Report of
the 2012 National Survey of
Science and Mathematics Education

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Disclaimer

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CHAPTER ONE

Introduction

Background and Purpose of the Study

In 2012, the National Science Foundation supported the fifth in a series of national surveys of science and mathematics education 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, a third survey was conducted in 1993, and a fourth in 2000.

The 2012 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 7,752 science and mathematics teachers in schools across the United States participated in this survey. The research questions addressed by the survey are:

1. To what extent do science and mathematics instruction and ongoing assessment mirror current understanding of learning?

2. What influences teachers' decisions about content and pedagogy?

3. What are the characteristics of the science/mathematics teaching force in terms of race, gender, age, content background, beliefs about teaching and learning, and perceptions of preparedness?

4. What are the most commonly used textbooks/programs, and how are they used?

5. What formal and informal opportunities do science/mathematics teachers have for ongoing development of their knowledge and skills?

6. How are resources for science/mathematics education, including well-prepared teachers and course offerings, distributed among schools in different types of communities and different socioeconomic levels?

The design and implementation of the 2012 National Survey involved developing a sampling strategy and selecting samples of schools and teachers, developing and piloting 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.

Sample Design and Sampling Error Considerations

The 2012 National Survey 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 Common Core of Data and Private School Survey databases—programs of the U.S. Department of Education's National Center for Education Statistics—which include 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.

As 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 were 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.

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 2012 National 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 2012 National Survey is included in Appendix A.

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 elementary 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 computer usage estimates between 5 percent and 9 percent (that is, 7 percent ± 2 standard error units).

In survey research, 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 that 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 that are substantial as well as statistically significant at the 0.05 level.[2] All population estimates presented in this report were computed using weighted data.

Instrument Development

As one purpose of the 2012 National Survey 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, 1993, and 2000. The project Advisory Board, 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.

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[1] The aim of non-response adjustments is to reduce possible bias by distributing the non-respondents' weights among the respondents expected to be most similar to these non-respondents. In this study, adjustment was made by region, school metro status, grade level, type (public, catholic, other private), and percent minority enrollment.

[2] The False Discovery Rate was used to control the Type I error rate when comparing multiple groups on the same outcome. Benjamini, Y. and Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society*, B, 57, 289–300.

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

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, including rounds of cognitive interviews with teachers 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 questionnaires are included in Appendix B.

Data Collection

HRI secured permission for the study from education officials at various levels. First, notification letters were mailed to the Chief State School Officers. Similar letters were subsequently mailed to superintendents of districts including sampled public schools and diocesan offices of sampled Catholic schools, identifying the schools in the district/diocese that had been selected for the survey. (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 log onto the study website and designate a school contact person or "school coordinator." The school coordinator designation page was designed to confirm the principal's contact information, as well as to obtain the name, title, phone number, and email address of the coordinator. Of the 2,000 target slots, 1,504 schools were successfully recruited and 35 were ineligible (e.g., closed or merged with another school) for a response rate of 77 percent.

An incentive system was developed to encourage school and teacher participation in the survey. School coordinators were offered an honorarium of up to $200 ($100 for completing a teacher list and school questionnaire, $15 for completing each program questionnaire (optional), and $10 for each completed teacher questionnaire). Teachers were offered a $25 honorarium for completing the teacher questionnaire.

Survey invitation letters were mailed to teachers beginning in February 2012. In addition to the incentives described, phone calls and emails to school coordinators were used to encourage non-respondents to complete the questionnaires. In May 2012, a final questionnaire invitation mailing was sent to teachers who had not yet completed their questionnaires. The teacher response rate was 77 percent. The response rate for the school program questionnaires was 83 percent. A detailed description of the data collection procedures is included in Appendix D.

Outline of This Report

This report of the 2012 National Survey is organized into major topical areas. In most cases, results are presented for groups of teachers categorized by grade level—elementary, middle, and high. In addition, factor analysis was used to create several composite variables related to key constructs measured on the questionnaires. Composite variables, which are more reliable than individual survey items, were computed to have a minimum possible value of 0 and a maximum possible value of 100. The definitions of these 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 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 that are likely to affect science and mathematics instruction, including school-wide programs, practices, and problems.

In addition, each chapter contains a set of "equity tables." These tables show the distribution of key outcomes across schools and classes of different demographic characteristics. For these tables, data from the program questionnaires are examined by four school-level factors: percentage of students eligible for free/reduced-price lunch (FRL), school size, community type, and region. Data from the teacher questionnaires were examined by an additional two factors: prior achievement level of students in the randomly selected class, and percentage of non-Asian minority students in the randomly selected class. Although the specific equity factors displayed in the body of the report vary by outcome, tables showing each examined outcome by all relevant equity factors are included in Appendix F.

CHAPTER TWO

Teacher Background and Beliefs

Overview

A well-prepared teaching force is essential for effective science and mathematics education. This chapter provides data about the nation's science and mathematics teachers, including their age, gender, race/ethnicity, teaching experience, and course backgrounds.

Teacher Characteristics

As can be seen in Tables 2.1 and 2.2, the vast majority of science and mathematics teachers at the elementary level are female. The proportion of science/mathematics teachers who are female decreases as grade level increases, to roughly half at the high school level. In contrast, the teacher experience data—experience teaching any subject at the K–12 level, experience teaching science/mathematics, and experience teaching at the present school—are striking in their similarity by subject and grade range.

Black, Hispanic, and other minority teachers continue to be underrepresented in the science and mathematics teaching force; at a time when only 62 percent of the K–12 student enrollment is White and non-Hispanic, roughly 90 percent of science/mathematics teachers in each grade range characterize themselves that way.

In addition, the majority of the science/mathematics teaching force is older than 40. It is difficult to predict whether teacher supply will meet demand, as many people who prepare to become teachers do not enter the profession, and others who leave the classroom return at a later date. However, the fact that more than 25 percent of science/mathematics teachers in each grade range are older than 50, and smaller percentages are age 30 or younger, raises concerns about having an adequate supply of science/mathematics teachers in the future.

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

	Percent of Teachers					
	Elementary		Middle		High	
Sex						
Male	6	(0.8)	30	(2.0)	46	(1.4)
Female	94	(0.8)	70	(2.0)	54	(1.4)
Race						
White	91	(1.5)	90	(1.4)	92	(0.8)
Black or African-American	5	(1.1)	6	(1.2)	3	(0.5)
Hispanic or Latino	8	(1.4)	5	(1.0)	4	(0.6)
Asian	2	(0.4)	2	(0.8)	2	(0.5)
American Indian/Alaskan Native	1	(0.3)	0	(0.2)	0	(0.2)
Native Hawaiian/Other Pacific Islander	0	(0.2)	0	(0.1)	0	(0.2)
Two or more races	1	(0.4)	1	(0.3)	2	(0.4)
Age						
≤ 30	18	(1.5)	11	(1.0)	16	(1.4)
31–40	29	(1.8)	28	(2.2)	30	(1.3)
41–50	25	(1.8)	28	(2.1)	24	(1.3)
51–60	20	(1.4)	26	(2.5)	22	(1.3)
61+	8	(1.1)	7	(1.5)	7	(1.0)
Experience Teaching any Subject at the K–12 Level						
0–2 years	11	(1.2)	9	(1.5)	14	(1.3)
3–5 years	17	(1.4)	14	(1.6)	13	(0.9)
6–10 years	20	(1.5)	22	(2.6)	23	(1.4)
11–20 years	32	(1.9)	33	(2.8)	30	(1.6)
≥ 21 years	19	(1.6)	22	(2.6)	19	(1.3)
Experience Teaching Science at the K–12 Level						
0–2 years	16	(1.4)	14	(1.7)	13	(1.1)
3–5 years	17	(1.6)	19	(1.8)	15	(1.2)
6–10 years	21	(1.5)	26	(2.6)	23	(1.5)
11–20 years	28	(1.7)	26	(2.1)	31	(1.4)
≥ 21 years	17	(1.5)	16	(2.4)	18	(1.1)
Experience Teaching at this School, any Subject						
0–2 years	24	(1.8)	22	(2.1)	23	(1.3)
3–5 years	23	(1.7)	22	(2.2)	21	(1.2)
6–10 years	23	(1.7)	24	(2.5)	23	(1.4)
11–20 years	21	(1.4)	23	(2.8)	24	(1.3)
≥ 21 years	9	(1.3)	8	(1.9)	9	(1.0)

Table 2.2
Characteristics of the Mathematics Teaching Force, by Grade Range

	Percent of Teachers					
	Elementary		**Middle**		**High**	
Sex						
Male	8	(1.0)	24	(1.9)	44	(1.7)
Female	92	(1.0)	76	(1.9)	56	(1.7)
Race						
White	92	(1.1)	89	(1.3)	92	(1.0)
Black or African-American	4	(0.9)	6	(0.9)	3	(0.6)
Hispanic or Latino	9	(1.3)	5	(0.7)	5	(0.6)
Asian	1	(0.3)	3	(1.0)	3	(0.6)
American Indian/Alaskan Native	1	(0.3)	1	(0.2)	1	(0.4)
Native Hawaiian/Other Pacific Islander	0	(0.3)	0	(0.2)	0	(0.1)
Two or more races	1	(0.3)	1	(0.3)	1	(0.2)
Age						
≤ 30	17	(1.2)	18	(1.3)	17	(1.2)
31–40	26	(1.4)	26	(2.1)	25	(1.3)
41–50	27	(1.6)	30	(2.2)	27	(1.2)
51–60	24	(1.4)	21	(1.7)	20	(1.1)
61+	6	(0.9)	5	(0.9)	10	(1.1)
Experience Teaching any Subject at the K–12 Level						
0–2 years	9	(1.0)	11	(1.2)	10	(1.0)
3–5 years	13	(1.2)	15	(1.2)	13	(1.1)
6–10 years	23	(1.3)	20	(1.6)	21	(1.2)
11–20 years	30	(1.6)	33	(2.1)	33	(1.5)
≥ 21 years	24	(1.6)	21	(1.9)	23	(1.2)
Experience Teaching Mathematics at the K–12 Level						
0–2 years	12	(1.1)	14	(1.4)	10	(0.8)
3–5 years	15	(1.4)	17	(1.3)	14	(1.1)
6–10 years	22	(1.3)	25	(1.8)	22	(1.3)
11–20 years	30	(1.6)	29	(1.9)	33	(1.4)
≥ 21 years	21	(1.6)	15	(1.6)	21	(1.1)
Experience Teaching at this School, any Subject						
0–2 years	20	(1.5)	23	(1.7)	21	(1.3)
3–5 years	21	(1.4)	23	(1.7)	23	(1.2)
6–10 years	26	(1.3)	23	(1.8)	25	(1.3)
11–20 years	22	(1.3)	23	(2.1)	23	(1.3)
≥ 21 years	11	(1.2)	8	(1.3)	8	(0.7)

Analyses were conducted to examine how teachers are distributed among schools; for example, whether teachers with the least experience are concentrated in high-poverty schools. As can be seen in Table 2.3, science classes in high-poverty schools are more likely than those in low-poverty schools to be taught by teachers with five or fewer years of experience.

Table 2.3
Classes Taught by Teachers with Varying Experience Teaching Subject, by Subject and Proportion of Students Eligible for Free/Reduced-Price Lunch

	Percent of Classes			
	Lowest Quartile	Second Quartile	Third Quartile	Highest Quartile
Experience Teaching Science				
0–2 years	10 (1.3)	11 (1.4)	16 (1.7)	23 (2.6)
3–5 years	15 (1.8)	16 (2.0)	16 (1.7)	22 (2.5)
6–10 years	26 (2.3)	23 (2.0)	21 (2.0)	23 (2.1)
11–20 years	34 (2.5)	30 (1.9)	30 (2.0)	21 (2.2)
≥ 21 years	15 (1.6)	20 (2.2)	17 (1.6)	11 (1.4)
Experience Teaching Mathematics				
0–2 years	12 (2.2)	12 (1.0)	12 (1.4)	14 (1.6)
3–5 years	13 (1.4)	13 (1.4)	16 (1.8)	19 (1.9)
6–10 years	24 (1.9)	24 (1.7)	22 (1.8)	21 (1.7)
11–20 years	30 (2.1)	32 (2.0)	30 (1.8)	31 (2.1)
≥ 21 years	22 (2.0)	19 (1.5)	21 (1.6)	15 (1.6)

Table 2.4 shows the percentage of classes taught by non-Asian minority teachers by the proportion of non-Asian minority students in the class. Note that in both science and mathematics, classes in the highest quartile in terms of students from underrepresented groups are more likely than those in the lowest quartile to be taught by teachers from underrepresented groups.

Table 2.4
Classes Taught by Non-Asian Minority Teachers, by Subject and Proportion of Non-Asian Minority Students in Class

	Percent of Classes	
	Science	Mathematics
Lowest Quartile of Non-Asian Minority Students	3 (0.8)	1 (0.5)
Second Quartile of Non-Asian Minority Students	3 (0.9)	4 (0.7)
Third Quartile of Non-Asian Minority Students	7 (1.0)	12 (1.7)
Highest Quartile of Non-Asian Minority Students	34 (2.5)	33 (2.7)

Teacher Preparation

In order to help students learn science/mathematics content, teachers must themselves have a firm grasp of the important ideas in the discipline. Because direct measures of teachers' content knowledge were not feasible in this study, the survey used a number of proxy measures, including teachers' major areas of study and courses completed. As can be seen in Table 2.5, very few teachers of science/mathematics at the elementary level have college or graduate degrees in these disciplines. The percentage of teachers with one or more degrees in science/mathematics increases with increasing grade range, with 52 percent of high school mathematics teachers and 61 percent of high school science teachers having a major in their discipline. If the definition of degree in discipline is expanded to include degrees in science/mathematics education, these figures increase to 73 percent of high school mathematics teachers and 82 percent of high school science teachers.

Table 2.5
Teacher Degrees, by Grade Range

	Percent of Teachers		
	Elementary	**Middle**	**High**
Science Teachers			
Science/Engineering	4 (0.7)	26 (2.0)	61 (1.6)
Science Education	2 (0.5)	27 (1.9)	48 (1.4)
Science/Engineering or Science Education	5 (0.8)	41 (2.5)	82 (1.3)
Mathematics Teachers			
Mathematics	4 (0.5)	23 (1.7)	52 (1.5)
Mathematics Education	2 (0.3)	26 (2.0)	54 (1.7)
Mathematics or Mathematics Education	4 (0.6)	35 (2.2)	73 (1.7)

Table 2.6 shows the percent of science/mathematics teachers with degrees in their discipline (including science/mathematics education), by schools with different concentrations of students eligible for free/reduced-price lunch. In science, but not in mathematics, significantly fewer teachers with degrees in the discipline work in schools in the highest quartile compared to the schools in the lowest quartile.

Table 2.6
Secondary Teachers with a Degree in Discipline,
by Proportion of Students Eligible for Free/Reduced-Price Lunch

	Percent of Teachers			
	Lowest Quartile	**Second Quartile**	**Third Quartile**	**Highest Quartile**
Science Teachers	68 (3.1)	57 (3.3)	62 (3.7)	58 (3.9)
Mathematics Teachers	56 (3.5)	53 (2.8)	54 (3.1)	51 (3.7)

Table 2.7 shows the percentage of science teachers in each grade range with at least one college course in each of a number of science disciplines. Note that 90 percent or more of science teachers at each level had coursework in the life sciences, 85 percent or more had at least one course in science education, and roughly 70 percent had a student teaching experience that included science. In contrast, in both chemistry and physics, the percent of teachers with at least one college course in the discipline increases substantially with increasing grade range.

Table 2.7
Science Teachers with College Coursework in Various Science Disciplines, by Grade Range

	Percent of Teachers		
	Elementary	Middle	High
Chemistry	47 (1.8)	72 (2.3)	93 (1.1)
Life sciences	90 (1.1)	96 (0.9)	91 (0.9)
Physics	32 (1.7)	61 (2.3)	86 (1.1)
Earth/space science	65 (2.0)	75 (2.3)	61 (1.7)
Environmental science	33 (1.8)	57 (2.5)	56 (1.1)
Engineering	1 (0.4)	7 (1.1)	14 (1.0)
Science education	89 (1.1)	89 (1.7)	85 (1.4)
Student teaching in science	70 (1.6)	73 (2.3)	72 (1.5)

Tables 2.8–2.13 provide additional information about secondary science teacher coursework in biology/life science, chemistry, physics, Earth/space science, environmental science, and engineering, respectively, in each case showing the percentage of middle and high school teachers who had one or more courses beyond the introductory level as well as the percentage who have completed each of a number of individual courses. Typically, high school teachers are substantially more likely than their middle grades counterparts to have taken coursework beyond the introductory level in a given discipline. Earth/space science and environmental science are the exceptions, where the course-taking profiles of middle and high school science teachers are quite similar.

Table 2.8
Secondary Science Teachers Completing Various Biology/Life Science Courses, by Grade Range

	Percent of Teachers	
	Middle	High
Introductory biology/life science	**96 (0.9)**	**91 (0.9)**
One or more biology/life science courses beyond the introductory level	**65 (2.6)**	**79 (1.2)**
Anatomy/Physiology	36 (2.1)	54 (1.5)
Genetics	24 (1.9)	54 (1.2)
Ecology	33 (2.1)	50 (1.5)
Cell Biology	28 (2.0)	48 (1.5)
Microbiology	23 (1.7)	48 (1.4)
Botany	26 (2.0)	44 (1.4)
Biochemistry	16 (1.5)	43 (1.5)
Zoology	25 (1.8)	40 (1.4)
Evolution	14 (1.5)	27 (1.2)

Table 2.9
Secondary Science Teachers Completing
Various Chemistry Courses, by Grade Range

	Percent of Teachers			
	Middle		High	
Introductory chemistry	**72**	**(2.3)**	**93**	**(1.1)**
One or more chemistry courses beyond the introductory level	**35**	**(2.3)**	**74**	**(1.3)**
Organic Chemistry	25	(2.0)	64	(1.5)
Inorganic Chemistry	17	(1.7)	46	(1.7)
Biochemistry	14	(1.4)	40	(1.4)
Analytical Chemistry	7	(1.3)	29	(1.5)
Physical Chemistry	11	(1.1)	26	(1.4)
Quantum Chemistry	2	(0.6)	8	(0.8)

Table 2.10
Secondary Science Teachers Completing
Various Physics Courses, by Grade Range

	Percent of Teachers			
	Middle		High	
Introductory physics	**61**	**(2.3)**	**86**	**(1.1)**
One or more physics courses beyond the introductory level	**15**	**(1.5)**	**36**	**(1.6)**
Mechanics	6	(1.1)	22	(1.1)
Electricity and Magnetism	8	(1.2)	21	(1.1)
Heat and Thermodynamics	6	(0.8)	21	(1.1)
Modern or Quantum Physics	3	(0.5)	16	(1.0)
Optics	3	(0.5)	13	(1.1)
Nuclear Physics	1	(0.3)	9	(0.8)

Table 2.11
Secondary Science Teachers Completing
Various Earth/Space Science Courses, by Grade Range

	Percent of Teachers			
	Middle		High	
Introductory Earth/space science	**75**	**(2.3)**	**61**	**(1.7)**
One or more Earth/space science courses beyond the introductory level	**28**	**(1.8)**	**30**	**(1.4)**
Geology	22	(1.6)	23	(1.2)
Astronomy	16	(1.3)	17	(1.1)
Physical Geography	14	(1.2)	11	(0.9)
Meteorology	9	(1.0)	11	(1.0)
Oceanography	10	(1.4)	10	(0.9)

Table 2.12
Secondary Science Teachers Completing
Various Environmental Science Courses, by Grade Range

	Percent of Teachers	
	Middle	**High**
Introductory environmental science	**57 (2.5)**	**56 (1.1)**
One or more environmental science courses beyond the introductory level	**23 (1.7)**	**27 (1.3)**
Ecology	17 (1.6)	21 (1.3)
Conservation Biology	8 (1.1)	10 (1.0)
Oceanography	6 (0.8)	9 (0.9)
Hydrology	4 (0.8)	5 (0.6)
Forestry	3 (0.6)	5 (0.6)
Toxicology	2 (0.4)	3 (0.5)

Table 2.13
Secondary Science Teachers Completing
Various Engineering Courses, by Grade Range

	Percent of Teachers	
	Middle	**High**
One or more engineering courses	**7 (1.1)**	**14 (1.0)**
Mechanical Engineering	1 (0.4)	5 (0.6)
Electrical Engineering	2 (0.6)	4 (0.6)
Chemical Engineering	1 (0.5)	3 (0.4)
Computer Engineering	1 (0.3)	3 (0.6)
Civil Engineering	1 (0.4)	2 (0.4)
Bioengineering/Biomedical Engineering	1 (0.2)	1 (0.2)
Industrial/Manufacturing Engineering	1 (0.2)	1 (0.3)
Aerospace Engineering	0 (0.2)	1 (0.3)

In addition to asking teachers about the types of science/mathematics courses they had completed in college, the 2012 National Survey asked teachers how many of those courses they had taken at two-year institutions, including community colleges and technical schools, and how many at four-year colleges/universities. As can be seen in Table 2.14, similar proportions of teachers in the various subject/grade-range categories have taken at least some disciplinary courses at two-year institutions. The extent to which those teachers completed their science/mathematics coursework at two-year institutions varied considerably by grade range, with the proportion of courses taken decreasing with increasing grade level (see Table 2.15).

Table 2.14
Teachers Completing at Least One Course
in Their Field at Two-Year Institutions, by Grade Range

	Percent of Teachers		
	Elementary	**Middle**	**High**
Science	33 (2.4)	35 (3.0)	31 (2.2)
Mathematics	35 (2.5)	28 (2.6)	31 (2.0)

Table 2.15
Average Percentage† of Courses Teachers Completed in Their Field at Two-Year Institutions, by Grade Range

	Average Percent of Courses in Field		
	Elementary	Middle	High
Science Teachers	55 (2.3)	38 (2.3)	26 (2.3)
Mathematics Teachers	48 (1.8)	41 (3.0)	30 (1.7)

† Includes only teachers who completed part of the coursework in their field at a two-year institution.

Teachers of science in the elementary grades are typically responsible for instruction across science disciplines. Accordingly, the National Science Teachers Association (NSTA) has recommended that rather than studying a single science discipline in depth, elementary science teachers be prepared to teach life science, Earth science, and physical science. As can be seen in Table 2.16, 36 percent of elementary science teachers have had courses in all three of those areas, and another 38 percent have had coursework in two of the three areas. At the other end of the spectrum, 6 percent of elementary science teachers have not had any college science courses.

Table 2.16
Elementary Science Teachers Meeting NSTA Course-Background Standards

	Percent of Teachers
Courses in life, Earth, and physical science†	36 (1.6)
Courses in two of the three areas	38 (1.7)
Courses in one of the three areas	20 (1.4)
No courses in any of the three areas	6 (0.9)

† Physical science is defined as a course in either chemistry or physics.

NSTA's recommendations for teachers in the middle grades are a bit more stringent, suggesting coursework in both chemistry and physics, as well as in the life and Earth sciences. Forty-five percent of middle grades teachers assigned to classes in general and/or integrated science meet that standard, and another 28 percent have had coursework in three of the four areas (see Table 2.17).

Table 2.17
Middle School Teachers of General/Integrated Science Meeting NSTA Course-Background Standards

	Percent of Teachers
Coursework in life science, Earth science, physics, and chemistry	45 (2.4)
Three of four recommended courses	28 (2.3)
Two of four recommended courses	22 (2.4)
One of four recommended courses	5 (0.9)
None of four recommended courses	1 (0.7)

Many secondary science classes, especially at the high school level, focus on a single area of science, such as biology or chemistry. Table 2.18 provides information about the course background of high school science teachers. Biology teachers tend to have particularly strong backgrounds in their discipline, with 53 percent having a degree in biology, and another 37 percent with at least three college courses beyond introductory biology.

Table 2.18
Secondary Science Teachers with Varying Levels of Background in Subject†

	Percent of Teachers			
	Degree in Field	No Degree in Field, but 3+ Courses beyond Introductory	No Degree in Field, but 1–2 Courses beyond Introductory	No Degree in Field or Courses beyond Introductory
Middle				
Life science/biology	27 (4.1)	31 (4.4)	20 (3.9)	22 (3.9)
Earth science	9 (2.6)	16 (2.8)	10 (3.3)	64 (5.0)
Physical science	8 (3.3)	23 (3.7)	27 (4.8)	42 (5.8)
High				
Life science/biology	53 (2.4)	37 (2.3)	4 (1.0)	6 (1.2)
Chemistry	25 (1.8)	43 (2.2)	21 (2.3)	11 (2.4)
Physics	20 (2.4)	36 (3.1)	16 (2.5)	29 (3.7)
Earth science	14 (3.0)	24 (4.3)	20 (3.4)	42 (6.9)
Physical science	10 (2.9)	48 (6.0)	25 (3.9)	17 (4.0)
Environmental science	9 (2.7)	19 (3.4)	23 (5.4)	49 (5.1)

† Teachers assigned to teach classes in more than one subject area are included in each category.

Additional analyses were conducted to examine the extent to which teachers with the strongest background in their field are equitably distributed. As can be seen in Table 2.19, secondary science classes with different proportions of non-Asian minority students; in schools of different sizes; and in rural, urban, and suburban schools, are about equally likely to be taught by teachers who have had at least three courses in the subject beyond the introductory level. In contrast, classes described as composed of high-achieving students are significantly more likely to be taught by teachers with strong content background than those with low levels of prior achievement.

Table 2.19
Secondary Science Classes Taught by Teachers with Substantial Background† in Subject of Selected Class, by Equity Factors

	Percent of Classes
Prior Achievement Level of Class	
Mostly High Achievers	69 (2.9)
Average/Mixed Achievers	64 (2.1)
Mostly Low Achievers	57 (6.4)
Percent of Non-Asian Minority Students in Class	
Lowest Quartile	63 (4.1)
Second Quartile	69 (3.0)
Third Quartile	63 (2.9)
Highest Quartile	62 (3.6)
Percent of Students in School Eligible for FRL	
Lowest Quartile	67 (2.5)
Second Quartile	67 (3.1)
Third Quartile	61 (4.1)
Highest Quartile	65 (4.4)
School Size	
Smallest Schools	61 (3.5)
Second Group	70 (3.1)
Third Group	65 (3.1)
Largest Schools	61 (3.3)
Community Type	
Rural	66 (3.8)
Suburban	65 (2.3)
Urban	61 (2.7)

† Defined as having either a degree or at least three advanced courses in the subject of their selected class.

Turning to elementary grades mathematics, as can be seen in Table 2.20, nearly all teachers have completed college coursework in mathematics for elementary school teachers and mathematics education. Roughly half of elementary mathematics teachers have had college courses in each of a number of areas of mathematics, including algebra and statistics.

Table 2.20
Elementary Mathematics Teachers Completing Various College Courses

	Percent of Teachers
Mathematics content for elementary school teachers	95 (0.7)
College algebra/trigonometry/elementary functions	55 (1.6)
Computer Science	50 (2.1)
Statistics	46 (1.6)
Integrated mathematics	43 (1.7)
Probability	24 (1.5)
College Geometry	24 (1.5)
Calculus	19 (1.4)
Mathematics education	95 (0.7)
Student teaching in mathematics	86 (1.2)

The National Council of Teachers of Mathematics (NCTM) has recommended that elementary mathematics teachers take college coursework in a number of different areas, including number and operations (for which "mathematics for elementary teachers" can serve as a proxy), algebra, geometry, probability, and statistics. As can be seen in Table 2.21, only 10 percent of elementary mathematics teachers have had courses in each of these areas; the typical elementary teacher has had coursework in only 1 or 2 of these 5 areas.

Table 2.21
Elementary Mathematics Teachers' Coursework Related to NCTM Course-Background Standards

	Percent of Teachers
All 5 courses	10 (1.2)
3–4 courses	32 (1.6)
1–2 courses	57 (1.8)
No courses	1 (0.3)

Table 2.22 shows the percentage of middle and high school mathematics teachers with coursework in each of a number of areas. Note that nearly all high school mathematics teachers have completed a calculus course, and 79 percent have taken a course in advanced calculus. Similarly, more than 3 out of 4 high school mathematics teachers have had college coursework in linear algebra and in statistics. Other college courses completed by a majority of high school mathematics teachers include abstract algebra, differential equations, axiomatic geometry, analytic geometry, probability, number theory, and discrete mathematics. Substantially fewer teachers at the middle grades have had college coursework in each of these areas.

Table 2.22
Secondary Mathematics Teachers
Completing Various College Courses, by Grade Range

	Percent of Teachers	
	Middle	**High**
Calculus	63 (2.3)	93 (0.9)
Advanced calculus	37 (2.1)	79 (1.6)
Differential equations	22 (1.5)	62 (1.7)
Real analysis	18 (1.7)	44 (1.7)
Linear algebra	39 (1.9)	80 (1.7)
Mathematics content for middle/high school teachers	56 (2.3)	71 (1.8)
Abstract algebra	28 (1.6)	67 (1.7)
Axiomatic geometry (Euclidean or non-Euclidean)	21 (1.6)	55 (1.7)
Analytic/Coordinate geometry	26 (1.9)	53 (1.7)
Integrated mathematics	40 (2.0)	34 (1.7)
Statistics	69 (2.1)	83 (1.5)
Probability	39 (2.2)	56 (1.7)
Number theory	32 (2.0)	54 (1.9)
Discrete mathematics	26 (1.7)	52 (1.8)
Other upper division mathematics	19 (1.5)	43 (1.5)
Computer science	61 (2.1)	77 (1.7)
Engineering	9 (1.2)	19 (1.4)
Mathematics education	87 (1.7)	87 (1.6)
Student teaching in mathematics	73 (2.1)	79 (1.6)

At the middle grades level, NCTM recommends that teachers have more extensive college coursework, including courses in number (for which "mathematics for middle school teachers" can serve as a proxy), algebra, geometry, probability, statistics, and calculus. As can be seen in Table 2.23, roughly half of middle grades mathematics teachers have had college courses in all or nearly all of these areas, having completed at least 4 of the 6 recommended courses.

Table 2.23
Middle School Mathematics Teachers' Coursework
Related to NCTM Course-Background Standards

	Percent of Teachers
All 6 courses	14 (1.4)
4–5 courses	35 (2.0)
2–3 courses	31 (2.1)
1 course	15 (1.6)
No courses	6 (1.0)

Table 2.24 provides analogous data for high school mathematics teachers, in this case based on a total of seven courses, including number theory and discrete mathematics and omitting mathematics coursework specifically aimed at teachers. Approximately two-thirds of high school teachers meet or come close to having taken courses in all seven areas, completing at least five.

Table 2.24
High School Mathematics Teachers' Coursework Related to NCTM Course-Background Standards

	Percent of Teachers
All 7 courses	26 (1.5)
5–6 courses	40 (1.6)
3–4 courses	22 (1.6)
1–2 courses	10 (1.4)
No courses	2 (0.7)

Teachers were also asked about their path to certification. As can be seen in Table 2.25, elementary science/mathematics teachers are more likely than those at the high school level to have had an undergraduate program leading to a bachelor's degree and a teaching credential. In contrast, high school science/mathematics teachers are more likely than their elementary school counterparts to have completed a post-baccalaureate credentialing program that did not include a master's degree. Ten percent of high school mathematics teachers and eight percent of high school science teachers have not had any formal teacher preparation.

Table 2.25
Teachers' Paths to Certification, by Subject and Grade Range

	Percent of Teachers		
	Elementary	**Middle**	**High**
Science			
An undergraduate program leading to a bachelor's degree and a teaching credential	61 (2.6)	47 (3.6)	34 (2.0)
A post-baccalaureate credentialing program (no master's degree awarded)	13 (1.8)	23 (2.5)	30 (1.9)
A master's program that also awarded a teaching credential	25 (2.3)	26 (3.1)	28 (1.8)
No formal teacher preparation	1 (0.5)	4 (1.5)	8 (1.3)
Mathematics			
An undergraduate program leading to a bachelor's degree and a teaching credential	63 (2.2)	55 (3.1)	48 (2.3)
A post-baccalaureate credentialing program (no master's degree awarded)	14 (1.9)	17 (2.1)	20 (1.8)
A master's program that also awarded a teaching credential	22 (2.0)	25 (2.7)	22 (1.6)
No formal teacher preparation	1 (0.4)	3 (1.1)	10 (1.9)

Teacher Pedagogical Beliefs

Teachers were asked about their beliefs regarding effective teaching and learning in science/ mathematics. Table 2.26 shows the percentage of science teachers in each grade range agreeing with each of the statements; data for mathematics teachers are shown in Table 2.27.

It is interesting to note that elementary, middle, and high school science teachers have similar views about a number of elements of science instruction. More than 85 percent of teachers in each grade range agree that: (1) students should be provided with the purpose for a lesson as it begins; (2) most class periods should include review of previously covered material; (3) most class periods should provide students opportunities to share their thinking/reasoning; and (4) most class periods should conclude with a summary of the key ideas addressed in that lesson.

A similarly large proportion of science teachers in each grade range believe that inadequacies in students' science background can be overcome by effective teaching. In contrast, teacher opinions about ability grouping vary considerably by grade range, with 65 percent of high school science teachers, 48 percent of those in the middle grades, and 32 percent at the elementary level indicating that students learn science best in classes with students of similar abilities.

There are also inconsistent views in relation to a number of elements of effective science instruction. Approximately three-fourths of teachers at each grade range agree that it is better to focus on ideas in depth, even if it means covering fewer topics, one of the central tenets of calls for reform in science instruction. At the same time, despite research on learning that suggests otherwise,[3] roughly 40 percent of science teachers at each grade level agree that teachers should explain an idea to students before having them consider evidence for that idea; and more than half indicate that laboratory activities should be used primarily to reinforce ideas that the students have already learned. And despite recommendations that students develop understanding of concepts first and learn the scientific language later, from 70 to 85 percent of science teachers at the various grade ranges indicate that students should be given definitions for new vocabulary at the beginning of instruction on a science idea.

[3] National Research Council. (2005). *How students learn: History, mathematics, and science in the classroom.* M. S. Donovan and J. D. Bransford, (Eds.) Washington, DC: National Academy Press.

Table 2.26
Science Teachers Agreeing[†] with Various
Statements about Teaching and Learning, by Grade Range

	Percent of Teachers					
	Elementary		Middle		High	
Most class periods should provide opportunities for students to share their thinking and reasoning	98	(0.5)	95	(1.1)	92	(0.9)
Most class periods should conclude with a summary of the key ideas addressed	96	(0.7)	93	(1.1)	88	(1.0)
Students should be provided with the purpose for a lesson as it begins	93	(1.0)	90	(1.3)	88	(1.0)
Most class periods should include some review of previously covered ideas and skills	91	(1.1)	89	(1.5)	86	(1.2)
Inadequacies in students' science background can be overcome by effective teaching	89	(1.2)	89	(1.9)	84	(1.1)
It is better for science instruction to focus on ideas in depth, even if that means covering fewer topics	72	(1.6)	77	(1.9)	73	(1.3)
At the beginning of instruction on a science idea, students should be provided with definitions for new scientific vocabulary that will be used	85	(1.3)	78	(2.1)	70	(1.7)
Students learn science best in classes with students of similar abilities	32	(1.7)	48	(2.3)	65	(1.7)
Hands-on/laboratory activities should be used primarily to reinforce a science idea that the students have already learned	54	(1.9)	57	(2.8)	56	(1.9)
Students should be assigned homework most days	38	(2.2)	33	(2.4)	48	(1.4)
Teachers should explain an idea to students before having them consider evidence that relates to the idea	45	(1.9)	41	(2.3)	39	(1.7)

† Includes teachers indicating "strongly agree" or "agree" on a 5-point scale ranging from 1 "strongly disagree" to 5 "strongly agree."

As can be seen in Table 2.27, mathematics teachers share many of the views of their science counterparts, with at least 85 percent of teachers in each grade range agreeing that students should be provided with the purpose for a lesson as it begins and that most class periods should include review, provide students opportunities to share their thinking and reasoning, and conclude with a summary of the key ideas addressed.

More than three-fourths of mathematics teachers at each grade range indicate that inadequacies in students' mathematics background can be overcome by effective teaching. At the same time, 51 percent of elementary mathematics teachers, increasing to 69 percent in the middle grades, and 77 percent at the high school level, indicate that students learn mathematics best in classes with students of similar abilities.

