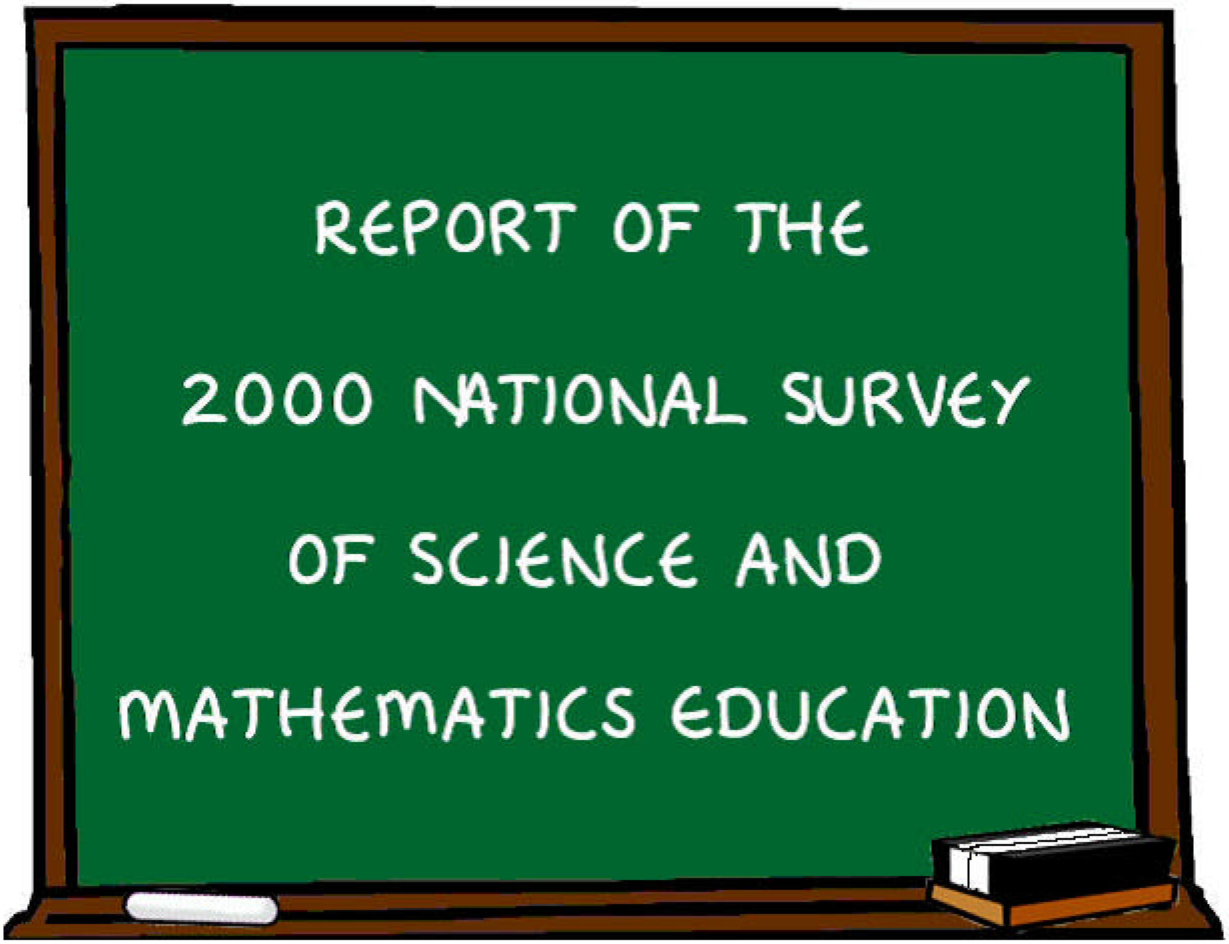

REPORT OF THE 2000 NATIONAL SURVEY OF SCIENCE AND MATHEMATICS EDUCATION

December 2001

Horizon Research, Inc.
326 Cloister Court
Chapel Hill, NC 27514-2296

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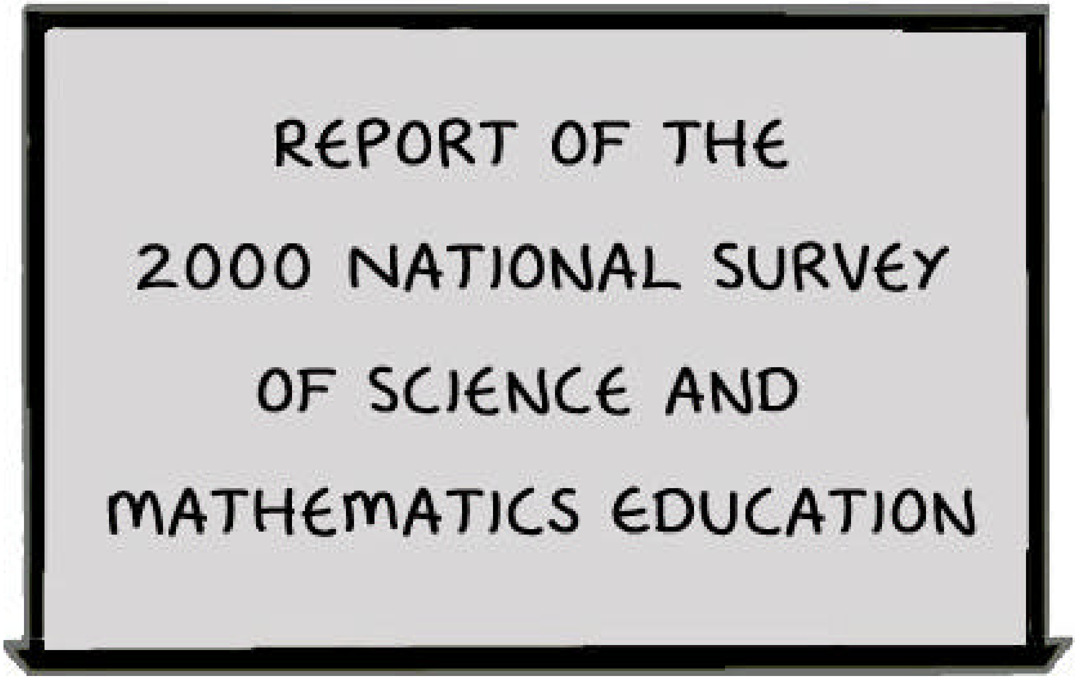

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Chapter One

Introduction

A. Background and Purpose of the Study

In 2000, the National Science Foundation supported the fourth in a series of surveys through a grant to Horizon Research, Inc. (HRI). The first survey was conducted in 1977 as part of a major assessment of science and mathematics education consisting of a comprehensive review of the literature; case studies of 11 districts throughout the United States; and a national survey of teachers, principals, and district and state personnel. A second survey of teachers and principals was conducted in 1985–86 to identify trends since 1977, and a third survey was conducted in 1993.

The 2000 National Survey of Science and Mathematics Education was designed to provide up-to-date information and to identify trends in the areas of teacher background and experience, curriculum and instruction, and the availability and use of instructional resources. A total of 5,728 science and mathematics teachers in schools across the United States participated in this survey. Among the questions addressed by the survey:

- How well prepared are science and mathematics teachers in terms of both content and pedagogy?

- What are teachers trying to accomplish in their science and mathematics instruction, and what activities do they use to meet these objectives?

- To what extent do teachers support reform notions embodied in the National Research Council's *National Science Education Standards* and the National Council of Teachers of Mathematics' *Principles and Standards for School Mathematics*?

- What are the barriers to effective and equitable science and mathematics education?

The design and implementation of the 2000 National Survey of Science and Mathematics Education involved developing a sampling strategy and selecting samples of schools and teachers; developing and field testing survey instruments; collecting data from sample members; and preparing data files and analyzing the data. These activities are described in the following sections. The final section of this chapter outlines the contents of the remainder of the report.

B. Sample Design and Sampling Error Considerations

The 2000 National Survey of Science and Mathematics Education is based on a national probability sample of science and mathematics schools and teachers in grades K–12 in the 50 states and the District of Columbia. The sample was designed to allow national estimates of science and mathematics course offerings and enrollment; teacher background preparation; textbook usage; instructional techniques; and availability and use of science and mathematics facilities and equipment. Every eligible school and teacher in the target population had a known, positive probability of being drawn into the sample.

The sample design involved clustering and stratification prior to sample selection. The first stage units consisted of elementary and secondary schools. Science and mathematics teachers constituted the second stage units. The target sample sizes were designed to be large enough to allow sub-domain estimates such as for particular regions or types of community.

The sampling frame for the school sample was constructed from the Quality Education Data, Inc. (QED) database, which includes school name and address and information about the school needed for stratification and sample selection. The sampling frame for the teacher sample was constructed from lists provided by sample schools, identifying current teachers and the specific science and mathematics subjects they were teaching.

Since biology is by far the most common science course at the high school level, selecting a random sample of science teachers would result in a much larger number of biology teachers than chemistry or physics teachers. Similarly, random selection of mathematics teachers might result in a smaller than desired sample of teachers of advanced mathematics courses. In order to ensure that the sample would include a sufficient number of advanced science and mathematics teachers for separate analysis, information on teaching assignments was used to create separate domains, e.g., for teachers of chemistry and physics, and sampling rates were adjusted by domain.

The study design included obtaining in-depth information from each teacher about curriculum and instruction in a single, randomly selected class. Most elementary teachers were reported by their principals to teach in self-contained classrooms, i.e., they are responsible for teaching all academic subjects to a single group of students. Each such sample teacher was randomly assigned to one of two groups—science or mathematics—and received a questionnaire specific to that subject. Most secondary teachers in the sample taught several classes of a single subject; some taught both science and mathematics. For each such teacher, one class was randomly selected. For example, a teacher who taught two classes of science and three classes of mathematics each day might have been asked to answer questions about his first or second science class or his first, second, or third mathematics class of the day.

Whenever a sample is anything other than a simple random sample of a population, the results must be weighted to take the sample design into account. In the 2000 Survey, the weight for each respondent was calculated as the inverse of the probability of selecting the individual into the sample multiplied by a non-response adjustment factor.[1] In the case of data about a randomly selected class, the teacher weight was adjusted to reflect the number of classes taught, and therefore, the probability of a particular class being selected. Detailed information about the sample design, weighting procedures, and non-response adjustments used in the 2000 National Survey of Science and Mathematics Education is included in Appendix A. All data presented in this report are weighted.

The results of any survey based on a sample of a population (rather than on the entire population) are subject to sampling variability. The sampling error (or standard error) provides a measure of the range within which a sample estimate can be expected to fall a certain proportion of the time. For example, it may be estimated that 7 percent of all grade K–4 mathematics lessons involve the use of computers. If it is determined that the sampling error for this estimate was 1 percent, then according to the Central Limit Theorem, 95 percent of all possible samples of that same size selected in the same way would yield calculator usage estimates between 5 percent and 9 percent (that is, 7 percent ±2 standard error units).

The decision to obtain information from a sample rather than from the entire population is made in the interest of reducing costs, in terms of both money and the burden on the population to be surveyed. The particular sample design chosen is the one which is expected to yield the most accurate information for the least cost. It is important to realize that, other things being equal, estimates based on small sample sizes are subject to larger standard errors than those based on large samples. Also, for the same sample design and sample size, the closer a percentage is to zero or 100, the smaller the standard error. The standard errors for the estimates presented in this report are included in parentheses in the tables. The narrative sections of the report generally point out only those differences which are substantial as well as statistically significant at the 0.05 level or beyond.

C. Instrument Development

Since a primary purpose of the 2000 National Survey of Science and Mathematics Education was to identify trends in science and mathematics education, the process of developing survey instruments began with the questionnaires that had been used in the earlier national surveys, in 1977, 1985–86, and 1993. The project Advisory Panel, comprised of experienced researchers in science and mathematics education, reviewed these questionnaires and made recommendations about retaining or deleting particular items. Additional items needed to provide important information about the current status of science and mathematics education were also considered.

Preliminary drafts of the questionnaires were sent to a number of professional organizations for review; these included the National Science Teachers Association, the National Council of

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[1] The aim of non-response adjustments is to reduce possible bias by distributing the non-respondent weights among the respondents expected to be most similar to these non-respondents. In this study, adjustment was made by region and by urbanicity of the school.

Teachers of Mathematics, the National Education Association, the American Federation of Teachers, and the National Catholic Education Association.

The Education Information Advisory Committee (EIAC) also played an important role in the instrument development process. This committee was established by the Council of Chief State School Officers to reduce the burden of data collection efforts on local education agencies; most state commissioners of education will not approve a survey unless it is first endorsed by EIAC. Horizon Research, Inc. worked with members of the EIAC committee throughout the planning stages of this project to make sure that the disruption to school activities and the burden on schools and teachers would be kept to a minimum.

The survey instruments were revised based on feedback from the various reviewers, field tested, and revised again. The instrument development process was a lengthy one, constantly compromising between information needs and data collection constraints. There were several iterations of field testing and revision to help ensure that individual items were clear and unambiguous and that the survey as a whole would provide the necessary information with the least possible burden on participants. Copies of the survey questionnaires are included in Appendix B.

D. Data Collection

Once the Education Information Advisory Committee had approved the study design, instruments, and procedures, the data collection subcontractor (Westat, Inc.) proceeded with securing permission from education officials. First, notification letters were mailed to the Chief State School Officers, identifying the schools in the state that had been selected for the survey. Similar letters were subsequently mailed to superintendents of districts including sampled public schools and diocesan offices of sampled Catholic schools. (Information about this pre-survey mail-out is included in Appendix C.) Copies of the survey instruments and additional information about the study were provided when requested.

Principals were asked to provide demographic information about the students in the school; the names of the science and mathematics department heads or other individuals who would be able to provide information about the science and mathematics programs in the school; and a list of all teachers responsible for teaching science and/or mathematics to one or more classes. The response rate at the school level was 73 percent.

An incentive system was developed to encourage school and teacher participation in the survey. Each school was given a credit of $50 towards the purchase of science and mathematics education materials; the amount was augmented by $15 for each responding teacher. At the completion of the data collection phase, schools were sent vouchers that they could use for purchasing professional publications, calculators, science activity books, kits, etc. from a catalogue developed for this study.

Survey mailings to teachers began in March 2000. In addition to the incentives described, phone calls and additional mailings of survey materials were used to encourage non-respondents to complete the questionnaires. In the fall of 2000, a final questionnaire mailing was sent to non-respondent teachers. Over the summer, some teachers left the schools at which they taught when they were originally sampled. If these teachers were considered ineligible for the study, the teacher response rate was 74 percent. When they were included as non-respondents, the response rate was 67 percent. The final response rate for the school program questionnaires was 79 percent. A more detailed description of the data collection procedures is included in Appendix D.

E. File Preparation and Analysis

Completed questionnaires were recorded in the data receipt system and routed to editing and coding. Manual edits were used to identify missing information and obvious out-of-range answers; to identify and, if possible, resolve multiple responses; and to make a number of consistency checks. When necessary, respondents were re-contacted and asked to clarify and/or complete responses to key items. After data entry, machine edits were performed to check for out-of-range answers, adherence to skip patterns, and logical inconsistencies, and weights were added to the data files. All population estimates presented in this report were computed using weighted data.

F. Outline of This Report

This report of the 2000 National Survey of Science and Mathematics Education is organized into major topical areas. In most cases, results are presented for groups of teachers categorized by grade ranges—grades K–4, 5–8, and 9–12. The definitions of these categories and other reporting variables used in this report are included in Appendix E.

Chapter Two focuses on science and mathematics teacher backgrounds and beliefs. Basic demographic data are presented along with information about course background, perceptions of preparedness, and pedagogical beliefs. Chapter Three examines data on the professional status of teachers, including their perceptions of their autonomy in making curriculum and instructional decisions, and their opportunities for continued professional development.

Chapter Four presents information about the time spent on science and mathematics instruction in the elementary grades, and about science and mathematics course offerings at the secondary level. Chapter Five examines the instructional objectives of science and mathematics classes, and the activities used to achieve these objectives, followed by a discussion of the availability and use of various types of instructional resources in Chapter Six. Finally, Chapter Seven presents data about a number of factors which are likely to affect science and mathematics instruction, including school-wide programs, practices, and problems.

Chapter Two

Teacher Background and Beliefs

A. Overview

While various reform efforts may focus initially on different parts of the science and mathematics education system, e.g., curriculum, assessment, or in-service teacher education, there is a consensus that having a well-prepared teaching force is essential for effective science and mathematics education. The 2000 National Survey of Science and Mathematics Education collected a variety of information about science and mathematics teachers, including their age, sex, race/ethnicity, number of years teaching, course background, and pedagogical beliefs. These data are presented in the following sections.

B. Teacher Characteristics

As can be seen in Table 2.1, the vast majority of science and mathematics teachers in grades K–4 are female. In grades 5–8, approximately three-fourths of the science and mathematics teachers are female, compared to about half in grades 9–12.

Blacks, Hispanics, and other minority groups continue to be underrepresented in the science and mathematics teaching force; at a time when minorities constitute roughly 40 percent of the student enrollment,[2] only 9–14 percent of the science and mathematics teachers, depending on subject and grade range, are members of minority groups.

As can also be seen in Table 2.1, the majority of the science and mathematics teaching force is older than 40. While it is extremely difficult to monitor teacher supply—many people who prepare to become teachers do not actually do so and many others who leave the profession return at a later date—the fact that about 3 in 10 science and mathematics teachers in each grade range are over age 50 (and smaller percentages are age 30 or younger) raises concerns about having an adequate supply of qualified teachers as these teachers reach retirement age.

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[2] Horizon Research, Inc. tabulations of the 1999 Common Core of Data. Original data are available from the National Center for Education Statistics.

Table 2.1
Characteristics of the Science and Mathematics Teaching Force, by Grade Range

	Percent of Teachers					
	Science			**Mathematics**		
	Grades K–4	**Grades 5–8**	**Grades 9–12**	**Grades K–4**	**Grades 5–8**	**Grades 9–12**
Sex						
Male	8 (1.2)	23 (3.1)	50 (2.1)	4 (1.0)	24 (3.3)	45 (2.0)
Female	92 (1.2)	77 (3.1)	50 (2.1)	96 (1.0)	76 (3.3)	55 (2.0)
Race						
White	88 (1.9)	87 (1.8)	90 (1.2)	90 (1.5)	86 (2.1)	91 (1.1)
Black or African-American	5 (0.9)	5 (1.1)	4 (0.8)	4 (0.8)	8 (1.6)	4 (0.8)
Hispanic or Latino	4 (1.1)	3 (1.0)	3 (0.5)	5 (1.2)	6 (1.4)	2 (0.4)
American Indian or Alaskan Native	1 (0.3)	1 (0.5)	2 (0.5)	1 (0.2)	1 (0.3)	1 (0.3)
Native Hawaiian or Other Pacific Islander	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.3)	0 (0.2)
Asian	1 (1.0)	1 (0.6)	2 (0.6)	0 (0.2)	1 (0.6)	1 (0.3)
Age						
≤ 30	20 (2.0)	19 (2.8)	20 (2.5)	21 (2.0)	21 (2.6)	16 (1.4)
31–40	19 (1.8)	22 (3.1)	23 (1.7)	21 (1.9)	23 (2.6)	24 (1.5)
41–50	34 (2.1)	30 (3.1)	29 (1.9)	31 (2.4)	27 (3.0)	29 (2.0)
51 +	27 (1.9)	29 (3.7)	28 (1.7)	27 (2.4)	30 (3.4)	30 (1.7)
Experience						
0–2 years	14 (1.6)	16 (2.7)	16 (2.2)	18 (1.9)	20 (3.2)	13 (1.4)
3–5 years	17 (1.6)	9 (1.5)	16 (1.7)	13 (1.5)	12 (1.8)	15 (1.6)
6–10 years	16 (1.8)	19 (2.6)	18 (1.4)	14 (1.6)	16 (2.4)	14 (1.5)
11–20 years	27 (1.9)	24 (3.3)	21 (1.6)	26 (2.0)	21 (2.5)	24 (1.7)
≥ 21 years	26 (2.4)	32 (3.1)	29 (1.7)	29 (2.4)	31 (3.3)	34 (2.0)
Master's Degree						
Yes	41 (2.7)	50 (3.0)	57 (2.3)	41 (2.6)	44 (3.7)	51 (2.2)
No	59 (2.7)	50 (3.0)	43 (2.3)	59 (2.6)	56 (3.7)	49 (2.2)

About 40 percent of the teachers in grades K–4 have earned a degree beyond the Bachelor's, increasing to roughly 45 percent in grades 5–8 and 50 percent in grades 9–12. It is interesting to note that the percentage of teachers with Master's Degrees rises steadily with years of teaching experience; for example, as can be seen in Table 2.2, only 19 percent of the grade K–12 science teachers with two or fewer years prior teaching experience have Master's Degrees, compared to 64 percent of those with more than 20 years prior teaching experience.

Table 2.2
Science and Mathematics Teachers with Degrees Beyond the Bachelor's, by Prior Years Teaching Experience

	Percent of Teachers	
	Science	**Mathematics**
0–2 Years	19 (3.6)	20 (4.2)
3–5 Years	30 (4.4)	36 (4.4)
6–10 Years	42 (4.6)	41 (4.1)
11–20 Years	46 (3.5)	45 (3.6)
≥ 21 Years	64 (3.8)	58 (3.1)

C. Teacher Preparation

National standards call for the introduction of challenging science and mathematics content to all students beginning in the early grades. If teachers are to guide students in their exploration of science and mathematics concepts, they must themselves have a firm grasp of powerful science and mathematics concepts.

Since it would be extremely difficult to gauge the extent to which a large national sample of teachers understands science and mathematics concepts (and knows how to help their students learn these concepts), proxy measures such as major or number of courses taken in the field are typically used. Table 2.3 shows that very few grade K–4 teachers had undergraduate majors in these fields (roughly 80 percent majored in elementary education). While science and mathematics teachers in grades 5–8 were more likely than their grade K–4 colleagues to have undergraduate majors in science or mathematics, a majority still had majors in education.

Table 2.3
Teachers' Undergraduate Majors in
Science and Mathematics, by Grade Range*

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Science Teachers						
Science	2	(0.7)	11	(1.4)	81	(2.0)
Science Education	2	(0.6)	5	(1.1)	6	(0.9)
Other Education	86	(1.9)	74	(3.1)	6	(1.5)
Other Fields	11	(1.7)	10	(2.5)	7	(1.0)
Mathematics Teachers						
Mathematics	0	(0.1)	9	(1.3)	58	(2.1)
Mathematics Education	0	(0.2)	6	(0.9)	21	(2.0)
Other Education	91	(1.6)	72	(2.7)	10	(1.4)
Other Fields	9	(1.6)	14	(2.5)	10	(1.2)

* These data should be interpreted with caution. When asked to specify the subject(s) of their degrees, approximately 10 percent of teachers indicated they had undergraduate majors in three or more fields. These teachers were excluded from these analyses.

Grade 9–12 science teachers were much more likely to have majored in a science discipline (81 percent) than in science education (6 percent). The comparable figures for mathematics teachers were 58 percent mathematics majors and 21 percent mathematics education majors. While the percentages of teachers with major in field are greater for grades 9–12 than for the lower grades, roughly 1 out of 10 high school science teachers and 2 out of 10 high school mathematics teachers did not major in their fields.

Tables 2.4, 2.5, and 2.6 tell a similar story, in this case using the number of semesters of college science coursework completed by science teachers in each grade range: elementary teachers have less extensive backgrounds in science than do their middle grade counterparts, who in turn have had less science coursework than their high school counterparts. For example, Table 2.4 shows the percentages of grade K–4, 5–8, and 9–12 science teachers who have completed various numbers of semesters of college science coursework; the average number of courses completed ranges from 6.1 for grades K–4 to 18.2 for grades 9–12.

Table 2.4
Number of Semesters* of College Coursework in Science, by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Fewer than 6 Semesters	56	(2.2)	41	(3.9)	0	(0.2)
6–10 Semesters	30	(2.3)	33	(3.8)	8	(1.9)
11–14 Semesters	6	(1.6)	10	(1.7)	17	(1.4)
15–20 Semesters	5	(1.1)	10	(1.5)	46	(2.2)
More than 20 Semesters	2	(0.5)	5	(1.0)	29	(1.9)
Average Number of Semesters	6.1	(0.2)	8.5	(0.3)	18.2	(0.3)

* The highest number of courses a teacher could indicate for each of the four categories—life science, chemistry, physics/physical science, and earth/space science—was "> 8," and 9 was used as the number of courses in those cases. As a result, these figures underestimate the total for any teacher who completed more than eight courses in a particular category.

As can be seen in Table 2.5, 91 percent of the grade K–4 science teachers have had at least one college course in the life sciences. Most have had coursework in earth science (83 percent), science education (77 percent), and physics/physical science (61 percent), while roughly one-half have had one or more college courses in chemistry. Similarly, most grade 5–8 science teachers have had coursework in the life sciences (96 percent), earth sciences (84 percent), science education (79 percent), physics/physical science (69 percent), and chemistry (67 percent).

Table 2.5
Number of Semesters Completed by Science Teachers in Various Course Categories

	Percent of Teachers							
	Zero Semesters		1–2 Semesters		3–5 Semesters		6 or More Semesters	
Grades K–4								
Life sciences	9	(1.5)	62	(2.6)	20	(2.1)	9	(1.5)
Chemistry	49	(2.3)	42	(2.3)	7	(1.2)	2	(0.5)
Physics/physical science	39	(2.4)	50	(2.6)	10	(1.6)	1	(0.6)
Earth/space science	17	(1.6)	53	(2.3)	25	(1.8)	4	(1.0)
Science education	23	(2.6)	55	(2.9)	16	(1.7)	6	(1.1)
Grades 5–8								
Life sciences	4	(1.1)	53	(3.4)	23	(2.7)	20	(2.3)
Chemistry	33	(3.7)	47	(3.6)	15	(1.6)	5	(1.0)
Physics/physical science	31	(2.7)	54	(2.8)	11	(1.8)	4	(0.8)
Earth/space science	16	(2.4)	48	(3.5)	28	(3.1)	7	(1.3)
Science education	21	(2.7)	51	(3.8)	19	(2.6)	10	(1.5)
Grades 9–12								
Life sciences	7	(1.0)	13	(2.0)	13	(1.1)	67	(2.1)
Chemistry	3	(0.5)	18	(1.7)	39	(2.1)	41	(2.1)
Physics/physical science	7	(0.9)	40	(2.2)	26	(1.7)	28	(1.9)
Earth/space science	23	(2.6)	32	(1.6)	26	(1.7)	18	(1.5)
Science education	20	(2.3)	31	(2.1)	24	(1.6)	25	(1.6)

Almost all high school science teachers have had at least one course in chemistry (97 percent), biology/life science (93 percent), and physics or physical science (93 percent). Somewhat fewer have had coursework in earth/space science (77 percent) or science education (80 percent). The most frequently cited courses, each completed by a majority of high school science teachers are general chemistry, introductory biology, general physics, botany, cell biology, ecology, zoology, organic chemistry, anatomy/physiology, genetics, life science, and microbiology. (See Table 2.6.)

Table 2.6
Middle and High School Science Teachers Completing Various College Courses, by Grade Range

	Percent of Teachers			
	Grades 5–8		Grades 9–12	
General methods of teaching	98	(0.6)	90	(2.0)
Methods of teaching science	78	(2.9)	76	(2.6)
Instructional uses of computers/other technologies	49	(3.8)	48	(2.3)
Supervised student teaching in science	41	(3.9)	69	(2.4)
General/introductory chemistry	64	(3.8)	95	(0.9)
Analytical chemistry	5	(0.9)	43	(2.0)
Organic chemistry	13	(1.6)	73	(1.8)
Physical chemistry	7	(1.3)	31	(1.9)
Quantum chemistry	0	(0.2)	7	(0.7)
Biochemistry	8	(1.4)	39	(2.0)
Other chemistry	7	(1.5)	25	(1.6)
Introductory earth science	59	(2.8)	36	(2.2)
Astronomy	24	(3.1)	34	(1.8)
Geology	32	(2.8)	45	(2.3)
Meteorology	8	(1.3)	20	(1.7)
Oceanography	9	(1.7)	18	(1.5)
Physical geography	28	(3.2)	18	(1.6)
Environmental science	30	(3.1)	41	(2.2)
Agricultural science	3	(0.7)	7	(0.9)
Introductory biology/life science	88	(1.9)	85	(1.6)
Botany, plant physiology	25	(2.6)	62	(2.3)
Cell biology	15	(2.0)	52	(2.3)
Ecology	20	(2.4)	53	(2.3)
Entomology	6	(1.5	19	(1.5)
Genetics, evolution	12	(1.4)	61	(2.2)
Microbiology	15	(2.0)	51	(2.2)
Anatomy/Physiology	22	(2.6)	60	(2.1)
Zoology, animal behavior	20	(2.2)	56	(2.3)
Other life science	21	(2.9)	53	(2.1)
Physical science	47	(3.2)	45	(2.4)
General/introductory physics	32	(3.3)	82	(1.6)
Electricity and magnetism	6	(1.1)	29	(2.4)
Heat and thermodynamics	5	(1.1)	23	(2.1)
Mechanics	2	(0.5)	26	(2.4)
Modern or quantum physics	1	(0.2)	14	(1.3)
Nuclear physics	1	(0.4)	11	(1.1)
Optics	1	(0.4)	15	(2.0)
Solid state physics	2	(0.9)	6	(0.9)
Other physics	3	(0.8)	17	(1.4)
History of science	6	(1.5)	17	(1.6)
Philosophy of science	4	(1.0)	14	(1.3)
Science and society	7	(1.7)	15	(1.3)
Electronics	1	(0.4)	7	(1.0)
Engineering (any)	1	(0.3)	9	(1.1)
Integrated science	7	(1.5)	5	(0.8)
Computer programming	15	(3.0)	28	(2.2)
Other computer science	19	(3.2)	20	(1.6)

The National Science Teachers Association (NSTA) has recommended that for the preparation of elementary and middle school science teachers in addition to coursework in science education, "conceptual content should be balanced among life, earth/space, physical, and environmental science, including natural resources" (National Science Teachers Association, 1998). Using completion of a college course as a proxy for competency, Table 2.7 shows that 52 percent of the science teachers in grades K–4, and 63 percent in grades 5–8 meet those standards, while another 11 percent meet the science coursework standard, but lack a course in science education.

Table 2.7
Science Teachers Meeting NSTA Course-Background Standards, by Grade Range

	Percent of Teachers			
	Grades K–4		Grades 5–8	
Coursework in each science discipline plus science education	52	(3.0)	63	(2.5)
Lack science education only	11	(1.9)	11	(1.9)
Lack one science discipline	25	(2.2)	17	(2.1)
Lack two science disciplines	9	(1.4)	9	(2.2)
Lack three science disciplines	3	(0.7)	0	(0.2)

At the high school level, NSTA's recommendations are very detailed and extensive, including lists of specific concepts in which teachers of each discipline should be competent. Because very few teachers, even those with considerable coursework in the field, meet the very specific NSTA requirements, analyses of data from the 2000 National Survey of Science and Mathematics Education used a more general measure in defining "well-prepared"—six or more courses in field.

As can be seen in Table 2.8, there is considerable variation in extent of teacher preparation for the various science subjects taught at the secondary level. For example, 85 percent of secondary life science classes are taught by teachers who have taken six or more semesters of college biology, but only 39 percent of grade 7–12 earth science classes are taught by teachers who have had six or more earth science courses. Note also that while 90 percent or more of high school biology, chemistry, and physics classes are taught by teachers with in-depth preparation either in that discipline or in another science discipline, substantial percentages of grade 7–12 earth science and physical science classes are taught by teachers who have not had in-depth preparation in any science discipline.

Table 2.8
Science Classes Taught by Teachers with Six or More College Courses in Field, in Another Science Field, and Lacking In-Depth Preparation in Any Science

	Percent of Classes					
	Six or More Courses In Field		Not In-Depth in Field, But Six or More in Another Science		Not In-Depth in Any Science	
Grades 7–12						
Life science/biology	85	(2.5)	3	(1.2)	12	(2.2)
Earth science	39	(5.2)	36	(5.5)	24	(5.6)
Physical science	67	(6.8)	11	(2.9)	22	(7.2)
Grades 9–12						
Biology	94	(1.8)	1	(0.8)	4	(1.6)
Chemistry	74	(4.2)	17	(3.3)	9	(2.8)
Physics	64	(5.8)	26	(5.4)	10	(3.7)
Earth science	58	(6.1)	34	(5.4)	8	(3.7)

Most prospective secondary school science teachers are prepared to teach one discipline, typically biology, chemistry, or physics. The reality, however, is that many science teachers will be assigned to teach courses in more than one discipline, resulting in extensive out-of-field teaching. As can be seen in Table 2.9, this situation is particularly prevalent in rural schools, where 48 percent of the teachers teach courses in two or more science disciplines.

Table 2.9
Grade 7–12 Science Teachers Teaching Courses in One, Two, or Three or More Science Subjects, by Community Type

	Percent of Teachers							
	Total		Urban		Suburban		Rural	
Number of Subjects Taught								
One Subject	67	(2.4)	73	(4.7)	70	(3.0)	52	(6.0)
Two Subjects	28	(2.3)	21	(3.7)	27	(2.8)	39	(5.9)
Three or More Subjects	5	(1.6)	5	(4.5)	3	(1.8)	9	(3.0)

Turning to mathematics, the 2000 National Survey of Science and Mathematics Education found that, as is the case in science, mathematics teachers in the higher grades tend to have much stronger course backgrounds in mathematics than do their colleagues in the lower grades. For example, as can be seen in Table 2.10, 94 percent of grade 9–12 mathematics teachers have had at least eight semesters of coursework in mathematics, compared to 29 percent of those teaching in grades K–4. It is interesting to note that while only 52 percent of grade 5–8 mathematics teachers have had eight or more semesters of college mathematics, 67 percent of grade 5–8 mathematics classes are taught by these teachers, a reflection of the fact that teachers in grades 7 and 8 are generally both better prepared than teachers in grades 5 and 6 and are more likely to teach multiple mathematics classes each day.

Table 2.10
Number of Semesters* of College Coursework in Mathematics, by Teachers and Classes, and by Grade Range

	Percent of Teachers						Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12		Grades K–4		Grades 5–8		Grades 9–12	
Fewer than 4 Semesters	24	(2.0)	13	(2.5)	2	(0.8)	24	(1.9)	8	(1.5)	1	(0.4)
4–7 Semesters	46	(2.4)	35	(2.7)	4	(0.8)	45	(2.4)	26	(2.2)	4	(0.9)
8–11 Semesters	20	(2.0)	26	(2.8)	12	(1.6)	21	(2.1)	25	(2.3)	12	(1.3)
More than 11 Semesters	9	(1.5)	26	(2.2)	82	(1.8)	10	(1.7)	42	(2.6)	84	(1.5)

* The highest number of courses a teacher could indicate for each of the four categories—calculus, statistics, advanced calculus, and "all other mathematics courses"—was "> 8," and 9 was used as the number of courses in those cases. As a result, these figures underestimate the total for any teacher who completed more than eight courses in a particular category.

As can be seen in Table 2.11, the vast majority of grade K–4 teachers have had college coursework in mathematics for elementary school teachers and in mathematics education. Far fewer have had college coursework in algebra, probability and statistics, or geometry, areas that the National Council of Teachers of Mathematics suggests should be addressed beginning in the primary grades (National Council of Teachers of Mathematics, 2000).

Table 2.11
Grade K–4 Mathematics Teachers Completing Various College Courses

	Percent of Teachers	
Mathematics for elementary school teachers	96	(1.0)
Mathematics education	94	(1.1)
College algebra/trigonometry/elementary functions	42	(2.2)
Probability and statistics	33	(2.5)
Applications of mathematics/problem solving	21	(1.9)
Geometry for elementary/middle school teachers	21	(1.5)
Calculus	12	(1.7)

Table 2.12 shows the percentages of grade 5–8 and 9–12 mathematics teachers who have completed each of a number of college courses in mathematics and related fields. At the middle/junior high school level, the National Council of Teachers of Mathematics has recommended that mathematics teachers have college coursework in abstract algebra, geometry, calculus, probability and statistics, applications of mathematics/problem solving, and history of mathematics (National Council of Teachers of Mathematics, 1998). Percentages of grade 5–8 teachers having completed these courses range from 51 percent for probability and statistics to 11 percent for history of mathematics.

In contrast, the 2000 Survey found that high school mathematics teachers have relatively strong content backgrounds. The majority has had college coursework in calculus (96 percent); college algebra (80 percent); geometry (82 percent); probability and statistics (86 percent); linear algebra

(81 percent); abstract algebra (64 percent); advanced calculus (70 percent); differential equations (65 percent); other upper division mathematics (59 percent); and number theory (56 percent). The only three NCTM-recommended areas where fewer than half of high school mathematics teachers had coursework were applications of mathematics/problem-solving (37 percent), discrete mathematics (37 percent) and history of mathematics (42 percent).

Table 2.12
Middle and High School Mathematics Teachers Completing Various College Courses, by Grade Range

	Percent of Teachers			
	Grades 5–8		Grades 9–12	
Mathematics for middle school teachers	28	(2.8)	26	(1.9)
Geometry for elementary/middle school teachers	28	(2.4)	17	(1.6)
College algebra/trigonometry/elementary functions	56	(3.5)	80	(1.5)
Calculus	31	(2.5)	96	(0.9)
Advanced calculus	13	(1.5)	70	(2.0)
Real analysis	6	(1.0)	38	(2.0)
Differential equations	12	(1.5)	65	(2.0)
Geometry	37	(3.2)	82	(1.3)
Probability and statistics	51	(3.5)	86	(1.7)
Abstract algebra	12	(1.3)	64	(2.0)
Number theory	20	(2.6)	56	(2.1)
Linear algebra	16	(1.8)	81	(1.6)
Applications of mathematics/problem solving	23	(2.2)	37	(1.7)
History of mathematics	11	(1.5)	42	(1.9)
Discrete mathematics	7	(0.9)	37	(1.7)
Other upper division mathematics	17	(2.0)	59	(1.9)
Biological sciences	71	(2.9)	49	(2.1)
Chemistry	40	(3.3)	47	(2.0)
Physics	26	(2.8)	52	(2.1)
Physical science	49	(3.4)	23	(2.0)
Earth/space science	42	(3.6)	20	(1.8)
Engineering (any)	4	(0.9)	15	(1.5)
Computer programming	29	(2.8)	63	(2.1)
Other computer science	28	(3.2)	28	(2.1)
Computer programming/other computer science	47	(3.1)	68	(2.0)
General methods of teaching	93	(1.5)	90	(1.2)
Methods of teaching mathematics	80	(2.6)	77	(2.2)
Instructional uses of computers/other technologies	44	(3.8)	43	(2.2)
Supervised student teaching in mathematics	42	(3.8)	70	(2.0)

As can be seen in Table 2.13, 28 percent of grade 5–8 mathematics teachers have not had any of the 6 recommended mathematics courses; only 6 percent have had at least 5 of the 6. Just over a third of all high school mathematics teachers had completed at least 9 of the 11 recommended courses; another 45 percent had completed 6, 7, or 8 of these courses.

Table 2.13
Mathematics Teachers Completing NCTM-Recommended College Mathematics Courses, by Grade Range

	Percent of Teachers			
	Grades 5–8		Grades 9–12	
Recommended for Middle/Junior High School Teachers				
No Courses	28	(3.1)	1	(0.7)
1–2 Courses	47	(3.6)	10	(1.4)
3–4 Courses	20	(1.9)	48	(2.1)
5-6 Courses	6	(0.9)	40	(2.0)
Recommended for High School Teachers				
0–1 Courses	40	(3.2)	2	(0.8)
2–5 Courses	45	(3.2)	17	(1.9)
6–8 Courses	11	(1.4)	45	(2.1)
9–10 Courses	4	(0.6)	28	(1.8)
11 Courses	1	(0.1)	7	(1.3)

There is evidence, however, that students who take lower-level mathematics classes at the high school level are not as likely to get the benefits of having well-prepared teachers. For example, Table 2.14 shows the percentage of high school mathematics teachers who have completed each of a number of college mathematics classes, comparing those who do and do not teach advanced mathematics courses (Algebra II or higher). Note that much larger percentages of teachers who are assigned to advanced classes have taken coursework in a number of these areas. For example, among high school teachers assigned only to lower-level mathematics courses, 54 percent have had coursework in abstract algebra, compared to 72 percent of those who teach at least one advanced mathematics course.

Table 2.14
Grade 9–12 Mathematics Teachers Completing Various College Courses, by Teaching Assignment

	Percent of Teachers			
	Teaching No Advanced Courses		Teaching One or More Advanced Courses	
Calculus	92	(1.9)	99	(0.6)
Advanced calculus	57	(3.3)	79	(2.2)
Differential equations	58	(3.2)	70	(2.5)
Geometry	80	(2.4)	84	(1.6)
Probability and statistics	82	(3.3)	89	(1.3)
Abstract algebra	54	(3.1)	72	(2.7)
Number theory	51	(3.5)	60	(2.3)
Linear algebra	75	(3.2)	86	(1.7)
Applications of mathematics/problem solving	35	(3.0)	38	(2.6)
History of mathematics	39	(3.0)	44	(2.5)
Discrete mathematics	31	(2.8)	42	(2.1)
Other upper division mathematics	52	(2.7)	65	(2.6)
Computer programming	57	(3.1)	67	(2.4)
Instructional uses of computers/other technologies	40	(3.0)	46	(3.1)

Policymakers have begun to include two-year community colleges in their thinking about improving pre-service teacher preparation. Accordingly, the 2000 National Survey asked teachers to indicate where they had taken their science and mathematics courses. Roughly one-fourth of the teachers in each subject/grade range took one or more of these courses at a two-year college. At the same time, as shown in Table 2.15, most teachers completed a majority of their undergraduate science/mathematics courses at a four-year college or university. On the average, grade K–4 and 5–8 science teachers took nearly 90 percent of their undergraduate science courses at a four-year college or university. Grade 9–12 science teachers took 95 percent of their undergraduate science courses at a four-year institution. The pattern is nearly identical for mathematics teachers.

Table 2.15
Average Percentage of Undergraduate Science/Mathematics Courses Teachers Completed in Their Field at Two- and Four-Year Institutions, by Grade Range

	Average Percent of Courses in Field					
	Grades K–4		Grades 5–8		Grades 9–12	
Science Teachers						
Two-year college/community college/technical school	12	(1.4)	13	(2.6)	5	(0.5)
Four-year college/university	88	(1.4)	87	(2.6)	95	(0.5)
Mathematics Teachers						
Two-year college/community college/technical school	12	(1.2)	12	(1.9)	6	(0.8)
Four-year college/university	88	(1.2)	88	(1.9)	94	(0.8)

D. Teacher Pedagogical Beliefs

The National Council of Teachers of Mathematics (NCTM) originally published *Curriculum and Evaluation Standards* in 1989, followed by *Principles and Standards for School Mathematics* in 2000. In science, the National Research Council (NRC) released the *National Science Education Standards* in 1996. As one measure of the influence of the *Standards*, teachers in the 2000 National Survey of Science and Mathematics Education were asked the extent of their familiarity with each of these documents. Science teachers as a whole are much less likely to be familiar with the NRC *Standards* than mathematics teachers are with the NCTM *Standards*. As can be seen in Table 2.16, high school and middle school science teachers (62 and 58 percent, respectively) are more likely to be familiar with the *Standards* than are elementary school science teachers (33 percent). In each grade range, roughly 70 percent of the science teachers familiar with the national standards agree with their vision and indicate that they are implementing their recommendations at least to a moderate extent.

Table 2.16
Science Teachers' Familiarity with, Agreement with, and Implementation of the NRC *Standards*, by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Familiarity with NRC *Standards*						
Not at all familiar	67	(2.2)	42	(3.7)	37	(2.0)
Somewhat familiar	22	(1.8)	31	(3.0)	34	(2.2)
Fairly familiar	9	(1.3)	19	(2.4)	18	(1.4)
Very familiar	2	(0.5)	8	(1.6)	10	(1.1)
Extent of agreement with NRC *Standards***						
Strongly disagree	0	(0.4)	0	--*	0	(0.2)
Disagree	4	(2.0)	5	(2.3)	7	(1.6)
No Opinion	26	(3.7)	27	(4.1)	22	(2.3)
Agree	61	(4.1)	62	(4.4)	65	(2.9)
Strongly Agree	8	(2.4)	6	(2.0)	5	(0.9)
Extent to which recommendations have been implemented**						
Not at all	5	(1.9)	4	(2.1)	4	(1.1)
To a minimal extent	26	(3.9)	22	(5.1)	28	(2.3)
To a moderate extent	57	(4.1)	51	(5.3)	56	(2.5)
To a great extent	12	(2.5)	23	(4.5)	12	(1.6)

* No teachers in the sample selected this response option. Thus, it is not possible to calculate the standard error of this estimate.
** These analyses included only those teachers indicating they were at least somewhat familiar with the *Standards.*

As can be seen in Table 2.17, mathematics teachers in the higher grades are much more likely than their counterparts in the lower grades to report that they are familiar with the NCTM *Standards*. Sixty-two percent of elementary mathematics teachers, 73 percent of the middle grade mathematics teachers, and 85 percent of the high school mathematics teachers indicated they were at least "somewhat familiar" with the *Standards*.

Table 2.17
Mathematics Teachers' Familiarity with, Agreement with, and Implementation of the NCTM *Standards*, by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Familiarity with NCTM *Standards*						
Not at all familiar	38	(2.9)	27	(3.0)	15	(1.5)
Somewhat familiar	31	(2.4)	24	(3.1)	31	(1.8)
Fairly familiar	21	(2.0)	30	(2.7)	35	(1.8)
Very familiar	10	(1.5)	19	(2.1)	19	(1.3)
Extent of agreement with NCTM *Standards**						
Strongly Disagree	0	(0.2)	0	(0.2)	0	(0.2)
Disagree	1	(0.4)	3	(0.9)	6	(1.0)
No Opinion	20	(2.2)	20	(3.4)	19	(2.0)
Agree	69	(2.7)	61	(3.7)	66	(2.5)
Strongly Agree	10	(1.9)	16	(3.7)	8	(1.1)
Extent to which recommendations have been implemented*						
Not at all	2	(1.0)	0	(0.1)	3	(1.0)
To a minimal extent	16	(2.1)	17	(3.0)	23	(2.2)
To a moderate extent	56	(3.5)	59	(3.1)	57	(2.6)
To a great extent	26	(2.8)	25	(3.1)	17	(1.8)

* These analyses included only those teachers indicating they were at least somewhat familiar with the *Standards.*

Further, those teachers who indicated they were familiar with the *Standards* were asked to indicate the extent to which they agreed with the national standards and the extent to which they have implemented the *Standards* in their teaching. Regardless of grade level, approximately 75 percent of the mathematics teachers familiar with the NCTM *Standards* indicated they agreed with that vision of mathematics education. Similarly, roughly three-fourths of the mathematics teachers at each grade level who were familiar with the NCTM *Standards* indicated they have implemented the *Standards* at least to a moderate extent.

E. Teacher Perceptions of Their Preparation

Knowing the extent of teachers' course backgrounds provides useful information about the preparation of the nation's science and mathematics teaching force. Of equal importance are teachers' perceptions of their preparation—how well prepared teachers feel they are to teach the various content areas and to use the various instructional strategies recommended for science and mathematics education.

Elementary teachers are typically assigned to teach science, mathematics, and other academic subjects to one group of students, but it is clear that they do not feel equally qualified to teach all of these subjects. Table 2.18 shows self-contained elementary (grade K–6) teachers' perceptions of their qualifications to teach reading/language arts, social studies, mathematics, and science. Seventy-six percent of the elementary teachers assigned to teach all four subjects indicated they felt very well qualified to teach reading/language arts, compared to 60 percent for mathematics and 52 percent for social studies. Only 18–29 percent of the elementary teachers feel very well qualified to teach physical science, earth science, and life science.

Table 2.18
Elementary Teachers' Perceptions of
Their Qualifications to Teach Each Subject

	Percent of Teachers					
	Not Well Qualified		**Adequately Qualified**		**Very Well Qualified**	
Life Science	10	(0.9)	61	(1.7)	29	(1.7)
Earth Science	11	(1.1)	64	(1.5)	25	(1.4)
Physical Science	21	(1.6)	61	(1.7)	18	(1.1)
Mathematics	1	(0.4)	39	(1.5)	60	(1.6)
Reading/Language Arts	1	(0.3)	23	(1.5)	76	(1.6)
Social Studies	4	(0.6)	44	(1.8)	52	(1.8)

Tables 2.19 and 2.20 provide more detailed data on middle and high school science teachers' perceptions of their qualifications to teach each of a number of subjects in their particular grade levels. Middle school teachers (defined here as those in non-self-contained classes in grades 5–8) tend to feel more qualified to teach science process and inquiry skills and topics related to earth science, environmental science, and biology at their grade level and less well qualified to teach topics in chemistry and physics.

Table 2.19
Middle School Science Teachers' Perceptions of Their Qualifications to Teach Each of a Number of Subjects

	Percent of Teachers					
	Not Qualified		Adequately Qualified		Very Well Qualified	
Earth science						
Earth's features and physical processes	10	(2.4)	51	(3.8)	38	(3.8)
The solar system and the universe	11	(2.2)	52	(4.0)	37	(3.9)
Climate and weather	15	(3.3)	53	(4.2)	32	(3.7)
Biology						
Structure and function of human systems	9	(2.1)	41	(3.8)	50	(3.9)
Plant biology	11	(2.5)	44	(3.8)	45	(3.5)
Animal behavior	11	(2.5)	45	(4.1)	45	(3.8)
Interactions of living things/ecology	6	(1.9)	41	(3.9)	53	(4.0)
Genetics and evolution	27	(3.9)	45	(3.9)	28	(2.7)
Chemistry						
Structure of matter and chemical bonding	26	(3.5)	45	(4.0)	29	(3.4)
Properties and states of matter	16	(3.4)	38	(3.7)	45	(3.7)
Chemical reactions	24	(3.6)	48	(4.2)	28	(3.5)
Energy and chemical change	24	(3.7)	50	(4.0)	26	(3.1)
Physics						
Forces and motion	24	(3.9)	51	(4.0)	25	(3.2)
Energy	19	(3.2)	56	(3.8)	25	(3.2)
Light and sound	30	(3.7)	48	(3.9)	22	(3.2)
Electricity and magnetism	28	(3.3)	52	(4.1)	20	(3.1)
Modern physics (e.g., special relativity)	63	(3.6)	30	(3.2)	7	(2.1)
Environmental and resource issues						
Pollution, acid rain, global warming	10	(2.0)	46	(3.7)	44	(3.6)
Population, food supply and production	14	(2.9)	46	(3.6)	40	(3.8)
Science process/inquiry skills						
Formulating hypotheses, drawing conclusions, making generalizations	5	(2.1)	38	(4.3)	57	(4.5)
Experimental design	15	(3.3)	43	(3.9)	42	(4.1)
Describing, graphing, and interpreting data	7	(2.2)	40	(4.1)	53	(4.1)

High school science teachers (defined here as those in non-self-contained classes in grades 9–12) show more variation in their preparedness to teach different subjects, most likely attributable to the fact that most high school science teachers specialize in one subject. As with middle school teachers, high school science teachers are most likely to feel at least adequately qualified to teach science process and inquiry skills.

Table 2.20
High School Science Teachers' Perceptions of Their Qualifications to Teach Each of a Number of Subjects

	Percent of Teachers					
	Not Qualified		**Adequately Qualified**		**Very Well Qualified**	
Earth science						
Earth's features and physical processes	26	(1.8)	50	(2.5)	24	(1.9)
The solar system and the universe	32	(2.0)	42	(2.4)	26	(1.9)
Climate and weather	29	(1.7)	51	(2.1)	20	(1.5)
Biology						
Structure and function of human systems	20	(1.7)	22	(1.9)	58	(2.4)
Plant biology	24	(1.8)	30	(2.2)	46	(2.4)
Animal behavior	24	(1.9)	28	(2.0)	49	(2.4)
Interactions of living things/ecology	18	(1.6)	24	(2.0)	58	(2.3)
Genetics and evolution	20	(1.7)	24	(1.8)	55	(2.3)
Chemistry						
Structure of matter and chemical bonding	7	(0.9)	37	(2.0)	55	(2.0)
Properties and states of matter	6	(0.8)	33	(1.9)	61	(2.0)
Chemical reactions	12	(1.2)	37	(2.0)	51	(2.1)
Energy and chemical change	13	(1.2)	36	(2.0)	52	(2.0)
Physics						
Forces and motion	24	(1.8)	39	(1.7)	37	(2.1)
Energy	23	(1.7)	41	(1.8)	36	(2.2)
Light and sound	30	(1.9)	38	(2.1)	32	(2.1)
Electricity and magnetism	40	(1.7)	34	(1.8)	26	(2.1)
Modern physics (e.g., special relativity)	56	(2.0)	28	(1.9)	16	(2.2)
Environmental and resource issues						
Pollution, acid rain, global warming	10	(1.1)	45	(2.5)	45	(2.3)
Population, food supply and production	15	(1.4)	42	(2.1)	43	(2.1)
Science process/inquiry skills						
Formulating hypotheses, drawing conclusions, making generalizations	1	(0.6)	24	(1.8)	74	(1.9)
Experimental design	6	(1.2)	33	(1.9)	61	(1.8)
Describing, graphing, and interpreting data	3	(0.8)	26	(1.9)	72	(2.0)

Based on the results of a factor analysis, the items in Tables 2.20 were combined into seven content preparedness composite variables. (Definitions of all composite variables, descriptions of how they were created, and reliability information are included in Appendix E.) Each composite has a minimum possible score of 0 and a maximum possible score of 100. Table 2.21 shows the mean content composite scores for all high school science teachers, for those responsible for teaching that subject, and for those not teaching that subject.

Not surprisingly, those assigned to teach physics feel much more qualified to teach physics topics than those not assigned to this course (with mean composite scores of 82 and 55, respectively). The same pattern holds true for most of the science areas, including biology, chemistry, and earth science. In contrast, teachers of environmental science, integrated science, and physical science do not feel more qualified to teach their subject than science teachers as a whole.

Table 2.21
Content Preparedness Composite Scores of High School Science Teachers

	Mean Score			
	Teach Subject		Do Not Teach Subject	
Chemistry	90	(1.2)	70	(1.1)
Biology/Life science	84	(1.4)	60	(1.6)
Physics	82	(3.1)	55	(1.1)
Earth science	81	(1.5)	63	(0.9)
Environmental science	73	(2.8)	68	(0.9)
Physical science	66	(3.3)	60	(1.0)
Integrated/general science	64	(1.4)	62	(0.9)

Mathematics teachers were also given a list of 16 mathematics topics recommended by the NCTM *Principles and Standards for School Mathematics* (NCTM, 2000), the updated version of the mathematics standards, and asked to indicate how well qualified they felt to teach each one at the grade level they teach. As can be seen in Table 2.22, a majority of middle school teachers feel very well qualified to teach each of eight topics: computation (90 percent); estimation (83 percent); measurement (81 percent); numeration and number theory (76 percent); pre-algebra (75 percent); patterns and relationships (73 percent); geometry and spatial sense (57 percent); and data collection and analysis (56 percent). Nearly that many feel very well qualified to teach algebra (49 percent) and probability (46 percent). Relatively few feel very well qualified to teach functions and pre-calculus concepts (19 percent); statistics (18 percent); technology in support of mathematics (18 percent); topics from discrete mathematics (8 percent); mathematical structures (6 percent); or calculus (4 percent).

As can be seen in Table 2.23, a majority of the high school mathematics teachers feel very well qualified to teach each of 9 out of the 16 topics listed, ranging from 94 percent for algebra and pre-algebra to 61 percent for functions and pre-calculus concepts. In contrast, only about one-quarter of the high school mathematics teachers feel very well qualified to teach statistics; calculus; and technology in support of mathematics. Even fewer feel very well qualified to teach mathematical structures or topics from discrete mathematics (12 and 16 percent, respectively).

Table 2.22
Middle School Mathematics Teachers' Perceptions of Their Qualifications to Teach Each of a Number of Subjects

	Percent of Teachers					
	Not Well Qualified		Adequately Qualified		Very Well Qualified	
Numeration and number theory	1	(0.5)	23	(3.4)	76	(3.5)
Computation	0	(0.1)	10	(1.9)	90	(1.9)
Estimation	0	(0.1)	17	(2.8)	83	(2.8)
Measurement	1	(0.5)	18	(2.9)	81	(2.9)
Pre-algebra	2	(0.9)	22	(3.8)	75	(3.9)
Algebra	11	(2.1)	40	(3.9)	49	(3.6)
Patterns and relationships	1	(0.5)	26	(3.7)	73	(3.7)
Geometry and spatial sense	3	(0.8)	41	(4.2)	57	(4.3)
Functions (including trigonometric functions) and pre-calculus concepts	50	(3.9)	32	(3.4)	19	(2.2)
Data collection and analysis	3	(0.7)	41	(3.4)	56	(3.5)
Probability	5	(1.2)	50	(3.1)	46	(2.9)
Statistics (e.g., hypothesis tests, curve fitting and regression)	41	(4.1)	41	(4.2)	18	(2.3)
Topics from discrete mathematics (e.g., combinatorics, graph theory, recursion)	62	(4.0)	30	(4.1)	8	(1.8)
Mathematical structures (e.g., vector spaces, groups, rings, fields)	68	(4.0)	26	(4.0)	6	(1.6)
Calculus	78	(2.4)	18	(2.4)	4	(0.9)
Technology (calculators, computers) in support of mathematics	34	(3.7)	48	(4.4)	18	(2.5)

Table 2.23
High School Mathematics Teachers' Perceptions of Their Qualifications to Teach Each of a Number of Subjects

	Percent of Teachers					
	Not Well Qualified		Adequately Qualified		Very Well Qualified	
Numeration and number theory	6	(0.7)	30	(2.1)	64	(2.2)
Computation	1	(0.2)	11	(1.4)	88	(1.5)
Estimation	1	(0.2)	14	(1.6)	85	(1.7)
Measurement	1	(0.2)	14	(1.7)	85	(1.7)
Pre-algebra	1	(0.2)	5	(1.0)	94	(1.1)
Algebra	0	(0.2)	5	(1.1)	94	(1.1)
Patterns and relationships	1	(0.3)	24	(1.9)	75	(2.0)
Geometry and spatial sense	4	(0.8)	26	(2.0)	70	(2.3)
Functions (including trigonometric functions) and pre-calculus concepts	6	(0.9)	34	(2.0)	61	(2.0)
Data collection and analysis	9	(1.1)	45	(2.5)	46	(2.5)
Probability	10	(1.2)	48	(1.9)	42	(2.0)
Statistics (e.g., hypothesis tests, curve fitting and regression)	23	(1.6)	51	(2.2)	26	(2.0)
Topics from discrete mathematics (e.g., combinatorics, graph theory, recursion)	43	(1.8)	41	(1.7)	16	(1.5)
Mathematical structures (e.g., vector spaces, groups, rings, fields)	47	(2.1)	41	(1.9)	12	(1.4)
Calculus	39	(1.9)	36	(2.0)	24	(1.8)
Technology (calculators, computers) in support of mathematics	23	(1.9)	48	(2.1)	29	(2.1)

Earlier, it was noted that teachers of advanced high school mathematics classes had stronger mathematics backgrounds than did teachers who were not assigned to advanced classes. It is not surprising, therefore, that teachers of advanced classes are more likely to perceive themselves as well qualified to teach various mathematics topics. As can be seen in Table 2.24, the difference is particularly large for functions and pre-calculus concepts; 73 percent of the teachers assigned to one or more advanced high school mathematics classes, but only 41 percent of those who do not teach advanced classes, feel well qualified to teach this topic.

