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ABSTRACT

A survey of grade 7, 8 and 9 science teachers was conducted as part of a research program to determine the consequences for teaching and learning of the recent introduction of the SciencePlus Program developed by the Atlantic Science Curriculum Project and the need for further curriculum and professional development. The survey explored some of the conditions of teaching, teachers' goals and instructional practices, and teachers' professional development needs and preferences. Comparison with previously published research indicated that teaching practices in the region appear to have changed over the past decade in the direction of greater hands-on practical activity. Sections include: (1) "General Information"; (2) "Teaching Experience and Educational Background"; (3) "Institutional Arrangements"; (4) "Instructional Goals"; (5) "Instructional Methods"; (6) "Student Assessment Practices"; and (7) "Professional Development Needs." A copy of the survey questionnaire is appended. (KR)

ATLANTIC SCIENCE
CURRICULUM PROJECT

SCIENCE TEACHING IN NEW BRUNSWICK GRADES 7,8 AND 9

SCIENCE TEACHING IN NEW BRUNSWICK GRADES 7, 8 AND 9:
Results of a teacher survey conducted in May, 1990

Research Report Number 3
Atlantic Science Curriculum Project

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PREFACE

More than three decades have passed since the onset of the last major wave of science curriculum reform. Led by the scientific community and supported in most countries by various government and private agencies, that reform focused on adjusting the content of science teaching to the results of the major scientific revolutions that occurred during the first half of the twentieth century.

Some of the direct results of that reform include curriculum materials and a philosophy of science teaching widely adopted in New Brunswick schools. For example, BSCS biology and PSSC physics have been used extensively in senior high schools in New Brunswick. As well, most of the other science curricula adopted in New Brunswick during the past two decades owe at least part of their content and approach to the influence of that reform movement.

A new phase of educational reform is now in progress. Although New Brunswick science teachers had no more than a very small role in the design, development and testing of curricula associated with the previous reform, many are already playing a much larger role in this one. Particularly relevant to the research reported here is the participation of scores of junior high science teachers in New Brunswick in the development of one of the earliest of the new curricula (ASCP, **SciencePlus**, 1986-1990) and the involvement beginning last year of hundreds more in the implementation of this curriculum.

The new reform movement is, of course, international in scope and therefore there are many models from which some generalizations can be made. Those who are interested in a brief description of several of these models may refer to a paper by Peter Fensham (in press) or to a recently published article by Bob Yager (1990). Yager has described the characteristics of the reform movement and some of the initially produced curricula. ASCP: **SciencePlus** is mentioned prominently in both of these reviews.

Judging from the curricula that have so far been developed and the arguments advanced by some of the leading proponents of this reform, the new curricula will be characterized by linkage of science with other areas of the curriculum and by greater attention to the methods of teaching than was the case previously.

These changes in curriculum reflect the larger role that science and technology now play in all aspects of human life and the need for better informed citizens who take greater individual responsibility and initiative for protecting the global environment and managing human affairs. The current educational reform movement is responding to the realization that society and human affairs are too complex to be effectively and safely run by an elite, no matter how well educated.

Very briefly, then, where is the new reform movement leading science teaching? Against what demands should current efforts of New Brunswick grade 7, 8 and 9 science teachers be evaluated? The main demands and the consequences for science curricula appear to be the following: (1) The most prominent demand is for "science for all" and one of its major consequences is increased attention to the problem of making science teaching relevant and meaningful to all students. (2) The educational goal of developing students' interest and ability to acquire information on their own as a life-long need and activity has been underscored by the exponentially increasing rate of accumulation of scientific and technological knowledge. (3) This explosion in knowledge has also obliged science teaching to shift from a focus on knowledge accumulation to an emphasis on assisting students to acquire a (mental) map they can use to find their way through the maze of scientific and technological information. As a result, science teaching is expected to make student's principal learning objective the assimilation of explanatory concepts and theories rather than the accumulation of factual information. (4) The demand for "science for informed participation in democratic decision making" requires science teaching to share responsibility with social studies for civic education. It also adds a social issues dimension to the traditional concern of science teaching for the development of analytical, synthetic and evaluative thought. (5) And the demand that science teaching contribute more to student's competence for living well and working productively requires that science teaching share with such subjects in the curriculum as health, technology and home economics a responsibility for enabling students to apply their scientific knowledge to practical matters.

The goals of the new period of curriculum reform were well stated by Al Baez in Halifax in 1979 at an international conference on world trends in science education. He argued for science teaching which stresses the four "C"s: curiosity, creativity, competence, compassion (Baez, 1980). It might be appropriate, therefore, to ask: To what extent and how well is junior high science teaching in New Brunswick addressing the four "C"s?

What are the results in New Brunswick of the Atlantic Science Curriculum Project? What further curriculum and professional development should be undertaken? A survey of the junior high science teachers (conducted in May, 1990), the observation of teaching and the analysis of tests and assignments (to be conducted in a random sample of schools during the 1990-91 school year), the recorded testimony of a sample of teachers and students and an evaluative study of student learning should provide reasonably comprehensive information to assist New Brunswick educators in evaluating the present status of their efforts and in making judgements about what steps should be taken to bring about further progress.

The frequency data resulting from the survey of grade 7, 8 and 9 science teachers in New Brunswick are reported here. These provide a picture of the range of conditions of teaching, teaching assignments, teacher's goals for teaching, instructional methods, student evaluation practices, and professional development needs. The degree of correspondence between various reported circumstances of teaching (for example, class size, teaching assignment and location of teaching) and the instructional methods employed will be reported in a subsequent publication.

This report begins with a brief account of what seem to the author to be the most significant implications of the frequency data. This data is then presented in a series of tables, accompanied by comments. The comments are intended only to initiate discussion, not to bring closure to the analysis. It is anticipated that further professional and curriculum development efforts will utilize the results of the survey as a basis for analysis, discussion and action. (The questionnaire used in the survey is included as an appendix.)

HIGHLIGHTS

I. The instructional goals of junior high science teachers in New Brunswick appear to be supported to a significant degree by instructional practices that go well beyond the traditional "chalk and talk" and by student evaluation methods that emphasize understanding and skills over short term recall of information. Specifically:

* The goals of developing students' curiosity and interest in learning and their understanding of concepts and relationships, including the ability to apply and use this understanding are the highest priority goals of junior high science teachers in New Brunswick. In contrast, the ability to recall information, formulas and statements, while still important, is assigned the lowest priority. The teachers' instructional goals are consistent with the current movement for science curriculum reform and, in particular, with the **SciencePlus** curriculum. (See Table 20 and the associated comments).

* Reported teaching practices in New Brunswick junior high science classes are reasonably consistent with the teachers' instructional goals and differ sharply from those observed in Nova Scotia a decade ago by Roger Hacker et al (1978). Classroom interaction now appears to be characterized by extensive opportunities for active student learning, including approximately half of class time spent in small group and individual work. Two or more opportunities per week for students to visualize processes and carry out practical work are provided by the majority of teachers. A majority of teachers also report engaging their students in science-related social issues and science-related technological problem solving. As well, a majority require their students to select, carry out and report independent projects in science. (See Tables 21 through 24 and the associated comments).

