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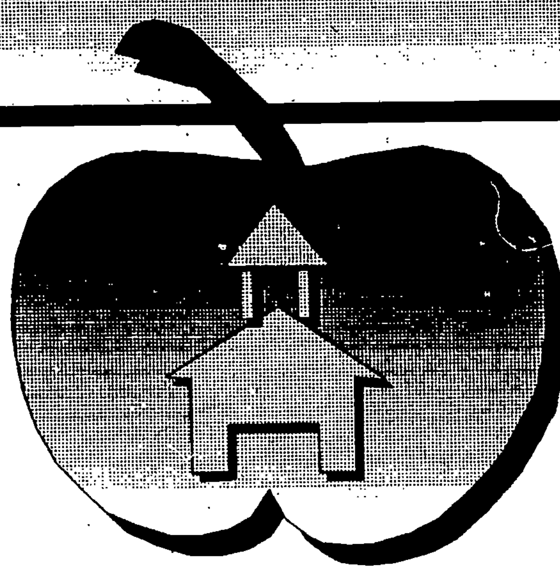
ABSTRACT

A suggested common core of understandings relating to what students in Idaho should know and be able to do in science is presented. The intent of this framework is to provide information which supports educational equity, recognizes the cultural and historical effects on science, and promotes excellence for all students. The following sections are included: (1) Major Shifts in Emphasis for Current Programs; (2) Definitions; (3) A Vision for Science Education in Idaho; (4) Idaho Goals for Science; (5) Secondary Exit Performance Standards; (6) Questions/Answers on Performance Based Education; (7) Guidelines for Writing/Using Performance Scoring Guides; (8) Implementation; (9) Curricular Frameworks; (10) Curricular Alignment; (11) Science Goals/Exit Performance Standards Matrix; (12) The Science Framework; (13) Kindergarten Science Framework; (14) Grade 1 Science Framework; (15) Grade 2 Science Framework; (16) Grade 3 Science Framework; (17) Grade 4 Science Framework; (18) Grade 5 Science Framework; (19) Grade 6-8 Introduction; (20) Grade 6 Science Framework; (21) Grade 7 Science Framework; (22) Grade 8 Science Framework; and (23) Grade 9-12 Science Framework. Contains 16 references. (ZWH)

CONTENT GUIDE AND FRAMEWORK



IDAHO

K-12 SCIENCE CONTENT GUIDE AND FRAMEWORK

1994

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K-12 SCIENCE CONTENT GUIDE AND FRAMEWORK

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The State Department of Education wishes to thank the "Framework Writing Team" for enduring a great deal of frustration and finally agreeing on what a framework for Idaho public school science education should resemble.

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FOREWORD

In February and again in April of 1994, 14 individuals from throughout the state convened in Boise to write Idaho's K-12 Science Content Guide and Framework. This committee was composed of educators involved in classroom teaching from kindergarten through the 12th grade, administrators, college level personnel, staff of the State Department of Education, and both practicing and retired scientists. The committee's resources included materials from other states; Idaho's performance based education documents; the work of "Project 2061: Science for All Americans," a study by the American Association for the Advancement of Science; the National Science Education Standards adopted by the National Committee on Science Education Standards and Assessment; and suggestions from Idaho teachers on the future of science education in Idaho.

This framework has been designed to help schools with the development of a science curriculum and program and to assist in formulating some realistic yet high goals for students. This framework is not intended to outline methods or procedures nor to recommend activities, projects, units, or plans for students and teachers. These are to be developed by local school districts. The State Department of Education recommends that all Idaho public school districts use this framework as a basic resource.

I commend each person who participated in the writing of this framework.

Jerry L. Evans
State Superintendent
of Public Instruction

HISTORY

In 1863, the territorial legislature of the Territory of Idaho established the Office of the Superintendent of Schools. To remind us of what that period of time was like, we need to remind ourselves that it wasn't until America's centennial year, 1876, that Custer made his big mistake at the Little Bighorn. It wasn't until 1886 that Geronimo finally surrendered after leading the U.S. Army all over the southwestern states.

In 1888, the territorial legislature established the Office of the State Board of Education. At the very first meeting of the State Board of Education, the first action taken was to purchase two notebooks for recording their minutes. These original handwritten records are still in existence.

In 1889, the territorial legislature convened a constitutional convention. It was immediately voted upon and adopted by citizens of the territory.

Then, in 1890, Idaho became the forty-third state. It was in 1892 that 18 men met at the University of Chicago to advise the committee of ten on science preparation needed for college admission. They agreed that at least one year of biology followed by one year of chemistry and one year of quantitative physics would best prepare young people to grow up to be just like them. The reports to the committee of ten included the recommendation that "the laboratory records should form part of the test for admission to college." It's interesting to note that this is essentially the curriculum that exists in the United States today. It's been rumored that the reason for the order (biology, chemistry, physics) is because that alphabetically it makes sense.

The major responsibility of the Idaho State Board of Education was teacher certification and the adoption of textbooks. It wasn't until 1945 that the State Board of Education first adopted any science books for use in the public schools. These books were primarily health and environmental education related. Then, in 1950, for the first time science textbooks consisting of the well-known sequence of biology, chemistry, and physics were adopted for the secondary schools.

In 1955, the state adopted, under the title of senior science "recommended for upper division students not taking chemistry or physics," one earth science textbook. The first curriculum guide produced for science was written in 1965, and variations have been produced in five-year cycles since that time. The curriculum guides, kindergarten through twelve, have always followed the separation of the teaching of the physical and life sciences with little change since the very beginning, except for the addition of earth science.

Within recent years a flurry of activity has started following the report A Nation at Risk and the announcement by the president and the National Governors' Association on national education goals and the publication of the National Council of Teachers of Mathematics Standards. Efforts to develop national standards in all content areas have been funded by the U. S. Department of Education. The publication of Project 2061: Science for All Americans and the document setting benchmarks to achieve these goals late in 1993 plus efforts in Idaho to develop performance based education have led to this document. This was the result of the appointment by the State Board of Education in 1991 of a committee to develop a strategic plan for reform of Idaho's public school system. A major priority of this committee was to shift education in Idaho to a performance-based system where instruction focuses on what students are expected to know and be able to do.

To guide that change, a committee called a Goals and Testing Commission was appointed to design the system and a way to measure the system's success. This commission's work has included developing curriculum goals, identifying and describing exit performance standards, and developing and implementing a state-wide assessment program that measures what students know and are able to do.

The Goals and Testing Commission has approved a vision for all Idaho high school graduates, and a set of state frameworks are being prepared for language arts, social studies, mathematics, science, comprehensive health education and physical education, fine arts and humanities, foreign language, and vocational/technical education. These frameworks describe in a general way what students will learn and will provide direction to schools to design their own programs of instruction. This document is an attempt to combine the work from all of these previous resources into a framework for science education for students in Idaho.

This framework represents a suggested common core of understandings relating to what students in Idaho should know and be able to do in science. It is not a curriculum guide, which should be developed at the local level. It is not a course of study guide, which is developed at the state level. Local schools and districts will use the framework as they develop or revise their curriculum guide to specifically reflect the needs of their students. The intent of this framework is to provide information which supports educational equity, recognizes the cultural and historical effects on science, and promotes excellence for all students.

The document delineates Standards, which were derived from the Project 2061 Benchmarks for Science Literacy, Performance Objectives, which reflect what all students will have the opportunity to learn, and Sample Progress Indicators, which are activities or settings in which student performance can be observed. Sample Progress Indicators are examples of activities that reflect the intent of the objectives as they are applied across the curriculum. The Sample Progress Indicators are models of activities that should be modified by teachers, depending on the students, materials, and technology available in their classrooms. Students who successfully complete activities similar to the Sample Progress Indicators are assumed to have met the Performance Objectives at their developmental level.

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TABLE OF CONTENTS

MAJOR SHIFTS IN EMPHASIS FROM CURRENT PROGRAMS

The standards for Idaho students must provide experiences that will allow them to achieve the vision of Idaho education. To accomplish this, a major paradigm shift must be made in the way in which science is organized, taught, and assessed. This is shown in Table 1, which follows:

FROM	TO
Science for some	Science for all
Behavior Based Behavioral objectives - learning is based on measurable behaviors	Constructivist Based Conceptual objectives - learning is based on constructing meaningful concepts/learning
Text based Passive Confirmatory investigation Fact oriented Teacher demonstrations	Hands-on/Minds-on Active Problem-solving investigation Concept oriented Labs/Field experiences
Science is seen as a single subject with little relationship to mathematics, social studies, language arts, art, or music.	Science is seen as part of an interdisciplinary world; emphasis is on relating science to the students' world, which is not compartmentalized.
The teacher imparts knowledge and students learn it; communication is generally one-way.	The teacher is a facilitator of learning and a learner as well; students are learners and teachers in some situations; networks emerge instead of one-way forms of communication.
Limited use of technology	Full integration of appropriate technology in instruction
Exclusive use of whole group instruction. The teacher imparts knowledge and students learn it; communication is generally one-way.	Students work independently in teams and become self-motivated learners.
Competitive learning	Cooperative learning
Exclusive use of paper and pencil assessment	Multidimensional assessment; assessment integrated with instruction
Many science topics covered with little depth.	Few science topics covered with more depth.
Single exposure	Spiral curriculum

Table 1

DEFINITIONS

Following are definitions of some of the educational vocabulary as used in this document.

CONTENT GUIDE -- The described necessary content that is most compelling in a discipline. It covers the basic skills and all the concepts that lead to what it is a student should know and be able to do at the various levels of the discipline.

FRAMEWORK -- A design that "frames" a series of critical components describing what we teach and how we assess it. It gives "unity" to what we do in that discipline. It is hoped that the state framework provides a model for school districts to use in their development of district frameworks that could also describe how a concept will be taught.

STRAND -- One learning segment of a standard. It may be called a theme.

STANDARD -- A broad description of what a student should know and be able to do.

GOAL -- A broad description of what is important in achieving proficiency in a standard.

OBJECTIVE -- A specific statement that describes what will be learned to reach the goal.

BENCHMARK -- A description of what a student should know and be able to do at a specified time. In Idaho, that time has been established at the 4th, 8th, and 12th grade levels. In science, it is at the 2nd, 5th, 8th, and 12th grade levels.

SAMPLE PROGRESS INDICATOR -- Problems or situations that teachers and students may use to assess and demonstrate student capability and performance. Performance on progress indicators will help students establish progress toward benchmark achievement within a standard and on the performance assessments administered at the 2nd, 5th, 8th, and 12th grade levels.

PERFORMANCE ASSESSMENT EXAMPLES -- A set of problems or situations that model similar problems or situations that will be found in the performance assessment.

PERFORMANCE ASSESSMENT SCORING STANDARD -- The holistic or analytical scoring device that will be used to score a performance assessment. It consists of a scoring standard and the traits that must be exhibited to demonstrate achievement at that scoring standard.

EXIT PERFORMANCE STANDARDS -- The final established benchmark describing a student as he/she exits our school at the 12th grade. It describes quite precisely what it is you want the student to know and be able to do when he/she exits the system.

PERFORMANCE ASSESSMENT -- An assessment in which students must demonstrate what they know and are able to do.

A VISION FOR SCIENCE EDUCATION IN IDAHO

A vision is a picture of the future, just beyond the grasp of those involved but so compelling as to make people want to attain it. A vision for Idaho science education is based on several principles similar to those developed by the National Committee on Science Education Standards and the National Educational Standards.

* All students should have the opportunity to learn science.
* With appropriate opportunities, all students can learn science.
* Students should learn science in ways that reflect the modes of inquiry that scientists use to understand the natural world.
* Learning is an active process that occurs best when students act as individuals who are members of a community of learners.
* The quantity of factual science knowledge that all students are expected to learn needs to be reduced so that students can develop a deeper understanding of science and science content.
* Teaching and assessment need to be considered in context and in relationship to each other.

The vision for Idaho education adopted by the Goals and Testing Commission follows. Through equal access to quality education, all Idaho high school graduates will understand and value life-long learning and possess the knowledge, skills, and attitudes necessary to:

* learn
* use critical thinking and reasoning ability to solve problems
* work independently and in groups
* communicate effectively in all forms
* understand, integrate, and use information and knowledge
* maintain personal, emotional, and physical well-being
* contribute to society as caring, responsible, and thoughtful citizens, and
* understand and appreciate ethnic and racial differences.

IDAHO GOALS FOR SCIENCE

Careful attention to system, program, assessment, and teaching standards will enable goals for science education to be met for all Idaho graduates. The term "all Idaho graduates" means students from a broad range of backgrounds and circumstances, including disadvantaged students, students with different racial and ethnic backgrounds, students with disability, students with limited English proficiency, and academically talented students.

The goals that have been defined for science education are:

GOAL 1 All students will have equal access to instruction and the study of science.

Students must be provided the necessary facilities and resources, from buildings to lab equipment, to study and learn science.

GOAL 2 All students will be able to understand the scientific component of issues that broadly impact their future.

As new problems and issues arise, students must be able to make the connections between present knowledge and how that knowledge can be used to help solve problems we will encounter in the future.

GOAL 3 All students will develop skills in critical thinking, logic, and problem-solving.

Tools such as mathematics and new technologies are essential for productive participation in society.

GOAL 4 All students will develop positive attitudes toward learning science.

Students who are excited and enthusiastic about the world around them and view the world from a scientific point of view will always be open to new learning.

GOAL 5 All students will become confident in their own scientific abilities.

Students need to understand and be able to distinguish between what is truly scientific and what is popular misconception or superstition.

GOAL 6 All students will understand the empirical nature of science as one method of knowing about the universe.

Science questions all things, rejects the labeling of statements as unalterable, and opens itself to continual scrutiny and modification.

SECONDARY EXIT PERFORMANCE STANDARDS

The Secondary Exit Performance Standards for high school graduates require mastery of basic skills and subject knowledge. Students' proficiency in these Performance Standards will be measured through a variety of tasks included in the statewide testing program.

An Idaho high school graduate

- **communicates effectively.**
- **uses knowledge, information, and technology effectively.**
- **solves problems.**
- **is creative and original.**
- **determines quality.**
- **collaborates with others.**
- **is a lifelong learner.**

What follows is a more complete statement of each standard and a list of traits which describe each standard in more detail.