As is the case in science, most mathematics teachers agree with the notion of covering fewer ideas in greater depth, but sizeable proportions do not agree with other recommendations for improving mathematics teaching and learning. For example, from 37 to 48 percent of mathematics teachers, depending on grade range, believe that teachers should explain ideas to students before they investigate those ideas. Similarly, from 39 to 52 percent agree that hands-on activities/manipulatives should be used primarily to reinforce ideas the students have already learned, despite recommendations that these be used to help students develop their initial understanding of key concepts. And even larger proportions of mathematics teachers, from 81 percent at the high school level to 90 percent at the elementary level, believe that students should be given definitions of new vocabulary at the beginning of instruction on a mathematical idea.

Table 2.27
Mathematics Teachers Agreeing† with Various Statements about Teaching and Learning, by Grade Range

	Percent of Teachers					
	Elementary		Middle		High	
Most class periods should provide opportunities for students to share their thinking and reasoning	97	(0.5)	95	(0.8)	93	(0.8)
Most class periods should conclude with a summary of the key ideas addressed	95	(0.8)	93	(1.0)	90	(0.9)
Most class periods should include some review of previously covered ideas and skills	96	(0.6)	90	(1.2)	87	(1.0)
Students should be provided with the purpose for a lesson as it begins	95	(0.6)	92	(1.2)	85	(0.9)
Students should be assigned homework most days	67	(1.7)	76	(1.9)	82	(1.3)
At the beginning of instruction on a mathematical idea, students should be provided with definitions for new vocabulary that will be used	90	(1.1)	83	(1.5)	81	(1.0)
It is better for mathematics instruction to focus on ideas in depth, even if that means covering fewer topics	78	(1.5)	82	(1.8)	78	(1.2)
Inadequacies in students' mathematics background can be overcome by effective teaching	87	(1.3)	83	(1.6)	77	(1.3)
Students learn mathematics best in classes with students of similar abilities	51	(1.7)	69	(2.2)	77	(1.1)
Hands-on activities/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned	52	(1.7)	40	(2.1)	39	(1.7)
Teachers should explain an idea to students before having them investigate the idea	48	(1.8)	37	(1.8)	38	(1.6)

† Includes teachers indicating "strongly agree" or "agree" on a 5-point scale ranging from 1 "strongly disagree" to 5 "strongly agree."

Teachers' Perceptions of Preparedness

Elementary teachers are typically assigned to teach multiple subjects to a single group of students, including not only science and mathematics, but other areas as well. However, as can be seen in Table 2.28, these teachers do not feel equally well prepared to teach the various subjects. Although 77 percent of elementary teachers of self-contained classes feel very well prepared to teach mathematics—slightly lower than the 81 percent for reading/language arts—only 39 percent feel very well prepared to teach science.

Table 2.28
Elementary Teachers' Perceptions of Their Preparedness to Teach Each Subject

	Percent of Teachers[†]			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Reading/Language Arts	0 (0.1)	2 (0.3)	17 (0.9)	81 (1.0)
Mathematics	1 (0.4)	3 (0.7)	19 (1.5)	77 (1.7)
Social Studies	1 (0.3)	12 (0.9)	41 (1.5)	47 (1.5)
Science	2 (0.5)	15 (1.4)	43 (1.8)	39 (2.1)

† Includes only teachers assigned to teach all four subjects to a single class of students in grades K–6.

As noted earlier, teachers of self-contained classes were randomly assigned to respond to either the science or mathematics teacher questionnaire. Those who received the science questionnaire were asked about their preparedness to teach each of the major science disciplines to that class, and those receiving the mathematics questionnaire were asked about a number of mathematics areas.

As can be seen in Table 2.29, elementary teachers are more likely to indicate feeling very well prepared to teach life science and Earth science than they are to teach physical science. Engineering stands out as the area where elementary teachers feel least prepared, with only four percent indicating they are very well prepared to teach it at their grade level, and 73 percent noting that they are not adequately prepared.

Table 2.29
Elementary Teachers' Perceptions of Their Preparedness to Teach Various Science Disciplines

	Percent of Teachers[†]			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Life Science	4 (0.6)	21 (1.6)	46 (1.9)	29 (1.6)
Earth Science	4 (0.6)	26 (1.8)	45 (1.8)	26 (1.4)
Physical Science	8 (1.0)	33 (2.1)	42 (1.9)	17 (1.2)
Engineering	73 (1.7)	18 (1.6)	5 (0.8)	4 (0.6)

† Includes only teachers assigned to teach mathematics, reading/language arts, science, and social studies to a single class of students in grades K–6.

Table 2.30 provides data on elementary teachers' perceptions of their preparedness to teach each of a number of mathematics topics at their assigned grade level. Interestingly, 77 percent of elementary teachers indicate feeling very well prepared to teach number and operations, the same percent that indicate feeling very well prepared to teach mathematics in general. The fact that markedly fewer teachers feel very well prepared to teach measurement and data representation, geometry, and early algebra suggests that elementary teachers equate teaching mathematics with teaching number and operations.

Table 2.30
Elementary Teachers' Perceptions of Their Preparedness to Teach Selected Mathematics Topics

	Percent of Teachers†							
	Not Adequately Prepared		Somewhat Prepared		Fairly Well Prepared		Very Well Prepared	
Number and Operations	0	(0.1)	2	(0.4)	21	(1.3)	77	(1.4)
Measurement and Data Representation	1	(0.4)	9	(1.1)	33	(1.9)	56	(2.0)
Geometry	3	(0.6)	10	(1.0)	33	(1.7)	54	(1.9)
Early Algebra	5	(0.7)	13	(1.1)	36	(1.7)	46	(2.0)

† Includes only teachers assigned to teach mathematics, reading/language arts, science, and social studies to a single class of students in grades K–6.

As noted earlier, the teacher questionnaires included a series of items about a single, randomly selected class. Middle and high school science teachers were shown a list of topics based on the subject of that class, and asked how well prepared they feel to teach each of those topics at the grade levels they teach. As can be seen in Table 2.31, high school chemistry teachers are more likely to report a high level of preparedness than teachers in any other subject/grade-range group, with 66–83 percent indicating they feel very well prepared to teach the various topics. (It is interesting to note the variation among topics within physics, with only 19 percent of high school physics teachers reporting feeling very well prepared to teach modern physics, e.g., relativity, compared to 43–71 percent for the other topics in the list.) High school biology, chemistry, and physics teachers are more likely than their middle grades counterparts to report feeling very well prepared to teach topics within those disciplines, differences not seen in Earth/space science and environmental science. Finally, fewer than 10 percent of middle and high school science teachers feel very well prepared to teach engineering concepts. This finding is not surprising given that few teachers have had college coursework in engineering (see Table 2.13), and engineering has not traditionally been part of the school curriculum. As the *Next Generation Science Standards* include engineering concepts for K–12, there will likely be a need for a major professional development effort focused on engineering.

Table 2.31
Secondary Science Teachers Considering Themselves Very Well Prepared to Teach Each of a Number of Topics, by Grade Range

	Percent of Teachers†			
	Middle		High	
Earth/Space Science				
Earth's features and physical processes	51	(2.9)	47	(3.1)
The solar system and the universe	36	(2.6)	41	(3.2)
Climate and weather	42	(3.0)	39	(3.8)
Biology/Life Science				
Cell biology	49	(2.6)	68	(2.2)
Structures and functions of organisms	52	(3.1)	64	(2.5)
Genetics	41	(2.5)	63	(2.5)
Ecology/ecosystems	48	(2.6)	56	(2.4)
Evolution	33	(2.5)	52	(2.5)
Chemistry				
Elements, compounds, and mixtures	53	(2.6)	83	(2.2)
The periodic table	49	(2.3)	82	(2.2)
States, classes, and properties of matter	58	(2.5)	80	(2.4)
Atomic structure	45	(2.4)	80	(2.3)
Chemical bonding, equations, nomenclature, and reactions	31	(2.0)	77	(2.5)
Properties of solutions	33	(2.3)	66	(2.5)
Physics				
Forces and motion	42	(2.7)	71	(3.0)
Energy transfers, transformations, and conservation	37	(2.6)	62	(3.3)
Properties and behaviors of waves	23	(2.5)	51	(3.1)
Electricity and magnetism	23	(2.5)	43	(2.8)
Modern physics (e.g., special relativity)	5	(1.3)	19	(2.1)
Other				
Environmental and resource issues (e.g., land and water use, energy resources and consumption, sources and impacts of pollution)	35	(3.0)	37	(3.8)
Engineering (e.g., nature of engineering and technology, design processes, analyzing and improving technological systems, interactions between technology and society)	6	(1.0)	7	(0.8)

† Each secondary science teacher was asked about one set of science topics based on the discipline of his/her randomly selected class, and all secondary science teachers were asked about engineering.

Table 2.32 provides data on secondary mathematics teachers' perceptions of their preparedness to teach each of a number of mathematics topics. At each grade level, teachers are most likely to indicate feeling very well prepared to teach algebraic thinking and the number system and operations, and least likely to report that level of preparedness for discrete mathematics. High school mathematics teachers are significantly more likely than middle school teachers to report feeling very well prepared to teach many of the listed topics, but there is no difference in number system and operations. In the case of statistics and probability, middle grades teachers are more likely than high school teachers to report feeling very well prepared.

Table 2.32
Secondary Mathematics Teachers Considering Themselves Very Well Prepared to Teach Each of a Number of Topics, by Grade Range

	Percent of Teachers	
	Middle	**High**
Algebraic thinking	76 (1.9)	91 (0.9)
The number system and operations	88 (1.4)	90 (1.1)
Functions	60 (1.9)	84 (1.5)
Measurement	66 (2.1)	79 (1.2)
Geometry	62 (2.0)	70 (1.4)
Modeling	49 (2.3)	58 (2.0)
Statistics and probability	48 (2.2)	30 (1.2)
Discrete mathematics	18 (1.5)	25 (1.2)

Two series of items focused on teacher preparedness for a number of tasks associated with instruction. First, teachers were asked how well prepared they feel to address diverse learners in their science/mathematics instruction, including encouraging participation of each of a number of underrepresented groups. Second, teachers were asked about how well prepared they feel to monitor and address student understanding, focusing on a specific unit in the randomly selected class.

As can be seen in Table 2.33, the majority of science teachers in each grade range report feeling very well prepared to manage classroom discipline, which is a necessary precursor to effective teaching. A majority of high school teachers also feel very well prepared to encourage the participation of females and to encourage student interest in science and/or engineering; the proportion of teachers feeling very well prepared decreases with decreasing grade level. Fewer teachers at all grade levels feel very well prepared to encourage the participation of students from low socioeconomic backgrounds and racial or ethnic minorities in science and/or engineering. Few teachers indicate feeling very well prepared to teach science to students who have learning or physical disabilities, or are English-language learners.

Table 2.33
Science Teachers Considering Themselves Very Well Prepared for Each of a Number of Tasks, by Grade Range

	Percent of Teachers					
	Elementary		Middle		High	
Manage classroom discipline	72	(2.3)	60	(3.6)	59	(2.3)
Encourage participation of females in science and/or engineering	30	(2.3)	46	(3.6)	55	(2.2)
Encourage students' interest in science and/or engineering	25	(2.1)	39	(3.3)	53	(2.2)
Encourage participation of students from low socioeconomic backgrounds in science and/or engineering	31	(2.2)	36	(3.8)	44	(2.1)
Encourage participation of racial or ethnic minorities in science and/or engineering	30	(2.2)	36	(3.5)	44	(2.0)
Plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	28	(2.4)	29	(3.0)	38	(1.9)
Provide enrichment experiences for gifted students	21	(2.3)	23	(2.9)	33	(2.0)
Teach science to students who have learning disabilities	15	(2.0)	23	(2.9)	21	(1.8)
Teach science to students who have physical disabilities	13	(1.9)	17	(2.7)	21	(1.8)
Teach science to English-language learners	15	(1.9)	13	(2.4)	14	(1.3)

Table 2.34 shows the percentage of science classes at each grade level taught by teachers who feel very well prepared for each of a number of tasks related to instruction. Two findings are notable. First, teacher preparedness for these tasks tends to increase with increasing grade range. Second, science teachers tend to feel less well prepared for "pre-instruction" tasks, both finding out what students already knew or thought about the key science ideas to be addressed, and anticipating what students might find difficult in the unit.

Table 2.34
Science Classes in Which Teachers Feel Very Well Prepared for Each of a Number of Tasks in the Most Recent Unit, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Assess student understanding at the conclusion of this unit	46	(2.2)	59	(2.5)	64	(1.6)
Monitor student understanding during this unit	46	(2.2)	51	(2.2)	57	(1.6)
Implement the science textbook/module to be used during this unit†	39	(2.7)	51	(2.9)	52	(2.3)
Anticipate difficulties that students may have with particular science ideas and procedures in this unit	28	(1.8)	39	(2.3)	49	(1.5)
Find out what students thought or already knew about the key science ideas	38	(1.8)	41	(2.4)	42	(1.4)

† This item was presented only to teachers who indicated using commercially published textbooks/modules in the most recent unit.

Table 2.35 shows the mean scores on each of several "teacher preparedness" composites for science classes categorized by a number of equity variables. The most striking differences are among classes of students with different levels of prior achievement. Compared to classes of "mostly low achievers," teachers of classes with "mostly high achievers" are more likely to feel well prepared to teach science content, encourage students' interest in science, teach students from diverse backgrounds, and implement instruction in a particular unit. In addition, classes containing a higher proportion of non-Asian minority students and classes in higher poverty schools are more likely to be taught by teachers who feel less well prepared to encourage students' interest in science and implement instruction in a particular unit.

Table 2.35
Class Mean Scores for Science Teacher
Perceptions of Preparedness Composites, by Equity Factors

	Mean Score							
	Teach Students from Diverse Backgrounds		Encourage Students' Interest in Science		Teach Science Content†		Implement Instruction in Particular Unit	
Prior Achievement Level of Class								
Mostly High Achievers	57	(1.8)	80	(1.3)	83	(1.1)	84	(1.0)
Average/Mixed Achievers	56	(1.0)	69	(1.2)	79	(0.8)	77	(0.5)
Mostly Low Achievers	51	(2.5)	65	(2.8)	73	(3.7)	75	(1.1)
Percent of Non-Asian Minority Students in Class								
Lowest Quartile	54	(1.8)	72	(1.8)	79	(1.6)	80	(1.0)
Second Quartile	54	(1.6)	70	(1.7)	81	(1.0)	79	(0.9)
Third Quartile	57	(1.4)	72	(1.5)	80	(1.1)	79	(0.9)
Highest Quartile	55	(1.4)	65	(2.4)	79	(1.7)	76	(1.0)
Percent of Students in School Eligible for FRL								
Lowest Quartile	60	(2.0)	74	(1.9)	81	(1.0)	79	(1.0)
Second Quartile	57	(1.5)	70	(1.8)	80	(1.1)	80	(0.6)
Third Quartile	54	(1.4)	67	(2.8)	79	(1.3)	76	(0.9)
Highest Quartile	54	(1.7)	68	(1.6)	80	(1.7)	76	(1.1)

† Perceptions of Preparedness to Teach Science Content score was computed only for non-self-contained classes and is based on content in the randomly selected class.

As in science, most mathematics teachers feel very well prepared to manage classroom discipline, and very few feel very well prepared to teach mathematics to students who have learning or physical disabilities, or are English-language learners (see Table 2.36). The majority of mathematics teachers feel very well prepared to encourage the participation of females in mathematics. In contrast to science, high school teachers feel less well prepared to encourage students from low socioeconomic backgrounds and racial or ethnic minorities in mathematics than do elementary and middle grades teachers.

Table 2.36
Mathematics Teachers Considering Themselves Very Well Prepared for Each of a Number of Tasks, by Grade Range

	Percent of Teachers					
	Elementary		Middle		High	
Manage classroom discipline	69	(2.1)	61	(2.9)	58	(2.3)
Encourage participation of females in mathematics	56	(2.2)	56	(2.9)	51	(2.2)
Encourage participation of students from low socioeconomic backgrounds in mathematics	52	(2.2)	53	(3.1)	40	(2.2)
Encourage participation of racial or ethnic minorities in mathematics	50	(2.1)	48	(2.8)	39	(2.0)
Encourage students' interest in mathematics	48	(2.3)	46	(3.0)	39	(2.2)
Plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	42	(2.2)	36	(2.7)	31	(1.9)
Provide enrichment opportunities for gifted students	27	(2.2)	33	(3.2)	23	(1.8)
Teach mathematics to students who have learning disabilities	23	(2.1)	27	(3.0)	19	(1.6)
Teach mathematics to students who have physical disabilities	16	(1.6)	21	(2.7)	17	(1.4)
Teach mathematics to English-language learners	23	(2.2)	17	(2.1)	13	(1.2)

Table 2.37 shows the percentage of elementary, middle, and high school mathematics classes taught by teachers who feel very well prepared for each of a number of instructional tasks. As is the case in science, mathematics teachers tend to feel less well prepared for finding out what students thought or already knew about the key ideas to be addressed in the unit, and anticipating what students might find difficult in the unit.

Table 2.37
Mathematics Classes in Which Teachers Feel Very Well Prepared for Each of a Number of Tasks in the Most Recent Unit, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Assess student understanding at the conclusion of this unit	66	(1.7)	72	(2.3)	72	(1.5)
Monitor student understanding during this unit	62	(1.6)	62	(2.1)	65	(1.7)
Implement the mathematics textbook/program to be used during this unit†	62	(2.0)	63	(2.3)	61	(1.8)
Anticipate difficulties that students will have with particular mathematical ideas and procedures in this unit	46	(1.8)	54	(2.4)	60	(1.3)
Find out what students thought or already knew about the key mathematical ideas	48	(1.8)	49	(2.3)	48	(1.5)

† This item was presented only to teachers who indicated using commercially published textbooks/programs in the most recent unit.

Table 2.38 shows the mean scores on each of the "teacher preparedness" composites for mathematics classes by a number of equity variables. As is the case in science, classes comprised of "mostly high achievers" are significantly more likely than those that include "mostly low achievers" to be taught by teachers who feel well prepared in mathematics content, to encourage students' interest in mathematics, and to implement instruction in a particular unit.

Table 2.38
Class Mean Scores for Mathematics Teacher
Perceptions of Preparedness Composites, by Equity Factors

	Mean Score			
	Teach Students from Diverse Backgrounds	**Encourage Students' Interest in Mathematics**	**Teach Mathematics Content†**	**Implement Instruction in Particular Unit**
Prior Achievement Level of Class				
Mostly High Achievers	59 (1.4)	79 (1.3)	86 (0.5)	88 (0.7)
Average/Mixed Achievers	58 (0.8)	78 (0.8)	81 (0.6)	83 (0.5)
Mostly Low Achievers	58 (1.5)	75 (1.5)	80 (0.8)	83 (0.8)
Percent of Non-Asian Minority Students in Class				
Lowest Quartile	55 (1.5)	75 (1.4)	82 (1.0)	85 (0.7)
Second Quartile	57 (1.2)	78 (1.2)	85 (0.6)	85 (0.7)
Third Quartile	59 (1.2)	78 (1.2)	82 (0.8)	84 (0.7)
Highest Quartile	61 (1.4)	79 (1.3)	81 (0.9)	83 (0.8)
Percent of Students in School Eligible for FRL				
Lowest Quartile	58 (1.4)	76 (1.5)	85 (0.6)	86 (0.7)
Second Quartile	60 (1.3)	79 (1.3)	82 (0.9)	85 (0.6)
Third Quartile	57 (1.2)	77 (1.2)	82 (1.0)	84 (0.7)
Highest Quartile	61 (1.6)	79 (1.5)	81 (1.0)	82 (0.8)

† Perceptions of Preparedness to Teach Mathematics Content score was computed only for non-self-contained classes.

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 prepared in each area. Roughly 80 percent of elementary teachers feel very well prepared to teach reading/language arts and mathematics, but fewer than half feel very well prepared to teach science.

In part, this result may be due to very few elementary science and mathematics teachers having undergraduate majors in these fields. Elementary teachers also have less extensive college coursework in science/mathematics than do their middle grade counterparts, who in turn have had less science/mathematics coursework than their high school counterparts. Still, many teachers at all grade levels have less extensive backgrounds in the discipline they teach than is recommended by NSTA and NCTM. In addition, few teachers at any grade level feel well prepared to teach engineering, a key element of the *Next Generation Science Standards*.

Science and mathematics teachers' beliefs about effective instruction are, in some ways, in line with current recommendations from research and, in other ways, are not well aligned. A large majority of teachers in all subject/grade-range categories believe that it is better to cover fewer topics in depth. However, many believe that students should be given definitions for new vocabulary at the beginning of instruction, that teachers should explain an idea to students before having them consider evidence for it, and that hands-on activities should be used primarily to reinforce ideas students have already learned.

The 2012 National Survey also found that well-prepared teachers are not necessarily equitably distributed. Classes in schools with high proportions of students eligible for free/reduced-price lunch are more likely than classes in schools with few such students to be taught by relatively inexperienced teachers. In addition, science and mathematics classes categorized as consisting of “mostly high achievers” are more likely than those categorized as “mostly low achievers” to be taught by teachers who feel well prepared to teach science/mathematics, encourage students’ interest in the discipline, and implement instruction in a unit (e.g., monitor student understanding).

CHAPTER THREE

Science and Mathematics Professional Development

Overview

Science and mathematics teachers, like all professionals, need opportunities to keep up with advances in their field, including both disciplinary content and how to help their students learn important science/mathematics content. Staying up-to-date is particularly challenging for teachers at the elementary level, as they typically teach multiple subjects. The 2012 National Survey collected data on teachers' participation in in-service education and other professional activities, as well as data on study groups, one-on-one coaching, and other professional growth opportunities provided by schools and districts. These data are discussed in this chapter.

Teacher Professional Development

One important measure of teachers' continuing education is how long it has been since they participated in professional development. As can be seen in Tables 3.1 and 3.2, more than 80 percent of middle and high school science teachers, and mathematics teachers at each grade range, have participated in discipline-focused professional development (i.e., focused on science/mathematics content or the teaching of science/mathematics) within the last three years. Elementary teachers stand out for the relative paucity of professional development in science or science teaching, with only 59 percent having participated in the last three years.

Table 3.1
Science Teachers' Most Recent Participation in Science-Focused† Professional Development, by Grade Range

	Percent of Teachers		
	Elementary	**Middle**	**High**
In the last 3 years	59 (2.0)	82 (2.3)	85 (1.3)
4–6 years ago	16 (1.4)	6 (1.2)	7 (0.7)
7–10 years ago	5 (0.8)	3 (1.0)	2 (0.3)
More than 10 years ago	5 (0.8)	4 (1.3)	1 (0.4)
Never	15 (1.4)	6 (1.4)	5 (1.0)

† Includes professional development focused on science or science teaching.

Table 3.2
Mathematics Teachers' Most Recent Participation in Mathematics-Focused† Professional Development, by Grade Range

	Percent of Teachers					
	Elementary		Middle		High	
In the last 3 years	87	(1.3)	89	(1.6)	88	(1.0)
4–6 years ago	7	(0.9)	4	(0.7)	6	(0.6)
7–10 years ago	1	(0.4)	1	(0.5)	2	(0.4)
More than 10 years ago	1	(0.3)	2	(0.6)	1	(0.3)
Never	3	(0.7)	4	(1.0)	4	(0.7)

† Includes professional development focused on mathematics or mathematics teaching.

Although some involvement in professional development may be better than none, a brief exposure of a few hours over several years is not likely to be sufficient to enhance teachers' knowledge and skills in meaningful ways. Accordingly, teachers were asked about the total amount of time they had spent on professional development related to science/mathematics teaching. As can be seen in Table 3.3, roughly 30 percent of middle and high school science and mathematics teachers, and far fewer of their elementary colleagues, participated in more than 35 hours of science/mathematics-focused professional development in the last three years.

Table 3.3
Time Spent on Professional Development in the Last Three Years, by Subject and Grade Range

	Percent of Teachers					
	Elementary		Middle		High	
Science						
Less than 6 hours	65	(1.9)	30	(2.6)	23	(1.6)
6–15 hours	22	(1.7)	24	(1.8)	20	(1.1)
16–35 hours	8	(0.9)	20	(2.0)	21	(1.4)
More than 35 hours	4	(0.7)	27	(2.0)	36	(1.1)
Mathematics						
Less than 6 hours	35	(2.1)	22	(2.1)	23	(1.5)
6–15 hours	35	(1.6)	24	(2.1)	24	(1.4)
16–35 hours	20	(1.5)	23	(1.6)	22	(1.1)
More than 35 hours	11	(1.0)	31	(1.9)	32	(1.5)

The data were also analyzed to examine the extent to which science and mathematics classes with different characteristics are taught by teachers who have participated in more than 35 hours of professional development. Interestingly, in science and mathematics, classes at both ends of the spectrum in terms of level of prior achievement are more likely than classes with students of average or mixed prior achievement to be taught by teachers who have had more than 35 hours of professional development in the last three years (see Table 3.4). Note also that mathematics classes with the highest percentage of non-Asian minority students are more likely than those with the lowest percentage to be taught by teachers who have participated in a relatively large amount of professional development in their field in the last three years.

Table 3.4
Classes Taught by Teachers with More than 35 Hours of Professional Development in the Last Three Years, by Subject and Equity Factors

	Percent of Classes	
	Science	**Mathematics**
Prior Achievement Level of Class		
Mostly High Achievers	33 (2.6)	28 (1.8)
Average/Mixed Achievers	19 (1.0)	20 (1.0)
Mostly Low Achievers	25 (2.8)	30 (2.2)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	20 (1.9)	19 (1.6)
Second Quartile	19 (1.5)	21 (1.4)
Third Quartile	27 (2.0)	23 (1.7)
Highest Quartile	23 (2.0)	29 (1.9)

Teachers who indicated they had recently participated in professional development were asked about the nature of those activities. Data for science teachers are shown in Table 3.5, and for mathematics teachers in Table 3.6. For each subject/grade-range combination, workshops are the most prevalent activity, with 84–92 percent of teachers who had participated in professional development activities in the last three years indicating they had attended a workshop. Roughly three-fourths of middle and high school mathematics and science teachers, but fewer of their elementary school colleagues, report participating in professional learning communities or other types of teacher study groups. Middle and high school teachers also attend science/mathematics teacher association meetings at a higher rate than do elementary teachers, likely a reflection of the fact that elementary teachers are responsible for teaching, and keeping up with, multiple disciplines. Finally, not only are elementary science teachers less likely to have participated recently in professional development, they are far less likely to have received feedback on their teaching from a mentor/coach than any other group.

Table 3.5
Science Teachers Participating in Various Professional Development Activities in the Last Three Years, by Grade Range

	Percent of Teachers		
	Elementary	**Middle**	**High**
Attended a workshop on science or science teaching	84 (1.8)	91 (1.7)	90 (1.2)
Participated in a professional learning community/lesson study/teacher study group focused on science or science teaching	55 (2.4)	75 (2.5)	73 (1.6)
Received feedback about your science teaching from a mentor/coach formally assigned by the school/district/diocese†	24 (2.5)	47 (3.5)	54 (2.4)
Attended a national, state, or regional science teacher association meeting	8 (1.2)	35 (2.8)	44 (1.7)

† This item was asked of all teachers whether or not they had participated in professional development in the last three years.

Table 3.6
Mathematics Teachers Participating in Various Professional Development Activities in the Last Three Years, by Grade Range

	Percent of Teachers					
	Elementary		Middle		High	
Attended a workshop on mathematics or mathematics teaching	91	(1.0)	92	(1.4)	89	(1.0)
Participated in a professional learning community/lesson study/teacher study group focused on mathematics or mathematics teaching	66	(1.7)	76	(2.2)	73	(2.1)
Received feedback about your mathematics teaching from a mentor/coach formally assigned by the school/district/diocese†	46	(2.2)	57	(3.0)	54	(2.2)
Attended a national, state, or regional mathematics teacher association meeting	10	(1.0)	32	(2.5)	38	(1.5)

† This item was asked of all teachers whether or not they had participated in professional development in the last three years.

The emerging consensus about effective professional development suggests that teachers need opportunities to work with colleagues who face similar challenges, including other teachers from their school and those who have similar teaching assignments. Other recommendations include engaging teachers in investigations, both to learn disciplinary content and to experience inquiry-oriented learning; to examine student work and other classroom artifacts for evidence of what students do and do not understand; and to apply what they have learned in their classrooms and subsequently discuss how it went.[4] Accordingly, teachers who had participated in professional development in the last three years were asked a series of additional questions about the nature of those experiences.

As can be seen in Tables 3.7 and 3.8, many secondary science and mathematics teachers (ranging from 54 to 70 percent) have had substantial opportunity to work closely with other teachers from their school and/or subject in their professional development. These percentages are somewhat lower for elementary teachers, especially for science-focused professional development activities. Similarly, only about a third of elementary science teachers, compared to roughly half of teachers in the other subject/grade categories have had substantial opportunity to try out and then discuss what they have learned in their professional development. Relatively few teachers in any subject/grade-range combination (ranging from 31 to 44 percent) have had substantial opportunity to examine classroom artifacts. Still, teachers who have participated in professional development appear to be pleased with the experiences as very few teachers believe that their recent professional development was a waste of their time.

[4] Elmore, R. F. (2002). *Bridging the gap between standards and achievement: The imperative for professional development in education.* Washington, DC: Albert Shanker Institute.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., and Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal 38*(4), 915–945.

Table 3.7
Science Teachers Whose Professional Development in the Last Three Years Had Each of a Number of Characteristics to a Substantial Extent,† by Grade Range

	Percent of Teachers		
	Elementary	Middle	High
Worked closely with other science teachers from your school	34 (3.5)	61 (3.5)	62 (2.6)
Worked closely with other science teachers who taught the same grade and/or subject whether or not they were from your school	37 (3.4)	54 (4.0)	58 (2.6)
Had opportunities to try out what you learned in your classroom and then talk about it as part of the professional development	34 (3.3)	51 (4.5)	47 (2.4)
Had opportunities to engage in science investigations	48 (3.5)	52 (3.0)	45 (2.8)
Had opportunities to examine classroom artifacts (e.g., student work samples)	31 (3.5)	40 (3.4)	33 (2.4)
The professional development was a waste of time	8 (2.0)	5 (1.1)	8 (1.1)

† Includes teachers indicating 4 or 5 on a 5-point scale ranging from 1 "Not at all" to 5 "To a great extent."

Table 3.8
Mathematics Teachers Whose Professional Development in the Last Three Years Had Each of a Number of Characteristics to a Substantial Extent,† by Grade Range

	Percent of Teachers		
	Elementary	Middle	High
Worked closely with other mathematics teachers from your school	54 (2.3)	70 (3.0)	67 (2.3)
Worked closely with other mathematics teachers who taught the same grade and/or subject whether or not they were from your school	49 (2.3)	57 (3.2)	56 (2.4)
Had opportunities to try out what you learned in your classroom and then talk about it as part of the professional development	46 (2.6)	51 (2.7)	47 (2.4)
Had opportunities to engage in mathematics investigations	46 (2.3)	51 (3.1)	41 (2.0)
Had opportunities to examine classroom artifacts (e.g., student work samples)	43 (2.4)	44 (3.1)	36 (2.4)
The professional development was a waste of time	5 (1.0)	4 (1.1)	7 (0.9)

† Includes teachers indicating 4 or 5 on a 5-point scale ranging from 1 "Not at all" to 5 "To a great extent."

Responses to these six items describing the characteristics of professional development experiences were combined into a single composite variable called "quality of professional development." As can be seen in Table 3.9, the mean scores on this composite are quite similar across subject/grade-range categories except for elementary science where teachers rated the quality of their professional development lower than the other subject/grade-range combinations.

Table 3.9
Teacher Mean Scores for the Quality of Professional Development Composite, by Subject and Grade Range

	Mean Score	
	Science	Mathematics
Elementary	55 (1.8)	62 (1.0)
Middle	65 (1.5)	66 (1.3)
High	62 (1.2)	63 (1.2)

As can be seen in Table 3.10, for both science and mathematics, classes in the smallest schools are taught by teachers who report lower quality professional development experiences than classes in the largest schools. There are no significant differences by school community type or proportion of students eligible for free/reduced-price lunch.

Table 3.10
Class Mean Scores for the Quality of Professional Development Composite, by Subject and Equity Factors

	Mean Score	
	Science	**Mathematics**
Percent of Students in School Eligible for FRL		
Lowest Quartile	60 (1.6)	65 (1.7)
Second Quartile	61 (1.7)	63 (1.2)
Third Quartile	64 (2.2)	64 (1.2)
Highest Quartile	62 (1.4)	65 (1.4)
School Size		
Smallest Schools	56 (2.1)	61 (1.4)
Second Group	62 (1.6)	63 (1.3)
Third Group	63 (1.3)	64 (0.9)
Largest Schools	63 (1.3)	68 (1.4)
Community Type		
Rural	59 (1.8)	62 (1.0)
Suburban	62 (1.1)	64 (0.9)
Urban	62 (1.7)	66 (1.3)

College courses have the potential to address content in more depth than may be possible in other professional development venues, such as workshops. As another indicator of the extent to which science and mathematics teachers are staying current in their field, the National Survey asked teachers when they had last taken a formal course for college credit in both disciplinary content and how to teach that content. As can be seen in Table 3.11, 53 percent of elementary science teachers, 40 percent at the middle school level, and 32 percent at the high school level have not taken a course for college credit in either science or the teaching of science in the last 10 years, including a handful of teachers who indicated they had never had coursework in these areas. Grade range differences are less pronounced in mathematics, with 46 percent of elementary teachers and 38 percent of middle grades teachers not having taken coursework in mathematics or the teaching of mathematics in the last 10 years (see Table 3.12).

Table 3.11
Science Teachers' Most Recent
College Coursework in Field, by Grade Range

	Percent of Teachers					
	Elementary		Middle		High	
Science						
In the last 3 years	8	(0.9)	22	(2.4)	24	(1.2)
4–6 years ago	17	(1.6)	14	(1.4)	19	(1.1)
7–10 years ago	17	(1.4)	19	(2.1)	18	(1.2)
More than 10 years ago	57	(2.0)	44	(2.7)	38	(1.2)
Never	1	(0.3)	1	(0.5)	1	(0.5)
The Teaching of Science						
In the last 3 years	11	(1.1)	21	(2.1)	25	(1.4)
4–6 years ago	15	(1.5)	14	(1.3)	16	(1.1)
7–10 years ago	14	(1.4)	16	(1.8)	14	(1.1)
More than 10 years ago	49	(1.9)	38	(2.6)	29	(1.2)
Never	11	(1.1)	11	(1.7)	16	(1.4)
Science or the Teaching of Science						
In the last 3 years	12	(1.2)	27	(2.6)	33	(1.4)
4–6 years ago	19	(1.5)	16	(1.5)	19	(1.0)
7–10 years ago	16	(1.4)	17	(2.0)	16	(1.1)
More than 10 years ago	52	(2.0)	39	(2.8)	31	(1.2)
Never	1	(0.3)	1	(0.5)	1	(0.5)

Table 3.12
Mathematics Teachers' Most Recent
College Coursework in Field, by Grade Range

	Percent of Teachers					
	Elementary		Middle		High	
Mathematics						
In the last 3 years	12	(1.1)	19	(1.4)	18	(1.1)
4–6 years ago	17	(1.4)	20	(1.5)	19	(1.1)
7–10 years ago	20	(1.3)	18	(1.6)	15	(1.0)
More than 10 years ago	50	(1.7)	43	(1.8)	48	(1.8)
Never	1	(0.3)	1	(0.4)	0	(0.1)
The Teaching of Mathematics						
In the last 3 years	14	(1.3)	19	(1.5)	20	(1.1)
4–6 years ago	17	(1.4)	17	(1.4)	15	(1.0)
7–10 years ago	18	(1.2)	16	(1.5)	13	(0.9)
More than 10 years ago	46	(1.7)	35	(2.2)	40	(1.5)
Never	5	(0.7)	13	(1.7)	13	(1.6)
Mathematics or the Teaching of Mathematics						
In the last 3 years	16	(1.4)	23	(1.6)	26	(1.3)
4–6 years ago	19	(1.3)	22	(1.6)	19	(1.1)
7–10 years ago	19	(1.4)	17	(1.6)	14	(1.0)
More than 10 years ago	45	(1.8)	37	(1.9)	41	(1.7)
Never	1	(0.3)	1	(0.4)	0	(0.1)

Another series of items asked about the focus of the opportunities teachers had to learn about content and the teaching of that content in the last three years, whether through professional development or college coursework. In science, teachers report that their recent professional development/coursework heavily emphasized planning instruction to enable students at different levels of achievement to enhance their understanding of the targeted ideas, monitoring student understanding during instruction, and assessing student understanding at the end of instruction on a topic (see Table 3.13). Professional development for elementary teachers was more likely than that for teachers in the higher grades to emphasize implementing the science instructional materials designated for use in their classroom. Surprisingly, learning opportunities for elementary science teachers were less likely than those for their middle and high school counterparts to emphasize deepening teacher content knowledge and considering difficulties students might have in learning particular ideas.