* Reported student assessment practices of most New Brunswick junior high science teachers are likewise reasonably consistent with the teachers' instructional goals and appear to be different from the assessment practices of teachers elsewhere (Fleming and Chambers, 1983; Bateson, 1990; Wilson, 1990). For example, in a study of teacher made tests, Fleming and Chambers report that only 1% of test items by Cleveland, Ohio junior high science teachers require more than tick marks or completions. By comparison, about 35% of

examination marks of New Brunswick junior high science students are based on questions that require sentence and paragraph response. Nearly 60% of these New Brunswick teachers report that approximately half or more of their test questions require students to apply their understanding to express their answers in their own words. Tests in New Brunswick account for about half of the student's final mark, while the remainder is based mainly on the student's laboratory work, projects and work on assigned questions and problems. (See Tables 25 through 28 and the associated comments).

II. There is considerable room for improvement in (i) institutional arrangements for science teaching in New Brunswick, including the degree of specialization in teaching assignments, maximum class size and amount of time budgeted for science and in (ii) facilities, including lab-classrooms or accessible laboratories for all science teachers. Specifically:

* While most science teaching in grades 7, 8 and 9 in New Brunswick is done by specialists (that is, teachers who teach mainly science), at least half of those who teach science in these grades do so as a secondary teaching assignment. (See Tables 1 and 15). The number of teachers who are apparently assigned to teach science to only one or two classes does not appear to be explained by small school size; only one-fifth of schools that include the junior high grades have fewer than 100 students in these grades. (See Table 7).

* The amount of time allocated to science in grades 7, 8 and 9 in New Brunswick is reported by teachers to average about 160 minutes per week. However, substantial numbers of teachers report an allocation of less than 120 minutes per week, probably not enough time to address meaningfully even the core concepts and learning activities within four units. (See Table 18).

* The majority of junior high science teachers report average science class sizes of greater than 25 students, including 11% who average more than 30 students, a probable factor limiting the amount of practical activity conducted by many science teachers. (Table 17).

* 30% of the respondents report teaching almost exclusively in a classroom without the features (such as running water, fire extinguisher and accessible storage space) needed for much of the practical activity included in junior high science. (Table 19).

III. There is a need for concerted attention to the improvement of opportunities for professional development and professional collaboration among junior high science teachers in New Brunswick. Specifically:

* Junior high science teachers in New Brunswick have an average of five years of university education and sixteen years of teaching experience, including about 8 years teaching junior high science. One-fifth have a completed undergraduate major in science. (See Tables 9, 10 and 11).

* The most strongly expressed professional development needs of junior high science teachers are for knowledge and skill with respect to a variety of science teaching methods and in connection with assessing students for a variety of educational goals. (See Table 29 and the associated comments).

* Two-thirds of junior high science teachers in New Brunswick consider that participation in a network of junior high science teachers for the purpose of discussing problems and sharing ideas is much needed. (See Table 30 and the associated comments).

* Nearly 40% report that they would likely enrol in Masters degree programs in science education if these were available in their home communities. 20% would likely enrol in science education doctoral programs if these were available in their home communities. Only a small fraction of those interested in graduate degree programs in science education, however, would leave their home communities to undertake these studies. (See Table 31 and the associated comments on the implications for schools and universities of teachers' interest in graduate studies).

DETAILED FREQUENCY DATA

PART I. GENERAL INFORMATION

Table 1. Response rate

Number of respondents	213
Number of junior high science teachers	417
Response rate	51 %

Comments: Copies of the survey questionnaire and response sheet were sent by the New Brunswick Department of Education to school principals who were requested to distribute and collect these from grade 7, 8 and 9 science teachers. The teachers were provided blank white envelopes to enclose their responses and the principals each received a larger brown envelope to collect and transmit these. This procedure was designed to assure respondents of anonymity while enlisting the principal's assistance.

How well do the 213 respondents (51% of those who teach science in grades 7, 8 and 9) represent junior high science teaching in New Brunswick? From the results of question 26 about teaching loads (summarized in Table 15 below) and question 28 about the average number of students taught in a class (Table 17), the respondents appear to do 65 to 85% of the science teaching done in New Brunswick in grades 7, 8 and 9. Therefore, the large number of non-respondents appear to be primarily teachers whose teaching assignment includes only one or two classes of science, that is, teachers who are less likely to consider themselves or be considered by their principals as science teachers. If there is a significant difference between the characteristics and instructional strategies of those who mainly teach science (45.7% of respondents) and those who mainly teach other subjects, the frequency data reported here would be biased towards the former. Since the former group appears to do about half the science teaching and about one-third of the latter group is included among the respondents, the survey results should give a reasonably accurate portrayal of junior high science teaching in New Brunswick. It may, however, understate problems with science teaching by non-specialists.

Further analysis of the survey data will examine whether there are significant differences in reported instructional practices according to the extent of specialization in the assignment to teach science. If the degree of specialization in science teaching proves to be significantly related say, to the amount of practical work done, as might be expected, then principals might be able to contribute to an improvement in science teaching through greater specialization in teaching assignments. Based on comments to the author from many teachers who are caught with the need to make extensive preparations to teach only one section of science, greater specialization in teaching assignments in science would be welcomed by many.

Table 2. Age

	Number	Percent
Under 26 years	15	7.1
26 - 35	37	17.6
36 - 45	105	50.0
46 - 55	48	22.9
56 and over	5	2.4

Comments: Both younger and older teachers appear to be somewhat under-represented among junior high science teachers, with the middle group (36 - 45 years of age) comprising half of respondents to the questionnaire.

Table 3. Sex

	Number	Percent
Male	134	64.1
Female	75	35.9

Comments: With respect to role models for students, females are significantly under-represented among junior high science teachers.

Table 4. Urban/rural teachers

	Number	Percent
Urban: Teachers in schools that draw primarily from incorporated cities and towns	97	46.2
Rural: Other teachers including in villages	113	53.8

Table 5. Type of school

Grades included	Number	Percent
Grade 1 to 12	7	3.3
Grade 1 to 9	48	22.7
Grade 1 to 8	10	4.7
7 to 9	77	36.5
7 to 12	25	11.8
Other range of grades	44	20.9

Comments: About half of respondents teach in junior or junior-senior high schools. A significant minority (at least 30% of respondents), however, teach in schools which include elementary grades.

Table 6. Total student population at schools which include the junior high grades

	Number	Percent
Under 300	59	28.0
300 to 599	105	49.8
600 to 899	31	14.7
900 to 1199	16	7.6
1200 or more	0	0.0

Comments: Better than half of junior high science teaching is done in schools with a total student population between 300 and 600. More than one-quarter of the junior high science teachers responding are located in smaller schools and about one-fifth in larger schools.

Table 7. Schools' grade 7, 8 and 9 populations

25 respondents (12%) reported teaching in schools which do not include all the junior high school grades. The breakdown among those who teach in schools which include all of the junior high grades is:

	Number	Percent
Under 100	36	19.4
100 to 199	54	29.0
200 to 299	31	16.7
300 to 399	24	12.9
400 to 499	12	6.5
500 to 599	8	4.3
600 or more	21	11.2

Comments: It appears that only a small minority of students in New Brunswick attend schools that are too small to employ a specialist science teacher (that is, a teacher who primarily teaches science). Nevertheless (Table 15), one-half of the respondents report that they teach more in another subject than in science. Among the 204 non-respondents, this proportion is undoubtedly much higher (See the comments in connection with Table 1).

PART II. Teaching Experience and Educational Background

Table 8. Experience using SciencePlus

	Number	Percent
Never used	81	38.6
First year	107	51.0
Second - fourth year	14	6.7
Fifth year or greater	8	3.8

Comments: The textbook program, **SciencePlus** was introduced into all grade 9 classes conducted in English in New Brunswick in the Fall of 1989. It is to be introduced into the grade 7 and 8 English-speaking classes over the following two years. Judging from the proportion of respondents using this program at the time of the survey (May, 1990), a substantial number of schools have introduced it sooner than required by the province.