1. **An Idaho high school graduate communicates effectively in written, oral, and multimedia forms, such as audio and video recorded presentations, charts, graphs, visual aids, and computer enhanced presentations.**

LIST OF TRAITS

* Ideas and Content -- The communication is clear, focused, interesting, and appropriate for the audience. Details and anecdotes demonstrate a command of the subject.
* Organization -- The communication addresses issues clearly and directly.
* Voice -- The communication speaks appropriately and directly to the audience in a way that is individualistic, expressive, and engaging.
* Form -- The chosen form of communication conveys the intended message.
* Conventions -- The communication includes appropriate use of grammar, capitalization, punctuation, usage, spelling, and paragraphing.

2. **An Idaho high school graduate locates, organizes, and uses knowledge, information, and technology effectively.**

LIST OF TRAITS

* Reading -- The student reads with accuracy and understanding.

* Active Listening -- The listener understands and evaluates verbal and nonverbal information and responds appropriately to the speaker.

* Identification of Sources -- Sources of knowledge and information are identified and used efficiently. Information technology is used appropriately.

* Organization of Information -- Information is effectively organized, using clear criteria to select materials.

3. **An Idaho high school graduate identifies and describes problems or issues and develops effective strategies for addressing those concerns.**

LIST OF TRAITS

* Presentation of Components -- The issue is clearly described, using figures, diagrams, or models as appropriate.

* Development and Implementation Strategies -- Clear and effective strategies for solving or addressing problems or issues are identified, implemented, and evaluated.

* Verification of Results -- Results are related to prior knowledge and evaluated for reasonableness.

4. **An Idaho high school graduate demonstrates creativity and originality in the design, production, and presentation of activities.**

LIST OF TRAITS

* Creativity and Originality -- Innovative methods of design, production, and presentation are developed, leading to new understanding, methods, or products.

5. **An Idaho high school graduate critiques and evaluates the quality of work products and processes.**

LIST OF TRAITS

* Group and Self-evaluation -- Individuals and groups are able to critique their own work and the work of others.

* Identification of Strengths -- Evidence of ability, talent, and knowledge are identified within the performance and related to previous performances.

* Identification of Weaknesses -- Areas for further improvement are identified, and ideas for improvements are discussed.

6. **An Idaho high school graduate demonstrates the ability and skills to work collaboratively.**

LIST OF TRAITS

* Monitor Behavior -- In group activities, the individual monitors and evaluates his or her behavior and demonstrates consideration for individual differences.

* Team Skills -- Active listening and participation skills are used in group activities.

* Provide Feedback -- Constructive comments on cooperative work are given and received.

* Group Functioning -- How the group does its work is assessed and managed, with conflict resolution skills used to solve problems.

* Ethnic and Racial Differences -- Learn to live in a changing society with mutual respect and appreciation for others.

7. **An Idaho high school graduate demonstrates characteristics of an effective lifelong learner.**

LIST OF TRAITS

* Vision -- Goals and priorities are identified.

* Self-esteem -- A positive vision of self and others is developed. A positive desire to learn is demonstrated.

* Initiative and Perseverance -- The desire and ability to plan, implement, and conclude a project over time is demonstrated.

* Responsibility -- Responsibility for personal actions is demonstrated.

* Adaptability -- Changes and challenges are dealt with in a positive way. Plans and actions are modified appropriately in response to changing circumstances.

* Skills of Strategic Learner -- A variety of strategies for learning are developed and used.

QUESTIONS AND ANSWERS ON PERFORMANCE BASED EDUCATION

Why should Idaho change tc performance based education?

The world is changing. As our society moves from the industrial age to the information age, schools must be redesigned to prepare students for the future. To be successful, students must become lifelong learners who can work with others, communicate clearly, apply what they have learned in practical ways, recognize quality, and be creative and original problem solvers. Performance based education ensures that students master both traditional basic skills (phonics, reading, writing, math, spelling, grammar, social studies, and science inquiry) and additional basic skills that emphasize application and use of what has been learned.

What is performance based education?

Performance based education clearly defines what students are expected to know and be able to do with that knowledge. Students are periodically tested or assessed to determine their progress, and each student is given needed time and assistance to become proficient. Students who show meaningful progress or skill development are advanced to more challenging material.

What are additional basic skills?

In Idaho we call them *exit performance standards*. We believe that besides demonstrating proficiency in the traditional basics, students who graduate from Idaho high schools must be able to

1) communicate clearly and effectively.
2) use knowledge and information effectively.
3) solve problems.
4) be creative and original.
5) determine quality.
6) work cooperatively with others, and
7) learn effectively throughout life.

These *exit performance standards* are additional basics that students must acquire in order to live and work in a complex and changing world.

How is performance based education different from traditional teaching methods?

In traditional methods, teachers present material, students study and do homework, students are tested, the grades are recorded, and the class moves on to the next topic--whether or not everyone has learned the information.

In performance based education, a student must demonstrate what he/she knows and is able to do in a given discipline. Thus, performance based education is more attentive to the individual student's progress.

Does performance based education "dummy down" the curriculum so that all students are learning less?

Just the opposite. Performance based education sets uniform standards for all students. To show proficiency, a student has to meet a rigorous predetermined standard. Because the standards set high expectations for all students, students will learn more. Idaho's own Direct Writing Assessment program, now in its tenth year, is a good example: the quality of students' writing has improved during this time, because the tough standards go hand-in-hand with solid preparation.

How does performance based education teach students to think?

Performance based education requires students to analyze, synthesize, evaluate, internalize, and apply what they have learned. Students are also taught to evaluate their own progress and set goals for improvement.

What are the differences between traditional testing and performance based assessment?

A traditional pencil and paper test requires that students show what they have learned. They do not have to demonstrate what they can do with what they know, and they are not able to demonstrate the depth and breadth of their knowledge. Often grades are reported as the percentage of test questions answered correctly. It is possible to receive credit by mastering as little as 60 percent of the information (usually a "D").

In a performance assessment, students are expected to answer two questions: *What do you know?* and *What can you do with what you know?* Students show their basic knowledge and understanding through a variety of activities that demonstrate their level of proficiency. This kind of assessment not only requires thorough knowledge of the basic skills, but demands that students demonstrate this knowledge through projects, performances, experiments, research, essays, critiques, and other practical ways.

What are performance based assessment standards?

Performance based assessment standards describe the student's level of proficiency in meeting the *exit performance standards*:

4) **Advanced:** The student goes beyond the basic requirements, demonstrates a thorough understanding of the exit performance standards, and communicates those concepts clearly and easily.

3) **Proficient:** The student meets the basic requirements and communicates these concepts clearly and easily.

2) **Developing toward Proficiency:** The student meets some, but not all, of the basic requirements. He or she has difficulty in communication.

1) **Minimum Development toward Proficiency:** The student meets few of the basic requirements set forth in the *exit performance standards* and is unable to communicate in a clear and thoughtful way.

How will changing to performance based assessment affect classroom teaching?

Classrooms of the future may look quite different. Instead of the teacher standing in front of the room lecturing for 50 minutes, students will work separately--and together--to produce products (writing portfolios, art portfolios, exhibits, plays, poems, science experiments, math demonstrations) or performances (typing tests, dramatic and musical performances, or oral debates). The teacher will decide on the content and purpose of each lesson, but the students will learn through active involvement.

Does performance based assessment replace college entrance exams?

No. A number of colleges, however, are no longer requiring students to take entrance exams but are requesting that students send "portfolios" (collections) of their work in a particular subject. A performance assessment would be an important part of a student's portfolio.

What happens to the gifted and talented student?

Performance based assessment is particularly good for the gifted and talented student. Now students only demonstrate their proficiency to the limit of the traditional test. With open-ended performance based assessment, these students can truly demonstrate their gifts and talents. Thus, gifted students are identified early and given more challenging material.

Does performance based education teach "values clarification"?

No. What it does is require students to go beyond the memorization of facts and show how to use what they know.

Will performance based assessment take place at every grade level?

Yes, although often this is informal assessment by teachers. Formal assessment will probably occur at grades 4, 8, and 11. Students will also be tested in traditional ways so that their progress can be compared to national scores.

GUIDELINES FOR WRITING AND USING PERFORMANCE SCORING GUIDES

1. Decide upon the performance you want to assess. Is it a student product or a process? If the performance includes both a **process** and a **product**, use two **separate** scoring guides. Students (and teachers) become confused when too many performances are assessed at the same time.

2. Refer to the **State of Idaho Exit Performance Standards** to **select area(s)** under which the performance falls. Many performances include more than one target or exit performance. For example, an essay may include the target of effective communication and quality work. If the teacher is also assessing the process of gathering information and writing the essay, another assessment guide may include collaborative work or independent learning. A science laboratory report may include the performances of effective communication and problem-solving. Teacher observations of students "doing" science may include collaborative work and quality producer.

3. Once you have decided which targets are involved in the performance, **identify the traits under these targets.** These will be the essential elements for your performance assessment. Identify criteria for each essential element so that the criteria describe the student's level of proficiency. Levels of proficiency described by the State of Idaho are as follows: 4 - Advanced, 3 - Proficient, 2 - Developing toward Proficiency, and 1 - Minimum Development toward Proficiency.

4. Begin to write your scoring guide by **linking each of the original elements and descriptions to the specific performance** you will have your students undertake. Check to make certain that the 4-3-2-1 labels and descriptions are **consistent** with the state guidelines. Now, it's time to **add the specific content you want** to see in the performance you are about to assess. Many teachers simply add a separate category titled Content to the Scoring Guide.

5. Once you have a draft of your scoring guide, write another **guide in student language.** The student guide should be given to students when you assign the performance.

6. All scoring guides begin as analytical guides, because it is important to identify levels of performance for each element. Analytical guides have greater explanatory and diagnostic power than holistic guides. If desired, any analytical guide can be turned into a holistic guide by simply taking all criteria for a "4" and placing it under one heading. The same is done with criteria for a 3, a 2, and a 1.

7. If necessary, revise your scoring guide and **make copies available to students.** Begin to write range finders (examples of student work that demonstrate the different levels of performance) that show students what the different levels of performance look

like. Range finders may be taken from actual student work if you take care not to embarrass students.

8. Have the students use the scoring guide with the range finders and with either their own or peer work. This is important because **students must internalize the criteria** in order to make progress.

9. A performance may be a **subset** of one of the exit performances. For example, a teacher may decide that students need practice in the skill of analysis. Analysis is a subset of the problem-solving exit performance. Before writing a scoring guide for a performance that is a part of a larger area, identify the "big outcome" to the students and communicate where the performance fits into the exit performance. Match your essential elements to those identified in the generic scoring guide for that performance. Doing this will help students transfer skills from one class to another. Northwest Regional Laboratory's classroom assessment tapes provide information about skills that fit under the state exit performances.

10. Remember that performances involve the simultaneous application of many skills. Students find if difficult to draw upon several skills at one time. Sustained practice over a long period of time is necessary for students to develop the types of skills required in complex performances. Agreement among teachers about the rules students will follow is critical to student success.

IMPLEMENTATION

Implementation of a science program is influenced by more than **Science Standards.** Implementation also depends upon the system, the science program, assessment practices, and teaching practices. The purpose of describing system, program, assessment, and teaching standards is to illustrate what should be attained. Standards offer coherent guidelines that ensure that all parts of the system are moving forward in unison.

I. System Standards

The Idaho State Legislature, Department of Education, local school boards, and administrators can take specific action to implement the substance of this document. Actions that can facilitate implementation include the following areas:

A. Assessment

* Align assessment policy with the **Science Framework** and assessments.
* Self-assessment becomes an inherent part of assessment.

B. Teacher preparation and certification

* Teacher preparation, inservice training, and certification policies match teaching standards.

C. Communication

* Communication regarding science standards is coherent and consistent among local, regional, and national groups.
* Educators have access to information services.

D. Resource allocation

* Consistent with teaching and program standards.
* Aligned with principles equity.

E. Evaluation of educators

* Realign personnel evaluation criteria to reflect current standards of practice in assessment, instruction, and professional development.

II. Program Standards

Local districts provide resources that enable educators to design a coherent K-12 science program.

A. Science education programs are consistent and coherent.

* Critical learnings and expected outcomes are clearly understood by the entire educational community.

* Themes, habits of mind, and content strands are aligned and articulated among grade levels.
* Instruction and assessment are consistent with benchmarks.

B. Program design criteria aligned with standards and coordinated.

* Consistent with the developmental nature of students.
* Emphasizes investigation and inquiry as the means to developing scientific literacy.

C. Science program is coordinated with mathematics, language arts, and social studies.

* Subject matter is integrated so that interdisciplinary connections are a natural by-product of the curriculum.
* K-12 science education program and K-12 mathematics program are coordinated.
* Mathematics is used as a tool which enhances the understanding of science.

D. Program resources are appropriate and sufficient.

* Access to appropriate planning time, sufficient laboratory space, equipment, and personnel.

E. Program promotes an atmosphere of cooperative learning, trust, and interaction.

* K-12 science education program provides opportunity to learn science; is consistent with scientific attitudes, habits of mind, and values; promotes ability to work in groups; and extends responsibility for learning to the student.

F. Program places a high priority on equity.

* K-12 science program must meet each student's needs regardless of background, circumstance, primary language, or life goals.
* K-12 science program provides all students with opportunities and guidance to achieve the desired outcome defined by the science framework.
* Provides access to facilities, material, and equipment; quality teaching; and a heterogeneous community of learners.

III. Assessment Standards

A. Assess and evaluate critical learnings and outcome.

* Assessment and evaluation activities focus on the science that is most important for students to know and do.

B. Substance of assessment is consistent with teaching standards.

C. Evaluation and assessments are used as a basis for decision making.

* Assessments inform about students and are a part of program evaluation.
* Assessments and evaluations are valid and reliable.

D. Assessment Equity

* Practices are fair to all who are assessed by accommodating the needs of all students.

E. Involve teachers and students in assessment activities.

* Assessment process involves science teachers and other professionals in the design, development, and interpretation of assessment activities and the resulting information.
* Self-assessment is an integral part of student learning.
* Assessment is interdependent for both teachers and students.

F. Assess opportunity to learn and attainment.

* Assessment focuses both on program evaluation and on student attainment.
* Opportunity to learn will depend on teacher competence, equity treatment, support for teachers, and resources for teaching and learning.

G. Assessment design is determined by use of information.

* Design of the assessment process is determined by the intended use of the resulting information.

IV. Teaching Standards

A. Teacher planning and unit design is based on critical learning and outcome described in the science framework.

* Guided by content standards.
* Based on best research of how science is taught and learned.