Table 2.24
High School Mathematics Teachers Considering Themselves Well Qualified to Teach Each of a Number of Subjects, by Teaching Assignment

	Percent of Teachers			
	Teaching No Advanced Courses		**Teaching One or More Advanced Courses**	
Pre-algebra	94	(1.2)	94	(1.6)
Algebra	92	(1.6)	95	(1.6)
Computation	85	(2.4)	90	(1.8)
Estimation	85	(2.1)	85	(2.0)
Measurement	83	(2.5)	87	(2.0)
Patterns and relationships	69	(3.0)	79	(2.3)
Geometry and spatial sense	67	(3.2)	72	(2.9)
Numeration and number theory	61	(3.1)	67	(2.6)
Data collection and analysis	42	(3.3)	48	(3.1)
Functions (including trigonometric functions) and pre-calculus concepts	41	(3.2)	73	(2.6)
Probability	38	(2.7)	44	(2.7)
Technology (calculators, computers) in support of mathematics	20	(2.4)	35	(2.9)
Statistics (e.g., hypothesis tests, curve fitting and regression)	17	(2.2)	32	(2.9)
Calculus	10	(1.7)	34	(2.6)
Topics from discrete mathematics (e.g., combinatorics, graph theory, recursion)	9	(1.5)	20	(2.3)
Mathematical structures (e.g., vector spaces, groups, rings, fields)	9	(2.2)	15	(1.9)

Composite variables were created to gauge mathematics teachers' feelings of qualification to teach both general and advanced mathematics topics. Table 2.25 shows mathematics teachers' scores on the mathematics content composites. Teachers of advanced mathematics courses feel better qualified than teachers of non-advanced courses to teach both advanced mathematics topics (mean composite scores of 63 and 51, respectively) and general mathematics topics (mean composite scores of 91 and 88, respectively).

Table 2.25
Content Preparedness Composite Scores of High School Mathematics Teachers for General and Advanced Mathematics

	Mean Score					
	All Teachers		Teach One or More Advanced Courses		Teach No Advanced Courses	
General Mathematics	89	(0.7)	91	(0.8)	88	(0.9)
Advanced Mathematics	59	(0.9)	63	(1.2)	51	(1.1)

Teachers were also asked about their enjoyment of science/mathematics teaching and whether or not they consider themselves to be “master” teachers of these subjects. As can be seen in Table 2.26, 88 percent of the grade K–4 teachers, 89 percent of the grade 5–8 teachers, and 98 percent of the grade 9–12 teachers reported that they enjoy teaching science. Ninety-four percent or more of the mathematics teachers in each grade range reported that they enjoy teaching that subject.

In grades K–4 and grades 5–8, mathematics teachers are more likely than science teachers to consider themselves “master” teachers. Nearly forty percent of the grade K–4 teachers consider themselves “master” teachers of mathematics compared to 20 percent in science. In grades 5–8, 57 percent of the mathematics teachers consider themselves “master” teachers, compared to 39 percent of the science teachers. In grades 9–12, science and mathematics teachers are more similar, with 64 percent and 69 percent, respectively, considering themselves “master” teachers of their subject.

Table 2.26
Teachers’ Opinions About Their Science and Mathematics Teaching, by Grade Range

	Percent of Teachers Agreeing*					
	Grades K–4		Grades 5–8		Grades 9–12	
Enjoy teaching subject						
Science	88	(1.9)	89	(2.7)	98	(0.8)
Mathematics	94	(1.2)	96	(1.8)	98	(0.7)
Consider themselves “master” teacher of subject						
Science	20	(2.1)	39	(3.5)	64	(2.4)
Mathematics	40	(2.3)	57	(3.6)	69	(1.9)

* Includes teachers indicating “strongly agree” or “agree” to each statement.

Both science and mathematics teachers were also asked how well prepared they felt for each of a number of tasks they might be expected to accomplish as part of their teaching responsibilities. Table 2.27 shows the percentage of grade K–4, 5–8, and 9–12 science teachers indicating they were either “fairly well prepared” or “very well prepared” for each task; analogous results for mathematics teachers are presented in Table 2.28.

Table 2.27
Science Teachers Considering Themselves Well Prepared* for Each of a Number of Tasks, by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Take students' prior understanding into account when planning curriculum and instruction	71	(2.4)	76	(3.3)	77	(1.5)
Develop students' conceptual understanding of science	73	(2.4)	84	(3.1)	92	(0.9)
Provide deeper coverage of fewer science concepts	60	(2.3)	76	(3.1)	88	(1.2)
Make connections between science and other disciplines	77	(1.8)	78	(3.4)	89	(1.3)
Lead a class of students using investigative strategies	62	(2.3)	77	(2.9)	82	(1.7)
Manage a class of students engaged in hands-on/project-based work	79	(2.3)	87	(2.7)	92	(1.2)
Have students work in cooperative learning groups	83	(2.0)	92	(1.5)	86	(1.5)
Listen/ask questions as students work in order to gauge their understanding	88	(1.5)	92	(1.8)	96	(0.8)
Use the textbook as a resource rather than the primary instructional tool	76	(2.4)	81	(3.1)	85	(1.5)
Teach groups that are heterogeneous in ability	87	(1.9)	85	(2.7)	80	(1.9)
Teach students who have limited English proficiency	30	(2.3)	27	(3.1)	21	(1.8)
Recognize and respond to student cultural diversity	65	(2.4)	68	(3.3)	61	(2.1)
Encourage students' interest in science	89	(1.5)	92	(2.3)	95	(1.1)
Encourage participation of females in science	92	(1.3)	93	(2.1)	95	(0.7)
Encourage participation of minorities in science	87	(1.6)	87	(2.6)	89	(1.3)
Involve parents in the science education of their children	47	(2.4)	51	(3.7)	44	(2.1)
Use calculators/computers for drill and practice	45	(2.5)	56	(3.9)	68	(1.9)
Use calculators/computers for science learning games	36	(2.4)	47	(3.5)	48	(2.1)
Use calculators/computers to collect and/or analyze data	29	(2.3)	51	(3.9)	67	(1.9)
Use computers to demonstrate scientific principles	18	(1.9)	35	(2.9)	51	(2.4)
Use computers for laboratory simulations	12	(1.6)	24	(2.8)	45	(2.2)
Use the Internet in your science teaching for general reference	39	(2.7)	53	(3.9)	65	(2.1)
Use the Internet in your science teaching for data acquisition	29	(2.5)	46	(3.6)	57	(2.1)
Use the Internet in your science teaching for collaborative projects with classes/individuals in other schools	15	(1.8)	29	(3.2)	30	(2.2)

* Includes teachers responding "very well prepared" or "fairly well prepared" to each statement.

While there have been calls for increased technology use in America's classrooms, data from the 2000 National Survey of Science and Mathematics Education highlight the need for professional development opportunities for teachers if that goal is to be achieved. For example, in science, while 45 percent of K–4 teachers indicate feeling at least fairly well prepared to use calculators/computers for drill and practice, only 18 percent indicated that level of comfort with using computers to demonstrate scientific principles. Feelings of preparedness increased with increasing grade range, but even at the high school level, only about half of teachers indicated they were at least fairly well prepared to use computers to demonstrate scientific principles or for laboratory simulations.

Teachers of mathematics generally indicated higher levels of preparedness to use calculators and computers. For example, 66 percent of the grade K–4 teachers, rising to 86 percent at the high school level, indicated feeling at least fairly well prepared to use calculators/computers for drill and practice. Similarly, the percentages of teachers indicating comfort with using these technologies to demonstrate mathematics principles ranged from 43 percent in grades K–4 to 75 percent in grades 9–12.

Table 2.28
Mathematics Teachers Considering Themselves Well Prepared* for Each of a Number of Tasks, by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Take students' prior understanding into account when planning curriculum and instruction	87	(1.8)	86	(2.7)	85	(1.5)
Develop students' conceptual understanding of mathematics	90	(1.7)	88	(1.9)	88	(1.6)
Provide deeper coverage of fewer mathematics concepts	76	(2.3)	82	(2.6)	76	(1.8)
Make connections between mathematics and other disciplines	83	(1.9)	78	(2.8)	68	(1.8)
Lead a class of students using investigative strategies	67	(2.4)	67	(3.3)	61	(2.1)
Manage a class of students engaged in hands-on/project-based work	84	(1.9)	76	(3.2)	69	(2.1)
Have students work in cooperative learning groups	86	(1.9)	85	(2.6)	76	(1.8)
Listen/ask questions as students work in order to gauge their understanding	94	(1.0)	95	(1.6)	92	(1.1)
Use the textbook as a resource rather than the primary instructional tool	81	(1.7)	71	(2.8)	71	(1.9)
Teach groups that are heterogeneous in ability	86	(1.9)	81	(3.1)	73	(2.0)
Teach students who have limited English proficiency	34	(2.5)	26	(3.0)	18	(1.5)
Recognize and respond to student cultural diversity	68	(2.2)	68	(2.8)	56	(2.2)
Encourage students' interest in mathematics	96	(0.8)	89	(1.5)	90	(1.2)
Encourage participation of females in mathematics	98	(0.6)	96	(0.9)	94	(0.9)
Encourage participation of minorities in mathematics	91	(1.4)	88	(2.2)	86	(1.4)
Involve parents in the mathematics education of their children	72	(2.4)	51	(3.0)	37	(2.0)
Use calculators/computers for drill and practice	66	(2.6)	74	(2.6)	86	(1.3)
Use calculators/computers for mathematics learning games	69	(2.6)	69	(2.9)	54	(2.2)
Use calculators/computers to collect and/or analyze data	39	(2.3)	64	(3.2)	66	(2.0)
Use calculators/computers to demonstrate mathematics principles	43	(2.4)	57	(3.1)	75	(1.8)
Use calculators/computers for simulations and applications	39	(2.3)	47	(3.5)	58	(1.9)
Use the Internet in your mathematics teaching for general reference	24	(1.9)	34	(3.0)	30	(1.9)
Use the Internet in your mathematics teaching for data acquisition	20	(1.8)	27	(2.8)	28	(1.8)
Use the Internet in your mathematics teaching for collaborative projects with classes/individuals in other schools	14	(1.5)	18	(2.5)	15	(1.4)

* Includes teachers responding "very well prepared" or "fairly well prepared" to each statement.

The 2000 National Survey of Science and Mathematics Education also provided evidence that many teachers do not feel well prepared to teach the diversity of students in our nation's schools. While the majority of science and mathematics teachers (ranging from 56 to 68 percent, depending on subject and grade range) feel well prepared to recognize and respond to student cultural diversity, only 18–34 percent feel well prepared to teach students who have limited English proficiency. At the same time, the vast majority of science and mathematics teachers reported feeling at least fairly well prepared to encourage the participation of females (92–98 percent), and to encourage the participation of minorities (86–91 percent).

In science, elementary teachers are less likely than middle and high school teachers to feel prepared to develop students' conceptual understanding of science, provide deeper coverage of fewer science concepts, make connections between science and other disciplines, lead a class of students using investigative strategies, and to manage a class of students engaged in hands-on/project-based work. In contrast, in mathematics, it is the high school teachers who are less likely to feel prepared to make connections between mathematics and other disciplines, and manage a class of students engaged in hands-on/project-based work; most teachers in all three grade ranges feel well prepared to develop students' conceptual understanding of mathematics, and to provide deeper coverage of fewer mathematics concepts. In both science and mathematics, grade 9–12 teachers are less likely than their grade K–8 counterparts to feel well prepared to teach groups that are heterogeneous in ability.

Table 2.29 displays the composite scores related to teachers' pedagogical preparedness by subject and grade range. It is interesting that in science, grade 9–12 teachers feel better prepared to use standards-based teaching practices than teachers of grades K–4 and 5–8, while in mathematics, teachers of grades 9–12 feel less well prepared to use standards-based teaching practices than grade K–4 and 5–8 teachers. A similar pattern exists for teachers' preparedness to teach students from diverse backgrounds. Grade 9–12 science teachers report feeling better prepared than K–4 teachers to handle diversity in the classroom; grade 9–12 mathematics teachers feel less well prepared to teach students from diverse backgrounds.

The composites related to teachers' preparedness to use calculators/computers and the Internet in the classroom indicate that the majority of teachers do not feel well prepared to use technology in their teaching. The exception to this is mathematics teachers' preparedness to use calculators/ computers in their teaching. However, this finding is likely a reflection of the widespread use of calculators in mathematics classes and may not be indicative of computer use.

Table 2.29
Composite Scores of Science and Mathematics Teachers' Pedagogical Preparedness

	Mean Score			
	Use Standards-Based Teaching Practices	**Teach Students from Diverse Backgrounds**	**Use Calculators/ Computers**	**Use the Internet**
Science				
Grades K–4	66 (0.9)	73 (1.0)	32 (1.4)	29 (1.5)
Grades 5–8	73 (1.4)	75 (1.7)	43 (1.9)	41 (2.3)
Grades9–12	76 (0.7)	77 (0.8)	54 (1.3)	50 (1.3)
Mathematics				
Grades K–4	73 (0.8)	78 (0.8)	50 (1.3)	24 (1.3)
Grades 5–8	73 (1.3)	78 (1.3)	59 (1.7)	31 (2.1)
Grades 9–12	68 (0.8)	73 (0.7)	63 (1.1)	30 (1.1)

F. Summary

Data in this chapter provide insight on teachers' preparation and indicate that science and mathematics teachers, especially in the elementary and middle grades, do not have strong content preparation in their respective subjects. Elementary teachers are typically assigned to teach science, mathematics, and other academic subjects to one group of students, but it is clear that they do not feel equally qualified in each area. While roughly 75 percent of the elementary teachers feel very well qualified to teach reading/language arts, approximately 60 percent feel very well qualified to teach mathematics and about 25 percent feel very well qualified to teach science. In part, this may be due to very few grade K–4 science and mathematics teachers having undergraduate majors in these fields, with the majority having majors in education.

While science and mathematics teachers in grades 5–8 were more likely than their grade K–4 colleagues to have undergraduate majors in science or mathematics, a majority still had majors in education. On the other hand, grade 9–12 science and mathematics teachers were much more likely to have majored in their discipline than in education. The number of semesters of college coursework completed by teachers tells a similar story: elementary teachers have less extensive backgrounds than do their middle grade counterparts, who in turn have had less science/ mathematics coursework than their high school counterparts.

Furthermore, there is evidence that students who take lower-level mathematics classes at the high school level are not as likely to get the benefits of having well-prepared teachers. Teachers of lower-level mathematics courses are much less likely than teachers of advanced mathematics courses to have completed coursework in a number of important mathematics topics.

The 2000 National Survey found that science teachers as a whole are much less likely to be familiar with the NRC *Standards* than mathematics teachers are with the NCTM *Standards*. In both subjects, teachers in the higher grades are more likely to be familiar with the respective *Standards* than teachers in the lower grades. Roughly 70 percent of the science and mathematics teachers familiar with the respective S*tandards* agree with their vision and indicate that they are implementing their recommendations at least to a moderate extent.

While the majority of science and mathematics teachers indicate feeling at least fairly well prepared to use many standards-based teaching practices, such as leading a class of students using investigative strategies or teaching groups that are heterogeneous in ability, relatively few feel well prepared to use technology (calculators, computers, or the Internet) in their teaching or to teach students who have limited English proficiency.

Chapter Three

Teachers as Professionals

A. Overview

The National Council of Teachers of Mathematics' *Principles and Standards for School Mathematics* (NCTM, 2000) and the National Research Council's *National Science Education Standards* (NRC, 1996) describe a vision for teaching in which teachers are treated as professionals, respected for their expertise, allowed to exercise their professional judgement, and provided ample opportunities to work collaboratively with their peers and to continue to learn throughout their careers. The 2000 National Survey of Science and Mathematics Education collected data related to teacher professionalism, including teacher perceptions of their autonomy in making curriculum and instructional decisions, their opportunities for collaborative work, and their participation in in-service education and other professional activities. These data are discussed in the following sections.

B. The School as a Collegial Work Place

Teacher perceptions on issues related to collegiality are shown in Tables 3.1 and 3.2 for science and mathematics, respectively. On the positive side, most science and mathematics teachers in each grade range indicate that teachers in their school share ideas and materials on a regular basis (54–66 percent). However, other indicators of collegiality are less encouraging. While slightly more than half of high school teachers report that they and their colleagues contribute actively to decisions about the science/mathematics curriculum, only about a third of elementary teachers do so. In addition, only about 1 in 4 science and mathematics teachers have time during the regular school week to work with their peers on curriculum and instruction and fewer than 1 in 10 indicate that science/mathematics teachers in their school regularly observe each other teaching classes as part of sharing and improving instructional strategies. The picture that emerges is one where teachers do not have time structured into the school day where they can collaborate.

Table 3.1
Science Teachers Agreeing* with Each of a Number of Statements Related to Teacher Collegiality, by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
My colleagues and I regularly share ideas and materials related to science teaching	54	(2.7)	59	(4.2)	66	(2.3)
Most science teachers in this school contribute actively to making decisions about the science curriculum	30	(2.5)	48	(3.6)	56	(2.5)
I have time during the regular school week to work with my colleagues on science curriculum and teaching	22	(2.2)	25	(2.7)	27	(2.4)
Science teachers in this school regularly observe each other teaching classes as part of sharing and improving instructional strategies	4	(0.9)	5	(1.2)	10	(1.1)

* Includes teachers indicating "strongly agree" or "agree" to each statement.

Table 3.2
Mathematics Teachers Agreeing* with Each of a Number of Statements Related to Teacher Collegiality, by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
My colleagues and I regularly share ideas and materials related to mathematics teaching	56	(2.5)	54	(3.5)	62	(2.4)
Most mathematics teachers in this school contribute actively to making decisions about the mathematics curriculum	37	(2.5)	40	(3.0)	58	(2.1)
I have time during the regular school week to work with my colleagues on mathematics curriculum and teaching	25	(2.0)	30	(4.0)	28	(1.6)
Mathematics teachers in this school regularly observe each other teaching classes as part of sharing and improving instructional strategies	5	(1.1)	7	(1.3)	8	(1.0)

* Includes teachers indicating "strongly agree" or "agree" to each statement.

C. Teacher Perceptions of Their Decisionmaking Autonomy

Underlying many school reform efforts is the notion that classroom teachers are in the best position to know their students' needs and interests, and therefore should be the ones to make decisions for tailoring instruction to a particular group of students. The 2000 National Survey of Science and Mathematics Education asked teachers the extent to which they had control over a number of curriculum and instructional decisions for their classes. Results for science and mathematics teachers are presented in Tables 3.3 and 3.4, respectively. Note that in both science and mathematics, teachers in all grade ranges are most likely to perceive themselves as having autonomy in selecting teaching techniques (56–80 percent); determining the amount of homework to be assigned (67–83 percent); choosing tests for classroom assessment (42–80 percent); choosing criteria for grading students (45–71 percent); and selecting both the sequence (36–64 percent) and the pace (45–63 percent) for covering topics. In addition, there is a clear and consistent pattern of perceived autonomy increasing with grade range.

Fewer science and mathematics teachers, especially in the elementary and middle grades, perceive themselves as having strong control in determining the goals and objectives of their courses; selecting the content, topics, and skills to be taught; or selecting textbooks. For example, while teachers in 68 percent of the grade 5–8 science classes report having strong control over the selection of teaching techniques, only 22 percent of these teachers report strong control in selecting the content, topics, and skills to be taught. Again, perceived control generally increases with grade range.

Table 3.3
Science Classes Where Teachers Report Having Strong Control* Over Various Curriculum and Instructional Decisions, by Grade Range

	Percent of Classes					
	Grades K–4		**Grades 5–8**		**Grades 9–12**	
Determining the amount of homework to be assigned	67	(2.5)	75	(2.4)	83	(1.5)
Selecting teaching techniques	56	(3.3)	68	(2.6)	80	(1.6)
Choosing tests for classroom assessment	53	(2.9)	70	(2.6)	80	(1.6)
Choosing criteria for grading students	50	(2.6)	63	(3.0)	71	(1.7)
Setting the pace for covering topics	45	(3.1)	56	(2.6)	63	(2.2)
Selecting the sequence in which topics are covered	44	(3.0)	59	(2.9)	64	(2.1)
Selecting other instructional materials	28	(2.1)	40	(2.8)	52	(2.5)
Determining course goals and objectives	14	(2.0)	24	(2.6)	39	(2.5)
Selecting content, topics, and skills to be taught	14	(2.0)	22	(2.4)	42	(2.6)
Selecting textbooks/instructional programs	8	(1.6)	22	(2.4)	36	(2.4)

*Teachers were given a five-point scale for each decision, with 1 labeled as “No Control” and 5 labeled “Strong Control.”

Table 3.4
Mathematics Classes Where Teachers Report Having Strong Control* Over Various Curriculum and Instructional Decisions, by Grade Range

	Percent of Classes					
	Grades K–4		**Grades 5–8**		**Grades 9–12**	
Determining the amount of homework to be assigned	68	(2.6)	72	(2.5)	82	(1.5)
Selecting teaching techniques	63	(2.5)	71	(2.7)	74	(1.6)
Setting the pace for covering topics	45	(2.8)	49	(2.5)	50	(1.9)
Choosing criteria for grading students	45	(2.8)	56	(2.3)	70	(1.7)
Choosing tests for classroom assessment	42	(2.5)	66	(2.7)	79	(1.6)
Selecting the sequence in which topics are covered	36	(2.6)	50	(3.2)	52	(2.0)
Selecting other instructional materials	30	(1.9)	41	(2.4)	44	(2.3)
Determining course goals and objectives	12	(1.6)	20	(2.6)	27	(2.0)
Selecting content, topics, and skills to be taught	9	(1.3)	20	(3.1)	27	(2.0)
Selecting textbooks/instructional programs	5	(1.0)	14	(1.7)	25	(2.1)

*Teachers were given a five-point scale for each decision, with 1 labeled as “No Control” and 5 labeled “Strong Control.”

Based on the results of a factor analysis, the items in Tables 3.3 and 3.4 were combined into two composite variables—Curriculum Control and Pedagogy Control. (Definitions of all composite variables, descriptions of how they were created, and reliability information are included in Appendix E.) Each composite has a minimum possible score of 0 and a maximum possible score of 100.

The items comprising Curriculum Control are:

- Determining course goals and objectives;
- Selecting textbooks/instructional program;
- Selecting other instructional materials;
- Selecting content, topics, and skills to be taught; and
- Selecting the sequence in which topics are covered.

For Pedagogy Control, the items are:

- Selecting teaching techniques;
- Determining the amount of homework to be assigned;
- Choosing criteria for grading students; and
- Choosing tests for classroom assessment.

Table 3.5 displays the composite scores for science and mathematics classes by grade range. These scores indicate that teachers perceive much more control over decisions related to pedagogy than over those related to curriculum. They also show that, as noted above, perceived control over both dimensions generally increases with increasing grade range. Differences between science and mathematics classes at the same grade range are minimal or non-existent.

Table 3.5
Curriculum Control and Pedagogy Control Composite Scores for Science and Mathematics Classes, by Grade Range

	Mean Score			
	Curriculum		Pedagogy	
Science Classes				
Grades K–4	51	(1.4)	82	(1.1)
Grades 5–8	63	(1.5)	90	(0.9)
Grades 9–12	73	(1.1)	93	(0.5)
Mathematics Classes				
Grades K–4	50	(1.3)	79	(1.3)
Grades 5–8	58	(1.6)	88	(0.8)
Grades 9–12	66	(1.1)	92	(0.4)

As can be seen in Table 3.6, there are some large regional differences in perceived control over decisionmaking. Given that state-wide textbook adoption is primarily a Southern and Western practice, it is not surprising that science and mathematics teachers in these regions are less likely to consider themselves as having strong control over textbook selection. Other differences are apparent between science teachers in the South and those in the Midwest. For example, only 45 percent of the science teachers in the South feel empowered to select the sequence or pace in which topics are covered, compared to 60 percent of the teachers in the Midwest. Interestingly, regional differences among mathematics teachers are much less pronounced. (See Table 3.7.)

Table 3.6
Science Classes Where Teachers Report Having Strong Control* Over Various Curriculum and Instructional Decisions, by Region

	Percent of Classes							
	Midwest		Northeast		South		West	
Determining the amount of homework to be assigned	78	(2.2)	73	(4.2)	72	(2.4)	70	(3.9)
Selecting teaching techniques	72	(2.4)	65	(4.3)	60	(2.4)	68	(4.8)
Choosing tests for classroom assessment	69	(2.4)	63	(4.6)	63	(2.8)	62	(4.2)
Choosing criteria for grading students	65	(2.5)	56	(3.7)	54	(2.5)	60	(4.2)
Setting the pace for covering topics	62	(2.7)	53	(4.9)	44	(2.4)	56	(4.5)
Selecting the sequence in which topics are covered	60	(3.0)	56	(4.8)	45	(2.4)	57	(4.3)
Selecting other instructional materials	40	(3.4)	36	(4.2)	33	(2.1)	38	(3.9)
Determining course goals and objectives	28	(2.7)	27	(4.2)	17	(2.0)	22	(2.7)
Selecting content, topics, and skills to be taught	28	(2.7)	22	(4.5)	18	(1.8)	26	(3.7)
Selecting textbooks/instructional programs	26	(2.7)	26	(3.4)	10	(1.5)	17	(2.4)

*Teachers were given a five-point scale for each decision, with 1 labeled as “No Control” and 5 labeled “Strong Control.”

Table 3.7
Mathematics Classes Where Teachers Report Having Strong Control* Over Various Curriculum and Instructional Decisions, by Region

	Percent of Classes							
	Midwest		Northeast		South		West	
Determining the amount of homework to be assigned	75	(3.0)	74	(2.7)	72	(2.1)	69	(3.0)
Selecting teaching techniques	71	(2.6)	71	(2.8)	66	(2.3)	66	(3.1)
Choosing tests for classroom assessment	60	(3.1)	63	(3.5)	58	(2.3)	53	(2.8)
Choosing criteria for grading students	55	(3.1)	59	(4.1)	53	(2.1)	52	(2.9)
Setting the pace for covering topics	52	(3.2)	54	(3.2)	42	(2.8)	45	(3.1)
Selecting the sequence in which topics are covered	46	(3.4)	54	(3.6)	38	(2.7)	44	(2.9)
Selecting other instructional materials	35	(2.5)	37	(3.3)	38	(2.4)	35	(2.6)
Determining course goals and objectives	20	(2.7)	24	(2.6)	15	(1.7)	17	(2.2)
Selecting content, topics, and skills to be taught	20	(2.4)	19	(2.7)	16	(1.9)	14	(2.3)
Selecting textbooks/instructional programs	16	(1.6)	18	(2.6)	11	(1.4)	9	(1.7)

*Teachers were given a five-point scale for each decision, with 1 labeled as “No Control” and 5 labeled “Strong Control.”

Some regional differences are also apparent when looking at the Curriculum Control composite variable. (See Table 3.8.) Again, teachers in classes in the South appear to have the least control over curriculum-related decisions. There are no regional differences in overall control over pedagogy.

Table 3.8
Curriculum Control and Pedagogy Control Composite Scores for Science and Mathematics Classes, by Region

	Mean Score			
	Curriculum		Pedagogy	
Science				
Midwest	66	(1.7)	89	(0.9)
Northeast	64	(2.2)	87	(1.4)
South	53	(1.3)	85	(1.0)
West	60	(2.3)	87	(1.8)
Mathematics				
Midwest	60	(1.6)	86	(1.5)
Northeast	62	(1.9)	87	(1.3)
South	51	(1.4)	84	(1.0)
West	57	(1.7)	84	(1.4)

D. Professional Development

Having discretion in making curriculum and instructional decisions is one of the hallmarks of teachers as professionals. Another is keeping up with advances in their field, a task which is particularly challenging for teachers at the elementary level since they typically teach multiple subjects. Teachers were asked to reflect back to their preparedness “3 years ago” as a backdrop for asking about how helpful their recent professional development experiences have been. Tables 3.9 and 3.10 show the percentage of science and mathematics teachers reporting that they perceived a moderate or substantial need for professional development in each of a number of areas. The relative order of perceived needs was virtually identical between subjects and among grade ranges within subjects—teachers were most likely to report that they needed professional development related to instructional uses of technology and generally least likely to perceive a need for deepening their own content knowledge. Elementary and middle school science teachers were an exception, with content needs rated second only to technology. About 6 in 10 teachers in each subject/grade range category reports needing at least moderate help in learning how to teach students with special needs.

Some striking differences appear in the perceived preparedness of science and mathematics teachers, particularly in the areas of understanding student thinking, assessing student learning, and deepening teachers’ own content knowledge. In each instance, elementary level mathematics teachers were less likely than their counterparts in science to perceive that they needed professional development in these areas. Elementary level science teachers are more likely than science teachers in grades 9–12 to report needs for professional development in all but one area (teaching students with special needs). Differences in teacher preparedness by grade level in mathematics were generally much smaller.

Table 3.9
Science Teachers Reporting They Perceived a Moderate or Substantial Need for Professional Development Three Years Ago, by Grade Range

	Percent of Teachers					
	Grades K–4		**Grades 5–8**		**Grades 9–12**	
Learning how to use technology in science instruction	85	(1.9)	78	(3.6)	71	(2.0)
Learning how to teach science in a class that includes students with special needs	59	(2.5)	59	(3.3)	59	(2.2)
Learning how to use inquiry/investigation-oriented teaching strategies	66	(2.2)	61	(3.7)	52	(2.0)
Understanding student thinking in science	62	(2.4)	58	(3.8)	47	(1.9)
Learning how to assess student learning in science	59	(2.5)	54	(3.3)	42	(2.1)
Deepening my own science content knowledge	71	(2.3)	67	(3.2)	38	(1.9)

Table 3.10
Mathematics Teachers Reporting They Perceived a Moderate or Substantial Need for Professional Development Three Years Ago, by Grade Range

	Percent of Teachers					
	Grades K–4		**Grades 5–8**		**Grades 9–12**	
Learning how to use technology in mathematics instruction	80	(2.2)	83	(2.2)	67	(1.8)
Learning how to teach mathematics in a class that includes students with special needs	57	(2.6)	59	(3.5)	55	(2.3)
Learning how to use inquiry/investigation-oriented teaching strategies	62	(2.6)	62	(3.6)	53	(2.2)
Understanding student thinking in mathematics	46	(2.3)	51	(3.5)	40	(2.3)
Learning how to assess student learning in mathematics	47	(2.4)	40	(3.5)	32	(2.0)
Deepening my own mathematics content knowledge	45	(1.9)	40	(3.1)	32	(2.2)

Table 3.11 shows the percentages of science and mathematics teachers in grades K–4, 5–8, and 9–12 spending various amounts of time on in-service education in their field in the last three years. While most science and mathematics teachers have had at least some in-service education in their field during that time, relatively few have devoted a substantial amount of time to these activities; percentages of teachers spending 35 or more hours on in-service education in science/mathematics in the prior three years ranged from 10 percent of the grade K–4 science teachers to 45 percent of the high school science teachers. Half of all K–4 science teachers report fewer than six hours of science-related professional development in the last three years. Taking these data together with those in Tables 3.9 and 3.10, it appears elementary science teachers are the most in need of professional development and the least likely to participate in it.

Table 3.11
Time Spent on In-Service Education in Science and Mathematics in Last Three Years, by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Science						
None	24	(2.2)	15	(2.4)	8	(1.0)
Less than 6 hours	26	(2.1)	15	(2.4)	8	(1.5)
6–15 hours	26	(2.1)	27	(3.5)	16	(1.3)
16–35 hours	14	(1.7)	25	(3.7)	23	(1.7)
More than 35 hours	10	(1.5)	18	(2.5)	45	(2.0)
Mathematics						
None	14	(1.7)	14	(3.3)	7	(1.3)
Less than 6 hours	22	(2.2)	15	(2.7)	8	(1.4)
6–15 hours	32	(2.2)	29	(3.0)	17	(1.7)
16–35 hours	18	(1.7)	19	(2.3)	25	(1.8)
More than 35 hours	14	(1.7)	23	(2.5)	43	(2.2)

A similar pattern emerges among mathematics teachers. Earlier it was noted that high school mathematics teachers who do not teach advanced classes have weaker content backgrounds than do teachers of advanced mathematics classes. Unfortunately, while these teachers appear to be more in need of in-service education, they are less likely to participate in it. As can be seen in Table 3.12, only 36 percent of the high school mathematics teachers who teach lower level classes had 16 or more hours of in-service education in mathematics in the last three years, compared to 71 percent of those who teach at least one advanced mathematics class.

Table 3.12
Time Spent by High School Mathematics Teachers on In-Service Education in Mathematics in Last Twelve Months and Last Three Years, by Teaching Assignment

	Percent of Teachers			
	Teach No Advanced Mathematics Courses		Teach At Least One Advanced Mathematics Course	
Last Twelve Months				
None	28	(1.9)	12	(1.8)
Less than 16 hours	57	(1.9)	50	(2.7)
16 or more hours	15	(1.1)	38	(2.6)
Last Three Years				
None	14	(1.5	6	(1.1)
Less than 16 hours	50	(1.9)	24	(2.6)
16 or more hours	36	(1.9)	71	(2.8)

Tables 3.13 and 3.14 show the types of professional development activities that science and mathematics teachers reported participating in during the preceding three years. In each subject/grade range category, attending a workshop focused on teaching the subject was the most commonly reported form of professional development; well over half of the teachers reported this activity. Generally, the second most frequently reported activity—ranging from 33 to 57 percent of the teachers—was observing other teachers, either formally or informally. Meeting

with a local group of teachers to discuss teaching issues on a regular basis also appears to be one of the more common forms of professional development.

Table 3.13
Science Teachers Participating in Various Professional Development Activities in Past Three Years, by Grade Range

	Percent of Teachers		
	Grades K–4	Grades 5–8	Grades 9–12
Attended a workshop on science teaching	58 (2.7)	65 (3.7)	70 (2.2)
Observed other teachers teaching science as part of your own professional development (formal or informal)	33 (2.3)	38 (3.7)	57 (2.2)
Met with a local group of teachers to study/discuss science teaching issues on a regular basis	25 (2.6)	41 (3.7)	53 (2.3)
Taken a formal college/university course in the teaching of science	14 (2.0)	20 (2.7)	26 (1.8)
Taken a formal college/university science course	12 (1.7)	22 (2.7)	37 (1.9)
Served as a mentor and/or peer coach in science teaching, as part of a formal arrangement that is recognized or supported by the school or district	8 (1.9)	14 (2.4)	24 (2.0)
Attended a national or state science teacher association meeting.	5 (1.0)	22 (3.0)	43 (2.1)
Collaborated on science teaching issues with a group of teachers at a distance using telecommunications	4 (0.8)	10 (2.2)	17 (1.4)
Applied or applying for certification from the National Board for Professional Teaching Standards (NBPTS)	3 (0.9)	2 (0.9)	4 (0.6)
Received certification from the National Board for Professional Teaching Standards (NBPTS)	2 (0.8)	2 (1.1)	2 (0.5)

Table 3.14
Mathematics Teachers Participating in Various Professional Development Activities in Past Three Years, by Grade Range

	Percent of Teachers		
	Grades K–4	Grades 5–8	Grades 9–12
Attended a workshop on mathematics teaching	68 (2.6)	74 (2.8)	80 (2.0)
Observed other teachers teaching mathematics as part of your own professional development (formal or informal)	45 (2.3)	50 (3.6)	53 (2.1)
Met with a local group of teachers basis to study/discuss mathematics teaching issues on a regular basis	35 (1.9)	47 (2.9)	50 (2.0)
Taken a formal college/university course in the teaching of mathematics	18 (2.0)	21 (3.0)	18 (1.5)
Served as a mentor and/or peer coach in mathematics teaching, as part of a formal arrangement that is recognized or supported by the school or district	13 (1.7)	12 (1.9)	20 (1.4)
Taken a formal college/university mathematics course	11 (1.3)	16 (1.9)	18 (1.8)
Attended a national or state mathematics teacher association meeting	7 (1.4)	21 (2.3)	40 (2.4)
Collaborated on mathematics teaching issues with a group of teachers at a distance using telecommunications	5 (1.0)	7 (1.3)	9 (1.4)
Applied or applying for certification from the National Board for Professional Teaching Standards (NBPTS)	3 (0.8)	2 (0.7)	3 (1.0)
Received certification from the National Board for Professional Teaching Standards (NBPTS)	2 (0.6)	1 (0.5)	2 (1.0)

Within subjects, some differences exist among grade ranges, with a general pattern of teachers in the higher grade ranges being more likely than their elementary counterparts to report particular types of professional development. In mathematics, roughly half of the teachers in grades 5–12 reported meeting with a local group of teachers on a regular basis, compared to one-third of the K–4 teachers. Mathematics teachers in grades 9–12 were about twice as likely as those in grades 5-8 and six times as likely as K–4 teachers to report attending a national or state mathematics teacher association meeting; a similar pattern was observed for science teachers. The pattern of higher grades teachers being more likely to report professional development activities was even more pronounced in science than in mathematics.

Some between-subjects differences appear as well. For example, 37 percent of the science teachers in grades 9–12 reported taking a formal college/university science course in the last three years, compared to 18 percent of the mathematics teachers in those grades.

Tables 3.15 and 3.16 show that science and mathematics teachers in the higher grades are more likely than those in the lower grades to have taken college coursework in their discipline in recent years. The pattern is much more pronounced in science than in mathematics. For example, in 2000 only 19 percent of the grade K–4 science teachers compared to 31 percent in grades 5–8 and 43 percent in grades 9–12 had taken a science course for college credit since 1996. Analogous figures for mathematics teachers are 24 percent in grades K–4, 23 percent in grades 5–8, and 30 percent in grades 9–12.

Similarly, when college courses in either science or the teaching of science are considered, only 27 percent of the science teachers in grade K–4 compared to 51 percent at the high school level had taken a college course since 1996, while the analogous figures for mathematics were 35 and 38 percent.

Table 3.15
Science Teachers' Most Recent College Coursework in Field, by Grade Range

	Percent of Teachers					
	Grades K–4		**Grades 5–8**		**Grades 9–12**	
Science						
1996–2000	19	(2.0)	31	(3.0)	43	(1.7)
1990–1995	23	(2.0)	23	(2.8)	28	(2.2)
Prior to 1990	58	(2.7)	46	(4.0)	29	(1.9)
Teaching of Science						
1996–2000	22	(1.9)	28	(3.1)	34	(2.0)
1990–1995	22	(2.5)	19	(2.4)	21	(1.9)
Prior to 1990	39	(2.8)	33	(3.1)	26	(1.8)
Never	17	(1.8)	19	(2.4)	19	(1.9)
Science or the Teaching of Science*						
1996–2000	27	(2.1)	40	(3.7)	51	(2.1)
1990–1995	25	(2.5)	20	(2.5)	25	(2.2)
Prior to 1990	48	(2.8)	40	(3.8)	24	(1.8)

* These analyses include only the 89 percent of teachers who indicated when they last completed a course in science and in the teaching of science.

Table 3.16
Mathematics Teachers’ Most Recent College Coursework in Field, by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Mathematics						
1996–2000	24	(1.8)	23	(3.0)	30	(2.2)
1990–1995	24	(2.0)	29	(3.3)	26	(1.8)
Prior to 1990	52	(2.2)	48	(3.8)	44	(1.8)
The Teaching of Mathematics						
1996–2000	29	(2.2)	28	(3.0)	28	(1.9)
1990–1995	24	(2.1)	21	(2.7)	21	(1.5)
Prior to 1990	40	(2.1)	39	(3.8)	37	(2.0)
Never	7	(1.2)	11	(2.0)	14	(1.6)
Mathematics or the Teaching of Mathematics*						
1996–2000	35	(2.3)	37	(3.8)	38	(2.2)
1990–1995	25	(2.1)	25	(3.1)	24	(1.7)
Prior to 1990	41	(2.3)	38	(3.8)	38	(1.9)

* These analyses include only the 92 percent of teachers who indicated when they last completed a course in mathematics and in the teaching of mathematics.

Teachers were also asked about different ways they may have served as a resource for their school/district in the 12-month period preceding the survey; these data are presented in Tables 3.17 and 3.18. In both science and mathematics, grade 9–12 teachers were generally more likely than grade 5–8 teachers, who in turn were more likely than grade K–4 teachers, to have participated in each type of activity. For example, 38 percent of high school mathematics teachers indicated serving on a school or district mathematics curriculum committee in the past 12 months, compared to 29 percent of grade 5–8 mathematics teachers and 14 percent of those in grades K–4.

Similarly, 37 percent of high school science teachers, compared to 28 percent in grades 5–8 and 12 percent in grades K–4, had served on a school or district science textbook selection committee in the previous year. Roughly 1 in 7 high school science teachers, but only about 1 in 50 at the elementary level had been involved in teaching science in-service workshops for other teachers. Finally, high school science teachers were considerably more likely than science teachers in the lower grades or mathematics teachers in any grade range to have received a local, state, or national grant or award related to their teaching in these fields.

Table 3.17
Science Teachers Participating in Various Science-Related Professional Activities in Last Twelve Months, by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Served on a school or district science curriculum committee	13	(1.5)	35	(3.1)	41	(2.1)
Served on a school or district science textbook selection committee	12	(1.5)	28	(2.9)	37	(2.1)
Mentored another teacher as part of a formal arrangement that is recognized or supported by the school or district, not including supervision of student teachers	15	(2.1)	19	(2.6)	24	(1.5)
Received any local, state, or national grants or awards for science teaching	2	(0.6)	6	(1.6)	16	(1.3)
Taught any in-service workshops in science or science teaching	2	(0.6)	10	(2.2)	15	(1.3)

Table 3.18
Mathematics Teachers Participating in Various Mathematics-Related Professional Activities in Last Twelve Months, by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Served on a school or district mathematics textbook selection committee	15	(1.8)	28	(3.0)	41	(2.2)
Served on a school or district mathematics curriculum committee	14	(1.5)	29	(2.5)	38	(2.1)
Mentored another teacher as part of a formal arrangement that is recognized or supported by the school or district, not including supervision of student teachers	16	(1.6)	17	(2.1)	19	(1.4)
Taught any in-service workshops in mathematics or mathematics teaching	4	(0.9)	13	(2.0)	14	(1.2)
Received any local, state, or national grants or awards for mathematics teaching	2	(0.7)	4	(0.9)	7	(0.8)

Tables 3.19 and 3.20 report teachers' ratings of the emphasis they perceived in their professional development experiences over the last three years. These data make it clear that learning to use inquiry- and investigation-oriented teaching strategies has been a priority in both science and mathematics professional development, ranking in the top two in every subject/grade range category. In mathematics, understanding student thinking has received special attention, especially in grades K–8 where it appears among the most emphasized topics. The emphasis given to technology in science and mathematics at the high school level is striking, especially compared to professional development emphases in grades K–8. Almost half of all high school science and mathematics teachers report that their professional development experiences emphasized learning to use technology for instruction to a great extent.

Finally, these data reveal an apparent mismatch between what teachers believe they need in professional development and what they actually receive. Taking all science and mathematics teachers together, learning to teach students with special needs was rated as one of the greatest needs. Yet across subjects and grade ranges, this area appears to have received the least attention among the listed topics. In a separate analysis, it was found that those who identified a moderate to substantial need for professional development in a specific area generally did not perceive their professional development experiences as emphasizing that area. For example, among mathematics teachers in grades K–4, 45 percent indicated a moderate or substantial need for deepening their own mathematics content knowledge, yet only 21 percent of these teachers perceived a strong emphasis on content in their professional development experiences. Generally, one-third or fewer of the teachers perceived a strong emphasis in the area where they indicated a strong need. The one exception was technology, where roughly half of the science and mathematics teachers in grades 9–12 who indicated a strong need perceived a strong emphasis in their professional development on learning how to use technology in their instruction.

Table 3.19
Science Teachers Reporting That Their Professional Development Gave Heavy Emphasis to Various Areas,* by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Learning how to use inquiry/investigation-oriented teaching strategies	28	(2.4)	36	(3.9)	35	(2.3)
Understanding student thinking in science	22	(2.4)	28	(3.5)	21	(1.8)
Deepening my own science content knowledge	19	(2.1)	30	(3.6)	26	(2.0)
Learning how to use technology in science instruction	16	(1.7)	30	(3.3)	47	(2.4)
Learning how to assess learning in science	17	(2.2)	26	(3.3)	24	(1.9)
Learning how to teach science in a class that includes students with special needs	9	(1.6)	13	(2.9)	13	(2.2)

* Teachers responding with 4 or 5 on a five-point scale, where 1 was "Not at all" and 5 was "To a great extent."

Table 3.20
Mathematics Teachers Reporting That Their Professional Development Gave Heavy Emphasis to Various Areas,* by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Understanding student thinking in mathematics	32	(2.0)	34	(2.9)	23	(1.8)
Learning how to use inquiry/investigation-oriented teaching strategies	32	(2.2)	32	(2.9)	27	(1.6)
Learning how to assess learning in mathematics	29	(2.1)	28	(2.6)	22	(1.8)
Learning how to use technology in mathematics instruction	22	(1.9)	29	(2.6)	47	(2.2)
Deepening my own mathematics content knowledge	20	(2.0)	20	(2.2)	16	(1.4)
Learning how to teach mathematics in a class that includes students with special needs	14	(1.5)	13	(1.9)	10	(1.3)

* Teachers responding with 4 or 5 on a five-point scale, where 1 was "Not at all" and 5 was "To a great extent."

Teachers who reported participating in professional development with a particular emphasis over the last three years were asked to describe these experiences in terms of whether they had "little or no impact," "confirmed what I was already doing," or "caused me to change my teaching practice." Tables 3.21 and 3.22 report the percentage of teachers indicating a change in their teaching practice. The data include only those teachers who report at least some science/mathematics-related professional development during that time. In general, the results mirror the emphasis teachers perceived in their professional development; i.e., the more emphasis in an area they perceived, the more likely they were to report changes in their practice in that area.

Table 3.21
Science Teachers Indicating Their Professional Development Activities in Last Three Years Caused Them to Change Their Teaching Practices,* by Grade Range

	Percent of Teachers					
	Grades K–4		**Grades 5–8**		**Grades 9–12**	
Deepening my own science content knowledge	19	(2.8)	24	(2.8)	16	(1.8)
Understanding student thinking in science	23	(3.0)	20	(3.2)	18	(1.6)
Learning how to use inquiry/investigation-oriented teaching strategies	31	(2.9)	30	(3.6)	28	(1.8)
Learning how to use technology in science instruction	22	(2.5)	33	(3.8)	42	(2.2)
Learning how to assess learning in science	17	(2.5)	20	(2.9)	16	(1.5)
Learning how to teach science in a class that includes students with special needs	10	(1.9)	16	(2.4)	13	(1.5)

* Includes only those teachers who reported at least some science-related professional development in the preceding three years.

Table 3.22
Mathematics Teachers Indicating Their Professional Development Activities in Last Three Years Caused Them to Change Their Teaching Practices,* by Grade Range

	Percent of Teachers					
	Grades K–4		**Grades 5–8**		**Grades 9–12**	
Deepening my own mathematics content knowledge	16	(2.2)	14	(2.7)	13	(1.7)
Understanding student thinking in mathematics	22	(2.0)	18	(2.7)	15	(1.7)
Learning how to use inquiry/investigation-oriented teaching strategies	31	(2.5)	26	(2.6)	23	(1.8)
Learning how to use technology in mathematics instruction	21	(2.5)	29	(2.8)	40	(2.0)
Learning how to assess learning in mathematics	19	(2.2)	19	(2.6)	15	(1.3)
Learning how to teach mathematics in a class that includes students with special needs	13	(1.8)	14	(2.1)	13	(1.4)

* Includes only those teachers who reported at least some mathematics-related professional development in the preceding three years.

The apparent impact of science and mathematics professional development is disappointingly weak. With the exception of high school teachers’ assessment of their technology-related professional development, fewer than a third of the teachers in each subject and grade range indicated that professional development experiences caused them to change their teaching practice. However, given that well over 50 percent of all science and mathematics teachers report fewer than four days of subject-related professional development in the last three years (see Table 3.11), this finding is not particularly surprising.

E. Summary

Much has been written about the less-than-optimal climate in which teachers work. In this chapter, the data presented on a key indicator of professional climate—collegiality—are not encouraging. In general, teachers do not have time during the school day to collaborate with their colleagues on issues of teaching science and mathematics.

Teachers are strikingly similar across subjects and grade ranges in the needs they perceive for their own professional development. Topping the list of reported needs is learning how to use technology for instruction. Among science teachers in grades K–8, deepening their content knowledge ranked a close second. By their own accounts, elementary science teachers are the most in need of professional development and the least likely to participate in it.

Participation in professional development activities related to science and mathematics teaching is generally low, especially among teachers in grades K–8 where less than 25 percent of the teachers have spent four or more days in professional development related to these subjects over the last three years. The workshop is the most commonly reported form of professional development.

In all their professional development experiences, science and mathematics teachers are most likely to report a strong emphasis on two topics: (1) learning to teach through inquiry and investigation, and (2) learning to use technology in instruction. There appears to be a mismatch between the needs teachers perceive and the emphases reported in their professional development experiences; in general, one-third or fewer of the respondents perceived a strong emphasis in an area where they indicated a strong need for professional development. Finally, less than a third of the teachers who participated in professional development indicated that they changed their teaching practice as a result.

Chapter Four

Science and Mathematics Courses

A. Overview

The 2000 National Survey of Science and Mathematics Education collected data on science and mathematics course offerings in the nation's schools. Teachers provided information about time spent in elementary science and mathematics instruction; titles and duration of secondary science and mathematics courses; class sizes; ability levels; gender and race/ethnic composition; and whether their classes included students with various types of special needs. These data are presented in the following sections.

B. Time Spent in Elementary Science and Mathematics Instruction

Each teacher was asked to indicate the number of minutes spent in the most recent lesson in a randomly selected class. It was recognized that some subjects are not taught every day in some classes; for example, some elementary classes have instruction in reading and mathematics every day and in science and social studies only on alternate days. Consequently, teachers were also asked to indicate if the selected lesson had taken place on the most recent school day. As can be seen in Table 4.1, in the early grades mathematics is taught more frequently than science. On a typical day, 95 percent of the grade K–4 classes spent time on mathematics instruction, but only 69 percent spent time on science instruction.

Table 4.1
Science and Mathematics Lessons
Taught on Most Recent Day of School

	Percent of Classes			
	Science		Mathematics	
Grades K–4	69	(2.2)	95	(1.1)
Grades 5–8	90	(1.9)	93	(1.8)
Grades 9–12	93	(1.1)	92	(1.0)

To avoid overestimating the number of minutes typically spent on science and mathematics instruction, if the most recent lesson did not take place on the last day school was in session, the number of minutes was treated as zero when the average was computed. As can be seen in Table 4.2, in grades K–3, an average of only 27 minutes per day is spent on science instruction, compared to 46 minutes for mathematics. Similarly, in grades 4–6 an average of 37 minutes per day is devoted to science instruction, compared to 57 minutes for mathematics.

Table 4.2
Average Number of Minutes Per Day Spent in Elementary School Science and Mathematics Classes*

	Number of Minutes			
	Science		Mathematics	
Grades K–3, Self-Contained	27	(1.3)	46	(1.1)
Grades 4–6, Self-Contained	37	(2.4)	57	(1.3)

* Classes in which the most recent lesson was not on the last day school was in session were assigned zeros for the number of minutes spent in the lesson.

In addition to asking teachers about the number of minutes spent in their most recent lesson in a particular subject, each elementary teacher was asked to write in the approximate number of minutes typically spent teaching mathematics, science, social studies, and reading/language arts. The average number of minutes per day typically spent on instruction in each subject in grades K–3 and 4–6 is shown in Table 4.3; to facilitate comparisons among the subject areas, only teachers who teach all four of these subjects to one class of students were included in these analyses. In 2000, grade K–3 self-contained classes spent an average of 115 minutes on reading instruction, and 52 minutes on mathematics instruction, compared to only 23 minutes on science and 21 minutes on social studies instruction. Differences in instructional time on the various subjects are not quite as pronounced in grades 4–6, ranging from 96 minutes spent on reading and 60 minutes on mathematics to 31–33 minutes on science and social studies instruction.

Table 4.3
Average Number of Minutes Per Day Spent Teaching Each Subject in Self-Contained Classes*

	Number of Minutes			
	Grades K–3		Grades 4–6	
Reading/Language Arts	115	(2.6)	96	(2.5)
Mathematics	52	(0.8)	60	(1.0)
Science	23	(0.6)	31	(0.9)
Social Studies	21	(0.7)	33	(0.8)

* Only teachers who indicated they teach reading, mathematics, science, and social studies to one class of students were included in these analyses.

C. Science and Mathematics Course Offerings

Middle and high schools in the sample were given a list of science and mathematics courses and asked to specify the number of sections of each course offered in the school. Respondents were also asked to write in course names for those science and mathematics courses offered in the school not already on the list.

Table 4.4 shows the percent of schools with grade 7 or 8 offering each science course; data for grade 9–12 science courses are provided in Table 4.5. The most commonly offered science course in grades 7–8 is life science, with 63 percent of the schools with one or both of these grades offering life science courses. Forty-eight percent of the schools with grades 7 and/or 8 offer earth science courses; 43 percent offer physical science in grade 7 or 8; and 65 percent offer some form of general, coordinated, or integrated science in these grades.

Table 4.4
Schools Offering Various Science Courses, Grade 7 or 8*

	Percent of Schools	
Life Science	63	(4.2)
Earth Science	48	(4.2)
Physical Science	43	(4.3)
General Science	44	(4.4)
Integrated Science	27	(3.7)
General, Coordinated, or Integrated Science	65	(4.3)

* Only schools containing grades 7 and/or 8 were included in these analyses.

At the high school level, a total of 95 percent of the schools with one or more of grades 10–12 offer courses in biology, with 91 percent offering such first-year courses as Biology I, Introductory Biology, General Biology, Regents Biology, and College-Prep Biology; 28 percent offering applied courses such as Basic Biology; 28 percent offering Advanced Placement Biology; and 48 percent offering another second year advanced biology course.

Most high schools (91 percent) offer such courses as Chemistry I, or General, Introductory, or Regents Chemistry; 13 percent offer applied chemistry courses such as Consumer, Technical, or Practical Chemistry; 24 percent offer Advanced Placement Chemistry; and 17 percent offer another second year advanced chemistry course.

Overall, 81 percent of the high schools offer a course in first-year physics, such as Physics I, or General, Introductory, or Regents Physics; 14 percent offer a first-year course in applied physics such as Practical Physics, Electronics, or Radiation Physics. Relatively few high schools (20 percent) offer one or more advanced physics courses, with 15 percent offering Advanced Placement Physics and only 6 percent offering other advanced physics courses.

Far fewer high schools offer coursework in earth science (34 percent) than in the other science disciplines, with first-year courses in earth science, or earth/space science, considerably more common than courses in specific earth science disciplines such as oceanography, astronomy, geology, or meteorology. Only 2 percent of high schools offer any second-year earth science courses.

Table 4.5
Schools Offering Various Science Courses, Grade 9 and Grade 10, 11, or 12

	Percent of Schools			
	Schools Including Grade 9		Schools Including Grade 10, 11, or 12	
Biology				
1st year	88	(3.2)	91	(2.9)
1st year, Applied	27	(3.7)	28	(3.7)
Any 1st year	92	(2.3)	95	(1.7)
2nd year, AP	26	(3.1)	28	(3.1)
2nd year, Advanced	44	(3.6)	48	(3.7)
2nd year, Other	22	(3.0)	23	(3.0)
Any 2nd year	64	(4.5)	69	(4.6)
Chemistry				
1st year	85	(3.5)	91	(3.2)
1st year, Applied	12	(2.0)	13	(2.0)
Any 1st year	86	(3.4)	91	(3.1)
2nd year, AP	21	(2.4)	24	(2.6)
2nd year, Advanced	16	(2.1)	17	(2.2)
Any 2nd year	33	(3.4)	36	(3.5)
Physics				
1st year	75	(4.2)	81	(4.1)
1st year, Applied	13	(2.2)	14	(2.2)
Any 1st year	77	(4.2)	83	(4.1)
2nd year, AP	14	(1.9)	15	(1.9)
2nd year, Advanced	6	(1.1)	6	(1.2)
Any 2nd year	18	(2.2)	20	(2.3)
Physical Science	48	(3.5)	48	(3.6)
Earth Science				
Astronomy/Space Science	17	(2.7)	19	(2.8)
Geology	8	(1.9)	8	(2.0)
Meteorology	3	(1.2)	3	(1.2)
Oceanography/Marine Science	9	(1.9)	10	(1.9)
1st year	32	(3.0)	31	(3.0)
1st Year, Applied	8	(3.1)	8	(3.2)
Any 1st year	36	(3.5)	34	(3.5)
2nd year, Advanced/Other	2	(0.8)	2	(0.8)
Other Science				
General Science	19	(2.9)	19	(3.0)
Environmental Science	36	(3.3)	39	(3.4)
Coordinated Science	4	(2.4)	4	(2.4)
Integrated Science	12	(1.9)	12	(1.9)
Other				
Coordinated/Integrated Science	16	(2.8)	16	(2.9)
General, Coordinated, or Integrated Science	31	(3.1)	32	(3.3)

In mathematics, most schools with grade 7 or 8 offer courses in regular mathematics at those grades, with 88 percent offering Regular Math 7 and 76 percent offering Regular Math 8. (See Table 4.6.) Overall, 62 percent of the schools offer Algebra I to their seventh and/or eighth graders.