Table 3.13
Science Teachers Reporting That Their Professional Development/Coursework in the Last Three Years Gave Heavy Emphasis† to Various Areas, by Grade Range

	Percent of Teachers					
	Elementary		Middle		High	
Assessing student understanding at the conclusion of instruction on a topic	47	(3.1)	54	(3.6)	58	(2.1)
Planning instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	47	(3.1)	64	(3.5)	56	(2.1)
Monitoring student understanding during science instruction	45	(3.0)	54	(3.3)	55	(2.2)
Learning about difficulties that students may have with particular science ideas and procedures	30	(2.6)	42	(3.1)	49	(2.5)
Deepening their science content knowledge	37	(2.9)	51	(4.0)	48	(2.1)
Finding out what students think or already know about the key science ideas prior to instruction on those ideas	41	(2.8)	46	(3.8)	44	(2.3)
Providing enrichment experiences for gifted students	32	(2.7)	30	(3.0)	33	(2.2)
Implementing the science textbook/module to be used in their classroom	39	(3.5)	30	(2.9)	29	(1.7)
Providing alternative science learning experiences for students with special needs	22	(2.5)	26	(2.7)	28	(2.1)
Teaching science to English-language learners	21	(2.5)	18	(2.4)	18	(1.8)

† Includes teachers responding 4 or 5 on a 5-point scale ranging from 1 “Not at all” to 5 “To a great extent.”

Although hands-on/laboratory activities have traditionally been a hallmark of science instruction, emphasis on the use of manipulatives to help students learn mathematics has been a more recent phenomenon. As can be seen in Table 3.14, a large proportion of mathematics teachers, especially at the elementary level, report that their professional growth opportunities in the last three years heavily emphasized learning how to use hands-on activities/manipulatives for mathematics instruction. Other areas emphasized were planning instruction so students at different levels of achievement can increase their understanding of targeted ideas, learning about difficulties that students may have with particular ideas and procedures, monitoring student understanding during instruction, and assessing student understanding at the end of instruction on a topic. As is the case in science, recent professional development for elementary mathematics teachers was more likely than that for middle and high school mathematics teachers to emphasize implementing particular instructional materials. In contrast to science, where the results are similar across grade ranges, larger proportions of elementary mathematics teachers than high school teachers indicate that their recent professional development/coursework focused heavily on finding out what students think or already know about the targeted ideas prior to instruction, and providing enrichment experiences for gifted students.

Table 3.14
Mathematics Teachers Reporting That Their Professional Development/Coursework in the Last Three Years Gave Heavy Emphasis† to Various Areas, by Grade Range

	Percent of Teachers		
	Elementary	Middle	High
Learning how to use hands-on activities/manipulatives for mathematics instruction	80 (2.3)	67 (3.4)	55 (2.3)
Planning instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	60 (2.8)	64 (3.4)	53 (2.3)
Assessing student understanding at the conclusion of instruction on a topic	58 (2.5)	57 (3.9)	49 (2.3)
Monitoring student understanding during mathematics instruction	56 (2.5)	55 (3.9)	49 (2.1)
Learning about difficulties that students may have with particular mathematical ideas and procedures	49 (2.7)	51 (3.4)	46 (2.3)
Deepening their mathematics content knowledge	43 (2.6)	44 (3.4)	35 (1.9)
Implementing the mathematics textbook/program to be used in their classroom	55 (3.0)	39 (3.5)	32 (1.9)
Finding out what students think or already know about the key mathematical ideas prior to instruction on those ideas	43 (2.4)	37 (3.5)	32 (1.9)
Providing alternative mathematics learning experiences for students with special needs	33 (2.6)	39 (3.4)	30 (1.9)
Providing enrichment experiences for gifted students	37 (3.0)	30 (3.3)	21 (1.9)
Teaching mathematics to English-language learners	21 (2.3)	19 (2.2)	18 (1.6)

† Includes teachers responding 4 or 5 on a 5-point scale ranging from 1 “Not at all” to 5 “To a great extent.”

Several items related to a focus on student-centered instruction in recent teacher professional development/coursework were combined into a composite variable. As can be seen in Table 3.15, the mean scores are the same for elementary science and elementary mathematics, with an average of 57 out of a possible 100 points. It is interesting to note that in science, professional development for middle and high school teachers gave more emphasis to student-centered instruction, and professional development for high school mathematics teachers had less focus on student-centered instruction.

Table 3.15
Teacher Mean Score on the Extent to which Professional Development/Coursework Focused on Student-Centered Instruction Composite, by Subject and Grade Range

	Mean Score	
	Science	Mathematics
Elementary	57 (1.6)	57 (1.2)
Middle	64 (1.4)	55 (1.5)
High	62 (1.2)	50 (0.8)

Table 3.16 provides information about the extent to which science and mathematics classes with different demographic characteristics have access to teachers who have had recent opportunities to learn about student-centered instruction. Interestingly, mathematics classes classified as consisting mostly of low achievers tend to be taught by teachers with higher scores on this composite than classes consisting of mostly high achievers. In addition, teachers of science and

mathematics classes with a high proportion of non-Asian minority students report a higher focus on student-centered instruction in their professional development/coursework than teachers of classes with relatively few non-Asian minority students.

Table 3.16
Class Mean Scores on the Extent to Which Professional Development/Coursework Focused on Student-Centered Instruction Composite, by Subject and Equity Factors

	Mean Score	
	Science	Mathematics
Prior Achievement Level of Class		
Mostly High Achievers	59 (2.3)	45 (1.9)
Average/Mixed Achievers	48 (1.3)	48 (1.2)
Mostly Low Achievers	51 (3.8)	51 (1.5)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	45 (2.1)	42 (1.8)
Second Quartile	49 (2.1)	44 (1.7)
Third Quartile	51 (2.8)	50 (1.5)
Highest Quartile	53 (2.6)	55 (1.7)

In addition to asking teachers about their involvement as participants in professional development, the survey asked teachers whether they had served in various leadership roles in the profession in the last three years. As can be seen in Tables 3.17 and 3.18, elementary teachers are far less likely than their secondary counterparts to have led teacher study groups, served as mentors/coaches for other teachers, and taught in-service workshops focused on science/mathematics. In contrast, elementary teachers are more likely than middle and high school science/mathematics teachers to have supervised student teachers in the last three years.

Table 3.17
Science Teachers Serving in Various Leadership Roles in the Last Three Years, by Grade Range

	Percent of Teachers		
	Elementary	Middle	High
Led a teacher study group focused on science teaching	4 (1.0)	19 (2.5)	26 (2.1)
Served as a formally assigned mentor/coach for science teaching	5 (1.0)	17 (2.2)	24 (2.2)
Supervised a student teacher	38 (2.5)	24 (2.5)	23 (1.7)
Taught in-service workshops on science or science teaching	3 (0.9)	15 (2.1)	17 (1.9)

Table 3.18
Mathematics Teachers Serving in Various Leadership Roles in the Last Three Years, by Grade Range

	Percent of Teachers		
	Elementary	Middle	High
Led a teacher study group focused on mathematics teaching	8 (1.4)	21 (2.4)	25 (1.9)
Supervised a student teacher	35 (2.3)	24 (2.6)	23 (2.0)
Served as a formally assigned mentor/coach for mathematics teaching	10 (1.5)	22 (2.5)	22 (1.8)
Taught in-service workshops on mathematics or mathematics teaching	6 (1.2)	14 (2.1)	15 (1.4)

Professional Development Offerings at the School Level

The data presented in this chapter thus far are drawn from the teacher questionnaires. The 2012 National Survey of Science and Mathematics Education also included "School Program Questionnaires" for science and mathematics, each completed by a person designated by the school coordinator as knowledgeable about school programs, policies, and practices in the designated subject.

School science and mathematics program representatives were asked whether professional development workshops in the designated discipline were offered by their school and/or district/diocese (if relevant), possibly in conjunction with other school systems, colleges or universities, museums, professional associations, and/or commercial vendors. As can be seen in Table 3.19, locally offered workshops are more prevalent in mathematics than in science, and within each subject, are more prevalent in schools that include elementary grades than those that include grades 9–12.[5]

Table 3.19
Professional Development Workshops Offered
Locally in the Last Three Years, by Subject and Grade Range

	Percent of Schools	
	Science	**Mathematics**
Elementary	48 (2.9)	65 (2.8)
Middle	42 (3.6)	60 (3.3)
High	36 (4.0)	51 (4.3)

Respondents who indicated that mathematics/science workshops were offered locally were asked about the extent to which that professional development addressed each of a number of areas. In both science and mathematics, locally offered workshops are more likely to emphasize state standards than any other of the listed areas. Locally offered workshops in science have a greater focus on investigation-oriented teaching strategies than those in mathematics. In contrast, workshops offered at the local level in mathematics are more likely than those in science to emphasize how to monitor student understanding during instruction and how to provide alternative learning experiences for students with special needs (see Table 3.20).

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

Table 3.20
Locally Offered Professional Development Workshops in the Last Three Years with a Substantial Focus† in Each of a Number of Areas, by Subject

	Percent of Schools	
	Science	Mathematics
State science/mathematics standards	64 (2.9)	76 (2.5)
Science/mathematics content	52 (3.2)	60 (3.0)
How to use particular science/mathematics instructional materials	52 (3.1)	55 (3.1)
How to use technology in science/mathematics instruction	41 (2.9)	46 (2.9)
How to monitor student understanding during science/mathematics instruction	33 (2.6)	43 (2.7)
How students think about various science/mathematics ideas	31 (2.4)	39 (2.8)
How to adapt science/mathematics instruction to address student misconceptions	31 (2.7)	38 (2.8)
How to use investigation-oriented science/mathematics teaching strategies	51 (3.2)	36 (2.9)
How to provide alternative science/mathematics learning experiences for students with special needs	11 (1.7)	22 (2.8)
How to teach science/mathematics to students who are English language learners	18 (2.5)	20 (2.3)

† Includes schools where respondent indicated 4 or 5 on a 5-point scale ranging from 1 "Not at all" to 5 "To a great extent."

One concern about professional development workshops is that teachers may not be given adequate assistance in applying what they are learning to their own instruction. Teacher study groups (Professional Learning Communities, lesson study, etc.) have the potential to help teachers focus on instruction. School science and mathematics program representatives were asked whether their school has offered teacher study groups in the last three years where teachers meet on a regular basis to discuss science/mathematics teaching and learning. As can be seen in Table 3.21, in elementary schools, study groups are more likely to have been offered in mathematics than in science.

Table 3.21
Teacher Study Groups Offered at Schools in the Last Three Years, by Subject and Grade Range

	Percent of Schools	
	Science	Mathematics
Elementary	32 (3.0)	46 (3.0)
Middle	43 (3.7)	51 (3.7)
High	47 (4.4)	48 (4.4)

Tables 3.22–3.26 present additional information provided by school program representatives about school-based teacher study groups focused on science and mathematics. As can be seen in Table 3.22, these study groups are similar in terms of whether teachers have been required to participate, whether the groups have operated on specified schedules, and whether they have had designated leaders. When study groups have had designated leaders, in both science and mathematics, the leaders have been most likely to come from within the school (see Table 3.23).

Table 3.22
Characteristics of Teacher Study Groups, by Subject

	Percent of Schools†	
	Science	**Mathematics**
Participation is required	79 (2.5)	78 (2.3)
School specifies schedule	62 (2.9)	66 (2.7)
Has designated leaders	56 (3.3)	65 (2.8)

† Includes only those schools that offered teacher study groups in the last three years.

Table 3.23
Origin of Designated Leaders of Teacher Study Groups, by Subject

	Percent of Schools†	
	Science	**Mathematics**
From within the school	87 (3.0)	87 (3.1)
From another school in district/diocese‡	26 (3.2)	28 (3.3)
From external sources	13 (3.0)	13 (2.8)

† Includes only those schools that offered teacher study groups in the last three years with designated leaders.
‡ Item presented only to public and Catholic schools.

Table 3.24 shows the frequency and duration of school-based study groups that have a specified schedule. Note that although most study groups in both science and mathematics have met for the entire school year, there is considerable variation in the frequency of study group meetings, with roughly a third meeting more than twice a month, but some meeting far less frequently.

Table 3.24
Frequency and Duration of Teacher Study Groups, by Subject

	Percent of Schools†	
	Science	**Mathematics**
Frequency		
Less than once a month	25 (4.0)	18 (3.0)
Once a month	31 (3.6)	33 (2.4)
Twice a month	12 (1.9)	15 (2.3)
More than twice a month	31 (3.5)	34 (3.1)
Duration		
The entire school year	89 (2.3)	90 (2.1)
One semester	7 (1.9)	4 (1.6)
Less than one semester	4 (1.2)	5 (1.4)

† Includes only those schools that offered teacher study groups in the last three years with specified schedules.

Most schools limit participation in their science/mathematics-focused study groups to teachers from their school, and most include teachers from multiple grade levels (see Table 3.25). Many study groups include school and/or district administrators.

Table 3.25
Composition of Teacher Study Groups, by Subject

	Percent of Schools†	
	Science	Mathematics
Limited to teachers from this school	66 (3.9)	76 (2.8)
Include teachers from other schools in the district/diocese‡	35 (3.8)	23 (2.7)
Include teachers from other schools outside of their jurisdiction	7 (3.0)	4 (1.7)
Include teachers from multiple grade levels	65 (3.4)	61 (2.3)
Include school and/or district/diocese administrators	44 (3.7)	50 (2.7)
Include higher education faculty or other "consultants"	10 (2.4)	15 (2.0)
Include parents/guardians or other community members	0 (0.1)	3 (1.0)

† Includes only those schools that offered teacher study groups in the last three years.
‡ Item presented only to public and Catholic schools.

School program representatives were also asked about the activities typically included in teacher study groups focused on science/mathematics teaching and learning. As can be seen in Table 3.26, 73 percent of study groups in science and 83 percent in mathematics have involved teachers in analyzing student assessment results. Roughly two-thirds of study groups in each subject have had teachers analyze student instructional materials and plan lessons together. Considerably fewer study groups have engaged teachers in the analysis of classroom artifacts and conducting science/mathematics investigations.

Table 3.26
Description of Activities in Typical Teacher Study Groups, by Subject

	Percent of Schools†	
	Science	Mathematics
Teachers analyze student science/mathematics assessment results	73 (3.5)	83 (2.4)
Teachers analyze science/mathematics instructional materials	65 (3.3)	65 (2.7)
Teachers plan science/mathematics lessons together	67 (3.0)	62 (3.2)
Teachers analyze classroom artifacts	37 (3.6)	34 (2.7)
Teachers engage in science/mathematics investigations	25 (2.9)	30 (2.3)

† Includes only those schools that offered teacher study groups in the last three years.

Although there is general agreement that teachers can benefit from participating in professional development workshops and study groups, it is often difficult to find time for them to do so. In schools that offered in-service workshops and/or teacher study groups within the last three years, school representatives were given a list of ways in which time might be provided for teachers to participate, and asked to indicate which were used in their school. As can be seen in Table 3.27, teacher work days during the school year have been the most likely to be used, including 63 percent of schools for mathematics and 55 percent for science. Somewhat fewer schools have used common planning time, teacher work days outside the regular school year, substitute teachers, and early dismissal or late start for students to provide time for professional development.

Table 3.27
How Schools Provide Time for Science/Mathematics Professional Development†

	Percent of Schools	
	Science	**Mathematics**
Professional days/teacher work days during the students' school year	55 (2.6)	63 (2.3)
Common planning time for teachers	41 (2.6)	53 (2.3)
Professional days/teacher work days before and/or after the students' school year	38 (2.2)	50 (2.4)
Substitute teachers to cover teachers' classes while they attend professional development	36 (2.8)	43 (2.4)
Early dismissal and/or late start for students	29 (2.1)	37 (2.4)

† Includes in-service workshops and teacher study groups.

As noted earlier, professional development workshops and teacher study groups can provide important opportunities for teachers to deepen their content and pedagogical content knowledge, and to develop skill in using that knowledge for key tasks of teaching, such as analyzing student work to determine what a student does and does not understand. When resources allow, going the next step and offering one-on-one coaching to help teachers improve their practice can be a powerful tool. School program representatives were asked whether any teachers in their school had access to one-on-one coaching focused on improving their science/mathematics instruction; these data are shown in Table 3.28. At both the elementary and middle grades levels, schools are significantly more likely to provide coaching in mathematics than in science; there is no significant difference at the high school level.

Table 3.28
Schools Providing One-on-One Science/Mathematics Coaching

	Percent of Schools	
	Science	**Mathematics**
Elementary	17 (1.9)	27 (2.3)
Middle	17 (2.1)	26 (2.6)
High	22 (2.0)	26 (2.4)

In schools where science/mathematics teachers have access to one-on-one coaching, program representatives were asked who provides the coaching services. As can be seen in Table 3.29, in both subjects, approximately two-thirds of schools have a combination of teachers/coaches and administrators serve in this capacity.

Table 3.29
Teaching Professionals Providing Science- and Mathematics-Focused One-on-One Coaching

	Percent of Schools†	
	Science	**Mathematics**
Both teachers/coaches‡ and administrators	64 (4.0)	68 (3.5)
Teachers/coaches‡ only	25 (3.5)	21 (2.8)
Administrators only	12 (3.5)	11 (2.4)

† Includes only those schools that provide science/mathematics-focused coaching.
‡ Includes teachers/coaches of all levels of teaching responsibility: full-time, part-time, and not teaching.

Although most schools have both teachers/coaches and administrators provide coaching, it appears that teachers/coaches are responsible for the bulk of it. Table 3.30 shows the percentage of schools that indicated coaching is provided by different professionals to a substantial extent. In science, 34 percent of schools have teachers/coaches with full teaching loads provide one-on-one coaching to a substantial extent; 24 percent use teachers/coaches who do not have classroom teaching responsibilities. Forty percent of schools have one-on-one mathematics coaching provided to a substantial extent by teachers/coaches who do not have classroom teaching responsibilities; 28 percent use teachers/coaches with full class loads to a substantial extent.

Table 3.30
Professionals Providing Science- and Mathematics-Focused One-on-One Coaching to a Substantial Extent†

	Percent of Schools‡	
	Science	Mathematics
Teachers/coaches who do not have classroom teaching responsibilities	24 (3.4)	40 (3.7)
Teachers/coaches who have full-time classroom teaching responsibilities	34 (3.8)	28 (3.2)
District/Diocese administrators including mathematics supervisors/coordinators§	20 (2.9)	25 (3.2)
The principal of your school	14 (4.1)	16 (3.3)
Teachers/coaches who have part-time classroom teaching responsibilities	17 (3.1)	14 (2.4)
An assistant principal at your school	7 (1.9)	9 (2.0)

† Includes schools where respondent indicated 4 or 5 on a 5-point scale ranging from 1 "Not at all" to 5 "To a great extent."
‡ Includes only those schools that provide science/mathematics-focused coaching.
§ Presented only to public and Catholic schools.

Finally, school program representatives were asked about the services provided to teachers in need of special assistance; the data for science and mathematics are shown in Tables 3.31 and 3.32, respectively. Note that at least half of the schools at each grade range have mentors or coaches who provide guidance to teachers in particular need of help. Roughly 40 to 50 percent of schools in the various subject/grade-range categories provide seminars, classes, and/or study groups for this purpose. In science, as the grade range of the school increases, schools become increasingly likely to provide a higher level of supervision for these teachers; the apparent differences by school grade range in mathematics are not statistically significant.

Table 3.31
Services Provided to Science Teachers in Need of Special Assistance in Teaching, by Grade Range

	Percent of Schools		
	Elementary	Middle	High
Guidance from a formally designated mentor or coach	51 (3.4)	50 (3.3)	63 (3.3)
Seminars, classes, and/or study groups	41 (2.5)	52 (3.0)	50 (3.7)
A higher level of supervision than for other teachers	12 (2.1)	21 (2.3)	34 (2.7)

Table 3.32
Services Provided to Mathematics Teachers in Need of Special Assistance in Teaching, by Grade Range

	Percent of Schools		
	Elementary	**Middle**	**High**
Guidance from a formally designated mentor or coach	56 (3.5)	59 (3.4)	66 (3.6)
Seminars, classes, and/or study groups	53 (3.2)	49 (3.4)	43 (3.6)
A higher level of supervision than for other teachers	25 (2.5)	30 (2.7)	36 (3.7)

Additional analyses were conducted to see if each of a number of professional development resources is equitably distributed across schools. As can be seen in Table 3.33, schools with different proportions of students eligible for free/reduced-price lunch are about equally likely to provide assistance to science teachers in need. In contrast, the largest schools are significantly more likely than the smallest schools to offer science-focused teacher study groups. The most variation is in the percentage of schools offering one-on-one coaching, which is more likely to be offered in schools in the highest quartile of proportion of students eligible for free/reduced-price lunch than in schools in the lowest quartile. The largest schools are more likely than the smallest to offer coaching, and schools in urban areas are most likely and schools in rural areas least likely to offer one-on-one coaching.

Table 3.33
Schools Providing Various Services to Science Teachers, by Equity Factors

	Percent of Schools		
	Science-Focused Study Groups	**One-on-One Science-Focused Coaching**	**Assistance to Science Teachers in Need†**
Percent of Students in School Eligible for FRL			
Lowest Quartile	34 (4.7)	16 (3.1)	81 (4.0)
Second Quartile	34 (4.1)	17 (3.9)	78 (3.3)
Third Quartile	49 (4.0)	18 (2.6)	79 (3.6)
Highest Quartile	40 (4.2)	28 (3.8)	86 (3.0)
School Size			
Smallest Schools	35 (4.6)	14 (2.4)	82 (2.8)
Second Group	41 (4.2)	21 (3.0)	80 (3.3)
Third Group	41 (4.1)	24 (3.1)	83 (3.5)
Largest Schools	49 (3.9)	30 (4.1)	81 (3.8)
Community Type			
Rural	42 (4.4)	11 (2.2)	80 (3.1)
Suburban	38 (3.2)	20 (2.1)	83 (2.3)
Urban	38 (4.0)	30 (2.8)	80 (3.7)

† Assistance defined as guidance from a formally designated mentor or coach; seminars, classes, and/or study groups; or a higher level of supervision than for other teachers.

Table 3.34 shows analogous data for mathematics. The largest schools are substantially more likely than the smallest schools to offer each of these services, and schools with the largest proportion of students eligible for free/reduced-price lunch are substantially more likely than those in the lowest quartile to offer mathematics-focused study groups and one-on-one coaching.

In addition, urban schools are much more likely than either rural or suburban schools to offer one-on-one coaching in mathematics.

Table 3.34
Schools Providing Various Services to Mathematics Teachers, by Equity Factors

	Percent of Schools		
	Mathematics-Focused Study Groups	**One-on-One Mathematics-Focused Coaching**	**Assistance to Mathematics Teachers in Need†**
Percent of Students in School Eligible for FRL			
Lowest Quartile	39 (4.8)	22 (3.6)	76 (5.5)
Second Quartile	46 (4.9)	26 (4.5)	87 (4.0)
Third Quartile	56 (4.0)	29 (3.8)	90 (3.0)
Highest Quartile	61 (4.4)	41 (3.9)	81 (3.3)
School Size			
Smallest Schools	40 (4.4)	22 (3.0)	78 (4.2)
Second Group	52 (4.5)	30 (3.3)	86 (3.6)
Third Group	55 (3.8)	31 (3.5)	87 (2.8)
Largest Schools	67 (4.1)	43 (4.1)	91 (2.7)
Community Type			
Rural	48 (4.5)	18 (2.8)	84 (3.5)
Suburban	47 (3.4)	25 (2.5)	85 (3.0)
Urban	54 (4.2)	47 (4.0)	80 (3.2)

† Assistance defined as guidance from a formally designated mentor or coach; seminars, classes, and/or study groups; or a higher level of supervision than for other teachers.

Summary

With the exception of elementary science, a large percentage of science and mathematics teachers have participated in science/mathematics-focused professional development in the last three years. However, the extent to which professional development experiences incorporate elements of best practice varies. For example, of the science and mathematics teachers who have participated in professional development, the majority of secondary teachers have had opportunities to work closely with other teachers from their school or who teach the same subject/grade. In contrast, few science and mathematics teachers have had more than 35 hours of professional development in the last three years.

Workshops are the most prevalent form of professional development, and participation in teacher study groups is also quite common. Roughly one-third of secondary science and mathematics teachers have attended a meeting of a national, state, or regional professional association; few elementary teachers have attended such meetings in the last three years. Similar percentages of teachers have taken a formal course for college credit in science/mathematics, or the teaching of science/mathematics, in the last three years.

The emphasis of these professional development opportunities, across the subject and grade-range categories, has largely been on planning instruction to enable students at different levels of achievement to enhance their understanding, monitoring student understanding during instruction, and assessing student understanding at the end of instruction on a topic. Learning how to use hands-on/manipulatives has also been focused on heavily in mathematics professional development, especially at the elementary level. In science, deepening teacher content knowledge has been less of an emphasis at the elementary level than at the secondary level; in mathematics, grade level differences are less pronounced.

School program representatives were asked about locally offered professional development opportunities. In-service workshops have been the most prevalent form of professional development offered, and have been more common in mathematics than in science. In many schools, these workshops have had a substantial focus on state science/mathematics standards, science/mathematics content, and/or using instructional materials.

Teacher study groups also have been fairly common in both subjects and all grade ranges, with the exception of elementary science. These teacher study groups tend to involve teachers in analyzing student assessment results, analyzing instructional materials, and/or jointly planning lessons. Analyzing classroom artifacts and engaging teachers in science/mathematics investigations are less common. About one-fourth of schools offer one-on-one coaching in mathematics; about one-fifth offer coaching in science. Coaching in science and mathematics is typically provided by both teachers/coaches and administrators; however, teachers/coaches tend to shoulder more of this responsibility. Interestingly, one-on-one coaching is more prevalent in schools that are large, urban, or high-poverty.

CHAPTER FOUR

Science and Mathematics Courses

Overview

The 2012 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, gender and racial/ethnic composition, and prior achievement levels. These data are presented in the following sections.

Time Spent in Elementary Science and Mathematics Instruction

Self-contained elementary teachers were asked how often they teach science and/or mathematics. As can be seen in Table 4.1, mathematics is taught in nearly all classes on most or all school days in both grades K–3 and 4–6. In contrast, science is taught less frequently, with only 20 percent of grades K–3 classes and 35 percent of grades 4–6 classes receiving science instruction all or most days, every week of the school year. Many elementary classes receive science instruction only a few days a week or during some weeks of the year.

Table 4.1
Frequency with Which Self-Contained Elementary Classes Receive Science and Mathematics Instruction, by Subject

	Percent of Classes	
	Science	**Mathematics**
Grades K–3		
All/Most days, every week	20 (1.5)	99 (0.4)
Three or fewer days, every week	39 (1.5)	1 (0.3)
Some weeks, but not every week	41 (1.9)	1 (0.3)
Grades 4–6		
All/Most days, every week	35 (2.6)	98 (0.9)
Three or fewer days, every week	33 (2.6)	2 (0.9)
Some weeks, but not every week	32 (2.5)	0 ---†

† No grades 4–6 teachers in the sample selected this response option. Thus, it is not possible to calculate the standard error of this estimate.

The survey also asked the approximate number of minutes typically spent teaching mathematics, reading/language arts, science, and social studies in self-contained classes. 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 4.2; to facilitate comparisons among the subject areas, only teachers who teach all four of these subjects to one class of students are included in this analysis. In 2012, grade K–3 self-contained classes spent an average of 89 minutes per day on reading instruction and 54 minutes on mathematics instruction, compared to only 19 minutes on science and 16 minutes on social studies instruction. The pattern in grades 4–6 is similar, with 83 minutes per day devoted to reading, 61 minutes to mathematics, 24 minutes to science, and 21 minutes to social studies instruction. (Note: There are no substantive differences in instructional time on these subjects by the various equity factors; see Appendix F.)

Table 4.2
Average Number of Minutes per Day Spent
Teaching Each Subject in Self-Contained Classes,† by Grades

	Number of Minutes	
	Grades K–3	**Grades 4–6**
Reading/Language Arts	89 (1.7)	83 (2.2)
Mathematics	54 (1.0)	61 (1.4)
Science	19 (0.5)	24 (0.9)
Social Studies	16 (0.4)	21 (0.8)

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

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 about opportunities provided to students to take courses not offered on site such as through telecommunications or at another school.

Middle schools were asked whether they offered single-discipline science courses (e.g., life science, physical science), coordinated/integrated science courses, or both in each grade 6–8 contained in the school. As can be seen in Table 4.3, 45 percent of schools containing 6th grade offer only coordinated/integrated science, and 36 percent offer only single-discipline courses; this pattern is reversed in grades 7 and 8. Fewer than 1 in 5 schools containing these grades offer both types of courses.

Table 4.3
Type of Middle School Science Courses Offered, by Grade

	Percent of Schools		
	Grade 6	**Grade 7**	**Grade 8**
Single-Discipline Science Courses Only	36 (3.6)	46 (3.8)	47 (3.8)
Coordinated or Integrated Science Courses Only	45 (4.1)	38 (3.7)	36 (3.7)
Both	19 (3.5)	15 (3.6)	18 (3.5)

Table 4.4 shows courses offered in high schools. Almost all (98 percent) schools with grades 9–12 offer courses in biology/life science, with 73 percent offering non-college prep courses, 89 percent offering 1st year college preparatory courses, and 64 percent offering at least one 2nd year

biology/life science course. Overall, 94 percent of high schools offer some form of chemistry course. First-year college-preparatory chemistry courses are offered in 85 percent, and 2nd year chemistry in 44 percent of high schools. Most high schools (85 percent) offer physics courses. About three-fourths offer 1st year physics, and one-third offer 2nd year physics. Fewer high schools offer coursework in coordinated/integrated science (68 percent), environmental science (48 percent) or Earth/space science (48 percent) than in the other science disciplines. Only four percent of schools offer second-year Earth science courses; 18 percent offer a second course in environmental science. Nearly 1 in 4 high schools offer at least one engineering course; 14 percent offer non-college preparatory and 13 percent offer 1st year college-preparatory engineering courses. Only 5 percent of high schools offer a 2nd year engineering course.

Table 4.4
High Schools Offering Various Science Courses

	Percent of Schools
Biology/Life Science	
Any level	98 (0.9)
Non-college prep	73 (2.7)
1st year college prep, including honors	89 (1.9)
2nd year advanced	64 (3.4)
Chemistry	
Any level	94 (1.8)
Non-college prep	51 (2.7)
1st year college prep, including honors	85 (2.5)
2nd year advanced	44 (2.6)
Physics	
Any level	85 (1.9)
Non-college prep	37 (2.9)
1st year college prep, including honors	77 (2.5)
2nd year advanced	34 (2.2)
Coordinated or Integrated Science Courses (including General Science and Physical Science)	
Any level	68 (3.2)
Non-college prep	60 (3.2)
College prep, including honors	47 (2.8)
Environmental Science/Ecology	
Any level	48 (3.2)
Non-college prep	31 (2.7)
1st year college prep, including honors	31 (2.4)
2nd year advanced	18 (1.4)
Earth/Space Science	
Any level	48 (2.9)
Non-college prep	41 (2.9)
1st year college prep, including honors	25 (2.2)
2nd year advanced	4 (0.8)
Engineering	
Any level	24 (2.1)
Non-college prep	14 (2.1)
1st year college prep, including honors	13 (1.5)
2nd year advanced	5 (1.1)

Table 4.5 shows the percentage of high schools offering each of the Advanced Placement (AP) science courses and the percentage of grades 9–12 students in the nation at those schools. Biology is the most commonly offered AP course, offered by about 4 in 10 high schools, followed by AP Chemistry which is offered in roughly 1 in 3 schools. AP Physics B is offered in

22 percent of high schools; AP Physics C in only 12 percent of high schools. AP Environmental Science is offered in 17 percent of high schools. That the percentage of high school students with access to each course is much larger than the percentage of schools offering it indicates that larger schools are more likely than smaller schools to offer AP science courses.

Table 4.5
Access to AP Science Courses

	Percent of High Schools Offering	Percent of High School Students with Access
AP Biology	43 (2.8)	74 (1.7)
AP Chemistry	34 (2.3)	67 (1.8)
AP Physics B	22 (1.8)	48 (1.9)
AP Environmental Science	17 (1.3)	38 (2.0)
AP Physics C	12 (1.2)	25 (2.0)

Across the disciplines, 47 percent of high schools offer at least one AP science course, either this year or in alternating years (see Table 4.6). Approximately the same percentage of schools offers 1–4 AP science courses, with about 10 percent of schools in each category. Only 5 percent of schools offer all of the AP science courses.

Table 4.6
Number of AP Science
Courses Offered at High Schools

	Percent of Schools†
0 courses	53 (3.1)
1 course	11 (2.1)
2 courses	10 (1.4)
3 courses	11 (1.4)
4 courses	10 (1.2)
5 courses	5 (0.8)

† Only schools that responded about each AP science course are included in this analysis.

Table 4.7 shows the average number of AP science courses offered by various equity factors. Not surprisingly, small schools tend to offer fewer AP science courses than large schools. On average, suburban and urban schools offer more AP science courses than rural schools. In addition, schools with higher proportions of students eligible for free/reduced-price lunch offer fewer AP science courses.

Table 4.7
Average Number of AP Science Courses
Offered at High Schools, by Equity Factors

	Average Number of Courses
Percent of Students in School Eligible for FRL	
Lowest Quartile	2.0 (0.2)
Second Quartile	1.5 (0.3)
Third Quartile	1.1 (0.2)
Highest Quartile	1.1 (0.2)
School Size	
Smallest Schools	0.7 (0.1)
Second Group	1.2 (0.2)
Third Group	2.1 (0.2)
Largest Schools	2.8 (0.2)
Community Type	
Rural	0.7 (0.1)
Suburban	1.7 (0.2)
Urban	1.7 (0.3)

The survey also asked schools about opportunities provided to students to take science and engineering courses not offered on site. As was described previously, 85 percent of high schools offer at least one physics course; a small additional percentage of schools provide students with access to physics, either by offering it in alternative years or by allowing students to take the course off campus (see Table 4.8). Over one-fourth of high schools provide access to concurrent credit/dual enrollment courses—courses that count for high school and college credit. Having students take science and/or engineering courses at a Career and Technical Education Center, at a college/university, or via telecommunications are each opportunities at about 1 in 5 high schools. Fewer than 10 percent of high schools have students take science/engineering courses at another high school.

Table 4.8
Science Programs and Practices
Currently Being Implemented in High Schools

	Percent of Schools
Physics courses offered this school year or in alternating years, on or off site	88 (2.9)
Concurrent credit/dual enrollment courses offered this school year or in alternating years	28 (2.8)
Students go to a Career and Technical Education Center for science and/or engineering instruction	22 (3.2)
Students go to a college or university for science and/or engineering courses	22 (2.4)
Science and/or engineering courses offered by telecommunications	18 (2.9)
Students go to another K–12 school for science and/or engineering courses	8 (2.5)

In mathematics, middle schools were asked how many 8th grade students would complete Algebra 1 and Geometry prior to 9th grade. As can be seen in Table 4.9, three-fourths of middle schools have had some students complete Algebra 1 and just over one-fourth have had students complete Geometry. Fewer than one-third of middle schools have had 51 percent or more of their students complete Algebra 1; in schools that offer Geometry, only a small percentage of students typically complete the course prior to 9th grade.

Table 4.9
Middle Schools with Various Percentages of 8th Graders Completing Algebra 1 and Geometry Prior to 9th Grade

	Percent of Schools			
	Algebra 1		Geometry	
0 percent	25	(3.5)	72	(2.5)
1–10 percent	4	(1.0)	13	(1.4)
11–20 percent	10	(1.7)	7	(1.4)
21–30 percent	14	(1.7)	2	(0.5)
31–40 percent	11	(2.4)	3	(1.9)
41–50 percent	9	(2.3)	2	(1.0)
51–60 percent	7	(2.1)	2	(0.9)
61–70 percent	4	(1.5)	0	---†
71–80 percent	6	(1.9)	1	(0.5)
81–90 percent	2	(0.9)	0	---†
Over 90 percent	9	(1.8)	0	(0.1)

† No middle schools in the sample were in this category. Thus, it is not possible to calculate the standard error of this estimate

The data also show that students in high-poverty schools are less likely than students in low-poverty schools to complete either of these courses prior to 9th grade (see Table 4.10). In addition, a smaller proportion of students in rural middle schools complete Algebra 1 than in suburban and urban middle schools.