B. Teachers guide and facilitate learning.

* Interacts positively with students.
* Recognizes diversity.
* Engages all students in learning experiences.
* Challenges all students to be responsible individuals and collaborative learners.

* Provides students with exemplary habits of thinking, curiosity, and creativity.

C. Teachers assess learning and analyze results to guide instruction.

* Teachers trained in assessment and evaluation.
* Teachers trained in instructional strategies.

D. Teachers facilitate an atmosphere of cooperative learning, trust, and interaction.

* Teachers establish a learning community that engages students with: scientific habits of mind, attitudes, and values; respect for ideas and experiences; student voice in decisions and responsibility for learning; collaborative approach to experiences and learning; and shared understanding of the rules of scientific discourse.

E. Teachers design and manage the physical environment.

* Teachers provide students time, space, and resources consistent with best research.
* Design and management of the physical environment provide student opportunities for: extended investigations; in-depth inquiry; flexible exploration; hands-on investigation; a safe setting; appropriate print and material resources; out-of-school resource use; and opportunities for student-designed investigation.

F. Professional development standards.

* Professional development plans support and enhance teaching standards in science and include: training in laboratory science methods; safety training; assessment training; and inspire a thirst for learning and reflective practice.

V. Student Standards

Embedded in Standards I-IV is the assumption that students are responsible for their own learning. Students can facilitate responsibility for learning by:

A. Regular attendance.

B. Preparation for class.

C. Contributing to the learning environment.

D. Demonstrating scientific habits of mind.

VI. Parent Standards

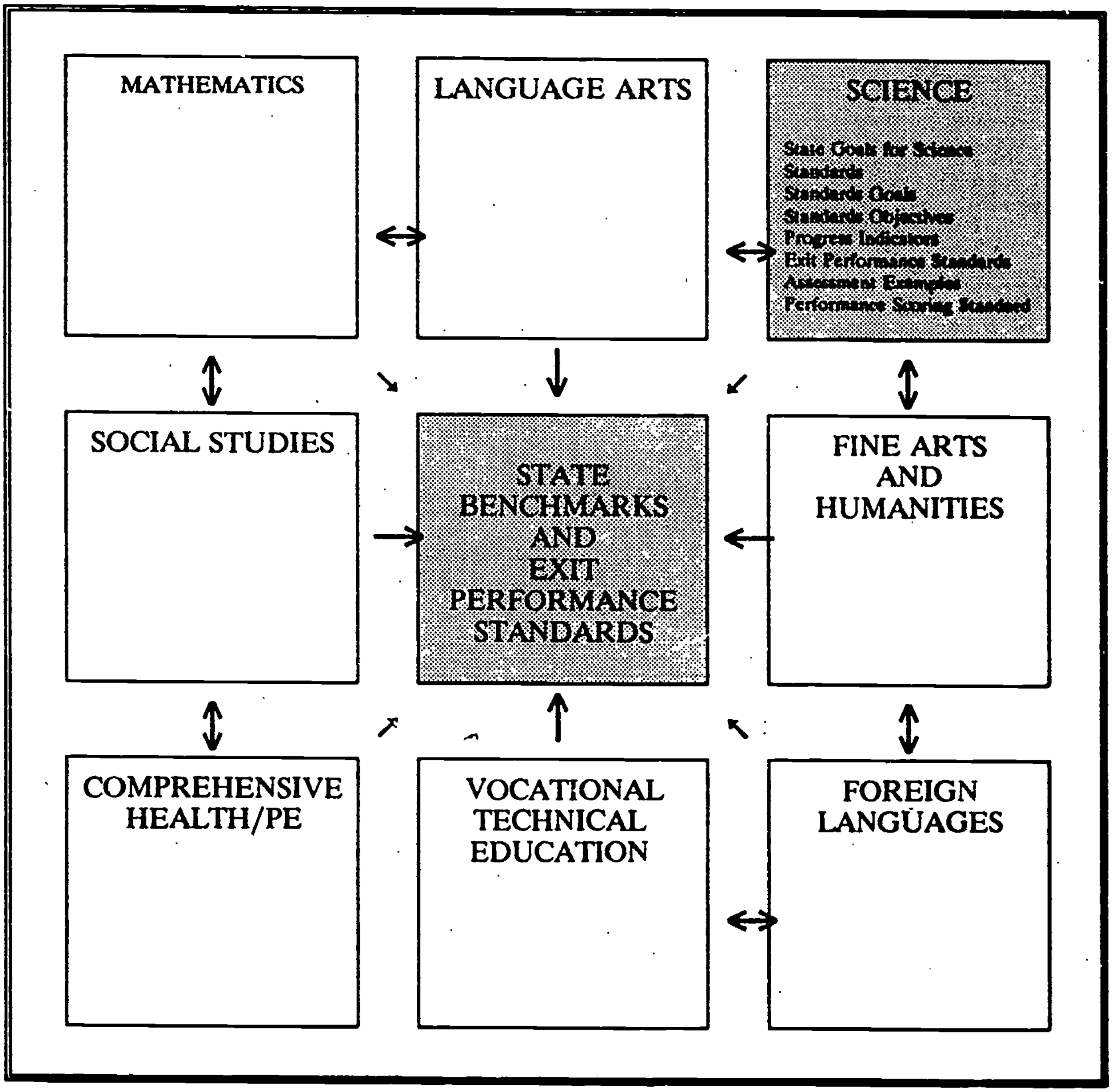
A. (Left blank on purpose)

CURRICULAR FRAMEWORKS

The Idaho Performance Based Educational System is focused on Exit Performance Standards that describe what students know and can do when they graduate from high school. Benchmarks provide opportunities to assess students' progress toward accomplishment of the Exit Performance Standards.

The Curricular Frameworks desc:ibe the scope and sequence of instruction and learning within each curriculum area. Working from the foundation of State Curriculum Goals and Content Standards, Grade-level Goals and Objectives have been identified. Recommended teaching and assessment practices are included.

Collectively the Curricular Frameworks address the Exit Performance Standards by encouraging the integration of student learning across the curriculum areas. The integration of learning is supported by the acquisition of knowledge and skill in each curriculum area, and it is enhanced by encouraging integrated instruction.



CURRICULAR ALIGNMENT

IDAHO GOALS

Broad description of what is important
in achieving proficiency in each subject area.

↗ ↖

↗ ↖

↙ ↘

↙ ↘

EXIT PERFORMANCE STANDARDS ← ← → → **CURRICULAR FRAMEWORKS**

What high school graduates know and are able to do.

A design that "Frames" a series of <u>critical components</u> describing <u>what we teach and how we assess it.</u>

IDAHO SCIENCE GOALS/EXIT PERFORMANCE STANDARDS MATRIX

A science program designed around the subject area goals will challenge students to progress toward achieving the Exit Performance Standards. Following is a matrix illustrating the relationship between the Idaho Goals for Science and the Exit Performance Standards.

GOALS ↓	EXIT PERFORMANCE STANDARDS						
	COMMUNICATES EFFECTIVELY	USES KNOWLEDGE EFFECTIVELY	SOLVES PROBLEMS EFFECTIVELY	IS CREATIVE AND ORIGINAL	DETERMINES QUALITY	COLLABORATES WITH OTHERS	IS A LIFELONG LEARNER
EQUAL ACCESS	X	X	X	X	X	X	X
UNDERSTANDS SCIENCE ISSUES	X	X	X	X	X	X	X
CRITICAL THINKING SKILLS	X	X	X	X	X		X
POSITIVE SCIENCE ATTITUDES	X	X	X	X			X
CONFIDENCE IN SCIENTIFIC ABILITIES	X	X	X	X	X	X	
NATURE OF SCIENTIFIC KNOWING	X	X	X	X	X		X

An **X** in a cell indicates that specific goal addresses achievement in that specific exit performance standard.

THE SCIENCE FRAMEWORK

You will find this framework document to be different from other frameworks you have encountered in the past. It is different in that there are only seven goals organized under three standards, and the goals and standards are the same for each grade level. These goals represent the important habits of mind, themes, and nature of science that make science a unique human endeavor. You will not find the state specifying that life science be taught at grade 7 or weather be covered at grade 4 as with previous frameworks documents. The specific content at each grade level is intended to be a local decision, with the exception of those content items stated as a performance objective.

Performance based classroom activities should be designed to incorporate all three standards and as many of the goals as possible simultaneously. Classroom activities should differ from grade to grade by the content and the level of difficulty. All activities must be developmentally appropriate for the target age group. The content can be locally determined to follow students' interests or to cover designated topics as specified by the district.

The authors of this framework sincerely believe that, for any given science topic, classroom activities exist that address all of the standards and goals contained in this document simultaneously at levels developmentally appropriate for any age group. This approach calls for a shift away from teaching science as a collection of isolated facts and terms toward a hands-on approach where students do science and come to understand and value science as a tool for understanding the world around them.

KINDERGARTEN

Introduction

In kindergarten, each simple experience leads to a new experience and expands the child's range of awareness. These experiences also encourage the child's natural inquisitiveness so that basic scientific concepts can be achieved without formally introducing science to the class. In addition to the usual probing children do, some science activities can be planned to foster a new consciousness of the world and its wonders.

Kindergarten experiences build a foundation for understanding change and constancy, systems and interactions, and models. The recommended method for developing a concept in kindergarten involves questioning, collecting data, analyzing the data, and, when possible, explaining. The emphasis is on "learning by doing."

Kindergarten students gain a beginning awareness of the study of science and the work of scientists. Kindergarten experiences can be structured to bring gradual awareness of the interactions of science, technology, and society. Children learn how science and technology affect the way they live.

STANDARD I. **HABITS OF THE MIND.** These are the universal thinking, communication, and problem-solving skills involved in all disciplines. They are best learned as processes within an authentic context rather than in isolation. Mathematical skills and reasoning are especially important in developing these habits of the mind in science.

GOAL A. **SCIENCE PROCESSES.** All students will

- practice science that emphasizes scientific process skills.

SCIENCE PROCESS SKILLS

Ask Questions By	Collecting Data By	Analyzing Data By	Explaining By
Noting Patterns	Observing	Predicting	Describing
Noting Discrepant Events	Measuring and Quantifying	Inferring	Defining
Seeking Information	Identifying Significance	Tabulating	Interpreting
Formulating Questions	Selecting Variables	Using Numbers	Developing Models
Mental Generating Hypotheses	Estimating	Correlating	Developing Physical Models
		Classifying	Communicating

Performance based skills are associated with each specific action.

TABLE 2

PERFORMANCE OBJECTIVES. All students will

- use their senses to explain why a person can sometimes get different information about the same thing by moving closer to it or further away from it.
- describe things as accurately as possible and compare their observations with those of others.
- learn about something around them by doing something to it and noting what happens.
- know the needs of living things and provide for them in the classroom or at home.
- create patterns by putting different shapes together or taking them apart.
- use numbers and shapes to tell about things.
- appropriately use common tools and equipment such as a VCR, tape recorder, etc.

SAMPLE PROGRESS INDICATORS.

- Teacher claps a rhythm that changes in a regular way, and students continue the pattern.
- Given an assortment of natural objects (e.g., leaves, seeds, shells, etc.,), students classify them by their physical characteristics.

GOAL B. VALUES. All students will

- practice science that develops the following attributes:

  value of scientific inquiry
  appreciation of technology
  honesty
  curiosity
  open-mindedness
  skepticism
  wonder
  perseverance
  enthusiasm

PERFORMANCE OBJECTIVES. All students will

- exhibit curiosity and wonder while exploring the natural world.

- ask scientific questions about their surroundings.

SAMPLE PROGRESS INDICATORS.

- Upon witnessing metamorphosis of a caterpillar into a butterfly, students ask questions regarding this transformation.

- After a nature walk in the school yard, students ask questions about something they observed, stating why they want to know, and suggest ways they might find out.

STANDARD II. **SCIENCE THEMES.** These are the universal organizing principles that transcend disciplinary boundaries. They pervade all scientific content and concepts. These themes promote integration, both within traditional science disciplines and across subject areas. The three themes are 1) Change and Constancy, 2) Systems and Interactions, and 3) Models, Scale, and Structure.

GOAL A. **CHANGE AND CONSTANCY.** All students will

- understand how physical and living entities undergo change and maintain constancy through the interaction of energy and matter.

PERFORMANCE OBJECTIVES. All students will

- cite examples of different ways things change, such as size, weight, color, and movement.

- give examples of changes that are so slow or so fast that they are hard to detect.

- observe and record that some events in nature have a repeating pattern.

SAMPLE PROGRESS INDICATORS.

- The weather changes some from day to day, but things such as temperature and rain or snow tend to be high, low, or medium in the same months every year. Students keep a picture journal of these changes on a calendar.

- The sun can be seen only in the daytime, but the moon can be seen sometime at night and sometime during the day. The sun, moon, and stars all appear to move slowly across the sky. Students keep a picture journal of these changes on a calendar.

GOAL B. **SYSTEMS AND INTERACTION.** All students will

- understand that a system is a collection of entities and processes that interact to perform some function.

PERFORMANCE OBJECTIVES. All students will

- assemble, describe, take apart, and reassemble constructions using interlocking blocks, erector sets, and the like.
- demonstrate that most living things need water, food, air, and shelter.

SAMPLE PROGRESS INDICATORS.

- People and animals have parts that help them seek, find, and take in food when they feel hunger -- eyes and noses for detecting food, legs to get to it, arms to carry it away, and a mouth to eat it. Students demonstrate feeding behaviors of animals using these body parts to seek and eat food.

GOAL C. MODELS, SCALE, AND STRUCTURE. All students will

- understand and be able to use models to explain, predict, or represent phenomena.
- understand that the way in which things work may change with scale.
- understand that structure is an integral part of any system.

PERFORMANCE OBJECTIVES. All students will

- explain how a model of something is alike and different from the real thing.

SAMPLE PROGRESS INDICATORS.

- Given a model car, students explain how it is alike and unlike a real car.

STANDARD III. NATURE OF SCIENCE. This standard involves the application of human intelligence to explain how the world works. This involves particular ways of observing, thinking, experimenting, and validating. These represent a fundamental aspect of the nature of science and reflect how science differs from other modes of knowing. Science influences and is influenced by history, culture, technology, and society.

GOAL A. SCIENCE AND TECHNOLOGY IN SOCIETY. All students will

- understand the relevance of science, its applications, and its interactions, including implications, with society.
- be able to apply current technology to the learning of science.

