using the object to determine weather it should be coded as T:CAN, T:CANS, or T:SAS.

- "Everydayness" of the object. The more likely students are to make a connection between the object being used and something familiar to them outside the classroom, the more likely it is that the teacher is using it to help students make a connection to their own lives. For example, if the teacher uses a guitar to demonstrate something about sound, it is very likely that he is using the instrument to help students connect the science to something they know. Unless the teacher explicitly tells students not to focus on the everydayness of such an object, it would be coded as T:SAS or T:CANS (depending on the type of connection being made). Other objects may be so unfamiliar to students, or so commonly used as part of science teaching, that the mere fact that the teacher is using them would not necessarily mean she is trying to help students make a connection to their own lives. Batteries and bulbs are examples of these kinds of objects. These objects are so commonly used in the teaching of electricity that their use alone does not warrant coding T:SAS or T:CANS. Samples of minerals or pH paper would be examples of these kinds of objects. For these types of objects it becomes more important to consider how the teacher is using them.

- How the object is being used inside the classroom. When the teacher is using the object to teach the science, determine the knowledge type by asking: Is there evidence that the teacher is using the object to try to make the science more real, relevant, or applicable to students' lives outside the classroom? How much of a connection is being made to students' lives outside the classroom?

Chapter D10: Science Content Development

The purpose of this dimension is to describe how science content is developed and supported in the classroom. Part one of this section describes the density of publicly-presented canonical ideas. Part two presents the different kinds of evidence used to support the science knowledge: first-hand data, phenomena, and visual representations. Part three of the manual explains how to identify the main ideas in a lesson and how the different types of evidence are linked to these main ideas. Part four describes how challenging is the content of a lesson. Part five describes how the content in a lesson is developed: focus on activities or content, conceptual links, patterns of content development, and the source of the content organization.

The Dimension 10 codes are lesson-level codes. One category is applied to the entire lesson. Two coders will code each lesson individually and then working with each other to reach consensus for each code applied.

- Density of publicly-presented canonical ideas [Q2]
- Who collects first-hand data and where is it generated [Q8]
- First-hand data [Q8.2]
- Phenomena [Q17]
- Visual representations [Q11]
- Main ideas [Q1]
- Main ideas supported with data [Q6A]
- Main ideas supported with more than one piece/set of data [Q7]
- Main ideas supported with phenomena [Q4A]
- Main ideas supported with more than one phenomena [Q5]
- Main ideas supported with visual representations [Q9A]
- Main ideas supported with more than one visual representation [Q10]
- Difficulty and complexity [Q20]
- Scientific laws and theories [Q3A]
- Activity-focused or content-focused [Q18]
- Conceptual links [Q21]
- Patterns of content development [Q22]
- Source of content organization [Q19]

What to code for content development

All segments of the lesson that are not included in these codes should be considered for Dimension 10 codes:

- Dimension 1
  - Non-science (PH:NS)
  - Science organization (PH:ORG)

- Dimension 5
  - Reviewing previous content (F:RE)

Assessing student learning (F:AS1)
Administrative (F:ADM)
Assigning homework (F:HW1)

- Dimension 5
  Blanks that do not overlap with independent activity structures (BLNK)

D10.1 Coding Canonical Ideas, First-Hand Data, Phenomena, and Visual Representations

D10.1.1 Density of Publicly-Presented Canonical Ideas

Canonical ideas that are publicly presented include such knowledge as scientific facts, concepts, patterns in data, descriptions of natural processes, scientific models and laws, and theoretical explanations. This knowledge is canonical in the sense that it is an understanding that is generally shared by members of the scientific community. For example, a teacher draws a series circuit on the board and describes it. The teacher's public description represents a canonical idea about the path of electron flow traveling through a series circuit. In another example, a public canonical idea can be represented during a class discussion about data collected during independent work in which the class identifies the pattern that water is slower to heat up and faster to cool down than other substances. Public canonical ideas also can be evidenced in a chemical reactions video that students watch or during a discussion about atoms and molecules when the teacher asks students to explain how water appears on the outside of a cold soft drink can. The following are examples of publicly-presented canonical ideas:

Examples:

- "Gas pressure increases as we decrease volume because gas is composed of many tiny particles moving at great speeds."
- "An object at rest tends to stay at rest unless acted on by a new force."
- "Hertz is defined as the number of vibrations per second."
- "In all our experiments water alone took longer to heat up than water with copper."

<u>D10.1.1.1 Where to Look for Publicly-Presented Canonical Ideas</u>

Publicly-presented canonical ideas will be identified in segments marked T:CAN or T:CANS from Dimension 9 coding.

<u>D10.1.1.2 Density of Publicly-Presented Canonical Ideas</u>

To determine the density of the canonical ideas in the science lessons, we will examine how many canonical ideas are observed being publicly presented in the eighth-grade science lessons. Three levels of the density of canonical scientific ideas are defined as follows:

Q2 = 0 Low number of public canonical ideas -- A lesson that contains few, if any, publicly-presented canonical ideas. For example, a lesson with few canonical ideas might focus on understanding three different types of faults: the students read definitions of the three types of faults, engage in building models of the three types, and finally discuss their models. A lesson might have no publicly-developed ideas if the students spend the entire class period working independently on an activity or if the ideas discussed publicly are not canonical in nature (e.g. discussing ways to prevent diseases or different birth control strategies without reference to any scientific ideas that would explain why these behaviors either prevent disease or prevent pregnancy).

Q2 = 1 Moderate number of public canonical ideas -- A lesson that contains 7 to 14 distinct publicly-presented canonical ideas. For example, the main concept about why life exists on earth might include public discussion about why the earth has water and other planets do not, why the earth's atmosphere provides a relatively stable temperature range for life to thrive, and that the earth has a high percentage of oxygen. Each of these three canonical ideas might be supported by 3 or 4 other canonical ideas.

Q2 = 2 High number of public canonical ideas -- A lesson that is very dense with a high number of publicly-presented canonical ideas that includes at least 15 or more ideas. If the ideas were relatively complex and involved many components in developing the ideas, a lesson with 12 ideas also would be considered to be very dense with ideas.

Note: See lessons SNL045 and SCZ027 for examples of lessons with a high number of public canonical ideas, lessons SAU008, SUS008, and SUS056 for lessons with a medium number of public canonical ideas, and lessons SAU043 and SJP056 for examples of lessons with a low number of public canonical ideas.

D10.1.2 First-hand data [Q8, Q8.2]

First-Hand Data [Q8, Q8.2] are specific things or events that can be observed or measured directly. First-hand data may be presented as a single unit or one first-hand data point or a first-hand data set, which may include multiple first-hand data points. The first-hand data may be confirmed by measurement or other observation although not necessarily observed or measured in the class.

Examples

- individual volcanoes;
- individual stars, planets;
- actual rocks;
- specific weather events;
- measurements of pressure;
- individual circuits;
- individual sounds produced by an instrument; and

- the bile made the fat turn into small chunks.

D10.1.2.1 Questions about First-Hand Data

When you identify first-hand data, also code for the following:

Q8. Who collects data and where? Mark all that apply. *(Restrict to the person actually performing the physical manipulation; disregard verbal input from others)*

Q8 = 0 AS:WP, students only

Q8 = 1 ASPDF or ASPPD, students only

Q8 = 2 ASPDF or ASPPD, students and teacher

Q8 = 3 ASPDF or ASPPD, teacher only

Q8 = 4 Other (e.g., video, text, or other second-hand data source)

Q8 = 99 Does not apply (no data in lesson)

Q8.2. What Types of first-hand data are present in the lesson?

Q8.2 = 1 Illustrations and examples -- Things or events that are often used informally, linked to everyday objects or events in the real world, or used to make a phenomena, event, definition, or category real for students. Typically, they are used as representatives of a larger class of objects or events. This type of data is not used as evidence to support a scientific claim.

Examples:

- Teacher holds up cow's heart as an example of this category.
- Teacher hits a tuning fork while explaining how to tune a guitar by loosening or tightening the string until the pitch is the same as the tuning fork.
- Teacher holds up vinegar as an example of a common acidic substance; no measurements are taken or observation made that support the fact that vinegar is an acid.

Q8.2 = 2 Qualitative and/or quantitative data -- Measurements or observations of qualitative and/or quantitative data that are more formally generated or serve as evidence to support a scientific claim. Usually this occurs during a scientific experiment or demonstration.

Examples

- Measurements of current are used to support the idea that current is the same in all areas of a series circuit.

- Observations of plants in different conditions of light are used to support an idea about the role of light in photosynthesis.

- Teacher holds up a test tube with fat and water to illustrate the idea that fat floats on top of water.

- Teacher dips litmus paper into vinegar to support the idea that vinegar is acidic.

Q8.2 = 3 Both illustrations and examples and qualitative and/or quantitative data.

Q8.2 = 4 Does not apply or no data in lesson.

Special considerations and clarifications

- <u>Identifying first-hand data</u>. First-hand data can occur anywhere in the lesson. When coding for first-hand data, do not consider information on student worksheets or textbook pages unless they are made public. First-hand data need to be either physically shown or verbally discussed during the lesson.

- <u>First-hand data generated in a previous class</u>. Sometimes the class will discuss first-hand data that were generated in a previous class. If the first-hand data being discussed were generated first-hand in the previous lesson, consider the data first-hand in the present lesson.

- <u>When to group different first-hand data points and when to treat them as separate codes</u>. When first-hand data sets are presented as a whole, code the In-Point at the onset of the first-hand data reporting. Do not code for each individual first-hand data point, including segments when a table of first-hand data is presented, when teachers ask groups to report on their results by raising their hands, or when students publicly report on results one after another without any intervening ideas not involving first-hand data reports (i.e., no patterns or theory).

  Example

  The teacher asks students what happened during the AS:WP. She first asks one group what they found and then asks the rest of the students to raise their hands if they found the same thing. There is no other intervening knowledge type (e.g., pattern or theory) between the reporting of the group's results and the confirmation by the rest of the class. Code for first-hand data only once in this case. Code the In-Point at the first instance of the first first-hand data reporting.

- <u>Referring to first-hand data</u>. In addition to reporting first-hand data, sometimes teachers ask students to use first-hand data in forming a more general statement. For example, "Based on your observations during your lab, can you describe the relationship between physical activity and heart rate?" Code these types of references as first-hand data if (a) the reference is clear enough that you can reasonably assume students will know the first-hand data to which the teacher is referring, and (b) there is no explicit statement of first-hand data nearby. If there is an explicit reference describing the first-hand data, do not repeat the code. A vague reference to a previous lab activity or demonstration (e.g., "You should be familiar with this concept from our previous lab") is not specific enough to be coded as first-hand data.

- How much to include in first-hand data. A segment that includes both a statement of how the first-hand data were obtained and the result of that process should be coded as one piece of first-hand data (e.g., "The magnesium burned to produce a white smoke that dissolved in water to turn the indicator blue indicating an alkali”).

- First-hand data used for both illustrations and examples and qualitative and/or quantitative data. The same first-hand data may be used in different ways as an illustration and as qualitative and/or quantitative first-hand data. If both types of uses occur, code the first-hand data type as qualitative and/or quantitative [Q8.2=3].

D10.1.3 Phenomena [Q17]

Science is a study that is concerned with describing and explaining phenomena in the world around us. Scientists offer theories to explain phenomena as well as ways to catalog phenomena. In the science classroom, teachers often choose to enhance students’ understanding of science concepts by providing students with experiences with phenomena, either through first-hand observations or through vicarious experiences with phenomena (such as watching a phenomenon occur on videotape).

Phenomena [Q17] refers to a change event of scientific interest that students have the opportunity to experience. Teachers may provide these experiences either through first-hand observations or through vicarious experiences (e.g., watching a phenomenon occur on videotape). To be considered a Phenomena, the change event must be connected in some way to the intended science learning goals (i.e., science content) of the lesson.

Examples

- a chemical reaction,
- melting ice,
- observations of plants at different stages of development, and
- time-lapse photography of a natural event that would take longer than a class period to complete.

Students can experience a phenomenon that happens during the lesson. Some phenomena take place over long periods of time and cannot be observed occurring within a science lesson (e.g., formation of rocks, development of ecosystems, or plant growth from seeds). However, objects representing these longer-term or ongoing phenomena can be observed in the classroom (e.g., observations of rocks, observations of ecosystems, observations of plants at different stages of development, or observations of plants that have been growing in the light and the dark). Short-term and long-term phenomena may be experienced either first- or second-hand.

D10.1.3.1 Questions about Phenomena

To identify a potential phenomenon, indicate whether it is a simulated or a real phenomenon. This distinction will help describe the range of phenomena types teachers use during the lesson and will help determine whether or not the change event should be coded as a phenomenon.

Q17. What types of phenomena are present in the lesson?

Q17 = 1 Simulated phenomena. Change events of scientific interest that students experience second-hand or vicariously. Also models of phenomena may be used to simulate important features of a real change events.

Examples

- Students watch a car rolling down a ramp on a video.
- Students drop different size rocks into sand from different heights to simulate how craters are formed by meteorites.
- Students model how geological faults occur with clay.

Q17 = 2 Real phenomena. Change events of scientific interest that occur in the classroom and provide students with the opportunity to observe first-hand.

Examples

- a chemical reaction,
- an object floating or sinking, and
- ice melting.

Q17 = 3 Both simulated and real phenomena.

Q17 = 4 Does not apply or no phenomena in lesson.

Special considerations and clarification

<u>When all students cannot observe the change event</u>**.** The teacher may decide, because of the nature of the observation or the available materials, to have one or a few students make the first-hand observation of an event rather than all the students. Code this event as a phenomenon only if the results of the observations by one or a few students are shared with the rest of the class.

Examples

- A teacher asks one student to make the reading of electric current on the ammeter. This student then reports the reading to the whole class. In this case, one student's indirect observations of an event are shared with everyone.

- The teacher holds a vibrating tuning fork up to one student's earring and asks a student if he hears it. The student says “Yes” making public his first-hand observation of an event.

D10.1.4 Visual Representations [Q11]

Visual Representations [Q11] include showing, creating, or modifying/manipulating drawings, 3-Dimensional models, photographs, diagrams, tables, charts, concept maps, or other visual images to explain or describe science content. These visual images are representations used to help students imagine or better understand the real object or process by visualizing objects, processes, phenomena, data, concepts and their relationships to each other. Instead of observing the real objects or events, the students have the opportunity to observe, create, or modify visual images that help describe or explain the real objects or events. The visual images often include words along with some kind of organizing framework other than narrative text. For example, students observe a diagram or photograph of the human heart but not the real heart itself. A diagram can include arrows and words that help students visualize the process of blood flow and the movement of carbon dioxide and oxygen and the functions of these gases in the body. Thus, the visual representations highlight concepts and processes as well as the object.

Visual representations of objects, ideas, or concepts includes 2-Dimensional representations such as drawings, diagrams, maps, concept maps, and photographs and 3-Dimensional objects such as models.

Tables are included as visual representations only if the tables organize information in a definite, compact, and comprehensive form. The tables typically will have rows and/or columns with appropriate labels and borders.

The visual images must represent content that is being studied in the classroom. Sometimes the teacher may show a photograph that is related to the content but that is not a representation of the content idea. For example, the teacher may show a photograph of a cereal factory when comparing the leaf cell to a factory. Since the content that is being addressed is the leaf cell’s production of food but not a cereal factory, the photograph of the factory would not be coded as a visual representation. (Note: the photograph would be coded as T:SAS).

D10.1.4.1 Questions about Visual Representations

Q11. What types of visual representations are in the overall lesson?

Q11A = 1 3-Dimensional Models. 3-Dimensional representations of a science object (e.g., a plastic model of an atom, or models of human organs such as the heart or lung).

Q11B = 1 Graphic organizers. 2-Dimensional representations that organize information in a definite, compact, and comprehensive form including graphs, charts, tables and conceptual maps (e.g., flowcharts, bar charts, data tables, and line graphs).

Q11C = 1 Formula. Groups of symbols that represent scientific knowledge as mathematical statements (e.g., D=M/V).

Q11D = 1 Computer simulations. Computer images of scientific objects or processes.

Q11E = 1 Diagrams. 2-Dimensional representations that highlight concepts and processes as well as the science object. For example, a diagram of a human heart that includes arrows and words would help students visualize the processes of blood flow and movement of carbon dioxide and oxygen through the body, or a drawing of an experimental setting would help students visualize the various steps of the experimental procedure.

Q11F = 1 Other visual representations. Visual images that are not included in any of the above categories although they provide descriptions or explanations of the science knowledge (e.g., pictures and photographs).

D10.1.4.2 What is Excluded as Visual Representations?

- Analogies and metaphors -- Analogies and metaphors as representations will be coded as Real-World Connections,
- Projected images of something that is happening in the classroom (e.g., real-time video images of a teacher demonstration or overhead transparency projections of objects),
- Symbols for chemical elements, compounds, etc., and
- Text or words only.

Special considerations and clarifications

- Visual representations within videos or computer presentations. If a video is shown or a computer presentation is made (e.g., Power Point) that includes anything that fits the definition of a Visual Representation (e.g., tables, diagrams, concept maps, photo or video of real objects/events, etc.), treat each Visual Representation within the video or computer presentation as if the teacher or a student had been presenting the representation.

- Visual representations and real-life issues**.** Visual representations can occur during T:SAS (Dimension 9) segments. For example, the teacher draws a diagram of a flashlight to help students understand how a flashlight works.

- Visual representations and real phenomena**.** Visual representations and real phenomena are defined as mutually exclusive, that is, the event or object of interest is EITHER observed first-hand (the real phenomena) or experienced through a visual representation.

- Visual representations and simulated phenomena. Visual representations and simulated phenomena that are experienced through videos or through descriptions of experiments can occur simultaneously. For example, the teacher is describing an experiment that students have done in the past and to assist with this description he draws a diagram of the experiment on the board. The drawing on the board is a visual representation that is part of the simulated phenomena and related talk.