Table 4.6
Schools Offering Various Mathematics Courses, Grade 7 or 8*

	Percent of Schools	
Remedial Mathematics, Grade 7	27	(3.6)
Regular Mathematics, Grade 7	88	(3.1)
Accelerated Mathematics, Grade 7	41	(4.1)
Remedial Mathematics, Grade 8	30	(3.6)
Regular Mathematics, Grade 8	76	(3.7)
Enriched Mathematics, Grade 8	25	(3.3)
Algebra 1, Grade 7 or 8	62	(4.3)
Integrated Middle Grades Math, Grade 7 or 8	7	(2.3)

* Only schools containing grades 7 and/or 8 were included in these analyses.

At the high school level, the traditional three-year, formal mathematics sequence is offered in the vast majority of schools with grades 10–12, with 98 percent offering Introductory Algebra or the first year in a unified/integrated mathematics sequence; 94 percent offering Geometry or a second-year formal unified course; and 96 percent offering Intermediate Algebra or a third year of unified/integrated mathematics. While 89 percent of high schools offer a fourth year in the formal mathematics sequence, including such courses as Trigonometry, Advanced Algebra, and Pre-Calculus, only 43 percent of high schools offer level-five courses such as Calculus, and only 36 percent offer a course in Advanced Placement Calculus. (See Table 4.7.)

Table 4.7
Schools Offering Various Mathematics Courses, Grade 9 and Grade 10, 11, or 12

	Percent of Schools			
	Schools Including Grade 9		Schools Including Grade 10, 11, or 12	
Review Mathematics				
Level 1 (e.g., Remedial Mathematics)	28	(2.6)	28	(2.5)
Level 2 (e.g., Consumer Mathematics	26	(2.6)	27	(2.5)
Level 3 (e.g., General Mathematics 3)	16	(2.3)	17	(2.4)
Level 4 (e.g., General Mathematics 4)	9	(1.7)	10	(1.8)
Informal Mathematics				
Level 1 (e.g., Pre-Algebra)	51	(3.6)	50	(3.5)
Level 2 (e.g., Basic Geometry)	21	(2.7)	23	(2.7)
Level 3 (e.g., after Pre-Algebra, but not Algebra 1)	17	(2.1)	17	(2.1)
Formal Mathematics				
Level 1 (e.g., Algebra 1 or Integrated Math 1)	98	(0.9)	98	(0.8)
Level 2 (e.g., Geometry or Integrated Math 2)	93	(2.2)	94	(2.2)
Level 3 (e.g., Algebra 2 or Integrated Math 3)	93	(2.2)	96	(2.0)
Level 4 (e.g., Algebra 3 or Pre-Calculus)	84	(3.1)	89	(2.9)
Level 5 (e.g., Calculus)	41	(3.5)	43	(3.5)
Level 5, AP	33	(3.0)	36	(3.2)
Other Mathematics Courses				
Probability and Statistics	21	(2.6)	23	(2.7)
Mathematics integrated with other subjects	4	(0.8)	4	(0.8)

In addition to obtaining information on school course offerings, the survey instruments requested that each science and mathematics teacher provide the title of a randomly selected class. As can be seen in Table 4.8, the most common science courses in grades 6–8 are General Science (29 percent of the classes) and Integrated Science (22 percent). Life Science is the most frequent of the single-discipline science courses, accounting for 20 percent of the science classes in grades 6–8.

Thirty percent of the science courses in grades 9–12 are first-year biology; first-year chemistry accounts for 19 percent of the courses; first-year physics for 10 percent; and physical science and earth science each for 7 percent. A total of 9 percent of the high school science courses are either general, integrated, or coordinated science, and 11 percent are advanced courses in biology, chemistry, or physics.

Table 4.8
Most Commonly Offered Grade 6–12 Science Courses, by Grade Range

	Percent of Classes	
Grades 6–8 Science		
Life Science	20	(2.4)
Earth Science	14	(2.3)
Physical Science	16	(2.5)
General Science	29	(2.8)
Integrated Science	22	(2.1)
Grades 9–12 Science		
1st Year Biology	30	(2.1)
Advanced Biology	6	(0.8)
1st Year Chemistry	19	(1.2)
Advanced Chemistry	3	(1.6)
1st Year Physics	10	(1.0)
Advanced Physics	2	(0.3)
Physical Science	7	(1.0)
Earth Science	7	(1.0)
General Science	3	(0.7)
Integrated/Coordinated Science	6	(0.8)
Other Science	8	(1.1)

Turning to mathematics, Table 4.9 shows that 63 percent of the courses in grades 6–8 are “regular mathematics”; 30 percent are some kind of enriched or accelerated mathematics, including Algebra I; and 6 percent are remedial mathematics.

In grades 9–12, the most commonly offered courses are Algebra I, Geometry, and Algebra II, each accounting for 18–23 percent of the mathematics courses. More advanced mathematics offerings, including Algebra III, Pre-Calculus, and Calculus, comprise 19 percent of the grade 9–12 courses. “Informal” mathematics courses such as Basic Algebra and Basic Geometry account for 12 percent of the grade 9–12 mathematics courses, while 5 percent of the courses at this level focus on review mathematics.

Table 4.9
Most Commonly Offered Grade 6–12 Mathematics Courses, by Grade Range

	Percent of Classes	
Grades 6–8 Mathematics		
Remedial Mathematics, 6	2	(0.7)
Regular Mathematics, 6	32	(2.9)
Accelerated/Pre-Algebra Mathematics, 6	4	(1.0)
Remedial Mathematics, 7	3	(0.8)
Regular Mathematics, 7	18	(1.8)
Accelerated Mathematics, 7	7	(1.4)
Remedial Mathematics, 8	1	(0.3)
Regular Mathematics, 8	13	(1.6)
Enriched Mathematics, 8	9	(1.5)
Algebra I, Grade 7 or 8	10	(1.5)
Integrated Middle Grades Math,7 or 8	1	(0.5)
Grades 9–12 Formal Mathematics		
Mathematics Level 1, Algebra 1	23	(1.7)
Mathematics Level 2, Geometry	20	(1.4)
Mathematics Level 3, Algebra 2	18	(1.4)
Advanced Mathematics/Calculus	19	(1.7)
Informal/Basic Mathematics	12	(1.2)
Review/General Mathematics	5	(0.8)
Other Mathematics	3	(0.8)

D. Other Characteristics of Science and Mathematics Classes

The 2000 National Survey found that the average size of science and mathematics classes is generally around 22 to 24 students (see Table 4.10). However, as can be seen in Figures 4.1–4.6, averages obscure the wide variation in class sizes. For example, 12 percent of mathematics classes in grades 9–12 have 30 or more students.

Table 4.10
Average Science and Mathematics Class Size

	Number of Students			
	Science		Mathematics	
Grades K–12				
K–4	21.5	(0.3)	22.0	(0.3)
5–8	23.3	(0.3)	22.9	(0.5)
9–12	21.7	(0.4)	21.4	(0.3)
Grade 9–12 Science Courses				
1st Year Biology	23.1	(1.0)	—	—
1st Year Chemistry	21.4	(0.5)	—	—
1st Year Physics	16.8	(1.1)	—	—
Advanced Science Courses	19.7	(1.4)	—	—
Grade 9–12 Mathematics Courses				
Review Mathematics	—	—	18.6	(0.9)
Informal Mathematics	—	—	20.7	(0.7)
Algebra I	—	—	22.2	(0.6)
Geometry	—	—	22.6	(0.6)
Algebra II and Higher Mathematics	—	—	21.0	(0.5)

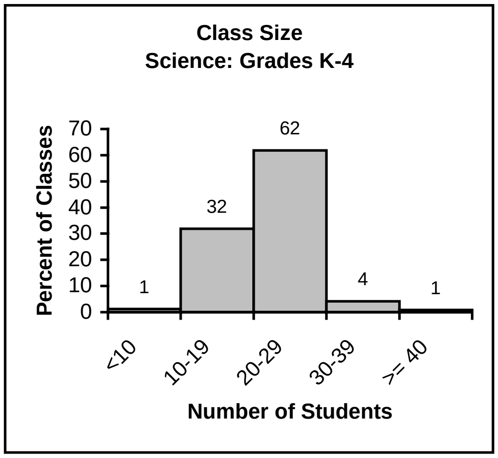

Figure 4.1

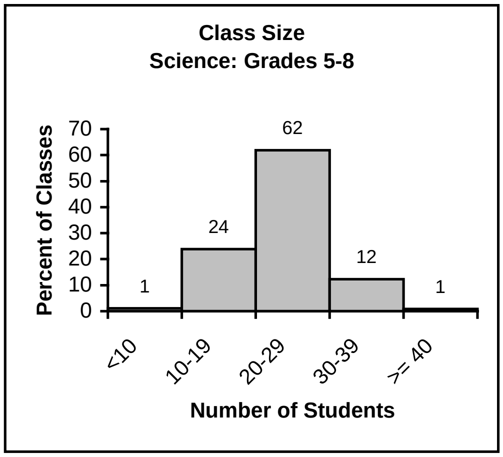

Figure 4.2

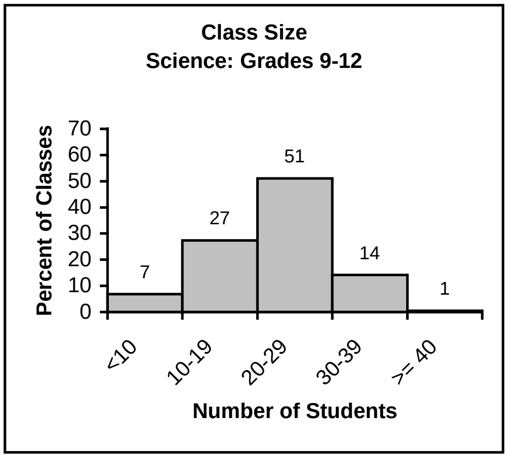

Figure 4.3

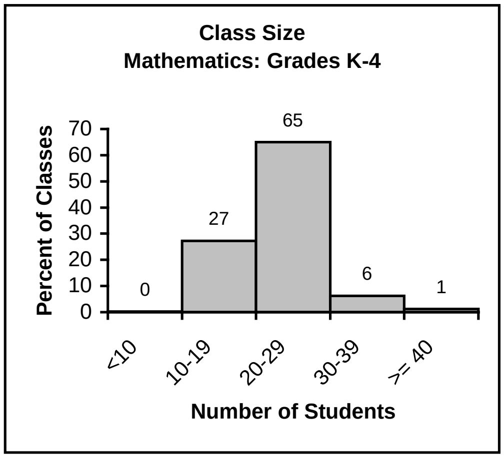

Figure 4.4

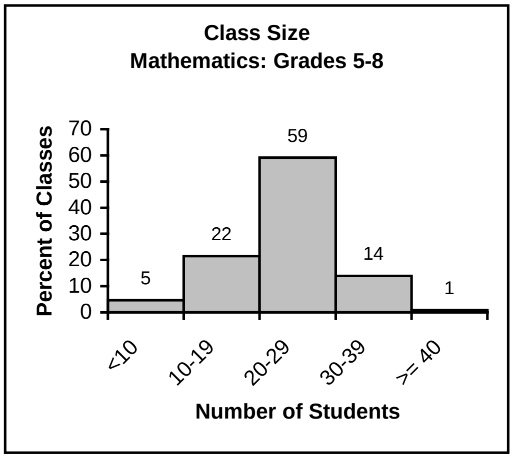

Figure 4.5

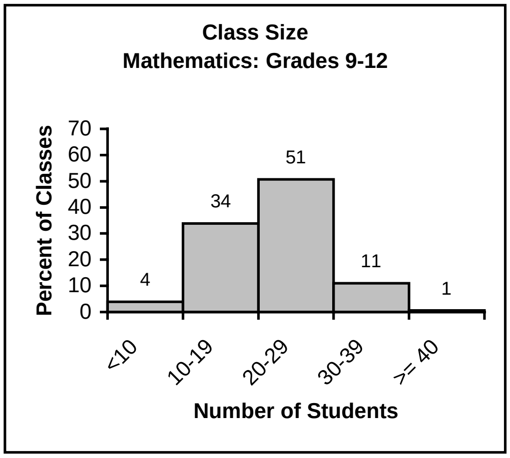

Figure 4.6

Teachers were asked whether students in the randomly selected science or mathematics class were assigned to that class by level of ability. Table 4.11 shows that the practice of assigning students to classes by ability level is generally more prevalent in mathematics than in science, and in each case is much more common in the higher grades, with 40 percent of the grade 9–12 science classes and 65 percent of the grade 9–12 mathematics classes having students assigned by ability level.

Table 4.11
Students Assigned to Science and Mathematics Classes by Ability Level

	Percent of Classes			
	Science		Mathematics	
Grades K–4	6	(1.2)	10	(1.6)
Grades 5–8	14	(1.5)	46	(2.2)
Grades 9–12	40	(2.3)	65	(2.0)

Teachers were also asked to indicate the ability make-up of the selected class, specifying if the class was fairly homogeneous in ability or indicating that it was a mixture of ability levels. As can be seen in Table 4.12, roughly two-thirds of the classes in grades K–4 are heterogeneous in ability; most of the remaining classes are composed primarily of average-ability students. The percent of classes that are heterogeneous in ability declines with increasing grade level, with more than 60 percent of the K–4 classes, but only 37 percent of the high school science classes and 26 percent of the high school mathematics classes comprised of students of varying ability levels.

Table 4.12
Ability Grouping in Science and Mathematics Classes, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Science Classes						
Fairly homogeneous and low in ability	6	(1.6)	8	(1.4)	7	(0.9)
Fairly homogeneous and average in ability	28	(2.4)	23	(2.3)	29	(2.1)
Fairly homogeneous and high in ability	5	(1.3)	11	(1.4)	27	(2.1)
Heterogeneous, with a mixture of two or more ability levels	62	(2.6)	58	(2.3)	37	(2.0)
Mathematics Classes						
Fairly homogeneous and low in ability	6	(1.2)	12	(1.4)	17	(1.3)
Fairly homogeneous and average in ability	21	(1.9)	26	(2.1)	31	(1.6)
Fairly homogeneous and high in ability	5	(1.0)	18	(2.1)	26	(1.8)
Heterogeneous, with a mixture of two or more ability levels	68	(2.2)	44	(2.4)	26	(1.9)

Table 4.13 shows that the trend of decreasing percentages of heterogeneous classes with increasing grade level occurs *within* the high school grades as well. For example, 1 in 3 Geometry and Algebra II classes, but only 1 in 5 more advanced classes are heterogeneously grouped.

Table 4.13
Ability Grouping in Selected High School Science and Mathematics Classes

	Percent of Classes			
	Low	**Average**	**High**	**Heterogeneous**
Science Classes				
1st Year Biology	9 (1.8)	34 (4.5)	17 (2.5)	41 (3.9)
1st Year Chemistry	3 (0.9)	30 (3.7)	33 (3.9)	35 (4.2)
1st Year Physics	1 (0.4)	20 (4.5)	46 (6.2)	33 (6.7)
Mathematics Classes				
Geometry/Integrated Mathematics 2	7 (1.9)	36 (3.7)	25 (3.8)	32 (4.5)
Algebra II/Integrated Mathematics 3	4 (1.5)	33 (3.7)	29 (3.7)	34 (3.8)
Algebra III/Integrated Mathematics 4/Calculus	2 (1.1)	18 (3.8)	59 (6.7)	20 (7.3)

Table 4.14 presents data on ability grouping for science classes categorized by the percent of minority students in the class; comparable data for mathematics classes are shown in Table 4.15. Note that classes labeled “low ability” are more likely to contain a high proportion of minority students. For example, while overall 31 percent of the science classes in grades 5–8 have at least 40 percent minority students, 66 percent of the “low ability” classes are high minority.

Table 4.14
Ability Grouping in Grade K–12 Science Classes with Low, Medium, and High Percentages of Minority Students

	Percent of Classes				
	Total	**Low**	**Average**	**High**	**Heterogeneous**
Grades K–4					
< 10% Minority	33 (3.0)	18 (9.8)	30 (6.1)	51 (15.9)	34 (3.9)
10–39% Minority	30 (3.1)	21 (11.5)	37 (6.7)	34 (18.6)	28 (3.1)
≥ 40% Minority	37 (3.4)	61 (16.4)	33 (5.7)	15 (8.1)	38 (3.5)
Grades 5–8					
< 10% Minority	42 (3.4)	14 (9.3)	49 (6.7)	45 (6.3)	42 (4.4)
10–39% Minority	27 (2.6)	20 (7.5)	27 (5.6)	32 (7.4)	28 (3.5)
≥ 40% Minority	31 (3.0)	66 (10.4)	24 (4.2)	22 (5.5)	30 (4.0)
Grades 9–12					
< 10% Minority	41 (2.6)	40 (10.2)	40 (5.1)	48 (5.1)	37 (3.8)
10–39% Minority	33 (2.0)	20 (4.6)	34 (4.3)	38 (4.3)	31 (3.7)
≥ 40% Minority	26 (2.4)	40 (9.5)	26 (5.5)	15 (2.6)	32 (3.5)

Table 4.15
Ability Grouping in Grade K–12 Mathematics Classes with Low, Medium, and High Percentages of Minority Students

	Percent of Classes				
	Total	**Low**	**Average**	**High**	**Heterogeneous**
Grades K–4					
< 10% Minority	35 (3.2)	2 (1.9)	33 (6.0)	38 (11.1)	37 (3.7)
10–39% Minority	32 (2.8)	33 (11.9)	42 (5.7)	39 (10.9)	28 (3.1)
≥ 40% Minority	33 (3.1)	65 (11.8)	25 (4.6)	23 (9.7)	34 (3.4)
Grades 5–8					
< 10% Minority	40 (2.8)	29 (6.9)	31 (4.3)	51 (6.2)	43 (4.1)
10–39% Minority	30 (2.6)	30 (6.0)	37 (4.8)	36 (5.9)	23 (3.7)
≥ 40% Minority	30 (2.7)	41 (7.8)	32 (4.5)	13 (3.9)	34 (4.5)
Grades 9–12					
< 10% Minority	42 (2.4)	29 (4.2)	40 (3.2)	54 (4.6)	39 (5.3)
10–39% Minority	31 (1.9)	30 (4.2)	35 (3.1)	30 (3.6)	27 (3.5)
≥ 40% Minority	28 (2.2)	41 (4.8)	25 (3.2)	16 (3.3)	34 (4.3)

Teachers were also asked to indicate if the randomly selected science/mathematics class included students who were formally classified as limited English proficiency, learning disabled, mentally handicapped, or physically handicapped. As can be seen in Table 4.16, students with mental handicaps are more likely to be included in regular science and mathematics instruction in the earlier grades. Students with physical handicaps are more evenly distributed, with 4–7 percent of the classes in each subject and grade range including students with physical handicaps.

Table 4.16
Science and Mathematics Classes with One or More Students with Particular Special Needs, by Grade Range

	Percent of Classes		
	Grades K–4	**Grades 5–8**	**Grades 9–12**
Science			
Learning Disabled	50 (2.6)	63 (2.6)	37 (2.2)
Limited English Proficiency	38 (2.8)	22 (2.3)	17 (1.5)
Mentally Handicapped	8 (1.3)	9 (1.5)	3 (0.8)
Physically Handicapped	7 (1.5)	7 (1.3)	4 (0.7)
Mathematics			
Learning Disabled	47 (2.3)	47 (2.6)	31 (1.8)
Limited English Proficiency	34 (3.0)	20 (1.7)	16 (1.3)
Mentally Handicapped	7 (1.3)	2 (0.5)	2 (0.5)
Physically Handicapped	6 (1.0)	4 (0.9)	4 (0.6)

Table 4.16 also shows that sizeable numbers of science and mathematics classes in grades K–4 and 5–8 (from 47 to 63 percent) include students with learning disabilities, decreasing to 31–37 percent overall in grades 9–12. Depending on subject and grade range, 16–38 percent of the science and mathematics classes in grades K–4, 5–8, and 9–12 include one or more students with limited English proficiency (LEP). However, as can be seen in Table 4.17, the percentages of science and mathematics classes including students with LEP varies considerably by region and type of community. For example, only 17 percent of science classes in the Midwest and

Northeast, but 52 percent of those in the West, include LEP students. Similarly, 25–34 percent of urban and suburban science and mathematics classes, but only 12–14 percent of those in rural areas, include LEP students.

Table 4.17
Grade K–12, Science and Mathematics Classes with One or More Limited English Proficiency Students, by Region and Community Type

	Percent of Classes			
	Science		Mathematics	
Region				
Midwest	17	(2.7)	13	(1.9)
Northeast	17	(3.5)	14	(2.6)
South	25	(2.5)	25	(2.6)
West	52	(4.1)	47	(4.2)
Community Type				
Urban	33	(2.8)	34	(2.5)
Suburban	30	(2.5)	25	(2.6)
Rural	14	(3.0)	12	(2.2)

While females in each grade range are about as likely as males to be enrolled in science and mathematics classes overall, there are differences among courses at the high school level, with higher proportions of females in high school biology and chemistry classes and in the formal mathematics sequence (See Table 4.18.).

Table 4.18
Female and Non-Asian Minority Students in Science and Mathematics Classes, by Grade Range and Subject

	Percent of Students							
	Science				Mathematics			
	Female		Non-Asian		Female		Non-Asian	
Grades								
K–4	49	(0.5)	32	(3.1)	49	(0.5)	30	(2.7)
5–8	50	(0.7)	29	(2.3)	50	(0.7)	28	(2.3)
9–12	52	(0.6)	25	(1.6)	52	(0.6)	26	(1.5)
Science Courses								
1st Year Biology	52	(1.0)	25	(2.1)	—	—	—	—
1st Year Chemistry	56	(1.3)	21	(2.4)	—	—	—	—
1st Year Physics	46	(1.9)	19	(3.5)	—	—	—	—
Mathematics Courses								
Review Mathematics	—	—	—	—	46	(2.6)	41	(4.8)
Informal Mathematics	—	—	—	—	47	(1.7)	33	(3.6)
Algebra 1	—	—	—	—	53	(1.5)	36	(2.9)
Geometry/Mathematics Level 2	—	—	—	—	54	(1.2)	21	(2.4)
Algebra 2/Mathematics Level 3	—	—	—	—	54	(1.3)	23	(2.3)
Advanced Mathematics	—	—	—	—	52	(1.2)	12	(1.7)

Non-Asian minority students make up roughly 30 percent of the enrollment in grades K–12. It is interesting to note that this enrollment is fairly stable across key science courses at the high school level (ranging from 25 percent in first-year biology to 19 percent in first-year physics), but decreases markedly with increasing course levels in mathematics. For example, non-Asian minority students comprise 36 percent of the enrollment in Algebra I, but only 21 to 23 percent of the enrollment in Geometry and Algebra II, and only 12 percent of the enrollment in more advanced mathematics courses.

E. Summary

Data from the 2000 National Survey indicate that in the early grades, mathematics is taught quite a bit more frequently than science. On a typical day, almost all grade K–4 classes spend time on mathematics instruction, compared to only 7 in 10 on science instruction. Further, mathematics lessons in the early grades tend to be substantially longer than science lessons, although the amount of time devoted to reading instruction in grades K–6 dwarfs both science and mathematics.

In terms of the number of schools offering courses, the most commonly offered science course in grades 7–8 is life science, followed by earth science and then physical science. At the high school level, virtually all schools offer an introductory biology course, compared to 9 in 10 schools offering chemistry and 8 in 10 offering physics. Only about a third of high schools offer coursework in earth science. In mathematics, most schools with grade 7 or 8 offer courses in regular mathematics at those grades. Only about 6 in 10 schools offer Algebra I to their seventh and/or eighth graders. At the high school level, almost all schools offer the three-course sequence of introductory algebra, geometry, and intermediate algebra. While 9 in 10 high schools offer a fourth year in the formal mathematics sequence, only 4 in 10 offer level-five courses such as Calculus, and only about a third offer a course in Advanced Placement Calculus.

The 2000 National Survey found that the practice of assigning students to classes by ability level is generally more prevalent in mathematics than in science, and much more common in the higher grades. As a result, the percentage of classes that are heterogeneous in ability declines with increasing grade level. Further, students are not assigned to homogeneous classes proportionally by race; classes labeled “low ability” are more likely to contain a high proportion of minority students.

In the sciences, more than half of the students in high school biology and chemistry classes are females; this is also the case in courses in the formal mathematics course sequence at the high school level. Non-Asian minority students make up roughly 30 percent of the enrollment in grades K–12, but at the high school level, the proportion of these students decreases as the level of mathematics increases. The percentage of non-Asian minority students is fairly stable across high school science classes.

Chapter Five

Instructional Objectives and Activities

A. Overview

Most science and mathematics teachers at the secondary level teach multiple classes. To minimize response burden, teachers were asked to provide detailed information about instruction in a particular, randomly selected science or mathematics class. Questions focused on teachers' objectives for instruction, the class activities they use in accomplishing these objectives, and how student performance is assessed. These results are presented in the following sections.

B. Objectives of Science and Mathematics Instruction

The survey provided a list of possible objectives of science and mathematics instruction and asked how much emphasis each would receive in the entire course. Table 5.1 shows the percentage of science classes whose teachers indicated heavy emphasis for each objective.

One instructional objective stands out as key in science classes at all grade levels, with two-thirds or more of grades K–4, 5–8, and 9–12 science classes giving heavy emphasis to learning basic science concepts. Two-thirds of the grade 5–12 teachers also give heavy emphasis to learning science process/inquiry skills, an objective much less likely to be emphasized in grades K–4. Interestingly, despite the reported emphasis on science process and inquiry skills, classes at all levels are much less likely to stress having students learn to explain ideas in science (21–39 percent) or learn to evaluate arguments based on scientific evidence (8–29 percent), two skills integral to scientific inquiry.

Quite a few science classes focus on having students learn important terms and facts of science, ranging from 42 percent in grades K–4 to 52 percent in grades 9–12. About one-fifth of classes at each grade level emphasize preparing students for standardized tests. The objectives least likely to be emphasized heavily in science classes are learning about the history and nature of science and learning about the applications of science in business and industry.

Table 5.1
Science Classes with Heavy Emphasis on Various Instructional Objectives, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Learn basic science concepts	66	(2.7)	76	(2.1)	81	(1.3)
Increase students' interest in science	57	(2.5)	58	(2.9)	45	(2.5)
Learn important terms and facts of science	42	(2.8)	43	(2.9)	52	(2.5)
Learn science process/inquiry skills	37	(2.9)	64	(2.7)	65	(2.2)
Prepare for further study in science	25	(2.2)	39	(2.3)	48	(2.4)
Learn how to communicate ideas in science effectively	21	(2.0)	39	(2.6)	39	(2.3)
Prepare for standardized tests	21	(2.2)	23	(2.1)	21	(1.5)
Learn about the relationship between science, technology, and society	10	(1.6)	24	(2.3)	29	(2.0)
Learn to evaluate arguments based on scientific evidence	8	(1.3)	21	(2.4)	29	(1.9)
Learn about the history and nature of science	7	(1.3)	11	(1.7)	11	(0.9)
Learn about the applications of science in business and industry	4	(1.1)	11	(1.4)	20	(2.2)

Differences between types of objectives and among grade ranges are captured in the mean scores on two composite variables—Science Content and Nature of Science—as shown in Table 5.2. (See Appendix E for definitions of all composite variables, descriptions of how they were created, and reliability information.) The composite related to Science Content objectives included the following items:

- Learn basic science concepts;
- Learn important terms and facts of science;
- Learn science process/inquiry skills; and
- Prepare for further study in science.

The Nature of Science composite included the following:

- Learn to evaluate arguments based on scientific evidence;
- Learn about the history and nature of science;
- Learn how to communicate ideas in science effectively;
- Learn about the applications of science in business and industry; and
- Learn about the relationship between science, technology, and society.

Of the two types of objectives, science content is emphasized more frequently and fairly uniformly across grade ranges. Nature of science objectives receive heavy emphasis less frequently and are quite a bit more likely to be stressed in grade 5–12 classes than in classes at the lower grades.

Table 5.2
Mean Composite Scores Related to Science Class Objectives, by Grade Range

	Mean Score					
	Grades K–4		Grades 5–8		Grades 9–12	
Science Content	76	(1.1)	83	(0.7)	85	(0.6)
Nature of Science	46	(1.1)	63	(1.2)	66	(0.8)

Instructional objectives in mathematics classes are more similar among the grade levels. (See Table 5.3.) Learning mathematical concepts, learning how to solve problems, and learning how to reason mathematically are emphasized heavily in 66–88 percent of the grade K–4, 5–8, and 9–12 mathematics classes. Other objectives that have similar emphasis across grade ranges include, in decreasing order of emphasis: learning how mathematical ideas connect with one another (55–59 percent); learning to explain ideas in mathematics effectively (32–42 percent); preparing for standardized tests (28–38 percent); learning how to apply mathematics in business and industry (10–18 percent); and learning about the history and nature of mathematics (3 percent).

In general, teachers reported that their mathematics classes emphasize conceptual mastery (85–88 percent) more frequently than development of what might be thought of as basic skills: computational skills (37–64 percent); mathematical algorithms/procedures (41–57 percent); and performing computations with speed and accuracy (20–39 percent).

Table 5.3
Mathematics Classes with Heavy Emphasis on Various Instructional Objectives, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Learn mathematical concepts	88	(1.4)	88	(1.9)	85	(1.4)
Learn how to solve problems	80	(1.8)	82	(2.2)	74	(1.7)
Learn to reason mathematically	66	(2.2)	72	(2.6)	72	(1.8)
Develop students' computational skills	64	(2.3)	61	(2.4)	37	(1.9)
Learn how mathematics ideas connect with one another	57	(2.3)	59	(2.3)	55	(1.8)
Increase students' interest in mathematics	53	(2.5)	43	(2.4)	29	(1.8)
Prepare for further study in mathematics	44	(2.4)	50	(2.2)	61	(1.9)
Learn mathematical algorithms/procedures	41	(2.1)	55	(2.7)	57	(1.9)
Learn to perform computations with speed and accuracy	39	(2.3)	35	(2.6)	20	(1.6)
Prepare for standardized tests	36	(2.5)	38	(2.6)	28	(1.9)
Learn to explain ideas in mathematics effectively	34	(2.1)	42	(2.5)	32	(2.0)
Understand the logical structure of mathematics	27	(2.3)	33	(2.3)	38	(1.6)
Learn how to apply mathematics in business and industry	10	(1.4)	18	(1.9)	16	(1.4)
Learn about the history and nature of mathematics	3	(0.7)	3	(0.7)	3	(0.5)

Several objectives are treated differently depending on grade range. Elementary and middle grades mathematics classes are much more likely than high school mathematics classes to emphasize increasing interest in mathematics, developing students' computational skills, and learning to perform computations with speed and accuracy.

Comparing science and mathematics classes, two objectives are more likely to be emphasized heavily across grade ranges in mathematics: preparing for further study in the discipline and preparing for standardized tests.

Table 5.4 presents means for the composite variables related to objectives for mathematics classes. Across grade ranges, the greatest emphasis appears to be on objectives related to mathematics reasoning—learning mathematical concepts, learning how to solve problems, learning to reason mathematically, and learning how mathematics ideas connect with one another. Basic mathematics skills (e.g., developing computational skills, preparing for standardized tests) are the next most emphasized objectives followed by helping students learn about the nature of mathematics (e.g., learning about the logical structure, history, and nature of mathematics).

Table 5.4
Mean Composite Scores Related to
Mathematics Class Objectives, by Grade Range

	Mean Score					
	Grades K–4		Grades 5–8		Grades 9–12	
Mathematics Reasoning	90	(0.7)	91	(0.6)	90	(0.5)
Basic Mathematics Skills	75	(0.9)	75	(1.2)	64	(1.0)
Nature of Mathematics	51	(1.0)	61	(0.8)	60	(0.7)

C. Class Activities

Teachers were given a list of activities and asked how often they did each in the randomly selected class; response options were: never, a few times a year, once or twice a month, once or twice a week, and all or almost all science/mathematics lessons. Results for science instruction are presented first, followed by mathematics instruction.

Science Instruction

Table 5.5 shows the percentage of classes in which the teacher reported doing the activity on a daily basis. As the grade range increases, science classes are less likely to incorporate whole class discussion; almost 6 in 10 grade K–4 classes use this strategy, compared to 4 in 10 and 3 in 10 for grade 5–8 and 9–12 classes, respectively. Classes in grades K–4 are also somewhat more likely than those in grades 9–12 to incorporate open-ended questioning and to allow students to work at their own pace. High school classes, in contrast, were more likely than those in grades K–4 to introduce content through formal presentations. Of the activities listed in Table 5.5, the one most likely to occur on a daily basis in grades 9–12 was assigning homework (39 percent). Science classes in grades K–8 were less likely to assign homework that frequently.

Table 5.5
Science Classes Where Teachers Report Using Various Strategies on a Daily Basis, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Engage the whole class in discussions	57	(2.4)	43	(3.0)	31	(2.3)
Pose open-ended questions	36	(2.2)	33	(3.0)	27	(1.9)
Allow students to work at their own pace	24	(2.0)	19	(2.1)	14	(2.1)
Help students see connections between science and other disciplines	20	(1.8)	27	(2.2)	19	(1.5)
Require students to supply evidence to support their claims	16	(1.9)	27	(2.4)	20	(1.5)
Ask students to explain concepts to one another	14	(1.5)	15	(2.0)	14	(1.3)
Introduce content through formal presentations	12	(1.6)	16	(2.0)	22	(1.3)
Ask students to consider alternative explanations	10	(1.3)	14	(1.8)	9	(0.9)
Read and comment on the reflections students have written, e.g., in their journals	5	(1.1)	7	(1.5)	6	(1.1)
Assign science homework	4	(1.0)	17	(2.0)	39	(2.3)

Table 5.6 shows the percentage of grades K–4, 5–8, and 9–12 science classes participating in various instructional activities at least once a week. Three instructional activities occur at least once a week in many science classes across the grade levels: working in groups (64–80 percent); doing hands-on/laboratory science activities or investigations (50–71 percent); and following specific instructions in an activity or investigation (46–71 percent). (In grade 9–12 classes, students listening and taking notes during a presentation by the teacher and answering textbook or worksheet questions were also frequent activities.) The least frequent activities were also strikingly similar across grade ranges. These involved students:

- Working on extended science investigations or projects;
- Designing their own investigations;
- Using computers as a tool;
- Participating in field work;
- Taking field trips; and
- Making formal presentations to the rest of the class.

The fact that science is often taught on a less-than-daily basis in elementary schools is reflected in the finding that only one activity (working in groups) was reported by more than half of the grade K–4 teachers as happening at least weekly. This stands in sharp contrast to the six or seven activities occurring weekly in more than 50 percent of the classes in grades 5–12, where science is typically taught daily.

With only a few exceptions, class activities in grades 5–8 and 9–12 science classes are very similar. In grades 5–8, science classes are much more likely to include reading and reflective writing. In contrast, grade 9–12 science classes are much more likely to include answering textbook or worksheet questions and using mathematics as a tool in problem-solving.

Table 5.6
Science Classes Where Teachers Report that Students Take Part in Various Instructional Activities at Least Once a Week, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Work in groups	64	(2.6)	80	(2.0)	80	(2.0)
Do hands-on/laboratory science activities or investigations	50	(3.0)	65	(2.7)	71	(2.5)
Follow specific instructions in an activity or investigation	46	(2.6)	70	(2.9)	71	(2.5)
Read other (non-textbook) science-related materials in class	44	(2.6)	32	(2.5)	20	(2.3)
Read from a science textbook in class	31	(2.3)	46	(3.2)	28	(2.2)
Watch a science demonstration	30	(2.8)	42	(3.3)	43	(2.0)
Record, represent, and/or analyze data	29	(2.6)	51	(2.5)	54	(2.5)
Answer textbook or worksheet questions	28	(2.2)	56	(2.5)	72	(2.0)
Use mathematics as a tool in problem-solving	24	(2.3)	36	(2.6)	52	(2.1)
Write reflections (e.g., in a journal)	22	(2.3)	32	(2.7)	15	(1.5)
Watch audiovisual presentations (e.g., videotapes, CD-ROMs, videodiscs, television programs, films, or filmstrips)	18	(2.3)	19	(2.3)	21	(1.6)
Listen and take notes during presentation by teacher	15	(1.5)	54	(2.6)	86	(1.4)
Work on extended science investigations or projects (a week or more in duration)	9	(1.4)	10	(1.5)	7	(1.1)
Design or implement their *own* investigation	8	(1.6)	13	(1.8)	9	(1.1)
Use computers as a tool (e.g., spreadsheets, data analysis)	6	(1.1)	11	(1.7)	16	(2.2)
Participate in field work	5	(1.0)	7	(1.3)	4	(0.8)
Take field trips	5	(1.0)	3	(1.0)	2	(0.5)
Prepare written science reports	4	(0.8)	16	(2.0)	24	(2.1)
Make formal presentations to the rest of the class	3	(0.8)	9	(1.4)	6	(0.9)

Table 5.7 shows the percentage of science classes which never participate in particular instructional activities. At the high school level, students in 50 percent of the science classes never take field trips; those in 39 percent of the classes never write reflections; and in a third of the high school science classes, students never participate in field work. Using computers as a tool is very rare in grades K–4, with two-thirds of the science classes reporting no use.

Table 5.7
Science Classes Where Teachers Report that Students Never Take Part in Particular Instructional Activities, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Use computers as a tool (e.g., spreadsheets, data analysis)	64	(2.4)	24	(2.4)	21	(1.6)
Listen and take notes during presentation by teacher	47	(2.2)	2	(0.7)	0	(0.1)
Participate in field work	41	(2.4)	21	(2.8)	32	(2.1)
Prepare written science reports	41	(2.4)	5	(1.4)	7	(1.2)
Make formal presentations to the rest of the class	40	(2.4)	5	(1.2)	17	(1.5)
Read from a science textbook in class	32	(2.2)	7	(1.6)	15	(1.4)
Work on extended science investigations or projects (a week or more in duration)	30	(2.4)	7	(1.4)	17	(1.4)
Design and implement their *own* investigation	25	(2.1)	3	(0.8)	8	(0.9)
Write reflections (e.g., in a journal)	23	(2.2)	16	(2.1)	39	(2.5)
Answer textbook or worksheet questions	21	(2.1)	3	(1.2)	1	(0.3)
Take field trips	17	(2.1)	21	(2.3)	50	(2.4)
Use mathematics as a tool in problem-solving	15	(1.6)	3	(1.0)	5	(0.9)
Record, represent, and/or analyze data	9	(1.3)	1	(0.3)	1	(0.4)
Read other (non-textbook) science-related material in class	8	(1.8)	2	(0.6)	10	(1.2)
Watch audiovisual presentations (e.g., videotapes, CD-ROMs, videodiscs, television programs, films, or filmstrips)	6	(1.2)	2	(0.8)	3	(0.5)
Do hands-on/laboratory science activities or investigations	3	(0.8)	0	(0.1)	1	(0.2)
Follow specific instructions in an activity or investigation	3	(0.8)	0	(0.1)	0	(0.2)
Watch a science demonstration	2	(0.6)	0	(0.3)	1	(0.2)
Work in groups	1	(0.8)	0	(0.2)	0	(0.1)

Another question asked teachers about the ways they use computers in their science instruction. Table 5.8 shows the percentage of classes in which teachers report *never* using computers in various ways. The data make it clear that computers are not used in half of science classes in grades K–4 and in more than 40 percent of classes in grades 5–12. Beyond this general finding, a number of specific differences between grade ranges are apparent. In grade K–4 science classes, computers are used most for science learning games and to do drill and practice. In grades 5–8, computers are most likely to be used for learning games, to retrieve or exchange data, and to demonstrate scientific principles. In high school, the most frequent uses of computers are to retrieve or exchange data, to demonstrate scientific principles, and to do laboratory simulations.

In the early grades, computer use does not seem to have progressed beyond the notion of the “teaching machine” envisioned by B. F. Skinner decades ago. In later grades, the power of computing is more likely to be utilized, but the general picture is still one of limited use that falls well short of the role for computers visualized in the National Educational Technology Standards for Students (International Society for Technology in Education, 2000)

Table 5.8
Science Classes Where Teachers Report that Students Never Use Computers to do Particular Activities, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Collect data using sensors or probes	84	(1.7)	69	(2.7)	55	(2.3)
Do laboratory simulations	79	(1.6)	56	(3.0)	45	(2.2)
Take a test or quiz	77	(2.2)	61	(2.9)	69	(2.5)
Solve problems using simulations	76	(2.1)	55	(3.2)	54	(2.3)
Retrieve or exchange data	73	(2.1)	44	(2.6)	43	(2.3)
Demonstrate scientific principles	70	(2.2)	45	(3.1)	43	(2.2)
Do drill and practice	57	(2.6)	57	(2.7)	56	(2.2)
Play science learning games	48	(2.4)	46	(2.6)	59	(2.5)

A summary of the data on teaching practice is provided by the composite variables listed in Table 5.9. (See Appendix E for definitions of all composite variables, descriptions of how they were created, and reliability information.) A score of 100 is attained if an individual indicated s/he used each strategy in the composite in every science lesson. Similarly a score of 0 indicates that none of the strategies in the composite were ever used. The data suggest that traditional practices (e.g., students listening and taking notes during a lecture, doing textbook or worksheet questions, reviewing homework) are more common in grades 5–12 than in grade K–4 science classes, as is the use of projects and extended investigations. Computer use is quite infrequent across all grades.

Table 5.9
Class Mean Scores for Science Teaching Practice Composite Variables, by Grade Range

	Mean Score					
	Grades K–4		Grades 5–8		Grades 9–12	
Use of Strategies to Develop Students' Abilities to Communicate Ideas	68	(0.8)	73	(0.9)	69	(0.6)
Use of Laboratory Activities	60	(1.1)	69	(1.0)	69	(0.7)
Use of Traditional Teaching Practices	48	(0.7)	66	(0.6)	69	(0.4)
Use of Projects/Extended Investigations	25	(0.8)	39	(0.9)	35	(0.7)
Use of Computers	12	(0.8)	19	(0.9)	20	(1.1)

In addition to asking about class activities in the course as a whole, the 2000 National Survey of Science and Mathematics Education gave teachers a list of possible class activities and asked teachers to indicate those that took place during their most recent lesson in the randomly selected class. As can be seen in Table 5.10, 86–90 percent of the science lessons in each grade range included discussion, and 59–71 percent included lecture. In addition, more than 50 percent of the science lessons in each grade range included group work.

Approximately 6 in 10 science lessons in grades K–4 involved students doing hands-on/laboratory activities, compared to 5 in 10 in grades 5–8 and 4 in 10 in grades 9–12. In grades

K–8, 41 percent of the lessons included students reading about science, compared to 26 percent of the lessons at the high school level. Use of calculators was much more common in high school science classes (27 percent) than in elementary and middle school science classes (1 percent and 8 percent, respectively). Only 4–10 percent of the science lessons in any grade range involved computer use.

Table 5.10
Science Classes Participating in Various Activities in Most Recent Lesson, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Discussion	90	(2.0)	83	(2.6)	81	(1.4)
Students doing hands-on/laboratory activities	62	(2.6)	50	(3.2)	42	(2.2)
Lecture	59	(2.7)	62	(3.1)	71	(2.1)
Students working in small groups	55	(2.9)	56	(2.9)	52	(1.9)
Students completing textbook/worksheet problems	43	(2.5)	50	(3.0)	52	(2.3)
Students reading about science	41	(2.6)	41	(2.6)	26	(2.2)
Test or quiz	7	(1.4)	11	(1.6)	12	(1.2)
Student using computers	4	(0.8)	10	(1.6)	7	(1.0)
Students using other technologies	4	(0.9)	9	(1.4)	9	(1.2)
Students using calculators	1	(0.5)	8	(1.4)	27	(1.9)

The survey also asked science teachers to estimate the time spent on each of a number of kinds of activities in their most recent lesson in the randomly selected class. These results are shown in Table 5.11. Note that on the average, science lessons appear to be relatively similar in instructional arrangements in the various grade ranges, with roughly 33–37 percent of the class time spent on whole class lecture/discussion; 22–30 percent of the time on hands-on activities; and 14–18 percent of the time with students working individually reading textbooks and completing worksheets. Approximately 10 percent of class time was spent on non-instructional activities, including daily routines and interruptions.

Table 5.11
Average Percentage of Science Class Time Spent on Different Types of Activities, by Grade Range

	Percent of Class Time					
	Grades K–4		Grades 5–8		Grades 9–12	
Daily routines, interruptions, and other non-instructional activities	9	(0.5)	11	(0.5)	11	(0.3)
Whole class lecture/discussion	33	(1.0)	30	(1.2)	37	(1.1)
Individual students reading textbooks, completing worksheets, etc.	16	(1.0)	18	(1.0)	14	(0.9)
Working with hands-on, manipulative, or laboratory materials	30	(1.6)	24	(1.6)	22	(1.2)
Non-laboratory small group work	8	(0.8)	11	(1.1)	10	(0.8)
Other activities	4	(0.8)	5	(1.1)	7	(0.6)

Mathematics Instruction

Table 5.12 shows the percentage of mathematics classes in which teachers do various activities. The frequency of group discussion on a daily basis appears largely dependent on grade range, decreasing from 60 percent of the grade K–4 classes to 35 percent of the grade 9–12 classes. A similar trend is evident for allowing students to work at their own pace. In contrast, assigning of homework occurs on a daily basis much more frequently in grade 5–12 mathematics classes (about 8 in 10), compared to grade K–4 classes (about 4 in 10).

In roughly half of all classes, teachers report requiring students to supply evidence to support their claims on a daily basis, a practice consistent with the recommendations of the NCTM *Standards*. Other standards-based practices—e.g., considering alternative methods for solutions, asking students to explain concepts to one another, and asking students to use multiple representations—occur on a daily basis in fewer mathematics classes, ranging from 10 to 28 percent in the various grade range categories.

Table 5.12
Mathematics Classes Where Teachers Report Using Various Strategies on a Daily Basis, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Engage the whole class in discussions	60	(2.5)	45	(2.5)	35	(1.9)
Require students to explain their reasoning when giving an answer	52	(2.3)	56	(2.8)	46	(2.3)
Allow students to work at their own pace	50	(2.5)	30	(3.0)	16	(1.1)
Assign mathematics homework	43	(2.4)	75	(2.4)	80	(1.9)
Introduce content through formal presentations	37	(2.5)	43	(2.4)	49	(1.9)
Pose open-ended questions	33	(2.5)	32	(2.2)	29	(1.7)
Ask students to consider alternative methods for solutions	23	(1.9)	28	(2.0)	17	(1.4)
Help students see connections between mathematics and other disciplines	23	(1.9)	17	(2.0)	12	(1.1)
Ask students to explain concepts to one another	20	(2.1)	24	(1.9)	20	(1.4)
Ask students to use multiple representations (e.g., numeric, graphic, geometric, etc.)	14	(1.5)	10	(1.1)	13	(1.0)
Read and comment on the reflections students have written (e.g., in their journals)	7	(1.1)	6	(1.5)	2	(0.3)

Tables 5.13 and 5.14 present results on the frequency of student activities in mathematics classes. Note that students doing problems from textbooks or worksheets is a very frequent activity in mathematics classes, especially in the higher grades. Ninety-four percent of the grade 9–12 classes participate in this activity at least weekly, with 65 percent doing so on a daily basis; comparable figures for grades 5–8 are 89 percent weekly, and 55 percent daily; and for grades K–4, 82 percent weekly and 47 percent daily. Seventy-five percent or more of the mathematics classes across grade levels focus on practicing routine computations and algorithms at least once a week; 30 percent or more do this on a daily basis. Reviewing homework/worksheet assignments is also quite prevalent, especially in grades 5–12 where more than two-thirds of the classes take part in the activity on a daily basis.

Table 5.13
Mathematics Classes Where Teachers Report that Students Take Part in Various Instructional Activities at Least Once a Week, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Engage in mathematical activities using concrete materials	85	(1.9)	48	(2.8)	25	(1.5)
Answer textbook or worksheet questions	82	(1.9)	89	(1.5)	94	(1.0)
Practice routine computations/algorithms	77	(1.8)	80	(1.9)	75	(1.4)
Follow specific instructions in an activity or investigation	73	(2.0)	78	(2.0)	72	(1.8)
Work in groups	71	(2.4)	65	(2.4)	62	(2.1)
Review homework/worksheet assignments	71	(2.5)	93	(1.3)	93	(1.2)
Use mathematical concepts to interpret and solve applied problems	62	(2.1)	71	(2.3)	70	(1.8)
Record, represent, and/or analyze data	46	(2.5)	49	(3.1)	33	(1.8)
Read from a mathematics textbook in class	40	(2.5)	49	(2.8)	34	(1.9)
Use calculators or computers for learning or practicing skills	27	(2.3)	54	(2.9)	82	(1.6)
Read other (non-textbook) mathematics-related materials in class	26	(2.2)	17	(1.9)	6	(0.9)
Use calculators or computers to develop conceptual understanding	22	(2.2)	44	(2.3)	61	(2.0)
Write reflections (e.g., in a journal)	21	(1.8)	16	(1.9)	6	(0.9)
Listen and take notes during presentation by teacher	20	(2.2)	69	(3.1)	93	(1.2)
Design their *own* activity or investigation	15	(1.7)	11	(1.4)	6	(1.0)
Make formal presentations to the rest of the class	9	(1.3)	11	(2.0)	7	(1.0)
Use calculators or computers as a tool (e.g., spreadsheet, data analysis)	9	(1.4)	26	(2.5)	36	(2.0)
Work on extended mathematics investigations or projects (a week or more in duration)	6	(1.0)	7	(1.2)	4	(0.7)

The use of concrete materials (or manipulatives) and the use of calculators or computers for learning or practicing skills follow exactly opposite trends as grade range increases, with manipulative use most frequent in grades K–4 and calculator/computer use most frequent in grades 9–12. Computer/calculator use in general is quite low in grades K–4, with only about 1 in 4 classes participating in each activity on at least a weekly basis. The use of lecture (students listening and taking notes during a presentation by the teacher) increases sharply with grade range; the percentage of classes having lectures at least once a week increases from 20 percent in grades K–4 to 69 percent in grades 5–8 to 93 percent in grades 9–12.

Table 5.14
Mathematics Classes Where Teachers Report that Students Take Part in Various Instructional Activities on a Daily Basis, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Answer textbook or worksheet questions	47	(2.6)	55	(2.5)	65	(1.9)
Engage in mathematical activities using concrete materials	42	(2.4)	9	(1.8)	5	(0.5)
Practice routine computations/algorithms	36	(2.3)	36	(2.4)	30	(1.9)
Review homework/worksheet assignments	36	(2.3)	67	(2.7)	70	(1.9)
Follow specific instructions in an activity or investigation	30	(2.3)	32	(2.3)	28	(1.9)
Work in groups	17	(1.6)	18	(1.9)	19	(1.6)
Use mathematical concepts to interpret and solve applied problems	17	(1.7)	24	(2.5)	21	(1.5)
Read from a mathematics textbook in class	16	(1.9)	17	(2.2)	10	(1.4)
Listen and take notes during presentation by teacher	10	(1.5)	34	(2.4)	59	(1.7)
Record, represent, and/or analyze data	10	(1.4)	9	(1.7)	7	(0.9)
Read other (non-textbook) mathematics-related materials in class	5	(1.1)	3	(0.7)	1	(0.4)
Write reflections (e.g., in a journal)	5	(1.0)	4	(0.9)	1	(0.5)
Use calculators or computers for learning or practicing skills	3	(0.8)	16	(1.6)	49	(1.9)
Design their *own* activity or investigation	2	(0.6)	1	(0.6)	2	(0.8)
Work on extended mathematics investigations or projects (a week or more in duration)	2	(0.7)	1	(0.3)	1	(0.2)
Use calculators or computers to develop conceptual understanding	2	(0.6)	12	(1.4)	29	(1.8)
Make formal presentations to the rest of the class	1	(0.6)	2	(1.1)	1	(0.2)
Use calculators or computers as a tool (e.g., spreadsheets, data analysis)	1	(0.4)	6	(1.1)	16	(1.5)

Table 5.15 shows the percentage of mathematics classes that *never* take part in various instructional activities. Note particularly that 30–55 percent of the classes never write reflections about their mathematics work, and that 24–46 percent never work on extended mathematics investigations or projects.

Table 5.15
Mathematics Classes Where Teachers Report that Students Never Take Part in Particular Instructional Activities, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Listen and take notes during presentation by teacher	49	(2.6)	4	(1.3)	0	(0.1)
Use calculators or computers as a tool (e.g., spreadsheets, data analysis)	49	(2.8)	21	(2.1)	19	(1.6)
Work on extended mathematics investigations or projects (a week or more in duration)	46	(2.7)	24	(2.5)	37	(2.2)
Make formal presentations to the rest of the class	34	(2.2)	19	(1.9)	30	(1.9)
Read from a mathematics textbook in class	33	(2.3)	7	(1.4)	11	(1.2)
Write reflections (e.g., in a journal)	30	(2.4)	32	(2.3)	55	(2.1)
Use calculators or computers to develop conceptual understanding	17	(2.3)	6	(1.3)	4	(0.6)
Design their *own* activity or investigation	16	(2.0)	11	(1.4)	25	(1.9)
Read other (non-textbook) mathematics-related materials in class	15	(1.8)	14	(1.7)	28	(1.7)
Use calculators or computers for learning or practicing skills	14	(1.9)	4	(1.0)	3	(0.6)
Review homework/worksheet assignments	8	(1.1)	0	(0.1)	0	(0.1)
Practice routine computations/algorithms	6	(1.2)	1	(0.4)	1	(0.3)
Answer textbook or worksheet questions	5	(1.0)	0	(0.3)	0	(0.1)
Use mathematical concepts to interpret and solve applied problems	4	(0.9)	0	(0.2)	1	(0.3)
Record, represent, and/or analyze data	4	(1.1)	1	(0.2)	4	(0.6)
Work in groups	0	(0.2)	0	(0.1)	1	(0.3)
Engage in mathematical activities using concrete materials	0	(0.2)	1	(0.3)	4	(0.7)
Follow specific instructions in an activity or investigation	0	(0.3)	0	(0.1)	1	(0.2)

Teachers were asked to provide more detailed information about the use of calculators/computers in their mathematics instruction. Table 5.16 presents the percentage of classes in which calculators/computers are used in various ways on at least a weekly basis. There are sharp differences in use between grade levels. Teachers report that the most frequent use in grades K–4 is to play mathematics learning games, followed by drill and practice, which may well be similar activities at that grade level. At the high school level, the most frequent use of calculators/computers is for taking a test or quiz, followed closely by doing drill and practice. In roughly half of the high school mathematics classes, calculators/computers are used to demonstrate mathematics principles on at least a weekly basis.

Table 5.16
Mathematics Classes Where Teachers Report that Students Use Calculators/ Computers for Various Activities at Least Once a Week, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Play mathematics learning games	47	(2.2)	20	(2.1)	6	(0.9)
Do drill and practice	32	(2.3)	38	(3.1)	62	(1.9)
Demonstrate mathematics principles	18	(1.8)	37	(2.4)	51	(2.0)
Take a test or quiz	11	(1.7)	32	(2.8)	68	(2.2)
Do simulations	10	(1.2)	9	(1.4)	11	(1.2)
Solve problems using simulations	9	(1.3)	14	(1.6)	14	(1.5)
Retrieve or exchange data	5	(1.0)	8	(1.5)	9	(1.1)
Collect data using sensors or probes	3	(0.6)	3	(0.7)	4	(0.6)

Table 5.17 shows the percentage of "most recent lessons" in grades K–4, 5–8, and 9–12 mathematics classes that included various instructional activities. Discussion is the most frequently reported activity, occurring in 9 out of 10 mathematics classes at each grade range. Again, the preponderance of having students do textbook/worksheet problems is clear, with more than 75 percent of the mathematics lessons in each grade range involving these activities. Most mathematics lessons also include lecture, ranging from 68 percent in grades K–4 to 88 percent in grades 9–12. As is the case in science, use of small groups is essentially the same across grade levels, with about half of all classes including the activity in the most recent lesson. While computer use is generally low (ranging from 3 percent of the lessons in grades 9–12 to 7 percent in grades K–4), calculator use is fairly common, especially in the high school grades, where 80 percent of the lessons involved their use.

Table 5.17
Mathematics Classes Participating in Various Activities in Most Recent Lesson, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Discussion	89	(1.7)	91	(1.5)	90	(1.0)
Students completing textbook/worksheet problems	77	(2.2)	80	(1.8)	81	(1.6)
Students doing hands-on/manipulative activities	75	(2.2)	36	(2.9)	19	(1.5)
Lecture	68	(2.4)	80	(2.0)	88	(1.1)
Students working in small groups	52	(2.7)	52	(2.3)	55	(1.8)
Student reading about mathematics	17	(1.6)	26	(2.0)	17	(1.6)
Test or quiz	13	(1.7)	15	(1.8)	15	(1.3)
Students using computers	7	(1.1)	5	(1.0)	3	(0.7)
Students using calculators	5	(0.9)	39	(2.1)	80	(1.5)
Students using other technologies	2	(0.6)	4	(0.9)	1	(0.2)

Table 5.18 presents the means for composite variables related to mathematics teaching practice. To achieve a score of 100, a class would have to do each of the activities in a composite in every mathematics lesson. A score of 0 would indicate that none of the activities in a composite are ever done.