PERFORMANCE OBJECTIVES. None at this level.

SAMPLE PROGRESS INDICATORS. None at this level.

GOAL B. HISTORICAL AND CULTURAL PERSPECTIVE. All students will

- appreciate the historical and cultural influences on the development of science.

PERFORMANCE OBJECTIVES. None at this level.

SAMPLE PROGRESS INDICATORS. None at this level.

GRADE 1

Introduction

In the first grade, science knowledge is not an end in itself but a vehicle to teach problem-solving and process skills. The heaviest emphasis in science instruction should be on the nature of scientific problem-solving goals with less time spent on knowledge of science topics and concepts. Observing and describing the natural world provides a basis for language development in young children.

First grade students gain a beginning awareness of the study of science and the work of scientists. First grade experiences can be structured to bring gradual awareness of the interactions of science, technology, and society. Children learn how science and technology affect the way they live.

STANDARD I. **HABITS OF THE MIND.** These are the universal thinking, communication, and problem-solving skills involved in all disciplines. They are best learned as processes within an authentic context rather than in isolation. Mathematical skills and reasoning are especially important in developing these habits of the mind in science.

GOAL A. **SCIENCE PROCESSES.** All students will

- practice science that emphasizes scientific process skills.

SCIENCE PROCESS SKILLS

Ask Questions By	Collecting Data By	Analyzing Data By	Explaining By
Noting Patterns	Observing	Predicting	Describing
Noting Discrepant Events	Measuring and Quantifying	Inferring	Defining
Seeking Information	Identifying Significar [illegible]	Tabulating	Interpreting
Formulating Questions	Selecting Variables	Using Numbers	Developing Models
Mental Generating Hypotheses	Estimating	Correlating	Developing Physical Models
		Classifying	Communicating

Performance based skills are associated with each specific action. **TABLE 2**

PERFORMANCE OBJECTIVES. All students will

- ask, "How do you know?" in appropriate situations and attempt reasonable answers when others ask them the same question.
- elect to make some fresh observations instead of just arguing about who is right when people give different descriptions of the same thing.
- practice skills in observing and measuring by using standard and nonstandard units of measurement and communicating their results to others.
- determine the linear dimensions in whole units of objects having straight edges.
- use tools such as thermometers, magnifiers, rulers, or balances to obtain more information about things than could be obtained by just observing.
- provide examples of how various materials respond differently when the same thing is done to it.
- describe and compare things in terms of number, shape, texture, size, weight, color, and motion.
- use observable characteristics for grouping.
- sort a variety of kinds of living things into groups in many ways, using various features to decide which things belong to which group.
- draw pictures that correctly portray at least some features of the thing being described.
- give rough estimates of numerical answers to problems before doing them formally.
- will identify circles, squares, triangles, and other shapes found in things in nature and in things that people build.
- explain to other students how they go about solving numerical problems.

SAMPLE PROGRESS INDICATORS.

- Given different descriptions of the same thing, students elect to make some fresh observations instead of just arguing about who is right.
- Students explain to other students how they could go about solving numerical problems.
- Students determine the linear dimensions, of objects having straight edges, in whole units.

- Students work in teams to gather and organize leaves into a notebook that demonstrates a classification system developed by the group. They use their notebook to explain their classifications system to the class.

- Given a variety of living things (or pictures of living things), students group them according to their features and explain their reasons for these groups.

GOAL B. VALUES. All students will

- practice science that develops the following attributes:

  value of scientific inquiry
  appreciation of technology
  honesty
  curiosity
  open-mindedness
  skepticism
  wonder
  perseverance
  enthusiasm

PERFORMANCE OBJECTIVES. All students will

- understand that everybody can do science and invent things and ideas.

SAMPLE PROGRESS INDICATORS.

- Given a simple device or mechanical toy, students formulate and give an explanation of how it works and present their ideas to the other students. Discussions that encourage students to defend their explanations and refute the explanation of others foster skepticism, open-mindedness, curiosity, appreciation of technology, and an appreciation of scientific inquiry.

- Given a variety of materials, students construct a model of an invention of their choice and explain its use.

STANDARD II. SCIENCE THEMES. These are the universal organizing principles that transcend disciplinary boundaries. They pervade all scientific content and concepts. These themes promote integration, both within traditional science disciplines and across subject areas. The three themes are 1) Change and Constancy, 2) Systems and Interactions, and 3) Models, Scale, and Structure.

GOAL A. CHANGE AND CONSTANCY. All students will

- understand how physical and living entities undergo change and maintain constancy through the interaction of energy and matter.

PERFORMANCE OBJECTIVES. All students will

- perform simple experiments demonstrating that change is something that happens to many things.

- cite examples of how things change in some ways and stay the same in some ways.

SAMPLE PROGRESS INDICATORS.

- Students perform an experiment wherein water is left in an open container and disappears, while water left in a closed container does not disappear.

GOAL B. SYSTEMS AND INTERACTION. All students will

- understand that a system is a collection of entities and processes that interact to perform some function.

PERFORMANCE OBJECTIVES. All students will

- explain that living things are found almost everywhere in the world and that there are somewhat different kinds in different places.

- explain that different plants and animals have external features that help them thrive in different kinds of places.

SAMPLE PROGRESS INDICATORS.

- Given pictures of various animals and pictures of various environments, students match the animal with the most likely environment and explain reasons for their matching.

GOAL C. MODELS, SCALE AND STRUCTURE. All students will

- understand and be able to use models to explain, predict, or represent phenomena.

- understand that the way in which things work may change with scale.

- understand that structure is an integral part of any system.

PERFORMANCE OBJECTIVES. All students will

- compare a variety of models (dolls, cars, etc.) with the real object and describe their similarities and differences.

- describe something by saying how it is like something else.

SAMPLE PROGRESS INDICATORS.

- Given several models of the same kind of thing, such as dolls, houses, or cars, all students identify differences among models, as well as between the models and the real thing. Students also explain why they feel a particular model is more accurate.

STANDARD III. **NATURE OF SCIENCE.** This standard involves the application of human intelligence to explain how the world works. This involves particular ways of observing, thinking, experimenting, and validating. These represent a fundamental aspect of the nature of science and reflect how science differs from other modes of knowing. Science influences and is influenced by history, culture, technology, and society.

GOAL A. **SCIENCE AND TECHNOLOGY IN SOCIETY.** All students will

- understand the relevance of science, its applications, and its interactions, including implications, with society.
- be able to apply current technology to the learning of science.

PERFORMANCE OBJECTIVES. All students will

- use tools to observe, measure, and make things.
- identify fuel sources, such as wood, oil, coal, natural gas, or electricity, to cook their food.
- cite examples of recyclable materials and what each material can be used to produce.
- make something out of paper, cardboard, wood, plastic, metal, or existing objects that can actually be used to perform a task.

SAMPLE PROGRESS INDICATORS.

- Students investigate what happens to a selected material when it is recycled and present their findings to the class.
- Students research and prepare an entry for a science fair.

GOAL B. **HISTORICAL AND CULTURAL PERSPECTIVE.** All students will

- appreciate the historical and cultural influences on the development of science.

PERFORMANCE OBJECTIVES. None at this level.

SAMPLE PROGRESS INDICATORS. None at this level.

GRADE 2

Introduction

In the second grade, science knowledge is not an end in itself but a vehicle to teach problem-solving and process skills. The heaviest emphasis in science instruction should be on the problem-solving goals, with less time spent on knowledge of science topics and concepts. Simple recall and memorization of science knowledge is less important than the nature of scientific problem-solving skills when evaluating student progress.

Second grade students gain a beginning awareness of the study of science and the work of scientists. Second grade experiences can be structured to bring gradual awareness of the interactions of science, technology, and society. Children learn how science and technology affect their own lives and conditions of society in general.

STANDARD I. **HABITS OF THE MIND.** These are the universal thinking, communication, and problem-solving skills involved in all disciplines. They are best learned as processes within an authentic context rather than in isolation. Mathematical skills and reasoning are especially important in developing these habits of the mind in science.

GOAL A. **SCIENCE PROCESSES.** All students will

- practice science that emphasizes scientific process skills.

SCIENCE PROCESS SKILLS

Ask Questions By	Collecting Data By	Analyzing Data By	Explaining By
Noting Patterns	Observing	Predicting	Describing
Noting Discrepant Events	Measuring and Quantifying	Inferring	Defining
Seeking Information	Identifying Significance	Tabulating	Interpreting
Formulating Questions	Selecting Variables	Using Numbers	Developing Models
Mental Generating Hypotheses	Estimating	Correlating	Developing Physical Models
		Classifying	Communicating

Performance based skills are associated with each specific action. **TABLE 2**

PERFORMANCE OBJECTIVES. All students will

- raise questions about the world around them and be willing to seek answers to some of them by making careful observations and trying things out.
- seek information and decide if it is relevant to the question they have identified.
- cite examples of similar patterns evident in nature and in things people make.
- perform a science investigation two or more times and be able to get a very similar result each time.
- learn about groups of things by studying just a few of them.
- identify events that are more likely to happen and can be predicted well and other events that cannot.
- use whole numbers and simple, everyday fractions in ordering, counting, identifying, measuring, and describing things and experiences.
- make quantitative estimates of familiar lengths, weights, and time intervals and check them by measurements.
- take measurements to detect small changes and/or differences.
- use simple graphs and charts to tell about observations.

SAMPLE PROGRESS INDICATORS.

- Students test and sort items according to whether they are or are not magnetic and record the common physical characteristics of the items in each group.
- Students devise ways to make a ball move along straight, curved, circular, back-and-forth, and jagged paths when given a ball.
- Students measure the height of a short and a tall classmate and use those measurements to estimate the height of other classmates.

GOAL B. VALUES. All students will

- practice science that develops the following attributes:

  value of scientific inquiry
  appreciation of technology
  honesty
  curiosity
  open-mindedness
  skepticism

wonder
perseverance
enthusiasm

PERFORMANCE OBJECTIVES. All students will

- understand that everybody can do science and invent things and ideas.
- work with a team and share findings with others. All team members, however, should reach their own individual conclusions about what the findings mean.

SAMPLE PROGRESS INDICATORS.

- Students work in teams to brainstorm a list of questions inquiring about physical things they see but don't understand.

STANDARD II. **SCIENCE THEMES.** These are the universal organizing principles that transcend disciplinary boundaries. They pervade all scientific content and concepts. These themes promote integration both within traditional science disciplines and across subject areas. The three themes are 1) Change and Constancy, 2) Systems and Interactions, and 3) Models, Scale, and Structure.

GOAL A. **CHANGE AND CONSTANCY.** All students will

- understand how physical and living entities undergo change and maintain constancy through the interaction of energy and matter.

PERFORMANCE OBJECTIVES. All students will

- identify and describe examples of how animals and plants sometimes cause changes in their surroundings.
- formulate questions regarding the variety among animals and how some kinds of organisms that once lived on earth have completely disappeared, although they were somewhat like others that are alive today.
- observe variation among individuals of one kind of animal within a population.

SAMPLE PROGRESS INDICATORS.

- Students make observations and record data that documents that the moon looks a little different every day but looks the same about every four weeks.

- Students select a group of similar animals (e.g., pictures of cows, dogs, etc.,) and graph the variation among individuals of one kind within a population.

GOAL B. SYSTEMS AND INTERACTION. All students will

- understand that a system is a collection of entities and processes that interact to perform some function.

PERFORMANCE OBJECTIVES. All students will

- demonstrate that when parts are put together, they can do things that they could not do by themselves.
- cite examples and explain how a change in one thing causes changes in something else.
- cite examples of how animals eat plants or other animals for food and may also use plants of even other animals for shelter and nesting.
- identify the origins of various foods and identify factors that influence the supply.
- identify factors which promote good health and others that are harmful.
- identify behaviors that both increase and decrease the chances of contracting disease.

SAMPLE PROGRESS INDICATORS.

- Students draw a diagram showing the relationship between each plant and animal in the food chain when given a variety of plants and animals.
- Students document their activities over a period of one or more days and organize these behaviors according to those that promote good health and those which could be harmful.

GOAL C. MODELS, SCALE, AND STRUCTURE. All students will

- understand and be able to use models to explain, predict, or represent phenomena.
- understand that the way in which things work may change with scale.
- understand that structure is an integral part of any system.

PERFORMANCE OBJECTIVES. All students will

- construct a model of something and explain how it is different from the real thing but can be used to learn something about the real thing.

SAMPLE PROGRESS INDICATORS.

- Students make something out of paper, cardboard, wood, plastic, metal, or existing objects that can actually be used to perform a task.

- Students assemble, describe, take apart, and reassemble a simple machine using interlocking blocks, erector sets, and the like.

STANDARD III. **NATURE OF SCIENCE.** This standard involves the application of human intelligence to explain how the world works. This involves particular ways of observing, thinking, experimenting, and validating. These represent a fundamental aspect of the nature of science and reflect how science differs from other modes of knowing. Science influences and is influenced by history, culture, technology, and society.

GOAL A. **SCIENCE AND TECHNOLOGY IN SOCIETY.** All students will

- understand the relevance of science, its applications, and its interactions, including implications, with society.

- be able to apply current technology to the learning of science.

PERFORMANCE OBJECTIVES. All students will

- explain why it is not always possible to make or do everything that they can design.

- cite examples of tools and ways of doing things that people have invented and explain how each affect various aspects of our life.

- understand that devices can be used to send and receive messages quickly and clearly.

- identify the advantages and disadvantages of various ways information can be sent and received and explain that some allow answering back and some do not.

- identify the advantages and disadvantages of using various simple materials for making some particular thing.

- explain the steps necessary for making a particular thing.

SAMPLE PROGRESS INDICATORS.

- Students develop and demonstrate the use of a simple device for sending and receiving messages and do so.
- Students investigate the production of a simple item of their choice and identify the steps the product undergoes during the process.

GOAL B. HISTORICAL AND CULTURAL PERSPECTIVE. All students will

- appreciate the historical and cultural influences on the development of science.

PERFORMANCE OBJECTIVES. None at this level.

SAMPLE PROGRESS INDICATORS. None at this level.

GRADE 3

Introduction

In the third grade, science students have reached a point in their development where they are able to make much more accurate observations, including the use of standardized measuring devices for common measurements, such as linear and, to a degree, volumetric. Mass finally has a meaning to students at this age level, and they can make rough comparisons and even use scales as measuring devices.