- Number of visual representations**.** When a visual representation is being generated, consider the source and the format when making decisions about the number of visual representations.

    Example of change in the source of visual representations:

    A lesson includes 440 Hz represented on oscilloscope produced by a tuning fork and 440 Hz represented on oscilloscope produced by a pitch generator. Code each visual representation separately. The representation produced by the tuning fork will be the first visual representation and the representation produced by the pitch generator will be the second visual representation.

    In situations where the source changes in terms of teacher or student(s), but the representation is the same, do not code each visual representation separately. Typically, this would occur in situations where the teacher is drawing a diagram on the chalkboard with no further changes and students then copy that same diagram in their notes and talk about "their" drawings. The visual representation is the same. However, if the teacher creates a visual representation and the students copy that visual representation but makes changes to the original representation in their notes, consider these as two, separate Visual representations.

    Example of change in the format of visual representations:

    Students are presented with a wave drawn on *chalkboard* and a wave represented on *oscilloscope*. Code each visual representation separately. The representation produced by the chalkboard will be the first visual representation and the representation produced by the oscilloscope will be the second visual representation because the formats for representing the wave differ (chalkboard verses oscilloscope). Students have multiple opportunities to witness the representation in different ways. Although identifying the format is not a follow-up question for visual representations, it is helpful to consider how the representation is being presented to students. Keep in mind, however, that students copying a representation in their notes, which was first drawn by the teacher on the chalkboard, should not be considered a separate visual representation even though the format is different. In this case, still consider the visual representation as the same (see previous example).

D10.1.5 Clarifications for Coding any Type of Evidence in the Lesson

(See sections D10.1.1 through D10.1.4 for coding specific types of evidence.)

Coding during Independent practical activities and Independent seatwork activities. If phenomena, data, and/or visual representations occur during AS:WP and AS:WA segments, mark the presence at the In-Point of AS:WP or AS:WA. If there are multiple phenomena, data, and/or visual representations that occur in that same activity segment, mark and number the unique ones also at the In-Point. Unique first-data, phenomena, and/or visual representations are ones that are not continuations or repeats of those already marked.

Coding T:SAS. First-hand data, phenomena, and visual representations will not occur very often in T:SAS segments due to the social theme of this knowledge type, but they can exist. For example, if the lesson content is about health and the teacher provides first-hand data on the number of AIDS victims around the world, we want to capture the use of first-hand data. However, we do not want to capture student responses to the question, “Who here likes electricity?” as first-hand data because this information is the opinion of the class, even though the opinion is measured empirically through the show of hands.

Coding T:PRO and T:SAF. First-hand data, phenomena, and visual representations will not occur very often in T:PRO and T:SAF segments. However, make sure there is no T:CAN content in these segments that would stand out as essential to the lesson and should be considered for coding first-hand data, phenomena, or visual representations.

Coding talk about scientific techniques that involve evidence. Sometimes teachers may talk about techniques to make observations, conduct experiments, or produce a phenomenon. These sections will be coded as T:PRO. Sometimes part of the information may be coded as T:CAN (e.g., because it involves identifying materials). If the information is about the technique, do not code it.

Example

The teacher is telling students how to manipulate the materials to prepare for the experiment. The talk is helping students set up an experiment. The talk about the color or the indicator and the fact that it indicates the solution is neutral could be considered a pattern but, in this context, is done for the purpose of showing students how to use the indicator as a data collection tool and then treating this information as data or pattern that is the object of study. Do not code the segment for evidence.

Time	Person	Transcript
09:31	T	I want you to put a piece in some water in the beaker. That's- oh, too much. About that much. And a few drops of universal indicator in it.
09:47	T	And you'll need to share those b- those big beakers of water with the be- with the bench beside you. Right, put the universal indicator in now.
09:56	SN	How many drops?
09:57	T	About four or five. Pass the water over please ladies. ... Right. When you put the universal indicator in, the universal indicator will be that color.
10:12	T	Right, that indicates that the unit- that the solution in there is neither acid nor alkaline, acid or basic. It is neutral. Okay. That's the green color.

<u>Identifying objects and materials for use in labs and demonstrations</u>. Teachers may identify objects and materials for use in labs and demonstration (e.g., “This is an ammeter”; “This is a deflagrating spoon”). Do not code if the identification is of scientific apparatus or if the identification is presented only to indicate that the material will be used. Code identification of materials for lab use only IF the teacher descriptions of the objects include scientifically relevant characteristics of the material (e.g., “This is the sulfur we are going to use; sulfur is a yellow powder”). Natural objects that are used primarily for identification will be coded. For example, if the teacher holds up a real liver and states “This is a liver”, code for data if the real object is there and low level pattern (i.e., the identification of the object as a liver).

Transcript	Decision
“This is an ammeter.”	Identification of scientific apparatus. Do not code.
“This is the steel wool we'll be using in our experiment today.”	Identification of material for use in lab. Do not code.
“This is the sulfur we'll be using. Sulfur is a yellow powder.”	Code the sulfur as data and the identification of it as a yellow powder as a pattern.
“This is a liver.”	Code for data if the liver is actually there. Low level pattern for the identification.

<u>Marking In-Points when first-hand data, phenomena, or visual representations occur prior to explicit statement of pattern</u>**.** When first-hand data, phenomena, or visual representations are linked to patterns presented prior to an explicit statement of the pattern, mark the In-Point for the pattern at the first statement of the pattern and *NOT* at the initial first-hand data, phenomenon, or visual representation linked to the data.

Example: SJP056

During a segment in the lesson, data are first generated at 19:16 (the In-Point of AS:WP) when students measure current in a series circuits at two points and determine the current is the same. The pattern associated with these data is not explicitly stated until after the AS:WP at 28:39. Code the In-Point for the pattern at 28:39.

D10.2 Coding Main Ideas

D10.2.1 Main Ideas [Q1]

A large part of doing science involves using experiences and objects from the real world as data, looking for patterns in these data, and using these data and patterns to form theoretical explanations about the nature of various natural phenomena. We can think of each of these categories (data, patterns, and theory) as different types of knowledge involved in doing science. Visual representations also play a key role in this process and are used both to represent and make connections among these different knowledge types.

This section describes the types of knowledge that are present in the lesson and how the teacher makes use of these knowledge types, phenomena, real-world objects, and visual representations to build Main Ideas during the lesson. After this information has been coded and linked to Main Ideas, use this information to code different patterns of development during the lesson.

Main Idea [Q1] is defined as a set of related knowledge outcomes or ideas that the teacher publicly develops, treats as a main idea of the lesson, and links together. Generally, a main idea is a broad description of smaller, related ideas that range in level of specificity. A main idea must be sufficiently developed by the teacher and not just a quick reference. A main idea must contain multiple ideas, and these ideas must be chunked together or linked to each other.

A main idea is a “big idea” that organizes related ideas and detailed knowledge outcomes. Keep in mind that such a “big idea” typically would be represented in an eighth-grade science textbook in one to three pages and include one visual representation. However, some textbooks might spend a whole chapter on that one big idea and have multiple tables, figures, and diagrams to accompany that idea.

In our science lessons, a main idea (big idea) could be addressed by a teacher in the lesson in about 10-15 minutes, accompanied by one example (a diagram or a demonstration, for example) or it could be the focus of an entire lesson. A lesson with only one main idea for the entire lesson will be a very coherent, focused lesson. A lesson with many main ideas indicates that the lesson is less coherent – fewer strong connections among ideas.

Keep in mind that it is also possible for a lesson to have <u>no main ideas</u>. This could happen in a review lesson where many ideas are individually reviewed but are not brought together into main ideas. This could also happen in a lesson where students are doing activities independently without having those activities linked to any ideas.

D10.2.1.1 Where to Look for Main Ideas

Most main ideas will be developed during public talk segments that were previously marked as CANONICAL segments. We also will consider independent work time and other knowledge themes when we identify main ideas.

Code for main ideas that occur only during previously coded segments of:	Do NOT code for main ideas during previously coded segments of:
Dimension 4: Science instruction (PH:SI)	Dimension 4: Non science (PH:NS) Science organization (PH:ORG)
Dimension 5: Developing new content (F:DE) Going over homework (F:HW2) Going over assessment (F:AS2)	Dimension 5: Reviewing previous content (F:RE) Assessing student learning (F:AS1) Administrative (F:ADM) Assigning homework (F:HW1)
Dimension 9: Canonical knowledge (T:CAN) Real-life issues (T:SAS/T:CANS) Classroom safety knowledge (T:SAF) Procedural and experimental knowledge (T:PRO) Nature of science knowledge (T:NOS) Meta-cognitive hotel (T:MET)	Dimension 9: - Blanks that do not overlap with independent activity structure (TBLNK)

NOTE: If classroom safety, nature of science, meta-cognitive, or procedural and experimental knowledge are addressed in passing and are not linked to a larger main idea, they will NOT be marked as main ideas. They will also NOT be marked as Orphan Ideas (see below for more detail). Orphan Ideas are those ideas that are not developed by connecting them to other ideas or by spending considerable time on them. These are single ideas that are useful for code development but not coded as a main idea in the lesson; they help provide information when making judgments about codes.

D10.2.1.2 Criteria for Main Ideas

Think of the main idea as an umbrella being held by the teacher. Any ideas that the teacher brings under the same umbrella are part of the same main idea. These smaller ideas can range in level of specificity and organization. For example, you may identify an idea as a small unit of knowledge, or fact (e.g., “Iron is a metal”). You also may identify an idea as a larger concept (e.g., “metals have physical properties”). It does not need to be limited to canonical knowledge. An idea can be a skill (e.g., knowing how to use a Bunsen burner), a scientific habit of mind (e.g., being skeptical of data), a classroom safety issue (handling acids in safe and appropriate ways), or any other knowledge theme *as long as it meets the requirement of being a set of linked ideas that is a main focus of the lesson.*

Whatever the idea, groups of related ideas form a main idea. The main idea is typically more comprehensive—a larger, coherent understanding that encompasses multiple ideas that are related by a common thread (e.g., topic, theme, or characteristic). For example, "Metals and non-metals can be distinguished by their chemical properties."

Main ideas must satisfy the following criteria:

- A main idea must be composed of multiple ideas or knowledge outcomes that are developed by connecting them with each other**.** An idea or knowledge outcome is "developed" if it is connected or linked to other ideas. If the teacher states an idea but it is not linked to any other ideas, then it is an Orphan Idea. Orphan Ideas are those ideas that are not developed by connecting them to other ideas or by spending considerable time on them. Thus, ideas that are mentioned in passing but that are not connected by the teacher to other ideas will not be part of main ideas (these will probably be marked as Orphan Ideas; see below). And a main idea cannot be composed of just one idea.

- A main idea must be sufficiently developed in the lesson**.-**To determine if an idea is sufficiently developed, look at the smaller ideas that represent the potential main idea to determine if one or more of the following occurs. If yes, the ideas constitute a valid main idea, that is, the main idea would be considered sufficiently developed. If not, the individual ideas that are not developed will not constitute/belong to any main idea.

    - The component ideas occur repeatedly throughout the lesson,
    - The component ideas are talked about for long periods of time,
    - The component ideas are demonstrated in different contexts, or
    - The component ideas are highlighted or summarized by the teacher.

- A main idea must reflect how the teacher organizes ideas**.** The main ideas should reflect what we see in the lesson, not what an educated observer might see as a possible interpretation of the main ideas.

- A main idea must include all ideas that the teacher links to it**.** During the coding process, if you identify two candidate main ideas in the lesson and then see that the teacher links the two main ideas with an explicit statement(s), code these candidates as one main idea. You may need to reconsider which is the more central, comprehensive idea that is being developed and that idea will be coded as the main idea. Ideas that are linked by the teacher must be located together in the same main idea. The only exception is when the teacher's link is made only very weakly and during most of the lesson he/she treats the two ideas separately.

- A main idea will not occur in previously marked review previous content or assessing student learning phases of the lesson (Dimension 5)**.** In these segments, we assume that the teacher is reviewing many ideas rather than trying to develop big ideas.

- A main idea will not occur in previously marked non-science or science organization segments (Dimension 4), or in administrative or assigning homework phases of the lesson (Dimension 5).

D10.2.1.3 How to Code for Main Ideas

Step 1: Create transcripts with your partner.

- Examine coding from Dimension 5
    - Create a hard copy transcript that marks all review previous content and assessing student learning segments; label as review previous content and assessing student learning.
    - Mark off all administrative and assigning homework segments on the hard copy transcript. Mark as NRI (not related to main ideas).
- Examine coding from Dimension 4:
    - Mark off all segments of **PH:SO** and **PH:NS** that are not already marked off as NRI (not related to main ideas). Label them as NRI.
    - Make notes on the transcript of In-and Out-Points of all independent activities (**AS:WA, AS:WP, AS:CN, AS:IR,** and **AS:DC**).
- Make two copies of this transcript, one for each partner.

Step 2: Identify ideas or knowledge outcomes in the lesson individually.

Remember that an idea could be a small unit of knowledge (knowledge outcome), a larger concept, a skill, a thinking practice, or other learning objective or outcome. It is helpful to identify all the ideas as they occur chronologically in the lesson. In this way, you can start to discover a pattern in the ideas to see if they are related and possibly form a main idea.

Use the worksheet form to list in chronological order brief summary descriptions of the main ideas/knowledge outcomes for the lesson. In formulating these summary statements, use the teacher's words as much as possible.

Example: SNL008

Person	Transcript	Summary Descriptions
T	If we have a look, how is it that I make a sound and that you can hear it? So a few things must be present for this. In the first place there has to be a source.	There needs to be a source for sound.
T	As I am talking now, something happens in the throat. Maybe you saw that some time, how it works. But in my throat and in your throat, there are vocal chords.	There are vocal chords in the throat.
T	Those vocal chords are really like strings, right? They can vibrate. When you talk, air comes from the lungs and passes along those vocal cords. The vocal cords are made to vibrate and that produces sound.	Vocal chords are like strings. The air that comes from the lungs passes the vocal cords and vibrates, which produce sound.

<u>Step 3: Organize the ideas or knowledge outcomes individually into Main Ideas</u>

Once you have identified the multiple ideas in a lesson, review the lesson to determine if and how these ideas are connected by the teacher and/or students. For instance, in SNL008, the ideas identified in the example above (along with other ides in the lesson not shown here) were all connected to how sound is produced and heard. Therefore, the main idea can be phrased as: To produce and hear sound, you need a source (such as vocal cords), a medium for the sound to travel in (air), and a receiver (ear). This main idea organizes the individual ideas into a coherent meaning and reflects how the teacher organized these ideas.

Phrasing the wording for the main idea may sometimes prove difficult. You may be able to identify the topic of the big ideas, but find it difficult to phrase the ideas into a comprehensive statement. Consequently, a main idea can be phrased according to topic, followed by a list of ideas to help illustrate the big idea. For example, the main idea for a lesson on atoms might be the structure of the atom: The atom is comprised of neutrons, protons, and electrons; the neutrons and protons are located in the nucleus; and the electrons are located in energy clouds.

Keep in mind that the main idea is what the teacher is trying to help students develop in the overall lesson (i.e., a big idea). The teacher may focus the entire lesson on a relatively simple idea and not something necessarily comprehensive and all encompassing. For example, a teacher may spend a lot of time talking about a straightforward idea, “saliva takes part in digestion”, which may be considered a simple fact or concept, but the teacher may center the entire lesson on this idea: discussing the digestive system, lecturing about the saliva, highlighting the role of enzymes, having students work on a practical that involves the breakdown of simple starches and the use of indicators, etc. The big idea is one, relatively simple fact. The main idea is: saliva takes part in digestion.

Although it is not necessary to phrase each main idea to be exact for coding purposes, it is helpful for each partner in the coding pair to have a clear understanding of what the big ideas are in order to mark In- and Out-points.

Step 4: Come to consensus on main ideas with your partner.

Once you have identified the main ideas and Orphan Ideas, discuss the lesson with your partner. Be prepared to present your suggested main ideas and Orphan Ideas with a rationale that can be supported by specific points in the lesson (e.g., time, location, words, etc.). Pay special attention to the amount of talk spent by each partner so that one person is not necessarily dominating the conversation. The final main ideas and Orphan Ideas need to be agreed upon by both members.

Special Considerations and clarifications for main ideas

- How to code lessons that are primarily independent work lessons. Some lessons involve very little public work. Instead, students work independently for most of the lesson. Such lessons are not necessarily organized around publicly-developed main ideas. For these lessons, consider first whether the teacher (or the materials that students are reading together publicly) publicly provides a conceptual framework for the activity, either before or after the activity, that links the activity to some big idea beyond topic level. Even if the teacher does not spend much time on this idea development, describe it as a main idea in this situation.

  If the teacher simply tells students to get to work on the assignment or reminds students what to do (procedures) or how to do it (social organization), mark "0" (zero) main ideas.

  If the teacher mentions a science idea, but it is not clearly linked to the lesson activity or it addresses only one small part of the activity, code these as Orphan Ideas. DO NOT identify main ideas based on materials in students' handouts/textbooks (questions they are answering) unless these are discussed publicly at some point in the lesson.

  Example: SUS049

  Prior to continuing work on building rockets, the class discusses a homework assignment about making decisions about who they might want to take with them on a mission to Mars. There is also administrative talk about an upcoming field trip. This is all coded Administrative or Going over homework. The only talk related to the rockets is as follows.

Time	Person	Transcript
00:11:06	T	Get everything out, let's go. Get to work on your rockets please.
00:10:50	T	Now, we have lots and lots and lots of rocket work to do.

  Coding decision: Code as no main ideas.

Example: SNL060

Teacher tells students how to get to work without linking the activities to ideas, even at the topic level.