It is difficult to get a precise estimate from this data of how many respondents may have participated in the field test development of **SciencePlus** units. Publisher sponsored field testing was done from 1984. On a smaller scale, the Atlantic Science Curriculum Project organized field testing of first and second drafts of many units as early as 1980. During the three years prior to 1980, approximately 30 New Brunswick teachers participated in curriculum writing workshops conducted by the ASCP and 70 additional teachers also used some of the materials developed in these workshops. Although these early materials were written primarily for the teacher and did not utilize a constructivist pedagogy to the extent later materials have done, they undoubtedly did help pave the way for the **SciencePlus** program. (See McFadden, 1980).

Table 9. Teaching experience

	School		Science		7,8,9 Science	
	N	%	N	%	N	%
Up to 2	16	7.6	34	16.3	43	20.4
3 - 5	18	8.6	32	15.3	36	17.1
6 - 10	27	12.9	39	18.7	45	21.3
11 - 15	38	18.1	37	17.7	31	14.7
16 - 20	47	22.4	34	16.3	34	16.1
21 - 25	37	17.6	23	11.0	15	7.1
26 - 30	23	11.0	8	3.8	5	2.4
>30	4	1.8	2	1.0	2	0.9

Comments: 70% of those teaching science in grades 7, 8 and 9 have more than 10 years of teaching experience, including nearly 50% who have more than 10 years experience teaching science. On the other hand, although only 16% have five or less years of total teaching experience, 38% have been teaching junior high science for five or less years. These figures indicate the extent to which teachers are shifted during their careers from teaching other subjects to the teaching of junior high science.

Table 10. Highest level of education

	Number	Percent
*Less than a completed bachelor's degree	8	3.8
*A completed four year B.Ed. or equivalent (N.B. Certificate 4)	48	22.7
*A completed postgraduate degree or equivalent (N.B. Certificate 5)	104	49.3
*A completed masters degree or equivalent (without thesis)	37	17.5
*A completed masters degree including thesis	13	6.2
*One year or more in a doctoral program	1	0.5
*A completed doctoral program	0	0.0

Comments: Nearly 75% of junior high science teachers in New Brunswick have completed more than a first bachelor's degree, including 24% who have studied at least one year beyond the postgraduate degree in education.

Table 11. Highest level of education in science
(Data given in percent of respondents)

	Bio.	Geo.	Chem.	Phys.	Technology
Nothing beyond Grade 9	16.1	49.3	9.5	8.5	56.9
Senior high courses	29.9	23.9	47.4	50.2	23.9
1 or 2 univ. courses	29.9	22.0	29.4	34.1	12.0
3 or 4 univ. courses	8.5	3.3	10.4	5.2	2.9
>4 but less than major	2.8	0.0	0.9	1.4	2.4
Undergrad. major	10.4	1.4	1.4	0.5	1.9
Some grad. work	1.4		0.9		
Masters degree	0.9				
Doctoral degree					

Comments: Most of the respondents have studied some science at university, including about one-fifth who have a completed science major, mostly biology. However, while content from biology, geology, chemistry and physics is included in the junior high science curriculum, the percentage of teachers who have completed courses beyond high school in these subjects is only 54% in biology, 43% in chemistry, 41% in physics and 27% in geology.

A majority of respondents have taken no courses in technology or applied science after grade nine and only 19% have taken such courses beyond high school. This is a factor to be considered in any effort to link science and technology in grades 7, 8 and 9.

Table 12. Highest level of education in science curriculum and instruction

	Number	Percent
No courses in science education	104	49.3
A course at B.Ed. level	154	41.2
A graduate level course	35	7.6
A masters degree in science education	4	1.4
A doctoral degree in science education	1	0.5

Only 24% of respondents report taking a course in science curriculum and instruction within the past ten years.

Comment: The large percentage of science teachers who have never taken a course in science curriculum and instruction (49%) and the small percentage of teachers who have taken such a course within the past ten years (only 24%) may together explain the expressed need by teachers to become acquainted with the increasing range of curriculum resources and instructional methods that are now available to them. (See Table 29).

Table 13. Professional development activity

13A. Participation in school or district level science professional development activity within the past three years (All events where at least one hour was devoted to some aspects of science education)

	Number	Percent
None	28	13.4
One	33	15.8
Two	58	27.8
Three	25	12.0
More than three	65	31.1

13B. Participation in provincial, national or international professional development activity

	Number	Percent
None	94	44.8
One or two	74	35.2
Three or four	20	9.5
More than four	12	4.2

71% of the respondents report having taught science during each of the past three years and another 11% report having taught science for two of these years.

Comments: A substantial proportion of the respondents participated frequently in professional development activity. While only 13% report no participation in such activity at the local level during the past three years, nearly 45% report no such participation outside their schools or districts. This latter figure may be in part a consequence of teaching assignments which include science as less than half of the teacher's load (see Table 15). If so, administrators may have cause to seriously reconsider the wisdom of non-specialist teaching assignments in connection with science. It is particularly difficult to imagine how teachers might maintain their energy and interest in science teaching on the basis of only one and in some cases no meetings in three years with fellow science teachers, particularly in the context of the recent introduction of an innovative and challenging science program.

PART III. Institutional Arrangements

Table 14. Assignment to grade 7, 8 and 9 science teaching

	Number	Percent
Grade 7	105	49.8
Grade 8	100	47.6
Grade 9	91	43.3

Comment: The percentages add up to more than 100 because many of the respondents teach science at more than one of grades 7, 8 and 9.

Table 15. Teaching assignment

	Number	Percent
Only junior high science	28	13.3
Only junior and senior high science	12	5.7
At least half of teaching is science	56	26.7
Less than half of teaching is science	114	54.3

Comment: The results of this survey probably underestimate the proportion of science teachers whose teaching assignment is less than half science. As discussed earlier in connection with Table 1, non-respondents appear to be primarily teachers who teach science to only one or two classes.

Table 16. Number of subject preparations

	Number	Percent (of respondents)
1	5	2.4
2	26	12.4
3	53	25.4
4	51	24.4
5	36	17.2
6	17	8.1
7	12	5.7
8 to 10	9	4.3

Comment: Most respondents have four or less subject preparations. However, one-third of the respondents report having five or more subject preparations, including 10% who have 7 or more preparations. These teachers are likely to find it difficult to fit in the time required to prepare for the practical activity associated with the new science program.

Table 17. Average class size

	Number	Percent
Teachers who report that their average class size in science is:		
Less than 15	6	2.9
16 - 18	11	5.3
19 - 21	24	11.5
22 - 24	42	20.1
25 - 27	54	25.8
28 - 30	49	23.4
31 - 33	22	10.5
More than 33	1	0.5

Comments: A majority (60%) of teachers report average class sizes in junior high science of 25 or greater, including 11% who report that their average science class has more than 30 students. Classes of this size may be difficult to manage safely and effectively in a laboratory situation.

Table 18. Time for science

	Grade 7	Grade 8	Grade 9
The percent of science teachers who report that the average total time/week allocated to science is:			
Less than 120 minutes	16.8	17.6	21.6
120 - 134 minutes	15.4	11.5	5.8
135 - 149 minutes	6.3	7.4	5.0
150 - 164 minutes	22.4	23.0	18.0
165 - 179 minutes	7.0	7.4	10.8
180 - 194 minutes	12.6	12.8	11.5
195 - 209 minutes	11.9	11.5	8.6
210 - 224 minutes	3.5	4.7	7.9
225 - 239 minutes	3.5	2.7	5.0
240 or more minutes	0.7	1.4	5.8

Comments: The peaks in the table correspond to 3, 4 and 5 periods per week of 35-40 minutes. Based on its field test experience, the Atlantic Science Curriculum Project has found that most teachers require at least four periods per week to meet the Province of New Brunswick's minimum expectations for curriculum content (the core activities in four prescribed units each year). Nevertheless, approximately 30% of science teachers in each of grades 7, 8 and 9 report having less than this amount of time for science.