The science process skills become extremely critical at this grade level, since students have reached a point where they can ask questions about phenomena and facts that they have observed. They have developed many skills that are useful and can be cultivated in exploring their environment and suggesting solutions.

It is not important at this level that facts be memorized but that students become aware of methods of comparing material objects as well as ideas. Assessment must recognize the changes that have taken place in the student's abilities to make more accurate observations to measure, quantify, and, in some cases, identify the significance using numbers and explaining their observations. They are reaching a point where higher level learning certain problem-solving skills utilizing their minds can be cultivated.

STANDARD I. **HABITS OF THE MIND.** These are the universal thinking, communication, and problem-solving skills involved in all disciplines. They are best learned as processes within an authentic context rather than in isolation. Mathematical skills and reasoning are especially important in developing these habits of the mind in science.

GOAL A. **SCIENCE PROCESSES.** All students will

- practice science that emphasizes scientific process skills.

SCIENCE PROCESS SKILLS

Ask Questions By	Collecting Data By	Analyzing Data By	Explaining By
Noting Patterns	Observing	Predicting	Describing
Noting Discrepant Events	Measuring and Quantifying	Inferring	Defining
Seeking Information	Identifying Significance	Tabulating	Interpreting
Formulating Questions	Selecting Variables	Using Numbers	Developing Models
Mental Generating Hypotheses	Estimating	Correlating	Developing Physical Models
		Classifying	Communicating

Performance based skills are associated with each specific action.

TABLE 2

PERFORMANCE OBJECTIVES. All students will

- demonstrate the clear communication skills essential to doing science. These skills enable scientists to inform others about their work, expose their ideas to criticism by other scientists, and stay informed about scientific discoveries around the world.
- use physical characteristics to sort living things (or pictures thereof) into groups for a given purpose.
- recognize when comparisons might not be fair because some conditions are not kept the same.
- use appropriate units for measurement of customary amounts (length, time, and weight).
- judge whether measurements and computations of quantities such as length, area, volume, weight, or time are reasonable in a familiar context by comparing them to typical values.
- write instructions that others can follow in carrying out a procedure.
- describe natural objects using appropriate analogies and metaphors.
- make sketches to aid in explaining procedures or ideas.
- use numerical data in describing and comparing objects and events.
- use simple graphs and charts to tell about observations.

SAMPLE PROGRESS INDICATORS.

- Students observe and measure the growth and development of a plant or animal for at least two weeks, recording observable changes verbally and in pictures or on a chart or graph.
- Students prepare clear directions so that another student can continue recording the observations and measurements started in task above.
- Students draw a reasonable conclusion based on observed data and support the conclusion with specific data.

GOAL B. VALUES. All students will

- practice science that develops the following attributes:

  value of scientific inquiry
  appreciation of technology
  honesty
  curiosity

open-mindedness
skepticism
wonder
perseverance
enthusiasm

PERFORMANCE OBJECTIVES. All students will

- keep records of their investigations and observations and not change the records later.
- offer reasons for their findings and be open to the reasons suggested by others.
- seek better reasons for believing something than "Everybody knows that" or "I just know" and discount such reasons when given by others.

SAMPLE PROGRESS INDICATORS.

- Students examine simple weather data, such as the type of clouds in the sky, temperature, and wind direction, and make predictions about tomorrow's weather.
- Students present and justify their predictions to the class and are willing and prepared to defend their predictions when presented with an opposing view.

STANDARD II. **SCIENCE THEMES.** These are the universal organizing principles that transcend disciplinary boundaries. They pervade all scientific content and concepts. These themes promote integration, both within traditional science disciplines and across subject areas. The three themes are 1) Change and Constancy, 2) Systems and Interactions, and 3) Models, Scale, and Structure.

GOAL A. **CHANGE AND CONSTANCY.** All students will

- understand how physical and living entities undergo change and maintain constancy through the interaction of energy and matter.

PERFORMANCE OBJECTIVES. All students will

- use water as an example of how the three phases of matter are dependent on temperature.
- give examples of how air demonstrates the characteristics of gases.
- demonstrate the formation of soil through weathering and breakage of rocks.

- give examples of how heating and cooling cause changes in the properties of materials, especially how many kinds of changes occur faster under hotter conditions.
- compare the stages and duration of the life cycle of common organisms to that of human beings.
- give examples of how nutritional needs change through life as different basic nutrients are needed for growth and repair of body parts.
- explain how the sun provides energy for human use in the form of moving air and water or fossil fuels.

SAMPLE PROGRESS INDICATORS.

- Students describe how the freezing and cooling cycle seen on a typical winter day involves changes in all three phases of matter and many substances.
- Students describe how any particular species or individual organism is adapted to a particular habitat when given that species or organism.
- Students prepare a chart or poster that shows what might be needed to maintain health and growth.
- Students design a model house that uses some solar energy for heat.

GOAL B. SYSTEMS AND INTERACTION. All students will

- understand that a system is a collection of entities and processes that interact to perform some function.

PERFORMANCE OBJECTIVES. All students will

- diagram (not necessarily to scale) the essential components of the Earth-moon-sun system.
- demonstrate that the mass of an object remains constant whether the object is whole or broken into component parts.
- give examples of the effects of three forces (gravity, magnetism, and electrostatic) that influence objects without physical contact.
- describe situations when changes in an organism's habitat have been sometimes beneficial to it and sometimes harmful.
- give an example of both beneficial and pathological microorganisms.

- describe how insects and various other organisms depend on dead plant and animal material for food.
- construct a model of a simple food chain, including producers, consumers, and a predator.
- demonstrate how in something that consists of many parts, the parts usually influence one another, and it may not work as well (or at all) if a part of it is missing, broken, worn out, mismatched, or misconnected.
- describe the basic needs of all living things (including single-cell organisms) - food, water, air, a way to dispose of waste, and an environment in which they can live.
- describe some kinds of plants and animals that survive well, some that survive less well, and some that cannot survive at all for any particular environment.
- describe how the human body defends itself against infection and how some germs interfere with these defense mechanisms.

SAMPLE PROGRESS INDICATORS.

- Students use any medium to construct a model of the solar system or a food chain and weigh the materials before and after the construction.
- Students design a chart to show comparisons of magnetic and electrostatic force.
- Students write a story describing what might happen if a microorganism, either beneficial or pathological, is introduced into an organism or habitat.

GOAL C. MODELS, SCALE, AND STRUCTURE. All students will

- understand and be able to use models to explain, predict, or represent phenomena.
- understand that the way in which things work may change with scale.
- understand that structure is an integral part of any system.

PERFORMANCE OBJECTIVES. All students will

- give examples of objects that move very fast, very slow, and some that vary their speed.
- show how objects or patterns stay the same even if some features change or they are shifted over, or turned, or reflected, or seen from different directions.

SAMPLE PROGRESS INDICATORS.

- Students design a chart that shows the speeds at which various common animals can move.

STANDARD III. NATURE OF SCIENCE. This standard involves the application of human intelligence to explain how the world works. This involves particular ways of observing, thinking, experimenting, and validating. These represent a fundamental aspect of the nature of science and reflect how science differs from other modes of knowing. Science influences and is influenced by history, culture, technology, and society.

GOAL A. SCIENCE AND TECHNOLOGY IN SOCIETY. All students will

- understand the relevance of science, its applications, and its interactions, including implications, with society.

- be able to apply current technology to the learning of science.

PERFORMANCE OBJECTIVES. All students will

- describe the different forms scientific investigations may take, including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments. Investigations can focus on physical, biological, and social questions.

- give examples of ways human beings have modified materials (wood, clay, plants, and animal skins) and conditions (fertilizers and irrigation) to change their properties to serve useful purposes.

- ask for evidence that can be backed up with a logical argument to support claims about the way things work.

SAMPLE PROGRESS INDICATORS.

- Students express directions for completion of some simple task in at least two different forms of communication.

GOAL B. HISTORICAL AND CULTURAL PERSPECTIVE. All students will

- appreciate the historical and cultural influences on the development of science.

PERFORMANCE OBJECTIVES. All students will

- describe the development of some ways of communication, such as signed and spoken language and early forms of recording messages using markings on materials like wood or stone.

- describe examples of scientific work engaged in by men and women of all ages and backgrounds throughout history.

SAMPLE PROGRESS INDICATORS.

- Students briefly describe, after reading the biography or autobiography of a scientist, the question(s) the scientist set out to answer, the methods she or he used, and the results that were eventually discovered.

GRADE 4

Introduction

Fourth grade science remains one of the primary vehicles to teach problem-solving and process skills, but integration and connections with other subjects become more important and easier. Fourth grade students have developed many skills that are useful in exploring their environment, examining phenomena, and constructing solutions. Simple memorization of science knowledge is less important than the application of scientific problem-solving skills in the exploration of common phenomena. Assessment and evaluation methods must recognize this and include performances of significant tasks. Projects allowing students to explore and construct, using skills and information from all subjects, provide powerful strategies for enabling high level learning, problem-solving, and critical thinking.

STANDARD I. **HABITS OF THE MIND.** These are the universal thinking, communication, and problem-solving skills involved in all disciplines. They are best learned as processes within an authentic context rather than in isolation. Mathematical skills and reasoning are especially important in developing these habits of the mind in science.

GOAL A. **SCIENCE PROCESSES.** All students will

- practice science that emphasizes scientific process skills.

SCIENCE PROCESS SKILLS

Ask Questions By	Collecting Data By	Analyzing Data By	Explaining By
Noting Patterns	Observing	Predicting	Describing
Noting Discrepant Events	Measuring and Quantifying	Inferring	Defining
Seeking Information	Identifying Significance	Tabulating	Interpreting
Formulating Questions	Selecting Variables	Using Numbers	Developing Models
Mental Generating Hypotheses	Estimating	Correlating	Developing Physical Models
		Classifying	Communicating

Performance based skills are associated with each specific action. **TABLE 2**

PERFORMANCE OBJECTIVES. All students will

- explain that results of scientific investigations are seldom exactly the same, but if the differences are large, it is important to try to figure out why.

- perform scientific investigations using different methods, including observing things or events, collecting specimens for analysis, and doing experiments to investigate physical, biological, and social issues.
- evaluate mathematical results by whether they make sense and are useful.
- use a variety of measuring devices to record quantitative observations of objects and events.
- use multiple ways to sort living and extinct organisms into groups based on observable characteristics.
- state the purpose of each step in a calculation.
- read and follow step-by-step instructions in a calculator or computer manual when learning new procedures.
- keep a notebook describing observations made that is understandable weeks or months later.
- use tables and graphs to show how values of one quantity are related to values of another.
- examine graphical displays of numbers in order to spot patterns that are not otherwise obvious, such as comparative size and trends.
- demonstrate how determining the largest and the smallest possible values of something is often as revealing as knowing what the usual value is.

SAMPLE PROGRESS INDICATORS.

- Students perform an investigation or experiment at least three times, keeping careful records of observations and measurements for each trial and noting any differences in results.
- Students collect data from simple motion investigations, such as the distance a marble rolls down an inclined plane at different heights, record the data in a table, and show the relationship on a simple graph.

GOAL B. VALUES. All students will

- practice science that develops the following attributes:

  value of scientific inquiry
  appreciation of technology
  honesty

curiosity
open-mindedness
skepticism
wonder
perseverance
enthusiasm

PERFORMANCE OBJECTIVES. All students will

- operate as part of an investigative team by sharing knowledge with others but still state individual conclusions about the focus of the investigation.
- show at least two different approaches to solving a given problem, although neither approach must necessarily lead to a solution.
- listen to a point of view different from their own and summarize the important points to the satisfaction of the originator of the explanation.
- provide solid evidence to support a statement and identify the source for each piece of evidence.

SAMPLE PROGRESS INDICATORS.

- As part of a group, students generate a list of possible solutions to a given problem, and each student selects and defends one of these as being most appropriate.
- Students prepare a presentation, such as a play, poster, video, or persuasive essay, that argues for or against some local issue, including appropriate evidence and sources.

STANDARD II. **SCIENCE THEMES.** These are the universal organizing principles that transcend disciplinary boundaries. They pervade all scientific content and concepts. These themes promote integration both within traditional science disciplines and across subject areas. The three themes are 1) Change and Constancy, 2) Systems and Interactions, and 3) Models, Scale, and Structure.

GOAL A. **CHANGE AND CONSTANCY.** All students will

- understand how physical and living entities undergo change and maintain constancy through the interaction of energy and matter.

PERFORMANCE OBJECTIVES. All students will

- explain why the patterns of stars in the sky stay the same, although they appear to move across the sky nightly, and different stars can be seen in different seasons.

- describe the motion of various planets relative to the background of stars.

- give examples of how waves, wind, water, and ice shape and reshape the Earth's land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in seasonal layers.

- describe things which change in steady, repetitive, or irregular ways, or sometimes in more than one way at the same time, possibly using a table or graph of measurements to tell which kinds of change are happening.

SAMPLE PROGRESS INDICATORS.

- Students choose a constellation and chart its path over several weeks.

- Students choose a visible planet and chart its path over a period of time.

- Students identify and describe, using verbal or pictorial representations, a local example of erosion, including cause, effects, and possible solutions.

GOAL B. SYSTEMS AND INTERACTION. All students will

- understand that a system is a collection of entities and processes that interact to perform some function.

PERFORMANCE OBJECTIVES. All students will

- describe the functions of selected organs or other body parts.

- describe the relationship among force, mass, and motion. For example, the greater the force is, the greater the change in motion will be or the more the mass of an object is, the less effect the given force will have.

- construct a simple food web consisting of at least six organisms and describe how each organism gets the energy necessary for life.

SAMPLE PROGRESS INDICATORS.

- Students describe what would happen to a human being if a selected organ were damaged or impaired.

- Students measure and compare the amount of force needed to move objects of differing mass at a constant velocity or an object with a consistent mass at differing velocities.

GOAL C. MODELS, SCALE, AND STRUCTURE. All students will

- understand and be able to use models to explain, predict, or represent phenomena.
- understand that the way in which things work may change with scale.
- understand that structure is an integral part of any system.

PERFORMANCE OBJECTIVES. All students will

- demonstrate how changes made to a model may suggest how the real thing would work if the same were done to it.

SAMPLE PROGRESS INDICATORS.

- Students design and construct a model of an invention and discuss what production steps would be necessary to manufacture a real version.

STANDARD III. NATURE OF SCIENCE. This standard involves the application of human intelligence to explain how the world works. This involves particular ways of observing, thinking, experimenting, and validating. These represent a fundamental aspect of the nature of science and reflect how science differs from other modes of knowing. Science influences and is influenced by history, culture, technology, and society.