Time	Person	Transcript
00:12	T	On the computer will work: Ruurd with assignment A, Theo with assignment B, Arend with assignment C and Clemens with assignment D.
00:30	T	Then, Douwe with assignment D. Douwe, I will put down the answer sheets shortly; the others just continue on. I'll be back in a minute.

Coding decision: Code as no main ideas.

Example: SUS006

Students are continuing with their work on constellation maps (started in previous lesson). There is a short Presentation/Discussion segment before they start to work. During this brief public time, the teacher mostly gives procedural instructions about the activity, including the following.

Time	Person	Transcript
00:43	T	As far as Aquarius, Pisces, Taurus and all the zodiac signs, what I want you to do is in between the months on your map I want you to place the signs.
00:52	T	On page twenty-one…in your book, gives all the zodiac signs for those - for those months, okay? I put the dates up there and just cross reference.

Coding decision: This talk does not include any clear knowledge outcome statement and it refers to only one small aspect of the activity. Do not code as a main idea.

At 00:09, the teacher publicly states one idea that plays a central role in the activity. It is repeated many times as the teacher interacts with students while they are working independently.

Time	Person	Transcript
00:09	T	Little Dipper, so when we're plotting our constellations today, we're - what are we going to use as a beacon to locate the other constellations? The Little Dipper.

Coding decision: Even though this statement is brief and not repeated publicly, it is an idea that is linked to the activity and is repeated many times during the private work. Code as a main idea.

- <u>How to treat TBLNK segments that are left over from independent work</u>. When marking In- and Out-Points for Main ideas, consider TBLNK segments coded in Dimension 9 only if they are Independent Activity structures (i.e., AS:WA, AS:WP, AS:IR, AS:CN, and AS:DC). If the TBLNK segment continues beyond the end of the independent work, rely on the Dimension 9 coding and leave that segment blank (uncoded) regardless of the time duration.

  Examples: SJP056

  - Students are measuring I_1 in a series circuit that has 1 battery and 1 bulb. The AS:WP occurs during 19:16-23:17, but the entire TBLNK segment occurs from 19:16-23:25. The left-over TBLNK (23:17-23:25) will remain uncoded for main ideas.

TBLNK	19:16	*Students are measuring I_1 in a series circuit that has 1 battery and 1 bulb (**AS:WP**: 19:16-23:17)*	Main idea 1
	23:17	Okay, since it looks like this done, this time, one more time. This time. Okay, you know what it is already right?	
T:PRO	23:25	The electric current that flows in. Do this side this time.	Main idea 1

  - Students are measuring I_2 in a series circuit that has 1 battery and 1 bulb. The AS:WP occurs during 23:58-27:35, but the entire TBLNK segment goes from 23:58-27:55. The left-over TBLNK (27:35-27:55) lasting 20 seconds will remain uncoded for main ideas.

TBLNK	23:58	*Students are measuring I_2 in a series circuit that has 1 battery and 1 bulb (**AS:WP**: 23:58-27:35)*	
	27:35	Okay, it looks like everyone's done. Okay. Hey, one person in each group, look over here. One person lift this up like this and show it to me for a moment. Lift it up so that I can see it like this. Okay, hold this for a moment okay. Okay, okay. Starting from the back. Let's see.	
T:CAN	27:55	Two hundred and? Two hundred and huh? Hoshi-kun's group has two hundred and?	Main idea 1

<u>D10.2.1.4 Questions about Evidence Used to Support Main Ideas</u>

Q4a. How many of the Main Ideas are supported by a Phenomenon?

Q4a = 1 None
Q4a = 2 One to Some
Q4a = 3 Most
Q4a = 4 All

Q5. How many of the Main Ideas are supported by more than one Phenomenon?

Q5 = 1 None
Q5 = 2 One to Some
Q5 = 3 Most
Q5 = 4 All

Q6a. How many of the Main Ideas are supported by First-hand data?

Q6a = 1 None
Q6a = 2 One to Some
Q6a = 3 Most
Q6a = 4 All

Q7. How many of the Main Ideas are supported by more than one piece of First-hand data or First-hand data set?

Q7 = 1 None
Q7 = 2 One to Some
Q7 = 3 Most
Q7 = 4 All

Q9a. How many of the Main Ideas are supported by Visual Representations?

Q9a = 1 None
Q9a = 2 One to Some
Q9a = 3 Most
Q9a = 4 All

Q10. How many of the Main Ideas are supported by more than one Visual Representation?

Q10 = 1 None
Q10 = 2 One to Some
Q10 = 3 Most
Q10 = 4 All

D10.3 Other Codes [Q20]

D10.3.1 Difficulty and Complexity

Q20 Overall judgment of difficulty and complexity of information in the lesson

Review the overall information in the lesson and apply one of the following codes. Are the ideas challenging, difficult, or complex for eighth-grade students?

Q20 = 1 Simple and basic information for eighth-graders (would expect that even younger students could understand the information).

Q20 = 2 Mostly simple and basic information with some more challenging, difficult, or complex information.

Q20 = 3 A mix of simple, basic ideas and more challenging, difficult, or complex ideas.

Q20 = 4 All or mostly challenging, difficult, or complex information for eighth-graders.

Q20 = 99 Can’t tell.

D10.3.2 Scientific Laws and Theories [Q3a]

Q3a. What level of knowledge types are represented in the lesson?

Patterns and Theories [Q3a] describe how nature acts under certain conditions and will predict what will happen as long as those conditions are met. Patterns can predict a large range of phenomena and/or contexts; these are typically considered scientific laws. However, patterns can also include definitions, facts, characteristics, equations, or limited generalizations. Theories are often broader and more abstract. They provide explanations for why patterns hold true.

Q3a3. How many Scientific Patterns are represented in the lesson?

Q3a3 = A No scientific patterns represented in the lesson.
Q3a3 = B One or some scientific patterns represented in the lesson.
Q3a3 = C Mostly scientific patterns represented in the lesson.
Q3a3 = D All scientific patterns represented in the lesson.

Examples of scientific patterns:

- D = M/V.
- Sedimentary rocks have layers.
- An object at rest tends to stay at rest unless acted on by a new force.
- Plants make their own food.

Q3a4. How many Scientific Theories are represented in the lesson?

Q3a4 = A	No scientific theories represented in the lesson.
Q3a4 = B	One or some scientific theories represented in the lesson.
Q3a4 = C	Mostly scientific theories represented in the lesson.
Q3a4 = D	All scientific theories represented in the lesson.

Examples of scientific theories:

- The vibration of molecules causes sound.
- Electricity is the movement of charged particles.
- Atoms can lose, gain, or share electrons to have 8 valence electrons.
- Without plants as primary producers, there would be no life on Earth.

Special considerations

Conventions. Information that gets developed in a science class may include ideas or knowledge outcomes that are not dependent on data to be proven true or false. These are pieces of information that are based on tradition, convenience, or historical precedence and not related strictly to scientific practice (e.g., “That's just the way it is”; “That's the way it always has been done”; “That's what it is called”). Do not code for conventions. Conventions may sometimes be connected to other knowledge types. In such cases, include the convention in the coding of the other type of knowledge.

Examples

- Names of scientific apparatus (e.g., “This is called an ammeter”; “This is a deflagrating spoon”).
- Symbols (e.g., “The symbol for Hertz is Hz”; “The symbol for calcium is Ca”).

Definitions and formulas**.** Some definitions and formulas may appear to be conventions but, unlike conventions, they can be experimentally tested and describe relations that can be tested in the real world. For example, D = M/V describes the relationship between mass and volume as density. This is different from assigning a label (e.g., "We call this a deflagrating spoon"). Consider such formulas and definitions as scientific laws.

Incomplete theories**.** It is not necessary to identify a theory in its entirety to code for the presence of theory. A theory is rarely completely discussed in a lesson. Any idea that contains a part of a theory will be coded as theory.

Theoretical explanations vs. Laws used as explanations**.** Not every explanation is a theoretical one. In fact, often in lessons data are explained with scientific laws. The examples below illustrate this difference. While they are phrased as explanations in a conversational sense, the content of the statements fits most accurately into the category of scientific law described above.

Examples

- The brightness of the bulb increased because I added more batteries.
- The reason the gas pressured increased is because the volume was decreased.

<u>T:CAN information that is used to justify a technique</u>. Sometimes T:CAN information will be used to provide a rationale or justification for why a technique should be done a certain way. This information may seem like a theory. If the information is used to help students better *use* the tool or technique, consider the information as technique and leave blank. If the information goes beyond justification of the technique (e.g., if the teacher goes into some aspect that does not help students to use the tool), consider that part of the information as eligible for coding.

Example: SJP056

The teacher is leading a discussion about how to put the ammeter in the circuit to measure the current. In the context of this discussion, the teacher explains (at 16:14) what a series circuit is. Knowing what a series circuit is serves the purpose of helping students know how to do something (i.e., how to attach the ammeter to the circuit). Consider the information as technique and leave blank.

Time	Person	Transcript
16:00	T	Hm? How do you put it in? In relation to the circuit, did I teach you how you put it in? Kagawa-san.
16:12	SN	As a series circuit.
16:13	T	In a series. A series means that there is only one path right? One path. There are no forks in the road, Okay? There are no forks in the road.
16:21	T	So if it comes like this, it goes, goes, through like this because it doesn't split. So it would be fine if you inserted it here. This is the reason.

<u>When to count writing as an In-Point for a scientific law or theory</u>**.** Sometimes teachers may write information that could be considered as a scientific law or theory before they state the information publicly. In these cases, the act of writing the information should be considered as an In-Point ONLY if it is clear that the teacher wants students to attend to what is being written.

Example

In the example below, the teacher writes the statement of the pattern on the blackboard before he explicitly states it. He explicitly tells students to pay attention to what he is writing at 44:29. Mark the In-Point of the pattern at 44:29.

Time	Person	Transcript
44:22	T	Hey, pay attention over here. Pay attention. Ready? [T is writing on blackboard]
44:38	T	Oh, I made a mistake.
44:52	T	In a series circuit.
44:57	T	In a series circuit. How should I continue this sentence? Huh? In a series circuit? What should I say? Who knows?
45:13	T	This is difficult. In a series circuit.
45:34	T	In a series circuit, the electric current is equal anywhere. Okay?
45:39	T	This means that the electric current that flows through a series circuit is equal anywhere. In a series circuit the electric current is equal anywhere.

D10.4 How Content is Developed and From What Source

D10.4.1 Activity-focused versus content-focused lesson [Q18]

Q18. Is the lesson activity-focused or content-focused?

A lesson that is activity-focused means that students are doing activities without the opportunity to learn science content. The teacher focuses students' attention primarily on an activity, whether it is part of a whole-class practical activity [ASPPD] or independent practical or seatwork activity [AS:WP or AS:WA]. The activity does not require that students be physically involved. They can be observing an activity and still be engaged in that activity *or* in learning about a procedure.

A lesson that is content-focused means that students have the opportunity to learn science content. The teacher provides students with the opportunity to learn science content knowledge through whole-class instruction or an independent activity. Not all lessons that have activities will be considered activity-focused. Content-focused lessons may have activities that help develop some information, such as canonical knowledge. In those content focused-lessons, the *primary* focus is on the knowledge to be gained *by means of doing* the activity. Activity-focused lessons concentrate *primarily* on the activities themselves.

Q18 = [0]	Content-focused, learning science content
Q18 = [1]	Activity-focused, doing activities without the opportunity to learn science

Examples of content-focused lessons

- The teacher presents information about plate tectonic theory throughout the entire lesson (canonical content).
- Students work independently on a set of questions and problems about force throughout the entire lesson (canonical content).
- The teacher leads students through a series of simulation activities to demonstrate the relationship between population density and food supply (canonical content).
- Students examine the pros and cons of becoming an organ donor (societal issues content).
- Students learn about fair tests and control groups, and use this knowledge to design and carry out investigations (nature of science content).

Examples of activity-focused lessons

- Students learn the formula for density (D=M/V). For the rest of the lesson measure the mass of different objects and their volume and use these values to calculate the density. The primary focus of the lesson is not on the density of the different objects but on *how* to use the formula to determine mass.

- Students are learning how to classify things. In ASPDF, they describe items in their bedrooms and generate shared categories based on what everyone says. They also generate categories for which to classify different buttons during AS:WP. This lesson is activity-focused because the teacher primarily focuses students' attention on *learning about a procedure*: how to classify items, not because there are multiple activities (one activity in ASPDF and one activity in AS:WP).

- The teacher starts the class by talking about a hypothetical mission to Mars. The students then spend the entire rest of the class building rockets in an AS:WP. This lesson is activity-focused because the attention is on <u>building</u> rockets, not on knowledge about rockets (e.g., heat-resistant tiles, rocket propulsion, etc.).

If a lesson is focused on doing a worksheet, determine if the teacher is focusing students' attention on the knowledge contained within the worksheet, or just on completing the worksheet. In the latter case, the lesson would be coded activity-focused.

If a lesson has some parts that are activity-focused and some parts that are not, judge which of the two parts is more characteristic of the lesson. Consider time spent, number of activities, highlighting statements by the teacher, whether the activity is "filler" to use up extra time in a lesson, etc. Does the teacher focus students' attention primarily on an activity or procedures to be learned, or on the content or knowledge to be learned?

D10.4.2 Conceptual links [Q21]

Q21. Conceptual links

Coherence is judged by considering the lesson as a whole. Disregard segments with reviewing previous content (F:RE Dimension 5) since many of these sections are inconsistent with the new information being presented.

Q21 = 1 The lesson is coherent at the topic level only with no conceptual links -- The information presented in the lesson is related by one topic. The lesson may include activities, but the overall lesson focuses on a single, overarching topic with multiple components describing or illustrating that topic. There are no conceptual links that bring the components together. Information is presented but is not tightly connected by interlocking ideas. Framing statements may be a helpful indicator for coherence. A framing statement that exists at a general level of organization (e.g., "Today we are going to be learning about the heart"; "We're going to be make models of the solar system, using our information cards for each of the nine planets"; "We investigated different types of forces") may help identify the topic of the lesson, but careful examination reveals there is little to no conceptual connection among the different pieces of information. A lesson coded as "1" may have multiple main ideas and some orphan ideas (see SNL008 and SNL012 for examples).

Q21 = 2 The lesson is coherent by one topic and weak conceptual links -- The information presented in the lesson, including activities, is connected by a common topic plus some conceptual links or conceptual links that are weak. The lesson goes beyond topic coverage to include a few concepts that tie different information together. The teacher presents a storyline that students can follow with a few ideas build on one another. The overall lesson, however, is not considered to be a tight, compact lesson that is obviously coherent. Framing statements may provide more conceptual organization with a specific storyline (e.g., "Today, we are going to learn how blood travels through the heart"; "We're going to make models of the solar system and learn how distance from the sun affects planets' temperatures"; "We investigated the effect of gravitational force of objects with different mass"). The storyline must still be apparent throughout the lesson. A lesson coded as "2" would have a multiple main ideas and few orphan ideas (see SNL045 for an example).

Q21 = 3 The lesson is coherent by multiple topics and weak conceptual links -- A lesson may have two (or more) main topics with separate and somewhat distinct information. The information is coherent with conceptual links within its own topic. A lesson may have separate framing statements throughout the lesson, providing multiple storylines. A lesson coded as "3" would have multiple main ideas and few orphan ideas (see SNL057 and SUS008 for examples).

Examples

- Lesson SNL057 presents two topics about digestion: teeth and digestion. Although the students are working with a textbook that includes teeth as part of the chapter about digestion, the teacher does not make a strong connection between the two topics. The teacher largely focuses on dental procedures (e.g., crowns, root canals, and false teeth). He comments about the restoration of the chewing function, and states at 10:18, "But the chewing is necessary, we already saw that, with the digestion procedure so that process goes smoothly." This statement, although an interlocking idea that bridges the topic of teeth and digestion together, is a single, weak conceptual link. The teacher does not carry this point out in further detail, nor does he emphasize this point at later points in the lesson. This lesson would be coded as "3" having two topics with information that are distinct but still coherent.

- Lesson SUS008 is a lesson about two topics, electric charge and lightening safety, even thought the teacher stated the lesson sis about electricity. She states at 4:01, "First thing we're gonna do today is an activity on lightening." The activity is rubbing different surfaces with a silk scarf to produce positive and negative charges to see their effects. The only connection between this activity and information about lightening is that lightening is built of electric charges, which they read on their worksheet. There are no strong, conceptual links throughout the lesson that would sufficiently connect the activity about electric charges to the lecture about lightening safety. This lesson would be coded a "3" because it has two main topics and the information is coherent to its respective topic.

Q21 = 4 The lesson is coherent by one topic and strong conceptual links -- The information presented in the lesson, including activities, is strongly connected by one topic and strong conceptual links. There is one, clear storyline that students can easily follow. The information presented consists mostly of interlocking ideas where one idea builds on another, but not necessarily in linear fashion. The lesson is tight and compact, with a strong conceptual thread that weaves the entire lesson into an organized whole. A lesson coded as "4" would have a single main idea and few if any orphan ideas. Framing statements provide a clear storyline which the teacher maintains throughout the lesson (see SAU008 and SCZ056 for examples).

D10.4.3 Patterns of Content Development [Q22]

Q22. Patterns of content development

Codes that identify patterns of content development are lesson-level codes based on segments that are eligible for Dimension 10 Main Idea coding (see section 10.6 above). Assign only one code that captures the primary pattern used by the teacher to develop the content of the lesson.

<u>Making Connections</u>. Content is developed by making connections among experiences, patterns, and/or explanations. The class is engaged primarily in "sense making about patterns in experience". Reasoning is pattern-based. The class is engaged in recognizing, explaining, using patterns in the data. The focus of the lesson may be on building a case(s) or constructing/deconstructing an argument. This type of development is characterized by making connections across knowledge types (e.g., data, patterns, and theories). Not all knowledge types have to be present for this type of development to exist.

Q22 = A Inquiry or Inductive reasoning -- Constructing explanations from patterns in experience. Making connections from data to patterns to explanations.