Table 5.18
Class Mean Scores for Mathematics Teaching Practice Composite Variables, by Grade Range

	Mean Score					
	Grades K–4		Grades 5–8		Grades 9–12	
Use of Strategies to Develop Students' Abilities to Communicate Ideas	74	(0.8)	73	(0.8)	69	(0.7)
Use of Traditional Teaching Practices	66	(0.9)	81	(0.7)	82	(0.5)
Use of Calculators/Computers for Developing Concepts and Skills	34	(1.0)	49	(1.1)	68	(0.8)
Use of Calculators/Computers for Investigation	24	(0.9)	34	(1.1)	31	(0.8)

Teachers at all grade levels report using techniques aimed at helping students learn to communicate mathematics ideas; e.g., posing open-ended questions, asking students to explain their reasoning and to explain concepts to one another, asking students to use multiple representations. Traditional teaching practices—lecture, doing textbook/worksheet problems, and practicing routine computations—are also very clearly in evidence, particularly in grade 5–12 mathematics classes, where they dominate instruction. Activities involving the use of calculators/computers for developing concepts and skills show a steady increase from grades K–4 to grades 9–12.

As noted earlier, teachers were asked to estimate the time spent on each of a number of kinds of activities in their most recent lesson in the randomly selected class. The results for mathematics lessons are shown in Table 5.19. While the proportion of time spent on various instructional arrangements in science lessons was similar across the grades, mathematics classes vary considerably more by grade range. On average, more time is spent in whole class lecture/discussion in the higher grades, ranging from 27 percent in grades K–4 to 42 percent in grades 9–12; and more time is spent working with manipulative materials in the lower grades, ranging from 27 percent of class time in grades K–4 to 5 percent in grades 9–12. In mathematics classes, 21–25 percent of class time is spent reading textbooks and completing worksheets; and about 10 percent is spent on non-instructional activities.

Table 5.19
Average Percentage of Mathematics Class Time Spent on Different Types of Activities, by Grade Range

	Percent of Class Time					
	Grades K–4		Grades 5–8		Grades 9–12	
Daily routines, interruptions, and other non-instructional activities	10	(0.4)	12	(0.4)	12	(0.3)
Whole class lecture/discussion	27	(0.7)	36	(0.9)	42	(0.9)
Individual students reading textbooks, completing worksheets, etc.	24	(1.1)	25	(1.1)	21	(0.8)
Working with hands-on or manipulative materials	27	(1.2)	11	(1.0)	5	(0.4)
Non-manipulative small group work	8	(0.7)	10	(0.8)	15	(0.8)
Other activities	4	(0.6)	5	(0.6)	6	(0.4)

D. Homework and Assessment Practices

Science and mathematics teachers were asked about the amount of homework assigned per week in a randomly selected class. As can be seen in Table 5.20, teachers in only about 1 in 10 grade K–4 science classes and about 1 in 2 grade K–4 mathematics classes expect their students to do more than 30 minutes of homework in these subjects per week. Students in the higher grades are typically expected to spend more time on homework, especially in mathematics, with a median of 31–60 minutes in grades 5–8 science, 61–90 minutes in grades 5–8 mathematics and grades 9–12 science, and 91–120 minutes in grades 9–12 mathematics.

Table 5.20
Amount of Homework Assigned in Science and Mathematics Classes per Week, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Science						
0–30 minutes	89	(1.5)	37	(2.8)	11	(1.2)
31–60 minutes	8	(1.1)	35	(2.3)	27	(1.7)
61–90 minutes	2	(0.8)	19	(2.2)	25	(1.7)
91–120 minutes	1	(0.4)	6	(1.5)	16	(1.4)
2–3 hours	0	--*	3	(0.7)	14	(1.8)
More than 3 hours	0	(0.2)	0	(0.2)	7	(1.6)
Mathematics						
0–30 minutes	48	(2.3)	8	(1.3)	6	(0.9)
31–60 minutes	27	(2.3)	21	(2.2)	14	(1.3)
61–90 minutes	13	(1.8)	26	(2.5)	23	(2.0)
91–120 minutes	8	(1.3)	24	(2.4)	23	(1.6)
2–3 hours	3	(0.9)	17	(1.8)	23	(1.7)
More than 3 hours	1	(0.4)	5	(1.6)	11	(1.2)

* No teachers in the sample selected this response option. Thus, it is not possible to calculate the standard error of this estimate.

Teachers were also given a list of ways that they might assess student progress and asked to describe the frequency with which they did each in the randomly selected class. The percentages of classes in which teachers report using the various assessment strategies at least once a month are presented in Tables 5.21 and 5.22. In both science and mathematics, teachers report that five strategies for assessing student progress are by far the most common. These are:

- Asking students questions during large group discussions;
- Using assessments embedded in class activities to see if students are "getting it";
- Observing students and asking questions as they work individually;
- Observing students and asking question as they work in small groups; and
- Reviewing student homework.

These methods are especially prevalent in grades 5–12 where they occur in more than 90 percent of the science and mathematics classes on at least a monthly basis. Formal tests occur somewhat less frequently, especially in science in grades K–4. In contrast, some of the less traditional forms of assessing student progress, such as reviewing student portfolios, are used more frequently in the lower grades (K–8).

Table 5.21
Science Classes Where Teachers Report Assessing Students' Progress Using Various Methods at Least Monthly, by Grade Range

	Percent of Classes					
	Grades K–4		**Grades 5–8**		**Grades 9–12**	
Ask students questions during large group discussions	97	(0.8)	98	(0.7)	98	(0.5)
Observe students and ask questions as they work in small groups	90	(1.6)	96	(1.2)	96	(0.9)
Use assessments embedded in class activities to see if students are "getting it"	89	(2.1)	96	(1.0)	93	(1.3)
Observe students and ask questions as they work individually	88	(1.8)	95	(1.3)	95	(1.0)
Review student homework	59	(2.1)	93	(1.5)	94	(0.9)
Review student notebooks/journals	57	(2.9)	70	(2.6)	51	(2.7)
Conduct a pre-assessment to determine what students already know	54	(2.9)	57	(2.9)	46	(2.5)
Give predominantly short-answer tests (e.g., multiple choice, true/false, fill in the blank)	49	(2.5)	81	(2.5)	79	(1.8)
Have students present their work to the class	48	(2.3)	55	(3.3)	44	(2.2)
Give tests requiring open-ended responses (e.g., descriptions, explanations)	47	(2.6)	84	(1.7)	83	(1.8)
Review student portfolios	41	(2.6)	42	(2.9)	23	(2.2)
Grade student work on open-ended and/or laboratory tasks using defined criteria (e.g., a scoring rubric)	41	(2.2)	76	(2.5)	79	(1.7)
Have students assess each other (peer evaluation)	19	(2.0)	36	(2.3)	27	(2.1)
Have students do long-term science projects	17	(1.8)	31	(2.5)	25	(2.6)

Table 5.22
Mathematics Classes Where Teachers Report Assessing Students' Progress Using Various Methods at Least Monthly, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Ask students questions during large group discussions	100	(0.0)	100	(0.2)	97	(0.8)
Observe students and ask questions as they work individually	98	(0.6)	99	(0.3)	96	(1.3)
Use assessments embedded in class activities to see if students are "getting it"	98	(0.7)	98	(0.4)	93	(0.9)
Observe students and ask questions as they work in small groups	96	(1.0)	92	(1.5)	90	(1.6)
Review student homework	86	(1.6)	99	(0.3)	98	(0.7)
Conduct a pre-assessment to determine what students already know	69	(2.2)	59	(2.4)	45	(1.8)
Give predominantly short-answer tests (e.g., multiple choice, true/false, fill in the blank)	61	(2.5)	62	(2.8)	46	(2.0)
Review student notebooks/journals	53	(2.5)	59	(2.4)	44	(1.8)
Give tests requiring open-ended responses (e.g., descriptions, explanations)	49	(2.6)	71	(2.3)	75	(1.8)
Have students present their work to the class	48	(2.8)	57	(2.5)	53	(2.4)
Review student portfolios	45	(2.6)	30	(2.0)	17	(1.6)
Grade student work on open-ended and/or laboratory tasks using defined criteria (e.g., a scoring rubric)	35	(2.2)	50	(2.7)	46	(2.1)
Have students assess each other (peer evaluation)	29	(2.5)	37	(2.3)	23	(1.9)
Have students do long-term mathematics projects	14	(1.8)	26	(2.0)	16	(1.5)

These findings are summarized in the composite variables related to assessment practices; mean scores are presented in Table 5.23. The use of informal assessment strategies is much more frequent than the use of journals/portfolios, and use is quite similar across grade ranges and across subjects. The use of journals and portfolios is more common in grades K–4 and 5–8 classes than in high school classes.

Table 5.23
Class Mean Scores for Assessment Practice Composite Variables, by Grade Range

	Mean Score					
	Grades K–4		Grades 5–8		Grades 9–12	
Science Classes						
Use of Informal Assessment	70	(1.1)	75	(1.0)	74	(0.6)
Use of Journals/Portfolios	39	(1.4)	43	(1.6)	31	(1.3)
Mathematics Classes						
Use of Informal Assessment	83	(0.8)	81	(0.7)	78	(0.5)
Use of Journals/Portfolios	37	(1.3)	34	(1.1)	22	(0.8)

E. Summary

Data from the 2000 National Survey indicate clear patterns of emphasis in teachers' objectives for their classes and in the instructional activities they use. Across grade ranges, science classes are more likely to emphasize learning basic concepts than other objectives. At the secondary level, learning science process and inquiry skills also receives heavy emphasis. Mathematics classes emphasize the same three objectives regardless of grade level: learning mathematical concepts, learning how to solve problems, and learning how to reason mathematically. Mathematics teachers generally report that their classes emphasize conceptual mastery over what might be thought of as basic skills—e.g., computational skills and mathematical algorithms/procedures. Mathematics classes are more likely than science classes to stress preparing for further study in the discipline and preparing for standardized tests.

In terms of instructional activities, class discussion and lecture dominate science teaching. Teacher reports of their most recent lesson indicate that more than 80 percent of the science lessons in grades K–12 include discussion, and 59–71 percent of the lessons include lecture. Group work is included in more than half of all science lessons. Use of hands-on/laboratory activities varies by grade range; approximately 6 in 10 science lessons in grades K–4 involve students doing hands-on/laboratory activities, compared to 5 in 10 in grades 5–8 and 4 in 10 in grades 9–12. Computer use is quite infrequent across grade ranges, but varies by type of use. In the elementary grades, computers are used mostly for drill and practice, compared to the high school level where teachers use them primarily for laboratory simulations.

Discussion and lecture are also very prominent in mathematics instruction, as is the use of textbook/worksheet problems. Ninety percent or more of mathematics lessons include discussion; more than 75 percent, textbook/worksheet problems; and 70 percent or more, lecture. The use of small groups is essentially the same across grade levels, with about half of all classes including the activity in the most recent lesson. While computer use is generally infrequent (ranging from 3 percent of the lessons in grades 9–12 to 7 percent in grades K–4), calculator use is fairly common, especially in the high school grades, where 80 percent of the lessons involve their use. The use of hands-on/manipulative activities decreases sharply from 75 percent of mathematics lessons in grades K–4 to 19 percent in grades 9–12.

In both science and mathematics, informal means of assessment—e.g., asking students questions during large group discussions—are the most common ways of tracking student progress. Checking student homework is also quite common. Formal tests occur less frequently, especially in grade K–4 science. The use of journals and portfolios is more common in grades K–4 and 5–8 classes than in high school classes.

Chapter Six

Instructional Resources

A. Overview

Science and mathematics teaching is strongly affected by the quality and availability of instructional resources. The 2000 National Survey of Science and Mathematics Education included a series of items on science and mathematics textbooks/programs—which ones were being used, how much of the textbook was covered, and teachers' perceptions of textbook quality. Teachers were also asked about the availability and use of a number of other instructional resources, including various types of calculators, computers, and Internet capabilities. These results are presented in the following sections.

B. Textbook Usage

Each teacher in the sample was asked if a particular, randomly selected class was using one or more commercially published textbooks or programs. As can be seen in Table 6.1, 85 percent or more of grades 5–8 and 9–12 science classes and grades K–4, 5–8, and 9–12 mathematics classes use published textbooks/programs. Use of commercially produced textbooks/programs is markedly lower, however, in grade K–4 science classes (64 percent).

Table 6.1
Science and Mathematics Classes Using
Commercially Published Textbooks/Programs

	Percent of Classes			
	Science		Mathematics	
Grades K–4	64	(2.3)	87	(1.6)
Grades 5–8	85	(2.5)	92	(1.3)
Grades 9–12	96	(0.5)	94	(0.8)

Teachers who reported that the selected class uses a commercially published textbook or program were then asked if one material was used all or most of the time, or if multiple textbooks/programs were used. Table 6.2 shows teachers' responses to this question. Mathematics classes are more likely than science classes to use only one textbook or instructional program throughout the year (62–79 percent compared to 37–63 percent) while science classes are more likely to use multiple textbooks or programs (24–36 percent compared to 15–25 percent). In both science and mathematics instruction, reliance on a single textbook/program is highest in grades 9–12.

Table 6.2
Science and Mathematics Classes Using Textbooks and/or Programs, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Science						
Use one textbook or program all or most of the time	37	(2.6)	48	(3.0)	63	(2.7)
Use multiple textbooks or programs	24	(2.5)	36	(2.5)	32	(2.6)
No textbook or program used	38	(2.5)	15	(2.6)	4	(0.5)
Mathematics						
Use one textbook or program all or most of the time	62	(2.6)	66	(2.2)	79	(1.4)
Use multiple textbooks or programs	25	(2.4)	25	(2.1)	15	(1.3)
No textbook or program used	13	(1.6)	8	(1.3)	6	(0.8)

Teachers who indicated that the randomly selected class used a published textbook/program were given a list of science and mathematics textbook publishers and asked to indicate the publisher of the one textbook/program used most often by students in that class. Table 6.3 shows the share of the market held by each of the major science and mathematics textbook publishers.

It is interesting to note that three publishers (Addison-Wesley Longman, Inc./Scott Foresman; Silver, Burdett, & Ginn; and McGraw-Hill/Merrill Co.) account for almost 70 percent of the textbook usage in grade K–4 science classes. Similarly, three publishers (Prentice Hall; McGraw-Hill/Merrill; and Addison-Wesley Longman, Inc./Scott Foresman) account for 64 percent of the grade 5–8 science textbook usage, and three publishers (McGraw-Hill/Merrill Co; Holt, Rinehart, Winston; and Prentice Hall) account for 69 percent of the grade 9–12 science textbook usage.

The publishers with the largest grade K–4 mathematics textbook market share are Addison-Wesley Longman, Inc./Scott Foresman; Harcourt, Brace, & Jovanovich; and Houghton Mifflin/McDougall Littell/D.C. Heath; together these three account for 51 percent of the textbook usage. Similarly, three publishers—McGraw-Hill/Merrill Co.; Houghton Mifflin/McDougall Littell/D.C. Heath; and Addison-Wesley Longman, Inc./Scott, Foresman—account for 56 percent of the textbook usage in grade 5–8 mathematics classes and for 61 percent of the mathematics textbook usage in grades 9–12.

Table 6.3
Market Share of Commercial Science and Mathematics Textbook Publishers, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Science						
Addison Wesley Longman, Inc./Scott Foresman	30	(3.3)	17	(3.1)	13	(1.1)
Silver Burdett Ginn	26	(3.8)	14	(2.4)	0	*
McGraw-Hill/Merrill Co	13	(2.3)	23	(2.5)	30	(2.2)
Scholastic, Inc.	6	(1.6)	2	(1.4)	0	*
Harcourt Brace/Harcourt, Brace & Jovanovich	5	(1.6)	4	(1.2)	3	(0.5)
Holt, Rinehart and Winston, Inc.	2	(1.1)	6	(1.2)	21	(1.8)
Houghton Mifflin Company/McDougall Littell/D.C. Heath	2	(0.9)	3	(1.1)	5	(0.9)
Encyclopaedia Britannica**	2	(1.1)	0	(0.4)	0	*
A-Beka	2	(1.1)	0	*	0	*
National Science Resource Center	2	(1.3)	0	*	0	*
Kendall Hunt Publishing	0	(0.3)	1	(0.4)	2	(0.7)
Prentice Hall, Inc.	0	*	24	(2.4)	18	(1.5)
Globe Fearon, Inc/Cambridge	0	*	2	(0.6)	0	(0.2)
CORD Communications	0	*	0	*	2	(0.6)
Mathematics						
Addison Wesley Longman, Inc./Scott Foresman	20	(3.0)	16	(2.0)	12	(1.4)
Harcourt Brace/Harcourt, Brace & Jovanovich	16	(2.5)	10	(1.9)	1	(0.4)
Houghton Mifflin Company/McDougall Littell/D.C. Heath	15	(2.4)	18	(2.4)	27	(2.0)
Saxon Publishers	11	(2.5)	8	(1.9)	3	(0.8)
Silver, Burdett, & Ginn	11	(2.4)	3	(0.7)	0	*
McGraw-Hill/Merrill Co.	10	(2.6)	22	(2.3)	22	(1.8)
Everyday Learning Corporation	7	(1.7)	4	(1.4)	1	(0.2)
Dale Seymour Publications***	2	(0.9)	3	(0.7)	0	(0.0)
Open Court	2	(1.3)	0	*	0	*
A-Beka	1	(0.4)	3	(1.8)	0	*
Creative Publications	1	(0.5)	2	(0.9)	0	*
Holt, Rinehart and Winston, Inc.	0	(0.3)	0	(0.2)	4	(0.8)
Prentice Hall, Inc.	0	*	6	(1.2)	13	(2.4)
Aamsco	0	*	0	(0.1)	5	(1.1)
Key Curriculum Press	0	*	0	(0.1)	3	(0.6)
South-Western Educational Publishing	0	*	0	(0.3)	3	(0.7)

* No teachers in the sample selected this response option. Thus, it is impossible to calculate the standard error of this estimate.

** Includes responses where teachers wrote “FOSS” as the publisher.

***Between the time data were collected and this report was released, Dale Seymour Publications was bought by Prentice Hall.

Teachers were also asked to provide the title, author, and publication year of the textbook/program used most often in the selected class. Tables 6.4 and 6.5 list the most commonly used science and mathematics textbooks in each grade range; secondary textbooks are shown by course type, as well.

Table 6.4
Most Commonly Used Science Textbooks, by Grade Range and Course

	Publisher	Title
Grades K–5		
Elementary Science	Silver Burdett Ginn	*Horizons in Science*
	Addison Wesley Longman, Inc./Scott Foresman	*Discover Science*
	Addison Wesley Longman, Inc./Scott Foresman	*Discover the Wonder*
	Silver Burdett Ginn	*Discovery Works*
Grades 6–8		
Life Science	McGraw-Hill/Merrill Co.	*Life Science*
	Prentice Hall, Inc.	*Prentice Hall Science*
	Prentice Hall, Inc.	*Exploring Life Science*
Earth Science	McGraw-Hill/Merrill Co.	*Earth Science*
	Addison Wesley Longman, Inc./Scott Foresman	*Science Insights: Exploring Earth & Space*
	Prentice Hall, Inc.	*Exploring Earth's Weather*
Physical Science	Prentice Hall, Inc.	*Physical Science*
	Prentice Hall, Inc.	*Exploring Physical Science*
	McGraw-Hill/Merrill Co.	*Physical Science*
General/Integrated Science	McGraw-Hill/Merrill Co.	*Glencoe Science Interactions*
Grades 9–12		
Biology	Holt, Rinehart and Winston, Inc.	*Modern Biology*
	McGraw-Hill/Merrill Co.	*Biology—The Dynamics of Life*
	Prentice Hall, Inc.	*Prentice Hall Biology*
Chemistry	Addison Wesley Longman, Inc./Scott Foresman	*Addison-Wesley—Chemistry*
	Holt, Rinehart and Winston, Inc.	*Modern Chemistry*
	Prentice Hall, Inc.	*Chemistry: Connections to Our Changing World*
Physical Science	McGraw-Hill/Merrill Co.	*Physical Science*
	McGraw-Hill/Merrill Co.	*Glencoe Physical Science*
Physics	McGraw-Hill/Merrill Co.	*Physics—Principles and Problems*
Earth Science	Houghton Mifflin Company/McDougal Littell/ D.C. Heath	*Earth Science*

Table 6.5
Most Commonly Used Mathematics Textbooks, by Grade Range and Course

	Publisher	Title
Grades K–5		
Elementary Mathematics	Harcourt Brace/Harcourt, Brace & Jovanovich	*Math Advantage*
	Addison Wesley Longman, Inc./Scott Foresman	*Addison-Wesley Math*
	Everyday Learning Corporation	*Everyday Math*
	Silver Burdett Ginn	*Mathematics, The Path to Math Success*
	Addison Wesley Longman, Inc./Scott Foresman	*Exploring Mathematics*
	McGraw-Hill/Merrill Co.	*Math in My World*
Grades 6–8		
Middle School Mathematics	McGraw-Hill/Merrill Co.	*Mathematics Applications & Connections*
	Saxon Publishers	*Math 76*
	Harcourt Brace/Harcourt, Brace & Jovanovich	*Math Advantage*
	Dale Seymour Publications	*Connected Math*
Grades 9–12		
Algebra I	Prentice Hall, Inc.	*Algebra Tools for a Changing World*
	McGraw-Hill/Merrill Co.	*Algebra 1*
	Houghton Mifflin Company/McDougal Littell/ D.C. Heath	*Algebra 1: An Integrated Approach*
Geometry	Houghton Mifflin Company/McDougal Littell/ D.C. Heath	*Geometry: An Integrated Approach*
	Prentice Hall, Inc.	*Geometry Tools for a Changing World*
	Houghton Mifflin Company/McDougal Littell/ D.C. Heath	*Geometry*
	McGraw-Hill/Merrill Co.	*Geometry*
	Key Curriculum Press	*Discovering Geometry*
Algebra II	Prentice Hall, Inc.	*Advanced Mathematics: A Pre-calculus Approach*
	Houghton Mifflin Company/McDougal Littell/ D.C. Heath	*Algebra 2: An Integrated Approach*
	McGraw-Hill/Merrill Co.	*Algebra 2 with Trig: Applications and Connections*
	McGraw-Hill/Merrill Co.	*Algebra 2*
Algebra III	McGraw-Hill/Merrill Co.	*Advanced Mathematical Concepts: Pre-Calculus with Applications*
	Prentice Hall, Inc.	*Advanced Mathematics: A Pre-calculus Approach*

Table 6.6 shows the distribution of publication years of science and mathematics textbooks. In 2000, most science classes were using textbooks published prior to 1997, with 1 in 5 high school science classes, 1 in 4 middle school science classes, and 1 in 3 in grades K–4 using textbooks published in 1991 or earlier. In contrast, about half of the mathematics classes utilized books or programs published in 1997 or later, and roughly 1 in 5 in each grade range used books published in 1991 or earlier.

Table 6.6
Publication Year of Science and Mathematics Textbooks/Programs, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Science						
1986 or earlier	5	(1.8)	4	(1.0)	3	(0.7)
1987–1991	28	(3.6)	21	(3.1)	15	(1.6)
1992–1996	50	(4.2)	47	(3.0)	49	(2.3)
1997 or later	16	(3.4)	27	(2.5)	33	(2.2)
Mathematics						
1986 or earlier	3	(1.3)	2	(0.6)	4	(0.7)
1987–1991	11	(2.2)	12	(2.4)	14	(1.4)
1992–1996	34	(3.4)	32	(3.0)	34	(2.6)
1997 or later	51	(3.6)	54	(3.0)	49	(2.5)

Table 6.7 shows the percentages of science and mathematics classes in grades K–4, 5–8, and 9–12 which use published textbooks/programs that "cover" various proportions of their textbooks. Note that in each grade range mathematics classes are more likely than science classes to go through a substantial portion of their textbook, with 66–79 percent of the mathematics classes, compared to 39–50 percent of the science classes, covering 75 percent or more of their textbooks.

Table 6.7
Percentage of Science and Mathematics Textbooks/Programs Covered During the Course,* by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Science Classes						
Less than 25 percent	5	(1.2)	8	(1.5)	3	(0.6)
25–49 percent	16	(2.2)	19	(2.2)	13	(1.4)
50–74 percent	30	(3.1)	33	(2.7)	38	(2.3)
75–90 percent	24	(2.4)	28	(2.5)	37	(2.2)
More than 90 percent	26	(2.9)	11	(1.7)	9	(1.1)
Mathematics						
Less than 25 percent	1	(0.4)	1	(0.5)	1	(0.2)
25–49 percent	3	(1.0)	5	(1.1)	6	(0.8)
50–74 percent	17	(2.2)	27	(2.5)	28	(2.0)
75–90 percent	38	(2.7)	46	(3.3)	47	(2.4)
More than 90 percent	41	(3.0)	21	(2.2)	19	(1.5)

* Only classes using published textbooks/programs were included in these analyses

It is interesting to note that while national experts in science and mathematics education are often critical of textbook quality (American Association for the Advancement of Science, 2000a; 2000b), most teachers consider their textbooks to be of relatively high quality. As can be seen in Table 6.8, the majority of science and mathematics teachers in each grade range consider their textbooks/programs to be good or better, including 56–78 percent of science teachers and 76–79 percent of mathematics teachers at the various grade ranges.

Table 6.8
Teachers' Perceptions of Quality of Textbooks/Programs Used in Science and Mathematics Classes,* by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Science						
Very Poor	4	(1.2)	3	(0.9)	1	(0.3)
Poor	7	(1.6)	8	(2.6)	4	(0.8)
Fair	33	(3.1)	28	(2.6)	18	(1.8)
Good	33	(3.3)	32	(2.7)	39	(2.2)
Very Good	19	(2.6)	22	(2.6)	31	(2.1)
Excellent	4	(1.2)	6	(1.5)	8	(1.1)
Mathematics						
Very Poor	1	(0.5)	2	(0.7)	1	(0.2)
Poor	3	(0.9)	5	(1.3)	3	(0.6)
Fair	18	(2.3)	16	(1.7)	19	(1.7)
Good	35	(2.8)	33	(2.4)	34	(2.1)
Very Good	36	(2.7)	33	(2.6)	34	(2.1)
Excellent	8	(1.5)	10	(1.9)	9	(1.2)

*Only classes using published textbooks/programs were included in these analyses.

C. Facilities and Equipment

Science and mathematics teachers were given a list of equipment and asked to indicate the approximate number of times per semester each type of equipment is used in the randomly selected class. Tables 6.9–6.14 show the percentage of grade K–4, 5–8, and 9–12 science and mathematics classes reporting at least some use of each type of equipment, as well as the percentages of classes where each is "needed, but not available" or "not needed."

Note that overhead projectors are commonly used in K–12 science and mathematics instruction, with 87–92 percent of science and mathematics classes in the various grade ranges making use of them. Videotape players are far more likely to be used in science instruction, with 90–95 percent of classes reporting usage, compared to 42–48 percent of the mathematics classes. Similarly, science classes are more likely than mathematics classes to use videodisc players. Perhaps due to the more varied offerings on CD-ROM software, use of that technology is fairly high across both subjects, though use in mathematics classes is lower in grades 5–8 than in grades K–4, and lower still in grades 9–12.

The majority of science and mathematics classes at each grade range use computers at some point in the class. Use in science classes ranges from 69 to 91 percent, with grades 5–8 most likely to use computers. Mathematics classes range from 60 to 89 percent, with teachers in grades K–4 most likely to report computer use.

Four-function calculators are used by roughly 60 percent of the classes in most subject/grade range categories, with grade K–4 science classes least likely (30 percent) and grade 5–8 mathematics classes most likely to report their use (82 percent). As expected, more sophisticated calculators are more likely to be used in the higher grades. For example, 49 percent of grade 5–8 mathematics classes and 78 percent of grade 9–12 mathematics classes use scientific calculators at some point during the year; comparable figures for science are 29 percent in grades 5–8 and 58 percent in grades 9–12.

Science teachers were also asked about the use of specific laboratory facilities and equipment. Use of electric outlets in laboratory work is high across all grade levels (87–97 percent), as is use of running water (80–96 percent). Fewer classes make use of gas for burners or hoods/air hoses in their science classes, with use increasing with grade level.

Table 6.9
Science Classes Where Various Equipment Is Used During Instruction, by Grade Range

	Percent of Classes					
	Grades K–4		**Grades 5–8**		**Grades 9–12**	
Videotape player	90	(1.6)	94	(1.6)	95	(0.9)
Overhead projector	87	(2.0)	92	(2.0)	88	(2.7)
Videodisc player	25	(2.9)	47	(3.4)	55	(2.4)
CD-ROM player	51	(3.2)	59	(3.0)	57	(2.5)
Four-function calculators	30	(2.8)	62	(3.0)	59	(2.3)
Fraction calculators	2	(0.7)	17	(2.8)	27	(2.7)
Graphing calculators	1	(0.3)	12	(1.7)	35	(2.6)
Scientific calculators	1	(0.6)	29	(2.7)	58	(2.6)
Electric outlets in labs/classrooms	87	(2.2)	96	(1.0)	97	(0.9)
Running water in labs/classrooms	80	(2.4)	91	(1.9)	96	(0.9)
Gas for burners in labs/classrooms	6	(1.2)	36	(2.9)	72	(2.1)
Hoods or air hoses in labs/classrooms	2	(0.8)	22	(2.7)	56	(2.4)
Computers	69	(2.8)	91	(1.5)	85	(1.7)
Calculator/computer lab interfacing devices	7	(1.4)	28	(2.8)	42	(2.5)
Computers with Internet connection	64	(3.3)	83	(2.3)	77	(1.9)

Table 6.10
Mathematics Classes Where Various Equipment Is Used During Instruction, by Grade Range

	Percent of Classes					
	Grades K–4		**Grades 5–8**		**Grades 9–12**	
Videotape player	46	(3.1)	48	(2.3)	42	(2.2)
Overhead projector	89	(1.7)	91	(2.2)	88	(1.5)
Videodisc player	10	(1.7)	10	(1.9)	4	(1.0)
CD-ROM player	52	(2.9)	39	(3.3)	22	(2.2)
Four-function calculators	62	(2.5)	82	(1.8)	65	(1.9)
Fraction calculators	4	(0.9)	54	(2.8)	61	(2.1)
Graphing calculators	2	(0.7)	26	(2.2)	77	(2.0)
Scientific calculators	3	(0.9)	49	(3.1)	78	(1.6)
Computers	89	(1.9)	78	(2.6)	60	(2.3)
Calculator/computer lab interfacing devices	22	(2.2)	29	(2.4)	32	(2.2)
Computers with Internet connection	47	(3.3)	58	(3.2)	42	(2.2)

Many science teachers reported needing particular types of equipment and not having them available. Calculator/computer lab interfacing devices were most frequently noted as “needed, but not available,” especially in the higher grades. (See Tables 6.11 and 6.12.)

Table 6.11
Science Classes Where Various Equipment Is Needed for Instruction, But Not Available, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Videotape player	2	(1.0)	0	(0.4)	0	(0.1)
Overhead projector	1	(0.4)	0	(0.3)	0	(0.1)
Videodisc player	7	(1.7)	11	(1.9)	7	(1.2)
CD-ROM player	6	(1.2)	7	(1.5)	8	(1.2)
Four-function calculators	3	(1.0)	3	(1.1)	5	(0.9)
Fraction calculators	4	(1.0)	4	(1.3)	4	(1.1)
Graphing calculators	3	(1.0)	8	(1.7)	5	(0.9)
Scientific calculators	3	(1.0)	4	(1.0)	4	(0.9)
Electric outlets in labs/classrooms	1	(0.5)	0	(0.2)	1	(0.7)
Running water in labs/classrooms	6	(1.1)	7	(1.8)	2	(0.4)
Gas for burners in labs/classrooms	8	(1.6)	11	(2.0)	5	(1.0)
Hoods or air hoses in labs/classrooms	6	(1.3)	15	(1.8)	11	(1.4)
Computers	2	(1.2)	3	(0.8)	6	(1.0)
Calculator/computer lab interfacing devices	5	(1.0)	16	(2.0)	18	(2.1)
Computers with Internet connection	7	(1.7)	9	(2.0)	8	(1.1)

Table 6.12
Mathematics Classes Where Various Equipment Is Needed for Instruction, But Not Available, by Grade Range

	Percent of Classes					
	Grades K–4		Grades 5–8		Grades 9–12	
Videotape player	0	(0.3)	1	(0.4)	0	(0.1)
Overhead projector	1	(0.4)	0	(0.2)	0	(0.3)
Videodisc player	3	(0.8)	6	(1.3)	3	(0.7)
CD-ROM player	5	(1.4)	4	(0.8)	3	(0.8)
Four-function calculators	2	(0.9)	1	(0.5)	1	(0.3)
Fraction calculators	6	(1.3)	7	(1.1)	1	(0.4)
Graphing calculators	4	(0.9)	9	(1.6)	2	(0.9)
Scientific calculators	3	(1.0)	6	(1.4)	1	(0.3)
Computers	2	(0.6)	4	(0.9)	5	(0.9)
Calculator/computer lab interfacing devices	8	(1.5)	14	(2.0)	10	(1.1)
Computers with Internet connection	7	(1.7)	6	(1.2)	5	(0.8)

The large percentages of science and mathematics teachers reporting they did not need particular types of equipment for their instruction were somewhat surprising, given the recommendations of national standards documents. (See Tables 6.13 and 6.14.) For example, teachers in 36 percent of grade K–4 mathematics classes indicated that they did not need four-function calculators and 20 percent of high school mathematics classes were reported as not needing graphing calculators. Similarly, 40 percent of high school science classes and 56 percent of those in grades 5–8 were reported as not needing calculator/computer lab interfacing devices.

Table 6.13
Science Classes Where Various Equipment Is Not Needed for Instruction, by Grade Range

	Percent of Classes					
	Grades K–4		**Grades 5–8**		**Grades 9–12**	
Videotape player	8	(1.2)	6	(1.6)	5	(0.9)
Overhead projector	13	(2.0)	8	(1.8)	12	(2.7)
Videodisc player	68	(3.0)	42	(3.2)	39	(2.1)
CD-ROM player	43	(3.3)	34	(3.2)	36	(2.3)
Four-function calculators	67	(2.9)	34	(2.9)	37	(2.3)
Fraction calculators	95	(1.2)	79	(3.1)	70	(2.8)
Graphing calculators	96	(1.1)	80	(2.0)	60	(2.7)
Scientific calculators	96	(1.2)	67	(2.6)	38	(2.6)
Electric outlets in labs/classrooms	12	(2.0)	4	(1.0)	2	(0.7)
Running water in labs/classrooms	14	(2.1)	3	(0.7)	2	(0.7)
Gas for burners in labs/classrooms	87	(2.1)	53	(3.0)	22	(2.0)
Hoods or air hoses in labs/classrooms	92	(1.7)	64	(2.9)	33	(2.0)
Computers	28	(3.0)	6	(1.4)	9	(1.3)
Calculator/computer lab interfacing devices	88	(1.8)	56	(3.2)	40	(2.7)
Computers with Internet connection	29	(3.1)	8	(1.3)	14	(1.7)

Table 6.14
Mathematics Classes Where Various Equipment Is Not Needed for Instruction, by Grade Range

	Percent of Classes					
	Grades K–4		**Grades 5–8**		**Grades 9–12**	
Videotape player	54	(3.1)	51	(2.2)	57	(2.2)
Overhead projector	10	(1.7)	9	(2.2)	12	(1.5)
Videodisc player	87	(2.0)	84	(2.3)	94	(1.2)
CD-ROM player	43	(2.8)	57	(3.2)	75	(2.2)
Four-function calculators	36	(2.4)	16	(1.8)	34	(1.9)
Fraction calculators	90	(1.5)	39	(3.0)	38	(2.1)
Graphing calculators	94	(1.2)	66	(2.7)	20	(1.9)
Scientific calculators	93	(1.4)	46	(3.1)	21	(1.6)
Computers	10	(1.9)	18	(2.4)	35	(2.2)
Calculator/computer lab interfacing devices	70	(2.4)	56	(2.8)	58	(2.5)
Computers with Internet connection	46	(3.3)	35	(3.3)	54	(2.3)

Factor analysis was performed on respondents’ answers to questions about use of the equipment listed in Table 6.15. The composite variables generated from that procedure were named Use of Multimedia, Use of Calculators, and for science classes only, Use of Laboratory Facilities. (For a detailed description of the creation of composites, definitions of all composite variables, and reliability information, please see Appendix E.) Each composite has a minimum possible score of 0 and a maximum of 100.

The Use of Multimedia composite contains the same items across both subjects, including teachers’ reports on their use of:

- Videotape players,
- Videodisc players,
- CD-ROM players, and
- Computers with Internet Connection.

While Use of Calculators composites were created for both science and mathematics based on the results of factor analysis, they are composed of somewhat different items. For example, in science classes calculator use typically occurs when students “use mathematics as a tool in problem-solving.” (Details of all types of classroom activities are addressed in Chapter Five.) Therefore, this item was included in the composite variable.

The items comprising Use of Calculators are:

Science

- Four-function calculators;
- Fraction calculators;
- Scientific calculators;
- Graphing calculators;
- Use mathematics as a tool in problem-solving; and
- Calculator/computer lab interfacing devices.

Mathematics

- Four-function calculators;
- Fraction calculators; and
- Scientific calculators.

The structure of a science classroom or laboratory (Use of Laboratory Facilities) also constitutes a composite examining the presence of the following equipment:

- Running water;
- Electric outlets;
- Gas for burners; and
- Hoods or air hoses.

Table 6.15 presents the composite scores for science and mathematics classes by grade range. The scores at each grade level reflect the percentages reported for the separate questions about equipment use. There is a clear pattern of increased calculator use in mathematics and science classes, and laboratory facilities use in science classes, with increasing grade levels. At each grade level, multimedia are more likely to be used in science classes than in mathematics classes.

Table 6.15
Science and Mathematics Composite Scores Related to Classroom Equipment Use, by Grade Range

	Mean Score					
	Grades K–4		Grades 5–8		Grades 9–12	
Science						
Use of Multimedia	30	(1.7)	41	(1.4)	42	(1.1)
Use of Calculators	15	(0.7)	26	(0.8)	38	(1.3)
Use of Laboratory Facilities	28	(0.9)	42	(1.3)	61	(1.3)
Mathematics						
Use of Multimedia	19	(1.0)	19	(1.0)	13	(0.8)
Use of Calculators	12	(0.6)	41	(1.5)	53	(1.7)

The school and teacher surveys also included a number of questions about the amount of money spent on science and mathematics equipment and supplies. As can be seen in Table 6.16, the typical elementary school reported spending only $250 on science equipment and $250 on consumable science supplies in their most recently completed budget year. Middle schools spent somewhat more (a median of $400 each on science equipment and science supplies) and high schools considerably more (a median of $1,000 on science equipment and $1,500 on science supplies). In contrast, in mathematics there was relatively little difference by grade range in the median amount spent on equipment and consumable supplies. Median amounts schools spent on software were small across the board, ranging from $0 to $150.

Table 6.16
Median Amount Schools Spent Per Year on Science and Mathematics Equipment, Consumable Supplies, and Software

	Median Amount		
	Equipment	Consumable Supplies	Software
Science			
Elementary Schools	$ 250	$ 250	$ 0
Middle Schools	$ 400	$ 400	$ 0
High Schools	$ 1,000	$ 1,500	$ 100
Mathematics			
Elementary Schools	$ 300	$ 500	$ 150
Middle Schools	$ 300	$ 300	$ 50
High Schools	$ 575	$ 300	$ 100

Table 6.17 shows the amount elementary, middle, and high schools reported spending on science and mathematics equipment, consumable supplies, and software, expressed as a per pupil amount. The typical elementary school spent only 79¢ per student in their most recently completed budget year on consumable science supplies such as chemicals, glassware, batteries, etc. and $1.58 per student on mathematics manipulative materials/supplies in the same time

period. These amounts are clearly insufficient at a time when a single meter stick costs $4.00 and a set of mathematics pattern blocks costs $20.00. Note that the amount spent on mathematics supplies per student is lower at the middle and high school levels, while the amount spent on science supplies increases with grade level. As can be seen in Table 6.18, while schools were likely to make at least some purchases to replenish consumable supplies, this was by no means universal. For example, 11 percent of the elementary schools reported spending *no* money in any of these categories in the previous year.

Table 6.17
Median Amount Schools Spent Per Pupil on Science and Mathematics Equipment, Consumable Supplies, and Software

	Median Amount		
	Equipment	**Consumable Supplies**	**Software**
Science			
Elementary Schools	$ 1.10	$ 0.79	$ 0.00
Middle Schools	$ 1.10	$ 1.33	$ 0.00
High Schools	$ 2.05	$ 3.12	$ 0.19
Mathematics			
Elementary Schools	$ 0.99	$ 1.58	$ 0.66
Middle Schools	$ 1.16	$ 0.94	$ 0.14
High Schools	$ 1.32	$ 0.61	$ 0.18

Table 6.18
Schools Purchasing Science and Mathematics Equipment, Consumable Supplies, Software, or Any Purchase in Previous Year

	Percent of Schools							
	Equipment		**Consumable Supplies**		**Software**		**Any Purchase**	
Science								
Elementary Schools	75	(3.5)	83	(2.7)	48	(4.0)	89	(2.2)
Middle Schools	70	(4.0)	84	(3.3)	43	(3.6)	87	(2.9)
High Schools	83	(3.4)	96	(1.7)	58	(4.1)	97	(1.6)
Mathematics								
Elementary Schools	78	(3.8)	90	(2.4)	65	(4.3)	94	(1.9)
Middle Schools	84	(3.0)	89	(2.4)	52	(4.3)	96	(1.7)
High Schools	85	(3.1)	86	(2.3)	56	(3.7)	98	(0.6)

Either because school funds are scarce and/or ordering procedures are cumbersome, most teachers wind up spending some of their own money for supplies for their science and mathematics classes, with a median amount ranging from $30 to $55 per class. (See Table 6.19.) The typical self-contained elementary teacher spends a total of about $70 per year on science and mathematics supplies; the typical high school mathematics teacher spends a total of $250 for five classes; and the typical high school science teacher, a total of $275 for five classes.

Table 6.19
Amount of Own Money Science and Mathematics Teachers Spent on Supplies Per Class

	Median Amount	
	Science	**Mathematics**
Grades K–4	$ 30	$ 40
Grades 5–8	$ 50	$ 50
Grades 9–12	$ 55	$ 50

D. Summary

An investigation of the textbooks and equipment teachers use with their classes reveals a great deal about the learning-environment experienced by grade K–12 students in 2000.

Science classes are more likely to use multiple textbooks than are mathematics classes. However, with the exception of grades 9–12, science classes are also more likely to use no textbook or program in their instruction. Across both science and mathematics, at all grade levels, publication of textbooks used by classes in 2000 was dominated by three publishers who accounted for at least 50 percent of the market at each level (though there was a different group of publishers depending on subject and grade level). In mathematics classes, about half of the classes are using a textbook published since 1997, compared to a third or fewer of science classes, depending on grade range. Interestingly, most teachers in both subjects rate their textbooks as good or better.

Measures of equipment use between the two subjects reveal that science classes are more likely to use multimedia devices such as videodisc and CD-ROM players than are their mathematics counterparts. Computer use is higher in grade K–4 mathematics than the corresponding grade range in science. At the 5–8 and 9–12 grade levels the pattern changes, however, as science classes are more likely to use the computer in some capacity. Calculator use is higher in mathematics classes, especially at the grade K–4 level, though a substantial proportion of grade 5–8 and 9–12 science classes also use these tools for instruction.

No specific type of instructional equipment was reported by a high percentage of teachers in either subject as being “needed for instruction, but not available” to them. The rather high percentages indicating equipment as unnecessary to instruction seems surprising in light of current recommendations for science and mathematics instruction. Similarly, the amount of money schools report spending on instructional resources seems quite inadequate, especially viewed as a per pupil expenditure. It is not surprising that teachers across subjects and grade ranges report spending a good deal of their own money on class supplies each year.

Chapter Seven

Factors Affecting Instruction

A. Overview

Students' opportunities to learn science and mathematics are affected by a myriad of factors, including not only teacher preparedness, but also school and district policies and practices, as well as administrator and community support. While the primary focus of the 2000 National Survey of Science and Mathematics Education was on teachers and teaching, some information was also collected on the context of classroom practice. The principal of each school in the sample was asked to designate persons to answer questions about the school's science and mathematics programs; typically these were the science and mathematics chairs or lead teachers. Among the data collected were the extent of use of various programs and practices in the school, the extent of influence of national standards for science and mathematics education, and the extent of various problems that may affect science and mathematics instruction in the school. These data are presented in the following sections.

B. School Programs and Practices

The designated school program representatives were given a list of programs and practices and asked to indicate whether each was being implemented in the school. Tables 7.1 and 7.2 show the percentages of elementary, middle, and high schools indicating that each program or practice is in place.[3]

Of those listed, by far the most extensively used practice is school-based management, reported in use by more than half of the schools at each grade range. Far fewer schools, ranging from 25 to 32 percent depending on subject and grade range, have designated lead teachers in science/mathematics, and only 14–21 percent provide a common daily planning period for their science/mathematics teachers.

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[3] Elementary school is defined as any school containing grade K, 1, 2, and/or 3; middle school is defined as any school containing grade 7 or 8, or any school containing only grades 4, 5, and/or 6, or any school containing only grade 9; and high school is defined as any school containing grade 10, 11, or 12.

Table 7.1
Science Programs Indicating Use of Various Programs/Practices, by School Type

	Percent of Schools					
	Elementary		Middle		High	
School-based management	62	(3.9)	58	(3.6)	58	(3.2)
Common daily planning period for members of the science department	16	(2.3)	20	(3.1)	21	(3.2)
Common work space for members of the science department	17	(2.5)	27	(3.2)	40	(3.2)
Teachers *formally* designated and serving as science lead teachers	32	(3.9)	30	(3.8)	25	(3.1)
Teachers provided with release time to help other teachers in the school/district	21	(3.0)	14	(2.6)	15	(2.6)
Interdisciplinary teams of teachers who share the same students	52	(3.8)	61	(3.7)	28	(3.9)
Students assigned to science classes by ability	6	(1.5)	18	(2.5)	47	(3.2)
Use of vocational/technical applications in science instruction	31	(3.2)	46	(4.4)	60	(2.7)
Integration of science subjects (e.g., physical science, life science, and earth science all taught together each year)	67	(3.3)	56	(3.7)	33	(3.2)

Table 7.2
Mathematics Programs Indicating Use of Various Programs/Practices, by School Type

	Percent of Schools					
	Elementary		Middle		High	
School-based management	61	(3.9)	56	(4.3)	55	(3.2)
Common daily planning period for members of the mathematics department	14	(2.3)	17	(3.0)	19	(3.1)
Common work space for members of the mathematics department	12	(2.3)	17	(3.0)	32	(2.7)
Teachers *formally* designated and serving as mathematics lead teachers	27	(3.5)	25	(3.5)	28	(3.4)
Teachers provided with release time to help other teachers in the school/district	27	(4.2)	17	(2.9)	18	(2.7)
Interdisciplinary teams of teachers who share the same students	54	(3.8)	65	(4.1)	24	(3.4)
Students assigned to mathematics classes by ability	29	(3.4)	58	(3.9)	70	(3.5)
Use of vocational/technical applications in mathematics instruction	32	(3.1)	47	(3.5)	69	(2.8)
Integration of mathematics subjects (e.g., algebra, probability, geometry, etc. all taught together each year)	67	(3.6)	65	(3.7)	41	(4.1)

More than half of the elementary and middle schools, and about 1 in 4 high schools, report considerable use of interdisciplinary teams of teachers who share the same students. Similarly, elementary and middle schools are substantially more likely than high schools to report that the various science subjects (e.g., life, earth, and physical science) are taught in an integrated fashion and that mathematics topics such as algebra, probability, and geometry are taught together each year. In contrast, high schools are more likely than elementary or middle schools to use vocational/technical applications in science and mathematics instruction. Ability grouping is more common in mathematics than in science, and becomes more widespread in the higher grades. For example, 6 percent of the elementary schools, compared to 47 percent of the high schools, frequently assign students to science classes by ability level; comparable figures for mathematics are 29 percent at the elementary level and 70 percent at the high school level.

School science and mathematics program representatives were also asked about several instructional arrangements for elementary students—whether they were pulled out from self-contained classes for remediation or enrichment in science and mathematics and whether they received science and mathematics instruction from specialists instead of, or in addition to, their regular teacher. These results are shown in Tables 7.3 and 7.4. Note that pulling students out of self-contained classes for remedial instruction is much more common in mathematics, with 55 percent of the elementary schools using that approach in mathematics, but only 7 percent in science, likely a reflection of the fact that Title I funds for students in poverty are more frequently targeted to improving instruction in reading and mathematics than in science or other subjects. Elementary schools are also more likely to pull students out for enrichment in mathematics (29 percent of the schools), than in science (13 percent).

Table 7.3
Use of Science and Mathematics Instructional Arrangements in Elementary Schools

	Percent of Schools					
	Used		Not Used		Don't Know/ Not Applicable	
Science						
Students receiving instruction from science specialists *in addition to* their regular teacher	15	(2.8)	83	(2.8)	1	(0.8)
Students pulled out from self-contained classes for enrichment in science	13	(2.1)	81	(2.7)	5	(2.0)
Students receiving instruction from science specialists *instead of* their regular teacher	12	(2.6)	87	(2.7)	1	(0.8)
Students pulled out from self-contained classes for remedial instruction in science	7	(1.8)	88	(2.6)	6	(2.0)
Mathematics						
Students pulled out from self-contained classes for remedial instruction in mathematics	55	(4.0)	42	(4.0)	3	(1.4)
Students pulled out from self-contained classes for enrichment in mathematics	29	(3.3)	67	(3.3)	4	(1.5)
Students receiving instruction from mathematics specialists *in addition to* their regular teacher	21	(3.0)	77	(3.1)	2	(1.0)
Students receiving instruction from mathematics specialists *instead of* their regular teacher	14	(2.4)	83	(2.6)	3	(1.1)

Table 7.4
Use of Science and Mathematics Instructional Arrangements in Middle Schools

	Percent of Schools					
	Used		Not Used		Don't Know/ Not Applicable	
Science						
Students pulled out from self-contained classes for remedial instruction in science	16	(2.4)	76	(3.0)	7	(2.1)
Students receiving instruction from science specialists *in addition to* their regular teacher	12	(2.6)	84	(2.7)	4	(1.3)
Students receiving instruction from science specialists *instead of* their regular teacher	12	(3.0)	83	(3.2)	5	(1.8)
Students pulled out from self-contained classes for enrichment in science	11	(1.9)	81	(2.5)	8	(2.3)
Mathematics						
Students pulled out from self-contained classes for remedial instruction in mathematics	48	(4.4)	46	(4.2)	6	(1.7)
Students pulled out from self-contained classes for enrichment in mathematics	20	(3.3)	74	(3.7)	6	(1.7)
Students receiving instruction from mathematics specialists *in addition to* their regular teacher	20	(2.7)	75	(3.0)	6	(2.0)
Students receiving instruction from mathematics specialists *instead of* their regular teacher	16	(2.9)	78	(3.3)	6	(2.0)

Finally, high school science and mathematics program representatives were asked about opportunities for students to take courses that are not a regular part of the school's course offerings. As can be seen in Table 7.5, high schools are more likely to have students go to colleges and universities for courses in mathematics (42 percent of the schools) than science (28 percent). Ten percent of the high schools offer science and mathematics courses by telecommunications. Only a handful of the high schools send students to other K–12 schools for courses in either science (4 percent) or mathematics (7 percent).

Table 7.5
Opportunities for High School Students to Take Science and Mathematics Courses Not Offered in Their School

	Percent of Schools					
	Used		Not Used		Don't Know/ Not Applicable	
Science						
Students going to a college or university for science courses	28	(2.7)	67	(2.9)	5	(1.4)
Science courses offered by telecommunications	10	(2.0)	85	(2.2)	5	(1.2)
Students going to another K–12 school for science courses	4	(1.1)	91	(1.7)	5	(1.2)
Mathematics						
Students going to a college or university for mathematics courses	42	(3.0)	56	(3.0)	2	(0.7)
Mathematics courses offered by telecommunications	10	(1.9)	85	(2.3)	5	(1.4)
Students going to another K–12 school for mathematics courses	7	(1.3)	90	(1.5)	3	(0.8)

C. Extent of Influence of National Standards

The decade preceding the 2000 National Survey saw a great deal of activity in relation to naturally promulgated standards, first in mathematics and later in science. School mathematics program representatives were given a series of statements about the influence of the NRC or NCTM *Standards* in their school and district, and asked the extent to which they agreed with each. As can be seen in Table 7.6, in 2000, roughly a third of elementary, middle, and high schools were reportedly engaged in school-wide efforts to make changes inspired by national science standards, and roughly half in relation to national standards in mathematics. Interestingly, while nearly 40 percent of the science program respondents reported that teachers in their school had implemented the *Standards* in their teaching, only about half that many indicated that the NRC *Standards* had been thoroughly discussed by teachers in the school. Analogous figures for mathematics were 55–59 percent for teachers implementing the NCTM *Standards* and 30–33 percent for thorough discussion school-wide. Most surprising was the fact that only 23–30 percent of the designated science program representatives and only 38–45 percent of the designated mathematics program representatives reported that they themselves were prepared to explain the *Standards* to their colleagues.

Implementing changes in response to national standards will require that administrators and other key stakeholders are knowledgeable about, and supportive of, these efforts. In both science and mathematics, larger percentages of school program representatives reported that principals and superintendents than local school boards are well-informed about national standards. Percentages of schools reporting that parents are well-informed about standards were lowest of all: 5–8 percent in science and 6–14 percent in mathematics.

Reforming science and mathematics education to align with the vision of the national standards documents will also require that school and district policies both encourage and facilitate the use of reform-oriented curriculum and instruction. The 2000 National Survey provides evidence that some district policies are changing more rapidly than others in response to national standards in science and mathematics. For example, 26–34 percent of the school science program representatives and 38–46 percent of the school mathematics program representatives reported that their districts are organizing staff development based on the *Standards*, but only 9–11 percent in science and 12–16 percent in mathematics indicated that their districts had changed how they evaluate teachers accordingly.

Table 7.6

Respondents Agreeing* with Various Statements Regarding the NRC *Standards* for Science Curriculum, Instruction, and Evaluation, by School Type

	Percent of Schools					
	Elementary		Middle		High	
I am prepared to explain the NRC *Standards* to my colleagues	26	(3.1)	23	(3.0)	30	(3.2)
The *Standards* have been thoroughly discussed by teachers in this school	18	(3.0)	21	(3.4)	21	(2.5)
There is a school-wide effort to make changes inspired by the *Standards*	34	(3.5)	39	(3.8)	36	(3.5)
Teachers in this school have implemented the *Standards* in their teaching	39	(3.7)	39	(3.7)	37	(3.6)
The principal of this school is well-informed about the *Standards*	29	(3.3)	19	(2.5)	25	(2.6)
Parents of students in this school are well-informed about the *Standards*	8	(1.8)	6	(1.5)	5	(1.2)
The superintendent of this district is well-informed about the *Standards*	27	(3.2)	19	(2.8)	21	(2.6)
The School Board is well-informed about the *Standards*	16	(2.5)	12	(2.3)	12	(2.5)
Our district is organizing staff development based on the *Standards*	34	(3.2)	28	(3.1)	26	(3.0)
Our district has changed how it evaluates teachers based on the *Standards*	11	(2.3)	9	(2.0)	10	(2.5)

* Includes responses of “Strongly Agree” or “Agree” to each statement.

Table 7.7

Respondents Agreeing* with Various Statements Regarding the NCTM *Standards* for Mathematics Curriculum, Instruction, and Evaluation, by School Type

	Percent of Schools					
	Elementary		Middle		High	
I am prepared to explain the NCTM *Standards* to my colleagues	38	(3.6)	41	(4.0)	45	(3.8)
The *Standards* have been thoroughly discussed by teachers in this school	33	(3.7)	30	(3.0)	32	(2.7)
There is a school-wide effort to make changes inspired by the *Standards*	55	(3.8)	54	(4.2)	49	(3.5)
Teachers in this school have implemented the *Standards* in their teaching	59	(4.2)	57	(4.0)	55	(3.2)
The principal of this school is well-informed about the *Standards*	50	(3.6)	35	(3.4)	32	(2.8)
Parents of students in this school are well-informed about the *Standards*	14	(2.5)	8	(1.9)	6	(1.1)
The superintendent of this district is well-informed about the *Standards*	34	(3.4)	30	(3.3)	26	(2.6)
The School Board is well-informed about the *Standards*	22	(2.9)	20	(2.2)	14	(2.6)
Our district is organizing staff development based on the *Standards*	46	(3.9)	39	(3.6)	38	(2.7)
Our district has changed how it evaluates teachers based on the *Standards*	16	(2.5)	14	(2.3)	12	(1.9)

* Includes responses of “Strongly Agree” or “Agree” to each statement.

Factor analysis of this series of items revealed strong relationships within subsets of them. (For a detailed description of the creation of composites, definitions of all composite variables, and reliability information, please see Appendix E.) For example, schools where the department chair, lead teacher, or other program representative reported that they were prepared to explain the national standards to their colleagues were also likely to have school-wide discussion and implementation of the *Standards*. Similarly, schools where the program representative reported that one type of stakeholder—e.g., the district superintendent—was well-informed about the *Standards* were more likely to report that the School Board and other stakeholders were also well-informed about them, and that district policy was changing based on the national standards. As can be seen in Table 7.8, attention to national standards was generally greater in mathematics than in science, which is likely a reflection of the fact that the NCTM *Standards* were published a number of years earlier.