GOAL A. SCIENCE AND TECHNOLOGY IN SOCIETY. All students will

- understand the relevance of science, its applications, and its interactions, including implications, with society.
- be able to apply current technology to the learning of science.

PERFORMANCE OBJECTIVES. All students will

- use invented devices, such as paper and ink, engraved plastic disks, and magnetic tapes, for recording information.
- describe an invention that was put to use as not initially intended or an invention that lead to the development of another invention.
- list inventions that have both positive (advantageous to human life) and negative (causing harm to humans or the environment) applications.

- list substances in the environment that can harm human beings and other living things, such as tobacco, alcohol, other drugs, and certain poisons in the environment (pesticides, lead).

- identify appropriate and inappropriate methods of limiting damage to crops caused by rodents, weeds, and insects; such as using poisons that may harm other plants or animals and the fact that pests tend to develop resistance to poisons.

- describe ways to retard the spoilage of food by microscopic organisms, such as the heating, salting, smoking, drying, cooling, and airtight packaging that make it possible for food to be stored for long intervals before being used.

- give examples of modern technologies that have increased the efficiency of agriculture so that fewer people are needed to work on farms than ever before.

- describe how any one of the wide variety of materials that do not appear in nature at all have become available through science and technology, ranging from steel to nylon to liquid crystals.

- evaluate the advantages and disadvantages of various energy sources in terms of their cost and levels of pollution generated.

SAMPLE PROGRESS INDICATORS.

- Students trace the settlement of their community, noting the inventions and technologies that made settlement possible.

- Students list common chemicals or substances and describe the benefits and potential problems related to the use and manufacture of each substance.

GOAL B. HISTORICAL AND CULTURAL PERSPECTIVE. All students will

- appreciate the historical and cultural influences on the development of science.

PERFORMANCE OBJECTIVES. All students will

- give examples of scientific contributions made by other cultures in other times and by people of all races, religions, and gender.

SAMPLE PROGRESS INDICATORS.

- Students write a brief biography of a scientist, including the reason for the initial investigation and how the results have been applied.

STANDARD I. **HABITS OF THE MIND.** These are the universal thinking, communication, and problem-solving skills involved in all disciplines. They are best learned as processes within an authentic context rather than in isolation. Mathematical skills and reasoning are especially important in developing these habits of the mind in science.

GOAL A. **SCIENCE PROCESSES.** All students will

- practice science that emphasizes scientific process skills.

SCIENCE PROCESS SKILLS

Ask Questions By	Collecting Data By	Analyzing Data By	Explaining By
Noting Patterns	Observing	Predicting	Describing
Noting Discrepant Events	Measuring and Quantifying	Inferring	Defining
Seeking Information	Identifying Significance	Tabulating	Interpreting
Formulating Questions	Selecting Variables	Using Numbers	Developing Models
Mental Generating Hypotheses	Estimating	Correlating	Developing Physical Models
		Classifying	Communicating

Performance based skills are associated with each specific action.

TABLE 2

PERFORMANCE OBJECTIVES. All students will

- make predictions based on what is known about the past, assuming that conditions are pretty much the same now.
- analyze the results of similar scientific investigations and explain why the results may differ.
- cite evidence from their investigations to support their explanations.
- use video recordings to examine motion and interaction.
- explain that communication technologies make it possible to send and receive information more and more reliably, quickly, and cheaply over long distance.
- add, subtract, multiply, and divide whole numbers mentally, on paper, and with a calculator.

- use fractions and decimals, translating when necessary between decimals and fractions -- halves, thirds, fourths, fifths, tenths, and hundredths (but not sixths, sevenths, etc.,).

- use calculators to determine area and volume from linear dimensions, aggregate amounts of area, volume, weight, time, and cost and find the difference between two quantities of anything.

- judge whether measurements and computations of quantities such as length, area, volume, weight, or time are reasonable in a familiar context by comparing them to typical values.

- record measurements and recognize that these are likely to give slightly different numbers, even if what is being measured stays the same.

- construct mathematical statements using symbols that may be true only when the symbols are replaced by certain numbers.

- describe objects in terms of simple plane figures and solids. Shapes can be compared in terms of concepts such as parallel and perpendicular, congruence and similarity, and symmetry. Symmetry can be found to be reflection, turns, or slides.

- find areas of irregular shapes by dividing them into squares and triangles.

- draw scale drawings that show shapes and compare locations of things very different in size.

- explain that statistical predictions (as for rainy days and accidents) are typically better for what proportion of a group will experience something than for which members of the group will experience it and better for how often something will happen than for exactly when.

- state that summary predictions are usually more accurate for large collections of events than for just a few. Even very unlikely events may occur fairly often in very large populations.

- use geometric figures, number sequences, graphs, diagrams, sketches, number lines, maps, and stories to represent objects, events, and processes in the real world, although such representations can never be exact in every detail.

SAMPLE PROGRESS INDICATORS.

GOAL B. VALUES. All students will

- practice science that develops the following attributes:

value of scientific inquiry
appreciation of technology
honesty
curiosity
open-mindedness
skepticism
wonder
perseverance
enthusiasm

PERFORMANCE OBJECTIVES. All students will

- use what they already know to make sense of new experience or information, not just store the new information in their heads.

SAMPLE PROGRESS INDICATORS.

STANDARD II. **SCIENCE THEMES.** These are the universal organizing principles that transcend disciplinary boundaries. They pervade all scientific content and concepts. These themes promote integration both within traditional science disciplines and across subject areas. The three themes are 1) Change and Constancy, 2) Systems and Interactions, and 3) Models, Scale, and Structure.

GOAL A. **CHANGE AND CONSTANCY.** All students will

- understand how physical and living entities undergo change and maintain constancy through the interaction of energy and matter.

PERFORMANCE OBJECTIVES. All students will

- explain that some characteristics are inherited, while others are not and that there exists a reliable way to transfer inherited information from one generation to the next.
- explain that individuals of the same kind differ in their characteristics, and sometimes the differences give individuals an advantage in surviving and reproducing.
- explain that an embryo is nourished by its mother and that the substances she takes in will affect how well or poorly the baby develops.
- state that when a new material is made by combining two or more materials, it has properties that are different from the original materials.

SAMPLE PROGRESS INDICATORS.

GOAL B. SYSTEMS AND INTERACTION. All students will

- understand that a system is a collection of entities and processes that interact to perform some function.

PERFORMANCE OBJECTIVES. All students will

- observe that things that give off light often also give off heat.
- demonstrate that when warmer things are put with colder ones, the warm ones lose their heat, and the cool ones gain it until they are all of the same temperature.
- observe that some materials conduct heat much better than others and that poor conductors car reduce heat loss.
- observe that some organisms are made up of a collection of similar cells that benefit from cooperating.

SAMPLE PROGRESS INDICATORS.

GOAL C. MODELS, SCALE, AND STRUCTURE. All students will

- understand and be able to use models to explain, predict, or represent phenomena.
- understand that the way in which things work may change with scale.
- understand that structure is an integral part of any system.

PERFORMANCE OBJECTIVES. All students will

- explain that stars are like the sun, some being smaller and some larger but so far away that they look like points of light.

SAMPLE PROGRESS INDICATORS.

STANDARD III. NATURE OF SCIENCE. This standard involves the application of human intelligence to explain how the world works. This involves particular ways of observing, thinking, experimenting, and validating. These represent a fundamental aspect of the nature of science and reflect how science differs from other modes of knowing. Science influences and is influenced by history, culture, technology, and society.

GOAL A. SCIENCE AND TECHNOLOGY IN SOCIETY. All students will

- understand the relevance of science, its applications, and its interactions, including implications, with society.
- be able to apply current technology to the learning of science.

PERFORMANCE OBJECTIVES. All students will

- list positive and/or negative impacts of technology.
- offer multiple explanations for a set of observations or data and identify questions for further investigation.
- explain that there are some diseases which can only be caught once and others that are prevented by vaccination.
- explain that some plants are better suited for some regions than others and that fertilizer and irrigation may help plants grow where conditions are not ideal.
- classify types of discarded products and relate those types of materials to the ease with which they can be recycled.
- practice conserving energy in order to slow down the depletion of energy resources and/or to save money.
- describe ways that technology has made it possible to repair and sometimes replace some body parts.

SAMPLE PROGRESS INDICATORS.

GOAL B. HISTORICAL AND CULTURAL PERSPECTIVE. All students will

- appreciate the historical and cultural influences on the development of science.

PERFORMANCE OBJECTIVES. All students will

SAMPLE PROGRESS INDICATORS.

GRADE 6 THROUGH GRADE 8

Introduction

Students at this level are unique in both their egocentrism and their idealism about the world. They are a real challenge to teach because of the radical physiological and social changes that affect their cognitive, physical, and social behaviors.

At this level, students need to be active and challenged with new ideas that are relevant and interesting to them. Although they can deal with increasingly abstract ideas, they need concrete examples and materials from which they can develop the more abstract ideas. It is imperative that middle level educators provide concrete experiences that will enable students to form a personal framework upon which conceptual understanding can be developed.

GRADE 6

STANDARD I. **HABITS OF THE MIND.** These are the universal thinking, communication, and problem-solving skills involved in all disciplines. They are best learned as processes within an authentic context rather than in isolation. Mathematical skills and reasoning are especially important in developing these habits of the mind in science.

GOAL A. **SCIENCE PROCESSES.** All students will

- practice science that emphasizes scientific process skills.

SCIENCE PROCESS SKILLS

Ask Questions By	Collecting Data By	Analyzing Data By	Explaining By
Noting Patterns	Observing	Predicting	Describing
Noting Discrepant Events	Measuring and Quantifying	Inferring	Defining
Seeking Information	Identifying Significance	Tabulating	Interpreting
Formulating Questions	Selecting Variables	Using Numbers	Developing Models
Mental Generating Hypotheses	Estimating	Correlating	Developing Physical Models
		Classifying	Communicating

Performance based skills are associated with each specific action. TABLE 2

PERFORMANCE OBJECTIVES. All students will

- ask questions by

a. noting patterns.
b. noting discrepant events.
c. seeking information.
d. formulating questions.
e. generating hypotheses.

- collect data by
  a. observing.
  b. measuring and quantifying.
  c. identifying significance and relevance.
  d. selecting variables.
  e. estimating.

- analyze data by
  a. predicting.
  b. inferring.
  c. tabulating.
  d. using numbers.
  e. correlating.
  f. classifying.

- explain data and information by
  a. describing.
  b. defining.
  c. interpreting.
  d. developing m_ntal models.
  e. developing physical models.
  f. communicating orally and in writing.

SAMPLE PROGRESS INDICATORS.

- After a class discussion about various concepts related to daily temperature variation, groups of students formulate questions to answer and will select variables, collect data to answer the questions, tabulate the data using appropriate mathematics operations, and interpret the data in a visual or written format.

- Students use data available from various sources (newspaper, TV, etc.) about the average rainfall or temperature for a region to predict or explain weather conditions and develop a physical or mental model.

GOAL B. VALUES. All students will

- practice science that develops the following attributes:

  value of scientific inquiry
  appreciation of technology

honesty
curiosity
open-mindedness
skepticism
wonder
perseverance
enthusiasm

PERFORMANCE OBJECTIVES. All students will

- critically evaluate information for accuracy, logic, and impact.
- identify two or more explanations for an event.
- recognize the difference between cause and effect relationships and correlated data.
- share experimental results with other students or classes, using appropriate technology.
- investigate ethical implications of scientific activities.

SAMPLE PROGRESS INDICATORS.

- Students research the techniques people have used to communicate from early times to modern. They develop a timeline which illustrates the technique or apparatus, describe the advantages and disadvantages of each, and identify the technological advances that made each possible.

STANDARD II. **SCIENCE THEMES.** These are the universal organizing principles that transcend disciplinary boundaries. They pervade all scientific content and concepts. These themes promote integration both within traditional science disciplines and across subject areas. The three themes are 1) Change and Constancy, 2) Systems and Interactions, and 3) Models, Scale, and Structure.

NOTE: *Teachers are encouraged to include historical anecdotes, regardless of gender or culture, as appropriate to the content to help students understand the context of current information.*

GOAL A. **CHANGE AND CONSTANCY.** All students will

- understand how physical and living entities undergo change and maintain constancy through the interaction of energy and matter.

PERFORMANCE OBJECTIVES. All students will

- demonstrate that physical and biological systems change until they become stable and then remain stable unless surroundings change.

- demonstrate that a system may stay the same because nothing is happening or because things are happening that exactly counterbalance one another.

- understand the purpose of feedback mechanisms.

- use mathematics to represent change.

- describe change and constancy, using factors like frequency, amplitude, magnitude, short- and long-term.

- recognize that the symmetry which occurs in natural events is a form of constancy.

SAMPLE PROGRESS INDICATORS.

- Students identify and describe/illustrate a cycle in nature, like the water cycle or life cycle, focusing on the changes that occur within that cycle. They present the information in a visual format.

GOAL B. SYSTEMS AND INTERACTIONS. All students will

- understand that a system is a collection of entities and processes that interact to perform some function.

PERFORMANCE OBJECTIVES. All students will

- explain that a system includes processes as well as things.

- understand that a system can be made up of several subsystems.

- demonstrate the interrelatedness of systems and their parts, both internally and externally.

SAMPLE PROGRESS INDICATORS.

- In a small group, students identify a body system and develop an understanding of how that system works. They identify another body system that affects the first system and develop a multimedia presentation utilizing appropriate technology that demonstrates how those two systems work together.

- Students interview a business person who works with a mechanical system and describe how that system works. They identify a malfunction of that system and describe what happens when that occurs.

GOAL C. **MODELS, SCALE, AND STRUCTURE.** All students will

- understand and be able to use models to explain, predict, or represent more complex phenomena. They will understand that the way things work may change with scale and that structure is an integral part of any system.

PERFORMANCE OBJECTIVES. All students will

- observe and explain a concrete model to others.
- develop a model which predicts an event based on observed data.
- construct models, using appropriate technologies.
- demonstrate an understanding of the relative nature of scales (i.e., time, speed, size, distance, weight).
- use a variety of techniques, including estimation and instrumentation, for measuring.

SAMPLE PROGRESS INDICATORS.