Q22 = B Application or Deductive reasoning -- Using scientific patterns and theories to describe, explain, predict, or design. Deconstructing a larger construct or verifying a "big idea". Moving from explanations to patterns to data.

Q22 = C Unidentified approach -- Content is developed by making connections but can't determine what type.

Acquiring Facts, Definitions, and Algorithms. Content is developed by involving the class primarily involved in learning about science as a set of facts, definitions, sequences, and/or problem-solving procedures. Reasoning is generally linear and information presented as pieces.

Q22 = D Discrete bits of information -- Information is presented as isolated and unrelated definitions, facts, processes, and/or problem-solving procedures. One indicator of a pattern presenting discrete bits of information would be a lesson with many orphan ideas.

Q22 = E Linear reasoning -- Information is presented as problem solving (e.g., Question -> steps to answer it - > answer). For example, learning the steps to balance chemical equations would fit a linear reasoning pattern. Learning how to calculate density from Mass and Volume would also be considered linear reasoning. Open-ended questions that require complex thinking would not fit this definition. For example, the teacher starts the lesson by asking "I wonder which direction electricity flows. That's our problem for the day". The teacher then leads students through a series of experiments where they generate data to answer this question.

Q22 = F Sequences of events -- Information is presented as facts describing processes or stages, for example, a description of the path for which blood travels through the heart.

Q22 = G Unidentified approach -- Content is developed by acquiring facts, definitions, and problem-solving procedures but can’t determine what type.

Notes for patterns of content development**.** Use the space on the codesheet after item 22 to document your decision regarding the mode and pattern of content development for the lesson. Try to summarize the idea(s) from the lesson, the approximate time in the lesson, the mode and pattern of content development, and any information that helps you determine whether or not the mode and pattern are substantive. See the example below.

Example

Time	Ideas and activities	Mode / Pattern
5:00 - 5:30 6:00 - 20:00 25:00 - 35:00	ASPDF -- Definition of circuit, parallel and series. AS:WP, ASPDF -- Students add bulbs and batteries to series circuit to determine influence. Post-lab class discussion of data. Adding bulbs in series decreases brightness adding batteries increases brightness. ASPDF, AS:WA -- Teacher explains Ohm's law pointing out that if you know the relationship between voltage, resistance and current, you can solve for one of them if the other two are known. Students complete worksheet of problems where they find the unknown using Ohm's law.	Discrete bits, precursor to lab, not substantive Inquiry/Inductive (Data --> Pattern) (primary) Linear reasoning (secondary)

D10.4.4 Source of content organization [Q19]

Q19. Source of content organization

Identify the primary source that determines how the information in the lesson is organized. Base your judgment on time spent for each source. Review all available scanned materials.

Q19 = 1 Textbook/Workbook: Explicit -- The lesson is significantly influenced by a textbook or a workbook. Students know they are supposed to be following along with the information presented in the textbook/workbook. The teacher makes this clear by publicly referencing parts of the textbook/workbook, such as a page number, problem, or figure, during the majority of the lesson. The organization of the content observed in the lesson is different from that presented in the textbook, workbook, or worksheet, or there is no textbook, workbook, or worksheet used.

Q19 = 2 Textbook/Workbook: Implicit -- The lesson is significantly influenced by a textbook/workbook, but it is not made public. No reference made is made by the teacher or students that they are referring to information from a textbook/workbook. It is apparent that the source of content is a textbook/workbook only after having examined the additional, scanned materials for the lesson.

Q19 = 3 Worksheet -- The class closely follows the information in a worksheet (e.g., a handout or lab protocol) for a large part of the period. A typical worksheet contains directions for how to carry out a practical activity or a set of questions or problems for students to answer. This category was created to capture and distinguish the use of print materials that primarily guided the lesson from the use of textbooks or workbooks. The worksheet can be commercially produced or produced by the teacher.

Q19 = 4 Teacher -- The source of the content organization is largely determined by the teacher during the lesson. For example, the class listens to the teacher, observes the teacher, follows the teacher's directions, has discussions with the teacher, or reads teacher materials that are different from the textbook, workbook, or worksheet. The organization of the content observed in the lesson is different from that presented in the textbook, workbook, or worksheet, or there is no textbook, workbook, or worksheet used.

Q19 = 5 Students -- The source of content organization is largely influenced by the students. This occurs in lessons where students play a central role in the development of new ideas (e.g., student presentations, design of own experiments, or independent research). Although not common, students in these lessons contribute many of their own ideas and/or experiences that result in significantly impacting the overall lesson.

Q19 = 6 Other source -- The content organization comes from some outside source such as a video.

Q19 = 7 More than one source -- More than one source that significantly influences the lesson *but no primary source can be determined*. If a primary source can be determined, code the source of the information in the lesson as that particular category.

Chapter D11: Types of Independent Practical Activities and Motivating Whole-Class Activities

D11.1 Types of Independent Practical Activities

This set of codes asks additional follow-up questions regarding Independent Practical Activities (AS:WP - Dimension 4). The codes in this dimension are organized as questions. Some of the questions ask only about events occurring during AS:WP segments while others apply to the whole lesson.

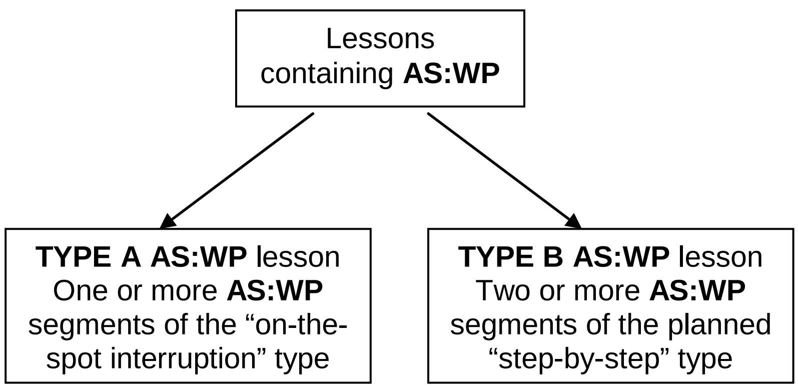
- Type of lesson with practical work [TYPE]
- Set-up talk [Q1]
- Purpose of practical activity before first segment [Q2]
- Relationship between multiple independent practical activities [Q3]
- Purpose of practical activity before last segment [Q4]
- Discussion of results [Q5]
- New questions to investigate are discussed or mentioned [Q6]
- Methods are critiqued or evaluated [Q7]
- Lab involves setting up for next lesson [Q8]
- Lab involves wrapping up from previous lesson [Q9]
- Lab segments related by topic [Q10]
- Link between primary and secondary labs [Q11]
- Primary lab segments related by [Q12]
- Teacher helps students make links between primary lab segments [Q13]
- Who generates the research question [Q15.1]
- Who designs procedures for investigations [Q15.2]
- Independent practical activity related to real-life issues [Q16]
- Students work with quantitative and qualitative data [Q17]
- Students collect and record data [Q18]
- Types of practical activities [Q19]
- Students make predictions [Q20]
- Where predictions occur [Q21]
- Prediction supported by theory [Q22]
- Prediction linked to results [Q23]
- Students organize or manipulate collected data [Q24]
- Students interpret results [Q25]

D11.1.1 How to Think about Lessons That Contain Practical Work

In order to analyze lessons with practical work, it is important to develop a strategy for how to look at lessons that contain one or more segments of practical work.

Because of the rules implemented for Dimension 4, lessons will have different numbers of AS:WP segments. How do we make sense of these numbers? In some cases, the students are given all the materials and directions and sent off to work on one long lab activity, but the teacher later realizes a need to interrupt them to provide some additional guidance. As a result, the lesson includes two or more AS:WP segments. In other cases, the teacher intentionally divides the lesson into different AS:WP segments that guide the students through the work in a stepwise process. Students are given only enough information to carry out the next step. For example, the teacher first asks students to set up their working materials. When this AS:WP segment is completed, the teacher gives directions for the next step in the lab activity. Students complete the next step and then stop again to listen to further instructions from the teacher. The work continues in this back-and-forth pattern between ASPDF and AS:WP. We are interested in identifying lessons of these two types. Are students sent off to work on one long lab that later gets interrupted for additional instructions from the teacher? Or does the teacher purposely divided the lesson into multiple AS:WP segments, giving students just enough information to carry out the next step of the activity? Codes were developed to capture these two types of organization of the practical work.

Figure 11.1. Codes for lessons containing AS:WP segments



TYPE = A This lesson contains one or more AS:WP segments. Students are set off to work with all the materials and directions needed to do the complete lab. Multiple segments of AS:WP appear only because the teacher interruptions appear to be made "on-the-spot" rather than planned out ahead of time. For example, the teacher may interrupt students' work and add some safety statement information, or the teacher can see that students are having difficulties with the task and he/she stops the work to provide additional instruction. Often, the interruption notifies students that it is time to clean up.

Examples: SAU024, SUS010 (density lesson)

TYPE = B Any lesson that is not TYPE A is a TYPE B. A TYPE B lesson contains two or more AS:WP segments. This is a lesson where the teacher does NOT give students all the information about materials and procedures needed to complete the AS:WP activities before students start to work on the first AS:WP segment. Instead, the teacher gives information in smaller chunks. Students need to come back together in a ASPDF segment to get further information about how to proceed with the next AS:WP segment. It is clear that the teacher has planned ahead of time to divide the lesson into different AS:WP segments to break the AS:WP tasks down into two or more steps.

Examples: SCZ006, SUS008, SJP056.

Special considerations for Type A and Type B [TYPE]

When there are multiple AS:WP segments and one of the segments is a secondary lab, ignore this segment when determining the type of lab. A secondary lab includes a lab that is a set-up for the next lesson (Q8), a lab that involves wrapping up from the previous lesson (Q9), or two labs that are related by topic (Q10). If there is only one segment, that one segment is the *primary lab*. We want to know if the *primary lab* is TYPE A or TYPE B.

- TYPE B lesson. Two or more lab segments are in a planned sequence TYPE B (students do not have enough information to do all the lab activities prior to the first segment) and these segments are followed by a summary or discussion of conclusions. A new AS:WP activity is started in the next AS:WP segment. In this situation, consider the lesson as TYPE B, with the first segments as the primary lab. Answer questions 1-7 and questions 12-13 in terms of the primary lab segments only. Consider the new activity segment at the end of the lesson as a new activity to be described in answering Q8, Q9, and Q10.

- TYPE A lesson. The teacher gives all the directions for the intended lab activities of the day before the students start to work on the first AS:WP segment (TYPE A). Near the end of the lesson, the teacher decides there is enough time for students to start or work on another AS:WP activity. Consider this lesson as TYPE A. The new activity added spontaneously at the end of the lesson will be considered a new lab activity to be described in answering Q8, Q9, and Q10. If there is only one segment in the primary lab, it is automatically coded TYPE A.

D11.2 Questions about Set-up of the Activity [Q1 to Q4]

Set-up for practical work is public talk (usually in form of ASPDF) that precedes the AS:WP activity and that is directly related to the upcoming activity. Set-up contains information about the practical activity, including either its content or procedures. During the set-up, students might be asked to generate hypotheses, be provided with theoretical background information, or given instructions for completing the tasks.

D11.2.1 Set-up talk [Q1]

To identify the set-up period, follow the content of the teacher's talk. When does the teacher begin to talk about the independent practical activity that students will be doing? Typically, this talk immediately will precede the AS:WP segment.

A good strategy to determine if the talk is set-up for practical work is to consider the student perspective. Students should know that the teacher's talk is about the upcoming practical activity. It is not sufficient for the teacher's talk to be topically related to the lab. For example, a teacher begins a lesson with a general review about acids and then begins to describe a lab they will be doing about acids. The set-up period begins when he/she talks about the upcoming lab, but not during the general review about acids. In contrast, another teacher begins by stating that students will do a lab in which they explore how acids react with different metals. The teacher then asks students what they already know about how acids react with metals and has them make specific predictions about the acids and metals they will be testing in the lab. During this time, students are aware that the discussion is related to a lab they will be doing. The entire time period is considered set-up.

Sometimes there is talk about ideas (not just mentioning of an idea) related to the main purpose of the lab. By "an idea" we mean that there is content that goes beyond topic and beyond goal for lab. In this case we will code '2' for the first question about set-up talk. When the idea related to the lab is discussed then students do not need to know the procedures of the lab or even that they are doing a lab, in order to code '2'.

Code one of the following to identify the type of set-up talk prior to the first AS:WP segment (of the primary lab):

Q1 = 0 There is no talk prior to first segment.

Q1 = 1 The talk focuses primarily on procedures; ideas are mentioned only at topic level or regarding tools to be used (e.g., "this is an ammeter") or how procedures and equipment work.

Q1 = 2 The talk is about ideas (not just mentioning of an idea) related to the main purpose of the lab. *By "an idea", we mean that there is content in the talk that goes beyond topic and beyond goal for lab.*

D11.2.2 Purpose of practical activity before first segment [Q2]

Do students know the purpose of the independent practical activity before they start on the first step or first segment? The judgment about this question is made on "big lab" level. Look for the conceptual reasons for doing the entire lab ("big lab"), not just individual AS:WP segments.

A conceptual reason for doing a lab describes a big idea, concept, or theory the students will learn about from doing the lab. The conceptual reason goes beyond describing what procedures students will follow, what skills they will practice, or what observations students will make. A conceptual reason describes how the observations can be used to explain a big idea, concept, or theory or how the procedures or skills are useful in understanding some big idea, concept, or theory.

For example, before the first AS:WP segment in lesson SCZ006, the students know that they will confirm that the reaction of HCl and Mg produces magnesium chloride and H_2. However, the "big lab", or conceptual reason for the practical activity, is about comparing different reactions of HCl and metals and comparing the speeds of the reactions. The students do not know this conceptual reason before the first AS:WP segment.

Exhibit 11.1. Examples of conceptual reasons for lab activities

Observations, Skills, Procedures Only	Conceptual Reasons
We will find out what happens when charged objects are brought together.	We will gather some data that will help us explain what causes lightning.
In this lab you will practice using pH paper to test whether household objects are acidic or basic.	In this lab, you will find out the how acids and bases are chemically different.
In this lab, you will do reactions of metals and HCl.	In this lab, we will look for ways in which reactions of HCl with different metals are similar and different.
We will learn how to use a microscope.	We are going to learn how to use the microscope so that you can use it to examine the structure of leaf cells.
Today we will make a circuit.	We will investigate the characteristics of a circuit.
We will find out if the light bulb will glow when you exchange the positive and negative.	We will look for patterns about when a circuit will light the bulb and when it won't – is there a general rule that we can use to predict what will happen?

Q2 = 0 Students only know the page number or topic [code only if set up talk is not '2'].

Q2 = 1 Students know an important knowledge outcome that they will verify or practice using in the lab; that is, a specific knowledge outcome is known. The knowledge outcomes that the teacher intends for them to learn from the lab are known by the students before they do the lab. For example, a knowledge outcome that is known and will be verified is: "We will prove that sound cannot travel in a vacuum." Practice includes applying theories or knowledge, not just simple repetitive tasks.

Q2 = 2 Students know at least one observation they will make (e.g., something they will observe, measure), but they do not know a conceptual reason why they will be making those observations or a big question that they will be able to answer from the lab. That is, they do not know the concepts that the teacher hopes they will learn from the AS:WP. (e.g., "Measure the size of the electric current"; "What happens when charged objects are brought together"). Specific knowledge outcomes are unknown and conceptual reasons are unknown.

Q2 = 3 Students do not know the specific knowledge outcomes intended by the lab (results) but they do know the conceptual reasons or big question for doing the lab. *They know a big idea or question they will be trying to discover* that ties the whole lab together; that is, the big concept of the lab or idea that explains WHY they made the observations or collected the data.

Specific knowledge outcomes are unknown and conceptual reasons (big questions or idea) are known. If the conceptual reason is written on a worksheet and the teacher tells them to read this worksheet, code '3' even if the teacher does not state the conceptual reason explicitly.

For example, in lesson SAU008, students will observe how metals and nonmetals burn and dissolve in water in order to learn how to distinguish metals and nonmetals chemically (the big idea), but they do not know the specific outcomes of the lab (e.g., how the different metals and nonmetals will react when heated and put into water).

D11.2.3 Relationship between Multiple Independent Practical Activities [Q3]

For lessons with multiple AS:WP segments TYPE B: What is the relationship between multiple independent practical activity segments?

Q3 = 0 The AS:WP segments are topic-related, but (a) the order of the segments could change without damaging the flow of content development, and (b) there is no big idea that summarizes or concludes the series of segments (see lesson SUS008).

Q3 = 1 The segments build on one another in a deliberate sequence, with each segment contributing to *one big idea* (even if the big idea is not stated by the teacher). The order of the segments could be changed and still make sense (see lessons SAU008 and SCZ006). Also, the segments could build on one another in a deliberate sequence, with each segment serving as a set up for the following segments, but changing the order of the segments would disrupt the build up to a big idea (see lessons SJP056).

Q3 = 99 Does not apply; lesson coded is TYPE A.

D11.2.4 Purpose of practical activity before last segment [Q4]

For lessons with multiple AS:WP segments TYPE B: Do students know the purpose of the independent practical activity *before they start on the last AS:WP segment* (or the last AS:WP segment of the primary lab)?

Q4 = 0 Students only know page number, procedures they are to do, or topic.

Q4 = 1 Students know an important knowledge outcome that they will verify or practice using in the lab. Specific knowledge outcomes are KNOWN. Practice includes applying theories or knowledge, not just simple repetitive tasks. An example where knowledge outcome is known and will be verified is the teacher telling the class: "We will prove that I1=I2=I3". Evaluate what students know before the *last* segment. For example, if the knowledge outcome is known and the students practice this knowledge in a second segment, code a '1'.