Table 7.8
Science/Mathematics Program Scores on Composites Related to the NRC/NCTM *Standards*, by School Type

	Mean Score					
	Elementary Schools		Middle Schools		High Schools	
Science						
Teacher Attention to *Standards*	41	(1.8)	43	(1.6)	42	(1.6)
Other Stakeholders' Attention to *Standards*	44	(1.5)	42	(1.3)	38	(1.4)
Mathematics						
Teacher Attention to *Standards*	52	(1.9)	52	(1.5)	52	(1.4)
Other Stakeholders' Attention to *Standards*	50	(1.3)	46	(1.3)	41	(1.0)

D. Problems Affecting Instruction

School science and mathematics program representatives were given a list of "factors" that might affect science and mathematics instruction in their school and asked to indicate which, if any, cause serious problems. (The other response options were "not a significant problem" and "somewhat of a problem.")

Results for individual science items are presented in Table 7.9 and those for mathematics in Table 7.10. In science, resource-related issues were typically the ones most often cited as serious problems. Inadequate funds for purchasing equipment and supplies was labeled a serious problem by 25–35 percent of the respondents, inadequate facilities by 20–28 percent, and lack of materials for individualized instruction by 16–27 percent. Inadequate access to computers and computer software also appeared to be quite problematic, with as many as 40 percent of the middle schools rating lack of appropriate computer software a serious problem for teaching science. Finally, 15–22 percent of the school program representatives reported that the lack of a system for distributing and refurbishing science materials was a serious problem at their schools.

Other issues appeared to become increasingly problematic for science education in the higher grades, including student reading ability, student absences, and large classes. In contrast, time to teach science was more problematic in the lower grades, with 20 percent of the elementary school representatives and 12 percent of those in middle schools compared to only 4 percent at the high school level citing lack of time to teach science as a serious problem. Similarly, teacher preparation to teach science, time available for teacher professional development in science, and time for teachers to plan and prepare science lessons all seemed more problematic at the elementary level.

Two other areas were considered serious problems for science instruction by sizeable proportions of school program representatives in each grade range: 28–30 percent of the respondents cited lack of opportunities for teachers to work with one another during the school year as a serious problem, and 21–24 percent indicated that a lack of opportunities for teachers to share ideas was a serious problem. Maintaining discipline, public attitudes toward reform, and conflicting reforms within the district were less often cited as serious problems for science instruction.

Table 7.9
Science Program Representatives Viewing Each of a Number of Factors as a Serious Problem for Science Instruction in Their School, by School Type

	Percent of Schools					
	Elementary		Middle		High	
Facilities	20	(3.0)	28	(4.0)	21	(3.3)
Funds for purchasing equipment and supplies	35	(3.6)	33	(4.0)	25	(3.4)
Materials for individualizing instruction	27	(3.2)	25	(3.8)	16	(2.1)
Access to computers	17	(2.9)	18	(3.0)	22	(2.7)
Appropriate computer software	33	(3.5)	40	(3.9)	32	(3.0)
Student interest in science	4	(1.8)	4	(1.0)	8	(1.8)
Student reading abilities	11	(2.2)	18	(2.4)	22	(2.4)
Student absences	4	(1.4)	9	(2.0)	20	(2.6)
Teacher interest in science	8	(2.0)	3	(1.2)	2	(1.4)
Teacher preparation to teach science	14	(2.7)	5	(2.1)	5	(2.5)
Time to teach science	20	(2.9)	12	(3.2)	4	(0.9)
Opportunities for teachers to share ideas	24	(3.2)	21	(2.9)	21	(2.8)
In-service education opportunities	14	(2.6)	13	(2.8)	9	(1.4)
Interruptions for announcements, assemblies, other school activities	10	(2.3)	12	(2.7)	13	(1.9)
Large classes	7	(1.9)	12	(1.7)	14	(2.0)
Maintaining discipline	6	(1.8)	6	(1.1)	5	(0.9)
Parental support for education	12	(2.4)	11	(2.1)	13	(2.2)
State and/or district curriculum frameworks	5	(1.6)	3	(0.9)	7	(1.6)
State and/or district testing policies and practices	11	(2.1)	9	(1.4)	13	(1.9)
Importance that the school places on science	10	(2.1)	8	(2.2)	5	(1.1)
Public attitudes toward science reform at this school	4	(1.6)	3	(1.1)	6	(1.4)
Conflict between science reform efforts at this school and other school/district reform efforts	6	(1.8)	3	(0.8)	4	(1.0)
Time available for teachers to plan and prepare lessons	24	(3.5)	18	(3.5)	15	(2.1)
Time available for teachers to work with other teachers during the school year	30	(3.5)	29	(3.9)	28	(2.8)
Time available for teacher professional development	24	(3.2)	18	(3.0)	14	(2.1)
System of managing instructional resources at the district or school level (e.g., distributing science materials, refurbishing materials)	22	(2.8)	20	(3.6)	15	(2.5)

As in science, resource-related issues were the ones most likely to be cited as problematic in mathematics, although the problems appear to be less widespread. Lack of appropriate computer software was cited as a serious problem by 20–29 percent of the respondents, funds for purchasing equipment by 18–23 percent, access to computers by 14–19 percent, materials for individualized instruction by 11–14 percent, and the district system for maintaining and distributing materials by 6–11 percent. Only 4–5 percent of the school program representatives indicated that school facilities were a serious problem for mathematics, compared to 20 percent or more in science.

A lack of time available for teachers to work with one another during the school year was cited as a serious problem for mathematics instruction in 21–23 percent of the schools lack of opportunities for teachers to share ideas in 14–15 percent, and inadequate teacher in-service education opportunities in 9–10 percent.

Table 7.10
Mathematics Program Representatives Viewing Each of a Number of Factors as a Serious Problem for Mathematics Instruction in Their School, by School Type

	Percent of Schools					
	Elementary		Middle		High	
Facilities	4	(1.5)	4	(1.6)	5	(1.1)
Funds for purchasing equipment and supplies	23	(4.1)	19	(4.0)	18	(3.1)
Materials for individualizing instruction	14	(2.5)	13	(2.9)	11	(1.6)
Access to computers	14	(2.5)	17	(2.7)	19	(3.0)
Appropriate computer software	20	(2.9)	29	(3.7)	27	(3.1)
Student interest in mathematics	5	(1.3)	10	(1.7)	20	(2.5)
Student reading abilities	15	(2.5)	15	(2.2)	20	(2.5)
Student absences	4	(1.3)	7	(1.6)	17	(2.0)
Teacher interest in mathematics	1	(0.4)	0	(0.2)	0	(0.3)
Teacher preparation to teach mathematics	7	(2.0)	5	(2.2)	2	(1.0)
Time to teach mathematics	2	(0.9)	3	(0.9)	5	(1.2)
Opportunities for teachers to share ideas	15	(2.9)	14	(2.9)	14	(2.2)
In-service education opportunities	10	(2.3)	9	(2.8)	10	(2.6)
Interruptions for announcements, assemblies, other school activities	4	(1.1)	9	(1.6)	11	(1.7)
Large classes	8	(2.0)	6	(1.2)	10	(1.3)
Maintaining discipline	7	(1.9)	4	(0.9)	5	(1.1)
Parental support for education	11	(2.0)	11	(2.0)	15	(2.2)
State and/or district curriculum frameworks	3	(1.2)	5	(1.1)	9	(1.4)
State and/or district testing policies and practices	15	(2.8)	10	(1.8)	17	(1.9)
Importance that the school places on mathematics	1	(0.8)	2	(1.2)	3	(0.8)
Public attitudes toward mathematics reform at this school	2	(1.0)	2	(0.7)	6	(1.3)
Conflict between mathematics reform efforts at this school and other school/district reform efforts	2	(0.6)	3	(1.0)	4	(1.4)
Time available for teachers to plan and prepare lessons	17	(3.2)	7	(1.7)	9	(1.4)
Time available for teachers to work with other teachers during the school year	23	(3.3)	23	(3.1)	21	(2.5)
Time available for teacher professional development	15	(2.6)	9	(2.1)	12	(1.8)
System of managing instructional resources at the district or school level (e.g., distributing materials for mathematics activities, refurbishing materials)	11	(2.1)	11	(3.0)	6	(1.3)

Student reading abilities appeared to be problematic across the board, with 15–20 percent of the mathematics program representatives indicating that this area posed a serious problem for mathematics instruction. Some issues seemed more problematic in the higher grades, including student absences, rated a serious problem in 17 percent of the high schools, and lack of student interest in mathematics, considered serious in 20 percent of the high schools. Other areas were rarely considered a serious problem at any of the three levels, including maintaining discipline (4–7 percent) and large classes (6–10 percent).

The role of mathematics in the overall curriculum was rarely considered a serious problem, with only 1–3 percent of the school program representatives citing the importance that the school places on mathematics and only 2–5 percent citing a lack of time to teach mathematics. Similarly, only a handful of schools (2–4 percent) reported serious conflicts between mathematics reform and other school/district reform efforts.

While 11–15 percent of the school mathematics program representatives indicated that parental support for education posed a serious problem, the issues seemed not to be specific to mathematics instruction, with only 2–6 percent indicating that public attitudes toward mathematics reform at their school posed a serious problem. It is also interesting to note that relatively few mathematics program representatives (10–17 percent, depending on grade range) considered state/district testing problems as problematic for mathematics instruction, similar to the percentages in science (9–13 percent), even though testing is much more prevalent in mathematics.

Table 7.11 summarizes these data by presenting the scores for science and mathematics programs on a number of composite variables derived from a factor analysis of the individual items. Three factors were identified: (1) problems associated with time constraints, (2) those related to facilities and equipment, and (3) those involving student and parent attitudes and behaviors. Each composite has a minimum possible score of 0 and a maximum of 100. (See Appendix E for a detailed description of the composites, along with their reliabilities.) Note that problems with facilities are generally seen as more serious in science than in mathematics. Similarly, problems associated with time—to plan lessons, work with other teachers during the school year, participate in professional development, and teach the subject—are more likely to be perceived as serious in science than in mathematics. In contrast, perceptions of the extent of the problems caused by student-related factors (e.g., reading abilities, absenteeism, interest in the subject, and discipline problems) are roughly equivalent for science and mathematics, becoming more problematic with increasing grade level in each subject.

Table 7.11
Science and Mathematics Program Scores on Composites Related to Problems Affecting Instruction, by School Type

	Mean Score					
	Elementary		Middle		High	
Science						
Extent to Which Time Constraints Pose a Problem for Instruction	48	(1.9)	43	(1.8)	40	(1.5)
Extent to Which Facilities and Equipment Pose a Problem for Instruction	47	(1.7)	50	(2.2)	46	(1.7)
Extent to Which Students and Parents Pose a Problem for Instruction	23	(1.7)	29	(1.7)	34	(1.9)
Mathematics						
Extent to Which Time Constraints Pose a Problem for Instruction	37	(1.9)	36	(1.7)	35	(1.5)
Extent to Which Facilities and Equipment Pose a Problem for Instruction	34	(1.8)	37	(1.9)	38	(1.5)
Extent to Which Students and Parents Pose a Problem for Instruction	24	(1.6)	30	(1.8)	38	(1.6)

E. Summary

The 2000 National Survey data suggest that national standards in science and mathematics are influencing instruction, though the extent of impact is limited. Overall, attention to national standards is greater in mathematics than in science, likely due to the NCTM *Standards* being in the field for a longer period of time. About one-third of the schools at each level report making changes in keeping with the NRC *Standards,* and about half report such changes influenced by the NCTM *Standards*. Only about half of the schools that report changes inspired by the standards also report discussing the standards thoroughly among teachers in the school. Another indicator of the relatively shallow penetration is that only 23–30 percent of the science program representatives and only 38–45 percent of mathematics program representatives reported that they themselves were prepared to explain the *Standards* to their colleagues. Further, a third or fewer schools in each grade range report that their districts are planning staff development based on the NRC *Standards,* and less than half of the schools indicate such planning for the NCTM *Standards*.

Relatively few schools have structures in place specifically to facilitate the teaching of science and mathematics. One-fourth to one-third of elementary, middle, and high schools have designated lead teachers in science/mathematics, and one-fifth or fewer provide a common daily planning period for their science/mathematics teachers. Sizeable proportions of program representatives pointed to a lack of opportunities for teachers to work together and share ideas as a serious problem for science and mathematics instruction.

According to science and mathematics program representatives, the most serious instructional problems are related to resources. In science, these include funds for equipment and supplies, inadequate facilities, lack of computers and software, and lack of materials for individualizing instruction. In mathematics, lack of appropriate software, funds for equipment, access to computers, and lack of materials for individualizing instruction were the most commonly cited resource-related problems. Generally, problems with facilities were more frequently cited in science than in mathematics, as were problems associated with time; e.g., to plan lessons, work with other teachers during the school year, and teach the subject.

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APPENDICES

Appendix A

Sample Design

Sample Design

A. Design Overview

The sample design for the 2000 National Survey of Science and Mathematics Education is a national probability sample of schools and teachers in grades K–12 in the 50 states and the District of Columbia. The sample was designed to allow national estimates (totals and ratios of totals) of science and mathematics course offerings and enrollment; teacher background preparation; textbook usage; instructional techniques; and availability and use of science and mathematics facilities and equipment. Every eligible school and teacher in the target population had a known, positive probability of being drawn into the sample.

The sample design involved clustering and stratification. The first stage units consisted of elementary and secondary schools. Science and mathematics teachers constituted the second stage units. From the science and mathematics classes taught by sample teachers, a sample of one class was selected for each teacher. The target sample sizes were 1,800 schools and 9,000 teachers selected within sample schools. These sample sizes are large enough to allow sub-domain estimates such as for particular regions or types of community.

The sampling frame for the school sample was constructed from the Quality Education Data, Inc. database, which includes school name and address and information about other characteristics needed for stratification and sample selection. The sampling frame for the teacher sample was constructed from lists provided by sample schools identifying active teachers and the specific science and mathematics subjects they were teaching.

B. School Sample

This section describes the sample design features of the school sample. It is organized as follows:

- Target Population;
- Sampling Frame;
- Stratification;
- Sample Allocation;
- Sample Selection; and
- School Weight.

Target Population

The target population for the school sample includes all regular public and private schools in the 50 states and the District of Columbia. Excluded from the target universe are vocational/technical schools, schools offering alternative, special or adult education only, and preschool/kindergarten-only schools.

Sampling Frame

The sampling frame for the school sample was constructed from the Quality Education Data (QED) school-level database. Educational institutions classified by QED as public, private and Catholic elementary and secondary schools were included. Excluded were Bureau of Indian Affairs schools and Department of Defense schools. A file was extracted from the original QED file including records for all eligible schools.

For all schools in the database, QED included information on grade span by indicating the lowest and highest grade offered in the school. Schools eligible for the survey were classified on the basis of the grade span variables into one of three sampling frames corresponding to the three primary sampling strata. In schools with nonconsecutive grade spans, school eligibility and assignment to strata were based on the four grade-level fields on the QED file that provide the low and high grades for the nonconsecutive grade levels.

Stratification

Three primary sampling strata were defined for the school sample. The strata definitions are based on grade span as follows:

- Stratum 1: Schools with any grade 10, 11, or 12;
- Stratum 2: Schools not in stratum 1, but with no grades lower than 5; and
- Stratum 3: All other schools.

Secondary strata were defined by Census geographic region—Midwest, Northeast, South, and West; metropolitan status—urban, suburban and rural; and private (including parochial schools) versus public auspices. Implicit stratification was achieved by sorting the file by Orshansky percentile (i.e., proportion of the students in the school district who live in families with incomes under the poverty line) within secondary stratum.

Sample Allocation

The allocation of the total school sample (1,800 schools) among the three primary strata was based on the minimum sample size desired for each stratum and the desired sample sizes for teachers of advanced mathematics and physics/chemistry. The sample allocation was the following:

- Stratum 1: 940 schools;
- Stratum 2: 430 schools; and
- Stratum 3: 430 schools.

Sample Selection

The school sample was selected with probability proportional to size (PPS). The measure of size was defined for each of the primary strata as follows:

- Stratum 1: Estimated number of teachers in grades 10–12 [computed as: (number of grades in 10–12 range) x (total teachers from QED/number of grades)];
- Stratum 2: Total number of teachers, from QED; and
- Stratum 3: Total number of teachers, from QED.

For school records with missing teacher counts, the measure of size was estimated by imputing a total number of teachers in the relevant grades based on grade-specific student to teacher ratios, estimated separately for private and public schools.

Within primary stratum, the file was sorted by secondary strata and two independent half-samples of the specified sizes were selected using the standard PPS selection procedure. Independent random starts were generated to achieve independent half-samples within secondary strata. In the process of sample selection, a half-sample identifier was assigned to each sample record. Table A-1 shows the distribution of the sample by primary and secondary stratum.

Table A-1
Distribution of Sample, by Stratum

	Secondary Stratum			Primary Stratum		
	Region	**Status**	**Public/ Private**	**1 Grades 10–12**	**2 Grades 5–9**	**3 Other**
1	Midwest	Urban	Public	52	28	29
2			Private	9	—	5
3		Suburban	Public	113	58	43
4			Private	15	—	9
5		Rural	Public	53	14	20
6			Private	2	—	2
7	Northeast	Urban	Public	42	24	21
8			Private	11	—	5
9		Suburban	Public	103	51	38
10			Private	18	—	9
11		Rural	Public	25	7	11
12			Private	2	—	1
13	South	Urban	Public	90	57	48
14			Private	15	1	6
15		Suburban	Public	149	89	65
16			Private	14	—	6
17		Rural	Public	57	22	25
18			Private	4	—	1
19	West	Urban	Public	50	29	29
20			Private	9	—	4
21		Suburban	Public	82	44	40
22			Private	8	—	5
23		Rural	Public	16	6	7
24			Private	1	—	1
	TOTAL			**940**	**430**	**430**

School Weight

A base weight, W_{hs}—the reciprocal of the school's probability of selection—was assigned to every school in the sample as follows:

$$w_{hs} = \frac{MOS_h(total)}{n_h \ MOS_{hs}}$$

where:

MOS_h (*total*) = Total measure of size in primary stratum *h*
MOS_{sh} = Measure of size for school *s*

This is also the base weight associated with program heads since science and mathematics program questionnaires were distributed in every sample school.

C. Teacher Sample

The following section describes the sample design features of the teacher sample. It is organized as follows:

- Target Population;
- Sampling Frame;
- Stratification;
- Sample Allocation;
- Sample Selection; and
- Selection of Classes.

Target Population

The target population for the teacher sample consists of teachers in eligible schools (see School Sample, Target Population) who teach science and/or mathematics. Science includes biology, chemistry, physics, earth science, and other science.

Sampling Frame

The sampling frame for the teacher sample was constructed by requesting that principals in all sample schools provide a list of eligible teachers and identify the courses taught by each teacher. To assist the school in providing the information necessary to build the frame, a listing sheet was provided with appropriate column headings depending on the school's primary stratum. For schools in stratum 1 the following science and mathematics categories were listed:

- High school physics or chemistry;
- Other science;
- Mathematics: High school calculus or advanced mathematics; and
- Mathematics: Other mathematics.

For strata 2 and 3 the categories listed were:

- Science and
- Mathematics

Stratification

Based on the course information provided for teachers on the school list, each teacher was assigned to one of the following five teacher strata:

- Physics/chemistry with or without other science, no mathematics;
- Advanced mathematics with or without other mathematics, no science;
- Other science only;
- Other mathematics only; and
- Any combination of mathematics and science.

Sample Allocation

The target allocation of the sample of 9,000 teachers to the three primary school strata was the following:

- Stratum 1: 4,700 teachers;
- Stratum 2: 2,150 teachers; and
- Stratum 3: 2,150 teachers.

To meet the objectives of the survey, teachers in the higher grades and teachers teaching advanced mathematics and/or physics and/or chemistry were over sampled.

Sample Selection

The sampling rate for teachers in teacher stratum *l* (*l* = 1 – 5) was computed as follows:

$$f_l = \frac{n_l}{N_l}$$

where:

f_l = Overall stratum sampling fraction in teacher stratum *l*
n_l = Target sample size in stratum *l*
N_l = Number of listed teachers in stratum l

Within each primary school stratum and teacher stratum, an independent sample was selected at the specified rate. For each of the three school groups, Table A-2 shows the number of teachers selected in the cooperating schools and the sampling rate in each teacher stratum.

Table A-2
Teachers Selected in Each School Stratum

	Sample Size (n_l)	**Sampling Rate (f_l)**
School Stratum 1: Grades 10–12	**4446**	
1. Physics/chemistry with or without other science, no mathematics	1106	0.496
2. Advanced mathematics with or without other mathematics, no science	1062	0.478
3. Other science only	1049	0.289
4. Other mathematics only	1061	0.253
5. Any combination of science and mathematics	168	0.402
School Stratum 2: Grades 5–9	**1969**	
1. Physics/chemistry with or without other science, no mathematics	7	0.496
2. Advanced mathematics with or without other mathematics, no science	16	0.478
3. Other science only	776	0.450
4. Other mathematics only	801	0.418
5. Any combination of science and mathematics	369	0.608
School Stratum 3: Other	**2255**	
1. Physics/chemistry with or without other science, no mathematics	3	0.496
2. Advanced mathematics with or without other mathematics, no science	1	0.478
3. Other science only	58	0.470
4. Other mathematics only	81	0.470
5. Any combination of science and mathematics	2112	0.386

Selection of Classes

Sample teachers were sent a questionnaire by mail. As part of the sampling process, teachers in sub-stratum five in each stratum were assigned to receive either a science or a mathematics questionnaire. This represented an additional stage of sampling since only half of the sample teachers in this stratum were assigned to report on science and the other half on mathematics. This one-in-two sub-sampling must be reflected in producing science- or mathematics-specific estimates.

Some of the items on the questionnaire apply to individual classes. Teachers with multiple science or mathematics classes each day were asked to report on only one of these classes. Teachers were asked to list all of their science and mathematics classes in order by class period. The questionnaire instructed the teachers to refer to a pre-printed sampling table to make a random selection from among their classes listed. The sampling table was randomly generated so that a random selection of classes would be achieved overall.

D. Weighting and Variances

In surveys involving complex, multistage designs such as this national survey, weighting is necessary to reflect the differential probabilities of selection among sample units at each stage of selection. Weights were developed to produce unbiased estimates of the population of schools and teachers. Weighting is also used to adjust for different rates of participation in the survey by different types of schools and teachers.

Variance computation must also take into account the survey design. Sampling errors generated by available procedures in SAS, SPSS, and other standard statistical software packages are not appropriate because they assume simple random sampling. To accommodate the sample design used in this study, the WesVar statistics package was used to calculate direct estimators of the variance of an estimated total or ratio based on the two independent half-samples.

Weighting

Weights were developed to permit unbiased estimates for school and teacher characteristics. The base weight associated with a school or teacher is the reciprocal of the respective probabilities of selection. To adjust for different rates of participation in the survey by different types of schools and teachers, both school and teacher non-response adjustments were developed and applied to the base weight.

In addition, because in some cooperating schools the person designated to answer questions about the school science or mathematics program may have failed to participate, it was necessary to adjust the weights for school science and mathematics program level estimates. Accordingly, three distinct school non-response adjustments were developed:

- NRA1: To be applied to the school weight to produce teacher-level estimates
- NRA2: To produce mathematics program level estimates
- NRA3: To produce science program level estimates

For non-response adjustment cell *c,* the general form of the NRA is given by:

$$NRA_c = \frac{\sum_{(elig)\,in\ c} w_i}{\sum_{(resp)\,in\ c} w_i}$$

where w_i is the base weight of the i^{th} school in cell *c*. The numerator of the three adjustment factors is the same—all eligible schools. The denominator (respondents) for NR1 includes all schools that provided lists of teachers for sampling; respondents for NR2 and NR3 include only schools that completed a program questionnaire in science and mathematics, respectively.

Since non-response adjustment through weighting assumes that response patterns of non-respondents are similar to that of respondents, *c* corresponds to a secondary sampling stratum, except in cases where two or more secondary strata were collapsed because of small cell sizes (all private schools and suburban schools in a region were collapsed into a single stratum).

The three school weights adjusted for non-response are given by:

$$w_1{*}_{sh} = w_{sh} \cdot NR1_{h\in c}$$
$$w_2{*}_{sh} = w_{sh} \cdot NR2_{h\in c}$$
$$w_3{*}_{sh} = w_{sh} \cdot NR2_{h\in c}$$

where:

w_{sh} = Base weight associated with school *s* in stratum *h*

$NR1_{h\in c}$ = School non-response adjustment for estimates of teacher characteristics in cell *c*

$NR2_{h\in c}$ = School non-response adjustment for estimates of mathematics programs in cell *c*

$NR3_{h\in c}$ = School non-response adjustment for estimates of science programs in cell *c*.

The final weight associated with a teacher includes additional components related to teacher selection and participation. That is:

$$w{*}_{shl} = w{*}_{sh} \cdot w_{tl} \cdot NRT_l$$

where:

w_{tl} = Reciprocal of the probability of selection for teacher stratum *l*

$w{*}_{sh}$ = Final weight associated with the teacher's school

$w{*}_{shl}$ = Final weight associated with teachers in stratum *l*, school *s*

NRT_l = Non-response adjustment for teacher stratum *l*,

$$NRT_l = \frac{\sum_{t\,\varepsilon\,(elig)\,l} n_t}{\sum_{t\,\varepsilon\,(resp)\,l} n_t}$$

where:

n_t = Weighted number of teachers.

Variance Computation

With the survey design, direct estimators of the variance of an estimated total are available. Estimating the variance of a ratio, requires estimates of the variances of the numerator and denominator as well as estimates of their covariance. Direct estimates of the covariance are also available. The variance of a total for a given secondary stratum is estimated by:

$$var\ \ X\ =\ \sum_{h=1}^{100}(X_{hl}\ -\ X_{h2})^2$$

where X_{h1} and X_{h2} are the sums of the weighted values of the two half-samples in secondary stratum *h*.

The estimated covariance is:

$$cov\ \ X,Y\ =\ \sum_{h=1}^{100}(X_{h1}\ -\ X_{h2})\,(Y_{h1}\ -\ Y_{h2})$$

with similar definition of the *y* values. The estimated variance of the ratio Y/X is then simply:

$$var\ \ Y/X\ =\ 1/\ X^2\,[var\ \ Y\ +\ (Y/X\ )^2\,var\ \ X\ -\ 2(Y/X)\,cov\ \ X,Y]$$

For the entire universe, the variance of a total is estimated by the sum of the estimated variances of that total over all relevant primary and secondary strata. The same holds for the covariance. The variance of a ratio for the entire universe is estimated by the same formula given above for a single primary stratum.

Appendix B

Survey Questionnaires

Science Program Questionnaire

Mathematics Program Questionnaire

Science Questionnaire (Teacher)

Mathematics Questionnaire (Teacher)

List of Course Titles

2000 National Survey of Science and Mathematics Education
School Science Program Questionnaire

Instructions: Please use a #2 pencil or blue or black pen to complete this questionnaire. Darken ovals completely, but do not stray into adjacent ovals. Be sure to erase or white out completely any stray marks.

1. What is your title? (Darken all that apply.)

○ Science department chair
○ Science lead teacher
○ Teacher
○ Principal
○ Assistant principal
○ Other (please specify): ________________

2. Indicate whether each of the following programs/practices is currently being implemented in your school. (Darken one oval on each line.)

	Yes	No	Don't Know/ Not Applicable
a. School-based management	○	○	○
b. Common daily planning period for members of the science department	○	○	○
c. Common work space for members of the science department	○	○	○
d. Teachers *formally* designated and serving as science lead teachers	○	○	○
e. Teachers provided with release time to help other teachers in the school/district	○	○	○
f. Interdisciplinary teams of teachers who share the same students	○	○	○
g. Students assigned to science classes by ability	○	○	○
h. Use of vocational/technical applications in science instruction	○	○	○
i. Elementary or middle school students pulled out from self-contained classes for remedial instruction in science	○	○	○
j. Elementary or middle school students pulled out from self-contained classes for enrichment in science	○	○	○
k. Elementary or middle school students receiving instruction from science specialists *in addition to* their regular teacher	○	○	○
l. Elementary or middle school students receiving instruction from science specialists *instead of* their regular teacher	○	○	○
m. Science courses offered by telecommunications	○	○	○
n. Students going to another K-12 school for science courses	○	○	○
o. Students going to a college or university for science courses	○	○	○
p. Integration of science subjects (e.g., physical science, life science, and earth science all taught together each year)	○	○	○

3. Please give us your opinion about each of the following statements in regard to the National Research Council's (NRC) work in setting standards for science curriculum, instruction, and assessment. (Darken one oval on each line.)

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
a. I am prepared to explain the NRC *National Science Education Standards* to my colleagues.	○	○	○	○	○
b. The *Standards* have been thoroughly discussed by teachers in this school.	○	○	○	○	○
c. There is a school-wide effort to make changes inspired by the *Standards*.	○	○	○	○	○
d. Teachers in this school have implemented the *Standards* in their teaching.	○	○	○	○	○
e. The principal of this school is well-informed about the *Standards*.	○	○	○	○	○
f. Parents of students in this school are well-informed about the *Standards*.	○	○	○	○	○
g. The superintendent of this district is well-informed about the *Standards*.	○	○	○	○	○
h. The School Board is well-informed about the *Standards*.	○	○	○	○	○
i. Our district is organizing staff development based on the *Standards*.	○	○	○	○	○
j. Our district has changed how it evaluates teachers based on the *Standards*.	○	○	○	○	○

4. Does your school include students in grades 6 or higher? (Darken one oval.)

○ Yes, CONTINUE WITH QUESTION 5
○ No, SKIP TO QUESTION 8

5. Please give the number of sections of each of the following science courses currently offered in your school. (Additional course titles for these categories are shown on the enclosed "List of Course Titles.")

Current number of sections	Code	Course Category
_______	108	Life Science, 6 - 8
_______	109	Earth Science, 6 - 8
_______	110	Physical Science, 6 - 8
_______	111	General Science, 6 - 8
_______	112	Integrated Science, 6 - 8
		Grades 6-8, Other Science Courses
_______		_______________
_______		_______________
_______		_______________

Current number of sections	Code	Course Category
_______	114	Biology, 1st year
_______	115	Biology, 1st year, Applied
_______	116	Biology, 2nd year, AP
_______	117	Biology, 2nd year, Advanced
_______	118	Biology, 2nd year, Other
_______	119	Chemistry, 1st year
_______	120	Chemistry, 1st year, Applied
_______	121	Chemistry, 2nd year, AP
_______	122	Chemistry, 2nd year, Advanced
_______	123	Physics, 1st year
_______	124	Physics, 1st year, Applied
_______	125	Physics, 2nd year, AP
_______	126	Physics, 2nd year, Advanced
_______	127	Physical Science
_______	128	Astronomy/Space Science*
_______	129	Geology*
_______	130	Meteorology*
_______	131	Oceanography/Marine Science*
_______	132	Earth Science, 1st year
_______	133	Earth Science, 1st year, Applied
_______	134	Earth Science, 2nd year, Advanced/Other
_______	135	General Science
_______	136	Environmental Science
_______	137	Coordinated Science
_______	138	Integrated Science
		Grades 9-12, Other Science Courses
_______		_______________
_______		_______________
_______		_______________

* NOTE: A course that includes substantial content from two or more of the earth sciences should be listed under code 132, 133, 134, or 135.

6. Please give the code number of any science courses offered this year that will **not** be offered next year. If all will be offered next year, darken this oval ○ and continue with question 7. Otherwise, list the code number of courses that will not be offered:

_________ _________ _________ _________ _________

PLEASE DO NOT WRITE IN THIS AREA

[SERIAL]

7. Which of the following best describes the way science classes at your school are scheduled? (Darken one oval.)

① a. All or most classes meet five days per week for one year.
② b. All or most classes meet five days per week for one semester.
③ c. All or most classes meet three days one week and two days the next week for one year.

④ d. Other arrangement; on a separate page, please give a brief written description of how often classes meet and the number of minutes in each class session.

Please enter the number of minutes each class meets per session in the spaces provided to the right, then darken the corresponding oval in each column: (Please enter your answer as a 3-digit number; e.g., if 30 minutes, enter 030.)

☐	☐	☐
⓪	⓪	⓪
①	①	①
②	②	②
③	③	③
④	④	④
⑤	⑤	⑤
⑥	⑥	⑥
⑦	⑦	⑦
⑧	⑧	⑧
⑨	⑨	⑨

8. How much money was spent on science equipment and consumable supplies in this school during the most recently completed budget year? Provide your answer as a ***whole dollar amount***. (If you don't know the exact amounts, please provide your best estimates.) Please enter your answers in the spaces provided, then darken the corresponding oval in each column. Please right justify your answers; e.g., enter $125 as ☐☐☐ 1 2 5

a. Science Equipment (non-consumable, non-perishable items such as microscopes, scales, etc., but not computers)

b. Consumable Science Supplies (materials that must continually be replenished such as chemicals, glassware, batteries, etc.)

c. Science Software

	a. $						b. $						c. $					
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪
	①	①	①	①	①	①	①	①	①	①	①	①	①	①	①	①	①	①
	②	②	②	②	②	②	②	②	②	②	②	②	②	②	②	②	②	②
	③	③	③	③	③	③	③	③	③	③	③	③	③	③	③	③	③	③
	④	④	④	④	④	④	④	④	④	④	④	④	④	④	④	④	④	④
	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦
	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨

a. If this is an estimate, please darken this oval: ○

b. If this is an estimate, please darken this oval: ○

c. If this is an estimate, please darken this oval: ○

9. In your opinion, how great a problem is each of the following for science instruction **in your school as a whole**? (Darken one oval on each line.)

	Not a Significant Problem	Somewhat of a Problem	Serious Problem
a. Facilities	①	②	③
b. Funds for purchasing equipment and supplies	①	②	③
c. Materials for individualizing instruction	①	②	③
d. Access to computers	①	②	③
e. Appropriate computer software	①	②	③
f. Student interest in science	①	②	③
g. Student reading abilities	①	②	③
h. Student absences	①	②	③
i. Teacher interest in science	①	②	③
j. Teacher preparation to teach science	①	②	③
k. Time to teach science	①	②	③
l. Opportunities for teachers to share ideas	①	②	③

Question 9 continues on next page...

PLEASE DO NOT WRITE IN THIS AREA

[SERIAL]

9. *continued*

	Not a Significant Problem	Somewhat of a Problem	Serious Problem
m. In-service education opportunities	①	②	③
n. Interruptions for announcements, assemblies, other school activities	①	②	③
o. Large classes	①	②	③
p. Maintaining discipline	①	②	③
q. Parental support for education	①	②	③

10. In your opinion, how great a problem is each of the following for science instruction **in your school as a whole**? (Darken one oval on each line.)

	Not a Significant Problem	Somewhat of a Problem	Serious Problem
a. State and/or district curriculum frameworks	①	②	③
b. State and/or district testing policies and practices	①	②	③
c. Importance that the school places on science	①	②	③
d. Public attitudes toward science reform at this school	①	②	③
e. Conflict between science reform efforts at this school and other school/district reform efforts	①	②	③
f. Time available for teachers to plan and prepare lessons	①	②	③
g. Time available for teachers to work with other teachers during the school year	①	②	③
h. Time available for teacher professional development	①	②	③
i. System of managing instructional resources at the district or school level (e.g., distributing science materials, refurbishing materials)	①	②	③

Question 11 is being asked of all science teachers in the sample. If you received a Science Teacher Questionnaire in addition to this School Science Program Questionnaire, please darken this oval ① and SKIP TO QUESTION 12.

11a. How familiar are you with the *National Science Education Standards*, published by the National Research Council? (Darken one oval.)

① Not at all familiar, SKIP TO QUESTION 12
② Somewhat familiar
③ Fairly familiar
④ Very familiar

11b. Please indicate the extent of your agreement with the overall vision of science education described in the *National Science Education Standards*. (Darken one oval.)

Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
①	②	③	④	⑤

12. If you have an email address, please write it here: ____

13. When did you complete this questionnaire? __________ / _________ / __________
Month Day Year

Please make a photocopy of this questionnaire and keep it in case the original is lost in the mail. Please return the original to:

2000 National Survey of Science and Mathematics Education
Westat
1650 Research Blvd.
TB120F
Rockville, MD 20850

THANK YOU!

FOR OFFICE USE ONLY
Please do not write in this area.

⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪
①	①	①	①	①	①	①	①	①	①
②	②	②	②	②	②	②	②	②	②
③	③	③	③	③	③	③	③	③	③
④	④	④	④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨

2000 National Survey of Science and Mathematics Education
School Mathematics Program Questionnaire

Instructions: Please use a #2 pencil or blue or black pen to complete this questionnaire. Darken ovals completely, but do not stray into adjacent ovals. Be sure to erase or white out completely any stray marks.

1. What is your title? (Darken all that apply.)

○	Mathematics department chair	○	Principal
○	Mathematics lead teacher	○	Assistant principal
○	Teacher	○	Other (please specify): ____________________

2. Indicate whether each of the following programs/practices is currently being implemented in your school. (Darken one oval on each line.)

	Yes	No	Don't Know/ Not Applicable
a. School-based management	○	○	○
b. Common daily planning period for members of the mathematics department	○	○	○
c. Common work space for members of the mathematics department	○	○	○
d. Teachers *formally* designated and serving as mathematics lead teachers	○	○	○
e. Teachers provided with release time to help other teachers in the school/district	○	○	○
f. Interdisciplinary teams of teachers who share the same students	○	○	○
g. Students assigned to mathematics classes by ability	○	○	○
h. Use of vocational/technical applications in mathematics instruction	○	○	○
i. Elementary or middle school students pulled out from self-contained classes for remedial instruction in mathematics	○	○	○
j. Elementary or middle school students pulled out from self-contained classes for enrichment in mathematics	○	○	○
k. Elementary or middle school students receiving instruction from mathematics specialists *in addition to* their regular teacher	○	○	○
l. Elementary or middle school students receiving instruction from mathematics specialists *instead of* their regular teacher	○	○	○
m. Mathematics courses offered by telecommunications	○	○	○
n. Students going to another K-12 school for mathematics courses	○	○	○
o. Students going to a college or university for mathematics courses	○	○	○
p. Integration of mathematics subjects (e.g., algebra, probability, geometry, etc. all taught together each year)	○	○	○

3. Please give us your opinion about each of the following statements in regard to the National Council of Teachers of Mathematics' (NCTM) work in setting standards for mathematics curriculum, instruction, and assessment. (Darken one oval on each line.)

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
a. I am prepared to explain the NCTM *Standards* to my colleagues.	○	○	○	○	○
b. The *Standards* have been thoroughly discussed by teachers in this school.	○	○	○	○	○
c. There is a school-wide effort to make changes inspired by the *Standards*.	○	○	○	○	○
d. Teachers in this school have implemented the *Standards* in their teaching.	○	○	○	○	○
e. The principal of this school is well-informed about the *Standards*.	○	○	○	○	○
f. Parents of students in this school are well-informed about the *Standards*.	○	○	○	○	○
g. The superintendent of this district is well-informed about the *Standards*.	○	○	○	○	○
h. The School Board is well-informed about the *Standards*.	○	○	○	○	○
i. Our district is organizing staff development based on the *Standards*.	○	○	○	○	○
j. Our district has changed how it evaluates teachers based on the *Standards*.	○	○	○	○	○

4. Does your school include students in grades 6 or higher? (Darken one oval.)

○ Yes, CONTINUE WITH QUESTION 5
○ No, SKIP TO QUESTION 8

5. Please give the number of sections of each of the following mathematics courses currently offered in your school. (Additional course titles for these categories are shown on the enclosed "List of Course Titles.")

GRADES 6-8

Current number of sections	Code	Course Category
________	208	Remedial Mathematics 6
________	209	Regular Mathematics 6
________	210	Accelerated/Pre-Algebra Mathematics 6
________	211	Remedial Mathematics 7
________	212	Regular Mathematics 7
________	213	Accelerated Mathematics 7

Current number of sections	Code	Course Category
________	214	Remedial Mathematics 8
________	215	Regular Mathematics 8
________	216	Enriched Mathematics 8
________	217	Algebra 1, Grade 7 or 8
________	218	Integrated Middle Grade Mathematics, 7 or 8
	GRADES 6-8, OTHER MATHEMATICS COURSES	
________		______________________________
________		______________________________
________		______________________________

GRADES 9-12

Current number of sections	Code	Course Category
	GRADES 9-12, REVIEW MATHEMATICS	
________	219	Review Mathematics Level 1 (e.g., Remedial Mathematics)
________	220	Review Mathematics Level 2 (e.g., Consumer Mathematics)
________	221	Review Mathematics Level 3 (e.g., General Mathematics 3)
________	222	Review Mathematics Level 4 (e.g., General Mathematics 4)
	GRADES 9-12, INFORMAL MATHEMATICS	
________	223	Informal Mathematics Level 1 (e.g., Pre-Algebra)
________	224	Informal Mathematics Level 2 (e.g., Basic Geometry)
________	225	Informal Mathematics Level 3 (e.g., after Pre-Algebra, but not Algebra 1)

Current number of sections	Code	Course Category
	GRADES 9-12, FORMAL MATHEMATICS	
________	226	Formal Mathematics Level 1 (e.g., Algebra 1, or Integrated Math 1)
________	227	Formal Mathematics Level 2 (e.g., Geometry, or Integrated Math 2)
________	228	Formal Mathematics Level 3 (e.g., Algebra 2, or Integrated Math 3)
________	229	Formal Mathematics Level 4 (e.g., Algebra 3, or Pre-Calculus)
________	230	Formal Mathematics Level 5 (e.g., Calculus)
________	231	Formal Mathematics Level 5, AP
	GRADES 9-12, OTHER MATHEMATICS COURSES	
________	232	Probability and Statistics
________	233	Mathematics integrated with other subjects
________		______________________________
________		______________________________

PLEASE DO NOT WRITE IN THIS AREA

[SERIAL]

6. Please give the code number of any mathematics courses offered this year that will **not** be offered next year. If all will be offered next year, darken this oval ○ and continue with question 7. Otherwise, list the code number of courses that will not be offered:

__________ __________ __________ __________ __________

7. Which of the following best describes the way mathematics classes at your school are scheduled? (Darken one oval.)

○ a. All or most classes meet five days per week for one year.
○ b. All or most classes meet five days per week for one semester.
○ c. All or most classes meet three days one week and two days the next week for one year.

○ d. Other arrangement; on a separate page, please give a brief written description of how often classes meet and the number of minutes in each class session.

Please enter the number of minutes each class meets per session in the spaces provided to the right, then darken the corresponding oval in each column: (Please enter your answer as a 3-digit number; e.g., if 30 minutes, enter 030.)

☐	☐	☐
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

8. How much money was spent on mathematics equipment and consumable supplies in this school during the most recently completed budget year? Provide your answer as a ***whole dollar amount***. (If you don't know the exact amounts, please provide your best estimates.) Please enter your answers in the spaces provided, then darken the corresponding oval in each column. Please right justify your answers; e.g., enter $125 as

			1	2	5

a. Mathematics Equipment (non-consumable items such as calculators, but not computers)

$	☐	☐	☐	☐	☐	☐
	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
	4	4	4	4	4	4
	5	5	5	5	5	5
	6	6	6	6	6	6
	7	7	7	7	7	7
	8	8	8	8	8	8
	9	9	9	9	9	9

If this is an estimate, please darken this oval: ○

b. Consumable Mathematics Supplies (manipulatives)

$	☐	☐	☐	☐	☐	☐
	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
	4	4	4	4	4	4
	5	5	5	5	5	5
	6	6	6	6	6	6
	7	7	7	7	7	7
	8	8	8	8	8	8
	9	9	9	9	9	9

If this is an estimate, please darken this oval: ○

c. Mathematics Software

$	☐	☐	☐	☐	☐	☐
	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
	4	4	4	4	4	4
	5	5	5	5	5	5
	6	6	6	6	6	6
	7	7	7	7	7	7
	8	8	8	8	8	8
	9	9	9	9	9	9

If this is an estimate, please darken this oval: ○

9. In your opinion, how great a problem is each of the following for mathematics instruction **in your school as a whole**? (Darken one oval on each line.)

	Not a Significant Problem	Somewhat of a Problem	Serious Problem
a. Facilities	1	2	3
b. Funds for purchasing equipment and supplies	1	2	3
c. Materials for individualizing instruction	1	2	3
d. Access to computers	1	2	3
e. Appropriate computer software	1	2	3
f. Student interest in mathematics	1	2	3
g. Student reading abilities	1	2	3
h. Student absences	1	2	3

Question 9 continues on next page...

9. *continued*

		Not a Significant Problem	Somewhat of a Problem	Serious Problem
i.	Teacher interest in mathematics	①	②	③
j.	Teacher preparation to teach mathematics	①	②	③
k.	Time to teach mathematics	①	②	③
l.	Opportunities for teachers to share ideas	①	②	③
m.	In-service education opportunities	①	②	③
n.	Interruptions for announcements, assemblies, other school activities	①	②	③
o.	Large classes	①	②	③
p.	Maintaining discipline	①	②	③
q.	Parental support for education	①	②	③

10. In your opinion, how great a problem is each of the following for mathematics instruction **in your school as a whole**? (Darken one oval on each line.)

		Not a Significant Problem	Somewhat of a Problem	Serious Problem
a.	State and/or district curriculum frameworks	①	②	③
b.	State and/or district testing policies and practices	①	②	③
c.	Importance that the school places on mathematics	①	②	③
d.	Public attitudes toward mathematics reform at this school	①	②	③
e.	Conflict between mathematics reform efforts at this school and other school/district reform efforts	①	②	③
f.	Time available for teachers to plan and prepare lessons	①	②	③
g.	Time available for teachers to work with other teachers during the school year	①	②	③
h.	Time available for teacher professional development	①	②	③
i.	System of managing instructional resources at the district or school level (e.g., distributing materials for mathematics activities, refurbishing materials)	①	②	③

Question 11 is being asked of all mathematics teachers in the sample. If you received a Mathematics Teacher Questionnaire in addition to this School Mathematics Program Questionnaire, please darken this oval ○ and SKIP TO QUESTION 12.

11a. How familiar are you with the NCTM *Standards* for mathematics curriculum, instruction, and evaluation? (Darken one oval.)

① Not at all familiar, SKIP TO QUESTION 12
② Somewhat familiar
③ Fairly familiar
④ Very familiar

11b. Please indicate the extent of your agreement with the overall vision of mathematics education described in the NCTM *Standards*. (Darken one oval.)

Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
①	②	③	④	⑤

12. If you have an email address, please write it here: ______________________________

13. When did you complete this questionnaire? _________ / _________ / _________
Month Day Year

Please make a photocopy of this questionnaire and keep it in case the original is lost in the mail. Please return the <u>original</u> to:

2000 National Survey of Science and Mathematics Education
Westat
1650 Research Blvd.
TB120F
Rockville, MD 20850

THANK YOU!

FOR OFFICE USE ONLY
Please do not write in this area.

⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪
①	①	①	①	①	①	①	①	①	①
②	②	②	②	②	②	②	②	②	②
③	③	③	③	③	③	③	③	③	③
④	④	④	④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨

2000 National Survey of Science and Mathematics Education

Science Questionnaire

You have been selected to answer questions about your science instruction. If you do not currently teach science, please call us toll-free at 1-800-937-8288.

How to Complete the Questionnaire

Most of the questions instruct you to "darken one" answer or "darken all that apply." For a few questions, you are asked to write in your answer on the line provided. Please use a #2 pencil or blue or black pen to complete this questionnaire. Darken ovals completely, but do not stray into adjacent ovals. Be sure to erase or white out completely any stray marks.

Class Selection

Part of the questionnaire (sections C and D) asks you to provide information about instruction in a particular class. If you teach science to more than one class, use the label at the right to determine the science class that has been randomly selected for you to answer about. (If your teaching schedule varies by day, use today's schedule, or if today is not a school day, use the most recent school day.)

If You Have Questions

If you have questions about the study or any items in the questionnaire, call us toll-free at 1-800-937-8288.

Each participating school will receive a voucher for $50 worth of science and mathematics materials. The voucher will be augmented by $15 for each responding teacher. In addition, each participating school will receive a copy of the study's results in the spring of 2001.

Thank you very much. Your participation is greatly appreciated. Please return the completed questionnaire to us in the postage-paid envelope:

2000 National Survey of Science and Mathematics Education
Westat
1650 Research Blvd.
TB120F
Rockville, MD 20850

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A. Teacher Opinions

1. Please provide your opinion about each of the following statements. (Darken one oval on each line.)

		Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
a.	Students learn science best in classes with students of similar abilities.	①	②	③	④	⑤
b.	The testing program in my state/district dictates what science content I teach.	①	②	③	④	⑤
c.	I enjoy teaching science.	①	②	③	④	⑤
d.	I consider myself a "master" science teacher.	①	②	③	④	⑤
e.	I have time during the regular school week to work with my colleagues on science curriculum and teaching.	①	②	③	④	⑤
f.	My colleagues and I regularly share ideas and materials related to science teaching.	①	②	③	④	⑤
g.	Science teachers in this school regularly observe each other teaching classes as part of sharing and improving instructional strategies.	①	②	③	④	⑤
h.	Most science teachers in this school contribute actively to making decisions about the science curriculum.	①	②	③	④	⑤

2a. How familiar are you with the *National Science Education Standards*, published by the National Research Council? (Darken one oval.)

① Not at all familiar, SKIP TO QUESTION 3
② Somewhat familiar
③ Fairly familiar
○ Very familiar

2b. Please indicate the extent of your agreement with the overall vision of science education described in the *National Science Education Standards*. (Darken one oval.)

Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
①	②	③	④	⑤

2c. To what extent have you implemented recommendations from the *National Science Education Standards* in your science teaching? (Darken one oval.)

Not at all	To a minimal extent	To a moderate extent	To a great extent
①	②	③	○

B. Teacher Background

3. Please indicate how well prepared you currently feel to do each of the following in your science instruction. (Darken one oval on each line.)

		Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
a.	Take students' prior understanding into account when planning curriculum and instruction	①	②	③	④
b.	Develop students' conceptual understanding of science	①	②	③	④
c.	Provide deeper coverage of fewer science concepts	①	②	③	④
d.	Make connections between science and other disciplines	①	②	③	④
e.	Lead a class of students using investigative strategies	①	②	③	④

Question 3 continues on next page...

3. *continued...*

		Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
f.	Manage a class of students engaged in hands-on/project-based work	①	②	③	④
g.	Have students work in cooperative learning groups	①	②	③	④
h.	Listen/ask questions as students work in order to gauge their understanding	①	②	③	④
i.	Use the textbook as a resource rather than the primary instructional tool	①	②	③	④
j.	Teach groups that are heterogeneous in ability	①	②	③	④
k.	Teach students who have limited English proficiency	①	②	③	④
l.	Recognize and respond to student cultural diversity	①	②	③	④
m.	Encourage students' interest in science	①	②	③	④
n.	Encourage participation of females in science	①	②	③	④
o.	Encourage participation of minorities in science	①	②	③	④
p.	Involve parents in the science education of their children	①	②	③	④
q.	Use calculators/computers for drill and practice	①	②	③	④
r.	Use calculators/computers for science learning games	①	②	③	④
s.	Use calculators/computers to collect and/or analyze data	①	②	③	④
t.	Use computers to demonstrate scientific principles	①	②	③	④
u.	Use computers for laboratory simulations	①	②	③	④
v.	Use the Internet in your science teaching for general reference	①	②	③	④
w.	Use the Internet in your science teaching for data acquisition	①	②	③	④
x.	Use the Internet in your science teaching for collaborative projects with classes/individuals in other schools	①	②	③	④

4a. Do you have each of the following degrees?

Bachelors	○ Yes	○ No
Masters	○ Yes	○ No
Doctorate	○ Yes	○ No

4b. Please indicate the subject(s) for each of your degrees.
(Darken all that apply.)

	Bachelors	Masters	Doctorate
Biology/Life Science	○	○	○
Chemistry	○	○	○
Earth/Space Science	○	○	○
Physics	○	○	○
Other science, please specify: ______________________	○	○	○
Science Education (any science discipline)	○	○	○
Mathematics/Mathematics Education	○	○	○
Elementary Education	○	○	○
Other Education (e.g., History Education, Special Education)	○	○	○
Other, please specify: ____________________________	○	○	○

PLEASE DO NOT WRITE IN THIS AREA

[SERIAL]

5. Which of the following college courses have you completed? Include both semester hour and quarter hour courses, whether graduate or undergraduate level. Include courses for which you received college credit, even if you took the course in high school. (Darken all that apply.)

EDUCATION
- ○ General methods of teaching
- ○ Methods of teaching science
- ○ Instructional uses of computers/other technologies
- ○ Supervised student teaching in science

MATHEMATICS
- ○ College algebra/trigonometry/elementary functions
- ○ Calculus
- ○ Advanced calculus
- ○ Differential equations
- ○ Discrete mathematics
- ○ Probability and statistics

CHEMISTRY
- ○ General/introductory chemistry
- ○ Analytical chemistry
- ○ Organic chemistry
- ○ Physical chemistry
- ○ Quantum chemistry
- ○ Biochemistry
- ○ Other chemistry

EARTH/SPACE SCIENCES
- ○ Introductory earth science
- ○ Astronomy
- ○ Geology
- ○ Meteorology
- ○ Oceanography
- ○ Physical geography
- ○ Environmental science
- ○ Agricultural science

LIFE SCIENCES
- ○ Introductory biology/life science
- ○ Botany, plant physiology
- ○ Cell biology
- ○ Ecology
- ○ Entomology
- ○ Genetics, evolution
- ○ Microbiology
- ○ Anatomy/Physiology
- ○ Zoology, animal behavior
- ○ Other life science

PHYSICS
- ○ Physical science
- ○ General/introductory physics
- ○ Electricity and magnetism
- ○ Heat and thermodynamics
- ○ Mechanics
- ○ Modern or quantum physics
- ○ Nuclear physics
- ○ Optics
- ○ Solid state physics
- ○ Other physics

OTHER
- ○ History of science
- ○ Philosophy of science
- ○ Science and society
- ○ Electronics
- ○ Engineering (Any)
- ○ Integrated science
- ○ Computer programming
- ○ Other computer science

6. For each of the following subject areas, indicate the number of college semester and quarter courses you have completed. Count each course you have taken, regardless of whether it was a graduate or undergraduate course. If your transcripts are not available, provide your best estimates.

	Semester Courses	Quarter Courses
a. Life sciences	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8
b. Chemistry	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8
c. Physics/physical science	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8
d. Earth/space science	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8
e. Science education	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8
f. Mathematics	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8

7. Considering all of your undergraduate and graduate **science** courses, approximately what percentage were completed at each of the following types of institutions? (Darken one oval on each line.)

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
a. Two-year college/community college/technical school	○	○	○	○	○	○	○	○	○	○	○
b. Four-year college/university	○	○	○	○	○	○	○	○	○	○	○

8. In what year did you last take a formal course for college credit in:
(Please enter your answers in the spaces provided, then darken the corresponding oval in each column.)

a. Science

	○0	○0	○0
○1	○1	○1	○1
○2	○2	○2	○2
	○3	○3	○3
	○4	○4	○4
	○5	○5	○5
	○6	○6	○6
	○7	○7	○7
	○8	○8	○8
	○9	○9	○9

b. The Teaching of Science

	○0	○0	○0
○1	○1	○1	○1
○2	○2	○2	○2
	○3	○3	○3
	○4	○4	○4
	○5	○5	○5
	○6	○6	○6
	○7	○7	○7
	○8	○8	○8
	○9	○9	○9

If you have never taken a course in the teaching of science, darken this oval ○ and go to question 9.

9. What is the **total** amount of time you have spent on professional development in science or the teaching of science in the last 12 months? in the last 3 years? (Include attendance at professional meetings, workshops, and conferences, but **do not** include formal courses for which you received college credit or time you spent **providing** professional development for other teachers.) (Darken one oval in each column.)

Hours of In-service Education	Last 12 months	Last 3 years
None	○	○
Less than 6 hours	○	○
6-15 hours	○	○
16-35 hours	○	○
More than 35 hours	○	○

10. In the past **12 months**, have you: (Darken one oval on each line.)

a.	Taught any in-service workshops in science or science teaching?	○ Yes	○ No
b.	Mentored another teacher as part of a formal arrangement that is recognized or supported by the school or district, not including supervision of student teachers?	○ Yes	○ No
c.	Received any local, state, or national grants or awards for science teaching?	○ Yes	○ No
d.	Served on a school or district science curriculum committee?	○ Yes	○ No
e.	Served on a school or district science textbook selection committee?	○ Yes	○ No

11. In the past **3 years**, have you participated in any of the following activities related to science or the teaching of science? (Darken one oval on each line.)

a.	Taken a formal college/university science course. (Please do not include courses taken as part of your undergraduate degree.)	○ Yes	○ No
b.	Taken a formal college/university course in the teaching of science. (Please do not include courses taken as part of your undergraduate degree.)	○ Yes	○ No
c.	Observed other teachers teaching science as part of your own professional development (formal or informal).	○ Yes	○ No
d.	Met with a local group of teachers on a regular basis to study/discuss science teaching issues.	○ Yes	○ No
e.	Collaborated on science teaching issues with a group of teachers at a distance using telecommunications.	○ Yes	○ No
f.	Served as a mentor and/or peer coach in science teaching, as part of a formal arrangement that is recognized or supported by the school or district. (Please do not include supervision of student teachers.)	○ Yes	○ No
g.	Attended a workshop on science teaching.	○ Yes	○ No

Question 11 continues on next page...

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[SERIAL]

11. continued...

h.	Attended a national or state science teacher association meeting.	○ Yes	○ No
i.	Applied (or applying) for certification from the National Board for Professional Teaching Standards (NBPTS).	○ Yes	○ No
j.	Received certification from the National Board for Professional Teaching Standards (NBPTS).	○ Yes	○ No

Questions 12a-12c ask about your professional development in the last 3 years. If you have been teaching for fewer than 3 years, please answer for the time that you have been teaching.

12a. Think back to **3 years ago**. How would you rate your level of need for professional development in each of these areas *at that time*? (Darken one oval on each line.)

	None Needed	Minor Need	Moderate Need	Substantia Need
Deepening my own science content knowledge	○	○	○	○
Understanding student thinking in science	○	○	○	○
Learning how to use inquiry/investigation-oriented teaching strategies	○	○	○	○
Learning how to use technology in science instruction	○	○	○	○
Learning how to assess student learning in science	○	○	○	○
Learning how to teach science in a class that includes students with special needs	○	○	○	○

12b. Considering all the professional development you have participated in **during the last 3 years**, how much was each of the following emphasized? (Darken one oval on each line.)