Table 4.10
Average Percentage of 8th Graders Completing Algebra I and Geometry Prior to 9th Grade, by Equity Factors

	Percent of 8th Grade Students			
	Algebra 1		Geometry	
Percent of Students in School Eligible for FRL				
Lowest Quartile	46	(6.1)	13	(3.4)
Second Quartile	26	(4.5)	2	(0.6)
Third Quartile	31	(5.9)	2	(0.8)
Highest Quartile	28	(3.9)	6	(1.9)
School Size				
Smallest Schools	33	(4.6)	4	(1.4)
Second Group	34	(4.1)	7	(2.3)
Third Group	39	(4.0)	5	(1.8)
Largest Schools	42	(3.1)	5	(0.7)
Community Type				
Rural	27	(4.4)	3	(1.7)
Suburban	38	(3.2)	5	(1.5)
Urban	42	(4.7)	7	(1.9)
Region				
Midwest	31	(4.4)	4	(1.5)
Northeast	42	(6.2)	7	(2.9)
South	27	(3.4)	4	(1.4)
West	46	(6.3)	6	(2.2)

Table 4.11 shows mathematics courses offered at the high school level. Nearly all high schools offer a first year formal/college-preparatory mathematics course such as Algebra 1 or Integrated Math 1. The vast majority of high schools also offer a second and third year of formal mathematics. Fewer, but still a large majority offer a fourth year of formal mathematics such as Pre-Calculus. About three-fourths of high schools offer mathematics courses that might qualify for college credit such as AP Calculus or AP statistics.

Table 4.11
High Schools Offering Various Mathematics Courses

	Percent of Schools
Non-college prep (e.g., Remedial Math, General Math, Consumer Math)	78 (3.2)
Formal/College-prep Level 1 (e.g., Algebra 1, Integrated Math 1)	99 (0.7)
Formal/College-prep Level 2 (e.g., Geometry, Integrated Math 2)	90 (3.7)
Formal/College-prep Level 3 (e.g., Algebra 2, Algebra and Trigonometry)	94 (3.5)
Formal/College-prep Level 4 (e.g., Pre-Calculus, Algebra 3)	85 (3.8)
Courses that might qualify for college credit (e.g., AP Calculus, AP Statistics)	76 (4.0)

As can be seen in Table 4.12, just over half of high schools offer AP Calculus AB. AP Calculus BC and AP Statistics are each offered by about one-fourth of high schools. As was the case in science, AP mathematics courses are more likely to be offered in larger schools as the percentage of grades 9–12 students with access to each course is substantially greater than the percentage of schools offering it.

Table 4.12
Access to AP Mathematics Courses

	Percent of High Schools Offering	Percent of High School Students with Access
AP Calculus AB	52 (3.5)	81 (1.6)
AP Statistics	27 (2.1)	59 (1.9)
AP Calculus BC	23 (2.5)	47 (2.1)

Twenty percent of high schools offer only one AP mathematics course (see Table 4.13). Seventeen percent offer two and 14 percent offer three different AP mathematics courses.

Table 4.13
Number of AP Mathematics
Courses Offered at High Schools

	Percent of Schools†
0 courses	49 (3.5)
1 course	20 (2.6)
2 courses	17 (2.7)
3 courses	14 (1.3)

† Only schools that responded about each AP mathematics course are included in this analysis.

The data on the number of AP mathematics courses offered crossed by various equity factors follow the same pattern as in science. As can be seen in Table 4.14, small schools tend to offer fewer AP mathematics courses than large schools, and suburban and urban schools offer more AP mathematics courses than rural schools. High-poverty schools offer fewer AP mathematics courses on average than low-poverty schools.

Table 4.14
Average Number of AP Mathematics Courses Offered at High Schools, by Equity Factors

	Average Number of Courses
Percent of Students in School Eligible for FRL	
Lowest Quartile	1.4 (0.2)
Second Quartile	1.1 (0.2)
Third Quartile	0.8 (0.1)
Highest Quartile	0.7 (0.1)
School Size	
Smallest Schools	0.6 (0.1)
Second Group	0.9 (0.1)
Third Group	1.6 (0.1)
Largest Schools	2.1 (0.1)
Community Type	
Rural	0.6 (0.1)
Suburban	1.2 (0.1)
Urban	1.3 (0.2)
Region	
Midwest	0.8 (0.1)
Northeast	1.3 (0.2)
South	1.0 (0.1)
West	1.0 (0.1)

The mathematics program questionnaire also asked about a number of specific course-taking opportunities provided to students. As can be seen in Table 4.15, 76 percent of high schools offer some form of calculus course, including AP and non-AP calculus courses, and 41 percent offer some form of probability and/or statistics course. Over one-third of high schools offer Algebra 1 as a two-course sequence (e.g., Algebra A and Algebra B). Concurrent credit/dual enrollment courses in mathematics are more common than in science (40 percent vs. 28 percent), as is students taking mathematics courses at a local college or university (31 percent vs. 22 percent). Nearly one-fourth of high schools offer mathematics courses via telecommunications; very few have students take mathematics courses at a Career and Technical Education Centers or at other K–12 schools.

Table 4.15
Mathematics Programs and Practices
Currently Being Implemented in High Schools

	Percent of Schools
Calculus courses (beyond pre-Calculus) offered this school year or in alternating years, on or off site	76 (3.5)
Probability and/or statistics course offered	41 (3.0)
Concurrent credit/dual enrollment courses offered this school year or in alternating years	40 (3.4)
Algebra 1 course offered over two years or as two separate block courses (e.g., Algebra A and Algebra B)	37 (3.7)
Students go to a college or university for mathematics courses	31 (3.0)
Mathematics courses offered by telecommunications	24 (3.3)
Students go to a Career and Technical Education Center for mathematics instruction	11 (1.6)
Students go to another K–12 school for mathematics courses	5 (2.3)

In addition to obtaining information on school course offerings, the teacher questionnaires asked each science and mathematics teacher for the course type of a randomly selected class. As can be seen in Table 4.16, 24 percent of high school science classes are 1st year college preparatory biology; 1st year chemistry accounts for 17 percent of the classes; and 1st year physics for 10 percent.

Table 4.16
Most Commonly Offered High School Science Courses

	Percent of Classes
Life Science/Biology	
Non-college prep	8 (0.7)
1st year college prep, including honors	24 (1.3)
2nd year advanced	7 (0.9)
Chemistry	
Non-college prep	3 (0.5)
1st year college prep, including honors	17 (0.8)
2nd year advanced	2 (0.4)
Physics	
Non-college prep	2 (0.4)
1st year college prep, including honors	10 (0.9)
2nd year advanced	2 (0.4)
Earth/Space Science	
Non-college prep	4 (0.6)
1st year college prep, including honors	4 (0.6)
2nd year advanced	0 (0.2)
Environmental Science/Ecology	
Non-college prep	2 (0.4)
1st year college prep, including honors	1 (0.4)
2nd year advanced	2 (0.5)
Coordinated or Integrated Science Courses (including General Science and Physical Science)	
Non-college prep	6 (0.8)
College prep, including honors	5 (0.7)

In mathematics, formal/college-preparatory levels 1, 2, and 3 are the most common; each accounting for 20 percent or more of grades 9–12 mathematics classes. Formal level 4 courses make up 15 percent of the classes; non-college prep mathematics 13 percent; and courses that might qualify for college credit account for eight percent of classes.

Table 4.17
Most Commonly Offered High School Mathematics Courses

	Percent of Classes	
Non-college prep (e.g., Remedial Math, General Math, Consumer Math)	13	(1.0)
Formal/College-prep Level 1 (e.g., Algebra 1, Integrated Math 1)	20	(1.3)
Formal/College-prep Level 2 (e.g., Geometry, Integrated Math 2)	23	(1.2)
Formal/College-prep Level 3 (e.g., Algebra 2, Algebra and Trigonometry)	21	(1.1)
Formal/College-prep Level 4 (e.g., Pre-Calculus, Algebra 3)	15	(1.1)
Courses that might qualify for college credit (e.g., AP Calculus, AP Statistics)	8	(0.7)

Other Characteristics of Science and Mathematics Classes

The 2012 National Survey found that the average size of science and mathematics classes is generally around 21 to 24 students (see Table 4.18). However, as can be seen in Figures 4.1–4.6, averages obscure the wide variation in class sizes. For example, 20 percent of middle grades science classes have 30 or more students.

Table 4.18
Average Class Size, by Subject and Course Type

	Average Number of Students			
	Science		Mathematics	
Grade Range				
Elementary	21.9	(0.2)	21.4	(0.2)
Middle	23.6	(0.4)	22.1	(0.4)
High	21.7	(0.3)	21.4	(0.3)
High School Science Courses				
Non-college Prep	21.3	(0.5)	—	—
1st Year Biology	21.9	(0.7)	—	—
1st Year Chemistry	22.3	(0.6)	—	—
1st Year Physics	20.5	(1.0)	—	—
Advanced Science Courses	18.9	(0.8)	—	—
High School Mathematics Courses				
Non-college Prep (e.g., Remedial Math, General Math, Consumer Math)	—	—	19.0	(0.7)
Formal/College-prep Level 1 (e.g., Algebra 1, Integrated Math 1)	—	—	22.4	(0.5)
Formal/College-prep Level 2 (e.g., Geometry, Integrated Math 2)	—	—	22.5	(0.5)
Formal/College-prep Level 3 (e.g., Algebra 2, Algebra and Trigonometry)	—	—	21.4	(0.7)
Formal/College-prep Level 4 (e.g., Pre-Calculus, Algebra 3)	—	—	21.1	(0.5)
Courses that might qualify for college credit (e.g., AP Calculus, AP Statistics)	—	—	18.2	(0.9)

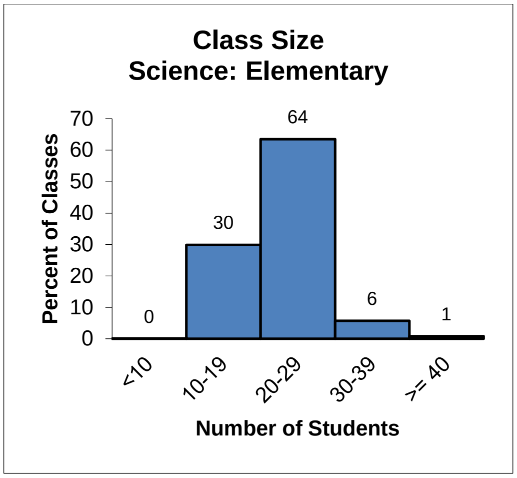

Figure 4.1

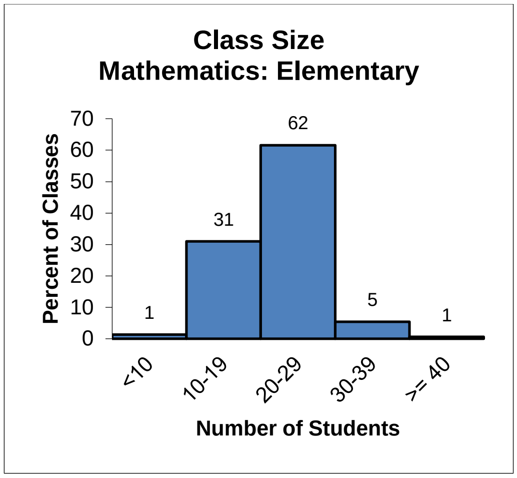

Figure 4.4

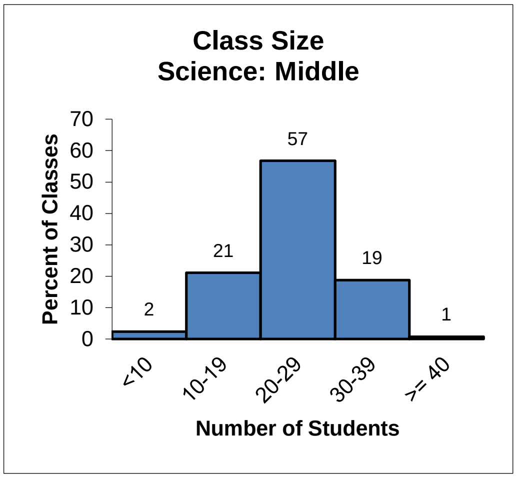

Figure 4.2

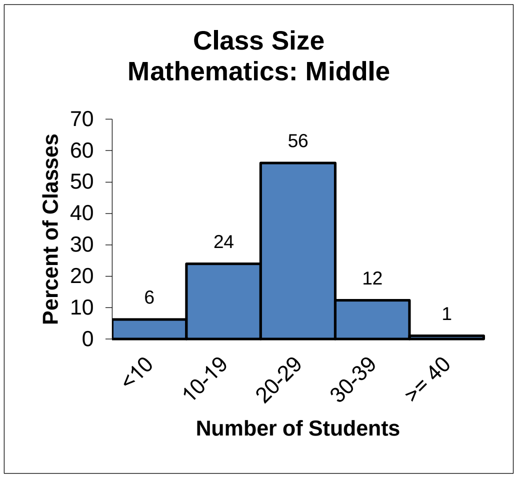

Figure 4.5

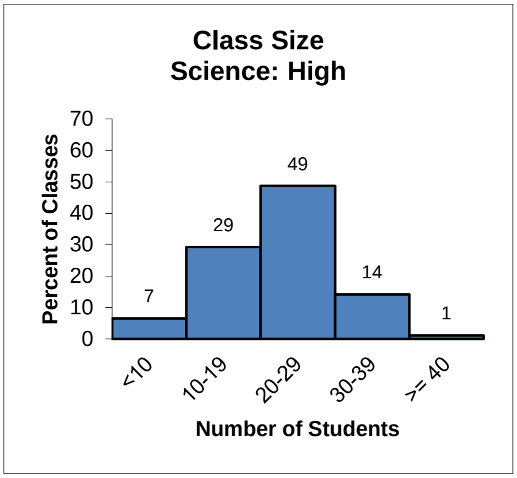

Figure 4.3

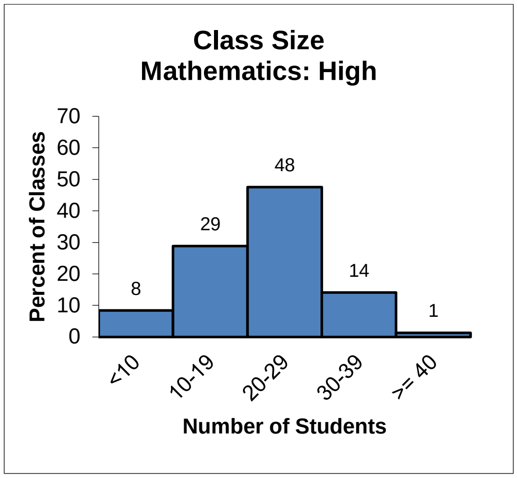

Figure 4.6

Teachers were asked to indicate the prior achievement level of students in the selected class relative to other students in the school. At the elementary level, 45 percent of science and mathematics classes are heterogeneous in prior achievement; most of the remaining classes are composed primarily of average-achieving students (see Table 4.19). Heterogeneous grouping is less common at the secondary level in both science and mathematics.

Table 4.19
Prior-Achievement Grouping in Classes, by Subject and Grade Range

	Percent of Classes		
	Elementary	**Middle**	**High**
Science Classes			
Mostly low achievers	10 (1.3)	14 (2.0)	13 (1.1)
Mostly average achievers	37 (1.8)	33 (2.0)	30 (1.3)
Mostly high achievers	9 (1.1)	13 (1.6)	28 (1.3)
A mixture of levels	45 (2.0)	39 (2.3)	29 (1.4)
Mathematics Classes			
Mostly low achievers	12 (1.0)	27 (1.8)	24 (1.1)
Mostly average achievers	35 (1.6)	24 (1.8)	28 (1.5)
Mostly high achievers	9 (0.9)	24 (1.7)	26 (1.1)
A mixture of levels	45 (1.5)	26 (1.8)	22 (1.1)

Table 4.20 shows that the use of heterogeneous grouping in high school science classes is similar across courses with the exception of advanced science courses where the percentage drops. Not surprisingly, the percentage of science classes composed mostly of high achievers tends to increase across the traditional course sequence; for example, 28 percent of 1st year chemistry classes consist mostly of high achievers, compared to 48 percent of 1st year physics classes and 67 percent of 2nd year science classes. A similar trend occurs in mathematics, where 29 percent of level 3 classes are composed mostly of high achievers compared to 52 percent of level 4 classes and 74 percent of classes that might qualify for college credit.

Table 4.20
Prior-Achievement Grouping in High School Courses, by Subject

	Percent of Classes			
	Mostly Low Achievers	**Mostly Average Achievers**	**Mostly High Achievers**	**A Mixture of Levels**
Science Courses				
Non-college prep	25 (2.7)	31 (2.3)	10 (1.9)	33 (3.3)
1st Year Biology	16 (2.7)	31 (3.0)	22 (2.9)	31 (3.7)
1st Year Chemistry	6 (1.2)	36 (3.3)	28 (2.6)	30 (2.9)
1st Year Physics	4 (1.8)	19 (2.9)	48 (5.0)	30 (4.2)
Advanced Science Courses	2 (1.2)	14 (3.6)	67 (4.3)	17 (3.3)
Mathematics Classes				
Non-college prep	72 (3.7)	14 (3.4)	2 (1.3)	12 (2.4)
Formal/College-prep Level 1	37 (3.1)	33 (3.2)	6 (1.5)	24 (2.5)
Formal/College-prep Level 2	17 (2.4)	37 (3.4)	21 (2.5)	26 (2.8)
Formal/College-prep Level 3	12 (2.5)	35 (3.3)	29 (2.4)	24 (2.7)
Formal/College-prep Level 4	4 (1.2)	28 (4.1)	52 (4.3)	17 (2.2)
Courses that might qualify for college credit	4 (2.2)	4 (1.8)	74 (5.2)	18 (4.9)

Tables 4.21 and 4.22 show data on prior-achievement grouping by the percentage of non-Asian minority students for science and mathematics classes, respectively. Across all grade levels and in both subjects, classes composed of 40 percent or more of non-Asian minority students are more likely to be classified as consisting of mostly low achievers than classes with smaller proportions of non-Asian minority students. For example, 39 percent of high school mathematics classes with a high percentage of non-Asian minority students are classified as being composed mostly of low achievers, compared to 14 percent of high school mathematics classes with a low percentage of non-Asian minority students.

Table 4.21
Prior-Achievement Grouping in Grade K–12 Science Classes with Low, Medium, and High Percentages of Non-Asian Minority Students

	Percent of Classes			
	Mostly Low Achievers	Mostly Average Achievers	Mostly High Achievers	A Mixture of Levels
Elementary				
< 10 percent non-Asian minority	6 (2.0)	38 (4.1)	10 (2.8)	46 (4.1)
10–39 percent non-Asian minority	8 (2.7)	38 (3.0)	11 (2.3)	43 (3.5)
≥ 40 percent non-Asian minority	13 (2.0)	36 (2.4)	5 (1.6)	45 (2.7)
Middle				
< 10 percent non-Asian minority	13 (5.3)	37 (4.5)	12 (2.5)	39 (5.3)
10–39 percent non-Asian minority	5 (1.1)	32 (3.4)	19 (3.4)	45 (3.8)
≥ 40 percent non-Asian minority	26 (4.0)	29 (2.5)	9 (1.6)	36 (4.4)
High				
< 10 percent non-Asian minority	6 (1.2)	22 (1.9)	43 (2.4)	29 (2.4)
10–39 percent non-Asian minority	10 (1.4)	31 (2.3)	29 (2.4)	30 (2.3)
≥ 40 percent non-Asian minority	24 (2.9)	33 (2.7)	13 (2.1)	30 (2.6)

Table 4.22
Prior-Achievement Grouping in Grade K–12 Mathematics Classes with Low, Medium, and High Percentages of Non-Asian Minority Students

	Percent of Classes			
	Mostly Low Achievers	Mostly Average Achievers	Mostly High Achievers	A Mixture of Levels
Elementary				
< 10 percent non-Asian minority	7 (1.7)	41 (3.2)	12 (1.8)	40 (3.2)
10–39 percent non-Asian minority	8 (2.1)	32 (2.6)	9 (1.8)	51 (3.3)
≥ 40 percent non-Asian minority	16 (2.0)	32 (2.6)	7 (1.4)	44 (2.9)
Middle				
< 10 percent non-Asian minority	15 (2.5)	25 (2.8)	31 (3.4)	28 (3.6)
10–39 percent non-Asian minority	17 (2.3)	25 (3.0)	31 (3.4)	26 (2.9)
≥ 40 percent non-Asian minority	43 (4.0)	21 (2.8)	11 (1.9)	25 (2.4)
High				
< 10 percent non-Asian minority	14 (1.7)	30 (3.3)	40 (2.6)	15 (1.9)
10–39 percent non-Asian minority	18 (1.8)	30 (2.5)	26 (1.7)	25 (2.1)
≥ 40 percent non-Asian minority	39 (2.5)	24 (2.7)	12 (1.6)	25 (2.3)

A similar pattern is seen in the class composition data for specific high school courses (see Table 4.23). The percentage of non-Asian minorities trends downward across the progression of science and mathematics courses. For example, 33 percent of students enrolled in 1st year Biology are classified as non-Asian minorities, similar to the overall percentage in high school science classes, compared to only 21 percent in advanced science courses. In mathematics, 39 percent of students in Formal/College-preparatory level 1 courses are non-Asian minorities, while fewer than one-fourth of students in level 4 or above courses are. In terms of gender, females are less likely than males to be enrolled in non-college preparatory science and mathematics classes, and more likely than males to be enrolled in advanced science courses.

Table 4.23
Average Percentages of Female and Non-Asian Minority Students in Courses, by Grade Range and Course Type

	Science		Mathematics	
	Female	**Non-Asian Minority**	**Female**	**Non-Asian Minority**
Grades				
Elementary	48 (0.5)	39 (1.9)	47 (0.5)	40 (1.5)
Middle	46 (0.7)	36 (1.6)	48 (0.6)	37 (1.8)
High	49 (0.8)	31 (1.2)	48 (0.7)	31 (1.1)
High School Science Courses				
Non-college prep	46 (1.2)	36 (2.3)	— —	— —
1st Year Biology	49 (1.6)	33 (2.7)	— —	— —
1st Year Chemistry	51 (1.4)	30 (1.8)	— —	— —
1st Year Physics	49 (1.8)	23 (2.7)	— —	— —
Advanced Science Courses	54 (1.9)	21 (2.3)	— —	— —
High School Mathematics Courses				
Non-college prep	— —	— —	42 (1.4)	45 (3.3)
Formal/College-prep Level 1	— —	— —	48 (1.1)	39 (2.2)
Formal/College-prep Level 2	— —	— —	50 (1.5)	31 (2.0)
Formal/College-prep Level 3	— —	— —	51 (1.4)	27 (2.3)
Formal/College-prep Level 4	— —	— —	48 (2.1)	22 (2.0)
Courses that might qualify for college credit	— —	— —	48 (1.7)	17 (2.0)

Summary

Data from the 2012 National Survey indicate that in the early grades, mathematics is taught much more frequently than science. Almost all elementary classes spend time on mathematics instruction every school day; in contrast, only 1 in 3 classes in grades 4–6 and 1 in 5 classes in grades K–3 classes receive science instruction every school day. In addition, elementary mathematics lessons tend to be substantially longer than science lessons, although the amount of time devoted to science and mathematics is substantially less than reading/language arts.

In terms of the number of high schools offering various courses, virtually all schools offer at least one biology course, and nearly all offer chemistry; somewhat fewer offer physics. Environmental science and Earth/space science courses are each offered in about half of high schools. In mathematics, although most middle schools offer Algebra 1, relatively few students complete it prior to 9th grade. At the high school level, almost all schools offer the three-course sequence of Algebra 1, Geometry, and Algebra 2. Nearly as many high schools offer a fourth year in the formal mathematics sequence; three-fourths of high schools offer a calculus course, though only about half offer Advanced Placement Calculus. It is somewhat surprising how few high schools offer science and mathematics courses by telecommunications (18–24 percent), a practice that will surely become more prominent as more states include taking an online class as a graduation requirement.

Advanced Placement courses in science and mathematics are offered in about half of high schools. These courses are less likely to be offered in schools with a high proportion of students eligible for free/reduced-price lunch, and more likely to be offered in large schools. Advanced Placement courses are also more common in suburban and urban schools than in rural schools.

The 2012 National Survey found that the percentage of classes that are heterogeneous in terms of prior achievement declines with increasing grade level. Further, students are assigned to classes that are homogeneous in regards to achievement disproportionally by race; classes with higher proportions of minority students are more likely to be labeled as consisting of "mostly low achievers."

In the sciences, about half of the students in high school biology, chemistry, and physics classes are females, though students in advanced science courses are more likely to be female than male. The proportion of females and males in college preparatory mathematics classes is about equal. Non-Asian minority students make up almost 40 percent of the enrollment in grades K–12, but at the high school level, the proportion of these students decreases as the level of science and mathematics increases.

CHAPTER FIVE

Instructional Decision Making, Objectives, and Activities

Overview

The 2012 National Survey of Science and Mathematics Education collected data about teachers' perceptions of their autonomy in making curriculum and instruction decisions. Questions also focused on teachers' instructional objectives, class activities they use in accomplishing these objectives, and how student performance is assessed in a particular, randomly selected science or mathematics class. These data are discussed in the following sections.

Teachers' Perceptions of Their Decision-Making 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 about tailoring instruction to a particular group of students. Teachers were asked the extent to which they had control over a number of curriculum and instruction decisions for their classes. Results for science and mathematics classes are presented in Tables 5.1 and 5.2, respectively. In science and mathematics classes across all grade levels, teachers are more likely to perceive themselves as having strong control over pedagogical decisions such as determining the amount of homework to be assigned (56–77 percent), selecting teaching techniques (44–73 percent), and choosing criteria for grading student performance (29–61 percent).

In fewer science and mathematics classes, especially in the elementary grades, teachers perceive themselves as having strong control in determining course goals and objectives (12–36 percent); selecting content, topics, and skills to be taught (8–35 percent); and selecting textbooks/modules/programs (3–33 percent). Perceived control in making these decisions tends to increase with grade range.

Table 5.1
Science Classes in Which Teachers Report Having Strong Control Over Various Curriculum and Instruction Decisions, by Grade Range

	Percent of Classes		
	Elementary	**Middle**	**High**
Determining the amount of homework to be assigned	64 (2.7)	75 (3.2)	76 (1.9)
Selecting teaching techniques	53 (2.5)	67 (3.6)	73 (2.0)
Choosing criteria for grading student performance	43 (3.3)	58 (3.5)	61 (2.3)
Determining course goals and objectives	14 (2.0)	21 (3.0)	36 (2.3)
Selecting content, topics, and skills to be taught	10 (1.8)	20 (2.9)	35 (2.7)
Selecting textbooks/modules	5 (1.1)	14 (2.7)	33 (2.6)

Table 5.2
Mathematics Classes in Which Teachers Report Having Strong Control Over Various Curriculum and Instruction Decisions, by Grade Range

	Percent of Classes		
	Elementary	Middle	High
Determining the amount of homework to be assigned	56 (2.6)	77 (2.4)	75 (2.0)
Selecting teaching techniques	44 (2.5)	70 (2.6)	72 (1.8)
Choosing criteria for grading student performance	29 (2.4)	56 (2.7)	55 (2.1)
Determining course goals and objectives	12 (1.5)	24 (2.1)	28 (2.1)
Selecting content, topics, and skills to be taught	8 (1.1)	23 (2.2)	24 (1.9)
Selecting textbooks/programs	3 (0.8)	13 (2.3)	20 (2.1)

The items shown in Tables 5.1 and 5.2 were combined into two composite variables—Curriculum Control and Pedagogical Control. Curriculum Control comprises the following items:

- Determining course goals and objectives;
- Selecting content, topics, and skills to be taught; and
- Selecting textbooks/modules/programs.

For Pedagogical Control, the items are:

- Choosing criteria for grading student performance;
- Determining the amount of homework to be assigned; and
- Selecting teaching techniques.

Table 5.3 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 curriculum. They also show that perceived control for both composite variables is greater in secondary classes than in elementary classes.

Table 5.3
Class Mean Scores for Curriculum Control and Pedagogical Control Composites, by Subject and Grade Range

	Mean Score	
	Curriculum	Pedagogical
Science Classes		
Elementary	32 (1.7)	81 (1.2)
Middle	45 (2.2)	88 (1.3)
High	59 (1.6)	89 (0.7)
Mathematics Classes		
Elementary	29 (1.2)	74 (1.1)
Middle	45 (1.5)	87 (1.4)
High	52 (1.4)	88 (0.7)

When looking at the Curriculum Control composite scores by region, teachers of science and mathematics classes in the South perceive less control over curriculum-related decisions than teachers of classes in other regions (see Table 5.4). There is less variation by region in pedagogical control.

Table 5.4
Class Mean Scores for Curriculum Control and Pedagogical Control Composites, by Subject and Region

	Mean Score	
	Curriculum	**Pedagogical**
Science		
Midwest	54 (2.4)	88 (1.1)
Northeast	46 (2.0)	84 (1.5)
South	34 (1.4)	83 (1.2)
West	48 (2.6)	89 (1.3)
Mathematics		
Midwest	48 (1.6)	84 (1.1)
Northeast	40 (2.0)	78 (1.8)
South	33 (1.4)	81 (1.2)
West	39 (2.0)	82 (1.4)

Objectives of Science and Mathematics Instruction

The survey provided a list of possible objectives of science and mathematics instruction and asked teachers how much emphasis each would receive in an entire course of a particular, randomly selected class. Table 5.5 shows the percentage of science classes by grade range whose teachers indicated heavy emphasis for each objective. Understanding science concepts is frequently emphasized, although more so in secondary classes (80 percent of middle and high school classes) than in elementary (59 percent of classes). Across all grade levels, 45 percent or more of science classes have a heavy emphasis on increasing students' interest in science, learning science process skills, and learning about real-life applications of science. Objectives least likely to be emphasized are learning test taking skills/strategies (fewer than 25 percent of science classes) and memorizing science vocabulary and/or facts (roughly 10 percent of science classes).

Table 5.5
Science Classes with Heavy Emphasis on Various Instructional Objectives, by Grade Range

	Percent of Classes		
	Elementary	**Middle**	**High**
Understanding science concepts	59 (2.2)	80 (2.1)	80 (1.2)
Increasing students' interest in science	56 (2.0)	57 (2.2)	50 (1.4)
Learning science process skills (e.g., observing, measuring)	47 (2.1)	54 (2.3)	49 (1.6)
Preparing for further study in science	35 (2.0)	40 (2.1)	46 (1.3)
Learning about real-life applications of science	46 (2.3)	45 (2.3)	45 (1.5)
Learning test taking skills/strategies	22 (1.6)	24 (1.7)	22 (1.2)
Memorizing science vocabulary and/or facts	10 (1.3)	10 (1.2)	13 (1.3)

The objectives related to reform-oriented instruction (understanding science concepts, increasing students' interest in science, learning science process skills, preparing for further study in science, and learning about real-life applications of science) were combined into a composite variable. Overall, scores on this composite are fairly high (see Table 5.6), indicating that science classes are likely to emphasize reform-oriented instructional objectives. There is little variation in scores among the grade ranges.

Table 5.6
Science Class Mean Scores on the
Reform-Oriented Instructional Objectives Composite, by Grade Range

	Mean Score
Elementary School	79 (0.7)
Middle School	83 (0.6)
High School	82 (0.4)

Scores on this composite were also analyzed by a number of equity factors. As can be seen in Table 5.7, classes containing mostly high-achieving students are more likely to stress reform-oriented instructional objectives than classes with mostly low-achieving students. There are no pronounced differences in scores by the percentage of non-Asian minority students in the class or the percentage of students in the school eligible for free/reduced-price lunch.

Table 5.7
Science Class Mean Scores on the
Reform-Oriented Instructional Objectives Composite, by Equity Factors

	Mean Score
Prior Achievement Level of Class	
Mostly High Achievers	86 (0.6)
Average/Mixed Achievers	81 (0.4)
Mostly Low Achievers	77 (1.5)
Percent of Non-Asian Minority Students in Class	
Lowest Quartile	82 (0.8)
Second Quartile	81 (0.6)
Third Quartile	81 (0.9)
Highest Quartile	80 (0.9)
Percent of Students in School Eligible for FRL	
Lowest Quartile	84 (0.8)
Second Quartile	80 (0.8)
Third Quartile	81 (0.8)
Highest Quartile	80 (0.9)

In mathematics, nearly 7 out of 10 elementary, middle, and high school mathematics classes focus heavily on having students understand mathematical ideas (see Table 5.8). Other objectives heavily emphasized by about half of classes across grade levels are preparing for further study in mathematics, learning mathematical practices, and learning mathematical procedures and/or algorithms.

The data also reveal notable differences in emphasis by grade range. For example, 50 percent of elementary mathematics classes focus heavily on increasing students' interest in mathematics, compared to 37 percent and 27 percent of middle and high school classes, respectively. A similar trend is evident in objectives related to learning about real-life applications of mathematics and test-taking skills/strategies, which receive less emphasis in high school classes. Learning to perform computations with speed and accuracy is heavily emphasized in twice as many elementary classes as high school classes (36 percent and 18 percent, respectively).

Table 5.8
Mathematics Classes with Heavy Emphasis on Various Instructional Objectives, by Grade Range

	Percent of Classes		
	Elementary	**Middle**	**High**
Understanding mathematical ideas	69 (1.4)	70 (2.0)	69 (1.4)
Preparing for further study in mathematics	47 (1.8)	57 (2.2)	55 (1.6)
Learning mathematical practices (e.g., considering how to approach a problem, justifying solutions)	51 (1.5)	54 (2.3)	55 (1.3)
Learning mathematical procedures and/or algorithms	44 (1.9)	49 (2.2)	48 (1.5)
Learning about real-life applications of mathematics	45 (1.7)	42 (1.9)	29 (1.3)
Learning test taking skills/strategies	37 (1.5)	36 (2.5)	28 (1.3)
Increasing students' interest in mathematics	50 (1.7)	37 (1.9)	27 (1.4)
Learning to perform computations with speed and accuracy	36 (1.9)	24 (1.8)	18 (1.2)

Table 5.9 presents mean class scores on the reform-oriented instructional objectives in mathematics composite by grade range. As in science, mathematics classes are likely to emphasize reform-oriented instructional objectives at all grade levels.

Table 5.9
Mathematics Class Mean Scores on the Reform-Oriented Instructional Objectives Composite, by Grade Range

	Mean Score
Elementary School	81 (0.5)
Middle School	81 (0.6)
High School	78 (0.4)

Also similar to science, there are differences in composite scores by the prior achievement level of the class. Reform-oriented instructional objectives are more heavily emphasized in classes with mostly high-achieving students than in classes with mostly low-achieving students (see Table 5.10).

Table 5.10
Mathematics Class Mean Scores on the
Reform-Oriented Instructional Objectives Composite, by Equity Factors

	Mean Score
Prior Achievement Level of Class	
Mostly High Achievers	85 (0.6)
Average/Mixed Achievers	80 (0.4)
Mostly Low Achievers	77 (0.7)
Percent of Non-Asian Minority Students in Class	
Lowest Quartile	80 (0.7)
Second Quartile	80 (0.5)
Third Quartile	80 (0.6)
Highest Quartile	81 (0.6)
Percent of Students in School Eligible for FRL	
Lowest Quartile	82 (0.8)
Second Quartile	79 (0.6)
Third Quartile	80 (0.6)
Highest Quartile	80 (0.8)

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, rarely (e.g., a few times a year), sometimes (e.g., once or twice a month), often (e.g., 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

As can be seen in Table 5.11, across the grade ranges, roughly 50 percent of classes include the teacher explaining science ideas in all or nearly all lessons. The majority of elementary science classes engage in whole class discussions in nearly every lesson, though this activity becomes less frequent as the grade level increases. Approximately a quarter of K–12 science classes have students work in small groups in all or almost all science lessons.