Q4 = 2 Students know at least one observation they will make (something they will observe or measure) but they do not know the conceptual reason *why* they will be making those observations. That is, they do not know the concepts that the teacher hopes they will learn from the AS:WP.

Specific knowledge outcomes are unknown and conceptual reasons are unknown (e.g., "Measure the size of the electric current"; "What happens when charged objects are brought together?").

Q4 = 3 Students know the conceptual reasons for doing the lab. They know a big idea or question they will be trying to find out about that ties the whole lab together, that is, the big concept of the lab, the idea that explains *why* they made the observations or collected the data. They do not know the specific knowledge outcomes or results of the lab.

Specific knowledge outcomes are unknown and conceptual reasons are known. For example, in lesson SAU008, students will observe how metals and nonmetals burn and dissolve in water in order to learn how to distinguish metals and nonmetals chemically (the big idea), but they do not know the specific outcomes of the lab (e.g., how the different metals and nonmetals will react when heated and put into water).

Q4 = 99 Does not apply; lesson coded as TYPE A.

D11.3 Post-Lab Questions [Q5 to Q13]

D11.3.1 Discussion of Results [Q5]

What results from the primary AS:WP are publicly discussed by the end of the lesson (includes public talk *during* and *in between* AS:WP segments)?

Q5 = 0 No public discussion about the results of the AS:WP.

Q5 = 1 Observations and data are discussed, shared, compared, and/or checked (results only, no conclusions). This includes times when the teacher compares results of different groups. This code does not include comparing results that also require interpretation or conclusions (e.g., "Which is the fastest reaction?").

Q5 = 2 Conclusions for different parts of the lab are discussed but they are not tied together into one big idea, one big summary; conclusions are treated as discrete bits of knowledge (interpretations or generalizations; see lesson SUS008 for example).

Q5 = 3 One big conclusion is made about the lab, one big idea that ties the whole lab together, that requires drawing together information from the various segments in independent practical work with multiple segments (interpretations or generalizations; see lessons SAU008, SCZ006, and SJP056 for examples).

D11.3.2 New Questions to Investigate are Discussed or Mentioned [Q6]

By the end of a lesson with AS:WP segment(s), are new questions to investigate discussed, mentioned, or written about by students (e.g., "There are unanswered questions"; "This lab leads to new questions"; "This lab doesn't answer everything")? This means that new questions for investigation should be "stated" for them to think about or to be done in a future class, but it does not matter whether they will answer the question in the future lesson or not. For example, teacher says: "Today we learned how current flows in serial circuit and next lesson we will investigate whether the same rules apply in parallel circuit." This does not include situations when the same activity will continue in the next lesson. Also, do not include such goal statements as "next lesson we will measure the pH-level of household plants".

Q6 = 0 No new questions to investigate.

Q6 = 1 Yes, new questions to investigate are discussed or mentioned (see SJP056, lab 1, for example).

D11.3.3 Methods are Critiqued or Evaluated [Q7]

Are the methods used in the lab critiqued or evaluated in terms of sources of error or methodological flaws or limitations publicly or in a written assignment? The purpose of this question is to determine if students are given the opportunity to evaluate the procedures used in a lab and their limitations.

This evaluation can occur

- during ASPDF, either before or after the AS:WP;
- during the AS:WP, stated *publicly*; or
- during independent work by all students (e.g., a question on the worksheet).

Do *not* include an evaluation that occurs privately between a teacher and a student (i.e., during TSI**,** Dimension 4 Follow-up).

Examples

- Students calculate the density of the object based on measuring the volume and mass. After this, there is discussion about the possible reasons for differences in results across groups.

- The teacher demonstrates that when hot water (70 degrees) is placed under a vacuum pump, you can easily see that after the air is pumped out the water starts to boil. In 2 minutes, the teacher repeats the experiment with boiling water but the water doesn't boil. The following discussion focuses on evaluating why the water did not boil this time.

- The class discusses why a certain procedure was used in this lab and how the procedure would have to be adapted under different circumstances.

Q7 = 0 No methods are critiqued or evaluated.

Q7 = 1 Yes, methods are critiqued and/or evaluated.

D11.4 Questions about Relatedness and Coherence between AS:WP Segments

D11.4.1 Lab Involves Setting Up for the Next Lesson [Q8]

Do any of the lab segments involve "setting up" or beginning a new lab that will continue in the next lesson"? This code is intended to identify a segment that does not belong to today's lab. We code a '1' only if this setting up of a lab is *not* the lab in today's lesson. In other words, if the entire lesson is a lab that students do today and will finish tomorrow, do *not* code this as '1'.

Q8 = 0 No, lab does not involve setting up for next lesson.

Q8 = 1 Yes, lab involves setting up for next lesson.

Q8 = 99 Does not apply; lesson contains only one AS:WP segment.

D11.4.2 Lab Involves Wrapping Up from Previous Lesson [Q9]

Do any of the lab segments involve "wrapping up an old lab from a previous lesson"? This code is intended to identify a segment that does not belong to today's lab: Do *not* code a '1' if the entire lesson is a lab that was started the day before.

Q9 = 0 No, lab does not involve wrapping up from previous lesson.

Q9 = 1 Yes, lab involves wrapping up from previous lesson.

Q9 = 99 Does not apply; lesson contains only one AS:WP segment.

D11.4.3 Lab Segments Related by Topic [Q10]

Are all lab segments related by topic? The topics of the AS:WP segments need to be related. The teacher does not have to state that they are related.

Q10 = 0 No, lab segments are not related by topic.

Q10 = 1 Yes, lab segments are related by topic.

Q10 = 99 Does not apply; lesson contains only one AS:WP segment.

NOTE: To code the following questions, the segment identified previously in questions Q8, Q9, and Q10 (e.g., the reason you coded question 8 or 9 as '1' or question 10 as '0') will be referred to as the *secondary lab*, regardless of the chronological placement in the lesson. The remaining AS:WP segments will be referred to as the *primary lab*.

D11.4.4 Link between Primary and Secondary Labs [Q11]

Does the teacher do anything to help students make links or comparisons between the two labs?

Q11 = 0 No link made between primary and secondary labs.

Q11 = 1 Yes, links made between primary and secondary labs.

Q11 = 98 Does not apply; no secondary lab identified (Q8 and Q9 were coded '0' and Q10 was coded as '1'.

Q11 = 99 Does not apply; lesson contains only one AS:WP segment.

D11.4.5 Primary Lab Segments Related by Topic [Q12]

Are all remaining AS:WP segments that are part of the *primary lab* related by topic?

Ignore the *secondary labs* coded '1' in question Q8 or Q9, or '0' in question Q10.

Q12 = 0 No, the remaining AS:WP segments are not all topically-related.

Q12 = 1 Yes, the secondary lab and the *remaining* AS:WP segments are topically-related.

Q12 = 2 Yes, there was no secondary lab and the AS:WP segments are *all* related by topic (Q8 and Q9 were coded as '0' and Q10 is coded as '1').

Q12 = 98 Does not apply; there is a primary and a secondary lab but the primary lab is only one segment.

Q12 = 99 Does not apply; lesson contains only one AS:WP segment.

D11.4.6 Teacher Helps Students Make Links between Primary Lab Segments [Q13]

Does the teacher do anything to help students make links or comparisons between two or more AS:WP segments, or does the teacher refer to a previous or future AS:WP segment?

What do we mean by links? These are the explicit statements that connect any two or more AS:WP segments. Ideally, we are looking for content links that explain how two segments are conceptually related, that is, the reason two segments are related. Exclude general references or procedural statements that link the AS:WP segments (e.g. "Keep the balloons; we will need them later again"). Simple summaries of what was done are not enough to count as a link. Below are some examples of links between primary lab segments:

Examples

- <u>Comparing any two segments</u>. Any statements that are comparing or contrasting some features of the AS:WP segments.
    - "Now, remember we noticed that in both previous activities we saw that reaction took place."
    - "How did the speed of this reaction compare to the last one?"
- <u>Helping students to make connection (content "hints")</u>. Statements that are hints for next AS:WP based on the results of the previous one.
    - "Ok you just investigated what happens when two positive charges are brought together. Now let's do the same think with two negative charges. What will happen? Remember they are same charges."

    NOTE**:** If you are unsure about whether the teacher is helping the students to make a connection, do not consider the statement as hinting or helping.
- <u>Explicit statements that indicate that AS:WP segments build on each other and are part of bigger lab (dependent).</u>
    - "Ok, just we measured the volume of the rock. Next thing we need to do in order to calculate the density of the rock is to measure the mass. Go and do this."

D11.4.7 Clarifications

<u>Look at the lesson in its entirety</u>. When making a judgment about links within a primary lab, sometimes the context of the lesson, how the lesson is introduced or framed, or goal statements may be helpful indicators when looking for these explicit statements.

<u>Do not count the following as links within a primary lab</u>:

- General reference or procedural statements that link the AS:WP segments,
- Just mentioning something will be done (e.g., "We will first do reaction with zinc and

then with cooper"), and

- Simply summarizing "what was done" or "what will be done" without drawing a closer comparison or relationship.

Q13 = 0 No, the teacher does not help students make links.

Q13 = 1 Yes, the teacher helps students make links between primary lab segments.

Q13 = 98 Does not apply; the remaining lab is only one segment.

Q13 = 99 Does not apply; lesson contains only one AS:WP segment, or the lab is Type A.

D11.5 Different Features of the AS:WP Task [Q15 to Q19]

D11.5.1 Student Role in Designing AS:WP Task and Procedures [Q15]

In this question, we look at two aspects of independent practical work and identify to what extent students play a role in planning or designing the practical assignment (AS:WP) tasks. The categories are mutually exclusive and identified in Table 11.2.

Table 11.1. Codes for students' involvement in planning or designing the AS:WP task

Question	Aspect of AS:WP task	Specified by the teacher	Option given by the teacher and students can choose	Decided through teacher and student discussion	Chosen by students
15.1	Question of task to be addressed or done during AS:WP	Q15.1=1	Q15.1=2		Q15.1=3
15.2	Equipment to be used or procedures to be followed	Q15.2=1	Q15.2=2		Q15.2=3

<u>D11.5.1.1 Who Generates the Research Question [Q15.1]</u>

Who generates the research question or task that students work on during the AS:WP?

Q15.1 = 1 Specified by the teacher, textbook, or worksheet. Question or task is introduced by the teacher. Students have no option to contribute to deciding what will be investigated. The question also may be posted in textbook or worksheet that is distributed by the teacher.

Q15.1 = 2 Option given by the teacher; students can choose. That is, *students have some degree of choice in the question to be investigated*. For example, in lesson SAU030, students help the teacher generate a list of 5 variables that can explain fungal growth. The teacher tells students they can choose one of 4 of these variables and design a hypothesis to test.

OR

Decided through the teacher-student discussion. The question or task that will be investigated is designed in the classroom through a dialogue between the teacher and the students. The teacher may lead the discussion, but it is clear that the intent is to involve students in helping to define the question.

Q15.1 = 3 Chosen by the students. For example, students design the question to be investigated on a topic of their choice (e.g., science fair projects) or students design the question to be investigated within a general topic area (e.g., explore some question related to weather).

Q15.1 = 99 None of the above applies or cannot tell.

D11.5.1.2 Who Designs Procedures for Investigations [Q15.2]

Who designs the procedures that will be used during the AS:WP?

Q15.2 = 1 Specified by the teacher. During practical work (AS:WP), students are mostly following procedures given by the teacher OR a textbook/worksheet. There is minimal or no student choice about what to do. It is clear that the procedures for the task have been designed for the students; the student role is to follow the given procedures. To use "recipe analogy", there is a recipe prepared for students to follow.

Q15.2 = 2 Option given by the teacher; students can choose. During practical work (AS:WP), students usually work according the plan that was designed by the teacher or textbook/worksheet. However, students have some degree of freedom in carrying out the task. They may make some choices in what to do and how to do it. For example, the teacher sets the goal to measure the gravity acceleration and offers two methods for students to use. Students may choose which method to follow. The option is given to the students during the set-up.

OR

Decided through the teacher-student discussion. During teacher-student discussion, students' ideas are used to help design the procedures that everyone in the class will follow. There is a negotiation process between teacher and students in designing the procedures, but all students follow the procedures that are mutually designed.

Q15.2 = 3 Chosen largely by students. Students are clearly "in charge of the task". They significantly contribute to the design of the task as well as carrying out the procedures. For example, students are told to design an activity to measure the speed of different objects. Students have freedom to carry out the task largely according to their own plans; they are not led by another source.

NOTE: Students must make some choices that involve scientific thinking. If they are simply choosing materials to use without any scientific thinking required to make those choices, do NOT code as ‘3’.

Q15.2 = 99 None of the above applies or cannot tell.

NOTE. The following hierarchy applies to the codes: 3>2>1.

D11.5.2 Independent Practical Activity Related to Real-Life Issues [Q16]

Does the AS:WP activity relate to students' everyday lives or to societal or social issues? These are the AS:WP segments that students would recognize as addressing their personal life experiences OR the usefulness of science-related knowledge in every day life. The entire focus of the AS:WP must be on real-life issues. Just the "familiar everyday context" is not enough.

Q16 = 0 No independent practical activity (AS:WP) is related to real-life issues.

Q16 = 1 Everyday materials are central or important in the task. Everyday materials, that is, materials that are familiar to students' everyday lives, are used (e.g., bread, steel wool, or cleaning pads) but the teacher does not emphasize the connection between the task and students. Real-world materials are used to support learning of science concepts, not to support making connections between the real world and science. If the material used is a regular science lab item (e.g., water, battery, or match), only code the material as an everyday object if the teacher emphasizes it's everyday use.

Examples

- Students bring an orange to construct the battery. Other than the presence of an orange, the task is not related to everyday life.
- Students are measuring the acidity of different solutions. Some of these solutions are common household items. The teacher does not emphasize the link between the measurements and students' personal lives.

Q16 = 2 The focus of the task is clearly related to students' personal lives and is designed so students can "discover something about how science works in my life".

Examples

- Students measure the acidity of various household products and the teacher emphasizes how materials that are basic and acidic have different kinds of uses in the home.
- Students building an emergency kit for earthquake.
- Students testing their own hearing ability or calculating their own horsepower or pulse or lung capacity.
- Students tasting foods from different food groups.

Q16 = 3 The focus of the task is related to societal Issues (e.g., energy saving, pollution of the air and nature, space trash, forensics, etc.).

Examples:

- Students weigh garbage collected at home.
- Students compost garbage from the lunch room.
- Students work in a fingerprinting lab.

NOTE. If more than one option applies, use the following hierarchy: 3>2>1>0.

D11.5.3 Students Work with Qualitative and Quantitative Data [AS:WP ONLY] [Q17]

This code enables us to collect more information about the kind of observations students are expected to make during this lesson: qualitative, quantitative, or both qualitative and quantitative data. The observations must be made during this lesson and must be related to the AS:WP.

Q17 = 0 Students do not work with data (e.g., students are building rockets or models of Newton's Laws).

Q17 = 1 Task requires students to make quantitative observations. Students are observing or measuring a physical quantity (or variable) associated with an object, materials, or an event.

Examples

- Students measure the resistance of a piece of wire.
- Students weigh objects, determine their volume, and then calculate the density of the objects.
- Students measure the volume of an acid solution needed to neutralize a given volume of an alkaline.

Q17 = 2 Task requires students to make qualitative observations. The observation may be of an object or a material. This code also includes observations such as comparing variables that could be measured but aren't. For example, students could be asked to compare if one object is larger or smaller than another but students do not measure the precise size of the objects.

Examples:

- Students observe an object.
- Students observe materials or an event.

- Other qualitative observation (e.g., an observation of color).

Q17 = 3 Task requires students to work with both qualitative and quantitative data.

D11.5.4 Students Collect and Record Data [AS:WP ONLY][Q18]

Are students involved in recording observations during this lesson? To answer this question, we are interested in whether students are involved physically in recording observations. Is it the student who has the chance to write down her/his own observations before they are provided by the teacher or another student? Include both numerical and descriptive observations that typically may occur in the classroom in two ways:

- An observation is recorded *during the AS:WP working time*. You would observe students writing down quantitative or qualitative observations.

- Students make observations during the AS:WP activity but the observations are recorded *after finishing the work completed during ASPDF or AS:WA time*. In this case, you must be certain that the actual observation was not provided to the students (e.g., “We observed that substance turned red. Now everybody write it down”).

When making a judgment, look at the nature of the task as well (rather than focusing only on whether the students are writing and assuming that they are recording observations). Both the nature of the task and observations of the students should provide adequate evidence for making the decision.

Examples of students recording observations

- Students are recording their own observations of the change of temperature in order to graph the values. This is done during the AS:WP segment.

- Students are observing a chemical reaction. After they are done, the teacher tells them to write down what they observed.

- Students are observing a process. As they work on the task during the AS:WP segment, they complete a worksheet. One of the questions asks about their observations and what they could see.

Examples of what does not count as students recording observations

- Students are observing a chemical reaction. After they are done with the task, the teacher shifts to a whole class interaction during which the class discusses what was observed.

- Students are observing water boiling in vacuum. When the teacher asks what they noticed about the water, the students say that they saw water boiling and also that they observed condensation. The teacher directs them to write these observations in their notebooks.

- Students are observing chemical reactions. After the AS:WP, they are asked to write down the chemical equation of the reaction. Recording representations of ideas or data does not count as students recording observations. Chemical reactions are representations rather than actual observations. In this case, recording observations would have involved describing the changes of the substances, such as temperature or color.

Q18 = 0 No students are involved in recording data. This also includes the option when Product (code P, Dimension 3) was coded as ‘0’.

Q18 = 1 Yes, the independent practical task (AS:WP) involves data collection and students are involved in recording the data or writing down their observations.

D11.5.5 Types of Practical Activities [AS:WP only] [Q19]

What type of practical activities do student work on? This code is intended to capture the level of practical tasks students are expected to work on independently.