	Not at all				To a great extent
Deepening my own science content knowledge	○	○	○	○	○
Understanding student thinking in science	○	○	○	○	○
Learning how to use inquiry/investigation-oriented teaching strategies	○	○	○	○	○
Learning how to use technology in science instruction	○	○	○	○	○
Learning how to assess student learning in science	○	○	○	○	○
Learning how to teach science in a class that includes students with special needs	○	○	○	○	○

12c. Considering all your professional development in the **last 3 years**, how would you rate its impact in each of these areas? (Darken one oval on each line.)

	Little or no impact	Confirmed what I was already doing	Caused me to change my teaching practices
Deepening my own science content knowledge	○	○	○
Understanding student thinking in science	○	○	○
Learning how to use inquiry/investigation-oriented teaching strategies	○	○	○
Learning how to use technology in science instruction	○	○	○
Learning how to assess student learning in science	○	○	○
Learning how to teach science in a class that includes students with special needs	○	○	○

13a. Do you teach in a **self-contained class**? (i.e., you teach multiple subjects to the same class of students all or most of the day.)

○ Yes, CONTINUE WITH QUESTIONS 13b AND 13c
○ No, SKIP TO QUESTION 14

13b. ***For teachers of self-contained classes***: Many teachers feel better qualified to teach some subject areas than others. How well qualified do you feel to teach each of the following subjects **at the grade level(s) you teach**, whether or not they are currently included in your curriculum? (Darken one oval on each line.)

		Not Well Qualified	Adequately Qualified	Very Well Qualified
a.	Life science	○	○	○
b.	Earth science	○	○	○
c.	Physical science	○	○	○
d.	Mathematics	○	○	○
e.	Reading/Language Arts	○	○	○
f.	Social Studies	○	○	○

13c. ***For teachers of self-contained classes****:* We are interested in knowing how much time your students spend studying various subjects. In a typical week, how many days do you have lessons on each of the following subjects, and how many minutes long is an average lesson? (*Please indicate "0" if you do not teach a particular subject to this class.* Please enter your answer in the spaces provided, then darken the corresponding oval in each column. Enter the number of minutes as a 3-digit number; e.g., if 30 minutes, enter as 030.)

Mathematics

Days Per Week	Approximate Minutes Per Day		
☐	☐	☐	☐
⓪	⓪	⓪	⓪
①	①	①	①
②		②	②
③		③	③
④		④	④
⑤		⑤	⑤
		⑥	⑥
		⑦	⑦
		⑧	⑧
		⑨	⑨

Science

Days Per Week	Approximate Minutes Per Day		
☐	☐	☐	☐
⓪	⓪	⓪	⓪
①	①	①	①
②		②	②
③		③	③
④		④	④
⑤		⑤	⑤
		⑥	⑥
		⑦	⑦
		⑧	⑧
		⑨	⑨

Social Studies

Days Per Week	Approximate Minutes Per Day		
☐	☐	☐	☐
⓪	⓪	⓪	⓪
①	①	①	①
②		②	②
③		③	③
④		④	④
⑤		⑤	⑤
		⑥	⑥
		⑦	⑦
		⑧	⑧
		⑨	⑨

Reading/Language Arts

Days Per Week	Approximate Minutes Per Day		
☐	☐	☐	☐
⓪	⓪	⓪	⓪
①	①	①	①
②	②	②	②
③		③	③
④		④	④
⑤		⑤	⑤
		⑥	⑥
		⑦	⑦
		⑧	⑧
		⑨	⑨

NOW GO TO SECTION C, PAGE 8.

14. Which of these categories best describes the way **your** classes at this school are organized? (Darken one oval.)

○ a. **Departmentalized Instruction**—you teach subject matter courses (including science, and perhaps other courses) to several different classes of students all or most of the day.
○ b. **Elementary Enrichment Class**—you teach only science in an elementary school.
○ c. **Team Teaching**—you collaborate with one or more teachers in teaching multiple subjects to the same class of students; your assignment includes science.

15a. ***For teachers of non-self-contained classes*****:** Within science, many teachers feel better qualified to teach some topics than others. How well qualified do you feel to teach each of the following topics **at the grade level(s) you teach**, whether or not they are currently included in your curriculum? (Darken one oval on each line.)

	Not Well Qualified	Adequately Qualified	Very Well Qualified
1. Earth science			
a. Earth's features and physical processes	①	②	③
b. The solar system and the universe	①	②	③
c. Climate and weather	①	②	③
2. Biology			
a. Structure and function of human systems	①	②	③
b. Plant biology	①	②	③
c. Animal behavior	①	②	③
d. Interactions of living things/ecology	①	②	③
e. Genetics and evolution	①	②	③
3. Chemistry			
a. Structure of matter and chemical bonding	①	②	③
b. Properties and states of matter	①	②	③
c. Chemical reactions	①	②	③
d. Energy and chemical change	①	②	③

Question 15a continues on next page...

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[SERIAL]

15a. continued...

	Not well qualified	Adequately qualified	Very well qualified
4. Physics			
a. Forces and motion	①	②	③
b. Energy	①	②	③
c. Light and sound	①	②	③
d. Electricity and magnetism	①	②	③
e. Modern physics (e.g., special relativity)	①	②	③
5. Environmental and resource issues			
a. Pollution, acid rain, global warming	①	②	③
b. Population, food supply and production	①	②	③
6. Science process/inquiry skills			
a. Formulating hypotheses, drawing conclusions, making generalizations	①	②	③
b. Experimental design	①	②	③
c. Describing, graphing, and interpreting data	①	②	③

15b. ***For teachers of non-self-contained classes*:** For each class period you are currently teaching, regardless of the subject, give *course title*, the *code-number* from the enclosed blue "List of Course Titles" that best describes the content addressed in the class, and the *number of students* in the class. (Please enter your answers in the spaces provided, then darken the corresponding oval in each column. **If you teach more than one section of a course, record each section separately below.**)

- **Note that if you have more than 39 students in any class, you will not be able to darken the ovals, but you should still write the number in the boxes.**
- **If you teach more than 6 classes per day, please provide the requested information for the additional classes on a separate sheet of paper.**

Course Title

Code #			# of Students	
⓪	⓪	⓪	⓪	⓪
①	①	①	①	①
②	②	②	②	②
③	③	③	③	③
	④	④		④
	⑤	⑤		⑤
	⑥	⑥		⑥
	⑦	⑦		⑦
	⑧	⑧		⑧
	⑨	⑨		⑨

Course Title

Code #			# of Students	
⓪	⓪	⓪	⓪	⓪
①	①	①	①	①
②	②	②	②	②
③	③	③	③	③
	④	④		④
	⑤	⑤		⑤
	⑥	⑥		⑥
	⑦	⑦		⑦
	⑧	⑧		⑧
	⑨	⑨		⑨

Course Title

Code #			# of Students	
⓪	⓪	⓪	⓪	⓪
①	①	①	①	①
②	②	②	②	②
③	③	③	③	③
	④	④		④
	⑤	⑤		⑤
	⑥	⑥		⑥
	⑦	⑦		⑦
	⑧	⑧		⑧
	⑨	⑨		⑨

Course Title

Code #			# of Students	
⓪	⓪	⓪	⓪	⓪
①	①	①	①	①
②	②	②	②	②
③	③	③	③	③
	④	④		④
	⑤	⑤		⑤
	⑥	⑥		⑥
	⑦	⑦		⑦
	⑧	⑧		⑧
	⑨	⑨		⑨

Course Title

Code #			# of Students	
⓪	⓪	⓪	⓪	⓪
①	①	①	①	①
②	②	②	②	②
③	③	③	③	③
	④	④		④
	⑤	⑤		⑤
	⑥	⑥		⑥
	⑦	⑦		⑦
	⑧	⑧		⑧
	⑨	⑨		⑨

Course Title

Code #			# of Students	
⓪	⓪	⓪	⓪	⓪
①	①	①	①	①
②	②	②	②	②
③	③	③	③	③
	④	④		④
	⑤	⑤		⑤
	⑥	⑥		⑥
	⑦	⑦		⑦
	⑧	⑧		⑧
	⑨	⑨		⑨

C. Your Science Teaching in a Particular Class

The questions in this section are about a particular science class you teach. **If you teach science to more than one class per day, please consult the label on the front of this questionnaire to determine which science class to use to answer these questions**.

16. Using the blue "List of Course Titles," indicate the code number that best describes this course. Please enter your answer in the spaces to the right, then darken the corresponding oval in each column. (If "other" [Code 199], briefly describe content of course:

____

____

____)

Code #

☐	☐	☐
○0	○0	○0
○1	○1	○1
○2	○2	○2
○3	○3	○3
	○4	○4
	○5	○5
	○6	○6
	○7	○7
	○8	○8
	○9	○9

17a. Are all students in this class in the same grade?

○ Yes, specify grade:
THEN SKIP TO QUESTION 18a ○K ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9 ○10 ○11 ○12

○ No, CONTINUE WITH QUESTION 17b

17b. What grades are represented in this class? (Darken all that apply.) For each grade noted, indicate the number of students in this class in that grade. Write your answer in the space provided, then darken the corresponding oval in each column. **Note that if more than 39 students in this class are in a single grade, you will not be able to darken the ovals, but you should still write the number in the boxes.**

○ K	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9	○ 10	○ 11	○ 12
☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐
○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0
○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1
○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2
○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3
○4	○4	○4	○4	○4	○4	○4	○4	○4	○4	○4	○4	○4
○5	○5	○5	○5	○5	○5	○5	○5	○5	○5	○5	○5	○5
○6	○6	○6	○6	○6	○6	○6	○6	○6	○6	○6	○6	○6
○7	○7	○7	○7	○7	○7	○7	○7	○7	○7	○7	○7	○7
○8	○8	○8	○8	○8	○8	○8	○8	○8	○8	○8	○8	○8
○9	○9	○9	○9	○9	○9	○9	○9	○9	○9	○9	○9	○9

18a. What is the total number of students in this class? Write your answer in the space provided, then darken the corresponding oval in each column. **Note that if you have more than 39 students in this class, you will not be able to darken the ovals, but you should still write the number in the boxes.**

☐	☐
○0	○0
○1	○1
○2	○2
○3	○3
	○4
	○5
	○6
	○7
	○8
	○9

18b. Please indicate the number of students in this class in each of the following categories. Consult the enclosed federal guidelines at the end of the course list (blue sheet) if you have any questions about how to classify particular students. (Please enter your answers in the spaces provided, then darken the corresponding oval in each column.)

RACE/ETHNICITY

American Indian or Alaskan Native		**Asian**		**Black or African-American**		**Hispanic or Latino (any race)**		**Native Hawaiian or Other Pacific Islander**		**White**	
Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0	○0 ○0
○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1	○1 ○1
○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2
○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3
○4	○4	○4	○4	○4	○4	○4	○4	○4	○4	○4	○4
○5	○5	○5	○5	○5	○5	○5	○5	○5	○5	○5	○5
○6	○6	○6	○6	○6	○6	○6	○6	○6	○6	○6	○6
○7	○7	○7	○7	○7	○7	○7	○7	○7	○7	○7	○7
○8	○8	○8	○8	○8	○8	○8	○8	○8	○8	○8	○8
○9	○9	○9	○9	○9	○9	○9	○9	○9	○9	○9	○9

19a. **Questions 19a and 19b apply only to teachers of non-self-contained classes. If you teach a self-contained class, please darken this oval ○ and skip to question 20.** What is the usual schedule and length (in minutes) of daily class meetings for this class? If the weekly schedule is normally the same, just complete Week 1, as in Example 1. If you are unable to describe this class in the format below, please attach a separate piece of paper with your description.

	Week 1	**Week 2**
Monday	________	________
Tuesday	________	________
Wednesday	________	________
Thursday	________	________
Friday	________	________

Examples

Example 1		**Example 2**	
Week 1	Week 2	Week 1	Week 2
45	_____	90	_____
45	_____	_____	90
45	_____	90	_____
45	_____	_____	90
45	_____	90	_____

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☐ ○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9
☐ ○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9
☐ ○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9

☐ ○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9
☐ ○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9
☐ ○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9

19b. What is the calendar duration of this science class? (Darken one oval.)

○1 Year
○2 Semester
○ Quarter

PLEASE DO NOT WRITE IN THIS AREA

[SERIAL]

20. Are students assigned to this class by level of ability? (Darken one oval.) ○ Yes ○ No

21. Which of the following best describes the ability of the students in this class relative to other students in this school? (Darken one oval.)

- ○ Fairly homogeneous and low in ability
- ○ Fairly homogeneous and average in ability
- ○ Fairly homogeneous and high in ability
- ○ Heterogeneous, with a mixture of two or more ability levels

22. Indicate if any of the students in this science class are **formally** classified as each of the following: (Darken all that apply.)

- ○ Limited English Proficiency
- ○ Learning Disabled
- ○ Mentally Handicapped
- ○ Physically Handicapped, please specify handicap(s): ______________________________

23. Think about your plans for this science class for the entire course. How much emphasis will each of the following **student objectives** receive? (Darken one oval on each line.)

		None	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis
a.	Increase students' interest in science	○	○	○	○
b.	Learn basic science concepts	○	○	○	○
c.	Learn important terms and facts of science	○	○	○	○
d.	Learn science process/inquiry skills	○	○	○	○
e.	Prepare for further study in science	○	○	○	○
f.	Learn to evaluate arguments based on scientific evidence	○	○	○	○
g.	Learn how to communicate ideas in science effectively	○	○	○	○
h.	Learn about the applications of science in business and industry	○	○	○	○
i.	Learn about the relationship between science, technology, and society	○	○	○	○
j.	Learn about the history and nature of science	○	○	○	○
k.	Prepare for standardized tests	○	○	○	○

24. About how often do **you** do each of the following in your science instruction? (Darken one oval on each line.)

		Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a.	Introduce content through formal presentations	○	○	○	○	○
b.	Pose open-ended questions	○	○	○	○	○
c.	Engage the whole class in discussions	○	○	○	○	○
d.	Require students to supply evidence to support their claims	○	○	○	○	○
e.	Ask students to explain concepts to one another	○	○	○	○	○
f.	Ask students to consider alternative explanations	○	○	○	○	○
g.	Allow students to work at their own pace	○	○	○	○	○
h.	Help students see connections between science and other disciplines	○	○	○	○	○
i.	Assign science homework	○	○	○	○	○
j.	Read and comment on the reflections students have written, e.g., in their journals	○	○	○	○	○

25. About how often do students in this science class take part in the following types of activities? (Darken one oval on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Listen and take notes during presentation by teacher	①	②	③	④	⑤
b. Watch a science demonstration	①	②	③	④	⑤
c. Work in groups	①	②	③	④	⑤
d. Read from a science textbook in class	①	②	③	④	⑤
e. Read other (non-textbook) science-related materials in class	①	②	③	④	⑤
f. Do hands-on/laboratory science activities or investigations	①	②	③	④	⑤
g. Follow specific instructions in an activity or investigation	①	②	③	④	⑤
h. Design or implement their *own* investigation	①	②	③	④	⑤
i. Participate in field work	①	②	③	④	⑤
j. Answer textbook or worksheet questions	①	②	③	④	⑤
k. Record, represent, and/or analyze data	①	②	③	④	⑤
l. Write reflections (e.g., in a journal)	①	②	③	④	⑤
m. Prepare written science reports	①	②	③	④	⑤
n. Make formal presentations to the rest of the class	①	②	③	④	⑤
o. Work on extended science investigations or projects (a week or more in duration)	①	②	③	④	⑤
p. Use computers as a tool (e.g., spreadsheets, data analysis)	①	②	③	④	⑤
q. Use mathematics as a tool in problem-solving	①	②	③	④	⑤
r. Take field trips	①	②	③	④	⑤
s. Watch audiovisual presentations (e.g., videotapes, CD-ROMs, videodiscs, television programs, films, or filmstrips)	①	②	③	④	⑤

26. About how often do students in this science class use **computers** to: (Darken one oval on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Do drill and practice	①	②	③	④	⑤
b. Demonstrate scientific principles	①	②	③	④	⑤
c. Play science learning games	①	②	③	④	⑤
d. Do laboratory simulations	①	②	③	④	⑤
e. Collect data using sensors or probes	①	②	③	④	⑤
f. Retrieve or exchange data	①	②	③	④	⑤
g. Solve problems using simulations	①	②	③	④	⑤
h. Take a test or quiz	①	②	③	④	⑤

27. How often do you assess student progress in science in each of the following ways? (Darken one oval on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Conduct a pre-assessment to determine what students already know.	①	②	③	④	⑤
b. Observe students and ask questions as they work individually.	①	②	③	④	⑤
c. Observe students and ask questions as they work in small groups.	①	②	③	④	⑤
d. Ask students questions during large group discussions.	①	②	③	④	⑤
e. Use assessments embedded in class activities to see if students are "getting it"	①	②	③	④	⑤
f. Review student homework.	①	②	③	④	⑤
g Review student notebooks/journals.	①	②	③	④	⑤
h. Review student portfolios.	①	②	③	④	⑤

Question 27 continues on next page...

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[SERIAL]

27. continued...

		Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
i.	Have students do long-term science projects.	①	②	③	④	⑤
j.	Have students present their work to the class.	①	②	③	④	⑤
k.	Give predominantly short-answer tests (e.g., multiple choice, true/false, fill in the blank).	①	②	③	④	⑤
l.	Give tests requiring open-ended responses (e.g., descriptions, explanations).	①	②	③	④	⑤
m.	Grade student work on open-ended and/or laboratory tasks using defined criteria (e.g., a scoring rubric).	①	②	③	④	⑤
n.	Have students assess each other (peer evaluation).	①	②	③	④	⑤

28. For the following equipment, please indicate the extent to which each is available, whether or not each is needed, and the extent to which each is integrated in this science class.

		Not at all Available		Readily Available	Needed?		Never use in this course	Use in specific parts of this course	Fully integrated into this cours
a.	Overhead projector	①	②	③	Ⓨ	Ⓝ	①	②	③
b.	Videotape player	①	②	③	Ⓨ	Ⓝ	①	②	③
c.	Videodisc player	①	②	③	Ⓨ	Ⓝ	①	②	③
d.	CD-ROM player	①	②	③	Ⓨ	Ⓝ	①	②	③
e.	Four-function calculators	①	②	③	Ⓨ	Ⓝ	①	②	③
f.	Fraction calculators	①	②	③	Ⓨ	Ⓝ	①	②	③
g.	Graphing calculators	①	②	③	Ⓨ	Ⓝ	①	②	③
h.	Scientific calculators	①	②	③	Ⓨ	Ⓝ	①	②	③
i.	Computers	①	②	③	Ⓨ	Ⓝ	①	②	③
j.	Computers with Internet connection	①	②	③	Ⓨ	Ⓝ	①	②	③
k.	Calculator/computer lab interfacing devices	①	②	③	Ⓨ	Ⓝ	①	②	③
l.	Running water in labs/classrooms	①	②	③	Ⓨ	Ⓝ	①	②	③
m.	Electric outlets in labs/classrooms	①	②	③	Ⓨ	Ⓝ	①	②	③
n.	Gas for burners in labs/classrooms	①	②	③	Ⓨ	Ⓝ	①	②	③
o.	Hoods or air hoses in labs/classrooms	①	②	③	Ⓨ	Ⓝ	①	②	③

29. How much of your own money do you estimate you will spend for supplies for this science class this school year (or semester or quarter if not a full-year course)? (Please enter your answer as a 3-digit number rounded to the nearest dollar, i.e., enter $25.19 as 025. Enter your answer in the spaces to the right, then darken the corresponding oval in each column.)

If none, darken this oval: ⓪

$			
	⓪	⓪	⓪
	①	①	①
	②	②	②
	③	③	③
	④	④	④
	⑤	⑤	⑤
	⑥	⑥	⑥
	⑦	⑦	⑦
	⑧	⑧	⑧
	⑨	⑨	⑨

30. How much of your own money do you estimate you will spend for your own professional development activities during the period Sept. 1, 1999 - Aug. 31, 2000? (Please enter your answer as a 3-digit number rounded to the nearest dollar, i.e., enter $25.19 as 025. Enter your answer in the spaces to the right, then darken the corresponding oval in each column.)

If none, darken this oval: ⓪

$			
	⓪	⓪	⓪
	①	①	①
	②	②	②
	③	③	③
	④	④	④
	⑤	⑤	⑤
	⑥	⑥	⑥
	⑦	⑦	⑦
	⑧	⑧	⑧
	⑨	⑨	⑨

31. How much control do you have over each of the following for this science class? (Darken one oval on each line.)

		No Control				Strong Control
a.	Determining course goals and objectives	①	②	③	④	⑤
b.	Selecting textbooks/instructional programs	①	②	③	④	⑤
c.	Selecting other instructional materials	①	②	③	④	⑤
d.	Selecting content, topics, and skills to be taught	①	②	③	④	⑤
e.	Selecting the sequence in which topics are covered	①	②	③	④	⑤
f.	Setting the pace for covering topics	①	②	③	④	⑤
g.	Selecting teaching techniques	①	②	③	④	⑤
h.	Determining the amount of homework to be assigned	①	②	③	④	⑤
i.	Choosing criteria for grading students	①	②	③	④	⑤
j.	Choosing tests for classroom assessment	①	②	③	④	⑤

32. How much science homework do you assign to this science class in a typical **week**? (Darken one oval.)

① 0-30 min ② 31-60 min ③ 61-90 min ④ 91-120 min ⑤ 2-3 hours ○ More than 3 hours

33a. Are you using one or more commercially published textbooks or programs for teaching science to this class? (Darken one oval.)

① No, SKIP TO SECTION D, PAGE 14
② Yes, CONTINUE WITH 33b

33b. Which best describes your use of textbooks/programs in this class? (Darken one oval.)

① Use one textbook or program all or most of the time
○ Use multiple textbooks/programs

34. Indicate the publisher of the **one** textbook/program used **most often** by students in this class. (Darken one oval.)

① Addison Wesley Longman, Inc/Scott Foresman
② Benjamin/Cummings Publishing Company, Inc.
③ Brooks/Cole Publishing Co
④ Carolina Biological Supply Co
⑤ Delta Education
⑥ Encyclopaedia Britannica
⑦ Globe Fearon, Inc / Cambridge
⑧ Harcourt Brace/Harcourt, Brace & Jovanovich
⑨ Holt, Rinehart and Winston, Inc
⑩ Houghton Mifflin Company/McDougal Littell/D.C. Heath
⑪ It's About Time
⑫ J.M. LeBel Enterprises
⑬ Kendall Hunt Publishing
⑭ Lawrence Hall of Science
⑮ McGraw-Hill/Merrill Co (including CTB/McGraw-Hill, Charles Merrill Publishing, Glencoe/McGraw-Hill, Macmillan/McGraw-Hill, McGraw-Hill School Division, Merrill/Glencoe, SRA/McGraw-Hill)
⑯ Modern Curriculum Press
⑰ Mosby/The C.V. Mosby Company
⑱ Nystrom
⑲ Optical Data Corporation
⑳ Prentice Hall, Inc.
㉑ Saxon Publishers
㉒ Scholastic, Inc.
㉓ Silver Burdett Ginn
㉔ South-Western Educational Publishing
㉕ Steck-Vaughn Company
㉖ Videodiscovery, Inc
㉗ W.H. Freeman
㉘ Wadsworth Publishing

(99) Other, please specify: ______________________

35a. Please indicate the title, author, and publication year of the **one** textbook/program used **most often** by students in this class.

Title: ____

First Author: ____

Publication Year: __________ Edition: ____________

For office use only

○0	○0	○0	○0
○1	○1	○1	○1
○2	○2	○2	○2
	○3	○3	○3
	○4	○4	○4
	○5	○5	○5
	○6	○6	○6
	○7	○7	○7
	○8	○8	○8
	○9	○9	○9

35b. Approximately what percentage of this textbook/program will you "cover" in this course? (Darken one oval.)

○ < 25% ○ 25-49% ○ 50-74% ○ 75-90% ○ >90%

35c. How would you rate the overall quality of this textbook/program? (Darken one oval.)

○ Very Poor ○ Poor ○ Fair ○ Good ○ Very Good ○ Excellent

D. Your Most Recent Science Lesson in This Class

Questions 36-38 refer to the last time you taught science to this class. Do not be concerned if this lesson was not typical of instruction in this class. (Please enter your answers as 3-digit numbers, i.e., if 30 minutes, enter as 030. Enter your answers in the spaces provided, then darken the corresponding oval in each column.)

36a. How many minutes were allocated to the most recent science lesson? (Note: Teachers in departmentalized and other non-self-contained settings should answer for the entire length of the class period, even if there were interruptions.)

○0	○0	○0
○1	○1	○1
	○2	○2
	○3	○3
	○4	○4
	○5	○5
	○6	○6
	○7	○7
	○8	○8
	○9	○9

36b. Of these, how many minutes were spent on the following:
(The sum of the numbers in 1.-6. below should equal your response in 36a.)

1. Daily routines, interruptions, and other non-instructional activities	2. Whole class lecture/discussions	3. Individual students reading textbooks, completing worksheets, etc.	4. Working with hands-on, manipulative, or laboratory materials	5. Non-laboratory small group work	6. Other
○0 ○0 ○0	○0 ○0 ○0	○0 ○0 ○0	○0 ○0 ○0	○0 ○0 ○0	○0 ○0 ○0
○1 ○1 ○1	○1 ○1 ○1	○1 ○1 ○1	○1 ○1 ○1	○1 ○1 ○1	○1 ○1 ○1
○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2
○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3
○4 ○4	○4 ○4	○4 ○4	○4 ○4	○4 ○4	○4 ○4
○5 ○5	○5 ○5	○5 ○5	○5 ○5	○5 ○5	○5 ○5
○6 ○6	○6 ○6	○6 ○6	○6 ○6	○6 ○6	○6 ○6
○7 ○7	○7 ○7	○7 ○7	○7 ○7	○7 ○7	○7 ○7
○8 ○8	○8 ○8	○8 ○8	○8 ○8	○8 ○8	○8 ○8
○9 ○9	○9 ○9	○9 ○9	○9 ○9	○9 ○9	○9 ○9

37. Which of the following activities took place during that science lesson? (Darken all that apply.)

- ○ Lecture
- ○ Discussion
- ○ Students completing textbook/worksheet problems
- ○ Students doing hands-on/laboratory activities
- ○ Students reading about science
- ○ Students working in small groups
- ○ Students using calculators
- ○ Students using computers
- ○ Students using other technologies
- ○ Test or quiz
- ○ None of the above

38. Did that lesson take place on the most recent day you met with that class? ○ Yes ○ No

E. Demographic Information

39. Indicate your sex:

- ○ Male
- ○ Female

40. Are you: (Darken all that apply)

- ○ American Indian or Alaskan Native
- ○ Asian
- ○ Black or African-American
- ○ Hispanic or Latino
- ○ Native Hawaiian or Other Pacific Islander
- ○ White

41. In what year were you born? (Enter the last two digits of the year you were born; e.g., if you were born in 1959, enter 59. Please enter your answer in the spaces to the right, then darken the corresponding oval in each column.)

☐	☐
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

42. How many years have you taught at the K-12 level prior to this school year? (Please enter your answer in the spaces to the right, then darken the corresponding oval in each column.)

☐	☐
0	0
1	1
2	2
3	3
4	4
5	5
	6
	7
	8
	9

43. If you have an email address, please write it here: ______________________________

44. When did you complete this questionnaire? Date: ______ / _______ / _______
Month Day Year

FOR OFFICE USE ONLY
Please do not write in this area.

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9

Please make a photocopy of this questionnaire and keep it in case the original is lost in the mail. Please return the original to:

2000 National Survey of Science and Mathematics Education
Westat
1650 Research Blvd.
TB120F
Rockville, MD 20850

THANK YOU!

PLEASE DO NOT WRITE IN THIS AREA

■ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ■■■■■■

[SERIAL]

2000 National Survey of Science and Mathematics Education

Mathematics Questionnaire

You have been selected to answer questions about your mathematics instruction. If you do not currently teach mathematics, please call us toll-free at 1-800-937-8288.

How to Complete the Questionnaire

Most of the questions instruct you to "darken one" answer or "darken all that apply." For a few questions, you are asked to write in your answer on the line provided. Please use a #2 pencil or blue or black pen to complete this questionnaire. Darken ovals completely, but do not stray into adjacent ovals. Be sure to erase or white out completely any stray marks.

Class Selection

Part of the questionnaire (sections C and D) asks you to provide information about instruction in a particular class. If you teach mathematics to more than one class, use the label at the right to determine the mathematics class that has been randomly selected for you to answer about. (If your teaching schedule varies by day, use today's schedule, or if today is not a school day, use the most recent school day.)

If You Have Questions

If you have questions about the study or any items in the questionnaire, call us toll-free at 1-800-937-8288.

Each participating school will receive a voucher for $50 worth of science and mathematics materials. The voucher will be augmented by $15 for each responding teacher. In addition, each participating school will receive a copy of the study's results in the spring of 2001.

Thank you very much. Your participation is greatly appreciated. Please return the completed questionnaire to us in the postage-paid envelope:

2000 National Survey of Science and Mathematics Education
Westat
1650 Research Blvd.
TB120F
Rockville, MD 20850

A. Teacher Opinions

1. Please provide your opinion about each of the following statements. (Darken one oval on each line.)

		Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
a.	Students learn mathematics best in classes with students of similar abilities.	○	○	○	○	○
b.	The testing program in my state/district dictates what mathematics content I teach.	○	○	○	○	○
c.	I enjoy teaching mathematics.	○	○	○	○	○
d.	I consider myself a "master" mathematics teacher.	○	○	○	○	○
e.	I have time during the regular school week to work with my colleagues on mathematics curriculum and teaching.	○	○	○	○	○
f.	My colleagues and I regularly share ideas and materials related to mathematics teaching.	○	○	○	○	○
g.	Mathematics teachers in this school regularly observe each other teaching classes as part of sharing and improving instructional strategies.	○	○	○	○	○
h.	Most mathematics teachers in this school contribute actively to making decisions about the mathematics curriculum.	○	○	○	○	○

2a. How familiar are you with the NCTM *Standards*? (Darken one oval.)

○ Not at all familiar, SKIP TO QUESTION 3
○ Somewhat familiar
○ Fairly familiar
○ Very familiar

2b. Please indicate the extent of your agreement with the overall vision of mathematics education described in the NCTM *Standards.* (Darken one oval.)

Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
○	○	○	○	○

2c. To what extent have you implemented recommendations from the NCTM *Standards* in your mathematics teaching? (Darken one oval.)

Not at all	To a minimal extent	To a moderate extent	To a great extent
○	○	○	○

B. Teacher Background

3. Please indicate how well prepared you currently feel to do each of the following in your mathematics instruction. (Darken one oval on each line.)

		Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
a.	Take students' prior understanding into account when planning curriculum and instruction	○	○	○	○
b.	Develop students' conceptual understanding of mathematics	○	○	○	○
c.	Provide deeper coverage of fewer mathematics concepts	○	○	○	○
d.	Make connections between mathematics and other disciplines	○	○	○	○
e.	Lead a class of students using investigative strategies	○	○	○	○
f.	Manage a class of students engaged in hands-on/project-based work	○	○	○	○
g.	Have students work in cooperative learning groups	○	○	○	○
h.	Listen/ask questions as students work in order to gauge their understanding	○	○	○	○
i.	Use the textbook as a resource rather than the primary instructional tool	○	○	○	○
j.	Teach groups that are heterogeneous in ability	○	○	○	○
k.	Teach students who have limited English proficiency	○	○	○	○
l.	Recognize and respond to student cultural diversity	○	○	○	○
m.	Encourage students' interest in mathematics	○	○	○	○
n.	Encourage participation of females in mathematics	○	○	○	○
o.	Encourage participation of minorities in mathematics	○	○	○	○

Question 3 continues on next page...

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[SERIAL]

3. *continued...*

		Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
p.	Involve parents in the mathematics education of their children	①	②	③	④
q.	Use calculators/computers for drill and practice	①	②	③	④
r.	Use calculators/computers for mathematics learning games	①	②	③	④
s.	Use calculators/computers to collect and/or analyze data	①	②	③	④
t.	Use calculators/computers to demonstrate mathematics principles	①	②	③	④
u.	Use calculators/computers for simulations and applications	①	②	③	④
v.	Use the Internet in your mathematics teaching for general reference	①	②	③	④
w.	Use the Internet in your mathematics teaching for data acquisition	①	②	③	④
x.	Use the Internet in your mathematics teaching for collaborative projects with classes/individuals in other schools	①	②	③	④

4a. Do you have each of the following degrees?

Bachelors	○ Yes	○ No
Masters	○ Yes	○ No
Doctorate	○ Yes	○ No

4b. Please indicate the subject(s) for each of your degrees.
(Darken all that apply.)

	Bachelors	**Masters**	**Doctorate**
Mathematics	○	○	○
Computer Science	○	○	○
Mathematics Education	○	○	○
Science/Science Education	○	○	○
Elementary Education	○	○	○
Other Education (e.g., History Education, Special Education)	○	○	○
Other, please specify ___________________________	○	○	○

5. Which of the following college courses have you completed? Include both semester hour and quarter hour courses, whether graduate or undergraduate level. Include courses for which you received college credit, even if you took the course in high school. (Darken all that apply.)

MATHEMATICS

- ○ Mathematics for elementary school teachers
- ○ Mathematics for middle school teachers
- ○ Geometry for elementary/middle school teachers
- ○ College algebra/trigonometry/elementary functions
- ○ Calculus
- ○ Advanced calculus
- ○ Real analysis
- ○ Differential equations
- ○ Geometry
- ○ Probability and statistics
- ○ Abstract algebra
- ○ Number theory
- ○ Linear algebra
- ○ Applications of mathematics/problem solving
- ○ History of mathematics
- ○ Discrete mathematics
- ○ Other upper division mathematics

SCIENCES/COMPUTER SCIENCES

- ○ Biological sciences
- ○ Chemistry
- ○ Physics
- ○ Physical science
- ○ Earth/space science
- ○ Engineering (any)
- ○ Computer programming
- ○ Other computer science

EDUCATION

- ○ General methods of teaching
- ○ Methods of teaching mathematics
- ○ Instructional uses of computers/other technologies
- ○ Supervised student teaching in mathematics

6. For each of the following subject areas, indicate the number of college semester and quarter courses you have completed. Count each course you have taken, regardless of whether it was a graduate or undergraduate course. If your transcripts are not available, provide your best estimates.

		Semester Courses	Quarter Courses
a.	Mathematics education	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8
b.	Calculus	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8
c.	Statistics	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8
d.	Advanced calculus	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8
e.	All <u>other</u> mathematics courses	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8
f.	Computer science	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8
g.	Science	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8	⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ >8

7. Considering all of your undergraduate and graduate **mathematics** courses, approximately what percentage were completed at each of the following types of institutions? (Darken one oval on each line.)

		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
a.	Two-year college/community college/technical school	○	○	○	○	○	○	○	○	○	○	○
b.	Four-year college/university	○	○	○	○	○	○	○	○	○	○	○

8. In what year did you last take a formal course for college credit in: (Please enter your answers in the spaces provided, then darken the corresponding oval in each column.)

a. Mathematics

	⓪	⓪	⓪
①	①	①	①
②	②	②	②
	③	③	③
	④	④	④
	⑤	⑤	⑤
	⑥	⑥	⑥
	⑦	⑦	⑦
	⑧	⑧	⑧
	⑨	⑨	⑨

b. The Teaching of Mathematics

	⓪	⓪	⓪
①	①	①	①
②	②	②	②
	③	③	③
	④	④	④
	⑤	⑤	⑤
	⑥	⑥	⑥
	⑦	⑦	⑦
	⑧	⑧	⑧
	⑨	⑨	⑨

If you have never taken a course in the teaching of mathematics, darken this oval ○ and go to question 9.

9. What is the **total** amount of time you have spent on professional development in mathematics or the teaching of mathematics in the last 12 months? in the last 3 years? (Include attendance at professional meetings, workshops, and conferences, but **do not** include formal courses for which you received college credit or time you spent **providing** professional development for other teachers.) (Darken one oval in each column.)

Hours of In-service Education	Last 12 months	Last 3 years
None	○	○
Less than 6 hours	○	○
6-15 hours	○	○
16-35 hours	○	○
More than 35 hours	○	○

PLEASE DO NOT WRITE IN THIS AREA

[SERIAL]

10. In the past **12 months**, have you:
(Darken one oval on each line.)

a.	Taught any in-service workshops in mathematics or mathematics teaching?	○ Yes	○ No
b.	Mentored another teacher as part of a formal arrangement that is recognized or supported by the school or district, not including supervision of student teachers?	○ Yes	○ No
c.	Received any local, state, or national grants or awards for mathematics teaching?	○ Yes	○ No
d.	Served on a school or district mathematics curriculum committee?	○ Yes	○ No
e.	Served on a school or district mathematics textbook selection committee?	○ Yes	○ No

11. In the past **3 years**, have you participated in any of the following activities related to mathematics or the teaching of mathematics? (Darken one oval on each line.)

a.	Taken a formal college/university mathematics course. (Please do not include courses taken as part of your undergraduate degree.)	○ Yes	○ No
b.	Taken a formal college/university course in the teaching of mathematics. (Please do not include courses taken as part of your undergraduate degree.)	○ Yes	○ No
c.	Observed other teachers teaching mathematics as part of your own professional development (formal or informal).	○ Yes	○ No
d.	Met with a local group of teachers to study/discuss mathematics teaching issues on a regular basis.	○ Yes	○ No
e.	Collaborated on mathematics teaching issues with a group of teachers at a distance using telecommunications.	○ Yes	○ No
f.	Served as a mentor and/or peer coach in mathematics teaching, as part of a formal arrangement that is recognized or supported by the school or district. (Please do not include supervision of student teachers.)	○ Yes	○ No
g.	Attended a workshop on mathematics teaching.	○ Yes	○ No
h.	Attended a national or state mathematics teacher association meeting.	○ Yes	○ No
i.	Applied or applying for certification from the National Board for Professional Teaching Standards (NBPTS).	○ Yes	○ No
j.	Received certification from the National Board for Professional Teaching Standards (NBPTS).	○ Yes	○ No

Questions 12a-12c ask about your professional development in the last 3 years. If you have been teaching for fewer than 3 years, please answer for the time that you have been teaching.

12a. Think back to **3 years ago**. How would you rate your level of need for professional development in each of these areas *at that time*? (Darken one oval on each line.)

	None Needed	Minor Need	Moderate Need	Substantial Need
Deepening my own mathematics content knowledge	○	○	○	○
Understanding student thinking in mathematics	○	○	○	○
Learning how to use inquiry/investigation-oriented teaching strategies	○	○	○	○
Learning how to use technology in mathematics instruction	○	○	○	○
Learning how to assess student learning in mathematics	○	○	○	○
Learning how to teach mathematics in a class that includes students with special needs	○	○	○	○

12b. Considering all the professional development you have participated in **during the last 3 years**, how much was each of the following emphasized? (Darken one oval on each line.)

	Not at all				To a great extent
Deepening my own mathematics content knowledge	○	○	○	○	○
Understanding student thinking in mathematics	○	○	○	○	○
Learning how to use inquiry/investigation-oriented teaching strategies	○	○	○	○	○
Learning how to use technology in mathematics instruction	○	○	○	○	○
Learning how to assess student learning in mathematics	○	○	○	○	○
Learning how to teach mathematics in a class that includes students with special needs	○	○	○	○	○

12c. Considering all your professional development in the **last 3 years**, how would you rate its impact in each of these areas? (Darken one oval on each line.)

	Little or no impact	Confirmed what I was already doing	Caused me to change my teaching practices
Deepening my own mathematics content knowledge	○	○	○
Understanding student thinking in mathematics	○	○	○
Learning how to use inquiry/investigation-oriented teaching strategies	○	○	○
Learning how to use technology in mathematics instruction	○	○	○
Learning how to assess student learning in mathematics	○	○	○
Learning how to teach mathematics in a class that includes students with special needs	○	○	○

13a. Do you teach in a **self-contained class**? (i.e., you teach multiple subjects to the same class of students all or most of the day.)

○ Yes, CONTINUE WITH QUESTIONS 13b AND 13c
○ No, SKIP TO QUESTION 14

13b. ***For teachers of self-contained classes*:** Many teachers feel better qualified to teach some subject areas than others. How well qualified do you feel to teach each of the following subjects **at the grade level(s) you teach**, whether or not they are currently included in your curriculum? (Darken one oval on each line.)

	Not Well Qualified	Adequately Qualified	Very Well Qualified
a. Life science	○	○	○
b. Earth science	○	○	○
c. Physical science	○	○	○
d. Mathematics	○	○	○
e. Reading/Language Arts	○	○	○
f. Social Studies	○	○	○

PLEASE DO NOT WRITE IN THIS AREA

[SERIAL]

13c. ***For teachers of self-contained classes:*** We are interested in knowing how much time your students spend studying various subjects. In a typical week, how many days do you have lessons on each of the following subjects, and how many minutes long is an average lesson? (*Please indicate "0" if you do not teach a particular subject to this class.* Please enter your answer in the spaces provided, then darken the corresponding oval in each column. Enter the number of minutes as a 3-digit number; e.g., if 30 minutes, enter as 030.)

Mathematics

Days Per Week	Approximate Minutes Per Day		
☐	☐	☐	☐
⓪	⓪	⓪	⓪
①	①	①	①
②		②	②
③		③	③
④		④	④
⑤		⑤	⑤
		⑥	⑥
		⑦	⑦
		⑧	⑧
		⑨	⑨

Science

Days Per Week	Approximate Minutes Per Day		
☐	☐	☐	☐
⓪	⓪	⓪	⓪
①	①	①	①
②		②	②
③		③	③
④		④	④
⑤		⑤	⑤
		⑥	⑥
		⑦	⑦
		⑧	⑧
		⑨	⑨

Social Studies

Days Per Week	Approximate Minutes Per Day		
☐	☐	☐	☐
⓪	⓪	⓪	⓪
①	①	①	①
②		②	②
③		③	③
④		④	④
⑤		⑤	⑤
		⑥	⑥
		⑦	⑦
		⑧	⑧
		⑨	⑨

Reading/Language Arts

Days Per Week	Approximate Minutes Per Day		
☐	☐	☐	☐
⓪	⓪	⓪	⓪
①	①	①	①
②	②	②	②
③		③	③
④		④	④
⑤		⑤	⑤
		⑥	⑥
		⑦	⑦
		⑧	⑧
		⑨	⑨

NOW GO TO SECTION C, PAGE 8.

14. Which of these categories best describes the way **your** classes at this school are organized? (Darken one oval.)

① a. **Departmentalized Instruction**—you teach subject matter courses (including mathematics, and perhaps other courses) to several different classes of students all or most of the day.

② b. **Elementary Enrichment Class**—you teach only mathematics in an elementary school.

③ c. **Team Teaching**—you collaborate with one or more teachers in teaching multiple subjects to the same class of students; your assignment includes mathematics.

15a. ***For teachers of non-self-contained classes:*** Within mathematics, many teachers feel better qualified to teach some topics than others. How well qualified do you feel to teach each of the following topics **at the grade level(s) you teach**, whether or not they are currently included in your curriculum? (Darken one oval on each line.)

		Not Well Qualified	Adequately Qualified	Very Well Qualified
a.	Numeration and number theory	①	②	③
b.	Computation	①	②	③
c.	Estimation	①	②	③
d.	Measurement	①	②	③
e.	Pre-algebra	①	②	③
f.	Algebra	①	②	③
g.	Patterns and relationships	①	②	③
h.	Geometry and spacial sense	①	②	③
i.	Functions (including trigonometric functions) and pre-calculus concepts	①	②	③
j.	Data collection and analysis	①	②	③
k.	Probability	①	②	③
l.	Statistics (e.g., hypothesis tests, curve fitting and regression)	①	②	③
m.	Topics from discrete mathematics (e.g., combinatorics, graph theory, recursion)	①	②	③
n.	Mathematical structures (e.g., vector spaces, groups, rings, fields)	①	②	③
o.	Calculus	①	②	③
p.	Technology (calculators, computers) in support of mathematics	①	②	③

15b. ***For teachers of non-self-contained classes*:** For each class period you are currently teaching, regardless of the subject, give *course title*, the *code-number* from the enclosed blue "List of Course Titles" that best describes the content addressed in the class, and the *number of students* in the class. (Please enter your answers in the spaces provided, then darken the corresponding oval in each column. **If you teach more than one section of a course, record each section separately below.**)

- **Note that if you have more than 39 students in any class, you will not be able to darken the ovals, but you should still write the number in the boxes.**
- **If you teach more than 6 classes per day, please provide the requested information for the additional classes on a separate sheet of paper.**

____
Course Title

Code #			# of Students	
○0	○0	○0	○0	○0
○1	○1	○1	○1	○1
○2	○2	○2	○2	○2
○3	○3	○3	○3	○3
	○4	○4		○4
	○5	○5		○5
	○6	○6		○6
	○7	○7		○7
	○8	○8		○8
	○9	○9		○9

____
Course Title

Code #			# of Students	
○0	○0	○0	○0	○0
○1	○1	○1	○1	○1
○2	○2	○2	○2	○2
○3	○3	○3	○3	○3
	○4	○4		○4
	○5	○5		○5
	○6	○6		○6
	○7	○7		○7
	○8	○8		○8
	○9	○9		○9

____
Course Title

Code #			# of Students	
○0	○0	○0	○0	○0
○1	○1	○1	○1	○1
○2	○2	○2	○2	○2
○3	○3	○3	○3	○3
	○4	○4		○4
	○5	○5		○5
	○6	○6		○6
	○7	○7		○7
	○8	○8		○8
	○9	○9		○9

____
Course Title

Code #			# of Students	
○0	○0	○0	○0	○0
○1	○1	○1	○1	○1
○2	○2	○2	○2	○2
○3	○3	○3	○3	○3
	○4	○4		○4
	○5	○5		○5
	○6	○6		○6
	○7	○7		○7
	○8	○8		○8
	○9	○9		○9

____
Course Title

Code #			# of Students	
○0	○0	○0	○0	○0
○1	○1	○1	○1	○1
○2	○2	○2	○2	○2
○3	○3	○3	○3	○3
	○4	○4		○4
	○5	○5		○5
	○6	○6		○6
	○7	○7		○7
	○8	○8		○8
	○9	○9		○9

____
Course Title

Code #			# of Students	
○0	○0	○0	○0	○0
○1	○1	○1	○1	○1
○2	○2	○2	○2	○2
○3	○3	○3	○3	○3
	○4	○4		○4
	○5	○5		○5
	○6	○6		○6
	○7	○7		○7
	○8	○8		○8
	○9	○9		○9

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[SERIAL]

C. Your Mathematics Teaching in a Particular Class

The questions in this section are about a particular mathematics class you teach. **If you teach mathematics to more than one class per day, please consult the label on the front of this questionnaire to determine which mathematics class to use to answer these questions.**

16. Using the blue "List of Course Titles," indicate the code number that best describes this course. Please enter your answer in the spaces to the right, then darken the corresponding oval in each column. (If "other" [Code 299], briefly describe content of course:

____

____

____)

Code #

○ 0	○ 0	○ 0
○ 1	○ 1	○ 1
○ 2	○ 2	○ 2
○ 3	○ 3	○ 3
	○ 4	○ 4
	○ 5	○ 5
	○ 6	○ 6
	○ 7	○ 7
	○ 8	○ 8
	○ 9	○ 9

17a. Are all students in this class in the same grade?

○ Yes, specify grade:
THEN SKIP TO QUESTION 18a ○ K ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 ○ 11 ○ 12

○ No, CONTINUE WITH QUESTION 17b

17b. What grades are represented in this class? (Darken all that apply.) For each grade noted, indicate the number of students in this class in that grade. Write your answer in the space provided, then darken the corresponding oval in each column. **Note that if more than 39 students in this class are in a single grade, you will not be able to darken the ovals, but you should still write the number in the boxes.**

○ K		○ 1		○ 2		○ 3		○ 4		○ 5		○ 6		○ 7		○ 8		○ 9		○ 10		○ 11		○ 12	
○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0
○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1
○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2
○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3
	○ 4		○ 4		○ 4		○ 4		○ 4		○ 4		○ 4		○ 4		○ 4		○ 4		○ 4		○ 4		○ 4
	○ 5		○ 5		○ 5		○ 5		○ 5		○ 5		○ 5		○ 5		○ 5		○ 5		○ 5		○ 5		○ 5
	○ 6		○ 6		○ 6		○ 6		○ 6		○ 6		○ 6		○ 6		○ 6		○ 6		○ 6		○ 6		○ 6
	○ 7		○ 7		○ 7		○ 7		○ 7		○ 7		○ 7		○ 7		○ 7		○ 7		○ 7		○ 7		○ 7
	○ 8		○ 8		○ 8		○ 8		○ 8		○ 8		○ 8		○ 8		○ 8		○ 8		○ 8		○ 8		○ 8
	○ 9		○ 9		○ 9		○ 9		○ 9		○ 9		○ 9		○ 9		○ 9		○ 9		○ 9		○ 9		○ 9

18a. What is the total number of students in this class? Write your answer in the space provided, then darken the corresponding oval in each column. **Note that if you have more than 39 students in this class , you will not be able to darken the ovals, but you should still write the number in the boxes.**

○ 0	○ 0
○ 1	○ 1
○ 2	○ 2
○ 3	○ 3
	○ 4
	○ 5
	○ 6
	○ 7
	○ 8
	○ 9

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18b. Please indicate the number of students in this class in each of the following categories. Consult the enclosed federal guidelines at the end of the course list (blue sheet) if you have any questions about how to classify particular students. (Please enter your answers in the spaces provided, then darken the corresponding oval in each column.)

RACE/ETHNICITY

American Indian or Alaskan Native		Asian		Black or African-American		Hispanic or Latino (any race)		Native Hawaiian or Other Pacific Islander		White	
Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐
0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2
3 3	3 3	3 3	3 3	3 3	3 3	3 3	3 3	3 3	3 3	3 3	3 3
4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9

19a. **Questions 19a and 19b apply only to teachers of non-self-contained classes. If you teach a self-contained class, please darken this oval** ○ **and skip to question 20.** What is the usual schedule and length (in minutes) of daily class meetings for this class? If the weekly schedule is normally the same, just complete Week 1, as in Example 1. If you are unable to describe this class in the format below, please attach a separate piece of paper with your description.

	Week 1	**Week 2**
Monday	____________	____________
Tuesday	____________	____________
Wednesday	____________	____________
Thursday	____________	____________
Friday	____________	____________

Examples

Example 1		**Example 2**	
Week 1	Week 2	Week 1	Week 2
45	_____	90	_____
45	_____	_____	90
45	_____	90	_____
45	_____	_____	90
45	_____	90	_____

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☐	0	1	2	3	4	5	6	7	8	9	☐	0	1	2	3	4	5	6	7	8	9
☐	0	1	2	3	4	5	6	7	8	9	☐	0	1	2	3	4	5	6	7	8	9
☐	0	1	2	3	4	5	6	7	8	9	☐	0	1	2	3	4	5	6	7	8	9

19b. What is the calendar duration of this mathematics class? (Darken one oval.)

○ Year
○ Semester
○ Quarter

20. Are students assigned to this class by level of ability? (Darken one oval.) ○ Yes ○ No

21. Which of the following best describes the ability of the students in this class relative to other students in this school? (Darken one oval.)

○ Fairly homogeneous and low in ability
○ Fairly homogeneous and average in ability
○ Fairly homogeneous and high in ability
○ Heterogeneous, with a mixture of two or more ability levels

22. Indicate if any of the students in this mathematics class are **formally** classified as each of the following: (Darken all that apply.)

○ Limited English Proficiency
○ Learning Disabled
○ Mentally Handicapped
○ Physically Handicapped, please specify handicap(s): ____________________

23. Think about your plans for this mathematics class for the entire course. How much emphasis will each of the following **student objectives** receive? (Darken one oval on each line.)

		None	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis
a.	Increase students' interest in mathematics	○	○	○	○
b.	Learn mathematical concepts	○	○	○	○
c.	Learn mathematical algorithms/procedures	○	○	○	○
d.	Develop students' computational skills	○	○	○	○
e.	Learn how to solve problems	○	○	○	○
f.	Learn to reason mathematically	○	○	○	○
g.	Learn how mathematics ideas connect with one another	○	○	○	○
h.	Prepare for further study in mathematics	○	○	○	○
i.	Understand the logical structure of mathematics	○	○	○	○
j.	Learn about the history and nature of mathematics	○	○	○	○
k.	Learn to explain ideas in mathematics effectively	○	○	○	○
l.	Learn how to apply mathematics in business and industry	○	○	○	○
m.	Learn to perform computations with speed and accuracy	○	○	○	○
n.	Prepare for standardized tests	○	○	○	○

24. About how often do **you** do each of the following in your mathematics instruction? (Darken one oval on each line.)

		Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all mathematics lessons
a.	Introduce content through formal presentations	○	○	○	○	○
b.	Pose open-ended questions	○	○	○	○	○
c.	Engage the whole class in discussions	○	○	○	○	○
d.	Require students to explain their reasoning when giving an answer	○	○	○	○	○
e.	Ask students to explain concepts to one another	○	○	○	○	○
f.	Ask students to consider alternative methods for solutions	○	○	○	○	○
g.	Ask students to use multiple representations (e.g., numeric, graphic, geometric, etc.)	○	○	○	○	○
h.	Allow students to work at their own pace	○	○	○	○	○
i.	Help students see connections between mathematics and other disciplines	○	○	○	○	○
j.	Assign mathematics homework	○	○	○	○	○
k.	Read and comment on the reflections students have written, e.g., in their journals	○	○	○	○	○

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■ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ■ ■ ■ ■ ■ ■ [SERIAL]

25. About how often do students in this **mathematics** class take part in the following types of activities? (Darken one oval on each line.)

		Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all mathematics lessons
a.	Listen and take notes during presentation by teacher	①	②	③	④	⑤
b.	Work in groups	①	②	③	④	⑤
c.	Read from a mathematics textbook in class	①	②	③	④	⑤
d.	Read other (non-textbook) mathematics-related materials in class	①	②	③	④	⑤
e.	Engage in mathematical activities using concrete materials	①	②	③	④	⑤
f.	Practice routine computations/algorithms	①	②	③	④	⑤
g.	Review homework/worksheet assignments	①	②	③	④	⑤
h.	Follow specific instructions in an activity or investigation	①	②	③	④	⑤
i.	Design their *own* activity or investigation	①	②	③	④	⑤
j.	Use mathematical concepts to interpret and solve applied problems	①	②	③	④	⑤
k.	Answer textbook or worksheet questions	①	②	③	④	⑤
l.	Record, represent, and/or analyze data	①	②	③	④	⑤
m.	Write reflections (e.g., in a journal)	①	②	③	④	⑤
n.	Make formal presentations to the rest of the class	①	②	③	④	⑤
o.	Work on extended mathematics investigations or projects (a week or more in duration)	①	②	③	④	⑤
p.	Use calculators or computers for learning or practicing skills	①	②	③	④	⑤
q.	Use calculators or computers to develop conceptual understanding	①	②	③	④	⑤
r.	Use calculators or computers as a tool (e.g., spreadsheets, data analysis)	①	②	③	④	⑤

26. About how often do students in this mathematics class use **calculators/computers** to: (Darken one oval on each line.)

		Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all mathematics lessons
a.	Do drill and practice	①	②	③	④	⑤
b.	Demonstrate mathematics principles	①	②	③	④	⑤
c.	Play mathematics learning games	①	②	③	④	⑤
d.	Do simulations	①	②	③	④	⑤
e.	Collect data using sensors or probes	①	②	③	④	⑤
f.	Retrieve or exchange data	①	②	③	④	⑤
g.	Solve problems using simulations	①	②	③	④	⑤
h.	Take a test or quiz	①	②	③	④	⑤

27. How often do you assess student progress in mathematics in each of the following ways? (Darken one oval on each line.)

		Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all mathematic lessons
a.	Conduct a pre-assessment to determine what students already know.	①	②	③	④	⑤
b.	Observe students and ask questions as they work individually.	①	②	③	④	⑤
c.	Observe students and ask questions as they work in small groups.	①	②	③	④	⑤
d.	Ask students questions during large group discussions.	①	②	③	④	⑤
e.	Use assessments embedded in class activities to see if students are "getting it"	①	②	③	④	⑤
f.	Review student homework.	①	②	③	④	⑤
g.	Review student notebooks/journals.	①	②	③	④	⑤
h.	Review student portfolios.	①	②	③	④	⑤
i.	Have students do long-term mathematics projects.	①	②	③	④	⑤
j.	Have students present their work to the class.	①	②	③	④	⑤
k.	Give predominantly short-answer tests (e.g., multiple choice, true/false, fill in the blank).	①	②	③	④	⑤

Question 27 continues on next page...

27. *continued*

		Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all mathematics lessons
l.	Give tests requiring open-ended responses (e.g., descriptions, explanations).	①	②	③	④	⑤
m.	Grade student work on open-ended and/or laboratory tasks using defined criteria (e.g., a scoring rubric).	①	②	③	④	⑤
n.	Have students assess each other (peer evaluation).	①	②	③	④	⑤

28. For the following equipment, please indicate the extent to which each is available, whether or not each is needed, and the extent to which each is integrated in this mathematics class.

		Not at all Available		Readily Available	Needed?		Never use in this course	Use in specific parts of this course	Fully integrated into this course
a.	Overhead projector	①	②	③	Ⓝ	Ⓨ	①	②	③
b.	Videotape player	①	②	③	Ⓝ	Ⓨ	①	②	③
c.	Videodisc player	①	②	③	Ⓝ	Ⓨ	①	②	③
d.	CD-ROM player	①	②	③	Ⓝ	Ⓨ	①	②	③
e.	Four-function calculators	①	②	③	Ⓝ	Ⓨ	①	②	③
f.	Fraction calculators	①	②	③	Ⓝ	Ⓨ	①	②	③
g.	Graphing calculators	①	②	③	Ⓝ	Ⓨ	①	②	③
h.	Scientific calculators	①	②	③	Ⓝ	Ⓨ	①	②	③
i.	Computers	①	②	③	Ⓝ	Ⓨ	①	②	③
j.	Calculator/computer lab interfacing devices	①	②	③	Ⓝ	Ⓨ	①	②	③
k.	Computers with Internet connection	①	②	③	Ⓝ	Ⓨ	①	②	③

29. How much of your own money do you estimate you will spend for supplies for this mathematics class this school year (or semester or quarter if not a full-year course)? (Please enter your answer as a 3-digit number rounded to the nearest dollar, i.e., enter $25.19 as 025. Enter your answer in the spaces to the right, then darken the corresponding oval in each column.)