- Students construct a model of a hydraulic cycle and explain orally and in writing how it works and what it is or could be used for in daily life.
- Students describe how you might prove that the historical basis of matter -- all things being made up of fire, water, earth, and air -- is not correct.
- Students design an experiment that shows various life cycle lengths, such as Fast Plants versus a variety of other seeds, and communicate the results.

STANDARD III. **NATURE OF SCIENCE.** This standard involves the application of human intelligence to explain how the world works. This involves particular ways of observing, thinking, experimenting, and validating. These represent a fundamental aspect of the nature of science and reflect how science differs from other modes of knowing. Science influences and is influenced by history, culture, technology, and society.

GOAL A. **SCIENCE AND TECHNOLOGY IN SOCIETY.** All students will

- understand the relevance of science, its applications, and its interactions, including implications, with society. They will be able to apply current technology to the learning of science.

PERFORMANCE OBJECTIVES. All students will

- evaluate the processes used to form an opinion and determine if other conclusions could have been formulated.
- utilize resources outside their classroom.

- identify examples of science applications in their daily lives.

- develop multimedia presentations using technology to explore, explain, or demonstrate scientific learning.

- use and recognize the limitations of scientific devices in the classroom, including microscopes, balances, electronic probes, etc.

SAMPLE PROGRESS INDICATORS.

- Students are members of an advisory committee to the city council. They identify an environmental or economic issue (mining, logging, salmon, population growth, garbage, electric use, etc.) that potentially has a positive and negative impact on the community. They describe both views.

- Students determine which areas of science have the greatest impact on a career of their choice. They develop a presentation for the class about the career.

- In small groups, students explore magnification devices and identify uses from magnifying glasses to electron microscopes or binoculars to the Hubble telescope. They present their findings to the class.

GOAL B. HISTORICAL AND CULTURAL PERSPECTIVE. All students will

- appreciate the historical and cultural influences on the development of science.

PERFORMANCE OBJECTIVES. All students will

- recognize that personal experiences, observations, and tools for observing and measuring will shape and limit beliefs.

- identify scientific beliefs from current or past cultures or civilizations that are different from their own.

SAMPLE PROGRESS INDICATORS.

- Students locate and read creation myths from various cultures. They compare and contrast the explanations they provide.

- Students describe what the world looks like if they live in each of the following locations and have no tools to explore beyond one mile:

  - on an iceberg in the Arctic Ocean.
  - in a cave on the side of a mountain.
  - in the tropical rain forest.
  - on a coral atoll.
  - in a desert oasis.

STANDARD I. **HABITS OF THE MIND.** These are the universal thinking, communication, and problem-solving skills involved in all disciplines. They are best learned as processes within an authentic context rather than in isolation. Mathematical skills and reasoning are especially important in developing these habits of the miıd in science.

GOAL A. **SCIENCE PROCESSES.** All students will

- practice science that emphasizes scientific process skills.

SCIENCE PROCESS SKILLS

Ask Questions By	Collecting Data By	Analyzing Data By	Explaining By
Noting Patterns	Observing	Predicting	Describing
Noting Discrepant Events	Measuring and Quantifying	Inferring	Defining
Seeking Information	Identifying Significance	Tabulating	Interpreting
Formulating Questions	Selecting Variables	Using Numbers	Developing Models
Mental Generating Hypotheses	Estimating	Correlating	Developing Physical Models
		Classifying	Communicating

Performance based skills are associated with each specific action.

TABLE 2

PERFORMANCE OBJECTIVES. All students will

- ask questions by
  a. noting patterns.
  b. noting discrepant events.
  c. seeking information.
  d. formulating questions.
  e. generating hypotheses.

- collect data by
  a. observing.
  b. measuring and quantifying.
  c. identifying significance and relevance.
  d. selecting variables.
  e. estimating.

- analyze data by

a. predicting.
b. inferring.
c. tabulating.
d. using numbers.
e. correlating.
f. classifying.

- explain data and information by
  a. describing.
  b. defining.
  c. interpreting.
  d. developing mental models.
  e. developing physical models.
  f. communicating orally and in writing.

SAMPLE PROGRESS INDICATORS.

- Students identify a country which lies at 45 degrees north latitude and another country which lies at 45 degrees south latitude. They predict how weather conditions in these countries compares to Idaho and develop data tables showing mean, median, and range for temperature and rainfall on a monthly basis. They plot, compare, and explain any differences or similarities noted.

GOAL B. VALUES. All students will

- practice science that develops the following attributes:

  value of scientific inquiry
  appreciation of technology
  honesty
  curiosity
  open-mindedness
  skepticism
  wonder
  perseverance
  enthusiasm

PERFORMANCE OBJECTIVES. All students will

- identify ethical implications related to scientific activities.

- recognize new scientific achievements found in current event resources.

- describe new applications of technology to everyday life.

- share their experimental results with other students or classes, using appropriate technology.

SAMPLE PROGRESS INDICATORS.

- Scientists have just developed a means for moving asteroids into Earth's orbit for the purposes of mining minerals. Students prepare a presentation that describes the practicality (cost, alternatives), mineral availability, sensibility, technology requirements, and the ethical implications.

- Students list all the applications of technology used during a one-day period that have been developed during the twentieth century. They compare and discuss the lists developed by different students.

STANDARD II. **SCIENCE THEMES.** These are the universal organizing principles that transcend disciplinary boundaries. They pervade all scientific content and concepts. These themes promote integration both within traditional science disciplines and across subject areas. The three themes are 1) Change and Constancy, 2) Systems and Interactions, and 3) Models, Scale, and Structure.

GOAL A. **CHANGE AND CONSTANCY.** All students will

- understand how physical and living entities undergo change and constancy through the interaction of energy and matter.

PERFORMANCE OBJECTIVES. All students will

- understand that physical and biological systems change until they become stable and then remain the same unless the surroundings change.

- understand that a system may stay the same because nothing is happening or because things are happening that exactly counterbalance one another.

- understand the purpose of feedback mechanisms.

- use mathematics to represent change.

- describe constancy and change, using factors like frequency, amplitude, magnitude, short- and long-term.

- recognize that the symmetry which occurs in natural events is a form of constancy.

SAMPLE PROGRESS INDICATORS.

- Given a car going 40 mph with the cruise control feature engaged to establish constancy, students identify and explain events that could cause a change in speed and identify the energy changes that occur.

- Students describe the concepts of constancy and change as they relate to the effects of earthquakes on land formations and man-made structures.

GOAL B. SYSTEMS AND INTERACTION. All students will

- understand that a system is a collection of things and processes that interact to perform some function.

PERFORMANCE OBJECTIVES. All students will

- explain that a system includes processes as well as things.

- understand that a system can be made up of several subsystems.

- demonstrate the interrelatedness of systems, both internally and externally.

SAMPLE PROGRESS INDICATORS.

- Students build a closed terrarium containing all the necessary elements of an ecosystem and develop an explanation for the observed changes over time.

- Students identify parts of a system and study cause and effect of decisions within that system over time. The system of paper production that starts with tree seed planting and includes harvesting, transporting, processing, production, shipping to customers, and waste removal is an example of this. Students explore the effects of decisions made at each point in the system from various perspectives, such as environmental impact, cost impact, human impact, quality impact, profit or loss impact.

GOAL C. MODELS, SCALE, AND STRUCTURE. All students will

- understand and be able to use models to explain, predict, or represent phenomena.

- understand that the way in which things work may change with scale.

- understand that structure is an integral part of any system.

PERFORMANCE OBJECTIVES. All students will

- observe and explain a concrete model to others.

- develop a model which predicts an event based on observed data.

- construct models, using appropriate technologies.

- identify and describe two or more models which explain the same phenomenon.

- demonstrate an understanding of the relative nature of scales (time, speed, size, distance, weight, etc.,).

- use a variety of techniques, including estimation and instrumentation, to measure different scales.

SAMPLE PROGRESS INDICATORS.

- Given strings of various lengths with a washer or other weight tied to one end, students develop an experiment with a cooperative learning group to predict the effect on the pendulum of changing string lengths. They chart or graph the results. From the graph, the students predict the effects of other string lengths and describe the experimental design and problems or solutions they found.

- Without seeing a creature, students determine its size and other characteristics from the size and shape of its tracks. They explain how they know and develop a presentation about their creature.

STANDARD III. **NATURE OF SCIENCE.** This standard involves the application of human intelligence to explain how the world works. This involves particular ways of observing, thinking, experimenting, and validating. These represent fundamental aspects of the nature of science and reflect how science differs from other modes of knowing. Science influences and is influenced by history, culture, technology, and society.

GOAL A. **SCIENCE AND TECHNOLOGY IN SOCIETY.** All students will

- understand the relevance and the interrelationships between science and society.

- apply current technology to the learning of science.

PERFORMANCE OBJECTIVES. All students will

- evaluate the processes used to form an opinion and determine if other conclusions could have been formulated.

- utilize resources outside their classroom.

- identify science applications that influence daily life.

SAMPLE PROGRESS INDICATORS.

- Students compare and contrast "pseudo-science" with science, such as astrology/astronomy and alchemy/chemistry. They describe the differences

- Students identify and describe some of the early theories about the causes for disease and illness. They explain why these theories are not considered scientifically valid today.

75

GRADE 8

STANDARD I. **HABITS OF THE MIND.** These are the universal thinking, communication, and problem-solving skills involved in all disciplines. They are best learned as processes within an authentic context rather than in isolation. Mathematical skills and reasoning are especially important in developing these habits of the mind in science.

GOAL A. **SCIENCE PROCESSES.** All students will

- practice science that emphasizes scientific process skills.

SCIENCE PROCESS SKILLS

Ask Questions By	Collecting Data By	Analyzing Data By	Explaining By
Noting Patterns	Observing	Predicting	Describing
Noting Discrepant Events	Measuring and Quantifying	Inferring	Defining
Seeking Information	Identifying Significance	Tabulating	Interpreting
Formulating Questions	Selecting Variables	Using Numbers	Developing Models
Mental Generating Hypotheses	Estimating	Correlating	Developing Physical Models
		Classifying	Communicating

Performance based skills are associated with each specific action. TABLE 2

PERFORMANCE OBJECTIVES. All students will

- ask questions by
  a. noting patterns.
  b. noting discrepant events.
  c. seeking information.
  d. formulating questions.
  e. generating hypotheses.

- collect data by
  a. observing.
  b. measuring and quantifying.
  c. identifying significance and relevance.
  d. selecting variables.
  e. estimating.

- analyze data by

a. predicting.
b. inferring.
c. tabulating.
d. using numbers.
e. correlating.
f. classifying.

- explain data and information by
  a. describing.
  b. defining.
  c. interpreting.
  d. developing mental models.
  e. developing physical models.
  f. communicating orally and in writing.

SAMPLE PROGRESS INDICATORS.

- Students explore the variation in pH levels in water available and used in the community. They develop questions to be answered through the investigation, plan the sampling process and data collections points, collect samples and quantify pH, analyze and tabulate data, hypothesize reasons for variation, and communicate findings in a presentation. They include implications for plants and animals based on those findings and use electronic (E-mail) or other means to communicate and compare findings with other regions.

GOAL B. **VALUES.** All students will

- practice science that develops the following attributes:

  value of scientific inquiry
  appreciation of technology
  honesty
  curiosity
  open-mindedness
  skepticism
  wonder
  perseverance
  enthusiasm

PERFORMANCE OBJECTIVES. All students will

- investigate ethical implications of scientific activities.

- explore alternatives to scientific activities.

- share their experimental results with other students or classes, using appropriate technology.

SAMPLE PROGRESS INDICATORS.

- A decision was made several years ago to ban DDT because of its perceived negative effects on the environment. After reviewing information about DDT and its effects, students identify the positive and negative implications of the decision to ban DDT. They describe the different effects for different regions or populations and the circumstances where the use of DDT might be warranted.

STANDARD II. **SCIENCE THEMES.** These are the universal organizing principles that transcend disciplinary boundaries. They pervade all scientific content and concepts. These themes promote integration both within traditional science disciplines and across subject areas. The three themes are 1) Change and Constancy, 2) Systems and Interactions, and 3) Models, Scale, and Structure.

NOTE: *Teachers are encouraged to include historical anecdotes as appropriate to the content to help students understand the context of current information.*

GOAL A. **CHANGE AND CONSTANCY.** All students will

- understand how physical and living entities undergo change and maintain constancy through the interaction of energy and matter.

PERFORMANCE OBJECTIVES. All students will

- understand that physical and biological systems change until they become stable and then remain the same unless the surroundings change.
- understand that a system may stay the same because nothing is happening or because things are happening that exactly counterbalance one another.
- identify feedback mechanisms.
- use mathematics to represent change.
- describe constancy and change, using factors like frequency, amplitude, magnitude, short- and long-term.
- recognize that the symmetry which occurs in natural events is a form of constancy.

SAMPLE PROGRESS INDICATORS.

- Students identify objects which change due to oxidation and compare and order the rates of oxidation. They identify and describe the change in energy that occurs in these chemical reactions and then describe practical applications for oxidized products or the energy these reactions create.

GOAL B. SYSTEMS AND INTERACTIONS. All students will

- understand that a system is a collection of entities and processes that interact to perform some function.

PERFORMANCE OBJECTIVES. All students will

- explain that a system includes processes, as well as things.
- understand that a system can be made up of several subsystems.
- recognize the interrelatedness of systems, both internally and externally.

SAMPLE PROGRESS INDICATORS.

- Students interview a business person who works with a mechanical system and describe how that system works. They identify a malfunction of that system and describe what happens when that occurs.
- Students compare the Earth-centered model of the solar system with the sun-centered model and discuss the historical context and/or societal implications of these models.
- Students divide into small groups and select an energy conversion system and research the effects of that system on society and the environment. They develop and make a presentation that identifies the positive and negative issues surrounding each system.

GOAL C. MODELS, SCALE, AND STRUCTURE. All students will

- understand and be able to use models to explain, predict, or represent phenomena.
- understand that the way in which things work may change with scale and understand that structure is an integral part of any system.

PERFORMANCE OBJECTIVES. All students will

- observe and explain a concrete model to others.
- develop a model which predicts an event based on observed data.
- construct models, using appropriate technologies.
- identify and describe two or more models which explain the same phenomenon.

- demonstrate an understanding of the relative nature of scales (time, speed, size, distance, weight, etc.).

- use a variety of techniques, including estimation and instrumentation, to measure different scales.

SAMPLE PROGRESS INDICATORS.

- Students utilize a computer simulation of a system (like SIM CITY or a data base or spread sheet program), introduce various changes, and observe the results. They explain orally and in writing what it depicts.