Clarifications

<u>Two or more codes apply to the practical activity (AS:WP)</u>. Code according to the activity that is the teacher’s focus (check any goal statement in the lesson and responses in the teacher questionnaire). If one of the activities is a scientifically-controlled experiment (code ‘5’), give this code priority. We want to capture all cases of controlled experiments.

Example of two different lab activities within the same primary lab

- The teacher tells students to design an experiment and then test this design through a scientifically-controlled experiment. This can be in one long AS:WP or multiple segments. Code a ‘5’ because priority is given to occurrences of scientifically-controlled experiments, regardless of the main focus.

- The teacher tells students design an object and later to use their designed object to produce first-hand data. In this case, you must determine the main goal of the activity. If the design is the more important goal of the AS:WP and producing first-hand data is secondary, code a ‘1’. If producing the data the main goal of the AS:WP, then code a ‘4’.

Example of one activity with aspects of two ‘types’ of practical activities

- The teacher tells students they are going to practice the scientific method, which is included in code ‘3’, by doing a scientific controlled experiment, which is included in code ‘5’. Code the activity a ‘5’ because this code has priority over all of the other codes for Q19.

- The teacher tells students to organize rocks into certain categories and, in order to do this, they have to test the rocks (e.g., produce phenomena to determine the type of rock). First, you must determine the focus of the task. If the focus is to classify, code a ‘2’.

Q19 = 1 Task requires students to design and make models or prototypes. Models may be designed for the purpose of illustrating scientific principles (e.g., using clay to demonstrate faults). Alternatively, models or prototypes may be built for the purpose of testing and comparing one design to another design (e.g., building rockets or a hovercraft).

Q19 = 2 Task requires students to learn how to present an object (or set of objects) to display certain features. For example, students are to carry out a dissection to show the parts of the circulatory system in a frog, to organize a set of rocks into categories, or to display and identify different plant parts.

Q19 = 3 Task requires students to practice using an instrument, procedure, or inquiry skill (in the absence of any science content learning goal). *The main focus is on usinq or masterinq* this scientific procedure or instrument (rather than using the tool or procedure to generate data that will be used to support the development of an idea). The student may be intended to

- use an observation or measuring instrument;
  - use pH paper to identify a variety of materials as either acidic or basic;
  - use a microscope to look at a variety of different kinds of materials;
  - use a barometer to measure air pressure; or
  - use Benedict's solution to test for the presence of sugar in various materials.

- use laboratory device, arrangement, or procedure;
  - set up distillation apparatus to separate two miscible liquids;
  - use a dissecting kit to remove a muscle from a chicken wing; or
  - set up a filter funnel to separate a solid from liquid.

- use an inquiry skill in the absence of any science content learning goal;
  - practice observational skills by trying to guess what is in a “mystery box” without opening it; or
  - practice classification skills by developing a system for classifying buttons.

Q19 = 4 Task requires students to produce and/or observe phenomena/events. For example, students observe a chemical reaction, describe characteristics of the chemical reactions, carry out a series of chemical reactions to make soap, or produce data.

Q19 = 5 Task is a traditional scientifically-controlled experiment. The practical activity is a traditional controlled scientific experiment when comparisons of a control and an experimental case can be made (e.g., comparing heating water alone and water with copper in it to determine which heats faster). A scientifically-controlled experiment could include a comparison of two or more conditions, such as observing the reaction under two different temperatures and comparing the results.

A controlled experiment is sometimes called a "fair test." The variables (quantitative or qualitative) in two or more groups are held constant except for one variable. Differences in the outcomes between the groups can then be attributed to the one variable that was different.

In cases where the teacher asks students to make a comparison of results before and after producing or observing an event or phenomenon, such a comparison is a good indicator of a controlled experiment but does not qualify for a scientifically-controlled experiment as defined above. This task would be coded a ‘4’.

Example

A hypothesis is made that plant seeds will grow better if they are germinated in the dark versus in the light. A controlled experiment is set up. The control group includes 50 bean seeds that are placed on top of paper towels that are kept constantly moist and at a steady temperature of 70 degrees Fahrenheit. The control group receives 10 hours a day of artificial light. Like the control group, the experimental group includes 50 bean seeds placed the exact same conditions. One variable is allowed to change: the experimental plants are kept in the dark at all times. All other variables remain constant. When the experiment is completed, the students can attribute differences between the two groups of seeds to the amount of light available to the seeds, the one variable that was allowed to change.

D11.6 Questions about Inquiry Behavior That are Related to the Practical Activities [Q20 to Q24]

The codes in questions Q20 through Q24 attempt to capture the inquiry behaviors students are involved in during either independent practical activities (AS:WP) or whole-class practical activities (ASPPD).

D11.6.1 Students Make Predictions [Q20]

Are students engaged in forming predictions, and what kind of predictions occurred in the lesson? Are they expected to form predictions or hypotheses in relationship to the AS:WP activities (that occur in this lesson and in future lessons) OR in relationship to ASPPD segments (only those occurring in the lesson). Look for occurrences when students are asked to form a prediction or they simply state a prediction about expected results of scientific process or activity. Also include occasions when the teacher asks students for a prediction, but no student gives a prediction.

Predictions can be asked for *publicly*, or they can occur independently if asked on a worksheet or textbook. The key is that *all* students are asked to make a prediction. Do not code predictions that the teacher asks for in private interactions with one or a few students.

Mark evidence of the teacher or worksheet explicitly asking students to predict what could or will happen in relationship to an AS:WP or ASPPD practical activity worked on during the lesson or in an AS:WP activity to be done in a future lesson.

D11.6.1.1 Types of Predictions

This is an occurrence code and In-Points will be marked for the following 4 types of predictions:

PRED1-PPD. Predictions are derived from previously known science knowledge (e.g., theory or laws) for the purpose of being verified. Students expect a certain outcome based on their previous study or knowledge of the science content. There is one correct prediction that the teacher expects. *The prediction relates to the ASPPD that is present in the lesson.*

PRED2-WP. Predictions are derived from previously known science knowledge (i.e., theory or laws) for the purpose of being verified. Students expect a certain outcome based on their previous study or knowledge of the science content. There is one correct prediction that the teacher expects. *The prediction relates to the AS:WP segment*.

PRED3-PPD. Predictions are made without known outcomes. Students do not have enough knowledge to predict a certain outcome. They can use any previous knowledge and/or guess about what will happen. Students are not expected to have one correct prediction. There is genuine uncertainty about the outcome. *The prediction relates to the ASPPD that is present in the lesson.*

PRED4-WP. Predictions are made without known outcomes. Students do not have enough knowledge to predict a certain outcome. They can use any previous knowledge and/or guess about what will happen. Students are not expected to have one correct prediction. There is genuine uncertainty about the outcome. *The prediction relates to AS:WP segment*. If students are asked to make a prediction about an outcome and this prediction is based on both an ASPPD and an AS:WP, the prediction will be coded for the AS:WP.

Special considerations

- What does not count as students making a prediction. A hypothetical problem and not something that the students measure or the teacher stating a known outcome to be verified.

  Examples

  > "Ok, yesterday we learned that at a higher speed, the more distance will an object travel. If a car is traveling 50 km/h and a bike is traveling 20km/h, which one will travel a greater distance in 2 hours? What do you think?"
  >
  > "We know the relationship between temperature and pressure is given by this formula. Let's verify whether this is true."

D11.6.1.2 Marking the In-Point for Each DIFFERENT Prediction That is Asked For

How many different predictions does a student have the opportunity to make in the lesson? There can be more than one prediction asked for during the lesson, and different predictions may be of the same or different types. By different predictions we mean predictions that are about a different content activity (not necessary about different activity structure segment). If two or more students state or share their predictions about same activity, code this as one prediction. If students make a prediction in writing and then discuss it publicly, code this as only one prediction.

Mark the In-Point at the beginning of the teacher request for a prediction or when a student begins to state a prediction without a teacher request. If predictions are not requested publicly but they are requested in worksheet or textbook, mark the In-Point at the beginning of the independent segment for which these are assigned.

For each *different* prediction, mark the In-Point AND one of the following:

Q20 = 0 No evidence of predictions in the lesson.

Q20 = 1 PRED1-PPD. Predictions are derived from theory or law, that is, the predictions are derived from already known facts and theories. The teacher expects students to be able to give a specific “correct” outcome based on what they have already learned. This prediction is stated for the first-hand data that is generated in ASPPD segment. This ASPPD has to occur in present lesson. Do not include predictions that refer to an ASPPD that will be done in future lesson.

Q20 = 2 PRED2-WP. Predictions are derived from theory or law. The prediction is derived from already known facts and theories. The teacher expects students to be able to give a specific “correct” outcome based on what they have already learned. This prediction is stated for the first-hand data that is generated in AS:WP segment. This AS:WP segment may occur in present lesson or in one of the following lessons.

Q20 = 3 PRED3–PPD. Students do not have enough knowledge to predict a certain outcome. They can use any previous knowledge and/or guess about what will happen. Students are not expected to have one correct prediction. There is genuine uncertainty about the outcome. This is when the predictions are not focused on "supporting the known" but rather exploring new science facts or knowledge. This prediction is stated for the first-hand data that is generated in ASPPD segment. This ASPPD has to occur in present lesson. Do not include predictions that refer to an ASPPD that will be done in future lesson.

Q20 = 4 PRED4–WP. Students do not have enough knowledge to predict a certain outcome. They can use any previous knowledge and/or guess about what will happen. Students are not expected to have one correct prediction. There is genuine uncertainty about the outcome. This is when the predictions are not focused on "supporting the known" but rather exploring new science facts or knowledge. This prediction is stated for the first-hand data that is generated in AS:WP segment. This AS:WP segment may occur in present lesson or in one of the following lessons. If students are asked to predict an outcome and this prediction is based on an ASPPD and an AS:WP, code the prediction for an AS:WP.

D11.6.2 Where Predictions Occur in the Lesson [Q21]

Where do predictions occur in the lesson? For this code, determine where the students are predicting and not where the teacher assigns the task of predicting. If Q20=1, 2, 3, or 4, identify where in the lesson predictions were made using the following codes.

Q21 = 1 Predictions made during ASPDF and AS:WA/AS:WP. Predictions are publicly discussed or shared in ASPDF format AND worked on during AS:WP/AS:WA segments. This includes situations when the teacher asks for predictions in ASPDF form and then also lets the students work on it during independent working time. Another situation is when students form predictions privately during AS:WA segment and then they share results together with the teacher.

Q21 = 2 Predictions made during ASPDF only. Predictions are presented or discussed in public form during the ASPDF segment only. The teacher publicly asks students about what could happen. The predictions may be stated by the teacher or by the students(s).

NOTE. We will code '2' if there is an explicit request for predictions but no prediction is ever stated.

Q21 = 3 Predictions made during AS:WA only. Students spend some time working independently on forming predictions or hypotheses in AS:WA form, that is, predictions are stated and worked on during AS:WA segment only.

Q21 = 4 Predictions made during AS:WP or AS:WP/AS:WA. There is no public discussion of prediction AND there is no task assigned (AS:WA) to students for the purpose of predictions. However, predicting is a part of the AS:WP task that students are working on (information provided from the additional materials).

Q21 = 99 Does not apply;

Q20 = 0.

D11.6.3 Prediction Supported by Theory [Q22]

Was the prediction supported by theory or reasoning? If question 20 was coded as '3' or '4', were students expected to support the predictions by theory or reasoning? Was there any evidence that students provided a reason for their predictions or that they were asked by the teacher or by a worksheet/textbook to provide these reasons?

Table 11.2. Prediction supported by theory

Person	Transcript
T	What is your prediction? How will electric current change in serial circuit if we will increase the resistance?
S1	It will decrease S2: Increase
S3	It will decrease if we will decrease the resistance and it will increase if we will increase resistance.
T	Can you say why?
S3	Relationship between Voltage, current and resistance is linear according Ohm law for serial circuit. That's why.

D11.6.3.1 What Counts as a "Reason" or "Theoretical Support"?

Many reasons given by students are incomplete, incorrect, or based on their experience rather than theory. Their reasons often will appear very simplistic. Code these as reasons as long as they are students' genuine attempts to explain or support a prediction.

Q22 = 0 No evidence of a reason or theoretical support for the prediction.

Q22 = 1 The teacher publicly provides a reason or theoretical support.

Q22 = 2 One or more, but not all, students provide a reason for the prediction during a private interaction with the teacher.

Q22 = 3 Students publicly provide a reason or theoretical support for the prediction.

Q22 = 4 All students independently provide a reason or theoretical support for the prediction. The question (written on the worksheet or stated by the teacher) must specifically ask for a reason. Do not assume that all predictions require a reason or theoretical support.

Q22 = 99 Does not apply: Q20=0, 1, or 2.

D11.6.4 Prediction Linked to Results [Q23]

Was the prediction linked to the actual result of an activity? If there was a prediction related to the AS:WP or ASPPD (Q20 =1, 2, 3, or 4), is there any evidence that the results of the AS:WP activity were later linked to the predictions? There must be an explicit statement from the teacher or on the worksheet that students should spend some time privately comparing their results with their original predicting OR the teacher publicly initiates a discussion about results of the AS:WP and makes a link to the original predictions. Links that are made privately during TSI (Dimension 4 follow-up) will not count.

The intent of this code is to capture whether after finishing a practical activity, the teacher provides an opportunity for students to link results of the AS:WP to predictions which were stated at the beginning of the AS:WP segment.

Examples

- The teacher compares students' results with predictions.
- The discussion focuses on describing why results were different from the prediction.

Q23 = 0 No evidence of linking the prediction to results, by either teacher or students.

Q23 = 1 Yes, there is evidence of linking the prediction to results, by either teacher or students.

Q23 = 99 Does not apply;

Q20 = 0.

D11.6.5 Students Organize or Manipulate Collected Data [Q24]

Do students organize or manipulate collected data into representations? The purpose of this code is to describe whether students are expected to work with first-hand data collected during an AS:WP activity and perhaps later looking at ASPPD activities. Are students asked to manipulate or organize the scientific data? We also mean that students have to make some kind of decision in the organization of the graph. For example, are students transforming first-hand data in different representations such as tables, graphs, or charts?

Look for evidence of first-hand data only and mark one of the following codes.

Q24 = 0 No evidence; first-hand data are discussed or talked about but there is no evidence that the data are manipulated into different representations.

Q24 = 1 Only the teacher or textbook organizes or manipulates the first-hand data into tables, graphs, or charts, including situations when the tables are in textbooks (see special considerations below). This code also includes times when the teacher provides the tables, graphs, and charts and students simply fill in the data.

Q24 = 2 The teacher and students together organize or manipulate the first-hand data into tables, graphs, or charts

Q24 = 3 Students only organize or manipulate the first-hand data into tables, graphs, or charts. For example, students have to decide whether data points should be drawn as lines or curves, or students decide how to label and what variable to be placed on their own "x" and "y" axes.

Q24 = 99 Lesson does not contain first-hand data. Question 17 is coded as '0'.

Special Considerations

- <u>The teacher or textbook provides organizational frameworks</u> — The purpose of the code is to capture students coming up with the organization of the first-hand data. Students should design their own graph or a table. When these organizational frameworks are fully provided by the teacher or a textbook, code Q24=1 (teacher or textbook only).

- <u>The teacher or textbook provides labeled graphs</u> — When students are expected to make graph, you will need to make a judgment about students' involvement in the graph design. If students are given graphs with labeled axes and scales, and all they need to do is to plug in data points, do not code as '3'. Code Q24=1 (teacher or textbook only).

D11.6.6 Students Interpret Results [Q25]

Are students expected to interpret first-hand data, use evidence of first-hand data to explain patterns, or draw conclusions or generalizations based on previously collected first-hand data? We are looking for "rich" generalizations that go beyond just the summary of the task. For example, students may be expected to come up with a new pattern, generalization, theory, law, or prediction based on the first-hand data. Look at the task as assigned. If the students are expected to answer questions on a worksheet, use all available information (e.g., teacher instructions, private interactions, visual information from the video, etc.) to determine if they are expected to interpret results. Look for first-hand data only and assign one of the following codes.

Q25 = 0 No evidence; first-hand data are collected but not discussed, or data are discussed but there is no evidence that the data are interpreted.

Q25 = 1 Only the teacher interprets the first-hand data and does not have expectations for students to make contributions.

Q25 = 2 The teacher and students together interpret the first-hand data. This code also includes when the teacher asks students to interpret data but the students are not successful in suggesting any interpretations. For example, in Discussion segments (Dimension 4 follow-up), the teacher might ask for interpretations but students are unable to answer the questions.

Q25 = 3 Students only interpret the first-hand data. Students are working independently and one of the tasks asks for their interpretations, or the teacher publicly asks for interpretations and students give an acceptable interpretation without further guidance from the teacher.

Q25 = 99 Lesson does not contain first-hand data. Question 17 is coded as '0'.

Special considerations

- Students might work on interpreting the first-hand data during an AS:WA segment or as part of a AS:WP segment (usually when a worksheet or report asks for it). Later, the teacher may publicly go over the interpretations. In these situations, code Q25=3. We will give students credit for their opportunity to work on the interpretations independently and ignore the later public discussion.

- If it becomes clear during the public discussion that none of the students ever made an interpretation, code according to the public discussion.

D11.7 Motivating Whole-Class Activities

A science inquiry activity, such as gathering data, is often motivating for students. The teacher intends the activity to be fun and interesting or at least more motivating than traditional school tasks, such as reading textbooks, answering questions from the textbook, etc. For this code, we are looking for *other* types of motivating activities. That is, the teacher is leading the class through an activity that is intended for students to be fun and that activity is *not* what scientists would describe as traditional science inquiry.

In general, we are looking for activities that appear to have been planned by the teacher. If the students bring up an interesting issue or story and the teacher picks up on it, however, we will include this as motivating if it is at least 10 seconds.