Table 5.11
Science Classes in Which Teachers Report Using Various Activities in All or Almost All Lessons, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Explain science ideas to the whole class	50	(1.8)	54	(2.2)	56	(1.6)
Engage the whole class in discussions	57	(1.6)	48	(2.5)	38	(1.5)
Have students work in small groups	28	(1.9)	25	(2.0)	22	(1.4)
Require students to supply evidence in support of their claims	15	(1.4)	17	(1.8)	18	(1.0)
Give tests and/or quizzes that are predominantly short-answer (e.g., multiple choice, true /false, fill in the blank)	6	(0.9)	9	(1.4)	9	(0.8)
Do hands-on/laboratory activities	16	(1.5)	10	(1.4)	8	(0.7)
Have students represent and/or analyze data using tables, charts, or graphs	8	(0.9)	8	(1.3)	8	(0.7)
Give tests and/or quizzes that include constructed-response/open-ended items	6	(0.7)	8	(1.5)	8	(0.8)
Have students write their reflections (e.g., in their journals) in class or for homework	13	(1.2)	13	(1.5)	7	(0.7)
Have students read from a science textbook, module, or other science-related material in class, either aloud or to themselves	15	(1.3)	12	(2.0)	7	(0.8)
Have students practice for standardized tests	4	(0.8)	5	(1.2)	5	(0.5)
Focus on literacy skills (e.g., informational reading or writing strategies)	17	(1.5)	10	(1.5)	4	(0.6)
Engage the class in project-based learning (PBL) activities	9	(1.3)	6	(1.2)	3	(0.5)
Have students make formal presentations to the rest of the class (e.g., on individual or group projects)	4	(0.7)	1	(0.3)	2	(0.5)
Have students attend presentations by guest speakers focused on science and/or engineering in the workplace	1	(0.4)	1	(0.4)	1	(0.2)

Three instructional activities occur at least once a week in most science classes across grade levels (see Table 5.12.): explaining science ideas to the whole class (88–96 percent), engaging the whole class in discussions (83–92 percent), and having students work in small groups (72–83 percent). Over half of K–12 science classes also include hands-on/laboratory activities and require students to supply evidence in support of their claims on a weekly basis; both activities are more likely to occur in high school classes than in elementary classes. Middle and high school science classes also include more frequent use of formal assessment practices (giving students short-answer or constructed-response tests/quizzes) than elementary classes.

In contrast, elementary and middle school science classes are much more likely than high school classes to include literacy activities at least once a week. For example, students read from a science textbook, module, or other science-related material on a weekly basis in approximately 5 out of 10 elementary and middle grades classes, compared to in fewer than 4 in 10 high school classes. Having students write reflections at least once a week is twice as common in elementary and middle school classes as it is in high school classes. In addition, nearly half of elementary classes focus on literacy skills at least once a week, compared to only one-fourth of high school classes.

Table 5.12
Science Classes in Which Teachers Report Using Various Activities at Least Once a Week, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Explain science ideas to the whole class	88	(1.3)	96	(0.9)	95	(0.8)
Engage the whole class in discussions	90	(0.9)	92	(1.0)	83	(1.0)
Have students work in small groups	72	(1.8)	79	(1.9)	83	(1.2)
Require students to supply evidence in support of their claims	54	(2.1)	64	(2.3)	61	(1.6)
Give tests and/or quizzes that are predominantly short-answer (e.g., multiple choice, true /false, fill in the blank)	31	(2.0)	44	(2.4)	44	(1.6)
Do hands-on/laboratory activities	55	(1.9)	62	(2.4)	70	(1.5)
Have students represent and/or analyze data using tables, charts, or graphs	44	(2.0)	54	(1.9)	58	(1.6)
Give tests and/or quizzes that include constructed-response/open-ended items	21	(1.7)	36	(2.1)	40	(1.4)
Have students write their reflections (e.g., in their journals) in class or for homework	44	(2.0)	44	(2.1)	21	(1.3)
Have students read from a science textbook, module, or other science-related material in class, either aloud or to themselves	48	(2.4)	56	(2.3)	37	(1.6)
Have students practice for standardized tests	19	(1.7)	23	(1.9)	20	(1.2)
Focus on literacy skills (e.g., informational reading or writing strategies)	48	(2.0)	44	(2.2)	25	(1.5)
Engage the class in project-based learning (PBL) activities	30	(1.7)	23	(1.9)	18	(1.2)
Have students make formal presentations to the rest of the class (e.g., on individual or group projects)	12	(1.2)	10	(1.4)	9	(1.0)
Have students attend presentations by guest speakers focused on science and/or engineering in the workplace	3	(0.6)	3	(0.8)	2	(0.5)

Table 5.13 shows the percentage of science classes never using these activities. Perhaps most striking, and in contrast to what is known from learning theory about the importance of reflection, is that students in one-fourth of high school science classes are never asked to write reflections on what they are learning. Having students attend presentations by guest speakers is also rare in grades K–12, with roughly 50 percent of science classes never having that experience.

Table 5.13
Science Classes in Which Teachers Report
Never Using Various Activities, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Explain science ideas to the whole class	0	---†	0	---†	0	(0.1)
Engage the whole class in discussions	0	---†	0	(0.1)	1	(0.5)
Have students work in small groups	0	(0.2)	0	(0.1)	0	(0.3)
Require students to supply evidence in support of their claims	5	(0.7)	1	(0.7)	1	(0.3)
Give tests and/or quizzes that are predominantly short-answer (e.g., multiple choice, true /false, fill in the blank)	15	(1.3)	2	(0.5)	3	(0.4)
Do hands-on/laboratory activities	2	(0.5)	2	(0.9)	1	(0.3)
Have students represent and/or analyze data using tables, charts, or graphs	2	(0.5)	0	(0.1)	0	(0.2)
Give tests and/or quizzes that include constructed-response/open-ended items	19	(1.5)	3	(0.5)	3	(0.4)
Have students write their reflections (e.g., in their journals) in class or for homework	10	(1.0)	9	(1.1)	25	(1.5)
Have students read from a science textbook, module, or other science-related material in class, either aloud or to themselves	9	(1.2)	4	(1.1)	10	(0.9)
Have students practice for standardized tests	32	(2.1)	13	(1.5)	19	(1.3)
Focus on literacy skills (e.g., informational reading or writing strategies)	6	(0.9)	3	(0.7)	9	(0.9)
Engage the class in project-based learning (PBL) activities	8	(1.4)	4	(0.7)	9	(1.0)
Have students make formal presentations to the rest of the class (e.g., on individual or group projects)	16	(1.5)	6	(1.1)	11	(0.9)
Have students attend presentations by guest speakers focused on science and/or engineering in the workplace	51	(1.8)	45	(2.3)	51	(1.6)

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

Teachers were also asked about the frequency with which they use various instructional technologies in their science classes. As can be seen in Table 5.14, technology use is generally low across grade ranges, with about one-third of classes using the Internet and 21–31 percent using personal computers at least once a week. Although calculators are used weekly in about 1 in 5 high school classes, very few elementary and middle school classes use them that often.

Table 5.14
Science Classes in Which Teachers Report that Students Use
Various Instructional Technologies at Least Once a Week, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Internet	31	(2.9)	32	(2.7)	35	(2.2)
Personal computers, including laptops	21	(3.0)	23	(2.2)	31	(2.3)
Calculators/Graphing calculators†	8	(1.7)	2	(0.5)	19	(1.7)
Hand-held computers	2	(0.8)	4	(1.2)	9	(1.3)
Probes for collecting data	7	(2.1)	2	(0.6)	8	(1.1)
Classroom response system or “Clickers”	8	(2.8)	6	(1.0)	6	(1.0)

† Elementary teachers were asked about their use of “calculators,” middle and high school teachers were asked about their use of “graphing calculators.”

Two composite variables were created from the instructional practices items: use of reform-oriented teaching practices (e.g., have students do hands-on/laboratory activities, require students to supply evidence in support of their claims, have students represent and/or analyze data using tables, charts, or graphs) and use of instructional technology. There is little, if any, difference in the use of reform-oriented teaching practices by grade level. Instructional technology is not used much in any grade level, but is used more heavily in high school classes.

Table 5.15
Class Mean Scores on
Science Teaching Practice Composites, by Grade Range

	Mean Score		
	Elementary	**Middle**	**High**
Use of Reform-Oriented Teaching Practices	60 (0.7)	63 (0.6)	59 (0.5)
Use of Instructional Technology	25 (1.1)	26 (0.9)	34 (0.9)

Table 5.16 displays the science teaching practice composite scores by different equity factors. Both sets of practices are more commonly used in classes consisting mostly of high achievers than in classes with mostly low achievers. There are no substantive differences in scores on these composites by the percentage of non-Asian minority students or students eligible for free/reduced-price lunch in the school.

Table 5.16
Class Mean Scores on
Science Teaching Practice Composites, by Equity Factors

	Mean Score	
	Use of Reform-Oriented Teaching Practices	**Use of Instructional Technology**
Prior Achievement Level of Class		
Mostly High Achievers	63 (0.8)	33 (1.6)
Average/Mixed Achievers	60 (0.4)	27 (0.8)
Mostly Low Achievers	59 (1.1)	25 (1.7)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	60 (0.6)	28 (1.2)
Second Quartile	60 (0.9)	28 (1.2)
Third Quartile	59 (0.8)	27 (1.1)
Highest Quartile	61 (0.8)	25 (1.4)
Percent of Students in School Eligible for FRL		
Lowest Quartile	63 (0.8)	29 (1.0)
Second Quartile	60 (0.9)	28 (1.3)
Third Quartile	60 (0.6)	27 (1.4)
Highest Quartile	60 (0.9)	26 (1.2)

In addition to asking about class activities in the course as a whole, the 2012 National Survey asked teachers about activities that took place during their most recent science lesson in the randomly selected class. As can be seen in Table 5.17, roughly 90 percent of classes in each grade range include the teacher explaining a science idea to the whole class in their most recent lesson. The use of whole class discussion is also prevalent, especially in elementary lessons (91 percent), but is less common in middle and high school lessons (77 and 67 percent, respectively). About half of elementary and middle school classes include students doing hands-on/laboratory activities and reading about science in the most recent lesson, compared to fewer than 4 in 10 high school classes. In contrast, students completing textbook/worksheet problems is more common in middle and high school science lessons (51 percent and 59 percent, respectively) than in elementary lessons (43 percent).

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

	Percent of Classes		
	Elementary	**Middle**	**High**
Teacher explaining a science idea to the whole class	89 (1.2)	89 (1.4)	90 (0.9)
Whole class discussion	91 (1.1)	77 (1.8)	67 (1.4)
Students completing textbook/worksheet problems	43 (1.8)	51 (2.2)	59 (1.6)
Students doing hands-on/laboratory activities	52 (1.9)	50 (2.3)	39 (1.5)
Students reading about science	53 (2.2)	50 (2.1)	35 (1.5)
Teacher conducting a demonstration while students watched	40 (2.0)	32 (2.4)	32 (1.4)
Students using instructional technology	22 (1.5)	30 (2.0)	27 (1.4)
Test or quiz	12 (1.2)	22 (2.0)	20 (1.4)
Practicing for standardized tests	5 (0.8)	9 (1.2)	10 (0.8)

The survey also asked teachers to estimate the time spent on each of a number of types of activities in this most recent science lesson. On average, there is little difference by grade level (see Table 5.18). Approximately 40 percent of class time is spent on whole class activities, 30 percent on small group work, and 20 percent on students working individually. Non-instructional activities, including attendance taking and interruptions, account for 10 percent or less of science class time.

Table 5.18
Average Percentage of Time Spent on Different Activities in the Most Recent Science Lesson, by Grade Range

	Average Percent of Class Time		
	Elementary	**Middle**	**High**
Whole class activities (e.g., lectures, explanations, discussions)	43 (0.8)	40 (0.9)	43 (0.6)
Small group work	32 (0.9)	31 (1.2)	30 (0.7)
Students working individually (e.g., reading textbooks, completing worksheets, taking a test or quiz)	19 (0.6)	20 (0.9)	18 (0.6)
Non-instructional activities (e.g., attendance taking, interruptions)	6 (0.3)	10 (0.3)	9 (0.3)

Mathematics Instruction

Table 5.19 shows the percentage of K–12 mathematics classes in which teachers use various activities in all or almost all mathematics lessons. The teacher explaining mathematical ideas is very common across all grade levels, occurring in all or almost all lessons in 71–77 percent of mathematics classes. As is the case in science, the use of whole class discussion is more common in elementary classes, taking place in nearly all lessons in 76 percent classes, compared to 59 percent and 48 percent of middle and high school classes, respectively. Another striking difference between the grade ranges is manipulative use in problem solving/investigations, with 34 percent of elementary classes providing manipulatives to students in all or almost all lessons, compared to less than 5 percent of secondary classes.

Table 5.19
Mathematics Classes in Which Teachers Report Using Various Activities in All or Almost All Lessons, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Explain mathematical ideas to the whole class	77	(1.7)	71	(1.8)	72	(1.4)
Engage the whole class in discussions	76	(1.6)	59	(1.9)	48	(1.3)
Have students explain and justify their method for solving a problem	49	(1.7)	48	(1.9)	36	(1.6)
Have students work in small groups	34	(1.8)	24	(1.6)	20	(1.3)
Have students consider multiple representations in solving a problem (e.g., numbers, tables, graphs, pictures)	33	(1.9)	24	(1.7)	19	(1.0)
Give tests and/or quizzes that include constructed-response/open-ended items	9	(1.0)	13	(1.4)	18	(1.0)
Have students compare and contrast different methods for solving a problem	25	(1.5)	19	(1.5)	14	(1.0)
Have students present their solution strategies to the rest of the class	26	(1.5)	21	(1.8)	12	(1.0)
Give tests and/or quizzes that are predominantly short-answer (e.g., multiple choice, true/false, fill in the blank)	12	(1.4)	8	(0.9)	10	(0.8)
Have students practice for standardized tests	9	(1.1)	10	(1.5)	9	(0.9)
Have students read from a mathematics textbook/program or other mathematics-related material in class, either aloud or to themselves	18	(1.5)	10	(1.3)	8	(0.8)
Focus on literacy skills (e.g., informational reading or writing strategies)	15	(1.4)	5	(0.8)	4	(0.4)
Have students write their reflections (e.g., in their journals) in class or for homework	9	(1.2)	6	(0.9)	3	(0.4)
Provide manipulatives for students to use in problem-solving/investigations	34	(1.9)	4	(0.9)	3	(0.5)
Have students attend presentations by guest speakers focused on mathematics in the workplace	1	(0.3)	1	(0.5)	0	(0.1)

The percentage of mathematics classes including these same activities at least once a week is displayed in Table 5.20. Not unexpectedly, nearly all classes at each grade level include explaining mathematical ideas and whole class discussions on a weekly basis. Having students explain and justify their method for solving a problem, a practice consistent with the "Standards for Mathematical Practice" in the *Common Core State Standards for Mathematics*,[6] is also a

[6] National Governors Association Center for Best Practices, Council of Chief State School Officers (2010). *Common Core State Standards.* Washington, DC: Author.

fairly common weekly occurrence across grade ranges, though its frequency decreases from 88 percent in elementary classes to 79 percent in high school classes. A similar pattern is evident for other standards-based practices such as providing manipulatives for students to use in problem solving, having students consider multiple representations, and having students compare and contrast different methods for solving a problem. Furthermore, elementary mathematics classes are more likely to focus at least once a week on literacy skills, such as informational reading or writing strategies, than secondary classes.

The weekly use of formal assessment practices also varies across the grade levels. Constructed-response tests/quizzes are given at least once a week in 50 percent or more of middle and high school classes, compared to in 39 percent of elementary classes. The opposite trend is evident in the use of short-answer tests/quizzes, with 47 percent of elementary classes including this assessment practice on a weekly basis, versus 39 percent and 36 percent of middle and high school classes, respectively.

Table 5.20
Mathematics Classes in Which Teachers Report Using Various Activities at Least Once a Week, by Grade Range

	Percent of Classes		
	Elementary	**Middle**	**High**
Explain mathematical ideas to the whole class	97 (0.5)	98 (0.5)	95 (0.7)
Engage the whole class in discussions	96 (0.8)	93 (1.1)	84 (1.1)
Have students explain and justify their method for solving a problem	88 (1.0)	85 (1.5)	79 (1.3)
Have students work in small groups	85 (1.2)	70 (2.1)	63 (1.7)
Have students consider multiple representations in solving a problem (e.g., numbers, tables, graphs, pictures)	78 (1.3)	75 (1.5)	65 (1.4)
Give tests and/or quizzes that include constructed-response/open-ended items	39 (1.9)	50 (2.3)	56 (1.6)
Have students compare and contrast different methods for solving a problem	66 (1.6)	63 (2.1)	56 (1.6)
Have students present their solution strategies to the rest of the class	64 (1.5)	60 (2.0)	46 (1.4)
Give tests and/or quizzes that are predominantly short-answer (e.g., multiple choice, true/false, fill in the blank)	47 (1.8)	39 (2.1)	36 (1.2)
Have students practice for standardized tests	31 (1.6)	40 (2.4)	32 (1.5)
Have students read from a mathematics textbook/program or other mathematics-related material in class, either aloud or to themselves	41 (1.8)	34 (2.3)	25 (1.4)
Focus on literacy skills (e.g., informational reading or writing strategies)	40 (2.0)	23 (1.9)	14 (1.0)
Have students write their reflections (e.g., in their journals) in class or for homework	26 (1.7)	21 (1.6)	11 (1.0)
Provide manipulatives for students to use in problem-solving/investigations	82 (1.2)	33 (1.9)	18 (1.0)
Have students attend presentations by guest speakers focused on mathematics in the workplace	3 (0.7)	2 (0.6)	1 (0.3)

Table 5.21 represents the percentage of K–12 mathematics classes that never have students take part in various activities. Similar to science instruction, many mathematics classes never have

students attend presentations by guest speakers. Also note that 43 percent of high school mathematics classes never ask students to write reflections.

Table 5.21
Mathematics Classes in Which Teachers Report Never Using Various Activities, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Explain mathematical ideas to the whole class	0	(0.2)	0	---†	0	(0.2)
Engage the whole class in discussions	0	(0.2)	0	---†	0	(0.2)
Have students explain and justify their method for solving a problem	0	(0.1)	0	(0.2)	0	(0.2)
Have students work in small groups	0	(0.2)	1	(0.2)	1	(0.5)
Have students consider multiple representations in solving a problem (e.g., numbers, tables, graphs, pictures)	1	(0.2)	0	(0.2)	1	(0.3)
Give tests and/or quizzes that include constructed-response/open-ended items	13	(1.2)	4	(0.7)	4	(1.0)
Have students compare and contrast different methods for solving a problem	2	(0.4)	1	(0.3)	2	(0.3)
Have students present their solution strategies to the rest of the class	3	(0.5)	2	(0.5)	4	(0.6)
Give tests and/or quizzes that are predominantly short-answer (e.g., multiple choice, true/false, fill in the blank)	11	(1.2)	8	(1.2)	13	(1.2)
Have students practice for standardized tests	17	(1.4)	4	(0.8)	9	(0.8)
Have students read from a mathematics textbook/program or other mathematics-related material in class, either aloud or to themselves	14	(1.1)	9	(1.0)	18	(1.1)
Focus on literacy skills (e.g., informational reading or writing strategies)	11	(1.0)	14	(1.3)	23	(1.3)
Have students write their reflections (e.g., in their journals) in class or for homework	22	(1.4)	26	(1.9)	43	(1.5)
Provide manipulatives for students to use in problem-solving/investigations	0	---†	1	(0.4)	7	(0.7)
Have students attend presentations by guest speakers focused on mathematics in the workplace	79	(1.5)	76	(1.8)	78	(1.2)

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

Teachers were asked to provide information about the use of technology in their mathematics instruction. Table 5.22 shows the percentage of classes in which various instructional technologies are used at least once a week. Graphing and/or scientific calculators are used most often at the high school level; very few elementary classes use any type of calculator on a weekly basis. In contrast, 43 percent of elementary mathematics classes use the Internet weekly, compared to just 26 percent of middle school mathematics classes and 11 percent of high school mathematics classes.

Table 5.22
Mathematics Classes in Which Teachers Report that Students Use Various Instructional Technologies at Least Once a Week, by Grade Range

	Percent of Classes		
	Elementary	Middle	High
Graphing calculators	0 (0.0)	13 (2.2)	64 (2.0)
Scientific calculators	4 (1.3)	40 (2.8)	53 (2.1)
Four-function calculators	13 (1.7)	40 (2.5)	33 (2.2)
Internet	43 (2.4)	26 (2.6)	11 (1.2)
Personal computers, including laptops	36 (2.5)	22 (2.8)	10 (1.2)
Classroom response system or “Clickers”	4 (1.3)	11 (1.6)	4 (0.7)
Hand-held computers	5 (1.1)	5 (1.5)	4 (0.8)
Probes for collecting data	0 (0.3)	1 (0.7)	1 (0.4)

Table 5.23 shows the means for composite variables related to mathematics teaching practice. Teachers at all grade levels report using reform-oriented teaching practices, such as having students solve problems and consider multiple representations, explain and justify their solution method, and compare and contrast different solution methods fairly often. However, the frequency of these practices is higher in elementary and middle grades classes than high school classes. In general, use of instructional technology is low in K–12 mathematics classes, and decreases with increasing grade level.

Table 5.23
Class Mean Scores on Mathematics Teaching Practice Composites, by Grade Range

	Mean Score		
	Elementary	Middle	High
Use of Reform-Oriented Teaching Practices	74 (0.8)	73 (1.1)	67 (0.7)
Use of Instructional Technology	33 (1.1)	28 (1.4)	21 (1.0)

With the exception of prior achievement level of class, there is little variation in composite scores related to mathematics teaching practices when analyzed by different equity factors (see Table 5.24). As is the case in science, reform-oriented teaching practices are more commonly used in mathematics classes consisting mainly of high achievers.

Table 5.24
Class Mean Scores on Mathematics Teaching Practice Composites, by Equity Factors

	Mean Score	
	Use of Reform-Oriented Teaching Practices	**Use of Instructional Technology**
Prior Achievement Level of Class		
Mostly High Achievers	74 (0.7)	27 (1.3)
Average/Mixed Achievers	72 (0.5)	28 (0.9)
Mostly Low Achievers	70 (0.9)	30 (1.1)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	71 (0.8)	27 (1.2)
Second Quartile	72 (0.7)	27 (1.4)
Third Quartile	72 (0.7)	30 (1.4)
Highest Quartile	73 (0.7)	29 (1.4)
Percent of Students in School Eligible for FRL		
Lowest Quartile	74 (0.8)	27 (1.4)
Second Quartile	71 (0.8)	29 (1.6)
Third Quartile	73 (0.6)	29 (1.5)
Highest Quartile	72 (0.9)	31 (1.9)

Table 5.25 presents the percentage of most recent lessons in K–12 mathematics classes that include various activities. With only a few exceptions, the frequency of activities in each grade range is fairly similar. For example, most elementary, middle, and high school lessons include the explanation of mathematical ideas (93–95 percent) and whole class discussion (75–89 percent). Having students complete textbook/worksheet problems is also prevalent, occurring in roughly 4 out of 5 mathematics lessons. Lessons vary across the grade ranges in the use of hands-on/manipulatives and instructional technology. At the elementary level, 77 percent classes include students doing hands-on/manipulative activities compared to only 21 percent of high school mathematics classes. In contrast, high school mathematics classes are more likely than elementary classes to include the use of instructional technology (43 versus 29 percent, respectively).

Table 5.25
Mathematics Classes Participating in Various Activities in the Most Recent Lesson, by Grade Range

	Percent of Classes		
	Elementary	**Middle**	**High**
Teacher explaining a mathematical idea to the whole class	93 (0.9)	93 (1.0)	95 (0.7)
Students completing textbook/worksheet problems	80 (1.5)	78 (1.8)	83 (1.0)
Whole class discussion	89 (1.1)	85 (1.4)	75 (1.3)
Teacher conducting a demonstration while students watched	74 (1.5)	71 (2.0)	65 (1.2)
Students using instructional technology	29 (1.7)	31 (1.8)	43 (1.3)
Students doing hands-on/manipulative activities	77 (1.4)	37 (1.6)	21 (1.3)
Test or quiz	19 (1.3)	19 (1.6)	20 (1.3)
Students reading about mathematics	19 (1.3)	23 (1.7)	17 (1.2)
Practicing for standardized tests	14 (1.3)	23 (1.9)	16 (1.1)

The proportion of time spent on various instructional arrangements in mathematics lessons is relatively similar across the grade levels (see Table 5.26), though there is some variation. On average, more time is spent in whole class activities in high school mathematics classes than in elementary and middle school classes, ranging from 40 to 48 percent of class time. In contrast, the time spent in small group work decreases with increasing grade range, from 29 percent of time in elementary classes to 22 percent of time in high school mathematics classes.

Table 5.26
Average Percentage of Time Spent on Different Activities in the Most Recent Mathematics Lesson, by Grade Range

	Average Percent of Class Time		
	Elementary	**Middle**	**High**
Whole class activities (e.g., lectures, explanations, discussions)	40 (0.6)	42 (0.8)	48 (0.7)
Small group work	29 (0.8)	24 (0.9)	22 (0.8)
Students working individually (e.g., reading textbooks, completing worksheets, taking a test or quiz)	26 (0.6)	24 (0.7)	22 (0.6)
Non-instructional activities (e.g., attendance taking, interruptions)	6 (0.3)	10 (0.2)	9 (0.2)

Homework and Assessment Practices

Science and mathematics teachers were asked about the amount of homework assigned per week in the randomly selected class. Across the grade levels, students in mathematics classes are assigned more homework than students in science classes (see Table 5.27). This pattern is particularly evident in elementary classes, where students in 35 percent of classes are given 31–60 minutes of mathematics homework a week; only 7 percent of elementary classes are assigned this much science homework. Not surprisingly, the amount of time students are asked to spend on science and mathematics homework increases with grade range. For example, nearly two-thirds of high school mathematics classes are assigned one or more hours of homework per week, compared to under one-third of elementary classes.

Table 5.27
Amount of Homework Assigned in Classes per Week, by Subject and Grade Range

	Percent of Classes		
	Elementary	**Middle**	**High**
Science			
Fewer than 15 minutes per week	73 (2.8)	22 (2.2)	9 (1.1)
15–30 minutes per week	17 (2.5)	29 (2.7)	17 (1.6)
31–60 minutes per week	7 (2.0)	30 (2.6)	34 (2.1)
61–90 minutes per week	2 (1.2)	14 (2.1)	24 (1.8)
91–120 minutes per week	0 (0.2)	3 (0.8)	7 (1.1)
More than 120 minutes per week	0 (0.3)	2 (1.6)	9 (1.1)
Mathematics			
Fewer than 15 minutes per week	16 (1.9)	5 (0.8)	7 (1.0)
15–30 minutes per week	19 (2.0)	13 (2.6)	8 (1.2)
31–60 minutes per week	35 (2.6)	28 (2.9)	22 (1.7)
61–90 minutes per week	17 (1.8)	29 (2.9)	27 (1.8)
91–120 minutes per week	9 (1.3)	14 (1.5)	13 (1.1)
More than 120 minutes per week	4 (0.9)	10 (1.6)	23 (1.8)

Teachers were also given a list of ways that they might assess student progress and asked to describe which practices they used in the most recently completed unit in the randomly selected class. These data are shown in Tables 5.28 and 5.29. In both science and mathematics, the vast majority of classes at all grade levels included informal assessment practices during the unit to see if students were "getting it." For example, more than 90 percent of K–12 science and mathematics classes involved the teacher questioning students during activities to monitor understanding. Using whole class informal assessments such as "thumbs up/thumbs down" was another common practice, used in most science and mathematics classes (80–90 percent) during the unit.

In addition, the use of formal assessment techniques such as grading student work, quizzes, and tests, as well as reviewing the correct answers to assignments were also prevalent features of science and mathematics units, especially in secondary classes. Middle and high school teachers in roughly 9 out of 10 classes administered a test or quiz to assign grades and assigned grades to student work; teachers in approximately 6 in 10 elementary classes used these practices during their most recent unit. In contrast, having students use rubrics to examine their own or their classmates' work was infrequent across all grade levels.

Table 5.28
Science Classes in Which Teachers Report Assessing Students Using Various Methods in the Most Recent Unit, by Grade Range

	Percent of Classes		
	Elementary	Middle	High
Questioned individual students during class activities to see if they were "getting it"	94 (0.9)	95 (1.4)	97 (0.5)
Reviewed student work (e.g., homework, notebooks, journals, portfolios, projects) to see if they were "getting it"	89 (1.4)	96 (0.7)	94 (0.7)
Assigned grades to student work (e.g., homework, notebooks, journals, portfolios, projects)	60 (1.8)	94 (0.9)	92 (0.7)
Administered one or more quizzes and/or tests to assign grades	56 (2.4)	90 (1.5)	91 (0.7)
Went over the correct answers to assignments, quizzes, and/or tests with the class as a whole	62 (2.2)	89 (1.7)	88 (1.0)
Administered one or more quizzes and/or tests to see if students were "getting it"	52 (2.5)	82 (1.7)	81 (1.3)
Used information from informal assessments of the entire class (e.g., asking for a show of hands, thumbs up/thumbs down, clickers, exit tickets) to see if students were "getting it"	87 (1.3)	86 (1.8)	80 (1.3)
Administered an assessment, task, or probe at the beginning of the unit to find out what students thought or already knew about the key science ideas	54 (2.0)	62 (2.1)	53 (1.4)
Had students use rubrics to examine their own or their classmates' work	14 (1.5)	27 (2.0)	18 (1.2)

Table 5.29
Mathematics Classes in Which Teachers Report Assessing Students Using Various Methods in the Most Recent Unit, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Questioned individual students during class activities to see if they were "getting it"	97	(0.6)	98	(0.6)	97	(0.5)
Reviewed student work (e.g., homework, notebooks, journals, portfolios, projects) to see if they were "getting it"	96	(0.7)	95	(0.9)	96	(0.7)
Administered one or more quizzes and/or tests to assign grades	73	(1.6)	88	(1.5)	94	(0.6)
Went over the correct answers to assignments, quizzes, and/or tests with the class as a whole	83	(1.2)	94	(0.9)	92	(0.7)
Administered one or more quizzes and/or tests to see if students were "getting it"	73	(1.7)	86	(1.5)	86	(1.4)
Assigned grades to student work (e.g., homework, notebooks, journals, portfolios, projects)	63	(1.9)	85	(1.6)	85	(0.9)
Used information from informal assessments of the entire class (e.g., asking for a show of hands, thumbs up/thumbs down, clickers, exit tickets) to see if students were "getting it"	90	(1.1)	88	(1.3)	83	(1.1)
Administered an assessment, task, or probe at the beginning of the unit to find out what students thought or already knew about the key mathematical ideas	63	(1.8)	52	(2.2)	42	(1.8)
Had students use rubrics to examine their own or their classmates' work	10	(1.1)	12	(1.3)	8	(0.7)

The survey asked how often students in the randomly selected class were required to take assessments the teachers did not develop, such as state or district benchmark assessments. Given the increased emphasis on high stakes assessment, a result of the 2001 No Child Left Behind Act, it is not surprising that the frequency of external testing is greater in mathematics classes than in science classes, particularly at the elementary and middle grades levels (see Table 5.30). At the elementary level, 50 percent of classes never administer external science assessments; only 9 percent never administer external mathematics assessments.

Table 5.30
Frequency of Required External Testing in Classes, by Subject and Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Science						
Never	50	(2.3)	21	(1.6)	30	(1.5)
Once a year	17	(1.6)	28	(2.2)	35	(1.6)
Twice a year	8	(1.2)	13	(1.8)	13	(1.0)
Three or four times a year	16	(1.6)	23	(2.0)	14	(1.1)
Five or more times a year	9	(1.6)	15	(1.4)	9	(0.9)
Mathematics						
Never	9	(0.9)	2	(0.4)	21	(1.3)
Once a year	14	(1.3)	19	(2.2)	28	(1.3)
Twice a year	7	(0.9)	10	(1.4)	15	(1.0)
Three or four times a year	38	(1.7)	38	(2.4)	22	(1.2)
Five or more times a year	31	(1.7)	31	(1.7)	14	(1.1)

The prior achievement level of the class, percentage of non-Asian minority students in the class, and percentage of students in the school eligible for free/reduced-price lunch are all related to the frequency with which science and mathematics classes are required to take external assessments. As can be seen in Table 5.31, in both subjects, classes with mostly low-achieving students are more likely than classes with mostly high achievers to take external assessments two or more times per year. Similarly, the greater the percentage of non-Asian minority students in the class and the greater the percentage of students in the school eligible for free/reduced-price lunch, the more likely students are to be tested this frequently.

Table 5.31
Classes Required to Take External Assessments Two or More Times per Year, by Subject and Equity Factors

	Percent of Classes	
	Science	**Mathematics**
Prior Achievement Level of Class		
Mostly High Achievers	36 (3.1)	60 (2.6)
Average/Mixed Achievers	36 (1.7)	71 (1.4)
Mostly Low Achievers	53 (3.6)	76 (2.2)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	26 (2.4)	56 (2.4)
Second Quartile	30 (2.6)	65 (2.0)
Third Quartile	38 (3.3)	71 (2.1)
Highest Quartile	52 (2.4)	83 (1.5)
Percent of Students in School Eligible for FRL		
Lowest Quartile	33 (2.9)	66 (2.4)
Second Quartile	35 (2.4)	73 (1.9)
Third Quartile	45 (3.5)	75 (1.9)
Highest Quartile	50 (3.0)	81 (1.7)

Summary

Data from the 2012 National Survey indicate that science and mathematics teachers perceive more control over decisions related to pedagogy than curriculum. Perceived autonomy over curriculum and pedagogy tends to increase with grade range in both science and mathematics classes, with teachers of elementary classes having less control over what and how they teach than teachers of high school classes.

Teachers of classes at all grade levels, and in both subjects, are fairly likely to emphasize reform-oriented instructional objectives, such as developing understanding of science concepts/ mathematics ideas, increasing student interest in the subject, and connecting what students are learning to real-life applications. However, there are some important differences between the subjects and among the grade levels. For example, science classes are more likely than mathematics classes to have a heavy emphasis on increasing students' interest in the subject. In both subjects, this objective is emphasized less in high school. Mathematics classes are more likely than science classes to focus on preparing students for further study in the discipline and, at the K–8 level, emphasize test taking skills.

In terms of instructional activities, teacher explanation of science ideas and whole group discussion are very common across the grade levels. The use of small group work and hands-on activities are also fairly prevalent, with over half of K–12 science classes including these activities on a weekly basis. Given that accountability efforts in recent years have focused on reading/language arts and mathematics, it is not surprising that science classes in grades K–8 often include literacy activities. In contrast, the use of instructional technology and practicing for standardized tests in science is quite infrequent across grade levels.

Explanation of ideas and whole group discussion are also very prominent in mathematics instruction, as is the use of textbook/worksheet problems. Having students engage in practices consistent with the *Common Core State Standards for Mathematics*, such as explaining and justifying methods for solving a problem and comparing/contrasting different solution methods, is also a common weekly occurrence across grade ranges, although the frequency of use decreases as grade range increases. For example, 78 percent of elementary classes have students consider multiple representations in solving a problem at least once per week, compared to only 65 percent of high school classes. Similar to science, the use of technology in mathematics instruction is fairly low across grade levels.

In both science and mathematics, informal means of assessment—e.g., questioning students during activities, reviewing student work—are commonly used to monitor student progress. Grading student homework, quizzes, and tests is also quite frequent, especially at the secondary level. Not surprisingly, external testing occurs more frequently in mathematics classes than science classes. However, in both subjects, the frequency of external testing varies by grade range.

Equity factors, in particular prior achievement level of the class, are related to objectives and instructional activities in science and mathematics. Classes with mostly high-achieving students are more likely to stress reform-oriented objectives and teaching practices than classes consisting of mostly low-achieving students. Classes of mostly low-achieving students tend to have to take external assessments more frequently than classes of mostly high-achieving students.

CHAPTER SIX

Instructional Resources

Overview

The quality and availability of instructional resources is a major factor in science and mathematics teaching. The 2012 National Survey of Science and Mathematics Education included a series of items on science and mathematics textbooks/programs—which ones were being used, how teachers used their textbooks, 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.

Textbook Usage

The 2012 National Survey collected data on the use of commercially published textbooks or programs in science and mathematics classes. As can be seen in Table 6.1, more than three-fourths of middle and high school science classes and elementary, middle, and high school mathematics classes use published textbooks/programs. Use of textbooks/programs is somewhat less common, however, in elementary science classes (69 percent).

Table 6.1
Classes Using Commercially Published Textbooks/Programs, by Subject

	Percent of Classes	
	Science	**Mathematics**
Elementary School	69 (2.1)	85 (1.5)
Middle School	80 (1.9)	81 (1.8)
High School	77 (1.2)	81 (1.0)

The survey also asked how if one textbook/program is used all or most of the time, or if multiple materials are used (see Tables 6.2 and 6.3). The percentage of mathematics classes using one or more commercially published materials is strikingly similar across grade ranges (81–85 percent). Most of these classes rely on a single textbook/program.