$		
⓪	⓪	⓪
①	①	①
②	②	②
③	③	③
④	④	④
⑤	⑤	⑤
⑥	⑥	⑥
⑦	⑦	⑦
⑧	⑧	⑧
⑨	⑨	⑨

If none, darken this oval: ⓪

30. How much of your own money do you estimate you will spend for your own professional development activities during the period Sept. 1, 1999 - Aug. 31, 2000? (Please enter your answer as a 3-digit number rounded to the nearest dollar, i.e., enter $25.19 as 025. Enter your answer in the spaces to the right, then darken the corresponding oval in each column.)

$		
⓪	⓪	⓪
①	①	①
②	②	②
③	③	③
④	④	④
⑤	⑤	⑤
⑥	⑥	⑥
⑦	⑦	⑦
⑧	⑧	⑧
⑨	⑨	⑨

If none, darken this oval: ⓪

31. How much control do you have over each of the following for this mathematics class? (Darken one oval on each line.)

		No Control				Strong Control
a.	Determining course goals and objectives	①	②	③	④	⑤
b.	Selecting textbooks/instructional programs	①	②	③	④	⑤
c.	Selecting other instructional materials	①	②	③	④	⑤
d.	Selecting content, topics, and skills to be taught	①	②	③	④	⑤
e.	Selecting the sequence in which topics are covered	①	②	③	④	⑤
f.	Setting the pace for covering topics	①	②	③	④	⑤
g.	Selecting teaching techniques	①	②	③	④	⑤
h.	Determining the amount of homework to be assigned	①	②	③	④	⑤
i.	Choosing criteria for grading students	①	②	③	④	⑤
j.	Choosing tests for classroom assessment	①	②	③	④	⑤

PLEASE DO NOT WRITE IN THIS AREA

[SERIAL]

32. How much mathematics homework do you assign to this mathematics class in a typical **week**? (Darken one oval.)

○ 0-30 min ○ 31-60 min ○ 61-90 min ○ 91-120 min ○ 2-3 hours ○ More than 3 hours

33a. Are you using one or more commercially published textbooks or programs for teaching mathematics to this class? (Darken one oval.)

○ No, SKIP TO SECTION D, PAGE 14
○ Yes, CONTINUE WITH 33b

33b. Which best describes your use of textbooks/programs in this class? (Darken one oval.)

○ Use one textbook or program all or most of the time
○ Use multiple textbooks/programs

34. Indicate the publisher of the **one** textbook/program used **most often** by students in this class. (Darken one oval.)

○ Addison Wesley Longman, Inc/Scott Foresman
○ Brooks/Cole Publishing Co
○ CORD Communications
○ Creative Publications
○ Dale Seymour Publications
○ EFA & Associates
○ Encyclopaedia Britannica
○ Everyday Learning Corporation
○ Globe Fearon, Inc / Cambridge
○ Harcourt Brace/Harcourt, Brace & Jovanovich
○ Holt, Rinehart and Winston, Inc
○ Houghton Mifflin Company/McDougal Littell/D.C. Heath
○ Kendall Hunt Publishing
○ Key Curriculum Press
○ McGraw-Hill/Merrill Co (including CTB/McGraw-Hill, Charles Merrill Publishing, Glencoe/McGraw-Hill, Macmillan/McGraw-Hill, McGraw-Hill School Division, Merrill/Glencoe, SRA/McGraw-Hill)
○ Optical Data Corporation
○ Prentice Hall, Inc.
○ Saxon Publishers
○ Silver Burdett Ginn
○ South-Western Educational Publishing
○ VideoText Interactive
○ Wadsworth Publishing
○ West Educational Publishing

○ Other, please specify: ____

35a. Please indicate the title, author, and publication year of the **one** textbook/program used **most often** by students in this class.

Title: ____

First Author: ____

Publication Year: __________ Edition: ____________

For office use only

○0	○0	○0	○0
○1	○1	○1	○1
○2	○2	○2	○2
	○3	○3	○3
	○4	○4	○4
	○5	○5	○5
	○6	○6	○6
	○7	○7	○7
	○8	○8	○8
	○9	○9	○9

35b. Approximately what percentage of this textbook/program will you "cover" in this course? (Darken one oval.)

○ < 25% ○ 25-49% ○ 50-74% ○ 75-90% ○ >90%

35c. How would you rate the overall quality of this textbook/program? (Darken one oval.)

○ Very Poor ○ Poor ○ Fair ○ Good ○ Very Good ○ Excellent

D. Your Most Recent Mathematics Lesson in This Class

Questions 36-38 refer to the last time you taught mathematics to this class. Do not be concerned if this lesson was not typical of instruction in this class. (Please enter your answers as 3-digit numbers, i.e., if 30 minutes, enter as 030. Enter your answers in the spaces provided, then darken the corresponding oval in each column.)

36a. How many minutes were allocated to the most recent mathematics lesson? Note: Teachers in departmentalized and other non-self-contained settings should answer for the entire length of the class period, even if there were interruptions.

○0	○0	○0
○1	○1	○1
	○2	○2
	○3	○3
	○4	○4
	○5	○5
	○6	○6
	○7	○7
	○8	○8
	○9	○9

36b. Of these, how many minutes were spent on the following:
(The sum of the numbers in 1.-6. below should equal your response in 36a.)

1. Daily routines, interruptions, and other non-instructional activities	2. Whole class lecture/discussions	3. Individual students reading textbooks, completing worksheets, etc.	4. Working with hands-on or manipulative materials	5. Non-manipulative small group work	6. Other
○0 ○0 ○0	○0 ○0 ○0	○0 ○0 ○0	○0 ○0 ○0	○0 ○0 ○0	○0 ○0 ○0
○1 ○1 ○1	○1 ○1 ○1	○1 ○1 ○1	○1 ○1 ○1	○1 ○1 ○1	○1 ○1 ○1
○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2	○2 ○2
○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3	○3 ○3
○4 ○4	○4 ○4	○4 ○4	○4 ○4	○4 ○4	○4 ○4
○5 ○5	○5 ○5	○5 ○5	○5 ○5	○5 ○5	○5 ○5
○6 ○6	○6 ○6	○6 ○6	○6 ○6	○6 ○6	○6 ○6
○7 ○7	○7 ○7	○7 ○7	○7 ○7	○7 ○7	○7 ○7
○8 ○8	○8 ○8	○8 ○8	○8 ○8	○8 ○8	○8 ○8
○9 ○9	○9 ○9	○9 ○9	○9 ○9	○9 ○9	○9 ○9

37. Which of the following activities took place during that mathematics lesson? (Darken all that apply.)

○ Lecture
○ Discussion
○ Students completing textbook/worksheet problems
○ Students doing hands-on/manipulative activities
○ Students reading about mathematics
○ Students working in small groups
○ Students using calculators
○ Students using computers
○ Students using other technologies
○ Test or quiz
○ None of the above

38. Did that lesson take place on the most recent day you met with that class? ○ Yes ○ No

PLEASE DO NOT WRITE IN THIS AREA

[SERIAL]

E. Demographic Information

39. Indicate your sex:

○ Male
○ Female

40. Are you: (Darken all that apply.)

○ American Indian or Alaskan Native
○ Asian
○ Black or African-American
○ Hispanic or Latino
○ Native Hawaiian or Other Pacific Islander
○ White

41. In what year were you born? (Enter the last two digits of the year you were born; e.g., if you were born in 1959, enter 59. Please enter your answer in the spaces to the right, then darken the corresponding oval in each column.)

○ 0	○ 0
○ 1	○ 1
○ 2	○ 2
○ 3	○ 3
○ 4	○ 4
○ 5	○ 5
○ 6	○ 6
○ 7	○ 7
○ 8	○ 8
○ 9	○ 9

42. How many years have you taught at the K-12 level prior to this school year? (Please enter your answer in the spaces to the right, then darken the corresponding oval in each column.)

○ 0	○ 0
○ 1	○ 1
○ 2	○ 2
○ 3	○ 3
○ 4	○ 4
○ 5	○ 5
	○ 6
	○ 7
	○ 8
	○ 9

43. If you have an email address, please write it here: ____

44. When did you complete this questionnaire? Date: ______ / _______ / _______
Month Day Year

Please make a photocopy of this questionnaire and keep it in case the original is lost in the mail. Please return the original to:

2000 National Survey of Science and Mathematics Education
Westat
1650 Research Blvd.
TB120F
Rockville, MD 20850

THANK YOU!

FOR OFFICE USE ONLY
Please do not write in this area.

○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0
○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1
○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2
○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3
○ 4	○ 4	○ 4	○ 4	○ 4	○ 4	○ 4	○ 4	○ 4	○ 4
○ 5	○ 5	○ 5	○ 5	○ 5	○ 5	○ 5	○ 5	○ 5	○ 5
○ 6	○ 6	○ 6	○ 6	○ 6	○ 6	○ 6	○ 6	○ 6	○ 6
○ 7	○ 7	○ 7	○ 7	○ 7	○ 7	○ 7	○ 7	○ 7	○ 7
○ 8	○ 8	○ 8	○ 8	○ 8	○ 8	○ 8	○ 8	○ 8	○ 8
○ 9	○ 9	○ 9	○ 9	○ 9	○ 9	○ 9	○ 9	○ 9	○ 9

LIST OF COURSE TITLES

A. SCIENCE COURSES

CODE	Course Category	Sample Course Titles
	Grades K – 5	
100	Science, Grade K	
101	Science, Grade 1	
102	Science, Grade 2	
103	Science, Grade 3	
104	Science, Grade 4	
105	Science, Grade 5	
106	Other Elementary Science	
	Grades 6 – 8	
108	Life Science	
109	Earth Science	
110	Physical Science	
111	General Science	
112	Integrated Science	
	Grades 9 – 12	
	Biology	
114	1st Year	Introductory Biology; Biology I; General Biology; College Prep Biology; Honors Biology
115	1st Year, Applied	Basic Biology; Applied Biology; Life Science; Biomedical Education; Animal Science; Horticulture; Biology Science; Health Science; Nutrition; Agriculture Science; Fundamentals of Biology
116	2nd Year, AP	Advanced Placement
117	2nd Year, Advanced	Biology II; Advanced Biology; College Biology; Physiology; Anatomy; Microbiology; Genetics; Cell Biology; Embryology; Molecular Biology; Invertebrate/Vertebrate Biology
118	2nd Year, Other	Zoology; Botany; Bio-Medical Careers; Field Biology; Marine Biology; Other Biological Sciences
	Chemistry	
119	1st Year	Introductory Chemistry; Chemistry I; General Chemistry; Honors Chemistry
120	1st Year, Applied	Applied Chemistry; Consumer Chemistry; Technical Chemistry; Practical Chemistry
121	2nd Year, AP	Advanced Placement Chemistry
122	2nd Year, Advanced	Chemistry II; Advanced Chemistry; College Chemistry; Organic Chemistry; Inorganic Chemistry; Physical Chemistry; Biochemistry; Analytical Chemistry
	Physics	
123	1st Year	Introductory Physics; Physics I; General Physics; Honors Physics;
124	1st Year, Applied	Applied Physics; Electronics; Radiation Physics; Practical Physics
125	2nd Year, AP	Advanced Placement Physics
126	2nd Year, Advanced	Physics II; Advanced Physics; College Physics; Nuclear Physics; Atomic Physics
127	Physical Science	Physical Science; Interaction of Matter and Energy; Applied Physical Science
	Earth Science	
128	Astronomy *	* NOTE: A course that includes substantial content from two or more of the earth sciences should be listed under code 132, 133, or 134.
129	Geology*	
130	Meteorology*	
131	Oceanography/Marine Science*	
132	1st Year	Earth Science; Earth/Space Science; Honors Earth Science
133	1st Year, Applied	Applied Earth Science; Fundamentals of Earth Science; Soil Science
134	2nd Year, Advanced/Other	Advanced Earth Science; Earth Science II
	Other Science	
135	General Science	General Science; Basic Science; Introductory Science; Investigations in Science
136	Environmental Science	Ecology; Environmental Science
137	Coordinated Science	Coordinated Science includes content from more than one science discipline, e.g., life and physical science, but keeps the disciplines separate
138	Integrated Science	Integrated Science includes content from the various science disciplines and blurs the distinctions among them
199	Other Science	

Course titles continue on next page…

B. MATHEMATICS COURSES

CODE	Course Category	Sample Course Titles
	Grades K – 5	
200	Mathematics, Grade K	
201	Mathematics, Grade 1	
202	Mathematics, Grade 2	
203	Mathematics, Grade 3	
204	Mathematics, Grade 4	
205	Mathematics, Grade 5	
206	Other Elementary Mathematics	
	Grades 6 – 8	
208	Remedial Mathematics 6	Remedial Math 6
209	Regular Mathematics 6	Math 6; Math Grade 6 regular
210	Accelerated/Pre-Algebra Mathematics 6	Accelerated Math 6; Pre-Algebra; Honors Math 6; Enriched Math 6;
211	Remedial Mathematics 7	Remedial Math 7
212	Regular Mathematics 7	Math 7; Math Grade 7 regular
213	Accelerated Mathematics 7	Accelerated Math 7; Pre-Algebra; Honors Math 7; Enriched Math 7;
214	Remedial Mathematics 8	Remedial Math 8
215	Regular Mathematics 8	Math 8; Math Grade 8 regular
216	Enriched Mathematics 8	Pre-Algebra; Accelerated Math 8[1]; Honors Math 8; Enriched Math 8
217	Algebra 1, Grade 7 or 8	Algebra 1; Beginning Algebra; Elementary Algebra
218	Integrated Middle Grade Math, 7 or 8	Integrated Math 7 or 8; Connected Math 7 or 8
	Grades 9 – 12	
	Review Mathematics	
219	Rev. Math Level 1	General Math 1; Basic Math; Math 9; Remedial Math; Developmental; High School Arithmetic; Math Comp Test; Comprehensive Math; Terminal Math
220	Rev. Math Level 2	General Math 2; Vocational Math; Consumer; Technical; Business; Shop; Math 10; Career Math; Practical Math; Essential Math; Cultural Math
221	Rev. Math Level 3	General Math 3; Math 11; Intermediate Math;
222	Rev. Math Level 4	General Math 4; Math 12; Mathematics of Consumer Economics
	Informal Mathematics	
223	Inf. Math Level 1	Pre-Algebra; Introductory Algebra; Basic; Applications; Algebra 1A (first of a two-year sequence for Algebra 1); Math A; Applied Math 1[2]
224	Inf. Math Level 2	Basic Geometry; Informal Geometry; Practical Geometry; Applied Math 2
225	Inf. Math Level 3	Applied Math 3, 4
	Formal Mathematics	
226	For. Math Level 1	Algebra 1; Elementary; Beginning; Unified Math I; Integrated Math 1; Algebra 1B (second year of a two-year sequence for Algebra 1); Math B
227	For. Math Level 2	Geometry; Plane Geometry; Solid Geometry; Integrated Math 2; Unified Math II; Math C
228	For. Math Level 3	Algebra 2; Intermediate Algebra; Algebra and Trigonometry; Advanced Algebra: Algebra and Analytic Geometry; Integrated Math 3; Unified Math III
229	For. Math Level 4	Algebra 3; Trigonometry; College Algebra; Pre-Calculus; Analytic/Advanced Geometry; Trigonometry and Analytic/Solid Geometry; Advanced Math Topics; Introduction to College Math; Number Theory; Math IV; College Prep Senior Math; Elementary Functions; Finite Math; Math Analysis; Numerical Analysis; Discrete Math; Probability; Statistics
230	For. Math Level 5	Calculus and Analytic Geometry; Calculus; Abstract Algebra; Differential Equations; Multivariate Calculus; Linear Algebra; Theory of Equations; Vectors/Matrix Algebra;
231	For. Math Level 5, AP	Advanced Placement Calculus (AB, BC); Advanced Placement Statistics
	Other Mathematics Courses	
232	Probability and Statistics	
233	Mathematics integrated with other subjects	
299	Other Mathematics	

Course titles continue on next page…

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[1] If Accelerated Math 8 is the same as Algebra 1 in your state, report the data under Math Grade 8, Algebra 1, and not Math Grade 8, Enriched.

[2] If Applied Math course includes some algebra and geometry, report under Informal Math, Level 1. If it does not, report under Review Math, Level 2.

C. OTHER COURSES

CODE	Course Category
301	Computer Science
302	Social Studies/History
303	English/Language Arts/Reading
304	Business Education
305	Vocational Education
306	Technology Education
307	Foreign Language
308	Health/Physical Education
309	Art/Music/Drama
399	Other subject

Federally Approved Definitions for Race/Ethnicity Categories

American Indian or Alaskan Native. A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.

Asian. A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.

Black or African-American. A person having origins in any of the black racial groups of Africa.

Hispanic or Latino. A person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race.

Native Hawaiian or Other Pacific Islander. A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.

White. A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

Appendix C

Pre-Survey Mailouts

Principal Letter

Fact Sheet

Information Needed Before the Survey

2000 National Survey of Science and Mathematics Education

Horizon Research, Inc.
111 Cloister Court, Suite 220
Chapel Hill, NC 27514-2296
PHN: (919) 489-1725 FAX: (919) 493-7589

WESTAT
1650 Research Boulevard
Rockville, MD 20850-3129
PHN: (800) 937-8288 FAX: (301) 294-2040

September 1, 1999

Dear Principal,

The purpose of this letter is to let you know that your school has been selected for the 2000 National Survey of Science and Mathematics Education and to request your cooperation in this effort. A total of 1,800 public and private schools and 9,000 K-12 teachers throughout the United States will be involved in the 2000 Survey. The survey, initiated by the National Science Foundation, is the fourth in a series of national surveys of science and mathematics education (the others were in 1977, 1985, and 1993). The enclosed *Fact Sheet* provides more information about the study.

The 2000 Survey will help determine how well prepared schools and teachers are for effective science and mathematics education, what would help them do a better job, and how federal resources can best be used to improve science and mathematics education. The survey is being conducted by Horizon Research, Inc., under the direction of Dr. Iris R. Weiss. Data collection is the responsibility of Westat, in Rockville, Maryland.

To help compensate participants for their time, the study has arranged to give each school a voucher to be used in purchasing science and mathematics education materials, including NCTM's *Curriculum and Evaluation Standards*, Project 206l's *Science for All Americans*, and NRC's *National Science Education Standards*, as well as calculators and other materials for classroom use. The amount of the voucher will depend on response rates, with each participating school receiving $50, plus $15 for each responding teacher. In addition, each school will receive a copy of the results of the survey.

The survey has two stages.

1. At this time, we ask that you complete the enclosed booklet and return it to us in the enclosed postage-paid envelope. The booklet requests that you:

   Part 1: Designate individuals, such as department heads, to receive the science and mathematics program questionnaires. We also request that you designate someone to serve as our contact point for the survey.

   Part 2: List all teachers responsible for science and/or mathematics instruction at your school, including teachers in self-contained classrooms. Instructions for creating the list have been included in the booklet.

   Part 3: Provide some basic background information about your school.

   When all booklets have been received, Westat will draw a sample of teachers at each school. On average, we will sample five teachers for each school.

2. In January 2000, we will mail teacher questionnaires and the two program questionnaires to the attention of the individual you designated as our contact point. Teacher questionnaires will take an average of 20-30 minutes to complete. The science and mathematics program questionnaires will take about 10 minutes. Respondents will be asked to return questionnaires directly to us, using the postage-paid envelopes provided.

Your cooperation is greatly appreciated. Please return the completed booklet for your school within the next 10 days so that we can begin the teacher selection process. If you have any questions about any of the items in the booklet or the study in general, please call us toll-free at 1-800-937-8288. Ask for the Science and Mathematics Survey specialist.

Thank you for your cooperation.

Sincerely,

Diane Ward
Data Collection Coordinator

DW/pss
Enclosures

2000 NATIONAL SURVEY OF SCIENCE AND MATHEMATICS EDUCATION

FACT SHEET

Overview

Approximately 1,800 schools in more than 1,200 school districts throughout the United States have been selected to participate in the 2000 National Survey of Science and Mathematics Education. The survey has been designed to collect information about science and mathematics education in grades K-12. It is being conducted by Horizon Research, Inc., under the direction of Dr. Iris R. Weiss. Data collection is the responsibility of Westat, in Rockville, Md. This is the fourth in a series of studies, initiated by the National Science Foundation in 1977.

Background and Purpose

The purpose of the survey is to provide the education community with accurate and current information about science and mathematics education and trends in the following areas.

- Science and mathematics course offerings and enrollments;
- Availability of facilities and equipment;
- Instructional techniques;
- Textbook usage;
- Teacher background; and
- Needs for in-service education.

How Schools Were Selected

A total of 1,800 schools were randomly selected, using the Quality Education Data (QED) database as a sampling frame. To ensure adequate representation for national and regional estimates, all schools in the country were stratified as follows before the sample was drawn:

- Grade span
- Region of the country
- Metropolitan status
- Public versus private
- Orshansky percentile

District superintendents were notified of the schools in their district selected for the survey. Approximately 9,000 teachers will be selected for the survey from lists of mathematics and science teachers provided by school principals. On average, five teachers will be selected from each school.

Survey Schedule

The survey is being conducted according to the following schedule:

Commissioners of Education notified	June 1999

District offices with sampled schools notified	June 1999
Mail to schools for list of teachers	Sept. 1999
Mail questionnaires to sampled teachers	Jan. 2000
Study results available	Spring 2001

Survey Questionnaires

In January 2000, we will mail questionnaires for all sampled teachers and department heads to the individual the principal has designated as the survey coordinator for the school. The coordinator will be asked to distribute the questionnaires within the school.

Each sampled teacher will receive one of the following types of questionnaires:

- Science Teacher Questionnaire
- Mathematics Teacher Questionnaire

Questionnaires will take about 25 minutes to complete. If the teacher has been categorized as both a mathematics and science teacher, the assignment of questionnaire type will be randomized.

Also included in the packet will be a short questionnaire (10 minutes) for each department head: the School Science Program Questionnaire and the School Mathematics Program Questionnaire.

Respondents who have any questions about items in the questionnaire can call us toll-free at 1-800-937-8288. A postage-paid return envelope will be included with each questionnaire. Once the questionnaire is completed, the teacher may simply seal it and drop it in the mail.

Confidentiality

All survey data received by Westat will be kept strictly confidential and will be reported only in aggregate form, such as by grade level or region of the country. No information identifying individual districts, schools, or teachers will be released. No identifying information whatsoever will be included in the dataset.

In Appreciation for Participation

While every school and teacher's cooperation is important to obtain accurate results, participation is voluntary. To compensate participants for their time, the study has arranged to give each school a voucher to be used in purchasing science and mathematics education materials. The amount of the voucher will depend on the degree each school participates. Each school completing the teacher listing phase and program head questions will receive a $50 voucher. Additionally, $15 will be given for each responding teacher. At the conclusion of the study, each school will receive a copy of the results of the survey.

2000 NATIONAL SURVEY OF SCIENCE AND MATHEMATICS EDUCATION

INFORMATION NEEDED BEFORE THE SURVEY

LABEL

Please complete the following items and return them to Westat in the enclosed postage-paid envelope. There are three parts:

Part 1: Designation of department heads and school survey coordinator.

Part 2: School background information.

Part 3: Names of science and mathematics teachers for sampling purposes.

If you have any questions, please call the Westat 2000 Survey information line at 1-800-937-8288 or e-mail us at 2000survey@westat.com.

Part 1. Designations

1. To whom should we address the School Science Program Questionnaire? This should be completed by the science department head or other staff member who is most knowledgeable about the science curriculum for all grades at your school. (The questionnaire takes about 10 minutes.)

Name ______________________ *Title* ______________________

2. To whom should we address the School Mathematics Program Questionnaire. This should be completed by the mathematics department head or other staff member who is most knowledgeable about the mathematics curriculum for all grades at your school. (The questionnaire takes about 10 minutes.)

Name ______________________ *Title* ______________________

3. We would like you to designate someone to serve as our contact point at the school. (We will send all questionnaires to this person for distribution to teachers/department heads.)

Name of contact ______________________ *Title* ______________________

(   ) ______________________ *Telephone number*

(   ) ______________________ *Fax number*

Part 2. Background Information About This School

1. How many K-12 students are there in this school at the present time? __________

2. Which grades are included in this school? *(Circle all that apply.)*

K 1 2 3 4 5 6 7 8 9 10 11 12

3. Which one of the following best describes the community in which this school is located?

A rural or farming community	01
A small city or town of fewer than 50,000 that is not a suburb of a large city	02
A medium-sized city (50,000 to 100,000 people)	03
A suburb of a medium-sized city	04
A large city (100,000 to 500,000 people)	05
A suburb of a large city	06
A very large city (over 500,000 people)	07
A suburb of a very large city	08
A military base or station	09
An Indian reservation	10

4. Does this school provide Chapter 1 services under the Elementary and Secondary Education Act as amended (i.e., Federal funds for the special educational needs of disadvantaged children)?

Yes .... 1 → **IF YES:** How many K-12 students are served? _________
No........... 2

5. Are any of the students in this school eligible for free or reduced-price lunches that are paid for with public funds (e.g., Federal government or other government)?

Yes .... 1 → **IF YES:** How many K-12 students received free or reduced-price lunches? _________
No........... 2

Part 2. Background Information About This School (CONTINUED)

6. Approximately what percentage of the students attending this school are: *(Round to the nearest **one-tenth** percent.)*

a. American Indian/Alaskan Native .... ______ %
b. Asian.. ______ %
c. Black/African American .... ______ %
d. Hispanic/Latino... ______ %
e. Native Hawaiian/Other Pacific Islander.. ______ %
f. White.. ______ %
TOTAL 100%

7. If we have questions about the information that has been provided, who should we contact?

a. Name: ____

b. Title: ____

c. Phone (______)____

d. E-mail: ____

PLEASE RETURN THESE MATERIALS TO WESTAT IN THE ENVELOPE PROVIDED BY OCTOBER 1, 1999 OR MAIL TO:

2000 SURVEY [TA150F]
C/O WESTAT
1650 RESEARCH BOULEVARD
ROCKVILLE, MD 20850

QUESTIONNAIRES WILL BE MAILED TO YOUR SCHOOL IN JANUARY, 2000.

THANK YOU FOR YOUR ASSISTANCE.

Part 3. Listing of Science and Mathematics Teachers

Instructions

On the following sheets*, please list every teacher in this school who is responsible for science and/or mathematics instruction. We will use this list to randomly select a sample of approximately five (5) teachers to receive questionnaires.

1. List all teachers who will be teaching science/mathematics at this school in the 1999-2000 school year. (If a teacher has been designated to receive the science or mathematics program questionnaire, the teacher should still be listed.)

2. Do not include teacher aides or teachers responsible only for special education or “pull-out” classes for remediation or enrichment of students who also receive science/mathematics instruction from the regular classroom teacher.

3. For each teacher you list, please indicate the type of class:

   - If the teacher has a self-contained class, such as in the elementary grades, circle 1.

   - If the teacher has classes that are not self-contained, circle all of the categories that apply for that teacher. For example, if a teacher teaches Physics I and Physical Science you would circle 1 and 2.

*If you have a listing of teachers for this school, you may send that back instead. Please make sure the list includes all teachers of science and mathematics and provides the other information we will need (i.e., self-contained classes or subject categories for block and departmentalized teachers.)

How to Categorize Science and Mathematics Classes

Here are some examples of science and mathematics courses in middle and high school grades, classified according to the four categories on the listing form:

- **High School Physics or Chemistry:** *Chemistry (1st year), Advanced Chemistry, Advanced Placement Chemistry, Physics I, Advanced Physics.*

- **Other Science:** *Biology, Earth Science, Physical Science, Integrated Science, General Science.*

- **High School Calculus or Advanced Math:** *Calculus, Pre-calculus, Algebra 3, Analytic Geometry, Trigonometry, Math IV, College Prep/Senior Math.*

- **Other Math:** *General Math, Basic math, Algebra 1, Algebra 2, Geometry, Integrated Math I-III Unified Math I-III*.

For the purposes of this survey, the following are not considered science or mathematics courses: Computer Science, Health, Hygiene, Technology Education, Business.

LABEL

Page 1 of ___

SCIENCE AND MATHEMATICS TEACHERS AT THIS SCHOOL
(See instructions on previous page)

IF YOU NEED ASSISTANCE, CALL
1-800-937-8288 or e-mail
2000Survey@westat.com

OR

		SELF-CONTAINED	**NOT SELF-CONTAINED**			
			(Circle all subject taught)			
			Science		**Math**	
	TEACHER NAME	**Any grade**	**High School Physics or Chemistry**	**Other Science**	**High School Calculus or Advanced Math**	**Other Math**
#	First Last					
01		1	1	2	3	4
02		1	1	2	3	4
03		1	1	2	3	4
04		1	1	2	3	4
05		1	1	2	3	4
06		1	1	2	3	4
07		1	1	2	3	4
08		1	1	2	3	4
09		1	1	2	3	4
10		1	1	2	3	4
11		1	1	2	3	4
12		1	1	2	3	4
13		1	1	2	3	4
14		1	1	2	3	4
15		1	1	2	3	4
16		1	1	2	3	4
17		1	1	2	3	4
18		1	1	2	3	4
19		1	1	2	3	4
20		1	1	2	3	4
21		1	1	2	3	4
22		1	1	2	3	4
23		1	1	2	3	4
24		1	1	2	3	4
25		1	1	2	3	4

LABEL

SCIENCE AND MATHEMATICS TEACHERS AT THIS SCHOOL
(See instructions on previous page)

**IF YOU NEED ASSISTANCE, CALL
1-800-937-8288 or e-mail
2000Survey@westat.com**

OR

#	TEACHER NAME First Last	SELF-CONTAINED	NOT SELF-CONTAINED *(Circle all subject taught)*			
			Science		Math	
		Any grade	High School Physics or Chemistry	Other Science	High School Calculus or Advanced Math	Other Math
26		1	1	2	3	4
27		1	1	2	3	4
28		1	1	2	3	4
29		1	1	2	3	4
30		1	1	2	3	4
31		1	1	2	3	4
32		1	1	2	3	4
33		1	1	2	3	4
34		1	1	2	3	4
35		1	1	2	3	4
36		1	1	2	3	4
37		1	1	2	3	4
38		1	1	2	3	4
39		1	1	2	3	4
40		1	1	2	3	4
41		1	1	2	3	4
42		1	1	2	3	4
43		1	1	2	3	4
44		1	1	2	3	4
45		1	1	2	3	4
46		1	1	2	3	4
47		1	1	2	3	4
48		1	1	2	3	4
49		1	1	2	3	4
50		1	1	2	3	4

Appendix D

Description of Data Collection

A. Advance Notification

B. Pre-Survey

C. Teacher Survey

D. Presidential Awardees

E. Prompting Respondents

F. Response Rates

G. Data Retrieval

H. File Preparation

Description of Data Collection

A. Advance Notification

In October 1998, the Principal Investigator met with the Council of Chief State School Officers' Subcommittee on Statistics, the Education Information Advisory Committee. The proposed study and survey instruments received a favorable review. Notification letters were mailed to the Chief State School Officers on May 25, 1999, advising them of the format and schedule of the study and identifying the schools in their states that had been sampled for the survey.

Three weeks later, similar information letters were mailed to superintendents of districts in which sampled public schools were located. District officials were asked to contact Horizon Research, Inc. if they had any questions or concerns, if any sampled schools had closed, or if school address information was incorrect.

B. Pre-Survey

In September 1999, a pre-survey packet was sent to the principal of each sampled school which had not refused participation at the district level. Based on information obtained during the initial district contact, packets for a few schools were directed to school district officials, who then forwarded them to the schools.

The pre-survey packet consisted of a cover letter from the data collection subcontractor (Westat), a fact sheet about the survey, and an eight-page pre-survey booklet. The booklet was designed to obtain the following information from the school principal, or someone designated by the principal:

- The names of the heads of the science and mathematics departments or, if there were no official departments, individuals who were knowledgeable enough about the science and mathematics programs at their school to complete school program questionnaires;

- The name of a person to act as our contact point for the survey;

- Names of those who taught science and mathematics at the school; and

- Key characteristics about the school and the population it served: number of students, grades included in the school, Chapter 1 status, community size description, number of students receiving free or reduced price lunches, and racial/ethnic breakdown of school population.

As an incentive for schools to participate, schools were offered a voucher redeemable for science and mathematics instructional materials. Schools which completed the pre-survey form were credited $50. (Later, during the questionnaire phase of the study, the value of the voucher increased by $15 for each completed teacher questionnaire and $15 for each completed program questionnaire.)

Principals from non-responding schools received telephone prompts from Westat. It generally required a series of telephone calls to determine whether anyone had received the pre-survey, to whom the task had been delegated, and whether or not that person was planning to complete it. In many cases, schools requested a re-mailing of the survey materials. For some of the smaller schools, prompters were able to complete the pre-survey form over the telephone. All schools were offered the option to send in teacher “codes” rather than actual teacher names, thereby preserving the anonymity of the respondents. Thirteen principals exercised this option.

A few school officials directly refused to participate at this stage, citing that the current state of school funding or low teacher salaries would not permit this additional burden. When this occurred, telephone prompters attempted to change the respondent’s mind. If a completed pre-survey was not received soon thereafter, a follow-up telephone call was made. While this method was effective in some cases, most direct refusers were fairly unyielding in their original decision.

Table D-1 summarizes the results of the pre-survey by stratum. A total of 8 schools were identified as ineligible. Completed pre-survey forms were received from 1,298 of the remaining 1,792 schools for an overall response rate of 72 percent.

Table D-1
Results of Pre-Surveys, by Stratum

	Stratum 1	**Stratum 2**	**Stratum 3**	**TOTAL**
Response Rate	75%	74%	66%	72%
Completed	700	319	278	1,298
Non-Response	238	111	146	494
Ineligible	2	0	6	8
TOTAL	940	430	430	1,800

Westat staff reviewed the completed pre-survey booklets carefully to ensure that school staff had provided the information needed for sampling teachers. In particular, the following checks were made:

- The address was the same as that found on the original Quality Education Data (QED) sampling frame;
- The school’s enrollment (by grade) was consistent with that reported by QED; and
- The number of teachers listed was consistent with the reported enrollment.

Discrepancies in this information were resolved by a call to the local contact.

In general, schools were asked to report information in a manner consistent with the way QED reported the grade range. If this was not possible because the QED file was in error or there had been a reorganization at the school, the school's revised grade range was used.

The pre-survey resulted in a file of 22,785 teachers. From this frame, a sample of 8,670 science and mathematics teachers was drawn. The number of teachers sampled per school ranged from 1 to 27, with a mean of 6 teachers and a median of 7. Teachers were sampled on a rolling basis in order that late responders to the pre-survey would not delay the main data collection effort.

C. Teacher Survey

In February 2000, Westat staff mailed program head and teacher questionnaires by priority mail to local contacts for the first sample of teachers. Additional mailings were sent as new samples were drawn. When requested, the packets were sent to district officials. The packets contained:

- A cover letter from Westat.
- A catalog of school supplies available through the redemption of the incentive voucher.
- A School Summary Sheet. This sheet listed the school name, address, ID number, grade range, local contact, program heads, sampled teachers and their subjects, and the potential value of the school's incentive voucher. It also provided an area for the local contact to keep track of which individuals had responded to the survey.
- A sealed envelope for each sampled teacher, the science program representative, and the mathematics program representative. Each packet contained:
    - A cover letter from Westat;
    - The appropriate version of the questionnaire, with a label identifying the particular class the teacher should consider when answering the class-specific sections of the questionnaire;
    - List of course codes to be used in identifying particular classes; and
    - A postage-paid return envelope.

Many of the individuals designated to respond for the program questionnaires were teachers and, consequently, had been randomly sampled as teachers as well. While these individuals received copies of both questionnaires, they were given a special cover letter which explained why both questionnaires had been included in the packet.

The 2000 National Survey of Science and Mathematics Education received letters of support from the following groups:

- American Federation of Teachers,
- National Catholic Education Association,
- National Council of Teachers of Mathematics,
- National Education Association, and
- National Science Teachers Association.

The endorsements were noted on the cover letters accompanying the questionnaires.

D. Presidential Awardees

In conjunction with the 2000 National Survey of Science and Mathematics Education, 2,652 recipients (from the years 1983–1999) of the Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST) were mailed copies of the science and mathematics questionnaires, as well as a questionnaire specific to the PAEMST program. Awardees received $15 for taking part in the survey. A small number of awardees had also been sampled as part of the main study. These individuals were sent only one copy of the questionnaire, but the resulting data were included in both datasets. A total of 1,996 out of 2,401 eligible[1] Presidential Awardees completed questionnaires, yielding an overall response rate of 83 percent.

E. Prompting Respondents

A series of steps was taken to increase the response rate, primarily through extensive telephone follow-up. In a number of instances, schools indicated they had not received materials, in which case materials were re-mailed.

Periodically, local school contacts were sent updated school summary sheets, indicating which teachers had returned completed questionnaires. The summary sheet also showed the current value of the school's supply voucher vs. the expected value if all sampled teachers and department heads returned questionnaires.

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[1] The 251 "ineligibles" include those who were deceased, as well as those who could not be located at the most recent address NSF had on file or through post office forwarding information.

F. Response Rates

Data collection was originally scheduled to conclude at the end of the 1999–2000 school year. However at this point, the response rate was only 53 percent. Horizon Research, Inc. continued data collection on the original sample in the fall of 2000 without sampling any new teachers.

Completed program questionnaires were received from 2,048 out of the 2,589 possible, for a response rate of 79 percent. A total of 5,728 out of 7,779 eligible teachers took part in the survey; the response rate was 74 percent.[2] Tables D-2 and D-3 provide response rate breakdowns for program heads and teachers, respectively.

Table D-2
Results of Program Questionnaires, by Stratum and Subject

	Sampled	Non-Response	Ineligible	Completed	Response Rate (Percent)
Stratum 1	**1,400**	**300**	**3**	**1,097**	**79**
Science	700	147	1	552	79
Mathematics	700	153	2	545	78
Stratum 2	**638**	**127**	**1**	**510**	**80**
Science	319	69	1	249	78
Mathematics	319	58	0	261	82
Stratum 3	**556**	**114**	**1**	**441**	**79**
Science	278	59	1	218	79
Mathematics	278	55	0	223	80
TOTAL	**2,594**	**541**	**5**	**2,048**	**79**

Table D- 3
Results of Teacher Questionnaires, by Stratum and Subject

	Sampled	Non-Response	Ineligible	Completed	Response Rate (Percent)
Stratum 1	**4,446**	**1,132**	**399**	**2,914**	**72**
Science	2,240	589	218	1,432	71
Mathematics	2,206	543	181	1,482	73
Stratum 2	**1,969**	**455**	**210**	**1,304**	**74**
Science	969	236	100	633	73
Mathematics	1,000	219	110	671	75
Stratum 3	**2,255**	**460**	**282**	**1,510**	**77**
Science	1,117	238	149	730	75
Mathematics	1,138	222	133	780	78
TOTAL	**8,670**	**2,047**	**891**	**5,728**	**74**

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[2] In the fall of 2000, a final questionnaire mailing was sent to non-respondent teachers. Over the summer, some teachers left the schools at which they taught when they were originally sampled. If these teachers are considered ineligible for the study, the teacher response rate was 74 percent. When they were included as non-respondents, the response rate was 67 percent.

G. Data Retrieval

Survey respondents did not always complete all items in the questionnaire data. A set of guidelines was developed to determine the course of action for varying degrees of missing data. For the pre-survey, certain items were considered crucial for verifying the correctness of the school sampling and the completeness of the teacher and program head sampling frame. Specifically, these items included:

- School grade range;
- Number of students;
- Names of teachers with either their subject area or the grade number of the self-contained class they taught;
- Names of science and mathematics program representatives; and
- Name of local contact.

Data retrieval was also conducted when information was missing from the program or teacher questionnaires. The following items were data-retrieved for the program questionnaires:

- Missed pages or sections;
- Reported grade ranges discrepant with school grade ranges; and
- Unclear or missing information for school course offerings.

For the teacher questionnaire, the following items were data-retrieved:

- Missing pages or sections;
- Missing or incomplete textbook titles;
- Teacher’s class load (or breakdown of time spent on various subjects for teachers in self-contained classrooms);
- The size of the class randomly sampled for Sections C and D of the questionnaire; and
- Missing subject for academic degrees.

Because it was difficult to reach individual teachers by telephone, those whose questionnaires required data retrieval were first sent forms on which they could check off the correct information or clarify their answers. The questionnaire included a space for teachers to write their e-mail address if they had one, and it was possible in many instances to get the necessary information in this manner. In some cases it was possible to obtain information about the number of classes taught, course names, and class sizes from school office staff.

H. File Preparation

Completed questionnaires were recorded in Westat's receipt system and given a batch number. Next they were routed to editing. Manual edits were used to identify missing information and obvious out-of-range answers; to identify and, if possible, resolve multiple answers; and to make several consistency checks.

Questionnaires requiring data retrieval were turned over to appropriate staff for follow-up. Those that were completely coded were given a final batch number and sent to Horizon Research, Inc. for scanning. The scanned data were sent through a machine-edit program, which checked for missing data, out-of-range answers, adherence to skip patterns, and logical inconsistencies. Corrections were made in the scanned data.

As questionnaires were processed, codes were created for open-ended questions. Many of the answers needing special codes involved course titles, as well as textbook titles and publishers.

Appendix E

Description of Reporting Variables

A. Region

B. Type of Community

C. Grade Range

D. Teach Advanced High School Mathematics

E. Overview of Composites

F. Definitions of Teacher Composites
- Teacher Opinions
    - Teacher Collegiality
- Teacher Preparation
    - Teacher Preparedness to Use Standards-Based Teaching Practices
    - Teacher Preparedness to Teach Students from Diverse Backgrounds
    - Teacher Preparedness to Use Calculators/Computers
    - Teacher Preparedness to Use the Internet
    - Teacher Content Preparedness: Science
    - Teacher Content Preparedness: Mathematics
- Instructional Objectives
    - Nature of Science/Mathematics Objectives
    - Basic Mathematics Skills Objectives
    - Mathematics Reasoning Objectives
    - Science Content Objectives
- Teaching Practices
    - Use of Traditional Teaching Practices
    - Use of Strategies to Develop Students' Abilities to Communicate Ideas
    - Use of Informal Assessment
    - Use of Journals/Portfolios
    - Use of Calculators
    - Use of Multimedia
    - Use of Projects/Extended Investigations
    - Use of Computers
    - Use of Laboratory Activities
    - Use of Laboratory Facilities
    - Use of Calculators/Computers for Investigation
    - Use of Calculators/Computers for Developing Concepts and Skills
- Instructional Control
    - Curriculum Control
    - Pedagogy Control

G. Definitions of Program Composites
- National Standards for Science and Mathematics Education
    - Teacher Attention to Standards
    - Other Stakeholders' Attention to Standards
- Factors Affecting Instruction
    - Extent to Which Facilities and Equipment Pose a Problem for Instruction
    - Extent to Which Students and Parents Pose a Problem for Instruction
    - Extent to Which Time Constraints Pose a Problem for Instruction

Description of Reporting Variables

A. Region

Each sample school and teacher was classified as belonging to 1 of 4 census regions.

- Midwest: IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI
- Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT
- South: AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, SC, TN, VA, WV
- West: AK, AZ, CA, CO, HI, ID, MT, NM, NV, OK, OR, TX, UT, WA, WY

B. Type of Community

Each sample school and teacher was classified as belonging to one of three types of communities.

- Urban: Central city
- Suburban: Area surrounding a central city, but still located within the counties constituting a Metropolitan Statistical Area (MSA)
- Rural: Area outside any MSA

C. Grade Range

Teachers were classified by grade range according to the information they provided about their teaching schedule. Most of the analyses in this report used the grade ranges K–4, 5–8, and 9–12 with teachers and classes being categorized based on the grade range information provided by the teacher.

D. Teach Advanced High School Mathematics

High school mathematics teachers who are assigned to teach Algebra II, Algebra III, Pre-Calculus, and/or Calculus were categorized as teaching “advanced” high school mathematics.

E. Overview of Composites

To facilitate the reporting of large amounts of survey data, and because individual questionnaire items are potentially unreliable, HRI used factor analysis to identify survey questions that could be combined into "composites." Each composite represents an important construct related to mathematics or science education. Composites were calculated for both the science and mathematics versions of the teacher questionnaire and for the program questionnaire completed by each responding school in the sample.

Each composite is calculated by summing the responses to the items associated with that composite and then dividing by the total points possible. In order for the composites to be on a 100-point scale, the lowest response option on each scale was set to 0 and the others were adjusted accordingly; so for instance, an item with a scale ranging from 1 to 4 was re-coded to have a scale of 0 to 3. By doing this, someone who marks the lowest point on every item in a composite receives a composite score of 0 rather than some positive number. It also assures that 50 is the true mid-point. The denominator for each composite is determined by computing the maximum possible sum of responses for a series of items and dividing by 100; e.g., a 9-item composite where each item is on a scale of 0–3 would have a denominator of 0.27.

F. Definitions of Teacher Composites

Composite definitions for the science and mathematics teacher questionnaire are presented below along with the item numbers from the respective questionnaires. Composites that are identical for the two subjects are presented in the same table; composites unique to a subject are presented in separate tables.

Teacher Opinions

These composites estimate the extent of teacher collegiality within their schools.

Table E-1
Teacher Collegiality

	Science	Mathematics
I have time during the regular school week to work with my colleagues on science/mathematics curriculum and teaching.	Q1e	Q1e
My colleagues and I regularly share ideas and materials related to science/mathematics teaching.	Q1f	Q1f
Science/mathematics teachers in this school regularly observe each other teaching classes as part of sharing and improving instructional strategies.	Q1g	Q1g
Most science/mathematics teachers in this school contribute actively to making decisions about the science/mathematics curriculum.	Q1h	Q1h
Number of Items in Composite	**4**	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.67**	**0.66**

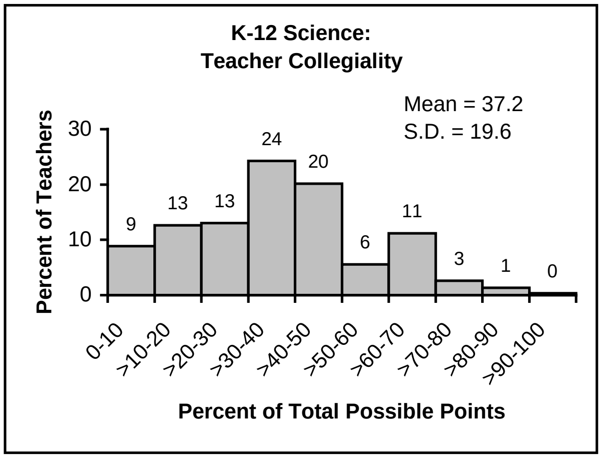


Figure E-1

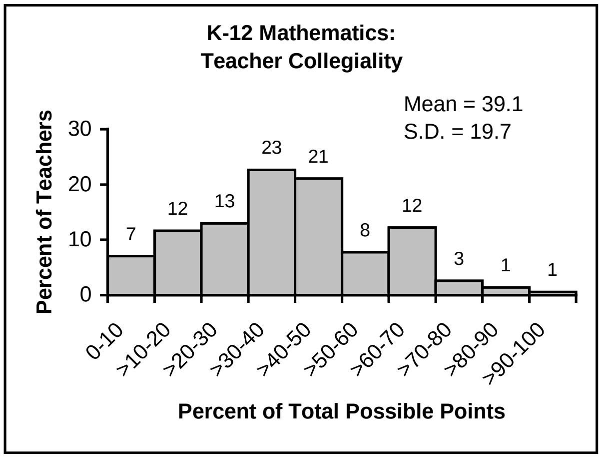


Figure E-2

Teacher Preparation

These composites estimate the extent to which teachers feel prepared in both science and mathematics content and pedagogy.

Table E-2
Teacher Preparedness to Use Standards-Based Teaching Practices

	Science	Mathematics
Take students' prior understanding into account when planning curriculum and instruction.	Q3a	Q3a
Develop students' conceptual understanding of science/mathematics	Q3b	Q3b
Provide deeper coverage of fewer science/mathematics concepts	Q3c	Q3c
Make connections between science/mathematics and other disciplines	Q3d	Q3d
Lead a class of students using investigative strategies	Q3e	Q3e
Manage a class of students engaged in hands-on/project-based work	Q3f	Q3f
Have students work in cooperative learning groups	Q3g	Q3g
Listen/ask questions as students work in order to gauge their understanding	Q3h	Q3h
Use the textbook as a resource rather than the primary instructional tool	Q3i	Q3i
Teach groups that are heterogeneous in ability	Q3j	Q3j
Number of Items in Composite	**10**	**10**
Reliability (Cronbach's Coefficient Alpha)	**0.88**	**0.86**

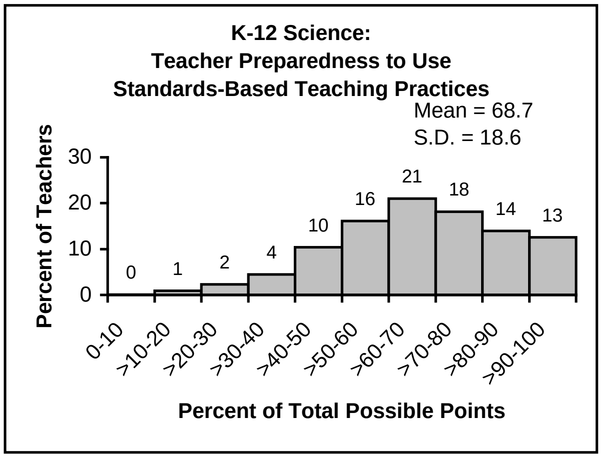


Figure E-3

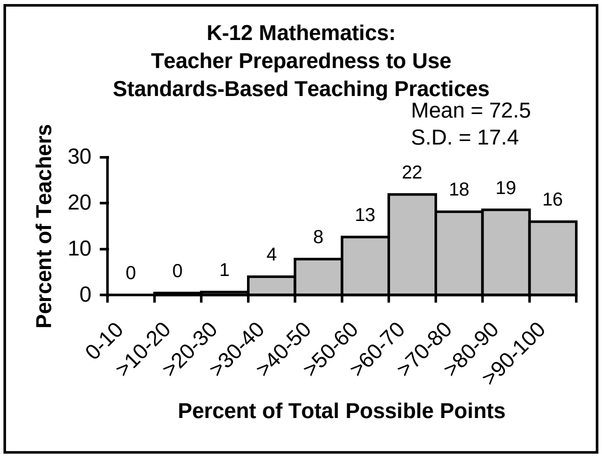


Figure E-4

Table E-3
Teacher Preparedness to Teach Students from Diverse Backgrounds

	Science	**Mathematics**
Recognize and respond to student cultural diversity	Q3l	Q3l
Encourage students' interest in science/mathematics	Q3m	Q3m
Encourage participation of females in science/mathematics	Q3n	Q3n
Encourage participation of minorities in science/mathematics	Q3o	Q3o
Number of Items in Composite	**4**	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.81**	**0.80**

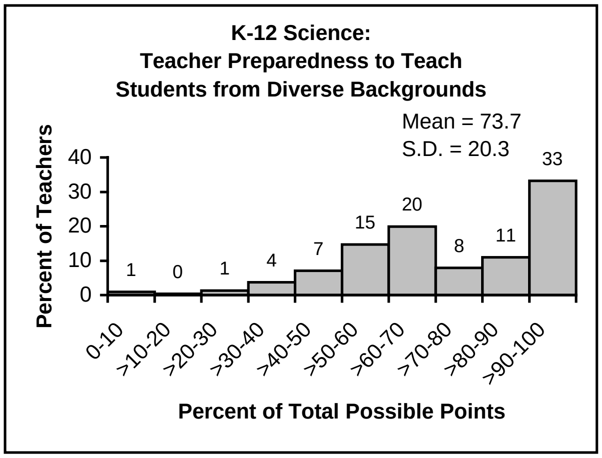


Figure E-5

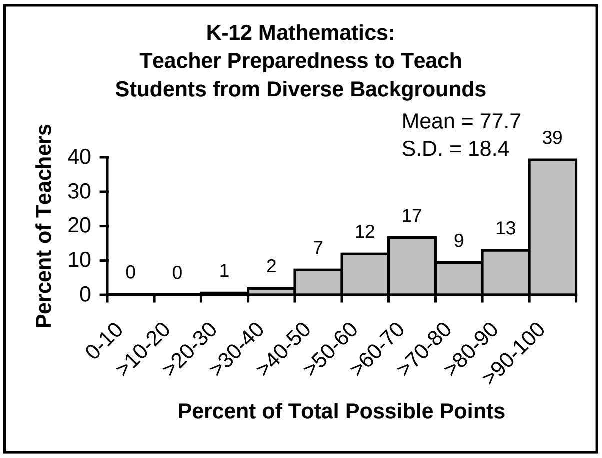
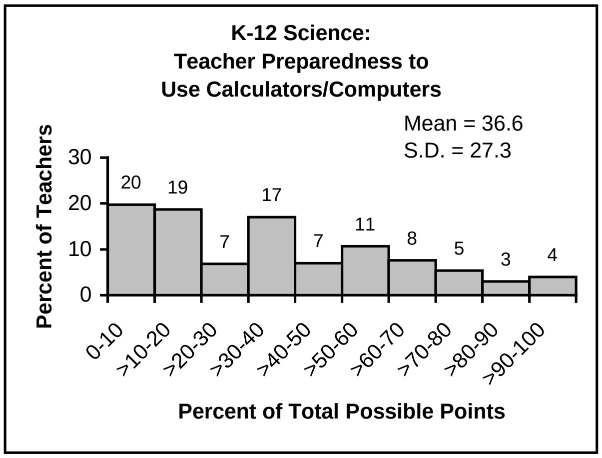


Figure E-6

Table E-4
Teacher Preparedness to Use Calculators/Computers

	Science	Mathematics
Use calculators/computers for drill and practice	Q3q	Q3q
Use calculators/computers for science/mathematics learning games	Q3r	Q3r
Use calculators/computers to collect and/or analyze data	Q3s	Q3s
Use computers to demonstrate scientific principles*	Q3t	
Use calculators/computers to demonstrate mathematics principles*		Q3t
Use computers for laboratory simulations*	Q3u	
Use computers for simulations and applications*		Q3u
Number of Items in Composite	**5**	**5**
Reliability (Cronbach's Coefficient Alpha)	**0.89**	**0.89**

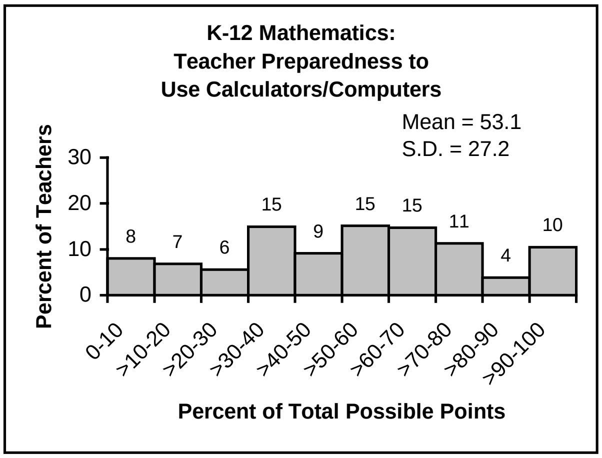
* The mathematics and science versions of this question are considered equivalent, worded appropriately for that discipline.