Only the 20% or so of teachers who report about 200 minutes or more for science each week are likely to have time to address the core and some of the optional components of four units and perhaps include some locally developed curriculum. In the United States, the National Science Teachers Association is recommending 7 hours of science instruction per week from grade 6 or 7 on in order for the U.S. to be competitive with Japan and Germany. The U.S. federal government is funding efforts by several school districts there to experiment with this amount of science instruction. (Aldridge, 1989)

Table 19. Location of science teaching

Percent of time in each location:	Classroom	Lab-classroom	Laboratory
	(Percent of teachers)		
Less than 5%	16.9	68.4	49.5
5 - 14%	0.5	7.9	13.0
15 - 24%	1.0	3.4	9.9
25 - 34%	1.9	2.3	11.5
35 - 44%	2.4	2.8	5.2
45 - 54%	7.7	3.4	4.2
55 - 64%	5.8	0.0	0.5
65 - 79%	16.9	1.7	1.6
80 - 94%	16.4	2.8	0.0
95% or more	30.4	7.3	4.7

Nearly 8% of respondents reported spending at least 5% of the time in other school locations. 15% of the respondents reported teaching 5% or more of the time outside of the school (for example, on field trips).

Comments: In the questionnaire, a classroom was defined as a place without flat top desks or benches, running water, fire extinguisher and readily accessible storage space. Nearly one-third of junior high science teachers use such a classroom almost exclusively when they teach science.

A lab-classroom, defined as a classroom with the features listed above, is the main teaching location for only 12% of the teachers. About half of the teachers teach in a science laboratory for 5% or more of the time, including only about 7% who teach in a science laboratory most of the time.

PART IV. Instructional Goals

An initial listing of goals was presented in individual interviews to twenty junior high science teachers, who were each asked to add to the initial list and indicate where clearer statements might be needed. The goals as listed in the questionnaire are a result of this process.

The questionnaire asked respondents to indicate the priority they think should be given to each of the 16 goals listed. Permitted responses to each goal statement were numbers on a scale of 1 to 5, representing low to high priority. (See the questionnaire in the appendix to this report). The goals (or in some cases groups of related goals) included in the list do not exhaust the possibilities nor is it likely that any two science educators would phrase them in precisely the same way. This procedure does, however, permit a record to be obtained of the relative priorities of teachers among the goals presented.

Table 20. Prioritization of selected goals
(Results are reported as the percent of respondents indicating each of the five possible degrees of priority)

Goal	Priority: Low 1	2	3	4	High 5	4+5
Curiosity, interest in further learning	0.0	0.5	6.6	28.0	64.9	92.9
Understanding of concepts and relationships, including ability to apply and use understanding	0.5	1.4	12.5	29.3	56.3	85.6
Critical thinking skills (such as analysis, synthesis and evaluation	0.0	1.9	13.8	31.0	53.3	84.3
Imagination and creativity	0.5	0.0	17.4	35.7	46.4	82.1
Skill at observing, measuring and reporting	1.0	2.4	15.7	42.9	38.1	81.0
A favourable disposition towards life-long, independent learning in relation to science and technology	1.0	4.8	24.5	33.2	36.5	69.7
Scientific experimental skills (hypothesizing, identifying and controlling variables, etc.)	0.5	6.2	24.8	35.2	33.3	68.5
Skills of written and oral communication	0.5	3.8	30.8	35.1	29.8	64.9
Interpersonal skills	2.0	5.9	34.3	33.3	24.5	57.8

Understanding of technology and its relation to science	1.9	7.1	37.1	39.0	14.8	53.8
Informed participation in democratic decision making on science related social issues	3.8	13.3	34.1	29.4	19.4	48.8
Ability to interpret and construct tables and graphs	1.0	10.5	42.4	31.4	14.8	46.2
Understanding of science as a human social activity conducted in a societal and historical context	3.5	15.3	37.1	28.7	15.3	44.0
Specific factual knowledge	2.9	13.0	40.9	28.8	14.4	43.2
Knowledge of relationships (such as ability to state laws and principles)	4.4	28.2	38.3	21.8	7.3	29.1
Knowledge of formulas	15.2	34.3	36.7	10.5	3.3	13.8

Comments: The results of this survey should put to rest any argument that teachers give priority to students' commitment to memory of information. In fact, the ability to recall statements, formulas and specific factual information is last among teachers' priorities.

The priorities of the teachers are consistent with the SciencePlus curriculum. For example, SciencePlus was specifically designed with an emphasis on facilitating understanding of concepts and relationships and promoting curiosity and interest in further learning, the two highest priority goals of junior high science teachers in New Brunswick. The emphasis that teachers give to critical thought, imagination and creativity, observing, measuring and recording, life-long learning of science, scientific experimental skills and written and oral communication is also consistent with the SciencePlus curriculum.

Some goals that are given significant priority by the teachers and are reflected in the SciencePlus curriculum are nevertheless not given as high a priority as some science educators are arguing for. For example, the physicist John Ziman (1980) has argued that the social study of science should have the highest priority. Bob Yager (1984) and Rodger Bybee (1984) among others have argued for a curriculum in science which gives priority to the relations between science, technology and society. On the other hand, the author has recently argued that a science-technology-society curriculum is an appropriate school curriculum, not simply a science curriculum (McFadden, 1989). Attention to the relations between science, technology and society should not displace the major contribution which science teachers can make to such a curriculum by helping students make scientific sense of the natural and human-built world.

It is believed that the agreement between emphases in the SciencePlus curriculum and the goals of the teachers is in large part the result of the role teachers played in shaping the SciencePlus curriculum and, in turn, the influence this program is having on teachers. The achievement of such consistency is probably attributable to the relative success of the Atlantic Science Curriculum Project in bringing together the process of provincial curriculum decision making, grass-roots control over curriculum materials development and commercial textbook publishing.

The argument offered by publishers (and supported by some educators) that teachers favour textbooks which emphasize fact-recall appears to be fallacious and may be self-serving. Textbooks which emphasize the narrative presentation of information, even when they include provision for extensive practical activity, are probably much easier for publishers to develop, lessening their dependence on authors. Teachers are, however, often driven to teach for fact-recall by curriculum decision-makers who insist on including more content than can be addressed in any meaningful way in the time available. In that sense, traditional curriculum decision making serves the maintenance of an unwanted fact-recall curriculum. This leads to the appearance that a fact-recall curriculum results from teacher demand, but the survey results reported here suggest that given the opportunity, teachers prefer a quite different kind of curriculum. (See McFadden, 1990, for a detailed account of ASCP's experience with this issue. For balance, this account includes comments from publishers and curriculum decision makers as well as teachers and authors.)

PART V. Instructional Methods

Table 21. Form of classroom interaction
(Results are reported as percents of respondents)

	Whole class	Individual	Small group
<5%	0.0	7.3	9.3
5 - 14%	2.9	22.8	21.5
15 - 24%	5.4	28.6	26.3
25 - 34%	11.7	30.6	22.4
35 - 44%	10.7	7.3	8.8
45 - 54%	22.0	2.4	4.9
55 - 64%	18.5	1.0	2.4
65 - 79%	15.6	0.0	3.9
80 - 94%	9.8	0.0	0.5
95% +	3.4	0.0	0.0

Comments: Very few teachers report using whole class teaching exclusively. On average, approximately half of class time is reportedly characterized by whole class teaching, but there is considerable variation about this median. For example, approximately one-quarter of the teachers report being engaged in whole class teaching two-thirds of the time or more.