Table 6.2
Instructional Materials Used in Mathematics Classes,† by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
One commercially published textbook or program most of the time	62	(2.2)	55	(2.4)	65	(1.4)
Multiple commercially published textbooks/programs most of the time	23	(1.6)	27	(2.1)	16	(0.9)
Non-commercially published instructional materials most of the time	15	(1.5)	19	(1.8)	19	(1.0)

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

Science instructional materials tend to be more diverse in format than mathematics materials. For that reason, teachers were presented with different options to describe the materials used in science classes. The data in Table 6.3 show some sharp contrasts among grade ranges. For example, high school science classes are much more likely than elementary and middle school classes to use a textbook rather than modules. Also noticeable is the relatively heavy use of non-commercially published materials in elementary school science classes, compared to science instruction in later grades, and compared to mathematics instruction in elementary grades (see Table 6.2). Overall, much science instruction in grades K–12 (particularly in elementary and middle grades) appears to be pulled together from multiple sources, more so than in mathematics instruction.

Table 6.3
Instructional Materials Used in Science Classes, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Mainly commercially published textbook(s)						
One textbook	26	(2.0)	34	(2.3)	52	(1.7)
Multiple textbooks	5	(0.8)	11	(1.0)	7	(0.7)
Mainly commercially published modules						
Modules from a single publisher	12	(1.5)	11	(1.9)	2	(0.4)
Modules from multiple publishers	4	(1.0)	3	(0.7)	2	(0.4)
Other						
A roughly equal mix of commercially published textbooks and commercially published modules most of the time	22	(1.7)	20	(2.0)	15	(1.2)
Non-commercially published materials most of the time	31	(2.1)	20	(1.9)	23	(1.2)

Teachers who indicated that the randomly selected class used a published textbook/program were asked to record the title, author, year, and ISBN of the material used most often in the class. Using this information, the publisher of the material was identified. Table 6.4 shows the market share held by each of the major science and mathematics textbook publishers. It is interesting to note that three publishers—Houghton Mifflin Harcourt, McGraw-Hill, and Pearson—account for instructional materials used in more than three-fourths of science and mathematics classes. In elementary and middle school mathematics, these three publishers alone account for the materials used in 95 percent or more of classes. The only other publisher with a substantial share of the market is Delta Education in elementary science.

Table 6.4
Market Share of Commercial Textbook Publishers[†], by Subject and Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Science						
Pearson	15	(2.4)	31	(2.9)	43	(2.2)
Houghton Mifflin Harcourt	47	(3.4)	33	(2.9)	22	(1.5)
McGraw-Hill	16	(2.4)	25	(2.6)	18	(1.3)
Cengage Learning	0	---[‡]	0	(0.2)	6	(0.8)
Delta Education	11	(1.9)	1	(0.7)	1	(0.2)
Carolina Biological Supply Company	2	(0.8)	2	(0.6)	0	---[‡]
Lab-Aids	0	---[‡]	2	(1.6)	0	(0.0)
National Geographic Society	4	(1.8)	0	(0.2)	0	---[‡]
Mathematics						
Houghton Mifflin Harcourt	35	(2.7)	41	(3.2)	35	(1.6)
Pearson	33	(3.0)	26	(2.5)	30	(2.0)
McGraw-Hill	29	(2.5)	28	(2.8)	18	(1.6)
Cengage Learning	0	---[‡]	0	---[‡]	9	(1.0)
W. H. Freeman	0	---[‡]	0	---[‡]	2	(0.6)

† Only publishers with two percent or more of the market share in any grade range are included in this table.
‡ No teachers at this grade level in the sample reported using materials from this publisher. Thus, it is not possible to calculate the standard error of this estimate.

Tables 6.5 and 6.6 list the most commonly used science and mathematics textbooks in each grade range; secondary textbooks are shown by course type, as well.

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

	Publisher	Title
Elementary		
Elementary Science	Houghton Mifflin Harcourt	*Harcourt Science*
	Pearson	*Scott Foresman Science*
Middle		
Life Science	Houghton Mifflin Harcourt	*Life Science*
	McGraw-Hill	*Life Science*
Earth Science	Pearson	*Earth Science*
	Houghton Mifflin Harcourt	*Earth Science*
Physical Science	Houghton Mifflin Harcourt	*Physical Science*
	Pearson	*Focus on Physical Science*
General/Integrated Science	McGraw-Hill	*Glencoe Science*
	Houghton Mifflin Harcourt	*Holt Science & Technology*
High		
Biology	Pearson	*Biology*
	Houghton Mifflin Harcourt	*Biology*
Earth Science	Houghton Mifflin Harcourt	*Earth Science*
	Pearson	*Earth Science*
Chemistry	Pearson	*Chemistry*
	Houghton Mifflin Harcourt	*Modern Chemistry*
Physics	Pearson	*Conceptual Physics*
	McGraw-Hill	*Physics - Principles and Problems*
Environmental Science	Houghton Mifflin Harcourt	*Environmental Science*
	Cengage Learning	*Living in the Environment*
Coordinated/Integrated Science	Pearson	*Physical Science Concepts in Action*
	McGraw-Hill	*Physical Science*

Table 6.6
Most Commonly Used Mathematics Textbooks, by Grade Range and Course

	Publisher	Title
Elementary		
Elementary Mathematics	Pearson	*Envision Math*
	McGraw-Hill	*Everyday Mathematics*
Middle		
Middle School Mathematics	McGraw-Hill	*Math Connects*
	Pearson	*Connected Mathematics*
	Houghton Mifflin Harcourt	*Mathematics Course 3*
	Houghton Mifflin Harcourt	*Algebra I*
	Houghton Mifflin Harcourt	*Mathematics Course 2*
High		
Non-college prep Mathematics	Houghton Mifflin Harcourt	*Algebra 1*
	Houghton Mifflin Harcourt	*Geometry*
	Pearson	*Algebra 1*
Formal/College-prep Mathematics Level 1	Houghton Mifflin Harcourt	*Algebra 1*
	Pearson	*Algebra 1*
	McGraw-Hill	*Algebra 1*
Formal/College-prep Mathematics Level 2	Houghton Mifflin Harcourt	*Geometry*
	Pearson	*Geometry*
Formal/College-prep Mathematics Level 3	Houghton Mifflin Harcourt	*Algebra 2*
	Pearson	*Algebra 2*
Formal/College-prep Mathematics Level 4	Cengage Learning	*Precalculus with Limits: A Graphing Approach*
	McGraw-Hill	*Advanced Mathematical Concepts: Precalculus with Applications*
Courses that might qualify for college credit	Pearson	*Calculus: Graphical, Numerical, Algebraic*
	Cengage Learning	*Calculus of a Single Variable*

Since 1950, the National Science Foundation (NSF) has funded the development of instructional materials in science and mathematics. Using title and publisher information, each textbook listed by teachers was coded as having been developed with NSF funding or not. As shown in Table 6.7, elementary mathematics classes are the most likely (25 percent) to be using such materials.

Table 6.7
Classes Using Instructional Materials
Developed with NSF Funding, by Subject and Grade Range

	Percent of Classes†			
	Science		Mathematics	
Elementary School	10	(1.8)	25	(2.5)
Middle School	6	(1.6)	11	(2.0)
High School	3	(0.5)	0	(0.2)

† Only classes using published textbooks/modules were included in these analyses.

Table 6.8 shows the publication year of science and mathematics textbooks. In 2012, more than half of science classes were using textbooks published prior to 2007. In general, mathematics classes are more likely than science classes to use newer textbooks. The contrast between elementary science and elementary mathematics is particularly striking, as science classes are much more likely than mathematics classes (58 percent vs. 30 percent) to use textbooks published in 2006 or earlier.

Table 6.8
Publication Year of Textbooks/Programs, by Subject and Grade Range

	Percent of Classes†		
	Elementary	**Middle**	**High**
Science			
2006 or earlier	58 (3.0)	52 (2.6)	60 (1.9)
2007–09	24 (2.8)	35 (2.9)	26 (1.8)
2010–12	18 (2.6)	13 (2.0)	14 (1.3)
Mathematics			
2006 or earlier	30 (2.4)	40 (2.4)	52 (1.9)
2007–09	52 (2.5)	44 (2.6)	33 (1.6)
2010–12	18 (2.3)	16 (1.4)	15 (1.0)

† Only classes using published textbooks/modules 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,[7] most teachers consider their textbooks to be of relatively high quality. As can be seen in Table 6.9, teachers in the majority of science and mathematics classes in each grade range consider their textbooks/programs to be good or better, including 71–76 percent of classes in science and 76–78 percent of classes in mathematics at the various grade ranges.

[7] For example, American Association for the Advancement of Science (2000). *Middle grades mathematics textbooks: A benchmarks-based evaluation.* Washington, DC: American Association for the Advancement of Science.

Table 6.9
Perceived Quality of Textbooks/Programs Used in Classes, by Subject and Grade Range

	Percent of Classes†					
	Elementary		Middle		High	
Science						
Very Poor	6	(2.6)	2	(1.5)	1	(0.5)
Poor	4	(1.4)	3	(1.0)	3	(0.8)
Fair	19	(2.6)	18	(2.5)	20	(2.6)
Good	32	(2.9)	32	(3.5)	32	(2.3)
Very Good	32	(3.7)	36	(3.3)	33	(2.6)
Excellent	7	(1.8)	8	(2.6)	11	(1.5)
Mathematics						
Very Poor	1	(0.6)	2	(1.2)	1	(0.4)
Poor	3	(0.9)	4	(0.9)	4	(0.8)
Fair	20	(2.4)	19	(2.4)	16	(1.3)
Good	38	(2.5)	34	(2.6)	33	(2.5)
Very Good	30	(2.5)	33	(2.9)	37	(2.3)
Excellent	9	(1.4)	9	(1.6)	8	(1.0)

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

Table 6.10 shows the percentages of science and mathematics classes in elementary, middle, and high school 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, often covering 75 percent or more of their textbooks.

Table 6.10
Percentage of Textbooks/Programs Covered during the Course, by Subject and Grade Range

	Percent of Classes†					
	Elementary		Middle		High	
Science						
Less than 25 percent	13	(3.3)	3	(1.3)	8	(1.7)
25–49 percent	8	(2.6)	15	(3.9)	18	(2.4)
50–74 percent	27	(4.7)	35	(4.7)	33	(2.8)
75–100 percent	52	(5.6)	47	(5.7)	41	(3.5)
Mathematics						
Less than 25 percent	2	(0.8)	2	(0.7)	1	(0.4)
25–49 percent	5	(1.3)	7	(2.1)	7	(1.2)
50–74 percent	13	(1.8)	22	(3.1)	25	(2.1)
75–100 percent	81	(2.4)	69	(3.5)	67	(2.1)

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

Mathematics classes at all grade ranges are more likely than science classes to spend a substantial portion of their time using the textbook (see Table 6.11). For example, almost half of high school mathematics classes use the textbook more than 75 percent of the time, compared to only 13 percent of high school science classes. It is also striking that in most high school science classes, less than half of the instructional time is spent using the textbook.

Table 6.11
Percentage of Instructional Time Spent Using Instructional Materials during the Course, by Grade Range

	Percent of Classes[†]					
	Elementary		Middle		High	
Science						
Less than 25 percent	15	(3.2)	25	(5.1)	46	(2.8)
25–49 percent	27	(3.4)	22	(3.3)	26	(2.3)
50–74 percent	22	(4.0)	26	(3.2)	15	(2.4)
75 percent or more	35	(4.2)	26	(4.8)	13	(2.1)
Mathematics						
Less than 25 percent	4	(1.2)	14	(2.0)	21	(2.2)
25–49 percent	12	(2.3)	14	(1.9)	14	(1.7)
50–74 percent	20	(2.6)	23	(3.2)	20	(1.7)
75 percent or more	64	(3.4)	49	(3.5)	45	(2.7)

[†] Only classes using published textbooks/programs were included in these analyses

Survey respondents were asked to describe how they used their textbook in their most recent unit. Two important findings emerge from these data. First, textbooks heavily influence science and mathematics instruction at all grade ranges (see Table 6.12). Teachers in 64 percent or more of classes in the various subject/grade-range categories report using the textbook substantially to guide the overall structure and content emphasis in their most recent unit; large proportions (45–74 percent) use the textbook for more detailed organization. There is some evidence that teachers in upper grades are less likely than those in lower grades to rely on the textbook for organizing instructional units. For example, in 45 percent of high school science classes, teachers use the textbook substantially to guide the detailed structure of the unit, compared to 65 percent of elementary classes.

Second, it is clear that teachers deviate from their textbooks substantially when designing instruction. In more than half of science and mathematics classes, teachers report incorporating activities from other sources substantially; more than 4 in 10 report "picking and choosing" from the textbook.

Table 6.12
Ways Teachers Substantially† Used Their Textbook in the Most Recent Unit, by Grade Range

	Percent of Classes‡					
	Elementary		Middle		High	
Science Classes						
You incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what the textbook/module was lacking	64	(2.7)	75	(2.5)	79	(1.7)
You used the textbook/module to guide the overall structure and content emphasis of the unit	77	(2.8)	66	(2.7)	64	(2.1)
You picked what is important from the textbook/module and skipped the rest	42	(2.2)	49	(3.2)	51	(2.0)
You followed the textbook/module to guide the detailed structure and content emphasis of the unit	65	(2.8)	51	(3.0)	45	(2.3)
Mathematics Classes						
You incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what the textbook/program was lacking	62	(2.1)	68	(2.6)	56	(1.9)
You used the textbook/program to guide the overall structure and content emphasis of the unit	81	(1.6)	71	(2.2)	74	(1.5)
You picked what is important from the textbook/program and skipped the rest	43	(2.0)	51	(2.5)	52	(1.6)
You followed the textbook/program to guide the detailed structure and content emphasis of the unit	74	(2.0)	56	(2.7)	57	(1.5)

† Includes those responding 4 or 5 on a 5-point scale ranging from 1 “not at all” to 5 “to a great extent.”
‡ Only classes using published textbooks/programs in the most recent unit were included in these analyses.

Teachers in over 40 percent of science and mathematics classes skip activities in the textbook substantially. In both subjects, the most often selected reason is having another activity that works better than the one skipped (see Table 6.13). Teachers cite this reason with striking consistency across grade ranges. Differences across grades, however, are also apparent. For example, in mathematics, teachers in 31 percent of elementary classes cite the difficulty of the activity as the reason for skipping it, compared to 55 percent in high school mathematics classes. Also, not having materials for an activity is much more likely to be cited as a reason in science classes (49–62 percent) than in mathematics classes (29–30 percent).

Table 6.13
Reasons Why Parts of the Textbook Are Skipped, by Grade Range

	Percent of Classes†					
	Elementary		Middle		High	
Science Classes						
You have different activities for those science ideas that work better than the ones you skipped	84	(2.8)	89	(3.2)	88	(1.8)
The science ideas addressed in the activities you skipped are not included in your pacing guide and/or current state standards	66	(3.5)	65	(5.0)	60	(3.1)
Your students already knew the science ideas or were able to learn them without the activities you skipped	60	(3.8)	56	(4.1)	57	(2.9)
You did not have the materials needed to implement the activities you skipped	62	(3.4)	61	(5.2)	49	(3.1)
The activities you skipped were too difficult for your students	50	(4.0)	47	(5.0)	49	(3.1)
Mathematics Classes						
You have different activities for those mathematical ideas that work better than the ones you skipped	78	(2.5)	79	(2.9)	79	(2.0)
The mathematical ideas addressed in the activities you skipped are not included in your pacing guide and/or current state standards	68	(2.9)	78	(3.2)	66	(2.9)
Your students already knew the mathematical ideas or were able to learn them without the activities you skipped	71	(2.9)	57	(3.9)	54	(2.8)
You did not have the materials needed to implement the activities you skipped	29	(2.9)	30	(4.4)	30	(2.7)
The activities you skipped were too difficult for your students	31	(3.2)	41	(3.3)	55	(2.5)

† Only classes using published textbooks/programs in the most recent unit and whose teachers reported skipping some activities were included in these analyses.

Given that teachers often report skipping activities in their textbooks because they know of better ones, it is perhaps not surprising that teachers in well more than half of science and mathematics classes report supplementing their published materials (see Table 6.12). Of the reasons listed on the questionnaire, two stand out above the rest: providing students with additional practice and differentiating instruction for students at different achievement levels (see Table 6.14). The influence of standardized testing is also evident, with teachers in anywhere from half to almost three-fourths of science and mathematics classes supplementing for test preparation purposes. Finally, in 36–58 percent of classes, depending on subject and grade level, teachers supplement their published text because their pacing guide indicates that they should. This finding both speaks to the prevalence of pacing guides and suggests that supplementing is commonly prescribed by schools/districts.

Table 6.14
Reasons Why the Textbook Is Supplemented, by Grade Range

	Percent of Classes[†]					
	Elementary		Middle		High	
Science Classes						
Supplemental activities were needed to provide students with additional practice	86	(2.1)	94	(2.4)	93	(1.6)
Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity	93	(1.6)	96	(1.2)	92	(1.4)
Supplemental activities were needed to prepare students for standardized tests	49	(4.1)	63	(5.4)	53	(3.3)
Your pacing guide indicated that you should use supplemental activities	58	(3.2)	49	(4.6)	37	(2.5)
Mathematics Classes						
Supplemental activities were needed to provide students with additional practice	95	(1.5)	96	(1.1)	94	(1.3)
Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity	96	(1.0)	97	(1.0)	91	(1.7)
Supplemental activities were needed to prepare students for standardized tests	65	(2.7)	72	(4.4)	55	(2.6)
Your pacing guide indicated that you should use supplemental activities	49	(3.1)	40	(4.2)	36	(2.1)

† Only classes using published textbooks/programs in the most recent unit and whose teachers reported supplementing with additional activities were included in these analyses.

Facilities and Equipment

Teachers were presented with a list of instructional technologies and asked about their availability in the randomly selected class. The three response options were:

- Do not have one per group available;
- At least one per group available upon request or in another room; and
- At least one per group located in your classroom.

The percentages of science classes with at least some availability (either in the classroom, upon request, or in another room) are shown in Table 6.15. Internet access is particularly widespread, regardless of grade range. Personal computers are also widely available. Other, more science-specific resources, seem to follow predictable patterns of availability. For example, microscopes and probes for collecting data are more prevalent in middle and high school than in elementary school classrooms, perhaps due to the sophistication of science activities in secondary grades.

Table 6.15
Availability† of Instructional Technologies in Science Classes, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Internet access	84	(1.9)	85	(2.4)	86	(1.3)
Microscopes	48	(3.2)	82	(1.9)	81	(1.9)
Personal computers, including laptops	69	(2.4)	75	(2.9)	79	(1.6)
Non-graphing calculators	69	(2.9)	83	(2.3)	77	(2.1)
Probes for collecting data (e.g., motion sensors, temperature probes)	32	(3.1)	43	(2.9)	64	(2.5)
Classroom response system or "Clickers" (handheld devices used to respond electronically to questions in class)	41	(3.8)	46	(2.7)	47	(2.3)
Graphing calculators	9	(2.3)	30	(2.9)	44	(2.3)
Hand-held computers (e.g., PDAs, tablets, smartphones, iPads)	20	(2.3)	19	(2.2)	20	(1.5)

† Includes only those rating the availability as at least one per group available, either in the classroom, upon request, or in another room.

Interestingly, the availability of some resources depends on the achievement level of students in the class. For example, as shown in Table 6.16, calculators, probes for collecting data, and microscopes are much more likely to be available in classes with mostly high-achieving students than in classes with mostly low-achieving students.

Table 6.16
Availability† of Instructional Technologies in Science Classes, by Prior Achievement Level of Students

	Percent of Classes					
	Mostly High Achievers		Average/Mixed Achievers		Mostly Low Achievers	
Graphing calculators	39	(3.6)	23	(1.5)	18	(3.3)
Non-graphing calculators	79	(3.3)	77	(1.6)	61	(6.0)
Probes for collecitng data	58	(4.7)	43	(2.1)	34	(4.4)
Microscopes	82	(3.0)	63	(2.0)	59	(5.1)

† Availability defined as having at least one instructional technology per small group (4–5 students).

In mathematics, it is not surprising that more sophisticated calculators are more widely available in secondary classes than in elementary classes. For example, the availability of graphing calculators ranges from 11 percent of elementary classes to 83 percent of high school classes (see Table 6.17).

Table 6.17
Availability† of Instructional Technologies in Mathematics Classes, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Graphing calculators	11	(1.9)	50	(2.9)	83	(1.7)
Scientific calculators	16	(2.2)	69	(2.7)	74	(1.7)
Internet access	80	(1.9)	80	(2.0)	70	(1.9)
Four-function calculators	58	(3.0)	77	(2.0)	61	(1.9)
Personal computers, including laptops	68	(2.5)	68	(2.5)	58	(2.3)
Classroom response system or "Clickers" (handheld devices used to respond electronically to questions in class)	39	(2.6)	53	(3.0)	44	(2.5)
Probes for collecting data (e.g., motion sensors, temperature probes)	19	(2.0)	18	(2.1)	26	(2.2)
Hand-held computers (e.g., PDAs, tablets, smartphones, iPads)	17	(2.2)	21	(2.5)	17	(1.4)

† Includes only those rating the availability as at least one per group available, either in the classroom, upon request, or in another room.

As in science, some resources are not distributed evenly across all mathematics classes. One obvious disparity is associated with the percentage of non-Asian minority students in the class. As can be seen in Table 6.18, calculators and probes for collecting data are much more likely to be available in classes with the lowest percentages of these students, compared to classes with the highest percentages.

Table 6.18
Availability† of Instructional Technologies in Mathematics Classes, by Percent of Non-Asian Minority Students in Class

	Percent of Classes							
	Lowest Quartile		Second Quartile		Third Quartile		Highest Quartile	
Scientific calculators	58	(2.4)	50	(3.5)	43	(3.1)	37	(3.2)
Graphing calculators	53	(2.6)	44	(3.0)	39	(3.2)	34	(3.2)
Probes for collecting data	30	(2.4)	18	(2.2)	20	(3.0)	16	(2.0)

† Availability defined as having at least one instructional technology per small group (4–5 students).

Clearly, not all mathematics classes have access to all types of calculators. It appears that teachers compensate in part by expecting students to provide their own; especially in the case of more sophisticated calculators in high school mathematics classes (see Table 6.19). For example, students in almost 4 out of 10 high school mathematics classes are expected to bring their own scientific calculator.

Table 6.19
Expectations that Students will Provide their Own Instructional Technologies, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Science Classes						
Graphing/Other calculators	4	(1.0)	27	(2.6)	55	(2.2)
Laptop computers	2	(0.8)	2	(0.9)	8	(1.1)
Hand-held computers	1	(0.7)	3	(1.3)	7	(1.0)
Mathematics Classes						
Scientific calculators	3	(0.8)	22	(2.2)	38	(2.0)
Graphing calculators	3	(0.7)	8	(1.9)	30	(2.0)
Four-function calculators	5	(1.3)	23	(2.4)	23	(1.8)
Laptop computers	3	(0.9)	4	(0.9)	7	(1.1)
Hand-held computers	3	(0.8)	3	(0.9)	6	(0.9)

The 2012 National Survey also asked science and mathematics program representatives how much money their schools spent during the most recently completed year on three kinds of resources: equipment (excluding computers), consumable supplies (e.g., chemicals, graph paper), and software specific to science and mathematics instruction. By dividing these amounts by school enrollment, per-pupil estimates were generated (see Table 6.20). In science, per-pupil spending on equipment and supplies increases sharply with grade range, as does overall per-pupil spending. In mathematics, per-pupil spending is substantially higher in elementary schools than in middle and high schools.

Table 6.20
Median Amount Schools Spend per Pupil on Science and Mathematics Equipment and Consumable Supplies,[†] by Grade Range

	Median Amount					
	Elementary		Middle		High	
Science						
Equipment	$ 0.26	(0.1)[‡]	$ 0.71	(0.2)	$ 2.06	(0.3)
Consumable Supplies	$ 0.95	(0.1)	$ 1.45	(0.1)	$ 3.44	(0.2)
Total[§]	$ 1.55	(0.3)	$ 3.13	(0.4)	$ 6.11	(0.7)
Mathematics						
Equipment	$ 0.95	(0.2)	$ 0.73	(0.1)	$ 1.05	(0.2)
Consumable Supplies	$ 1.08	(0.2)	$ 0.64	(0.1)	$ 0.61	(0.1)
Total[§]	$ 4.27	(0.7)	$ 2.76	(0.4)	$ 2.46	(0.4)

† The survey asked about spending on software in addition to equipment and supplies. The median per pupil spending on software in each subject/grade-range combination is $0.00.
‡ Standard errors for medians are typically computed in Wesvar 5.1 using the Woodruff method. Wesvar was unable to compute a standard error for this estimate using this method; thus, the potentially less-consistent replication standard error is reported.
§ Includes spending on software.

Expenditures for science and mathematics are not distributed equally across all schools. For example, rural schools spend more per pupil than suburban and urban schools on science and mathematics resources (see Tables 6.21 and 6.22). Per-pupil expenditures on science and mathematics equipment do not vary widely by the percentage of students in the school who are eligible for free/reduced-price lunch. And although there appears to be some variation in spending on supplies by percentage of students eligible for free/reduced-price lunch, there is no clear pattern.

Table 6.21
Median Amount Schools Spend per Pupil on Science Equipment and Consumable Supplies, by Equity Factors

	Median Amount					
	Equipment		Consumable Supplies		Total†	
Percent of Students in School Eligible for FRL						
Lowest Quartile	$ 0.63	(0.2)	$ 1.67	(0.5)	$ 3.56	(0.8)
Second Quartile	$ 0.27	(0.1)‡	$ 0.98	(0.3)	$ 1.85	(0.5)
Third Quartile	$ 0.57	(0.2)	$ 1.17	(0.2)	$ 2.47	(0.6)
Highest Quartile	$ 0.35	(0.4)‡	$ 0.65	(0.1)	$ 1.54	(0.5)
School Size						
Smallest Schools	$ 0.78	(0.2)	$ 1.95	(0.4)	$ 3.94	(0.5)
Second Group	$ 0.30	(0.1)‡	$ 1.08	(0.2)	$ 1.96	(0.4)
Third Group	$ 0.40	(0.1)	$ 0.95	(0.2)	$ 1.82	(0.4)
Largest Schools	$ 0.44	(0.1)	$ 0.79	(0.2)	$ 2.04	(0.4)
Community Type						
Rural	$ 0.81	(0.2)	$ 1.63	(0.3)	$ 3.78	(0.4)
Suburban	$ 0.39	(0.1)	$ 1.40	(0.2)	$ 2.49	(0.3)
Urban	$ 0.34	(0.2)	$ 0.98	(0.2)	$ 1.91	(0.7)
Region						
Midwest	$ 0.55	(0.2)	$ 1.80	(0.5)	$ 3.18	(0.7)
Northeast	$ 1.34	(0.3)	$ 1.99	(0.5)	$ 4.15	(1.0)
South	$ 0.56	(0.1)	$ 0.92	(0.1)	$ 2.42	(0.4)
West	$ 0.14	(0.3)‡	$ 0.99	(0.2)	$ 1.45	(0.5)

† The “Total” column includes spending on software.

‡ Standard errors for medians are typically computed in Wesvar 5.1 using the Woodruff method. Wesvar was unable to compute a standard error for this estimate using this method; thus, the potentially less-consistent replication standard error is reported.

Table 6.22
Median Amount Schools Spend per Pupil on Mathematics Equipment and Consumable Supplies, by Equity Factors

	Median Amount		
	Equipment	Consumable Supplies	Total†
Percent of Students in School Eligible for FRL			
Lowest Quartile	$ 0.93 (0.2)	$ 1.06 (0.3)	$ 3.60 (0.8)
Second Quartile	$ 0.82 (0.2)	$ 0.66 (0.1)	$ 2.75 (0.4)
Third Quartile	$ 1.02 (0.2)	$ 0.99 (0.2)	$ 3.69 (0.6)
Highest Quartile	$ 0.92 (0.1)	$ 0.65 (0.2)	$ 3.37 (1.0)
School Size			
Smallest Schools	$ 1.11 (0.2)	$ 0.86 (0.2)	$ 3.93 (0.8)
Second Group	$ 0.82 (0.2)	$ 0.68 (0.2)	$ 3.44 (0.5)
Third Group	$ 0.66 (0.1)	$ 0.92 (0.2)	$ 2.75 (0.4)
Largest Schools	$ 0.68 (0.2)	$ 0.61 (0.1)	$ 2.06 (0.5)
Community Type			
Rural	$ 1.29 (0.3)	$ 1.01 (0.2)	$ 4.58 (0.7)
Suburban	$ 0.81 (0.1)	$ 0.89 (0.1)	$ 2.98 (0.5)
Urban	$ 0.58 (0.1)	$ 0.49 (0.1)	$ 2.45 (0.5)
Region			
Midwest	$ 0.72 (0.2)	$ 0.70 (0.2)	$ 3.25 (0.6)
Northeast	$ 2.22 (0.5)	$ 1.11 (0.4)	$ 5.18 (1.4)
South	$ 0.89 (0.2)	$ 0.64 (0.1)	$ 2.93 (0.5)
West	$ 0.72 (0.2)	$ 0.91 (0.2)	$ 2.19 (0.7)

† The “Total” column includes spending on software.

Expenditures for science instruction seem to be reflected in teachers’ ratings of the adequacy of resources they have on hand. As shown in Table 6.23, teachers of high school science classes were much more likely than teachers of elementary school science classes to rate their facilities, equipment, consumable supplies, and instructional technology as mostly adequate (4 or 5 on a 5-point scale from 1 “not adequate” to 5 “adequate”). In elementary schools, teachers of about two-thirds of science classes rated their resources as somewhat adequate or less.

Table 6.23
Science Classes with Adequate† Resources for Instruction, by Grade Range

	Percent of Classes		
	Elementary	Middle	High
Facilities (e.g., lab tables, electric outlets, faucets and sinks)	31 (2.6)	57 (3.0)	71 (1.7)
Equipment (e.g., microscopes, beakers, photogate timers, Bunsen burners)	37 (2.5)	47 (2.8)	60 (1.8)
Consumable supplies (e.g., chemicals, living organisms, batteries)	34 (2.7)	39 (2.5)	59 (1.9)
Instructional technology (e.g., calculators, computers, probes/sensors)	34 (2.5)	37 (2.7)	48 (2.2)

† Includes those responding 4 or 5 on a 5-point scale ranging from 1 “not adequate” to 5 “adequate.”

In mathematics classes, a key finding is that teachers in 4 out of 5 elementary mathematics classes rated their manipulatives as mostly adequate, but the percentages in middle and high school mathematics classes are substantially lower (see Table 6.24). These data suggest that substantial proportions of secondary mathematics teachers want to use manipulative materials but do not have adequate access to them. Note also that with the exception of manipulatives in elementary grades, there is substantial room for improvement in teachers’ views of the adequacy of their resources.

Table 6.24
Mathematics Classes with Adequate† Resources for Instruction, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Measurement tools (e.g., protractors, rulers)	67	(1.9)	70	(2.1)	70	(1.4)
Instructional technology (e.g., calculators, computers, probes/sensors)	50	(2.1)	62	(2.2)	69	(1.7)
Consumable supplies (e.g., graphing paper, batteries)	57	(1.8)	62	(2.3)	66	(1.7)
Manipulatives (e.g., pattern blocks, algebra tiles)	82	(1.8)	58	(2.1)	43	(1.7)

† Includes those responding 4 or 5 on a 5-point scale ranging from 1 "not adequate" to 5 "adequate."

A composite variable named "Adequacy of Resources for Instruction" was created from these items. As shown in Table 6.25, perceptions of the adequacy of resources vary substantially by content area in elementary and middle school classrooms but are essentially the same in high school classrooms. This summary view echoes other findings reported in this section, suggesting that science instruction in the earlier grades is underresourced from the teachers' point of view.

Table 6.25
Class Mean Scores on the
Adequacy of Resources for Instruction Composite, by Grade Range

	Mean Score			
	Science		Mathematics	
Elementary School	49	(1.4)	70	(0.9)
Middle School	57	(1.4)	71	(1.0)
High School	68	(0.9)	70	(0.8)

Mathematics teachers' views of the adequacy of their resources do not tend to differ substantially by various equity factors. In science, teachers of classes with mostly high-achieving students have the most positive views about their resources, compared to classes with average/mixed achievers and those with mostly low-achieving students (see Table 6.26). Similarly, teachers of classes with the lowest percentage of non-Asian minority students have more positive views than those with the highest percentage, as do teachers of classes with the lowest percentage of free/reduced-price lunch students, compared to those with higher percentages.

Table 6.26
Class Mean Scores on the Adequacy of
Resources for Instruction Composite, by Equity Factors

	Mean Score	
	Science	**Mathematics**
Prior Achievement Level of Class		
Mostly High Achievers	69 (1.6)	74 (0.9)
Average/Mixed Achievers	56 (0.9)	70 (0.7)
Mostly Low Achievers	47 (2.4)	68 (1.4)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	60 (1.5)	73 (0.9)
Second Quartile	59 (1.5)	71 (1.1)
Third Quartile	58 (1.3)	70 (1.0)
Highest Quartile	50 (1.7)	69 (1.3)
Percent of Students in School Eligible for FRL		
Lowest Quartile	64 (1.7)	73 (1.3)
Second Quartile	55 (1.4)	71 (1.0)
Third Quartile	54 (1.5)	69 (1.1)
Highest Quartile	50 (1.7)	68 (1.4)

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 2012. Science classes are more likely than mathematics classes to use multiple textbooks (or programs or modules), especially at the elementary level. Across both science and mathematics, the same three publishers dominate, accounting for at least 75 percent of the market at each level. Science classes are more likely than mathematics classes to use older textbooks. For example, 58 percent of elementary science classes that use a textbook have one published before 2007, compared to 30 percent of elementary mathematics classes. Interestingly, more than 70 percent of teachers in both subjects rate their textbooks as good or better.

Textbooks appear to exert substantial influence on instruction, from the amount of class time spent using the textbook (especially in mathematics) to the ways teachers use them to plan for and organize instruction. At the same time, it is clear that teachers deviate from their published materials substantially, both skipping parts of the text (most often because teachers know of something better) and supplementing with other materials (most often to provide additional practice or to differentiate instruction).

The availability of instructional equipment follows somewhat predictable patterns in both subjects. More sophisticated technologies (e.g., microscopes, graphing calculators) are more likely to be present in high schools than elementary schools. However, across classes, these resources are sometimes not distributed equitably. In science for example, classes composed of mostly high-achieving students are more likely than those composed of mixed or low-achieving students to have access to microscopes and graphing calculators.

The amount of money schools report spending on instructional resources seems quite inadequate, especially viewed as a per-pupil expenditure. In science, the problem is especially pronounced in elementary grades, where median per-pupil spending is half of that spent in middle schools and less than one-third of spending in high schools. The lack of spending is related to the finding that elementary science teachers are less likely than their middle school and high school counterparts to view their resources as adequate. There is no such disparity by grade level in mathematics.

An analysis of spending by school poverty suggests no major differences; however, urban and suburban schools tend to spend less per pupil than rural ones on science and mathematics equipment and supplies. This disparity is almost certainly related to school size, as small schools spend substantially more per pupil than large schools.

CHAPTER SEVEN

Factors Affecting Instruction

Overview

Students' opportunities to learn science and mathematics are affected by a myriad of factors, including teacher preparedness, school and district policies and practices, and administrator and community support. Although the primary focus of the 2012 National Survey of Science and Mathematics Education was on teachers and teaching, the study also collected information on the context of classroom practice. Among the data collected were the extent of use of various programs and practices in the school, the extent of influence of state 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.

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. These individuals were also asked about several instructional arrangements for students in self-contained classrooms—whether they were pulled out 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. Table 7.1 shows the percentage of elementary schools indicating that each program or practice is in place.

The use of science specialists, either in place of or in addition to the regular classroom teacher, is uncommon (10–16 percent of schools). Pull-out instruction, whether for remediation or enrichment, is also quite rare (7–10 percent of schools). The picture is quite different in elementary school mathematics instruction. Students are pulled out for remediation in almost 60 percent of schools, and in roughly one-third of schools, students are pulled out for enrichment. The prevalence of these practices may be due in part to the fact that mathematics is much more likely than science to be tested for accountability purposes. In addition, Title 1 funds are more likely to be targeted for remediation in mathematics and reading than in science.