There are two types of motivating activities: whole-class practical (ASPPD) and whole-class seatwork (AS:PD) activities.

- Motivating AS:PD (whole-class seatwork activity) [ENG-F]
- Motivating ASPPD (whole-class practical activity) [ENG-D]

D11.7.1 Motivating AS:PD Activities [ENG-F]

<u>D11.7.1 Examples of Motivating AS:PD activities:</u>

- Games,
- Competitions (e.g., playing *Pictionary* as a review of terms with time challenges),
- Puzzles (e.g., playing Hangman to determine the topic of the lesson), not including paper and pencil matching tasks,
- Role playing or performing skits (e.g., students act like electrons in a current),
- Simulations that do or do not use a computer (e.g., students take on different roles and act out a problem scenario such as a scientist testifying before Congress about an environmental issue; "what would you pack in an earthquake survival kit?"),
- Dramatic or creative presentations or discussions:
    - Telling a story or scenario (real or imaginary),
    - Telling personal experiences (e.g., personal experiences with fire),
    - Telling amazing, surprising facts,
- Experiencing or using music, art, drama, poetry, or other creative arts (NOTE. If music is playing in background while students work, bring this issue to the team to decide on In- and Out-Points),
- Teacher telling about her/his personal life,

- Other activities that have an element of surprise (e.g., plotting a graph that becomes a picture of something),

- Using word cards in games or challenging, competitive activities (e.g., "come up to the board and see how many of these words on magnetic cards you can make into a sentence"),

- Jokes and humor; do NOT include teasing because it could be more hurtful than fun for the teased person,

- Giving out rewards and extra motivators (e.g., extra credit, prizes, and points for good behavior), and

- Other fun activities (e.g., energy clap, power whoosh, voting on classmates grades, and grading each others' papers while the teacher reads off the answers).

D11.7.2 Examples of AS:PD Activities That Would NOT Qualify as Motivating or Fun beyond Science Inquiry

- Use of science diagrams to present science content, unless used in humorous or surprising ways,

- Using of instructional technology to present science content (e.g., teacher uses PowerPoint to make presentation; videos used to present science content; closed circuit TV used to project images of an ASPPD demonstration),

- Brainstorming what students know about a topic (NOTE. If there is a competitive or challenging aspect to the brainstorming, count this activity as motivating; see above);

- Doing science inquiry activities (e.g., brainstorming hypotheses, graphing data, etc.),

- Student presentations about topics they have researched,

- Word cards when used to drill or review previous content,

- Comments by the teacher or students that are teasing someone,

- Students' jokes, unless invited by the teacher,

- Stories that involve History of Science (e.g., telling something about the scientists' life or research),

- T:SAS knowledge (social, personal, or societal connections) that are not presented in a dramatic way, and

- AS:PD talk that is about a motivating ASPPD (see Special Considerations, bullet 4, for Motivating AS:PD and Special Considerations, bullet 2, for Motivating ASPPD.

Special considerations

- Set-up for a motivating AS:WA or AS:WP — Do NOT include the set-up for a motivating AS:WA or AS:WP activity unless the set-up itself is exciting or motivating in some way.

- Set-up for a motivating AS:PD activity — If the only activity is a set-up for the motivating activity (e.g., going over the rules of a game), include this as part of the motivating activity.

  Example

  The teacher is going to have students role play that they are electrons. First, she must select students to play different roles in the role play. Include this selection of students as part of the motivating activity.

- AS:PD talk about a motivating ASPPD activity. AS:PD talk about motivating ASPPD activities that occur at different times should be coded as follows:

  - Talk during the ASPPD. Talk about motivating ASPPD activities will get coded as a Motivating ASPPD IF it occurs during the ASPPD itself (see rules for marking In- and Out-Points in section 11.9). This talk is simply part of the motivating ASPPD.

  - Talk outside of the ASPPD. Talk about motivating ASPPD activities will not be coded as Motivating ASPPD IF this talk is motivating for another reason. In other words, it has to fit the Motivating AS:PD rules.

  - Talk between a series of ASPPD segments. A series of Motivating ASPPD segments in a row (less than one minute between ASPPD segments) could have AS:PD talk about the motivating ASPPD between segments. Do *not* code this talk as either Motivating AS:PD or Motivating ASPPD.

  - If the ASPPD isn't motivating but the talk is motivating, code AS:PD segment as motivating; if the talk during ASPPD is motivating but not necessarily related to ASPPD, code the ASPPD segment as motivating.

- Social, personal, and societal connections to the science content. *Do not include all* social, personal, and societal connections to the science content. Connections between the science content and students' personal lives or societal issues are captured in Dimension 9 coding under the T:SAS code. In Dimension 11, we are looking only for personal or societal issues that are presented in a way that makes them particularly vivid, interesting, and exciting to students. Ask yourself: Is the teacher presenting this T:SAS knowledge in a way designed to really capture students' attention? For example, the teacher might put the information in the form of a personal story or scenario, or the teacher might present the T:SAS knowledge in a way that highlights surprising or amazing ideas or statistics.

- In biology, we will *not* assume that every mention of the something connected to students' own bodies is automatically "motivating." For example, if the teacher talks about students pulse rates and that these will increase when they are in gym class playing soccer, this is NOT motivating. However, if the teacher tells a story about some famous athlete and how her pulse rate is amazingly low compared to the average person, this would be considered motivating because the teacher is putting the information in a story context and also highlighting some surprising, amazing statistics.

- <u>Student volunteers a motivating story or fact</u>. In general, we are looking for activities that the teacher has planned to make the lesson more motivating to students. If a student volunteers a motivating story or amazing fact, include it as motivating if the teacher acknowledges the story beyond ONLY stating "That's interesting" or "Well, I don't know if that's true." The teacher must say something that indicates that the student's contribution is welcome and worth paying at least a little attention to. Volunteered student jokes do NOT count as Motivating AS:PD, even if the teacher picks up on them.

11.7.2 Motivating ASPPD Activities [ENG-D]

<u>D11.7.2.1 Examples of Motivating ASPPD Activities</u>

- Surprising outcome (e.g., discrepant event, unexpected noises, or smells),
- Dramatic events (e.g., rocket whizzing across the room, big flashy fires, explosions, crashes, "firecrackers", or exploding volcano models),
- Unusual objects, gadgets that are new to students; not ordinary, everyday things,
- Unusual events that are "cool" or exciting that students have likely never seen before,
- New environment (e.g., going outside), and
- Related to things of high interest to students (e.g., gross, dangerous, or sexual things).

<u>D11.7.2.2 Requirements and Indicators for Coding Motivating ASPPD Activities</u>

<u>Requirements for Motivating ASPPD activities</u>. In order for any events to be considered motivating, there must be evidence of one or both of the following:

- Students' reactions. -More than two or three students respond with "wow", "ooh", and "ahh"; ideally, there is a general hubbub or commotion in response to the ASPPD, and/or

- Teacher's presentation of the event. The teacher tries to make the event more dramatic (e.g., builds up students' expectations that something special is about to happen); the event is not presented it in a matter-of-fact way.

<u>Indicators for Motivating ASPPD activities</u>. There are three indicators that will help identify and code Motivating ASPPD activities:

- Motivating aspect of a ASPPD is highlighted. The teacher highlights the part of the ASPPD that is particularly exciting.

Examples

The teacher builds up to the ASPPD activity: “Now watch really carefully and be prepared. It will happen very fast.”

The teacher makes comments that describe the event as unusual or exciting: “Isn’t that amazing?”, “Did that surprise you?”, or “Pretty cool, isn’t it?”

The teacher might offer to repeat the event, not for a scientific reason but only because it is fun to watch.

- Student reactions. ASPPD activities that are particularly motivating may result in laughter or student responses, such as, “gee whiz”, “wow”, “cool” (e.g., gross materials, surprising phenomena, loud noises, or explosions). NOTE: One or two students saying “wow” does not automatically make it a motivating activity.

  Examples include fireworks dazzler, or watching a pile of books crush a student constructed bridge and topple over.

- Teacher presentation and tone of voice. Teacher uses words or a tone of voice that emphasize the dramatic nature of the event.

Special considerations

- <u>Set-up for a Motivating ASPPD activity</u>. First, find the motivating moments of the ASPPD. Then, mark that entire ASPPD segment as motivating.

- <u>If there is another ASPPD where the teacher sets up the ASPPD with the exciting event</u>, mark that ASPPD as motivating ONLY if the set up for the ASPPD activity is the only thing going on.

  Example

  The teacher says: “We’re going to fix this rocket like this and then we will see what happens to it when…” The teacher proceeds to set up the rocket and talk about the set-up of the rocket. She breaks out of the ASPPD segment to point to students’ predictions on the board and then returns to the rocket and sets it off. Mark both ASPPD segments as motivating.

- <u>A series of Motivating ASPPD segments</u>. When there is a series of ASPPD segments with less than a minute between them and with some AS:PD talk between that is about the motivating ASPPD, do NOT code this as either Motivating AS:PD or Motivating ASPPD. See Special Considerations for In- and Out-Points of Motivating ASPPD below.

D11.7.3 Marking In- and Out-Points for Motivating Activities

D11.7.3.1 Marking In- and Out-Points for Motivating AS:PD Activities [ENG-F]

Mark the In-Point for at the moment when the Motivating AS:PD activity or talk begins. The Out-Point will be marked at the moment when the motivating activity ends.

Example: SAU055

The **bolded** text below indicates the beginning and the end of the Motivating AS:PD segment.

Time	Person	Transcript
00:00:14	T	Um, we're going to just continue with a normal class, so we're going to cover a bit of revision on acids and bases.
00:00:21	T	**Before that, I thought that I would tell you a little story. I might have told you this story before.**
00:00:27	T	**What sort of animal is it?**
00:00:28	Ss	**Bug.**
00:00:29	SN	**Bug.**
00:00:31	T	**What sort of bug?**
00:00:32	SN	**Ant. //Ant.**
00:00:33	SN	**//Ant.**
00:00:33	T	**Well done. It's an ant.**
00:00:35	T	**Now, I don't know whether you have ever done this, but when I was a kid we used to get magnifying glasses, go out, and fry the ants.**
00:00:43	T	**And when you fry them they give off this really amazing smell.**
00:00:47	T	**Now I've told you that you will be able to go and do it, too.**
00:02:18	T	**And they'll continually do this although the ant's thrashing about and his antennas are going and he's telling them, "I'm still alive."**
00:02:24	T	**They'll keep doing this until the ant eventually dies of starvation.**
00:02:28	T	**So, ants aren't terribly bright, but they do use acids for communication.**
00:02:34	T	While I was talking, one of those properties of acids was brought up.
00:02:38	T	What was one of the properties of acids that I mentioned?
00:02:44	T	Properties of acids. It's on the board. It's got to be here somewhere.

Special considerations

- More than one Motivating AS:PD activity. If a second motivating activity stops and restarts within 10 seconds, do not interrupt the original segment. Code it as one continuous motivating activity.

- Scientific language during a Motivating AS:PD activity. Certain motivating activities in the lesson could contain scientific language that may appear to be more "theoretical" than "motivating". We will not always interrupt the motivating activity segment when such talk appears. Such theoretical talk may occur in the middle of the following motivating activities.

  Examples

  - dramatic or creative presentations or discussions:
  - telling a story or scenario that is real or imaginary,
  - telling stories of personal experiences,
  - teacher telling about her/his personal life,
  - role playing, performing skits (kids act like electrons in a current), or
  - games.

- Coding to keep as much of the story together as possible. We know that these stories will contain some science, since they were designed to "teach science". Interrupt the segment only when the shift in the type of talk is significant, that is, when it appears that focus is shifting away from the "story telling".

- A series of Motivating ASPPD segments with AS:PD talk. When there is a series of Motivating ASPPD segments in a row (less than a minute between one segment and the next), and the talk in between is about the Motivating ASPPD, mark the In- and Out-Points for each Motivating ASPPD segment. Ignore the AS:PD talk between the segments. Do not code it as either Motivating ASPPD or Motivating AS:PD.

D11.7.3.2 Marking In-and Out-Points for Motivating ASPPD Activities [ENG-F]

Mark the In- and Out-Point exactly as the motivating ASPPD. If there is a short break in the motivating ASPPD activity and it is coded as two ASPPD segments, also code two Motivating AS:PD activities (ENG-D). This includes the case when one ASPPD is the set up for the Motivating ASPPD activity (see Special Consideration 1, above).

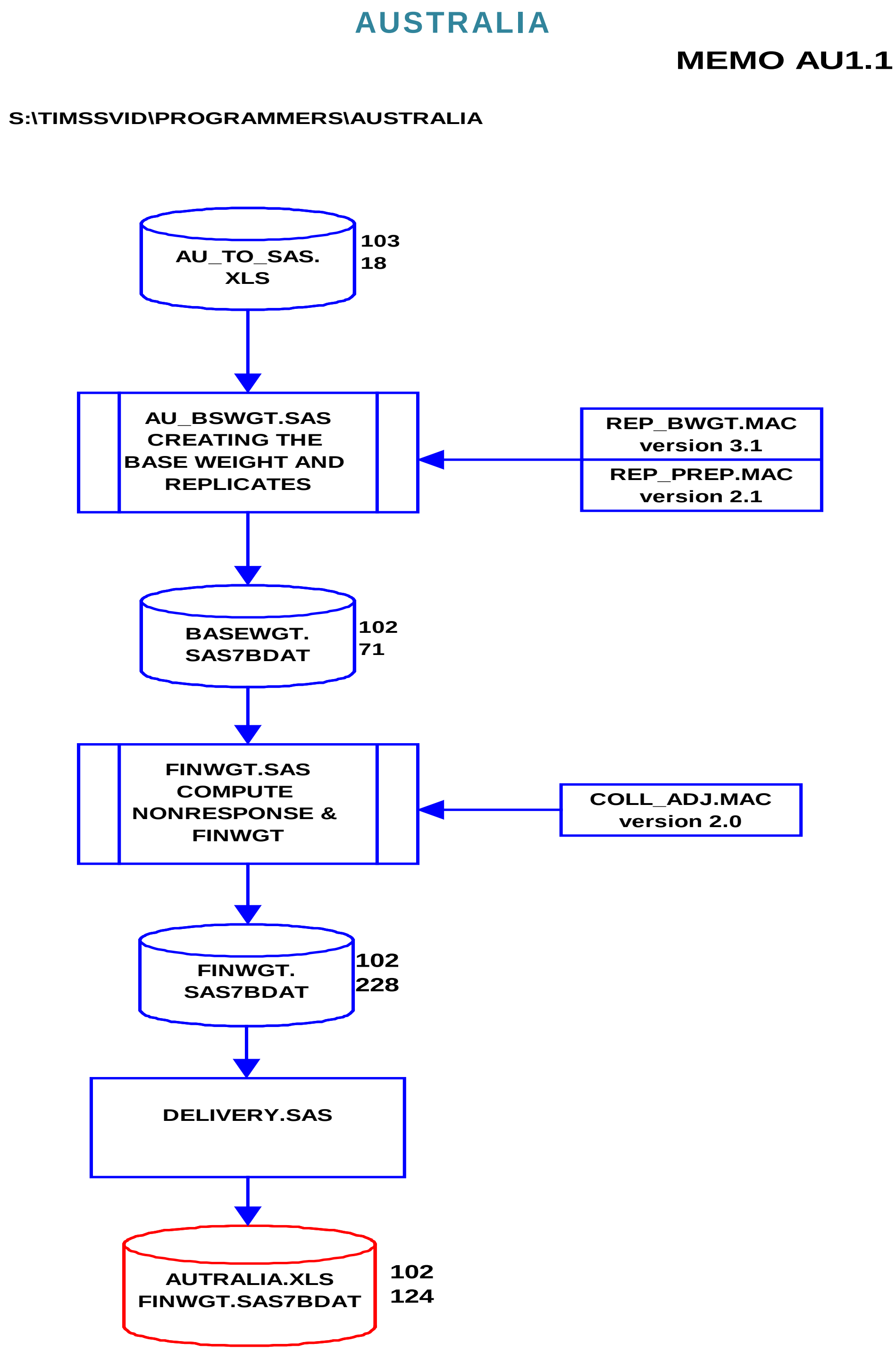
Special considerations

- Motivating ASPPD and Motivating AS:PD activities should not overlap.

- A Motivating AS:PD activity should occur only during an ASPPD segment, and a Motivating ASPPD activity should only occur during an AS:PD segment.