The average proportion of class time spent by students working individually is about 20%, but this also varies considerably among teachers. Some teachers provide very few opportunities for in-class individual work by students. Likewise, time spent by students in small group activity varies considerably around a median of about 30%.

Most teachers would probably agree that the interaction orchestrated by the teacher should support the teacher's instructional goals. For example, the high priority assigned by teachers to understanding concepts and relationships, including the ability to apply and use this understanding, should be supported by interaction in the classroom which maximizes the possibility for students to assimilate concepts. Opportunities to reformulate and apply concepts are probably critical to successful concept acquisition. Small group and individual work can provide these opportunities, depending on whether these forms of interaction are organized for this purpose by the teacher and how well this is done. These methods appear to be used extensively by junior high science teachers in New Brunswick.

Whole class interaction between the teacher and the students may be the most efficient way of communicating instructions, conducting demonstrations and providing essential information not otherwise readily accessible to students. This method appears to be over-used by many teachers, given that whole class teaching frequently means the engagement of only one student at a time in formulating and expressing an idea in response to a question and perhaps even more frequently means that most of the formulating, expressing and applying of concepts is done by the teacher. The extensive use of whole class teaching methods by many teachers suggests a possible inconsistency between their goals and instructional practices. This possibility deserves attention.

Table 22. Use of selected teaching methods
(Results are reported as percents of respondents)

	Demonstrations	Hands-on practical	Homework assigned	Information searches
Never	0.0	0.0	0.5	2.0
1 to 4/ year	5.3	10.4	4.9	36.5
1/ 1 or 2 mos	12.1	20.3	6.8	29.6
1/ 2 weeks	26.7	23.8	14.1	22.7
1/ week	28.6	24.8	30.6	7.9
2/ week	16.5	13.9	24.8	1.0
>2/ week	10.7	6.9	18.4	0.5

Comments: The frequency of demonstrations, practical activity, assigned homework and assignments to search for information in sources other than the textbook by the majority of junior high science teachers appears to be consistent with their instructional goals. There are still significant percentages of teachers whose infrequent use of these methods seems inconsistent with their instructional goals. Attention should be given to the possible reasons for this and assistance given to these teachers if that is needed.

On the whole, however, current instructional practices reported by junior high science teachers in New Brunswick (Tables 21 and 22) suggest that a change has taken place during the past decade. Based on an observational study of classroom interaction in grade 7, 8 and 9, Hacker et al (1978) concluded that junior high science teaching in this region was teacher-directed, non-practical and informational. It appears that could not be said today about the teaching done by 40% or more of the junior high science teachers in New Brunswick.

Table 23. Science-Technology-Society instruction

23A. Collective decision-making on a science related social issue (when students must make ethical decisions on a science-related issue taking relevant scientific knowledge into account)

	Number	Percent
Never	35	17.3
Once during the course	37	18.3
2 or 3 times per course	81	40.1
4 or 5 times per course	33	16.3
More than 5 times/course	16	7.9

23B. Technological problem solving (when students must design the solution to a human social or technical problem making use of relevant scientific or technical knowledge)

	Number	Percent
Never	78	38.0
Once during the course	52	25.4
2 or 3 times per course	53	25.9
4 or 5 times per course	15	7.3
More than 5 times/course	7	3.4

Comments: The majority of teachers report engaging their students in selected STS instructional activities. The reported extent of this engagement is probably consistent with a science curriculum which develops scientific understanding and skills in relevant contexts. If the junior high science curriculum presents the only opportunity for student reflection on science-related social issues and engagement in technological problem-solving, the engagement reported is probably less than adequate in relation to societal need.

Perhaps the solution to the problem of incorporating interdisciplinary issues and themes in the school curriculum without creating redundancy on the one hand or displacing important tasks of the subject disciplines on the other can be found in the development of coordinated multidisciplinary instruction. For such themes as environmental studies, sex education, structures and design or consumer products, for example, several subject disciplines in the curriculum could make an appropriate contribution. In connection with a given theme, the science class might emphasize the scientific concepts involved; the social studies class might focus on related social issues and democratic means for addressing them; the technology education, home economics or health class might give attention to problem solving that involves the application or use of appropriate technology; the language arts class might involve students in written and oral communication on the theme or engage them in the study of related literature. The present instructional goals and practices of science teachers would support such a solution to the need for an STS curriculum.

Table 24. Student projects (which the student selects, carries out and presents to others, perhaps in the form of an exhibit, such as science fair projects)

	Number	Percent
Such projects are required	111	54.1
Not required, but 50% + do them voluntarily	10	4.9
More than 10%, less than 50% do them voluntarily	14	6.8
Up to 10% do them voluntarily	26	12.7
Practically none do them	44	21.5

Comment: An impressive proportion of New Brunswick junior high science teachers (over one half) require their students to engage in such projects. This practice is consistent with several of the teachers' high priority goals. On the other hand, it is evident that when such projects are not required by teachers, few students do them.

PART V1. Student Assessment Practices

Table 25. Components of student assessment (percentage which each contributes to the final mark)

	Exams, tests quizzes	Labs/hands-on work	Assigned ques.&pbs.	Student projects	Other
<5%	0.5	15.0	25.7	20.9	61.1
5 - 14%	2.0	22.5	30.1	26.9	25.9
15 - 24%	6.4	40.0	24.3	32.3	11.9
25 - 34%	10.3	12.5	8.4	16.4	
35 - 44%	11.8	5.0	0.5	3.0	0.5
45 - 54%	27.0	4.0	0.5	0.5	0.5
55 - 64%	19.6	1.0			
65 - 79%	15.2		0.5		
80 - 94%	4.9				
95% +	2.5				

Comments: A significant proportion of marks (on average, nearly one-half) are assigned by teachers for a variety of products of student work, including practical work, assigned questions & problems and projects. It is most common to derive the other half of the marks from testing, but there is considerable variation in this practice. For example, 19% of respondents derive only one-third or less of students' final marks from testing while another 24% derive two-thirds or more of these marks from test results.

Table 26. Use of selected assessment methods

Method	Use: None (0%)	Minor (1-9%)	Major (10% +)
Observation of laboratory work	18.7	47.8	33.5
Observed class performance	8.9	52.2	38,9
Observed behaviour or attitudes	20.7	54.7	24.6
Student peer evaluation	70.1	27.9	2.0
Student self evaluation	73.6	23.9	2.5

Comments: This data indicates significant use of observation of students in assessing them for marks, but only minor use of student peer and self evaluation. A sharing of ideas, approaches and experiences with respect to these selected methods of student evaluation would probably be useful. Assessment based on observation can present difficulties with respect to objectivity and fairness, but does facilitate assessment of progress towards goals that are otherwise not easily evaluated. Greater use of student peer and self evaluation might have the merit of giving more students a sense of responsibility for their own education and ownership of the curriculum while permitting more continuous monitoring of progress to be done without significant additional work for the teacher.