Table 7.1
Use of Various Instructional Arrangements in Elementary Schools, by Subject

	Percent of Schools			
	Science		Mathematics	
Students in self-contained classes pulled out from science/mathematics instruction for additional instruction in other content areas	22	(2.3)	19	(2.6)
Students in self-contained classes receive science instruction from a science/mathematics specialist *in addition* to their regular teacher	16	(2.4)	26	(2.6)
Students in self-contained classes receive science instruction from a science/mathematics specialist *instead of* their regular teacher	10	(1.9)	10	(1.9)
Students in self-contained classes pulled out for enrichment in science/mathematics	10	(1.8)	31	(2.8)
Students in self-contained classes pulled out for remedial instruction in science/mathematics	7	(1.5)	58	(3.0)

Each high school science and mathematics program representative was asked how many years of the subject students were required to take in order to graduate. As shown in Table 7.2, the vast majority of schools require at least three years of science and mathematics; almost half require four years of mathematics. For most schools, graduation requirements are just as demanding as state university entrance requirements.[8] However, when there is a difference, graduation requirements tend to be more rigorous; 30 percent of schools require more science and mathematics courses for graduation than state universities do for entrance.

Table 7.2
High School Graduation vs.
State University Entrance Requirements, by Subject

	Percent of High Schools			
	Science		Mathematics	
Graduation Requirement				
1 Year	1	(1.0)	0	---†
2 Years	14	(1.6)	5	(1.0)
3 Years	64	(2.5)	50	(3.0)
4 Years	21	(2.4)	45	(3.0)
State University Entrance Requirement				
1 Year	0	---†	0	---†
2 Years	23	(1.4)	0	---†
3 Years	73	(2.2)	72	(2.3)
4 Years	4	(2.1)	28	(2.3)
Difference				
2 Years Fewer Required for Graduation	2	(1.2)	1	(0.7)
1 Year Fewer Required for Graduation	9	(2.0)	15	(2.2)
No Difference	59	(3.3)	53	(2.5)
1 Year More Required for Graduation	24	(2.9)	30	(2.4)
2 Years More Required for Graduation	6	(0.8)	0	---†

† No schools in the sample were in this category; thus, it is not possible to compute a standard error.

8 State (public) university entrance requirements were mined from the Internet. When state university systems included multiple tiers, the lowest 4-year university tier requirements were used.

The study asked schools whether they had implemented block scheduling. The rationale for block scheduling is largely two-fold. First, the schedule affords longer class periods, which can be especially important in science, where a 50-minute class constrains the kinds of laboratory activities that can be conducted. Second, students can take eight classes per year instead of six or seven. As shown in Table 7.3, approximately one-third of all middle and high schools use block scheduling.

Table 7.3
Prevalence of Block Scheduling

	Percent of Schools
Middle Schools	31 (3.4)
High Schools	34 (3.1)

Finally, science and mathematics program representatives were asked to indicate which of several practices their school included to enhance student interest and/or achievement. The results are shown in Tables 7.4 and 7.5. Especially in science, such programs tend to be more prevalent as grade range increases. For example, almost half of high schools have science clubs, compared to 20 percent of elementary schools. Similarly, 40 percent of high schools have one or more teams participating in science competitions, whereas only 13 percent of elementary schools do. In mathematics, the percentage of schools offering school-based programs to enhance interest and achievement (apart from tutoring) is strikingly low. For example, only one-third of high schools have mathematics clubs, and less than a fourth of all schools offer after-school enrichment in mathematics.

Table 7.4
School Programs/Practices to Enhance Students' Interest and/or Achievement in Science/Engineering, by Grade Range

	Percent of Schools		
	Elementary	Middle	High
Offers after-school help in science and/or engineering (e.g., tutoring)	31 (2.7)	53 (3.6)	81 (2.9)
Encourages students to participate in science and/or engineering summer programs or camps offered by community colleges, universities, museums, or science centers	50 (3.5)	63 (3.6)	75 (3.5)
Sponsors visits to business, industry, and/or research sites related to science and/or engineering	30 (2.7)	35 (3.4)	48 (3.6)
Offers one or more science clubs	20 (2.6)	29 (3.0)	47 (3.4)
Participates in a local or regional science and/or engineering fair	35 (3.0)	39 (3.3)	46 (3.2)
Has one or more teams participating in science competitions (e.g., Science Olympiad)	13 (2.0)	22 (2.2)	40 (3.4)
Has one or more teams participating in engineering competitions (e.g., Robotics)	11 (1.9)	19 (2.4)	33 (2.4)
Offers formal after-school programs for enrichment in science and/or engineering	17 (2.5)	24 (2.7)	29 (3.1)
Sponsors meetings with adult mentors who work in science and/or engineering fields	16 (2.4)	24 (3.0)	28 (2.6)
Offers one or more engineering clubs	7 (2.0)	13 (2.5)	21 (2.0)
Holds family science and/or engineering nights	26 (2.8)	23 (3.0)	16 (2.9)

Table 7.5
School Programs/Practices to Enhance Students' Interest and/or Achievement in Mathematics, by Grade Range

	Percent of Schools					
	Elementary		Middle		High	
Offers after-school help in mathematics (e.g., tutoring)	67	(2.4)	80	(2.8)	92	(2.7)
Encourages students to participate in mathematics summer programs or camps offered by community colleges, universities, museums or mathematics centers	44	(2.7)	51	(2.8)	55	(3.6)
Has one or more teams participating in mathematics competitions (e.g., Math Counts)	24	(2.4)	35	(2.7)	43	(3.6)
Offers one or more mathematics clubs	15	(2.0)	23	(2.0)	32	(2.7)
Offers formal after-school programs for enrichment in mathematics	18	(2.0)	24	(2.5)	21	(2.9)
Participates in a local or regional mathematics fair	13	(2.2)	17	(2.6)	21	(3.4)
Sponsors visits to business, industry, and/or research sites related to mathematics	15	(2.3)	15	(2.2)	17	(2.8)
Holds family math nights	31	(2.6)	19	(2.3)	10	(2.8)
Sponsors meetings with adult mentors who work in mathematics fields	10	(1.7)	9	(1.6)	10	(1.5)

Interestingly, these programs are not distributed equally across all types of schools. Some differences are particularly evident by size of school. For example, 37 percent of the largest schools hold family science nights compared to only 16 percent of the smallest schools (see Table 7.6). A similarly large gap exists for the prevalence of family math nights (see Table 7.7). Disparities are also evident for enrichment programs, discipline-specific clubs, participation in competitions, and participation in science fairs.

Table 7.6
School Programs/Practices to Enhance Students' Interest in Science/Engineering, by School Size†

	Percent of Schools							
	Smallest Schools		Second Group		Third Group		Largest Schools	
Encourage students to participate in summer programs/camps	58	(4.0)	59	(4.2)	54	(4.2)	65	(4.3)
Participation in local or regional science fair	28	(3.5)	43	(3.8)	45	(3.7)	54	(4.2)
After-school help	45	(3.8)	47	(3.7)	39	(3.4)	51	(4.0)
Science clubs	21	(3.0)	32	(3.3)	42	(3.8)	38	(4.0)
Family nights	16	(2.8)	23	(3.9)	29	(4.2)	37	(4.2)
Sponsor visits to business, industry, and/or research sites	34	(3.3)	31	(3.4)	34	(3.8)	36	(3.8)
After-school programs for enrichment	19	(2.9)	20	(2.9)	26	(2.7)	32	(4.1)
Participation in science competitions	18	(2.4)	19	(2.4)	27	(3.0)	29	(3.2)
Participation in engineering competitions	14	(2.4)	20	(2.8)	20	(2.5)	27	(2.9)
Sponsor meetings with mentors who work in science and/or engineering fields	17	(3.1)	23	(3.3)	19	(2.8)	21	(3.4)
Engineering clubs	10	(2.5)	10	(1.9)	16	(2.1)	19	(2.7)

† See Appendix E for a definition of the school size categories.

Table 7.7
School Programs/Practices to Enhance
Students' Interest in Mathematics, by School Size†

	Percent of Schools							
	Smallest Schools		Second Group		Third Group		Largest Schools	
After-school help	69	(3.4)	79	(3.8)	76	(3.6)	83	(3.1)
Encourage students to participate in summer programs/camps	46	(4.1)	47	(3.6)	48	(3.9)	50	(4.4)
Family nights	15	(2.8)	28	(3.8)	32	(4.0)	43	(4.3)
Participation in mathematics competitions	26	(3.3)	34	(4.1)	37	(3.6)	39	(4.3)
After-school programs for enrichment	16	(2.4)	25	(3.5)	22	(3.1)	32	(3.5)
Mathematics clubs	12	(1.7)	30	(3.9)	26	(3.0)	32	(3.3)
Participation in local or regional mathematics fair	11	(2.7)	16	(3.6)	18	(2.6)	18	(2.8)
Meetings with mentors who work in mathematics fields	10	(2.5)	10	(2.0)	8	(2.4)	14	(3.1)
Sponsors visits to business, industry, and/or research sites	19	(3.7)	12	(2.1)	10	(2.1)	13	(2.7)

† See Appendix E for a definition of the school size categories.

Extent of Influence of State Standards

School science and mathematics program representatives were given a series of statements about the influence of state standards in their school and district, and asked about the extent to which they agreed with each. A summary of responses is shown in Tables 7.8 and 7.9. It seems clear that state standards have a major influence at the school level. For example, 80 percent or more of program representatives agree that there is a school-wide effort to align instruction with the standards and that most teachers in the school teach to those standards. Similarly, the vast majority of representatives agree that the standards have been discussed by teachers in the school. It is somewhat surprising that in science, only about half of schools are in districts that organize professional development based on the standards. The proportion is somewhat higher for mathematics (66–70 percent depending on grade level), but still raises the question of how work to align instruction with standards is being done, if not in professional development.

Table 7.8
Respondents Agreeing† with Various Statements
Regarding State Science Standards, by School Type

	Percent of Schools					
	Elementary		Middle		High	
State science standards have been thoroughly discussed by science teachers in this school	69	(2.7)	77	(3.0)	83	(2.9)
There is a school-wide effort to align science instruction with the state science standards	80	(2.3)	83	(2.4)	82	(3.1)
Most science teachers in this school teach to the state standards	83	(2.6)	86	(2.5)	81	(3.8)
Your district/diocese organizes science professional development based on state standards	56	(2.7)	52	(3.0)	54	(2.4)

† Includes respondents indicating "strongly agree" or "agree" on a 5-point scale ranging from 1 "strongly disagree" to 5 "strongly agree."

Table 7.9
Respondents Agreeing† with Various Statements
Regarding State Mathematics Standards, by School Type

	Percent of Schools		
	Elementary	**Middle**	**High**
There is a school-wide effort to align mathematics instruction with the state mathematics standards	91 (2.1)	91 (2.6)	85 (3.2)
Most mathematics teachers in this school teach to the state standards	91 (1.8)	90 (2.3)	84 (3.3)
State mathematics standards have been thoroughly discussed by mathematics teachers in this school	85 (2.4)	86 (2.7)	83 (2.7)
Your district/diocese organizes mathematics professional development based on state standards	70 (3.1)	66 (3.4)	66 (2.9)

† Includes respondents indicating "strongly agree" or "agree" on a 5-point scale ranging from 1 "strongly disagree" to 5 "strongly agree."

By combining these items in a composite variable, an overview of the influence of standards is possible. As can be seen in Table 7.10, attention to standards is generally greater in mathematics than in science. The greater weight given to mathematics in school accountability probably contributes to the attention mathematics standards receive.

Table 7.10
School Mean Scores on the Focus on State Standards Composite

	Percent of Classes	
	Science	**Mathematics**
Elementary School	69 (1.1)	80 (1.3)
Middle School	72 (1.3)	79 (1.6)
High School	74 (1.4)	77 (1.7)

Factors That Promote and Inhibit 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 the influence of each. Results for individual science items are presented in Table 7.11 and those for mathematics in Table 7.12. As there is little variation by grade range, the results are presented for schools overall.[9]

Four factors are perceived by a majority of schools as promoting effective science instruction:

- Importance that the school places on science;
- District/Diocese science professional development policies and practices;
- Public attitudes toward science instruction; and

[9] Results are presented by grade range in the forthcoming *The 2012 National Survey of Science and Mathematics Education: Compendium of Tables* report.

- How science instructional resources are managed (e.g., distributing and refurbishing materials).

In addition, less than a fourth of schools see these as inhibiting science instruction. In contrast, time for professional development is seen as inhibiting effective science instruction in almost one-third of schools.

Table 7.11
Effect† of Various Factors on Science Instruction

	Percent of Schools					
	Inhibits		Neutral		Promotes	
Importance that the school places on science	18	(1.9)	21	(1.6)	60	(2.1)
District/Diocese science professional development policies and practices	14	(1.4)	35	(2.4)	52	(2.5)
Public attitudes toward science instruction	11	(1.7)	36	(2.3)	53	(2.5)
How science instructional resources are managed (e.g., distributing and refurbishing materials)	22	(2.0)	26	(2.2)	53	(2.5)
Time provided for teacher professional development in science	29	(2.2)	27	(1.9)	44	(2.3)
Conflict between efforts to improve science instruction and other school/district/diocese initiatives	32	(2.2)	41	(2.5)	27	(2.5)

† Respondents rated the effect of each factor on a 5-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction." The "Inhibits" column includes those responding 1 or 2. The "Promotes" column includes those responding 4 or 5.

The climate for mathematics instruction seems generally more supportive than that for science. For example, 82 percent of schools indicate that the importance the school places on the subject promotes effective mathematics instruction, compared to 60 percent for science. Similarly, professional development policies and practices, as well as time provided for professional development, are more likely to be viewed as promoting effective mathematics instruction.

Table 7.12
Effect† of Various Factors on Mathematics Instruction

	Percent of Schools					
	Inhibits		Neutral		Promotes	
Importance that the school places on mathematics	8	(1.2)	11	(1.5)	82	(1.8)
Equipment and supplies and/or manipulatives for teaching mathematics (for example: materials for students to draw, cut and build in order to make sense of problems)	13	(1.7)	19	(1.6)	69	(1.9)
District/Diocese mathematics professional development policies and practices	8	(1.4)	26	(1.9)	65	(2.1)
Public attitudes toward mathematics instruction	13	(1.5)	30	(2.1)	58	(2.3)
Time provided for teacher professional development in mathematics	20	(1.8)	23	(1.9)	56	(2.0)
Conflict between efforts to improve mathematics instruction and other school/district/diocese initiatives	23	(1.8)	39	(2.0)	37	(2.4)

† Respondents rated the effect of each factor on a 5-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction." The "Inhibits" column includes those responding 1 or 2. The "Promotes" column includes those responding 4 or 5.

Program representatives were also asked to rate each of several factors as either not a significant problem, somewhat of a problem, or a serious problem for instruction. In science, resource-related issues are most often cited as serious problems (see Table 7.13). Inadequate funds for purchasing equipment and supplies is perceived as a serious problem by 28–32 percent of the schools, lack of science facilities by 19–30 percent, and inadequate materials for individualized instruction by 17–21 percent. In the elementary grades, insufficient time to teach science is seen as a serious problem by 27 percent of schools, compared to 17 percent of middle schools and 10 percent of high schools. Inadequate science-related professional development opportunities are also more likely to be seen as a serious problem in elementary schools (23 percent) than in high schools (14 percent).

Table 7.13
Science Program Representatives Viewing Each of a Number of Factors as a Serious Problem for Science Instruction in Their School, by Grade Range

	Percent of Schools					
	Elementary		Middle		High	
Inadequate funds for purchasing science equipment and supplies	30	(3.0)	32	(3.4)	28	(3.9)
Lack of science facilities (e.g., lab tables, electric outlets, faucets and sinks in classrooms)	27	(3.3)	30	(4.0)	19	(4.3)
Low student reading abilities	16	(2.2)	19	(2.5)	19	(2.0)
Inadequate materials for individualizing science instruction	21	(2.6)	20	(3.0)	17	(3.1)
Large class sizes	13	(2.0)	15	(1.9)	16	(1.9)
Inadequate science-related professional development opportunities	23	(2.3)	20	(2.6)	14	(2.1)
Lack of opportunities for science teachers to share ideas	20	(2.5)	16	(2.5)	13	(2.3)
Inadequate supply of science textbooks/modules	14	(2.0)	13	(2.3)	13	(1.6)
High student absenteeism	8	(1.7)	13	(2.3)	13	(1.7)
Low student interest in science	5	(1.4)	11	(1.9)	13	(1.5)
Interruptions for announcements, assemblies, and other school activities	8	(1.5)	10	(1.6)	11	(1.6)
Insufficient time to teach science	27	(2.6)	17	(2.4)	10	(1.7)
Lack of parental support for science education	10	(1.8)	14	(2.2)	9	(1.3)
Inappropriate student behavior	9	(1.6)	15	(2.1)	8	(1.4)
Inadequate teacher preparation to teach science	11	(1.8)	9	(2.1)	3	(0.9)
Community resistance to the teaching of "controversial" issues in science (e.g., evolution, climate change)	3	(1.2)	6	(1.8)	2	(0.5)
Lack of teacher interest in science	4	(1.0)	3	(1.0)	2	(0.9)

In mathematics, only two factors are seen as a serious problem in a substantial proportion of schools: low student interest in the subject and low student reading abilities. Lack of student interest is more likely to be seen as a serious problem in middle and high schools than in elementary schools.

Table 7.14
Mathematics Program Representatives Viewing Each of a Number of Factors as a Serious Problem for Mathematics Instruction in Their School, by Grade Range

	Percent of Schools		
	Elementary	Middle	High
Low student interest in mathematics	14 (2.0)	25 (2.1)	30 (2.7)
Low student reading abilities	22 (1.8)	24 (2.1)	20 (2.3)
Inadequate funds for purchasing mathematics equipment and supplies	12 (2.1)	18 (2.7)	16 (3.3)
High student absenteeism	8 (1.6)	13 (2.1)	16 (1.8)
Lack of parental support for mathematics education	15 (1.9)	17 (2.0)	15 (1.6)
Inadequate mathematics-related professional development opportunities	18 (2.1)	16 (2.8)	15 (2.9)
Inadequate materials for individualizing mathematics instruction	12 (1.8)	16 (2.5)	15 (3.2)
Large class sizes	15 (1.6)	15 (1.7)	13 (1.7)
Inadequate supply of mathematics textbooks/programs	9 (1.9)	13 (2.5)	11 (2.6)
Inappropriate student behavior	10 (1.7)	16 (1.9)	10 (1.3)
Insufficient time to teach mathematics	13 (2.1)	12 (2.4)	10 (2.0)
Lack of opportunities for mathematics teachers to share ideas	15 (2.1)	14 (2.3)	9 (2.5)
Interruptions for announcements, assemblies, and other school activities	7 (1.3)	8 (1.4)	9 (1.5)
Inadequate teacher preparation to teach mathematics	4 (0.9)	3 (0.9)	3 (1.0)
Lack of teacher interest in mathematics	2 (0.7)	1 (0.4)	2 (0.7)

Composite variables created from these items allow for a summary of the factors affecting science and mathematics instruction. One striking difference is the generally more supportive context for elementary mathematics instruction compared to the climate for elementary science instruction (see Table 7.15). The difference is evidenced by the lack of time (for instruction, professional development, and teaching sharing) and lack of materials, as well as the magnitude of problems presented by teacher-related issues. Although some of these disparities exist in the middle grades as well, they tend to narrow considerably in high school. Within science, some differences across grade ranges are apparent, most notably with regard to time and teacher-related issues. Within mathematics, the influence of factors across grade ranges is much more similar.

Table 7.15
School Mean Scores on Factors Affecting Instruction Composites, by Grade Range

	Mean Score		
	Elementary	**Middle**	**High**
Science			
Supportive Context for Science Instruction	61 (1.4)	61 (1.9)	65 (1.6)
Extent to which a Lack of Materials and Supplies is Problematic	42 (1.8)	43 (2.1)	38 (2.4)
Extent to which a Lack of Time for Science is Problematic	46 (1.8)	38 (1.9)	33 (1.6)
Extent to which Student Issues are Problematic	25 (1.4)	31 (1.7)	32 (1.6)
Extent to which Teacher Issues are Problematic	27 (1.7)	17 (2.0)	10 (1.6)
Mathematics			
Supportive Context for Mathematics Instruction	71 (1.4)	70 (1.4)	69 (1.5)
Extent to which a Lack of Materials and Supplies is Problematic	29 (1.8)	34 (2.0)	32 (2.3)
Extent to which a Lack of Time for Mathematics is Problematic	35 (1.8)	34 (2.1)	32 (2.3)
Extent to which Student Issues are Problematic	32 (1.3)	37 (1.5)	38 (1.9)
Extent to which Teacher Issues are Problematic	15 (1.2)	12 (1.2)	8 (1.0)

When disaggregated by various school factors, some differences in composite means emerge (see Tables 7.16 and 7.17). The mean score for the "Extent to Which Student Issues are Problematic" composite, which includes items such as low student interest, high absenteeism, and inappropriate behavior, varies considerably in science by the percentage of students eligible for free/reduced-price lunch (ranging from 17 for the lowest quartile to 44 for the highest) and to a lesser extent by school size (ranging from 26 to 34). Though not as pronounced, gaps related to the same equity factors also exist for the composite variable labeled "Extent to Which Teacher Issues are Problematic," which includes items about the teacher interest in the subject and teacher preparation to teach the subject. Similar disparities exist in mathematics.

Table 7.16
School Mean Scores for Factors Affecting Science Instruction Composites, by Equity Factors

	Mean Score				
	Supportive Context for Science Instruction	**Extent to Which a Lack of Materials and Supplies is Problematic**	**Extent to Which Student Issues are Problematic**	**Extent to Which a Lack of Time for Science is Problematic**	**Extent to Which Teacher Issues are Problematic**
Percent of Students in School Eligible for FRL					
Lowest Quartile	65 (2.0)	36 (3.8)	17 (2.2)	40 (2.4)	16 (2.1)
Second Quartile	56 (2.0)	38 (2.8)	29 (2.0)	46 (2.6)	26 (2.8)
Third Quartile	61 (1.9)	42 (2.3)	35 (1.9)	45 (2.4)	23 (2.2)
Highest Quartile	59 (2.5)	42 (3.2)	44 (2.2)	45 (3.2)	26 (2.8)
School Size					
Smallest Schools	64 (2.1)	41 (2.4)	26 (1.9)	38 (2.4)	14 (2.1)
Second Group	56 (2.1)	40 (2.4)	32 (1.7)	48 (2.7)	27 (2.3)
Third Group	64 (1.8)	36 (2.4)	32 (2.0)	41 (2.1)	24 (2.3)
Largest Schools	62 (1.6)	37 (2.1)	34 (1.9)	48 (2.4)	29 (2.2)

Table 7.17
School Mean Scores for Factors Affecting Mathematics Instruction Composites, by Equity Factors

	Mean Score				
	Supportive Context for Mathematics Instruction	**Extent to Which a Lack of Materials and Supplies is Problematic**	**Extent to Which Student Issues are Problematic**	**Extent to Which a Lack of Time for Mathematics is Problematic**	**Extent to Which Teacher Issues are Problematic**
Percent of Students in School Eligible for FRL					
Lowest Quartile	74 (2.4)	26 (2.9)	20 (2.1)	31 (2.0)	9 (1.2)
Second Quartile	70 (2.0)	31 (2.8)	39 (2.3)	37 (3.1)	15 (2.3)
Third Quartile	70 (1.7)	29 (2.6)	44 (2.2)	35 (2.0)	13 (1.8)
Highest Quartile	68 (1.8)	35 (2.8)	50 (1.8)	37 (2.4)	19 (1.8)
School Size					
Smallest Schools	70 (1.9)	31 (2.6)	33 (2.0)	34 (2.5)	11 (1.6)
Second Group	68 (2.0)	30 (2.3)	39 (2.1)	35 (2.4)	13 (1.6)
Third Group	71 (1.6)	31 (2.2)	41 (1.7)	36 (2.1)	16 (1.9)
Largest Schools	74 (1.7)	27 (2.6)	41 (2.0)	36 (2.8)	18 (2.4)

Teachers were asked about factors that affect instruction in their randomly selected class. Because responses did not vary by grade range in science, combined K–12 results are shown in Table 7.18. In almost three-fourths of science classes, teachers rate principal support as promoting effective science instruction. In addition, in the vast majority of science classes, teachers see their state standards as either promoting (63 percent) or neutral toward (27 percent) science instruction; in only 10 percent of science classes teachers indicate that their state standards inhibit effective instruction. The results for district curriculum frameworks are virtually identical to those for state standards. Factors seen as inhibiting science instruction in 20 percent or more of classes are:

- Time for planning;
- Student reading abilities;
- Time for professional development; and
- Testing/accountability policies (both district and state).

Table 7.18
Effect[†] of Various Factors on
Instruction in the Randomly Selected Science Class

	Percent of Classes					
	Inhibits		Neutral		Promotes	
Principal support	6	(0.7)	21	(1.4)	73	(1.4)
Students' motivation, interest, and effort in science	13	(1.1)	16	(1.1)	71	(1.3)
Current state standards	10	(1.0)	27	(1.2)	63	(1.5)
District/Diocese curriculum frameworks	10	(1.1)	28	(1.6)	62	(1.7)
Time for you to plan, individually and with colleagues	25	(1.7)	17	(1.3)	58	(1.7)
District/Diocese/School pacing guides	14	(1.3)	33	(1.7)	53	(1.7)
Students' reading abilities	26	(1.2)	21	(1.3)	53	(1.5)
Time available for your professional development	23	(1.7)	25	(1.4)	51	(1.6)
Teacher evaluation policies	10	(0.9)	41	(1.8)	49	(1.6)
Parent expectations and involvement	19	(1.4)	33	(1.7)	48	(1.7)
Textbook/module selection policies	19	(1.4)	34	(1.7)	47	(2.0)
Community views on science instruction	13	(1.0)	41	(1.6)	46	(1.7)
District/Diocese testing/accountability policies	21	(1.9)	40	(2.0)	39	(1.8)
State testing/accountability policies	25	(1.6)	39	(1.8)	36	(1.7)

† Respondents rated the effect of each factor on a 5-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction." The "Inhibits" column includes those responding 1 or 2. The "Promotes" column includes those responding 4 or 5.

The results for mathematics vary considerably by grade level. As such, they are presented separately in Tables 7.19 (factors seen as promoting effective instruction, by grade range) and 7.20 (factors seen as inhibiting effective instruction, by grade range). In general, the context for mathematics instruction is more supportive in elementary classes than in middle and high school classes. For example, in 78 percent of elementary classes, teachers see their students' motivation, interest, and effort as promoting effective instruction, compared to 60 percent of middle grades classes and 55 percent of high school classes. Smaller, but still sizeable, gaps exist for parent expectations and involvement, community views on mathematics instruction, and both state and district testing/accountability policies. A similar image emerges when considering factors that inhibit mathematics instruction.

Table 7.19
Factors Seen as Promoting† Effective Instruction
in the Randomly Selected Mathematics Class, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Principal support	82	(1.8)	80	(2.3)	75	(1.9)
District/Diocese curriculum frameworks	76	(2.2)	69	(2.8)	63	(2.0)
District/Diocese/School pacing guides	69	(2.3)	58	(3.1)	63	(2.2)
Time for you to plan, individually and with colleagues	66	(2.3)	67	(3.0)	61	(2.2)
Current state standards	76	(2.5)	71	(3.0)	59	(1.8)
Time available for your professional development	63	(2.3)	57	(2.7)	56	(1.9)
Students' motivation, interest, and effort in mathematics	78	(2.2)	60	(3.2)	55	(2.3)
Teacher evaluation policies	59	(2.5)	56	(2.6)	55	(2.0)
Textbook/program selection policies	58	(2.6)	44	(3.1)	53	(2.0)
Parent expectations and involvement	59	(2.8)	46	(2.9)	46	(2.1)
District/Diocese testing/accountability policies	59	(2.6)	45	(2.9)	46	(2.3)
Students' reading abilities	60	(2.6)	53	(3.4)	44	(2.3)
State testing/accountability policies	52	(2.6)	44	(3.0)	40	(1.9)
Community views on mathematics instruction	48	(2.6)	38	(3.2)	39	(2.2)

† Includes those responding 4 or 5 on a 5-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction."

Table 7.20
Factors Seen as Inhibiting† Effective Instruction
in the Randomly Selected Mathematics Class, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Principal support	5	(1.1)	6	(1.9)	6	(1.0)
District/Diocese curriculum frameworks	7	(1.2)	9	(1.7)	8	(1.1)
District/Diocese/School pacing guides	13	(1.6)	17	(2.3)	10	(1.3)
Time for you to plan, individually and with colleagues	18	(1.8)	17	(2.2)	21	(1.8)
Current state standards	6	(1.1)	8	(1.4)	11	(1.1)
Time available for your professional development	15	(1.7)	17	(2.4)	16	(1.5)
Students' motivation, interest, and effort in mathematics	9	(1.2)	22	(2.1)	26	(2.0)
Teacher evaluation policies	9	(1.5)	11	(1.2)	12	(1.4)
Textbook/program selection policies	14	(1.6)	21	(2.7)	13	(1.4)
Parent expectations and involvement	15	(1.9)	25	(2.5)	25	(1.8)
District/Diocese testing/accountability policies	14	(1.8)	26	(2.4)	18	(1.8)
Students' reading abilities	18	(2.2)	29	(3.3)	27	(2.1)
State testing/accountability policies	19	(1.8)	27	(2.3)	25	(1.9)
Community views on mathematics instruction	11	(1.5)	17	(2.1)	22	(1.9)

† Includes those responding 1 or 2 on a 5-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction."

The teacher survey also included a series of items about technology-related issues. Teachers were asked to indicate how great a problem each posed for instruction in their randomly selected class. As shown in Tables 7.21 and 7.22, these resources are generally not seen as problematic. In science, the age of and access to computers is most likely to be seen as a problem in middle grades classes, compared to elementary and high school classes. Otherwise, few between-grades differences are apparent. In mathematics, age of and access to computers are more likely to be seen as problematic in elementary classes than in high school classes, but the percentages are generally quite low.

Table 7.21
Extent to Which Technology Quality is a Serious Problem for Instruction in the Randomly Selected Science Class, by Grade Range

	Percent of Classes		
	Elementary	Middle	High
Old age of computers	11 (1.7)	25 (3.1)	14 (1.7)
Lack of access to computers	12 (1.5)	21 (2.9)	12 (1.6)
Slow speed of the Internet connection	7 (1.3)	15 (2.7)	12 (1.5)
Lack of availability of technology support	9 (1.4)	14 (2.0)	12 (1.5)
Lack of availability of appropriate computer software	12 (1.8)	15 (2.3)	10 (1.6)
Unreliability of the Internet connection	6 (1.2)	9 (2.0)	10 (1.5)
Lack of access to the Internet	5 (1.1)	11 (2.4)	7 (1.4)

Table 7.22
Extent to Which Technology Quality is a Serious Problem for Instruction in the Randomly Selected Mathematics Class, by Grade Range

	Percent of Classes		
	Elementary	Middle	High
Old age of computers	18 (2.0)	13 (1.9)	9 (1.4)
Lack of access to computers	13 (1.7)	9 (1.5)	8 (1.3)
Slow speed of the Internet connection	10 (1.4)	7 (1.0)	6 (1.2)
Lack of availability of technology support	11 (1.7)	8 (1.4)	8 (1.1)
Lack of availability of appropriate computer software	10 (1.4)	11 (1.6)	11 (1.4)
Unreliability of the Internet connection	6 (1.2)	6 (0.9)	5 (1.0)
Lack of access to the Internet	6 (1.0)	4 (0.9)	3 (0.8)

Composites from these teacher questionnaire items were created to summarize the extent to which various factors support effective science and mathematics instruction. The means for each subject and grade range are shown in Table 7.23. Two patterns are apparent in the results. First, when differences exist between subjects, they tend to show greater support for mathematics instruction. For example, in elementary grades, the extent to which school support and the policy environment promote effective instruction is greater for mathematics than for science. (Interestingly, in high school, the perception of stakeholder support is reversed, with science being higher.) Second, within mathematics, the data suggest that the climate is generally more supportive in elementary classes than in middle and high school classes. Note, for example, the relatively high mean for the Stakeholder variable in elementary grades (a mean score of 71) compared to middle school (61) and high school (59).

Table 7.23
Class Mean Scores on Factors Affecting Instruction Composites, by Grade Range

	Mean Score					
	Elementary		Middle		High	
Science						
Extent to which School Support Promotes Effective Instruction	62	(1.6)	66	(2.5)	65	(1.5)
Extent to which Stakeholders Promote Effective Instruction	69	(1.0)	63	(1.5)	65	(1.1)
Extent to which the Policy Environment Promotes Effective Instruction	65	(1.3)	64	(1.7)	62	(0.9)
Extent to which IT Quality is Problematic for Instruction	21	(1.3)	30	(1.9)	25	(1.3)
Mathematics						
Extent to which School Support Promotes Effective Instruction	71	(1.4)	69	(1.7)	67	(1.1)
Extent to which Stakeholders Promote Effective Instruction	71	(1.3)	61	(1.6)	59	(1.2)
Extent to which the Policy Environment Promotes Effective Instruction	72	(1.2)	65	(1.4)	66	(0.8)
Extent to which IT Quality is Problematic for Instruction	24	(1.2)	21	(1.2)	18	(1.0)

The means for some of these factors vary substantially by equity factors. As shown in Tables 7.24 and 7.25, the mean for the Stakeholder composite is substantially higher when classes are composed of mostly high-achieving students, compared to classes with average/mixed or mostly low-achieving students. There is also a large gap for this variable with regard to poverty; classes in schools with a high percentage of students eligible for free/reduced-price lunch have lower scores than classes in schools with the lowest percentage of these students. In both instances, the data suggest that students already at some disadvantage are in classroom and school settings that are less supportive. Results in mathematics mirror those for science.

Table 7.24
Class Mean Scores on Factors Affecting Science Instruction Composites, by Equity Factors

	Mean Score			
	Extent to Which the Policy Environment Promotes Effective Instruction	**Extent to Which Stakeholders Promote Effective Instruction**	**Extent to Which School Support Promotes Effective Instruction**	**Extent to Which IT Quality is Problematic for Science Instruction**
Prior Achievement Level of Class				
Mostly High Achievers	67 (2.3)	76 (1.6)	70 (2.1)	22 (2.1)
Average/Mixed Achievers	64 (0.7)	66 (0.9)	64 (1.2)	23 (1.0)
Mostly Low Achievers	59 (2.6)	51 (2.0)	57 (4.0)	31 (3.5)
Percent of Non-Asian Minority Students in Class				
Lowest Quartile	61 (2.2)	68 (1.7)	63 (2.3)	22 (1.7)
Second Quartile	65 (1.3)	70 (1.4)	65 (2.7)	24 (1.7)
Third Quartile	64 (1.7)	66 (1.6)	63 (2.0)	22 (1.7)
Highest Quartile	65 (1.3)	60 (1.3)	64 (1.9)	28 (2.2)
Percent of Students in School Eligible for FRL				
Lowest Quartile	66 (1.7)	75 (1.6)	67 (2.1)	25 (1.8)
Second Quartile	62 (1.8)	66 (1.5)	61 (2.3)	23 (1.5)
Third Quartile	64 (2.3)	61 (1.5)	64 (2.6)	23 (1.7)
Highest Quartile	63 (1.4)	58 (1.5)	63 (2.2)	28 (2.4)
School Size				
Smallest Schools	64 (1.8)	66 (1.8)	59 (2.3)	24 (1.9)
Second Group	63 (1.5)	66 (1.5)	65 (1.9)	23 (1.7)
Third Group	66 (1.4)	66 (1.5)	65 (2.9)	23 (1.7)
Largest Schools	62 (1.3)	66 (1.4)	66 (2.0)	27 (2.1)

Table 7.25
Class Mean Scores on Factors
Affecting Mathematics Instruction Composites, by Equity Factors

	Mean Score			
	Extent to Which the Policy Environment Promotes Effective Instruction	**Extent to Which Stakeholders Promote Effective Instruction**	**Extent to Which School Support Promotes Effective Instruction**	**Extent to Which IT Quality is Problematic for Mathematics Instruction**
Prior Achievement Level of Class				
Mostly High Achievers	68 (1.9)	76 (1.7)	72 (1.7)	17 (1.3)
Average/Mixed Achievers	70 (0.8)	66 (1.1)	69 (1.0)	22 (0.9)
Mostly Low Achievers	65 (1.6)	52 (1.6)	68 (2.4)	25 (1.7)
Percent of Non-Asian Minority Students in Class				
Lowest Quartile	71 (1.1)	66 (1.6)	66 (1.9)	20 (1.2)
Second Quartile	69 (1.2)	70 (1.3)	69 (1.5)	19 (1.4)
Third Quartile	68 (1.3)	63 (1.6)	69 (2.1)	22 (1.7)
Highest Quartile	66 (1.6)	61 (1.8)	72 (2.0)	25 (1.4)
Percent of Students in School Eligible for FRL				
Lowest Quartile	70 (1.2)	72 (1.3)	70 (2.1)	19 (1.1)
Second Quartile	69 (1.2)	65 (1.3)	70 (1.6)	23 (1.9)
Third Quartile	69 (1.4)	63 (1.9)	68 (1.9)	23 (1.8)
Highest Quartile	66 (1.8)	57 (2.1)	69 (2.1)	24 (1.4)
School Size				
Smallest Schools	70 (1.4)	63 (1.5)	65 (2.4)	23 (1.4)
Second Group	69 (1.4)	62 (1.6)	68 (1.7)	20 (1.3)
Third Group	69 (1.4)	66 (1.5)	71 (1.7)	21 (1.4)
Largest Schools	66 (1.5)	68 (1.4)	73 (1.3)	24 (1.6)

Summary

The 2012 National Survey data suggest that the use of special instructional arrangements—e.g., subject matter specialists or pull-out instruction for enrichment and/or remediation—is much more prevalent in mathematics than in science, perhaps because of accountability pressures associated with mathematics. The availability of federal funds for mathematics instruction probably also plays a role. In contrast, programs to encourage student interest in mathematics are strikingly uncommon. For example, less than one-third of schools offer mathematics clubs. Such practices are more common in science and tend to increase with grade range. Further, in both subjects, the opportunities are not distributed evenly across types of schools, as they are more likely to occur in large schools than small ones.