- Students use the MONSTER PROBLEM from page 68 in the Mathematics Curriculum Framework. A monster weighs between 2 and 6 pounds at birth. It is between 3 and 5 feet long. During the first year of its life, both its weight and height double each month. What size range would the monster be on its first birthday? What shape could it be? Students graph the growth over the first 12 months and predict the size if the growth continues unchanged over the next year but is half as fast over the following year.

STANDARD III. **NATURE OF SCIENCE.** This standard involves the application of human intelligence to explain how the world works. This involves particular ways of observing, thinking, experimenting, and validating. These represent a fundamental aspect of the nature of science and reflect how science differs from other modes of knowing. Science influences and is influenced by history, culture, technology, and society.

GOAL A. **SCIENCE AND TECHNOLOGY IN SOCIETY.** All students will

- understand the relevance and interrelationships between science and society.

- be able to apply current technology to the learning of science.

PERFORMANCE OBJECTIVES. All students will

- evaluate the processes used to form an opinion and determine if other conclusions could have been formulated.

- utilize resources outside their classroom.

- identify science applications that influence daily life.

SAMPLE PROGRESS INDICATORS.

- Students explore the variation in pH found in various edible liquids (soda pops, fruit juices, saliva, etc.). They replicate the experiment, comparing two different batches of the same liquid or dilutions or the same material sampled over time. They then plot and interpret the results.

- Students participate in a design project that involves defined constraints and collect the data of the results for all participants. They identify the variables that would influence the results and analyze the data in terms of these variables. They then describe the optimum design based on the analysis.

GOAL B. HISTORICAL AND CULTURAL PERSPECTIVE. All students will

- appreciate the historical and cultural influences on the development of science.

PERFORMANCE OBJECTIVES. All students will

- recognize that personal experiences, observations, and tools for observing and measuring will shape and limit beliefs.
- understand that science and technology influence social change.
- identify scientific beliefs from current or past cultures or civilizations that are different from their own.

SAMPLE PROGRESS INDICATORS.

- Students compare the Earth-centered model of the solar system with the sun-centered model and develop a presentation that includes the historical context and/or societal implications of these models.
- Students brainstorm or generate a list of inventions that changed how work was done during the Industrial Revolution. They select an invention and describe the cultural or social effects.

GRADES 9-12

Introduction

At this level students are traditionally split into classes in earth, physical, and life sciences. To accommodate the trend toward integration of science disciplines, this framework has been designed around the underlying themes of science. These are identified as standards in this document. These standards apply to all disciplines of science. It should not preclude, however, the teaching of specific disciplines in lieu of integration. In schools still teaching separate disciplines of science, this framework will hopefully encourage teachers to integrate concepts from other disciplines.

Sample Progress Indicators are merely suggestions for ways to implement the performance objectives listed for each standard. They are not directives or mandated in any way. The Sample Progress Indicators are predominantly laboratory ideas. This is consistent with the philosophy that science should be a laboratory-based curriculum.

STANDARD I. **HABITS OF THE MIND.** These are the universal thinking, communication, and problem-solving skills involved in all disciplines. They are best learned as processes within an authentic context rather than in isolation. Mathematical skills and reasoning are especially important in developing these habits of the mind in science.

GOAL A. **SCIENCE PROCESSES.** All students will

- practice science that emphasizes scientific process skills.

SCIENCE PROCESS SKILLS

Ask Questions By	Collecting Data By	Analyzing Data By	Explaining By
Noting Patterns	Observing	Predicting	Describing
Noting Discrepant Events	Measuring and Quantifying	Inferring	Defining
Seeking Information	Identifying Significance	Tabulating	Interpreting
Formulating Questions	Selecting Variables	Using Numbers	Developing Models
Mental Generating Hypotheses	Estimating	Correlating	Developing Physical Models
		Classifying	Communicating

Performance based skills are associated with each specific action. TABLE 2

PERFORMANCE OBJECTIVES. All students will

- design an experiment using all elements of the scientific method.

- write clear, step-by-step instructions for conducting investigations, operating something, or following a procedure.
- collect data by properly using instruments, following directions in a manual, or from a facilitator.
- describe experimental data, utilizing appropriate statistics to explain experimental differences.
- analyze data quantitatively by graphing or using computer spreadsheets.
- explain their ideas either orally or in written form by using tables, charts, or graphs.
- identify and criticize arguments based on the faulty, incomplete, or misleading use of numbers.
- analyze data by using algebraic formulas and abstract symbols to solve problems.
- explain, make up, and write out simple algorithms for solving problems.
- be able to discriminate between chance events and cause-effect events.
- be able to formulate alternative conclusions or solutions based on evidence given.

SAMPLE PROGRESS INDICATORS.

- Students identify a problem, formulate a hypothesis, design an experiment, carry out that experiment, and analyze the resulting data. Teachers, as facilitators, provide material support for this project. Students work individually or in groups for this activity.
- Students collect data, analyze it, and predict the impact on local and global societies after observing a natural occurrence or phenomenon.
- Students collect data for a scientific event and then evaluate data for statistical accuracy. All students then discuss their findings in small groups.
- Students design a laboratory activity that lists the equipment, its cost, and proper use.
- Students create a poster-size timeline to illustrate how a scientific theory evolved over time. For example, one might track the evolution of astronomy from early history through the Middle Ages to the present.

- Students develop and apply a set of criteria to evaluate the validity of a conclusion based on numerical data. For example, one might determine the angle of the shadow of a meter stick at two different locations on the planet and from the data determine the radius of the Earth (extra credit for a family vacation).

- Students use dimensional analysis to convert to a different unit when given a specific unit of measurement.

- Students evaluate a geologic event and ask if the event shows evidence of geologic causes or coincidence.

- Students create a written critique and defend their conclusions.

- Students identify a problem and write a grant proposal for money to solve the problem. All students defend their proposal orally during class discussion.

GOAL B. VALUES. All students will

- practice science that develops the following attributes:

    value of scientific inquiry
    appreciation of technology
    honesty
    curiosity
    open-mindedness
    skepticism
    wonder
    perseverance
    enthusiasm

PERFORMANCE OBJECTIVES. All students will

- exhibit critical skills of curiosity, honesty, open-mindedness, and skepticism as these skills are incorporated into science.

- demonstrate the ability to evaluate scientific information without bias.

- exhibit wonder and curiosity about natural phenomena and demonstrate these attributes to their peers.

- exhibit perseverance by completing assigned or chosen tasks within reasonable time constraints.

SAMPLE PROGRESS INDICATORS.

- Students investigate the risks and benefits of a given technology. For example, students prepare an environmental impact statement for the use of primitive lands.
- Students compare the estimated risks and benefits of a proposed technology with various alternatives. For example, students role play significant personnel from a proposed oil refinery and local individuals from the area. They then present to a non-biased panel and substantiate their positions with current research.

- Students design a cart propelled by wind according to set criteria, evaluate the efficiency of their cart, and then redesign and reconstruct their cart.

- Students propose a plan for designing a device that incorporates how the device will be manufactured, operated, replaced, disposed of, who will sell it, operate it, take care of it, and the costs associated with these functions.

- Students present a variety of discrepant events to their peers and explain the phenomenon after the audience brainstorms that cause. This can be done in competitive teams.

- Teams of students are assigned a specific cultural region to determine that region's inherent scientific attitude. Students role play that attitude in a specific situation and use global issues such oil spoils or ozone layer depletion for the situation.

STANDARD II. **SCIENCE THEMES.** These are the universal organizing principles that transcend disciplinary boundaries. They pervade all scientific content and concepts. These themes promote integration both within traditional science disciplines and across subject areas. The three themes are 1) Change and Constancy, 2) Systems and Interactions, and 3) Models, Scale, and Structure.

GOAL A. **CHANGE AND CONSTANCY.** All students will

- understand how physical and living entities undergo change and maintain constancy through the interaction of energy and matter.

PERFORMANCE OBJECTIVES. All students will

- identify change as it relates to time, matter, and space.

- identify change and the rate at which it occurs as they relate to causative agents.

- use the concept of equilibrium as it relates to living and non-living systems.

- develop an understanding of the changing cycles characteristic of living and non-living systems.

- perceive the underlying necessity for periods of change and periods of constancy.

- identify change as a driving force for scientific inquiry.

SAMPLE PROGRESS INDICATORS.

- Students develop a model for the ongoing process of adaptation through time. For example, students create a new "critter" that is perfectly adapted to the future environment in 2050. Students determine what changes were mandated by changes on the planet over that time frame?

- Students use the scientific method to generate an experimental process where changes are observed. The data is used by the students to generate a proposal for continued study.

- Students plot a graph of position versus time for a ball rolling down an inclined plane. From that graph, students determine the velocity versus time graph and the acceleration versus time graph. The three graphs created are evaluated for evidence of change and constancy. Students repeat the experiment and alter the angle. They then evaluate the new data in comparison to the old data.

- Students open eggs and document the changes in the living embryo over a four- or five-day period of time. Students document their findings with pictures and written evaluations based on major morphological structures.

- Students determine the mass of two zinc plates in a zinc sulfate solution. They measure the current versus time as an electric current is run through the plates and then reweigh the plates and use the change to determine the charge per electron.

GOAL B. SYSTEMS AND INTERACTIONS. All students will

- understand that a system is a collection of entities and processes that interact to perform some function.

PERFORMANCE OBJECTIVES. All students will

- identify that a system is connected to other systems internally and externally.

- identify a solution to a problem through systems analysis.

- identify the stability of a system based on appropriate feedback mechanisms.

- recognize that living and non-living systems obey the laws of nature.
- appreciate the interconnectedness of systems that is necessary for correct function.

SAMPLE PROGRESS INDICATORS.

- Students build a circuit using common chemicals provided by the teacher that allows conduction of electric current and light a bulb.
- Students design a non-living system within which energy changes through three types, such as potential, kinetic, chemical, or thermal.
- Students carry out a lab mapping wind patterns by using bubbles to track the patterns. Students vary the wind patterns using variables such as temperature and wind velocity.
- Students create an analogy comparing the organs of the body to the master plan of a city. Structure and function are addressed in the analogy.
- Students develop a chart or poster documenting the feedback mechanisms involved with the human endocrine system.
- Students do a survey at school relating some topic of interest to a specific time of year. They then try the same survey and topic at a different time of year. One topic may be to survey for a preference for type of soda pop.

GOAL C. MODELS, SCALE, AND STRUCTURE. All students will

- understand and be able to use models to explain, predict, or represent phenomena.
- understand that the way in which things work may change with scale.
- understand that structure is an integral part of any system.

PERFORMANCE OBJECTIVES. All students will

- utilize a model to predict actual outcome given a set of actual observations from the real world.
- differentiate between models and real circumstances.
- demonstrate an understanding of how scale can impact function.

SAMPLE PROGRESS INDICATORS.

- Students compare and contrast structure and interactions within the solar system and within the atom.

- Students develop a three-dimensional model of the cell and relate the functions of the individual parts using analogy. Each organelle is structurally and functionally represented in the model. Students also create a poster to define and explain their analogies.

- Students develop an electronic system to accomplish a specific task and evaluate its efficacy in the real world.

- Students use a stream table to explore concepts such as river erosion and compare the results for the table model to what is known about full scale erosion models.

- Students design a unit based on a computer simulation game managing a city or any other system. Students justify their rationale during the decision making in the simulation. Students also role play city council members, the mayor, planner, engineer, concerned citizen, oil refinery owner, and rabble rouser.

STANDARD III. **NATURE OF SCIENCE.** This standard involves the application of human intelligence to explain how the world works. This involves particular ways of observing, thinking, experimenting, and validating. These represent a fundamental aspect of the nature of science and reflect how science differs from other modes of knowing. Science influences and is influenced by history, culture, technology, and society.

GOAL A. **SCIENCE AND TECHNOLOGY IN SOCIETY.** All students will

- understand the relevance of science, its applications, and its interactions, including implications, with society.

- be able to apply current technology to the learning of science.

PERFORMANCE OBJECTIVES. All students will

- understand the necessity of not overgeneralizing conclusions based on inadequate information.

- recognize bias in observations.

- recognize the impact that technological advances have on the quality of life.

- recognize that scientific research can have multiple societal impacts.

- develop an awareness of the environmental impacts of research.

SAMPLE PROGRESS INDICATORS.

- Students work in groups and develop a position statement about the development of a dam in a particular community. This may be a real situation or a simulation. Students compare their findings to an environmental impact statement for a similar situation.

- Students gather a collection of supermarket tabloids and identify the obvious biases in several articles.

- Students observe natural occurrences and evaluate information in situations where ethical or practical limitations prevent experimentation. For example, students are working on a cure for a particular congenital deformity and need to find out if their cure works.

- Students make position statements about the right of insurance companies to access individual genotype information, using the human genome project materials on Ethical, Legal, Social Implications (ELSI). If genotyping could be done in the classroom, students determine if the information should be made available to the administration.

- Students develop a travel brochure throughout time to visit at least fifteen of the greatest scientists in history. What "gems of wisdom" about the impact their work had on the world would you want to tell them. Students then present their brochures as a "sales pitch" to a different class. This may be a good option for a cross-curricular project with a history class.

- Students evaluate the impact of television on their lives today. They compare this to a teenager 200 years ago and a teenager 20 years ago.

GOAL B. HISTORY AND CULTURAL PERSPECTIVE. All students will

- appreciate the historical and cultural influences on the development of science.

PERFORMANCE OBJECTIVES. All students will

- understand that progress in science and invention depend heavily on societal factors.

- understand that the course of history is often influenced by scientific and technological developments.

- investigate the different science-related career possibilities that occur in science.

- predict future influences of science on society.

SAMPLE PROGRESS INDICATORS.

- Students create a list of the first twenty technologies a newly discovered tribe in the rain forest that has never seen any modern technology should be given. Students also create a list of twenty technologies that should not be introduced. They determine if the tribe should be given anything or left completely alone.

- Students evaluate the positive and negative implications on society of the human genome project. Students predict how this information will be used 10, 20, and 50 years from today.

- Students evaluate the implications of terra-forming another planet such as being proposed for changing the Martian environment to support human life. Students design a model for this process.

- Students hypothesize the outcome of World War II if the atomic bomb had not been perfected by the allies or how Great Britain would have fared without the invention of the V-2 or radar, or how the Atlantic naval war would have turned without the use of submarines by the Axis powers.

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