Table 27. Types of responses asked by questions used in exams, tests and quizzes (as a percent of the total mark)

	Tick mark	Word or phrase	Less than 50 words	Essay >50 words	Numbers, tables, graphs	Other
Use:						
<5%	19.3	4.9	4.9	42.4	32.3	51.3
5-14%	30.2	26.0	16.3	31.8	33.8	31.4
15-24%	26.7	36.8	27.6	18.2	21.2	12.0
25-34%	9.9	14.2	21.2	4.5	9.1	2.6
35-44%	6.4	6.9	15.8	1.5	2.0	0.5
45-54%	6.4	5.9	7.9	0.5	1.0	1.0
55-64%	0.5	2.9	0.5	0.5	0.5	0.5
65-79%	0.5	1.5	3.9	0.5		0.5
80-94%		1.0	2.0			
95%+						

Comments: Teaching which emphasizes students' ability to reformulate scientific concepts in their own words is likely to include in testing a large proportion of items that call for sentence and paragraph responses. On average, New Brunswick junior high science teachers report assigning approximately 35% of students' test marks to questions that call for sentence or paragraph responses. There is, however, quite a lot of variation in this practice.

By contrast with the significant use by New Brunswick teachers of test questions that call for sentence and paragraph respons, Margaret Fleming and Barbara Chambers (1983) in a study of teacher made tests in the Cleveland, Ohio school district found that in junior high science only 1 percent of test items involved more than tick marks or completions. When analyzed in terms of the behaviors required of students they found that only 13% involved more than direct recall and of these, all but 1% involved only the translation of information from verbal to numerical form or vice-versa. Similar results were found for all other subject areas and levels of schooling in Cleveland. In conclusion, Fleming and Chambers questioned teachers' instructional priorities and noted that "classroom tests and the learning they examine require students to remember knowledge, not to use it." (p.38) It would appear that the instructional priorities and student assessment methods of New Brunswick junior high science teachers are qualitatively different than their Cleveland, Ohio counterparts.

The reported results of recent research on the student evaluation practices of teachers in British Columbia and Ontario also suggest that these teachers give greater emphasis in testing for fact-recall and less to testing for student concept development than New Brunswick junior high science teachers. Wilson (1990) analyzed all the assessment instruments, including assignments and checklists as well as tests, of a sample of secondary teachers (Grades 8 - 12/13) in British Columbia and Ontario. He found that only 6% of students' final marks derived from essay forms of response (on tests and assignments) in British Columbia and 15% in Ontario, whereas tick mark and short answer responses were responsible for 78% of final student marks in B.C. and 46% in Ontario. These results include science together with such subjects as social studies and english, which traditionally include essay assignments; science assessment by itself might involve even fewer opportunities for students to express their knowledge in their own words.

Bateson (1990) has reported on student assessment practices of grade 7 science teachers in British Columbia. 54.4% of these teachers report that they give much emphasis in deriving the final marks of students to objective tests. In contrast, only 10.3% report giving much emphasis to "subjective tests", that is, essays and paragraphs.

Table 28. Testing for application of understanding

	Number	Percent
*All or nearly all test questions can be answered by recalling statements made in class or in the textbook.	22	10.8
*About 2/3 can be answered by recalling statements made in class or in the textbook.	60	29.4

*About half can be answered by recalling statements made in class or in the textbook.	63	30.9
*About 2/3 require students to apply their understanding to express their answers in their own words.	48	23.5
*All or nearly all require students to apply their understanding to express their answers in their own words.	11	5.4

Comments: 40% of New Brunswick respondents reported an emphasis on knowledge recall that is inconsistent with the much higher priority given by most teachers to the goal of student understanding. It is probable that many of these teachers would welcome opportunities to learn more about alternative approaches to student assessment from their colleagues (see Table 29). Also, the **Teachers Resource Books for SciencePlus** may prove helpful to the 40% of teachers who have not yet received them. For example, in Nova Scotia, where nearly all teachers are now using **SciencePlus**, only 16% report testing more for recall than understanding (see ASCP Research Report No.2).

PART VII. Professional Development Needs

Table 29. Need for specific forms of knowledge and skill
(Results in percent of respondents)

	None needed 1	2	3	4	Much needed 5
Content knowledge related to the science program	6.3	21.0	25.9	27.8	19.0
Knowledge about adolescent behaviour and needs	13.7	27.8	25.9	18.5	14.1
Knowledge and skill with respect to a variety of science teaching methods	3.4	8.3	21.4	40.8	26.2
Knowledge and skill with respect to assessing students for a variety of educational goals	4.5	14.4	26.9	38.3	15.9

Comment: A majority express a significant need for more knowledge and skill with respect to teaching methods and student assessment (67% and 54%, respectively) while a sizable minority express a need for more knowledge of program related science content and adolescent behaviour and needs (47% and 33%, respectively).

Table 30. Interest in selected forms of professional development activity (Results in percent of respondents)

	None needed 1	2	3	4	Much needed 5
Participation in a network of junior high science teachers for the purpose of discussing problems and sharing ideas	4.4	11.2	16.1	27.3	41.0
Locally conducted evening workshops during the school year	34.0	15.3	24.1	16.7	9.9
One week summer institute(s) in a centralized location	22.1	18.6	25.0	20.6	13.7
Non-credit summer courses	40.9	20.2	25.1	9.4	4.4
Credited summer courses	17.0	11.0	23.5	21.5	27.0

Comments: Among the above listed forms of professional development activity, a teacher network and credited summer courses are clearly the most favoured by teachers. Two thirds of respondents expressed a significant need for participation in a network of junior high science teachers to discuss problems and share ideas. Half expressed a need for credited summer courses.

Locally conducted evening workshops are likely to be successful only in the larger population centres. On the other hand, the one-third of teachers who identify a significant need for centralized one week summer institutes probably constitute a sufficient number to ensure the success of well-publicized, well-crganized, relevant summer institutes and conferences.

Table 31. Interest in pursuing graduate degree programs in science education within the next ten years

Teachers were asked whether they would likely enrol in the following programs if available. The number responding that they would are given below:

	Number	Percent
Masters in science education, but only if available at a site within commuting distance of home	53	26.5
Masters in science education if offered at a university in the Maritimes	22	11.0
Total	75	37.5
An additional 4 respondents (2.0%) indicated they would likely enrol in a masters in science education, but not within the next ten years.		
Doctoral degree in science education, but only if available at a site within commuting distance of home	19	9.5
Doctoral degree in science education if offered at a university in the Maritimes	9	4.5
Total	26	14.0
An additional 10 respondents (5.0%) indicated they would likely enrol in a doctoral program in science education, but not within the next ten years.		

Comments: The level of interest by junior high science teachers in graduate studies in science education is an indication of their desire for continuing scholarship and professional growth. At the same time, most of those interested in graduate studies in science education appear to regard the expense of leaving their own communities for that education as uneconomic. Although the question was not asked in the survey, it is also unlikely that a large percentage of those interested in graduate studies could or would forego a year or two of salary for that purpose.

The traditional view of universities that masters and especially doctoral degrees are primarily for intending university, government and industry researchers will have to change if the universities are to accommodate the kind of teacher interest revealed by this survey. Residence requirements will need to be dropped and resources will need to be committed to offering masters and doctoral degree opportunities through distance education.

If schools (and in the first place the students in them) are to get the full benefit of teachers' expanded participation in graduate studies, there will likely have to be a concomitant improvement in the opportunities teachers have for participation in curriculum development and an increasingly collegial environment in the school system, including a greater role for teachers in setting the school's academic policies.

If university education faculty members are to meet the teacher demand for graduate studies, most will need to be seriously involved in research and creative production. The usual forms of this research and creative activity should include collaboration between university and school faculty members. Some of the time for the greater responsibility of university faculty members for collaborative scholarship and creative activity might be found by giving the masters and doctoral education graduates employed in the schools more of the responsibility for initial teacher professional preparation.