K-12 Science:
Teacher Preparedness to
Use Calculators/Computers

Mean = 36.6
S.D. = 27.3

Figure E-7



K-12 Mathematics:
Teacher Preparedness to
Use Calculators/Computers

Mean = 53.1
S.D. = 27.2

Figure E-8

Table E-5
Teacher Preparedness to Use the Internet

	Science	Mathematics
Use the Internet in your science/mathematics teaching for general reference	Q3v	Q3v
Use the Internet in your science/mathematics teaching for data acquisition	Q3w	Q3w
Use the Internet in your science/mathematics teaching for collaborative projects with classes/individuals in other schools	Q3x	Q3x
Number of Items in Composite	**3**	**3**
Reliability (Cronbach's Coefficient Alpha)	**0.86**	**0.90**

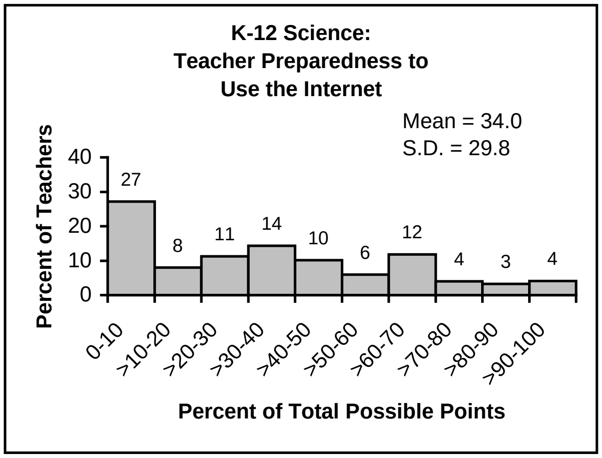


Figure E-9

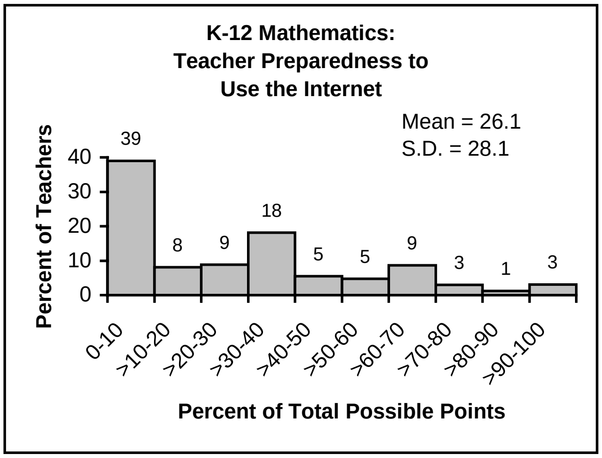


Figure E-10

Table E-6
Teacher Content Preparedness: Science*

	Biology/ Life Science	**Chem-istry**	**Earth Science**	**Environ-mental Science**	**Integrated/ General Science**	**Physical Science**	**Physics**
Earth's features and physical processes			Q15a1a	Q15a1a	Q15a1a	Q15a1a	
The solar system and the universe			Q15a1b		Q15a1b	Q15a1b	
Climate and weather			Q15a1c	Q15a1c	Q15a1c	Q15a1c	
Structure and function of human systems	Q15a2a				Q15a2a		
Plant biology	Q15a2b				Q15a2b		
Animal behavior	Q15a2c				Q15a2c		
Interactions of living things/ecology	Q15a2d			Q15a2d	Q15a2d		
Genetics and evolution	Q15a2e				Q15a2e		
Structure of matter and chemical bonding		Q15a3a			Q15a3a	Q15a3a	
Properties and states of matter		Q15a3b			Q15a3b	Q15a3b	
Chemical reactions		Q15a3c			Q15a3c	Q15a3c	
Energy and chemical change		Q15a3d			Q15a3d	Q15a3d	
Forces and motion					Q15a4a	Q15a4a	Q15a4a
Energy					Q15a4b	Q15a4b	Q15a4b
Light and sound					Q15a4c	Q15a4c	Q15a4c
Electricity and magnetism					Q15a4d	Q15a4d	Q15a4d
Modern physics (e.g., special relativity)					Q15a4e	Q15a4e	Q15a4e
Pollution, acid rain, global warming				Q15a5a	Q15a5a		
Population, food supply, and production				Q15a5b	Q15a5b		
Formulating hypothesis, drawing conclusions, making generalizations	Q15a6a	Q15a6a	Q15a6a	Q15a6a	Q15a6a	Q15a6a	Q15a6a
Experimental design	Q15a6b	Q15a6b	Q15a6b	Q15a6b	Q15a6b	Q15a6b	Q15a6b
Describing, graphing, and interpreting data	Q15a6c	Q15a6c	Q15a6c	Q15a6c	Q15a6c	Q15a6c	Q15a6c
Number of Items in Composite	**8**	**7**	**6**	**8**	**22**	**15**	**8**
Reliability (Cronbach's Coefficient Alpha)	**0.87**	**0.87**	**0.76**	**0.79**	**0.87**	**0.89**	**0.88**

* Questions comprising these composites were asked of only those teachers in non-self-contained settings.

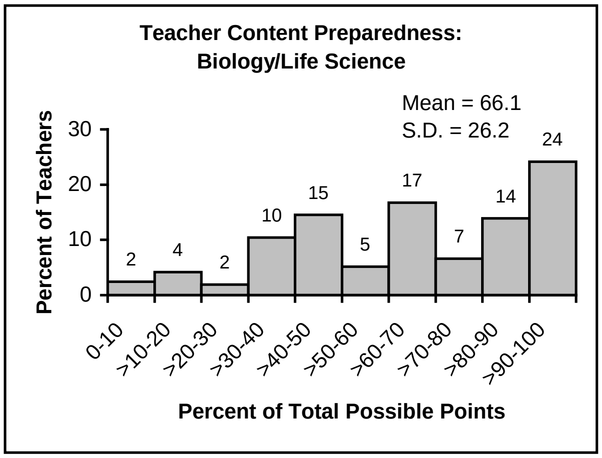
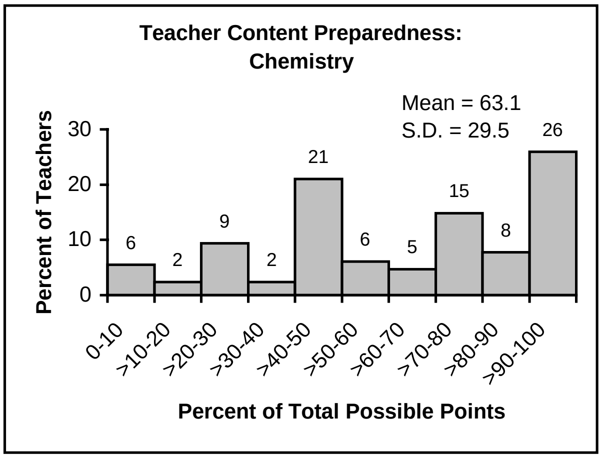


Figure E-11



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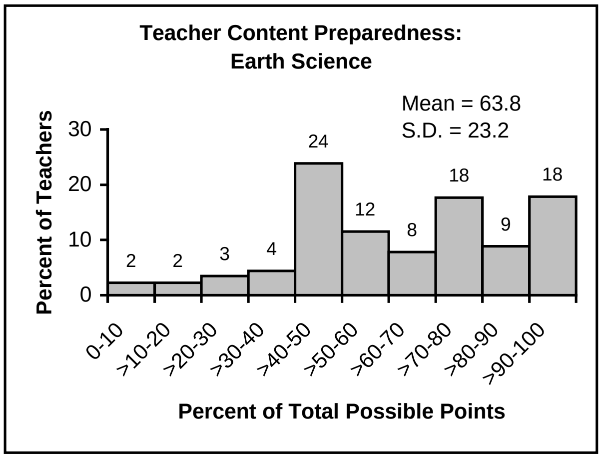

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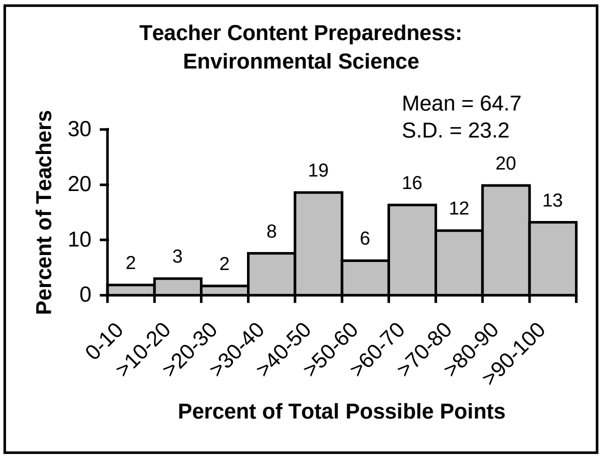

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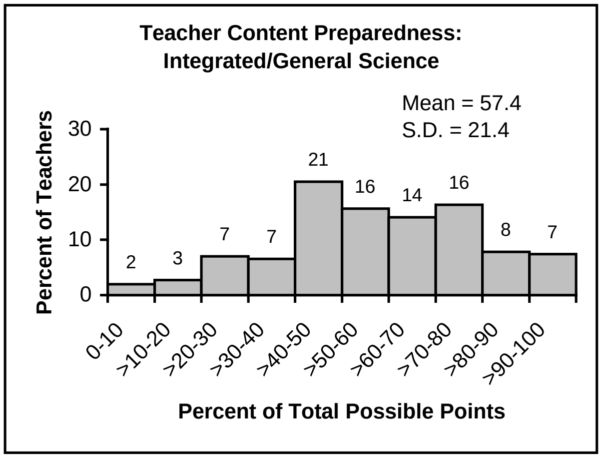


Figure E-15

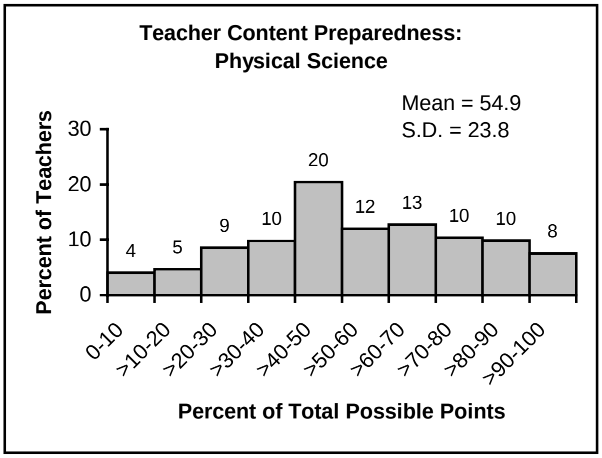


Figure E-16

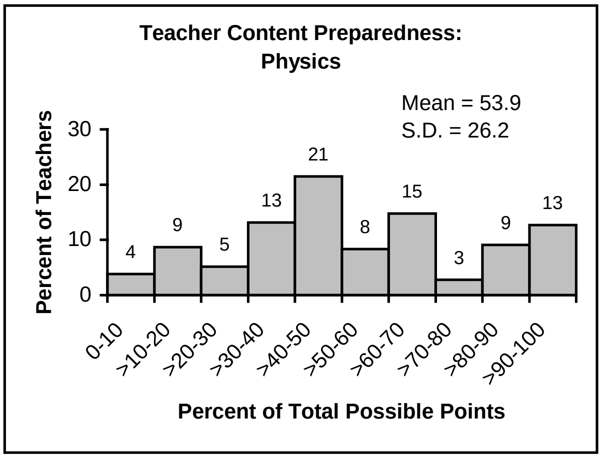

Teacher Content Preparedness:
Physics
Mean = 53.9
S.D. = 26.2
Percent of Teachers
30
20
10
0
4
9
5
13
21
8
15
3
9
13
0-10
>10-20
>20-30
>30-40
>40-50
>50-60
>60-70
>70-80
>80-90
>90-100
Percent of Total Possible Points

Figure E-17

Table E-7
Teacher Content Preparedness: Mathematics

	General Mathematics	Advanced Mathematics
Numeration and number theory	Q15aa	
Computation	Q15ab	
Estimation	Q15ac	
Measurement	Q15ad	
Pre-Algebra	Q15ae	
Algebra		Q15af
Patterns and relationships	Q15ag	
Geometry and spatial sense	Q15ah	
Functions (including trigonometric functions) and pre-calculus concepts		Q15ai
Data collection and analysis		Q15aj
Probability		Q15ak
Statistics (e.g., hypothesis tests, curve fitting and regression)		Q15al
Topics from discrete mathematics (e.g., combinatorics, graph theory, recursion)		Q15am
Mathematical structures (e.g., vector spaces, groups, rings, fields)		Q15an
Calculus		Q15ao
Technology (calculators, computers) in support of mathematics		Q15ap
Number of Items in Composite	**7**	**9**
Reliability (Cronbach's Coefficient Alpha)	**0.82**	**0.85**

* Questions comprising these composites were asked of only those teachers in non-self-contained settings.

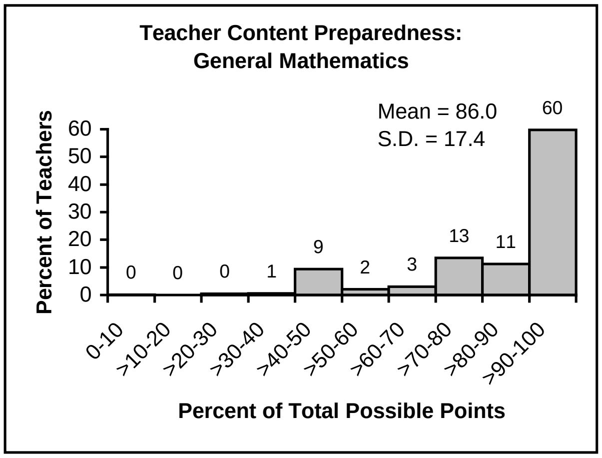


Figure E-18

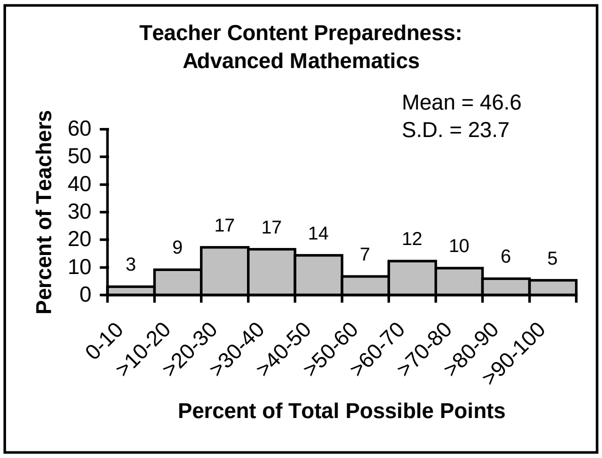


Figure E-19

Instructional Objectives

These composites estimate the amount of emphasis teachers place on various objectives.

Table E-8
Nature of Science/Mathematics Objectives

	Science	Mathematics
Learn to evaluate arguments based on scientific evidence	Q23f	
Understand the logical structure of mathematics		Q23i
Learn about the history and nature of science/mathematics	Q23j	Q23j
Learn how to communicate ideas in science effectively*	Q23g	
Learn how to explain ideas in mathematics effectively*		Q23k
Learn about the applications of science in business and industry*	Q23h	
Learn how to apply mathematics in business and industry*		Q23l
Learn about the relationship between science, technology, and society	Q23i	
Number of Items in Composite	**5**	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.84**	**0.73**

* The mathematics and science versions of this question are considered equivalent, worded appropriately for that discipline.

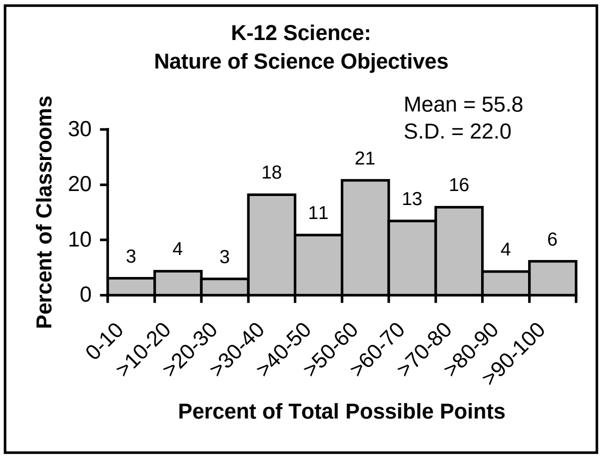


Figure E-20

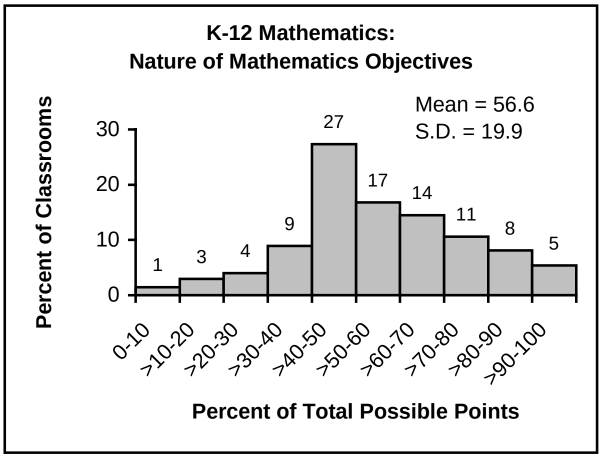


Figure E-21

Table E-9
Basic Mathematics Skills Objectives

	Mathematics
Develop students’ computational skills	Q23d
Learn to perform computations with speed and accuracy	Q23m
Prepare for standardized tests	Q23n
Number of Items in Composite	**3**
Reliability (Cronbach’s Coefficient Alpha)	**0.69**

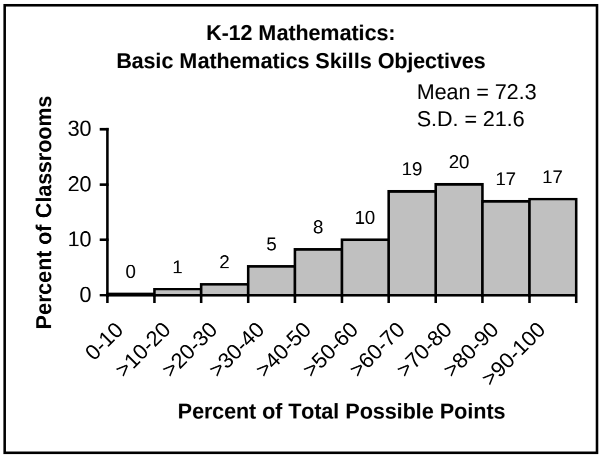


Figure E-22

Table E-10
Mathematics Reasoning Objectives

	Mathematics
Learn mathematical concepts	Q23b
Learn how to solve problems	Q23e
Learn to reason mathematically	Q23f
Learn how mathematics ideas connect with one another	Q23g
Number of Items in Composite	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.75**

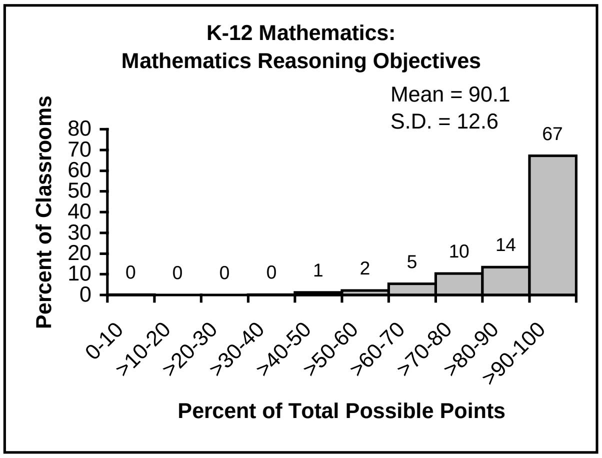


Figure E-23

Table E-11
Science Content Objectives

	Science
Learn basic science concepts	Q23b
Learn important terms and facts of science	Q23c
Learn science process/inquiry skills	Q23d
Prepare for further study in science	Q23e
Number of Items in Composite	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.60**

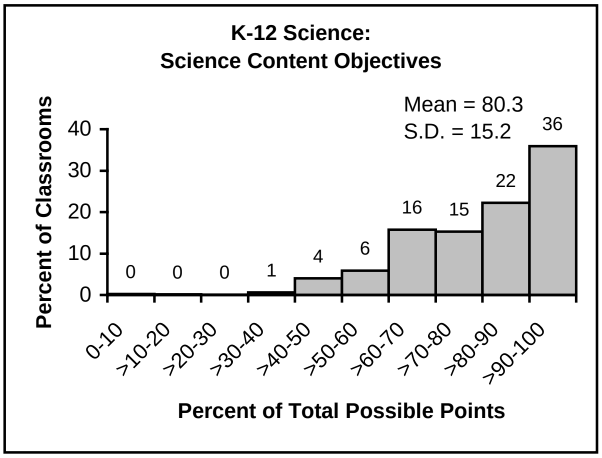


Figure E-24

Teaching Practices

These composites estimate the extent to which teachers use a variety of teaching practices and instructional technologies/facilities.

Table E-12
Use of Traditional Teaching Practices

	Science	Mathematics
Introduce content through formal presentations	Q24a	Q24a
Assign science/mathematics homework	Q24i	Q24j
Listen and take notes during presentation by teacher	Q25a	Q25a
Read from a science/mathematics textbook in class	Q25d	Q25c
Practice routine computations/algorithms		Q25f
Review homework/worksheet assignments		Q25g
Answer textbook or worksheet questions	Q25j	Q25k
Review student homework	Q27f	Q27f
Give predominantly short-answer tests (e.g., multiple choice, true/false, fill in the blank)	Q27k	
Number of Items in Composite	**7**	**8**
Reliability (Cronbach's Coefficient Alpha)	**0.78**	**0.74**

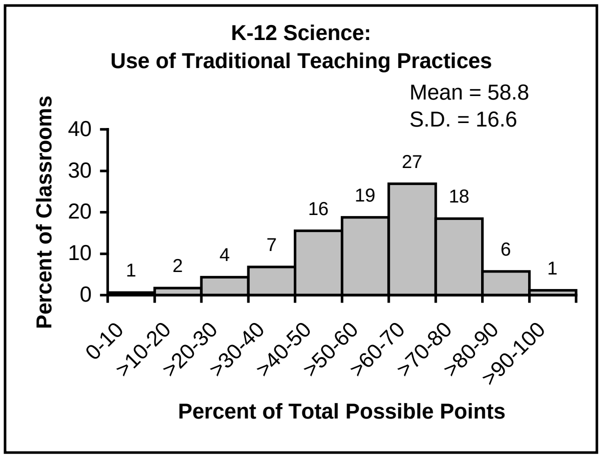


Figure E-25

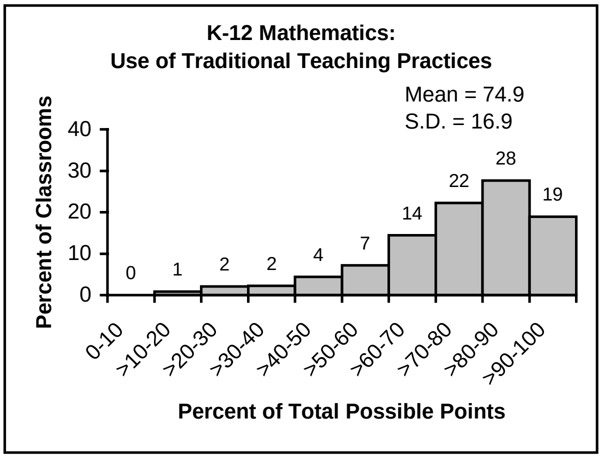


Figure E-26

Table E-13
Use of Strategies to Develop Students' Abilities to Communicate Ideas

	Science	Mathematics
Pose open-ended questions	Q24b	Q24b
Engage the whole class in discussions	Q24c	
Require students to supply evidence to support their claims*	Q24d	
Require student to explain their reasoning when giving an answer*		Q24d
Ask students to explain concepts to one another	Q24e	Q24e
Ask students to consider alternative explanations *	Q24f	
Ask students to consider alternative methods for solutions*		Q24f
Ask students to use multiple representations (e.g., numeric, graphic, geometric, etc.)		Q24g
Help students see connections between science/mathematics and other disciplines	Q24h	Q24h
Number of Items in Composite	**6**	**6**
Reliability (Cronbach's Coefficient Alpha)	**0.79**	**0.77**

* The mathematics and science versions of this question are considered equivalent, worded appropriately for that discipline.

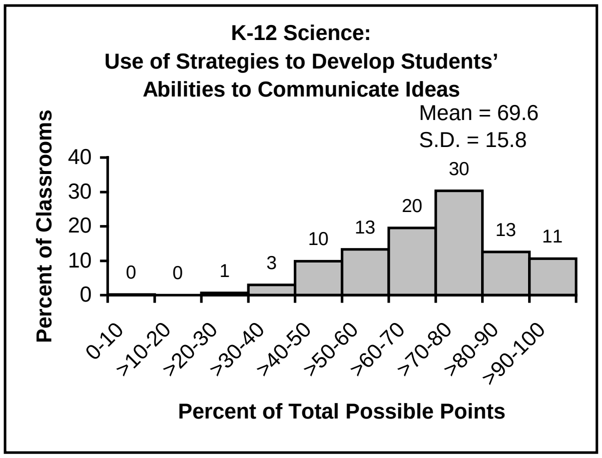


Figure E-27

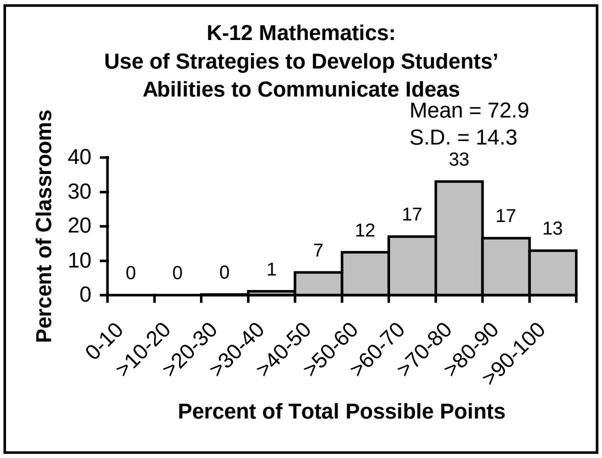
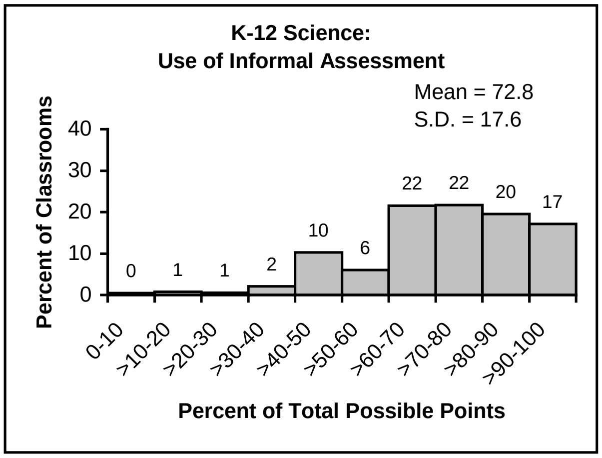


Figure E-28

Table E-14
Use of Informal Assessment

	Science	Mathematics
Observe students and ask questions as they work individually	Q27b	Q27b
Observe students and ask questions as they work in small groups	Q27c	Q27c
Ask students questions during large group discussions	Q27d	Q27d
Use assessments embedded in class activities to see if students are “getting it”	Q27e	Q27e
Number of Items in Composite	**4**	**4**
Reliability (Cronbach’s Coefficient Alpha)	**0.79**	**0.69**



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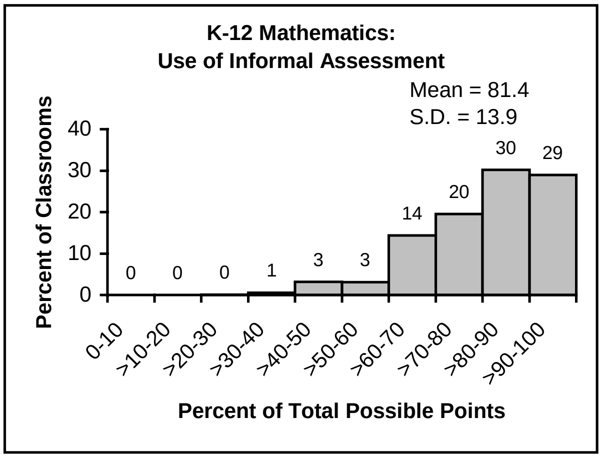


Figure E-30

Table E-15
Use of Journals/Portfolios

	Science	Mathematics
Read and comment on the reflections students have written, e.g., in their journals	Q24j	Q24k
Write reflections (e.g., in a journal)	Q25l	Q25m
Review student notebooks/journals	Q27g	Q27g
Review student portfolios	Q27h	Q27h
Number of Items in Composite	**4**	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.82**	**0.83**

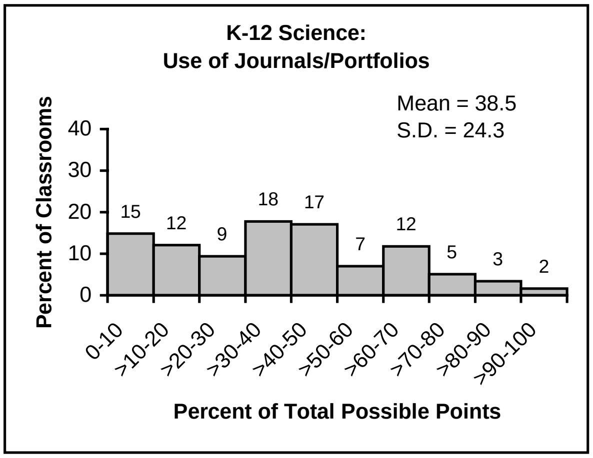


Figure E-31

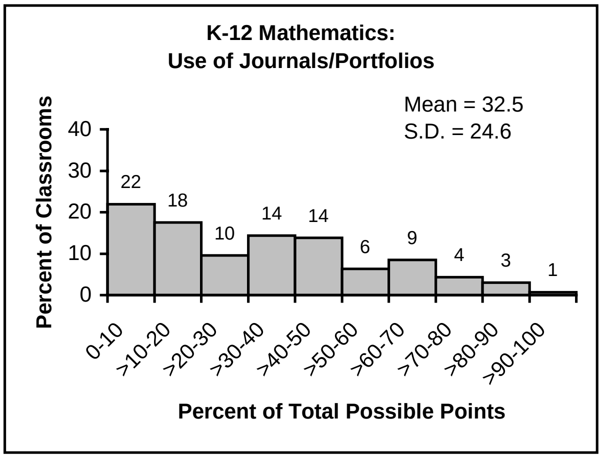
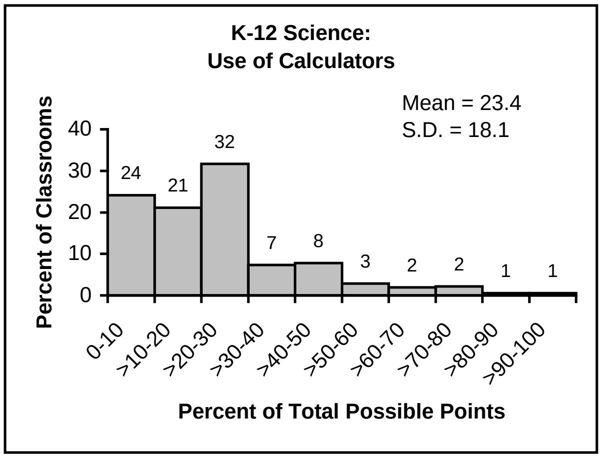


Figure E-32

Table E-16
Use of Calculators

	Science	Mathematics
Use mathematics as a tool in problem-solving	Q25q	
Use four-function calculators	Q28e3	Q28e3
Use fraction calculators	Q28f3	Q28f3
Use graphing calculators	Q28g3	
Use scientific calculators	Q28h3	Q28h3
Use calculator/computer lab interfacing devises	Q28k3	
Number of Items in Composite	**6**	**3**
Reliability (Cronbach's Coefficient Alpha)	**0.77**	**0.71**



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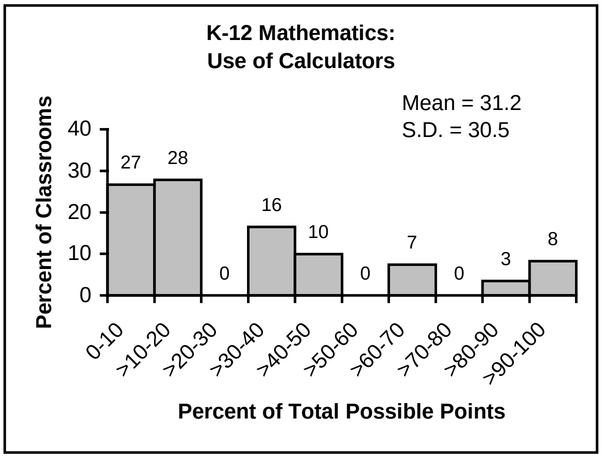
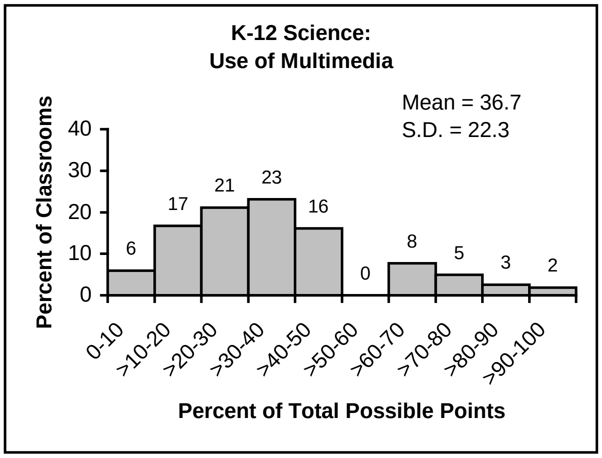


Figure E-34

Table E-17
Use of Multimedia

	Science	Mathematics
Use videotape player	Q28b3	Q28b3
Use videodisc player	Q28c3	Q28c3
Use CD-ROM player	Q28d3	Q28d3
Use computers with Internet connection	Q28j3	Q28k3
Number of Items in Composite	**4**	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.59**	**0.64**



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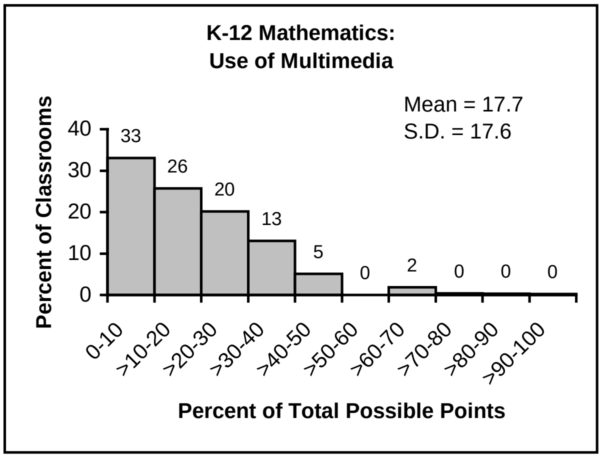


Figure E-36

Table E-18
Use of Projects/Extended Investigations

	Science
Design or implement their own investigation	Q25h
Participate in field work	Q25i
Prepare written science reports	Q25m
Make formal presentations to the rest of the class	Q25n
Work on extended science investigations or projects (a week or more in duration)	Q25o
Have students do long-term science projects	Q27i
Have students present their work to the class	Q27j
Grade student work on open-ended and/or laboratory tasks using defined criteria (e.g., a scoring rubric)	Q27m
Have students assess each other (peer evaluation)	Q27n
Number of Items in Composite	**9**
Reliability (Cronbach's Coefficient Alpha)	**0.85**

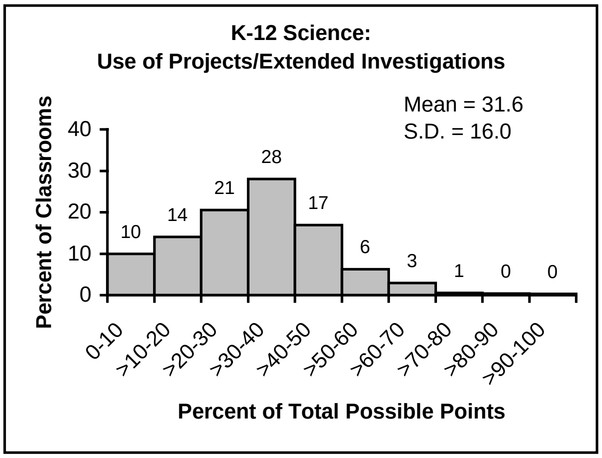


Figure E-37

Table E-19
Use of Computers

	Science
Use computers as a tool (e.g., spreadsheets, data analysis)	Q25p
Do drill and practice	Q26a
Demonstrate scientific principles	Q26b
Play science learning games	Q26c
Do laboratory simulations	Q26d
Collect data using sensors or probes	Q26e
Retrieve or exchange data	Q26f
Solve problems using simulations	Q26g
Take a test or quiz	Q26h
Number of Items in Composite	**9**
Reliability (Cronbach's Coefficient Alpha)	**0.91**

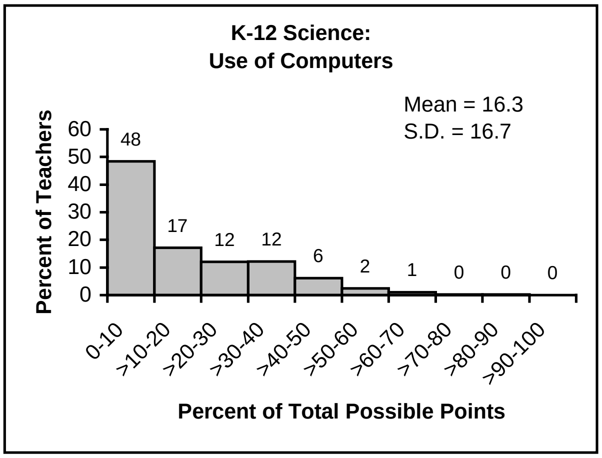


Figure E-38

Table E-20
Use of Laboratory Activities

	Science
Work in groups	Q25c
Do hands-on/laboratory science activities or investigations	Q25f
Follow specific instructions in an activity or investigation	Q25g
Record, represent, and/or analyze data	Q25k
Number of Items in Composite	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.80**

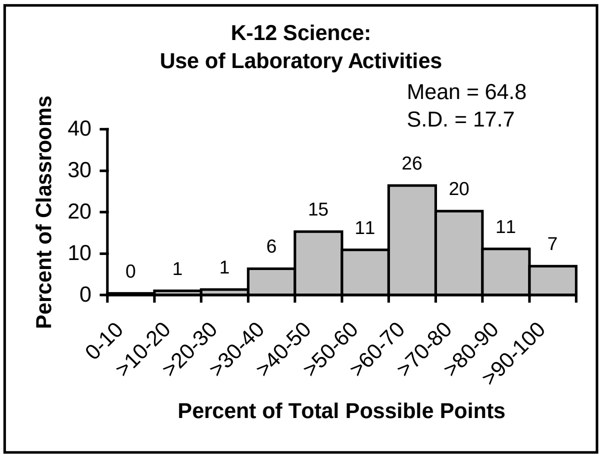


Figure E-39

Table E-21
Use of Laboratory Facilities

	Science
Use running water in labs/classrooms	Q28l3
Use electric outlets in labs/classrooms	Q28m3
Use gas for burners in labs/classrooms	Q28n3
Use hoods or air hoses in labs/classrooms	Q28o3
Number of Items in Composite	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.80**

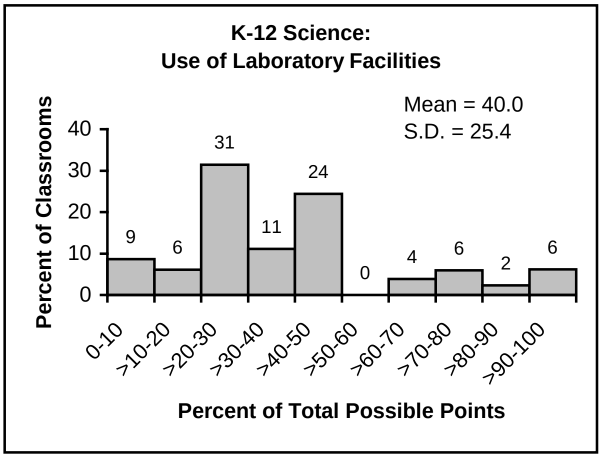


Figure E-40

Table E-22
Use of Calculators/Computers for Investigations

	Mathematics
Record, represent, and/or analyze data	Q25l
Use calculators or computers as a tool (e.g., spreadsheets, data analysis)	Q25r
Do simulations	Q26d
Collect data using sensors or probes	Q26e
Retrieve or exchange data	Q26f
Solve problems using simulations	Q26g
Number of Items in Composite	**6**
Reliability (Cronbach's Coefficient Alpha)	**0.85**

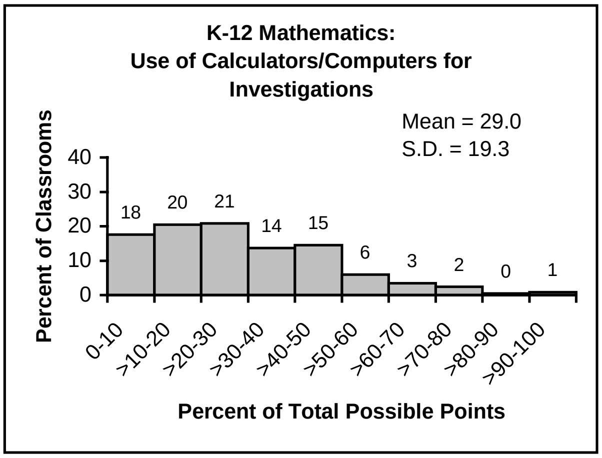


Figure E-41

Table E-23
Use of Calculators/Computers for Developing Concepts and Skills

	Mathematics
Use calculators or computers for learning or practicing skills	Q25p
Use calculators or computers to develop conceptual understanding	Q25q
Do drill and practice	Q26a
Demonstrate mathematics principles	Q26b
Take a test or quiz	Q26h
Use graphing calculators	Q28g3
Number of Items in Composite	**6**
Reliability (Cronbach's Coefficient Alpha)	**0.86**

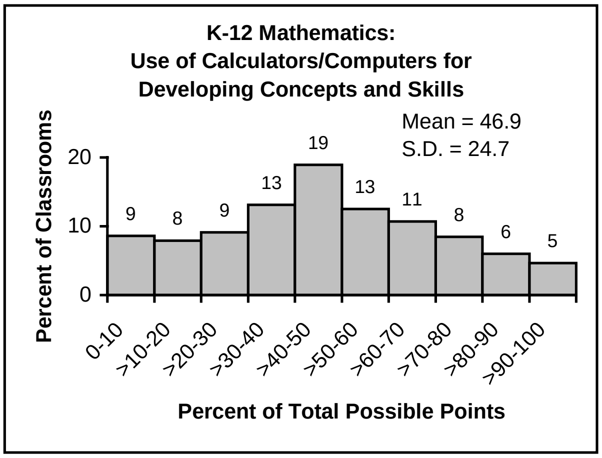


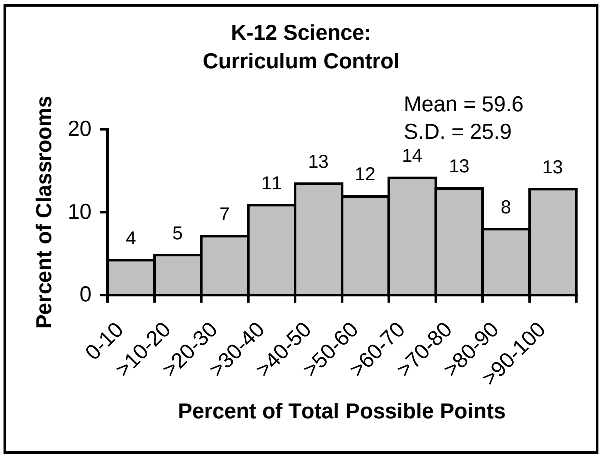
Figure E-42

Instructional Control

These composites estimate the level of control teachers perceive having over curriculum and pedagogy decisions for their classrooms.

Table E-24
Curriculum Control

	Science	Mathematics
Determining course goals and objectives	Q31a	Q31a
Selecting textbooks/instructional programs	Q31b	Q31b
Selecting other instructional materials	Q31c	Q31c
Selecting content, topics, and skills to be taught	Q31d	Q31d
Selecting the sequence in which topics are covered	Q31e	Q31e
Number of Items in Composite	**5**	**5**
Reliability (Cronbach's Coefficient Alpha)	**0.82**	**0.82**



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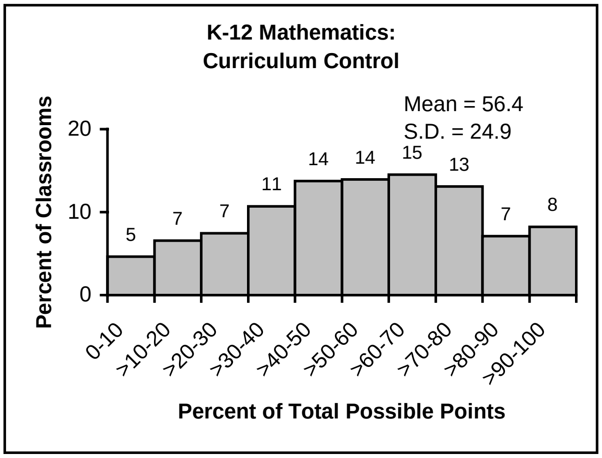
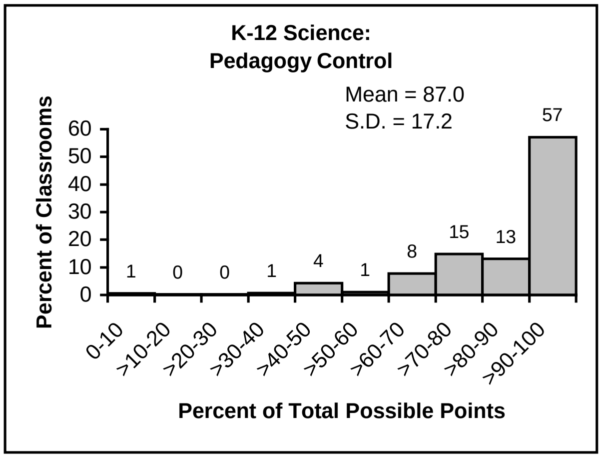


Figure E-44

Table E-25
Pedagogy Control

	Science	Mathematics
Selecting the pace for covering topics	Q31g	Q31g
Determining the amount of homework to be assigned	Q31h	Q31h
Choosing criteria for grading students	Q31i	Q31i
Choosing tests for classroom assessment	Q31j	Q31j
Number of Items in Composite	**4**	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.84**	**0.80**



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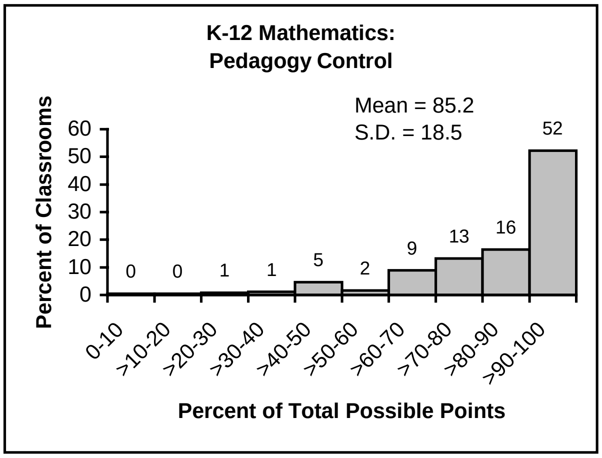

Figure E-46

G. Definitions of Program Composites

Composite definitions for the science and mathematics program questionnaire are presented below along with the item numbers from the respective questionnaires. Composites that are identical for the two subjects are presented in the same table; composites unique to a subject are presented in separate tables.

National Standards for Science and Mathematics Education

These composites estimate the level of attention to national standards given by teachers and other stakeholders. Science Standards refer to the NRC's *National Science Education Standards* (1996). Mathematics Standards refer to the National Council of Teachers of Mathematics (NCTM) *Standards* (1989,1991).

Table E-26
Teacher Attention to Standards

	Science	**Mathematics**
I am prepared to explain the *Standards* to my colleagues	Q3a	Q3a
The *Standards* have been thoroughly discussed by teachers in this school	Q3b	Q3b
There is a school-wide effort to make changes inspired by the *Standards*	Q3c	Q3c
Teachers in this school have implemented the *Standards* in their teaching	Q3d	Q3d
Number of Items in Composite	**4**	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.85**	**0.81**

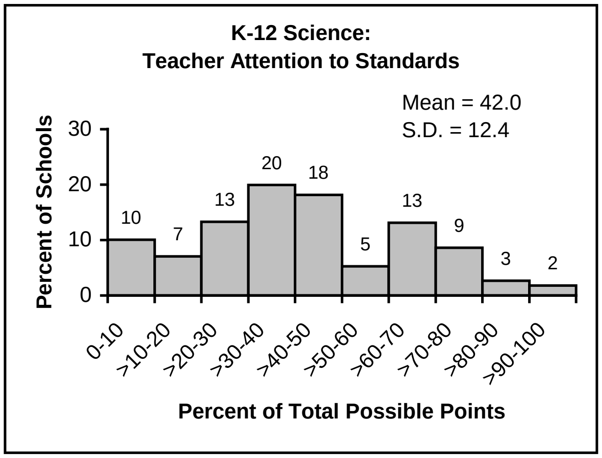

Figure E-47

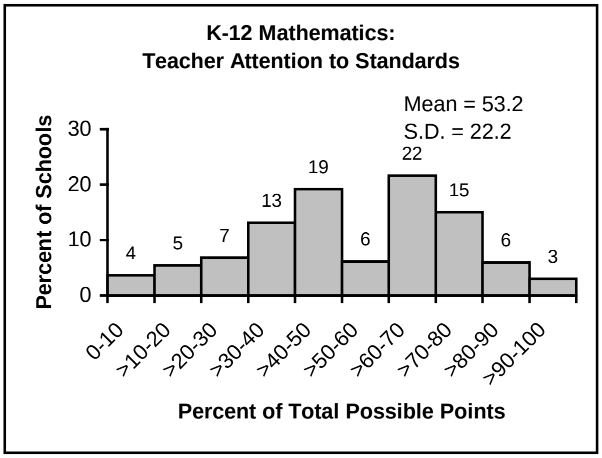

Figure E-48

Table E-27
Other Stakeholders' Attention to Standards

	Science	Mathematics
The principal of this school is well-informed about the *Standards*	Q3e	Q3e
Parents of students in this school are well-informed about the *Standards*	Q3f	Q3f
The Superintendent of this district is well-informed about the *Standards*	Q3g	Q3g
The School Board is well-informed about the *Standards*	Q3h	Q3h
Our district is organizing staff development based on the *Standards*	Q3i	Q3i
Our district has changed how it evaluates teachers based on the *Standards*	Q3j	Q3j
Number of Items in Composite	**6**	**6**
Reliability (Cronbach's Coefficient Alpha)	**0.90**	**0.87**

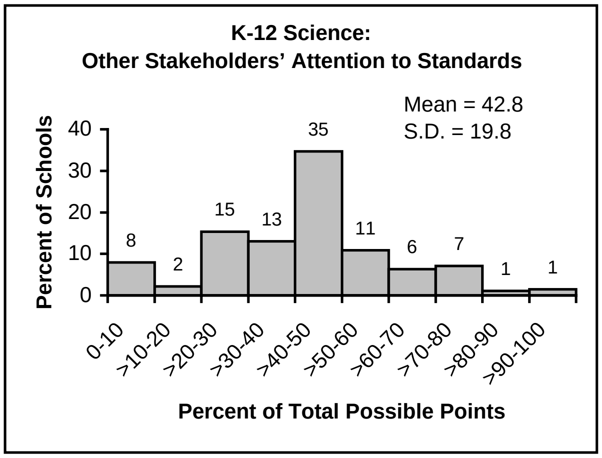

Figure E-49

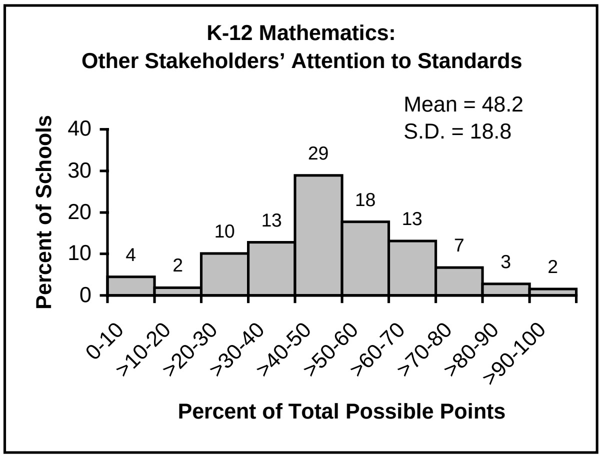

Figure E-50

Factors Affecting Instruction

These composites estimate the extent to which various factors negatively impact science/mathematics instruction in schools.

Table E-28
Extent to Which Facilities and Equipment Pose a Problem for Instruction

	Science	Mathematics
Facilities	Q9a	Q9a
Funds for purchasing equipment and supplies	Q9b	Q9b
Materials for individualizing instruction	Q9c	Q9c
Access to computers	Q9d	Q9d
Appropriate computer software	Q9e	Q9e
Number of Items in Composite	**5**	**5**
Reliability (Cronbach's Coefficient Alpha)	**0.73**	**0.75**

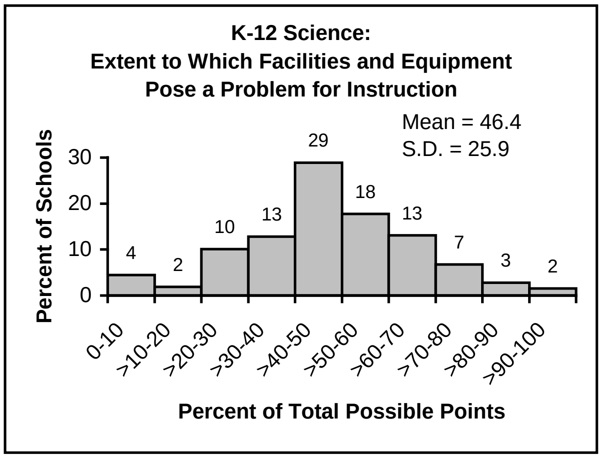

Figure E-51

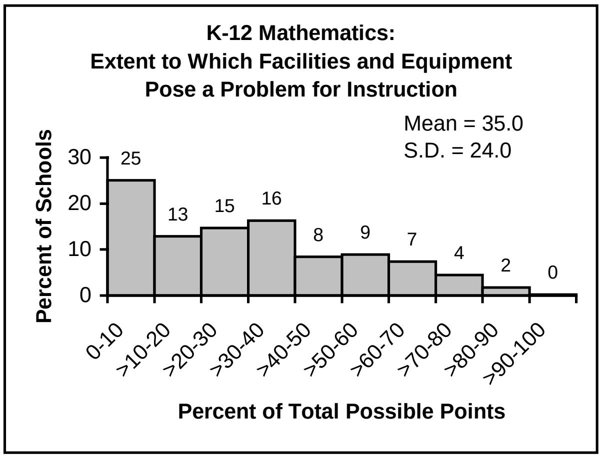

Figure E-52

Table E-29
Extent to Which Students and Parents Pose a Problem for Instruction

	Science	Mathematics
Student interest in science/mathematics	Q9f	Q9f
Student reading abilities	Q9g	Q9g
Student absences	Q9h	Q9h
Maintaining discipline	Q9p	Q9p
Parental support for education	Q9q	Q9q
Number of Items in Composite	**5**	**5**
Reliability (Cronbach's Coefficient Alpha)	**0.80**	**0.82**

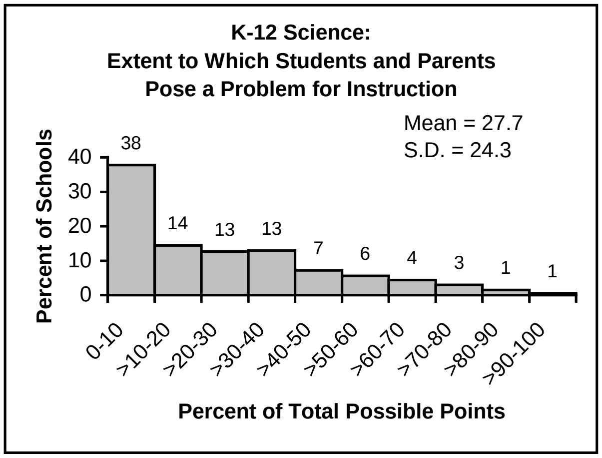

Figure E-53

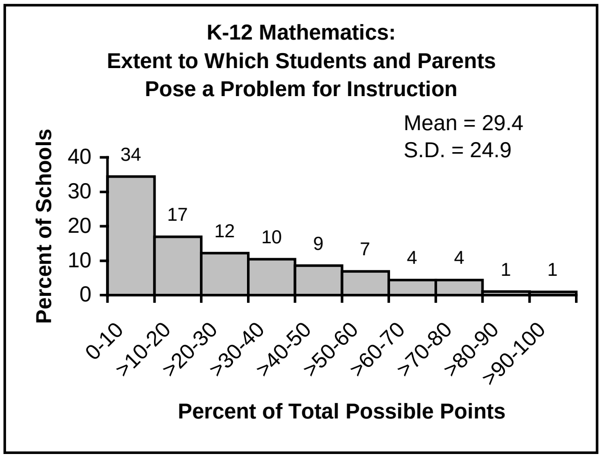

Figure E-54

Table E-30
Extent to Which Time Constraints Pose a Problem for Instruction

	Science	**Mathematics**
Time to teach science/mathematics	Q9k	Q9k
Opportunities for teachers to share ideas	Q9l	Q9l
In-service education opportunities	Q9m	Q9m
Time available for teachers to plan and prepare lessons	Q10f	Q10f
Time available for teachers to work with other teachers during the school year	Q10g	Q10g
Time available for teacher professional development	Q10h	Q10h
Number of Items in Composite	**6**	**6**
Reliability (Cronbach's Coefficient Alpha)	**0.81**	**0.83**

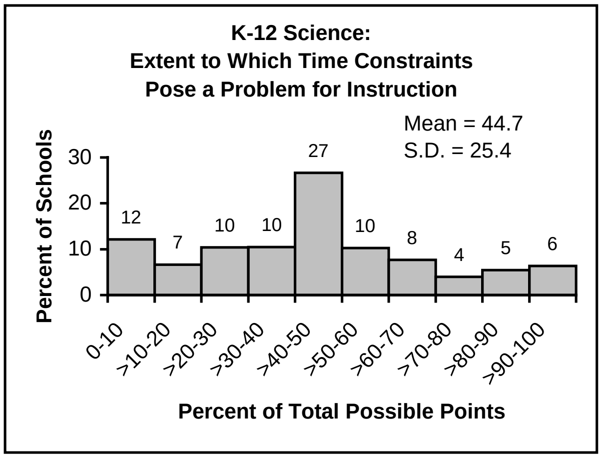

Figure E-55

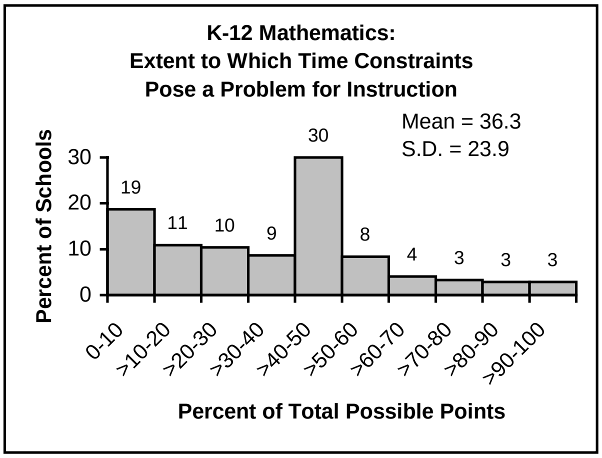

Figure E-56