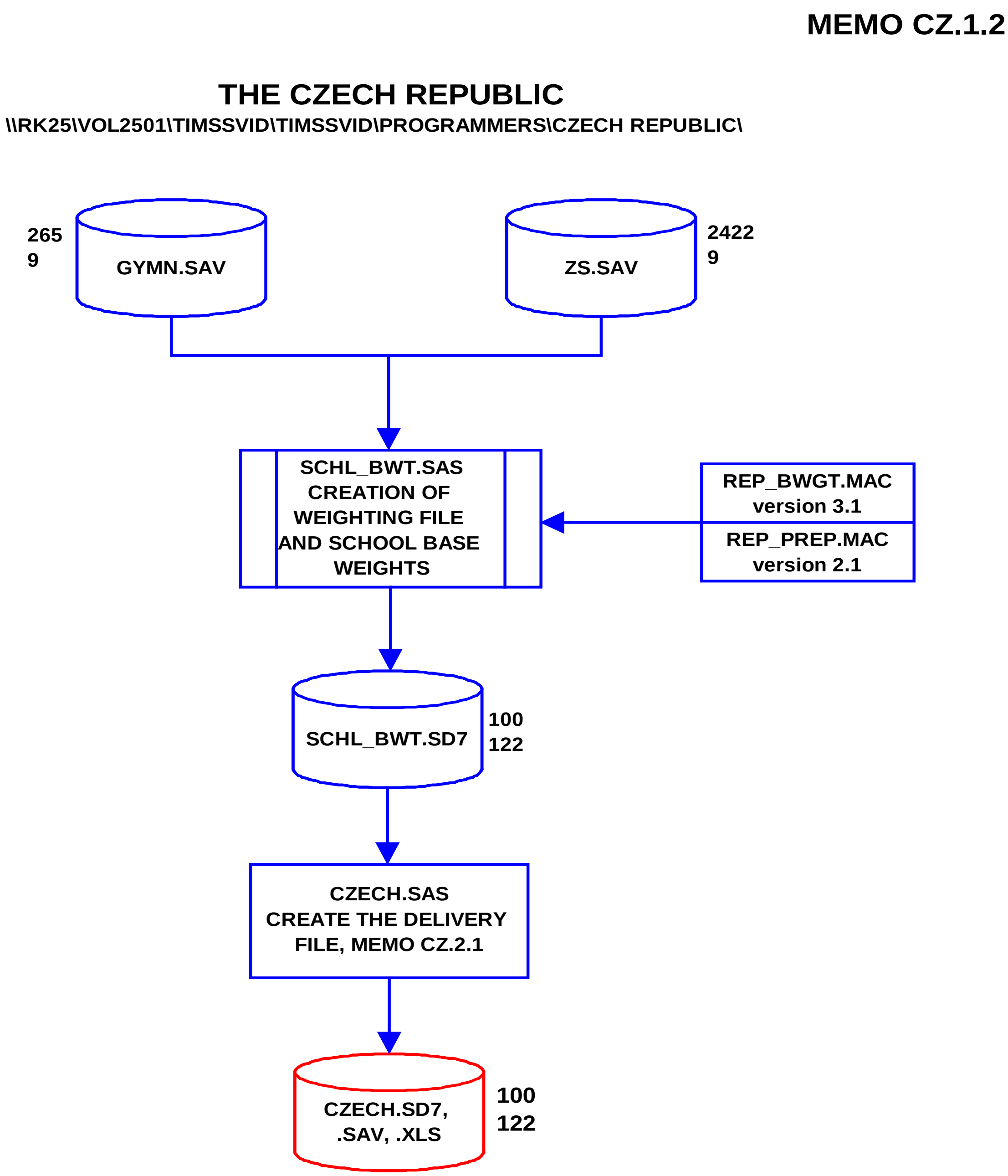
Appendix E: Steps for Weighting the Data for Each Country

Figure E.1. Steps for Weighting the Data for Australia: 1999



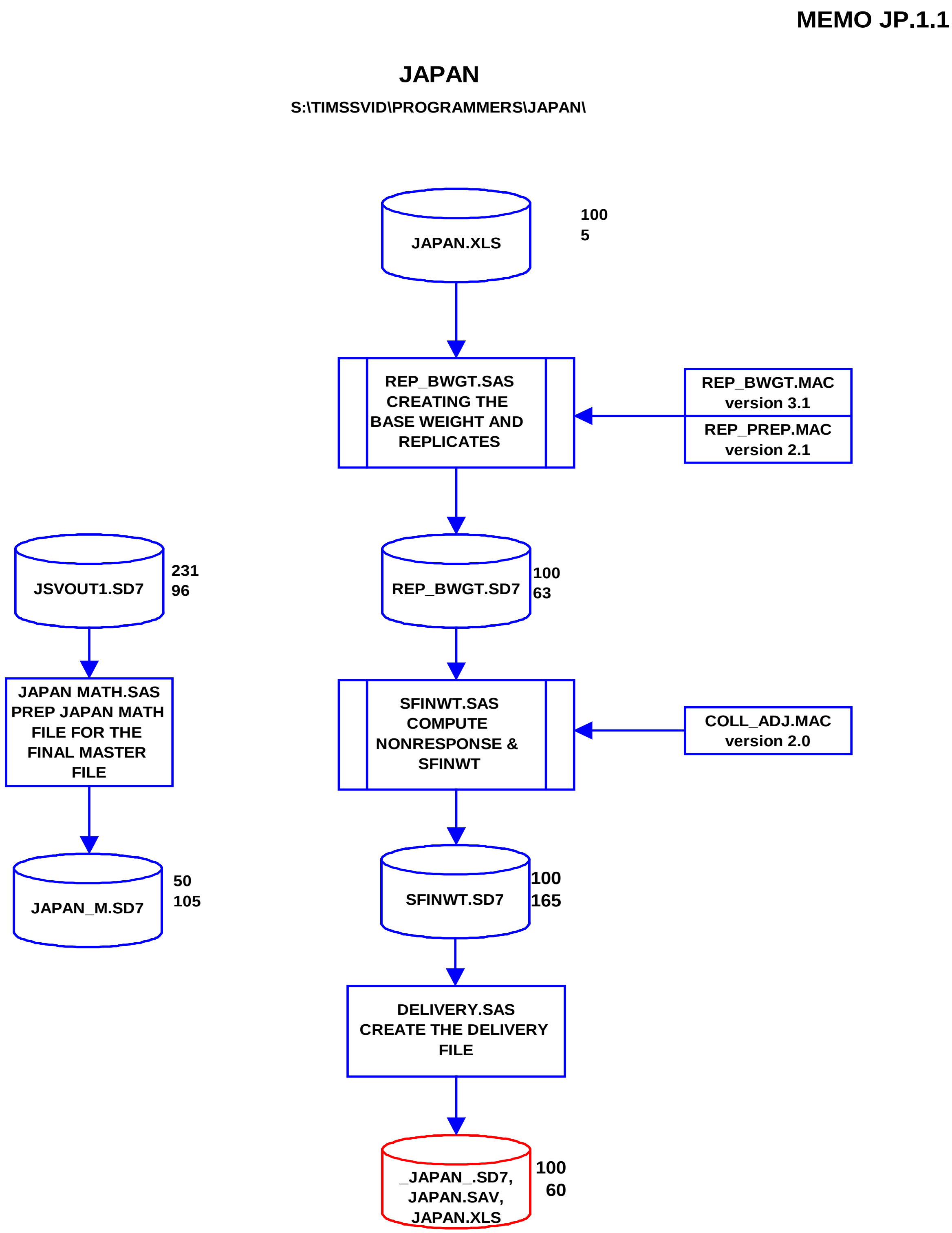
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

Figure E.2. Steps for Weighting the Data for the Czech Republic: 1999



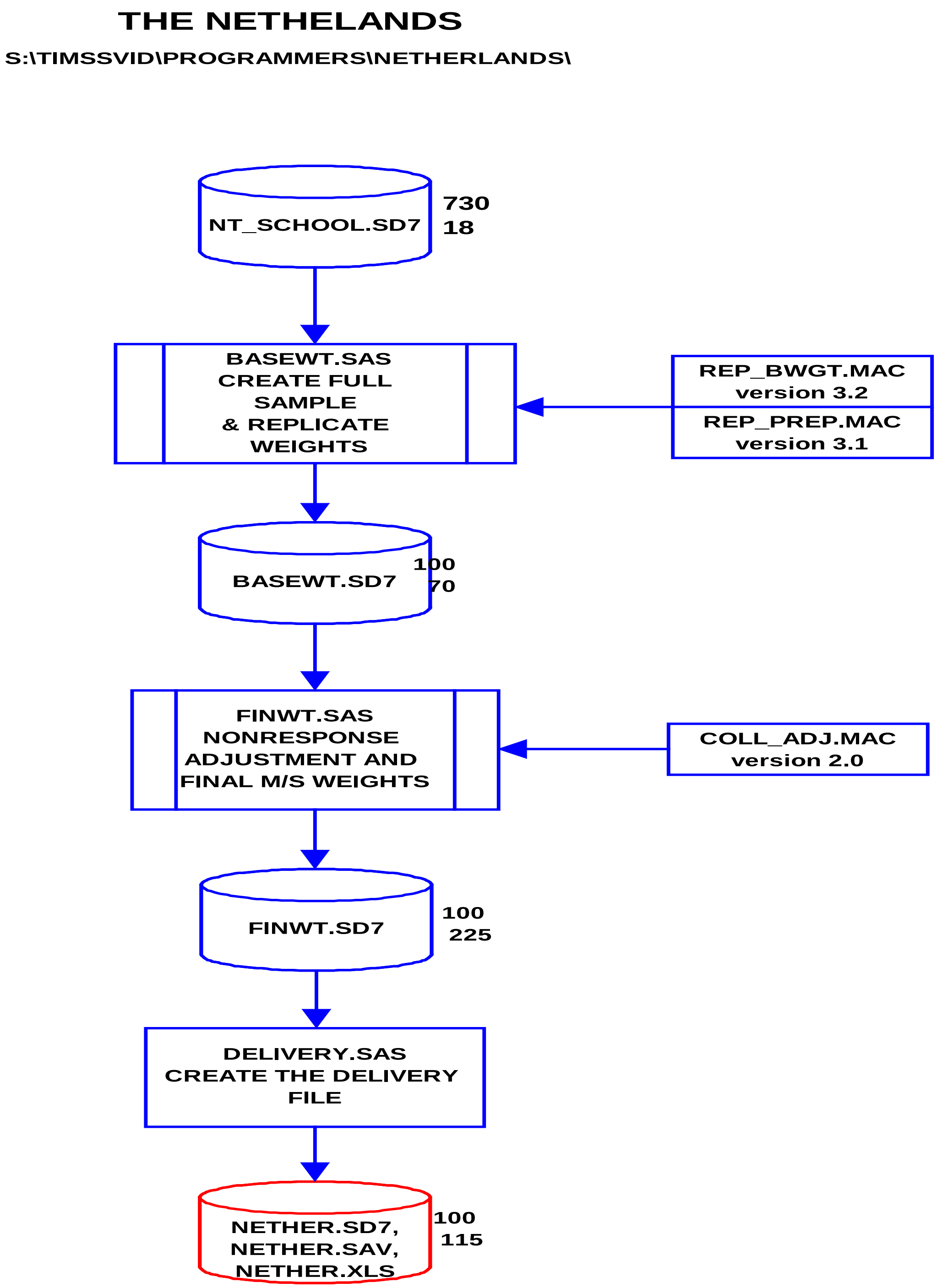
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

Figure E.3. Steps for Weighting the Data for Japan: 1999



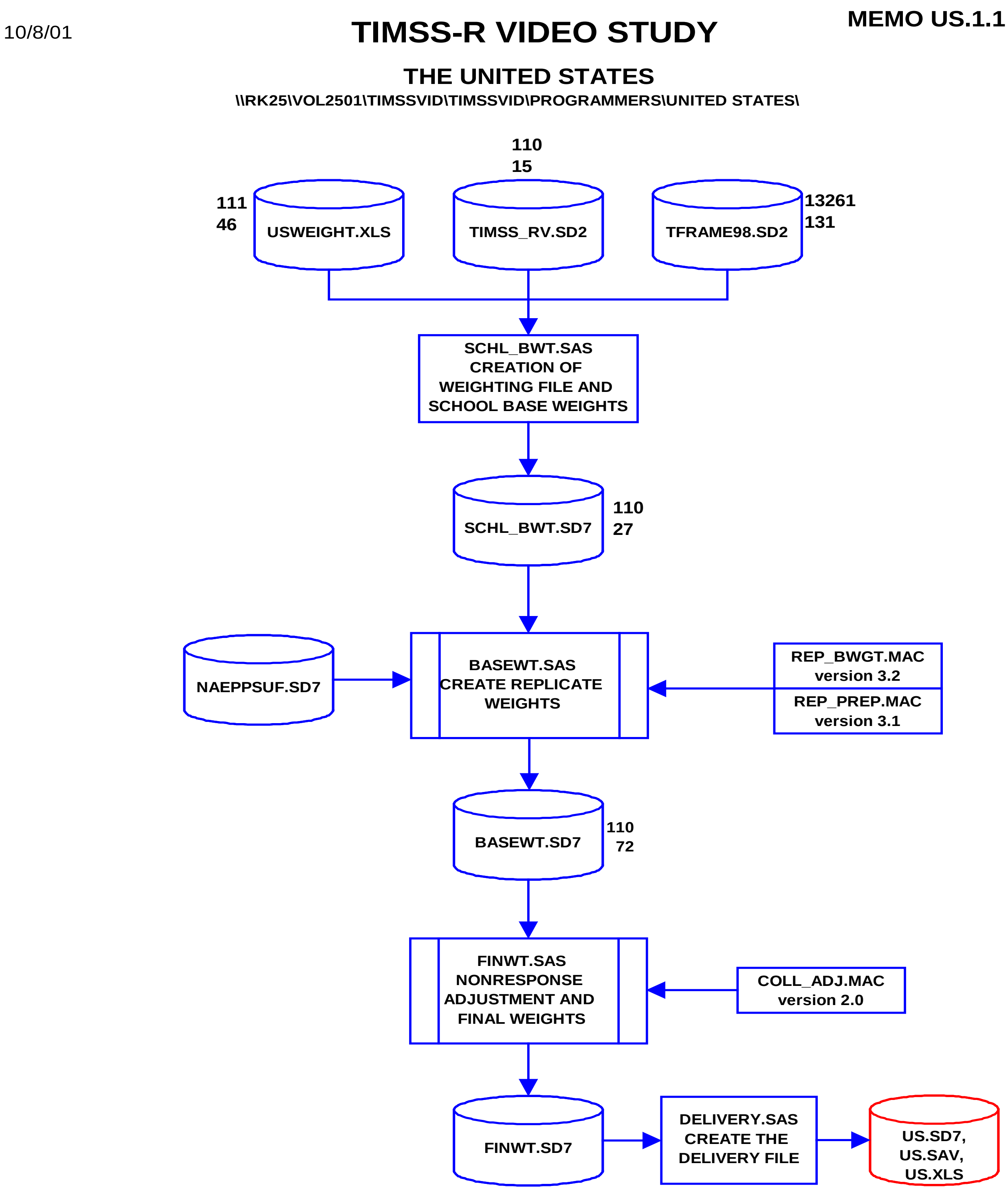
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

Figure E.4. Steps for Weighting the Data for the Netherlands: 1999



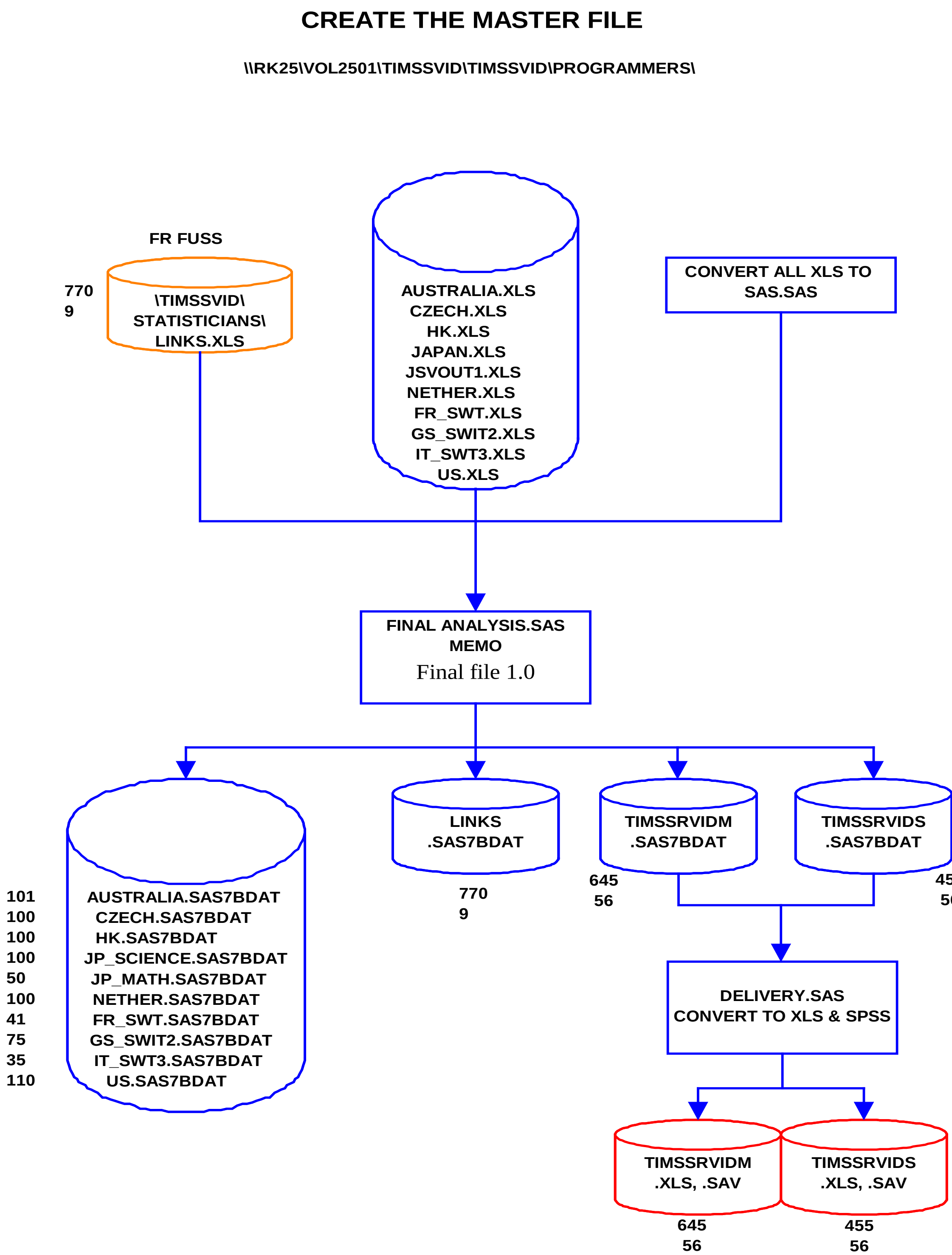
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

Figure E.5. Steps for Weighting the Data for the United States: 1999



SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.

Figure E.6. Steps for Creating the Master File for Weighting the Data: 1999



SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Video Study, 1999.