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Appendix 1.

SURVEY QUESTIONNAIRE: PROJECT ON JUNIOR HIGH SCIENCE TEACHERS' EVALUATION OF STUDENT LEARNING

The information you provide below constitutes part of the research data being gathered in this project. As such it may be included in research reports and be made available to other researchers through electronic storage. The primary audience for reports on this research will be the teaching profession, especially the junior high science teachers who participate in this survey. Thank you for your willingness to participate.

Your time and patience in completing this questionnaire should provide useful information to the teaching profession and all others concerned with improving the conditions and results of science teaching. This research is being conducted by Chuck McFadden, Alan Moore and Tom Morrisey with the encouragement and support of the New Brunswick and Nova Scotia Departments of Education and the Atlantic Science Curriculum Project.

Please answer directly on the scan sheet by bubbling in the correct response, using #2 pencil only. For example, if you teach in New Brunswick, your answer to question 1 would look like this:

A B C D E F G H I J
1 ● ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

You are not expected to provide your name or other identifying information that may be asked on the general purpose answer sheet. Thank you!

I. GENERAL INFORMATION

1. Which province do you teach in?

   A. New Brunswick
   B. Nova Scotia

2. What is your age?

   A. 25 and under
   B. 26-35
   C. 36-45
   D. 46-55
   E. over 55

3. What is your sex?

   A. Male
   B. Female

4. Does your school draw primarily from an urban or rural population? (For this purpose, incorporated cities and towns are considered urban, while villages are considered rural).

   A. Urban
   B. Rural

5. What is the range of grades included in your school?

   A. P or 1 to 12
   B. P or 1 to 9
   C. P or 1 to 8
   D. 7 to 9
   E. 7 to 12
   F. Other range of grades

6. What is your school's total student population?

   A. Under 300
   B. 300 to 599
   C. 600 to 899
   D. 900 to 1199
   E. 1200 or more

7. What is your school's grade 7, 8 and 9 population?

   A. My school does not include all these grades
   B. Under 100
   C. 100 to 199
   D. 200 to 299
   E. 300 to 399
   F. 400 to 499
   G. 500 to 599
   H. 600 or more

II. CURRENT TEACHING ASSIGNMENT

8. Do you teach grade 7 science this school year?

   A. Yes
   B. No

9. Do you teach grade 8 science this school year?

   A. Yes
   B. No

10. Do you teach grade 9 science this school year?

   A. Yes
   B. No

11. How many years have you been using the textbook program, SciencePlus (at any grade level)? (If you participated in the field tests or pilot trials, please include these years).

A. I have never used this program
B. This is the first year I have used it
C. " second "
D. " third "
E. " fourth "
F. " fifth "
G. " sixth "
H. " seventh "
I. " eighth "
J. " ninth or greater "

III. TEACHING EXPERIENCE

<u>The choices of answers for questions 12 to 14 are given below the set of questions</u>.

Including this year, how many years have you been teaching
12. In school?
13. In science?
14. In junior high science?

A. Up to 2
B. 3 to 5
C. 6 to 10
D. 11 to 15
E. 16 to 20
F. 21 to 25
G. 26 to 30
H. More than 30

IV. EDUCATIONAL BACKGROUND

15. What is the highest level of education you have completed?

A. Less than a completed bachelor's degree
B. A completed four year B.Ed. degree or equivalent (N.B. or N.S. Certificate 4)
C. A completed postgraduate B.Ed. degree or equivalent (N.B. or N.S. Certificate 5)
D. A completed masters degree by course work or the equivalent (without a thesis)
E. A completed masters degree including thesis
F. One year or more in a doctoral degree program
G. A completed doctoral degree

The choices of answers for questions 16 to 20 are given below this set of questions. Please answer each question by bubbling in the letter that best corresponds to your answer.

16.. What is the highest level of education you have received in biology (or other life sciences)?
17. " in geology (or other earth sciences)?
18. " in chemistry?
19. " in physics?
20. " in technology (including school level and post secondary technology courses and technological courses within university level engineering, applied science, nursing, medicine, forestry, architecture).

A. Zero courses beyond grade 9
B. One or two courses during grades 10 to 12 or the equivalent (including content courses taken from a teachers college or faculty of education)
C. One or two full year courses or equivalent at university level from science or applied science faculties.
D. Three or four full year courses or equivalent at university level from science or applied science faculties.
E. More than four full year courses or equivalent at university level from science or applied science faculties but less than a completed undergraduate major.
F. A completed undergraduate major in this subject area.
G. A completed undergraduate major plus further course work at the graduate level in this subject area.
H. A master's degree in this subject area.
I. A doctoral degree in this subject area.

21. Please indicate your highest level of education in science teaching methods and science curriculum.

A. No completed courses in science curriculum and instruction
B. A course or courses in science curriculum and instruction at the B.Ed. level
C. A graduate level course or courses in science curriculum and instruction
D. A masters degree in science education
E. A doctoral degree in science education

22. How long has it been since you last took a university or college course in science teaching methods?

A. No courses ever taken
B. Last course taken was more than ten years ago
C. Last course taken was more than five, but less than ten years ago
D. Such a course was taken within the past five years

23. Of the previous three years, during how many did you teach science?

A. None
B. One year
C. Two years
D. All three years

24. During the last three years, how many school or district level in-service or professional workshops, meetings and conferences concerned with science teaching did you attend? (Please include all those events where at least one hour was devoted to some aspects of science education.)

A. None
B. One
C. Two
D. Three
E. More than three

25. During the last three years, how many provincial, national or international conferences or workshops concerned with science teaching did you attend?

A. None
B. One or two
C. Three or four
D. Five or six
E. More than six

V. INSTITUTIONAL ARRANGEMENTS

26. Which statement most closely describes your teaching situation?

A. I teach only junior high science
B. I teach only science, including junior and senior high classes
C. At least half of my teaching is science, but I also teach another subject or subjects
D. Less than half of my teaching is science, but it is the subject area I teach most
E. I teach more in another subject area or areas than I do in science

27. How many different subjects do you have to prepare for?

A. 1   B. 2   C. 3   D. 4   E. 5

F. 6   G. 7   H. 8   I. 9   J. 10

28. What is the average number of students in your junior high science classes?

A. Less than 16
B. 16-18
C. 19-21
D. 22-24
E. 25-27
F. 28-30
G. 31-33
H. More than 33

29-31. For <u>each</u> of the junior high grades in which you teach science, please indicate the average total time allocated to science in minutes per week per class. (If your school is semestered, divide the total time per week by two to get the yearly average.)

29. Grade 7?
30. Grade 8?
31. Grade 9?

A. Less than 120
B. 120 - 134
C. 135 - 149
D. 150 - 164
E. 165 - 179
F. 180 - 194
G. 195 - 209
H. 210 - 224
I. 225 - 239
J. 240 or more

The choices of answers to questions 32 to 36 are given below the set of questions.

32-36. What percentage of your junior high science teaching do you do in each of the following locations? (Please check to see that the total of your estimates corresponds to 100%).

32. In a classroom (a location without flat-top desks or benches, running water, fire extinguisher, readily accessible storage space)

33. In a lab-classroom (a location with the features listed above but where non-laboratory teaching is also ordinarily done)

34. In a laboratory

35. In other school locations

36. Outside of the school (for example, field trips)

A. Less than 5%
B. 5-14%
C. 15-24%
D. 25-34%
E. 35-44%
F. 45-54%
G. 55-64%
H. 65-79%
I. 80-94%
J. 95% or more

VI. INSTRUCTIONAL GOALS

Please indicate the priority you think should be given in science education to each of the following goal areas.

Priority	Low 1	2	3	4	High 5
37. Specific factual knowledge....	A	B	C	D	E
38. Knowledge of formulas	A	B	C	D	E
39. Knowledge of relationships (such as ability to state laws and principles)...............	A	B	C	D	E
40. Understanding of concepts and relationships, including ability to apply and use understanding	A	B	C	D	E
41. Critical thinking skills (such as analysis, synthesis, evaluation	A	B	C	D	E
42. Curiosity, interest in further learning	A	B	C	D	E
43. Imagination and creativity	A	B	C	D	E
44. Scientific experimental skills (hypothesizing, identifying and controlling variables, etc.) ..	A	B	C	D	E
45. Ability to interpret and construct tables and graphs ...	A	B	C	D	E
46. Skills of written and oral communication.................	A	B	C	D	E
47. Interpersonal skills	A	B	C	D	E
48. Skill at observing, measuring and reporting	A	B	C	D	E
49. Understanding of science as a human social activity conducted in a societal and historical context	A	B	C	D	E
50. Understanding of technology and its relation to science ...	A	B	C	D	E
51. Informed participation in democratic decision making on science related social issues .	A	B	C	D	E
52. A favourable disposition towards life-long, independent learning in relation to science and technology	A	B	C	D	E

VII. INSTRUCTIONAL METHODS

The choices of answers to questions 53 to 55 are given below the set of questions.

53-55. Estimate the average percentage of class time in your junior high science classes that can be characterized primarily by each of the following kinds of student-teacher interaction. (Please check to see that the total of your estimates corresponds to 100%)

53. % Time teacher interacting with the whole class?
54. % Time students working individually?
55. % Time students working in small groups?

A. Less than 5%
B. 5-14%
C. 15-24%
D. 25-34%
E. 35-44%
F. 45-54%
G. 55-64%
H. 65-79%
I. 80-94%
J. 95% or more

56. How frequently do you conduct demonstrations in your typical junior high science class?

A. never
B. one to four times per year
C. once every month or two
D. once every couple of weeks
E. once every week, on average
F. twice per week, on average
G. more than twice per week, on average

57. How frequently do you have the students in your typical junior high science class conduct hands-on practical activity?

A. never
B. one to four times per year
C. once every month or two
D. once every couple of weeks
E. once every week on average
F. twice per week, on average
G. more than twice per week, on average

58. How frequently are students in your junior high science classes required to do homework assignments?

A. never
B. one to four times per year
C. once every month or two
D. once every couple of weeks
E. once every week on average
F. twice per week, on average
G. more than twice per week, on average

59. How frequently do you require your students to search for information from sources other than the class textbook?

A. never
B. one to four times per year
C. once every month or two
D. once every couple of weeks
E. once every week on average
F. twice per week, on average
G. more than twice per week, on average

60. How frequently do you engage your junior high science students in collective decision-making on a science related social issue (when they must make ethical decisions on a science-related issue taking relevant scientific knowledge into account)?

A. never
B. once during the course
C. twice or three times per course
D. four or five times per course
E. more than five times per course

61. How frequently do you engage your junior high science students in technological problem-solving (when students must design the solution to a human social or technical problem making use of relevant scientific and technical knowledge)?

A. never
B. once during the course
C. twice or three times per course
D. four or five times per course
E. more than five times per course

62. Are projects which the student selects, carries out and presents to others, perhaps in the form of an exhibit (such as science fair projects), required of students in the junior high science classes you teach?

A. Yes, such projects are required
B. No, but more than 50% do them voluntarily for science fairs or other events
C. No, but more than 10%, less than 50%, do them voluntarily for science fairs or other events
D. No, but up to 10% do them
E. No, such projects are not required and, to my knowledge, none or practically none of my students do them

VIII. STUDENT ASSESSMENT PRACTICES

The choices of answers to questions 63 to 67 are given below the set of questions.

63-67. Make the best estimate of the percentage which each of the following contributes to the final mark of your junior high students. (Please check to see that the total of your estimates corresponds to 100 %.)

63. % for exams, tests and quizzes?
64. % for laboratory/hands-on activities?
65. % for assigned questions and problems?
66. % for student projects, including research projects, science fair projects and other kinds of independent projects?
67. % for other forms of evaluation?

A. Less than 5%
B. 5-14%
C. 15-24%
D. 25-34%
E. 35-44%
F. 45-54%
G. 55-64%
H. 65-79%
I. 80-94%
J. 95% or more

68-72. Please indicate the extent to which you use the forms of student evaluation listed below (as a percentage of the total mark given students).

	Use: None (0%)	Minor (1-9%)	Major (10% +)
68. Observation of laboratory work	A	B	C
69. Observed class performance	A	B	C
70. Observed behaviour or attitude	A	B	C
71. Student peer evaluation	A	B	C
72. Student self evaluation	A	B	C

The choices of answers to questions 73-78 are given below the set of questions.

73-78. Estimate the worth (as a percentage of the total mark) of each of the following kinds of items in the exams, tests and quizzes which you give your junior high science students. (Please check to see that the total corresponds to 100%)

73. % that can be answered by a tick mark (e.g.true/false, multiple choice, matching)?
74. % that can be answered by a word or phrase?
75. % sentence or short paragraph answers (up to 50 words)?
76. % essay responses (50 words or more)?
77. % that require answers in the form of numbers, tables or graphs?
78. % for other kinds of questions?

A. Less than 5%
B. 5-14%
C. 15-24%
D. 25-34%
E. 35-44%
F. 45-54%
G. 55-64%
H. 65-79%
I. 80-94%
J. 95% or more

79. Which of the following best describes the extent to which you require recall of statements rather than application of understanding on your exams, tests and quizzes.

A. All or nearly all my questions can be answered by recalling statements made in class or in the textbook
B. About 2/3 can be answered by recalling statements made in class or in the textbook
C. About half can be answered by recalling statements made in class or in the textbook
D. About 2/3 require students to apply their understanding to express their answers in their own words
E. All or nearly all require students to apply their understanding to express their answers in their own words

IX. PROFESSIONAL DEVELOPMENT NEEDS

For the following questions, the summed data will be provided to the provincial departments of education, local school districts, universities and the science teachers' professional organizations to assist them in the planning and delivery of appropriate professional development activity.

	None needed				Much needed
80. Content knowledge related to the junior high science program.	A	B	C	D	E
81. Knowledge about adolescent behaviour and needs.	A	B	C	D	E
82. Knowledge and skill with respect to a variety of science teaching methods.	A	B	C	D	E
83. Knowledge and skill with respect to assessing students for a variety of educational goals.	A	B	C	D	E

Desired forms of the professional development activity

84. Participation in a network of junior high science teachers for the purpose of discussing problems and sharing ideas.	A	B	C	D	E
85. Locally conducted evening workshops during the school year	A	B	C	D	E
86. One week summer institute(s) in a centralized location	A	B	C	D	E
87. Non-credit summer courses	A	B	C	D	E
88. Credited summer courses	A	B	C	D	E

89-90. If the following programs where available in the Maritimes, would you likely enrol in them at some time?

89. A master's degree program in science education that could be pursued either full or part-time?
90. A doctoral degree program in science education?

A. No
B. Yes, but not within the next ten years.
C. Yes, within the next ten years, but only if available at a site within commuting distance of my home.
D. Yes, within the next ten years if offered at a university in the Maritimes.