In mathematics, the substantial influence of state standards is evident in multiple ways, among them school-wide efforts to discuss and align instruction with standards. And although science standards clearly exert their own influence, there is some evidence that standards play a larger role in mathematics instruction than in science, especially in the elementary grades.

Across the data in this chapter, there is an overall finding that the climate for mathematics instruction is generally more supportive than that for science. For example, in 82 percent of schools, the importance that the school places on mathematics is seen as supporting instruction, compared to only 60 percent of schools for science. Lack of time and materials for science instruction, especially in the elementary grades, is particularly problematic.

APPENDIX A

Sample Design

Sample Design

Design Overview

The sample design for the 2012 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 and 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 2,000 schools and 10,000 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 constructed from the Common Core of Data (CCD) and Private School Survey (PSS) databases—programs of the U.S. Department of Education's National Center for Education Statistics—that include 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.

School Sample

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

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

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.

School Sampling Frame

The sampling frame for the school sample was constructed from the final 2008–09 CCD and 2007–08 PSS public use files. Educational institutions classified as public, private, and Catholic elementary and secondary schools were included. Excluded were Bureau of Indian Affairs schools, Department of Defense schools, schools in Puerto Rico and the territories, alternative schools (e.g., special education, vocational, early childhood centers), ungraded schools, and pre-kindergarten only schools. For all schools in the database, CCD/PSS included information on grade span by indicating the lowest and highest grade offered in the school.

School 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.

Within primary strata, schools were further stratified by Census region (Midwest, Northeast, South, West), school metro status (rural, suburban/town, urban), and school type (public, private), resulting in a total of 72 strata.

School Sample Allocation

The allocation of the total school sample (2,000 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: 1,040 schools;
- Stratum 2: 480 schools; and
- Stratum 3: 480 schools.

School Sample Selection

Prior to sampling, schools were sorted by the first three digits of zip code (ZIP3) and total number of teachers within secondary strata. A serpentine sort was employed to sort schools from smallest to largest within ZIP3, then largest to smallest within the next ZIP3.

Schools were sampled within strata using probability proportional to size (PPS) systematic sampling, with measure of size equal to the total number of FTE teachers (public schools) or the total number of teachers (private schools) in the school. Schools with measure of size less than the 20th percentile for their stratum were assigned the 20^{th} percentile as a measure of size to avoid large weights. In 1.1 percent of the schools, the total number of teachers was imputed using the average pupil-teacher ratio for the cells formed by the cross-classification of stratum (1-72), school locale (see Table A-1 for definition), school type (public, Catholic, non-Catholic religious, other private) and the school's reported enrollment:

Total teachers = Total enrollment / average(pupil-teacher ratio).

Table A-1
Definition of School Locale Code, Based on School Address.

Locale Code	Definition
11	City, Large Territory inside an urbanized area and inside a principal city with pop >= 250,000
12	City, Mid-size Territory inside an urbanized area and inside a principal city with pop < 250,000 and >= 100,000
13	City, Small Territory inside an urbanized area and inside a principal city with a population < 100,000
21	Suburban, Large Territory outside a principal city and inside an urbanized area with pop >= 250,000
22	Suburban, Mid-Size Territory outside a principal city and inside an urbanized area with a pop < 250,000 and >= 100,000
23	Suburb, Small Territory outside a principal city and inside an urbanized area with a pop < 100,000
31	Town, Fringe Territory inside an urban cluster <= 10 miles from an urbanized area
32	Town, Distant Territory inside an urban cluster > 10 miles and <= 35 miles from an urbanized area
33	Town, Remote Territory inside an urban cluster > 35 miles from an urbanized area
41	Rural, Fringe Census-defined rural territory <= 5 miles from an urban area; also rural territory <= 2.5 miles from an urban cluster
42	Rural, Distant Census-defined rural territory > 5 miles and <= 25 miles from an urbanized area; also rural territory > 2.5 miles and < 10 miles from an urban cluster
43	Rural, Remote Census-defined rural territory > 25 miles from an urbanized area and > 10 miles from an urban cluster

Replacement Schools

Five replacement schools were designated for each sampled school in case of nonresponse for the originally sampled school. The fifth replacement school was intended for a pilot study and was not used in the main study. The five replacement schools were usually the two or three schools listed just before and after the sampled school on the frame, after sorting as described above. The replacement schools were ranked by similarity with the sampled school with respect to number of teachers and assigned an "order of use" number so that the closest matching school within the same stratum/ZIP3 would be used first.

Table A-2 shows the distribution of the sample by primary and secondary stratum.

Table A-2
Distribution of Sample, by Stratum

	Secondary Stratum			Primary Stratum			
	Region	**Status**	**Public/ Private**	**1 Grades 10–12**	**2 Grades 5–9**	**3 Other**	**All Grades**
1	Midwest	Urban	Public	47	20	25	92
2			Private	11	0	4	15
3		Suburban	Public	92	56	41	189
4			Private	11	0	6	17
5		Rural	Public	65	22	25	112
6			Private	4	0	2	6
7	Northeast	Urban	Public	40	20	23	83
8			Private	13	0	4	17
9		Suburban	Public	102	59	45	206
10			Private	18	0	6	24
11		Rural	Public	37	15	13	65
12			Private	4	0	1	5
13	South	Urban	Public	83	54	50	187
14			Private	27	0	5	32
15		Suburban	Public	135	89	76	300
16			Private	26	0	5	31
17		Rural	Public	125	58	53	236
18			Private	14	9	1	15
19	West	Urban	Public	62	31	33	126
20			Private	13	0	4	17
21		Suburban	Public	72	40	44	152
22			Private	9	0	3	12
23		Rural	Public	72	12	14	32
24			Private	3	0	0	3
	TOTAL			**1,045**	**476**	**479**	**2,000**

Teacher Sample

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

- Target Population;
- Teacher Sampling Frame;
- Teacher Stratification;
- Teacher 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.

Teacher Sampling Frame
The sampling frame for the teacher sample was constructed by requesting that coordinators in all sample schools provide a list of eligible teachers and identify the courses taught by each teacher. For schools in stratum 1, coordinators listed teachers in one of the following categories:

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

For strata 2 and 3, the categories listed were:

- Science and
- Mathematics

Teacher 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.

Teacher Sample Selection
The goal was to sample about 10,000 teachers. Within each sampled school, seven teachers were sampled with probability proportional to a measure of size that was designed to oversample advanced math and physics/chemistry teachers at a rate of three. In schools with fewer than seven science/mathematics teachers, all teachers were selected. Prior to sampling, teachers were sorted by teacher stratum. The resulting sample sizes were:

- Primary Stratum 1: 5,561 teachers;
- Primary Stratum 2: 2,435 teachers; and
- Primary Stratum 3: 2,230 teachers.

The sampling fraction 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 = Number of teachers sampled in stratum l

N_l = Number of listed teachers in stratum l

For each of the three school primary strata, Table A-3 shows the number of teachers selected in the cooperating schools and the overall sampling fraction in each teacher stratum.

Table A-3
Teachers Selected in Each School Stratum

	Sample Size (n_l)	**Sampling Fraction (f_l)**
School Stratum 1: Grades 10–12	**5,561**	
1. Physics/chemistry with or without other science, no mathematics	1,593	0.5147
2. Advanced mathematics with or without other mathematics, no science	1,489	0.5129
3. Other science only	949	0.2216
4. Other mathematics only	1,164	0.2256
5. Any combination of science and mathematics	366	0.4164
School Stratum 2: Grades 5–9	**2,435**	
1. Physics/chemistry with or without other science, no mathematics	0	0
2. Advanced mathematics with or without other mathematics, no science	0	0
3. Other science only	1,013	0.4922
4. Other mathematics only	1,210	0.4852
5. Any combination of science and mathematics	212	0.4371
School Stratum 3: Other	**2,230**	
1. Physics/chemistry with or without other science, no mathematics	0	0
2. Advanced mathematics with or without other mathematics, no science	0	0
3. Other science only	113	0.3951
4. Other mathematics only	259	0.4060
5. Any combination of science and mathematics	1,858	0.3301

Selection of Classes

As part of the sampling process, teachers in sub-stratum five in each stratum were randomly assigned to receive either a science or a mathematics questionnaire. This step 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 web questionnaire used a pre-generated sampling table to make a selection from among the classes listed. The sampling table was randomly generated so that a random selection of classes would be achieved overall.

Weighting and Standard Errors

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. The final adjusted weights permit the respondents from the sample to represent the population of schools and teachers.

Variance computation must also take into account the survey design using a method such as jackknife or BRR replication, or Taylor series linearization. Statistical software packages that assume simple random sampling are not appropriate because they will underestimate the standard errors. To accommodate the sample design used in this study, a set of 75 jackknife (JK2) replicate weights was created for each full-sample school and teacher weight.[1]

Three school weights were developed corresponding to the School Coordinator Questionnaire, Science Program Questionnaire, and the Mathematics Program Questionnaire. Separate teacher and class weights were developed for the Science and Mathematics Teacher Questionnaires.

School Weights

Weights were developed to permit unbiased estimates for school and teacher characteristics. The base weight associated with a school is the reciprocal of the school's probability of selection and is calculated as follows:

$$W_{hi} = \frac{\sum_{i=1}^{N_h} MOS_{hi}}{n_h MOS_{hi}}$$

where:

MOS_{hi} = measure of size for school i in stratum h
N_h = total number of schools on the frame in stratum h
n_h = number of schools sampled in stratum h
h = 1, 2, …..72.

Replacement schools were used to substitute for non-cooperating schools, and for these the probability of selection of the originally sampled school was used to calculate the base weight. Of the 2,007 schools in the final sample, 749 were replacement schools and 7 were new schools, each formed by the merger of two schools on the frame after the sample was selected. The probability of selection for the new schools was calculated to take into account their increased

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[1] Rust, K. F. and Rao, J. N. K. (1996). Variance estimation for complex surveys using replication techniques. *Statistical methods in medical research*, *5*(3), 283–310.

chance of selection. If the schools were from the same stratum, the probabilities of selection for the two schools that merged were summed. If they were from different strata, the probability of selection was calculated as 1 – (1-p(school 1))*(1-p(school 2)).

To adjust for different rates of participation in the survey by different types of schools, school nonresponse adjustments were developed and applied to the base weight.[2]

In some schools, the school coordinator questionnaire may not have been completed. In addition, the person designated to answer questions about the school science or mathematics program may have failed to participate. Accordingly, three distinct school non-response adjustments were developed:

- NRA1: To produce school estimates from the school coordinator questionnaire
- 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:

$$NRA_c = \frac{\sum_{i \in \text{elig in c}} w_i}{\sum_{i \in \text{resp in c}} w_i}$$

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 completed the school coordinator questionnaire; respondents for NR2 and NR3 include only schools that completed a program questionnaire in science and mathematics, respectively. As the replacement schools already compensate for non-response, the weights for these schools are included in the denominators of the adjustments.

Because nonresponse adjustment through weighting assumes that response patterns of non-respondents are similar to that of respondents, c corresponds to cells formed from school characteristics that were determined to be correlated with nonresponse. These characteristics were identified through a logistic regression model that predicted response propensity as a function of school characteristics. The characteristics identified by the model as correlated with response were school type (public, catholic, other private), primary stratum (grades 10–12, grades 5–9, other), high minority enrollment (> 25%), and metro status (urban, suburban, rural).

[2] For a discussion of nonresponse adjustments, see:

Kalton, G. and Kasprzyk, D. (1986). The treatment of missing survey data. *Survey Methodology, 12*(1), 1–16.

Brick, J.M. and Kalton, G. (1996). Handling missing data in survey research. *Statistical Methods in Medical Research, 5*(215), (http://smm.sagepub.com/cgi/content/abstract/5/3/215)

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

$W_{1i,\,nr} = w_i * NR1_c$
$W_{2i,\,nr} = w_i * NR2_c$
$W_{3i,\,nr} = w_i * NR3_c$

where:

w_i = Base weight associated with school *i*
$NR1_c$ = Non-response adjustment factor for school coordinator questionnaire for schools in cell *c*
$NR2_c$ = Non-response adjustment factor for school mathematics programs in cell *c*
$NR3_c$ = Non-response adjustment factor for school science programs in cell *c*.

The non-response adjusted school weights were trimmed to the 99^{th} percentile of the weight distribution to reduce the effect of a few extremely large weights. These outlier weights arose from a few very small private schools that had a very small probability of selection. The weights that were not trimmed received a small adjustment so that the sum of the final school weights would equal the total of the school weights before trimming.

Teacher Weights

The teacher base weight is equal to the inverse of the overall probability of selection of the teacher, including the school's probability of selection. The teacher base weight was calculated as:

Teacher base weight = final school weight * (1/teacher probability of selection)

where the final school weight was adjusted for schools who refused to allow sampling of their teachers. (This was essentially the same set of schools that did not complete the school coordinator questionnaire.) Each teacher responded to either the science or mathematics questionnaire, but not both. For teachers sampled in the 5^{th} teacher stratum (both mathematics and science taught), the teacher probability of selection includes a factor of 2 to reflect the random assignment of these teachers to mathematics or science with a probability of 1/2.

The teacher base weight was adjusted separately for nonresponse to the mathematics and science questionnaires, as separate weights were planned for mathematics and science teachers. That is,

$$W_{ijk,\,nr} = \text{final school weight}_i * \text{teacher base weight}_{ij} * NRT_{jk}$$

where:

$W_{ijk,\,nr}$ = nonresponse-adjusted weight teacher *j* in school *i*, subject *k*,
NRT_{jjk} = nonresponse adjustment factor for teacher *j* in school *i*, subject *k*,
k = math or science.

NRT_{ijk} was calculated within adjustment cell *c* for each subject *k* as:

$$NRT_c = \frac{\sum_{\text{j} \in \text{elig in c}} w_{ij}}{\sum_{\text{j} \in \text{resp in c}} w_{\text{ij}}}$$

where w_{ij} is the base weight for teacher *j* in school *i*.

The nonresponse adjustment factor was calculated within adjustment cells formed using variables that were determined to be correlated with teacher nonresponse. These variables were identified using logistic regression models to predict response propensity to the mathematics and science teacher questionnaires as a function of school characteristics and teacher stratum. The variables identified by the model for both subjects were school level (grades 10–12, grades 5–9, other), school type (public, catholic, other private), high minority enrollment (>25%) and region (Northeast, Midwest, South, West). The unweighted response rate for both the mathematics and science questionnaires was 77 percent.

Because a small number of secondary teachers incorrectly identified themselves on the questionnaire as self-contained teachers, a second set of teacher weights was calculated for nonresponse to the class schedule item. The nonresponse adjustment factor was calculated within cells formed by variables correlated with nonresponse to this item, given the teacher was a respondent to the mathematics or science questionnaire. These variables were identified from a logistic regression model as school level (grades 10–12, grades 5–9, other), school type (public, catholic, other private), school size (small, medium, large) and teacher stratum. The unweighted response rate for this item was 94 percent, given the teacher was a respondent to the mathematics or science questionnaire.

The nonresponse-adjusted teacher weights were trimmed to a threshold of 4*average teacher weight to prevent extremely large weights, and the remaining teacher weights received a small adjustment factor to preserve the sum of the nonresponse-adjusted teacher weights prior to trimming. Five percent of the teacher weights were trimmed.

Imputation of Number of Classrooms

The number of classrooms taught was imputed when missing for teachers who responded to the mathematics or science questionnaires, including teachers who were deemed to have reported teaching only one self-contained classroom in error. The number of classrooms was imputed from another randomly selected teacher within the same teacher stratum and school, when possible, using the hot deck method.[3] If such a teacher could not be found, a teacher from the same teacher stratum within another school in the same school stratum, size, and minority class was selected. The number of classrooms was imputed for five percent of teacher respondents. Nearly two-thirds of the imputed values came from a teacher within the same school.

[3] Andridge, R. R. and Little, R. J. A. (2010). A Review of Hot Deck Imputation for Survey Non-response. *International Statistical Review*, *78*(1), 40–64.

Calculating Standard Errors

Estimates obtained from a sample of teachers will differ from the true population parameters because they are based on a randomly chosen subset of the population, rather than on a complete census of all mathematics and science teachers. This type of error is known as sampling error**.** The differences between the estimates and the true population values can also be caused by nonsampling error. Nonsampling errors can result from many causes, such as measurement error, nonresponse, sampling frame errors, and respondent error. The precision of an estimate is measured by the standard error (defined as the square root of the variance due to sampling). The calculation of the standard error must reflect the manner in which the sample was drawn. Otherwise, the standard errors can be misleading and result in incorrect confidence intervals and p-values in hypothesis testing. The study's sampling involved stratification, clustering, and unequal probabilities of selection, all of which must be reflected in the standard error calculations.

Replication methods such as the jackknife are commonly used to estimate variances for complex surveys involving multi-stage sampling. Replication methods work by dividing the sample into subsample replicates that mirror the design of the sample. A weight is calculated for each replicate using the same procedures as for the full-sample weight. This produces a set of replicate weights for each sampled school and teacher. To calculate the standard error of a survey estimate, the estimate is first calculated for each replicate using the replicate weight and the same form of estimator as for the full sample. The variation among the replicates is then used to estimate the variance for the full sample estimate, as given below in the formula for jackknife replicates formed with two variance units or pseudo-psus (primary sampling units) per stratum (JK2)[4]:

$$\mathrm{var}(\hat{\theta}) = \sum_{g=1}^{G} (\hat{\theta}_{(g)} - \hat{\theta})^2$$

where G is the total number of replicates $\hat{\theta}_{(g)}$ and is the estimate of $\hat{\theta}$ based on the observations included in the gth replicate.

For the current study, a set of 75 jackknife replicate weights was created for each school and teacher weight for calculating standard errors for school and teacher estimates. These may be used with packages that accommodate replication methods, such as WesVar, SUDAAN, Stata, or the survey procs in SAS v9.

[4] Rust, K. F. and Rao, J. N. K. (1996). Variance estimation for complex surveys using replication techniques. *Statistical methods in medical research*, *5*(3), 283–310.

APPENDIX B

Survey Questionnaires

Science Program Questionnaire

Mathematics Program Questionnaire

Science Teacher Questionnaire

Mathematics Teacher Questionnaire

2012 NATIONAL SURVEY OF SCIENCE AND MATHEMATICS EDUCATION
SCIENCE PROGRAM QUESTIONNAIRE

This questionnaire asks a number of questions about "science teachers." In responding, unless otherwise specified, consider ALL teachers of science in your school, including self-contained teachers who teach science and other subjects to the same group of students.

1. Which of the following describe your position? [Select all that apply.]

□	Science department chair
□	Science lead teacher or coach
□	Regular classroom teacher
□	Principal
□	Assistant principal
□	Other (please specify: _______________)

School Programs and Practices

2. ***[Presented only to schools that include self-contained teachers]***
Indicate whether each of the following programs and/or practices is currently being implemented in your school. [Select one on each row.]

	Yes	No
a. Students in self-contained classes receive science instruction from a science specialist *instead of* their regular teacher.	○	○
b. Students in self-contained classes receive science instruction from a science specialist *in addition* to their regular teacher.	○	○
c. Students in self-contained classes pulled out for remedial instruction in science.	○	○
d. Students in self-contained classes pulled out for enrichment in science.	○	○
e. Students in self-contained classes pulled out from science instruction for additional instruction in other content areas.	○	○

3. ***[Presented only to schools that include any grades 9–12]***
Indicate whether each of the following programs and/or practices is currently being implemented in your school. [Select one on each row.]

	Yes	No
a. Physics courses offered this school year or in alternating years, on or off site	○	○
b. Students go to a Career and Technical Education (CTE) Center for science and/or engineering instruction.	○	○
c. Science and/or engineering courses offered by telecommunications.	○	○
d. Students go to another K–12 school for science and/or engineering courses.	○	○
e. Students go to a college or university for science and/or engineering courses.	○	○

4. Which of the following are provided to teachers considered in need of special assistance in science teaching (for example: new teachers)? [Select all that apply.]

□	Seminars, classes, and/or study groups
□	Guidance from a formally designated mentor or coach
□	A higher level of supervision than for other teachers

5. Indicate whether your school does each of the following to enhance students' interest and/or achievement in science and/or engineering. [Select one on each row.]

	Yes	No
a. Holds family science and/or engineering nights	○	○
b. Offers after-school help in science and/or engineering (for example: tutoring)	○	○
c. Offers formal after-school programs for enrichment in science and/or engineering	○	○
d. Offers one or more science clubs	○	○
e. Offers one or more engineering clubs	○	○
f. Participates in a local or regional science and/or engineering fair	○	○
g. Has one or more teams participating in science competitions (for example: Science Olympiad)	○	○
h. Has one or more teams participating in engineering competitions (for example: Robotics)	○	○
i. Encourages students to participate in science and/or engineering summer programs or camps offered by community colleges, universities, museums, or science centers	○	○
j. Sponsors visits to business, industry, and/or research sites related to science and/or engineering	○	○
k. Sponsors meetings with adult mentors who work in science and/or engineering fields	○	○

Your State Standards

6. Please provide your opinion about each of the following statements in regard to your current state standards for science. [Select one on each row.]

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
a. State science standards have been thoroughly discussed by science teachers in this school	①	②	③	④	⑤
b. There is a school-wide effort to align science instruction with the state science standards	①	②	③	④	⑤
c. Most science teachers in this school teach to the state standards	①	②	③	④	⑤
d. Your district/diocese organizes science professional development based on state standards ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤

Science Courses Offered in Your School

7. ***[Presented only to schools that include grade 6]***

What types of science courses are offered to 6th grade classes in your school?

○	Single-discipline science courses (for example: life science)
○	Coordinated or Integrated science courses
○	Both single-discipline and coordinated or integrated science courses

8. ***[Presented only to schools that include grade 7]***
What types of science courses are offered to 7th grade classes in your school?

○	Single-discipline science courses (for example: life science)
○	Coordinated or Integrated science courses
○	Both single-discipline and coordinated or integrated science courses

9. ***[Presented only to schools that include grade 8]***
What types of science courses are offered to 8th grade classes in your school?

○	Single-discipline science courses (for example: life science)
○	Coordinated or Integrated science courses
○	Both single-discipline and coordinated or integrated science courses

10. ***[Presented only to schools that include any grades 9–12]***
Approximately how many grades 9–12 students in this school will **not** take a science course this year? [Enter your response as a whole number (for example: 1500); do not use a comma.]

____

Science Courses Offered in Your School

[Questions 11–27 presented only to schools that include any grades 9–12; schools that do not include any of these grades skip to Q31]

This next set of questions asks about the number of sections and level of science courses offered in grades 9–12 in your school this year in each of the following categories:

- Coordinated or Integrated Science (including General Science and Physical Science)
- Earth/Space Science
- Life Sciences/Biology
- Environmental Science/Ecology (as a separate course)
- Chemistry
- Physics
- Engineering

11. Does your school offer one or more courses in Coordinated or Integrated science (including General Science and Physical Science) this school year in any of the grades 9–12?

○	Yes
○	No ***[Skip to Q13]***

12. How many sections of Coordinated or Integrated science courses (including General Science and Physical Science) are offered in your school this year at each of the following levels? [Enter each response as a whole number (for example: 15).]

a. Non-college prep ______
b. College prep, including honors ______

13. Does your school offer one or more courses in Earth/Space Science this school year in any of the grades 9–12?

○	Yes
○	No ***[Skip to Q15]***

14. How many sections of Earth/Space Science courses are offered in your school this year at each of the following levels? [Enter each response as a whole number (for example: 15).]

a. Non-college prep ______
b. 1st year college prep, including honors ______
c. 2nd year advanced, including Advanced Placement, International Baccalaureate, and concurrent college and high school credit/dual enrollment courses _____

15. Does your school offer one or more courses in Life Science/Biology this school year in any of the grades 9–12?

○	Yes
○	No ***[Skip to Q17]***

16. How many sections of Life Science/Biology courses are offered in your school this year at each of the following levels? [Enter each response as a whole number (for example: 15).]

a. Non-college prep ______
b. 1st year college prep, including honors _____
c. 2nd year advanced, including Advanced Placement, International Baccalaureate, and concurrent college and high school credit/dual enrollment courses _____

17. Does your school offer one or more courses in Environmental Science/Ecology this school year in any of the grades 9–12?

○	Yes
○	No ***[Skip to Q19]***

18. How many sections of Environmental Science/Ecology courses are offered in your school this year at each of the following levels? [Enter each response as a whole number (for example: 15).]

a. Non-college prep ______
b. 1st year college prep, including honors ______
c. 2nd year advanced, including Advanced Placement, International Baccalaureate, and concurrent college and high school credit/dual enrollment courses _____

19. Does your school offer one or more courses in Chemistry this school year in any of the grades 9–12?

○	Yes
○	No ***[Skip to Q21]***

20. How many sections of Chemistry courses are offered in your school this year at each of the following levels? [Enter each response as a whole number (for example: 15).]

a. Non-college prep ______
b. 1st year college prep, including honors ______
c. 2nd year advanced, including Advanced Placement, International Baccalaureate, and concurrent college and high school credit/dual enrollment courses _____

21. Does your school offer one or more courses in Physics this school year in any of the grades 9–12?

○	Yes
○	No ***[Skip to Q23]***

22. How many sections of Physics courses are offered in your school this year at each of the following levels? [Enter each response as a whole number (for example: 15).]

a. Non-college prep ______
b. 1st year college prep, including honors ______
c. 2nd year advanced, including Advanced Placement, International Baccalaureate, and concurrent college and high school credit/dual enrollment courses ____

23. Does your school offer one or more courses in Engineering this school year in any of the grades 9–12? Count courses that address such things as the nature of engineering, engineering design processes, technological systems, and technology and society. Do not include career-technical education (CTE) courses that cover such things as automotive repair, audio/video production, etc.

○	Yes
○	No ***[Skip to Q25]***

24. How many sections of Engineering courses are offered in your school this year at each of the following levels? [Enter each response as a whole number (for example: 15).]

a. Non-college prep ______
b. 1st year college prep, including honors ______
c. 2nd year advanced, including concurrent college and high school credit/dual enrollment courses _____

25. Does your school offer each of the following types of science courses that might qualify for college credit? (Include both courses that are offered every year and those offered in alternating years.) [Select one on each row.]

	Yes	**No**
a. Advanced Placement (AP) science courses	○	○
b. International Baccalaureate (IB) science courses	○	○
c. Concurrent college and high school credit/dual enrollment science courses	○	○

26. ***[Presented only to schools that answered "Yes" to Q25c]***
When are concurrent college and high school credit/dual enrollment science courses offered in this school?

○	Not offered this school year, but offered in alternating years
○	Offered this school year

27. ***[Q27a–e presented only to schools that answered "Yes" to Q25a; Q27f–h presented only to schools that answered "Yes" to Q25b]***
Is each of the following science courses offered in this school? [Select one on each row.]

	Not offered at all	**Not offered this school year, but offered in alternating years**	**Offered this school year**
a. AP Biology	○	○	○
b. AP Chemistry	○	○	○
c. AP Physics B	○	○	○
d. AP Physics C	○	○	○
e. AP Environmental Science	○	○	○
f. IB Biology	○	○	○
g. IB Chemistry	○	○	○
h. IB Physics	○	○	○

Science Requirements

28. ***[Presented only to schools that include grade 12]***
In order to graduate from this high school, how many years of grades 9–12 science are students required to take?

1 year	**2 years**	**3 years**	**4 years**
○	○	○	○

29. ***[Presented only to schools that include grade 12 and answered "Yes" to Q23]***
Does participation in Engineering courses count towards students' high school graduation requirements for science?

○	Yes
○	No

30. ***[Presented only to schools that include grade 12]***
How many years of science are required for entry into a four-year college or university in your state university system? If your state university system has multiple tiers, answer for the lowest tier that awards four-year degrees, not including community colleges that might include four-year programs.

1 year	**2 years**	**3 years**	**4 years**
○	○	○	○

Budget for Science Instruction

31. For this school, how much money was spent on each of the following during the most recently completed budget year? (If you don't know the exact amounts, please provide your best estimates.) [Enter each response as a whole dollar amount (for example: 1500); do not include commas or dollar signs.]

a. Consumable science supplies (for example: chemicals, living organisms, batteries) __________
b. Science equipment (non-consumable, non-perishable items such as microscopes, scales, etc., but not computers) __________
c. Software for science instruction __________

Influences on Science Instruction

32. Please rate the effect of each of the following on the quality of science instruction in your school. [Select one on each row.]

	Inhibits effective instruction		Neutral or mixed		Promotes effective instruction	N/A or Don't Know
a. District/Diocese science professional development policies and practices ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤	○
b. Time provided for teacher professional development in science	①	②	③	④	⑤	○
c. Importance that the school places on science	①	②	③	④	⑤	○
d. Public attitudes toward science instruction	①	②	③	④	⑤	○
e. Conflict between efforts to improve science instruction and other school and/or district/diocese initiatives	①	②	③	④	⑤	○
f. How science instructional resources are managed (for example: distributing and refurbishing materials)	①	②	③	④	⑤	○

33. In your opinion, how great a problem is each of the following for science instruction **in your school as a whole**? [Select one on each row.]

	Not a significant problem	Somewhat of a problem	Serious problem
a. Lack of science facilities (for example: lab tables, electric outlets, faucets and sinks in classrooms)	○	○	○
b. Inadequate funds for purchasing science equipment and supplies	○	○	○
c. Inadequate supply of science textbooks/modules	○	○	○
d. Inadequate materials for individualizing science instruction	○	○	○
e. Low student interest in science	○	○	○
f. Low student reading abilities	○	○	○
g. Lack of teacher interest in science	○	○	○
h. Inadequate teacher preparation to teach science	○	○	○
i. Insufficient time to teach science	○	○	○
j. Lack of opportunities for science teachers to share ideas	○	○	○
k. Inadequate science-related professional development opportunities	○	○	○
l. Interruptions for announcements, assemblies, and other school activities	○	○	○
m. Large class sizes	○	○	○
n. High student absenteeism	○	○	○
o. Inappropriate student behavior	○	○	○
p. Lack of parental support for science education	○	○	○
q. Community resistance to the teaching of "controversial" issues in science (for example: evolution, climate change)	○	○	○

Science Teacher Turnover

34. ***[Presented only to schools that include any grades 6–12]***
How many middle and/or high school science teachers who taught in your school last year (2010–11) did not return to teach science in your school this year (2011–12)? [Enter your response as a whole number (for example: 15). Please enter "0" if all teachers who taught science returned this school year.] __________ ***[If "0" Skip to Q36]***

35. ***[Presented only to schools that include any grades 6–12]***
How many of those teachers did not return for each of the following reasons? [Enter each response as a whole number (for example: 15). Please enter "0" for categories in which there were not any science teachers who did not return for that reason.]

a. Left voluntarily, including science teachers who moved to another department or school, left the profession, or retired __________
b. Were reassigned to another position, department, or school in the district/diocese __________
c. Were dismissed or not rehired for poor performance ________
d. Were dismissed or not rehired because of budget constraints __________

36. ***[Presented only to schools that include any grades 6–12]***
For the 2011–12 school year, how difficult was it to fill middle and/or high school science teacher vacancies in your school with fully qualified teachers?

○	There were no vacancies for science teachers ***[Skip to Q39]***
○	Easy
○	Somewhat difficult
○	Very difficult
○	Could not fill the vacancies

37. ***[Presented only to schools that include any grades 9–12]***
For the 2011–12 school year, were there particular science disciplines for which it was more difficult to fill vacancies with fully qualified teachers than others?

○	Yes
○	No ***[Skip to Q39]***

38. ***[Presented only to schools that include any grades 9–12]***
For the 2011–12 school year, how difficult was it to fill vacancies with fully qualified teachers of: [Select one on each row.]

	There were no vacancies for this discipline	Easy	Somewhat difficult	Very difficult	Could not fill the vacancies
a. Biology/Life science?	○	○	○	○	○
b. Chemistry?	○	○	○	○	○
c. Earth/Space science?	○	○	○	○	○
d. Physics?	○	○	○	○	○
e. A combination of science disciplines?	○	○	○	○	○

Science Professional Development Opportunities

39. This question is about in-service (professional development) programs offered by your school and/or district/diocese, possibly in conjunction with other organizations (for example: other school districts/dioceses, colleges or universities, museums, professional associations, commercial vendors).

In the last three years, has your school and/or district/diocese offered in-service **workshops** specifically focused on science or science teaching?

○	Yes
○	No ***[Skip to Q41]***

40. Please indicate the extent to which in-service **workshops** offered by your school and/or district/diocese **in the last three years** addressed deepening teacher understanding of each of the following: [Select one on each row.]

	Not at all		**Somewhat**		**To a great extent**
a. Science content	①	②	③	④	⑤
b. State science standards	①	②	③	④	⑤
c. How to use particular science instructional materials (for example: textbooks or modules)	①	②	③	④	⑤
d. How students think about various science ideas	①	②	③	④	⑤
e. How to monitor student understanding during science instruction	①	②	③	④	⑤
f. How to adapt science instruction to address student misconceptions	①	②	③	④	⑤
g. How to use technology in science instruction	①	②	③	④	⑤
h. How to use investigation-oriented science teaching strategies	①	②	③	④	⑤
i. How to teach science to students who are English language learners	①	②	③	④	⑤
j. How to provide alternative science learning experiences for students with special needs	①	②	③	④	⑤

41. In the last three years, has your school offered **teacher study groups** where teachers meet on a regular basis to discuss teaching and learning of science, and possibly other content areas as well (sometimes referred to as Professional Learning Communities, PLCs, or lesson study)?

○	Yes
○	No ***[Skip to Q53]***

42. ***[Presented only to schools that include any grades K–5]***
Are teachers of grades K-5 science classes required to participate in these science-focused **teacher study groups**?

○	Yes
○	No

43. ***[Presented only to schools that include any grades 6–8]***
Are teachers of grades 6-8 science classes required to participate in these science-focused **teacher study groups**?

○	Yes
○	No

44. ***[Presented only to schools that include any grades 9–12]***
Are teachers of grades 9-12 science classes required to participate in these science-focused **teacher study groups**?

○	Yes
○	No

45. Has your school specified a schedule for when these science-focused **teacher study groups** are expected to meet?

○	Yes
○	No ***[Skip to Q48]***

46. Over what period of time were these science-focused **teacher study groups** typically expected to meet?

○	The entire school year
○	One semester
○	Less than one semester

47. How often have these science-focused **teacher study groups** typically been expected to meet?

○	Less than once a month
○	Once a month
○	Twice a month
○	More than twice a month

48. Which of the following describe the typical science-focused **teacher study groups** in this school? [Select all that apply.]

□	Organized by grade level
□	Include teachers from multiple grade levels
□	Limited to teachers from this school
□	Include teachers from other schools in the district/diocese ***[Not presented to non-Catholic private schools]***
□	Include teachers from other schools outside of your district/diocese
□	Include school and/or district/diocese administrators
□	Include parents/guardians or other community members
□	Include higher education faculty or other “consultants”

49. Which of the following describe the typical science-focused **teacher study groups** in this school? [Select all that apply.]

□	Teachers engage in science investigations.
□	Teachers plan science lessons together.
□	Teachers analyze student science assessment results.
□	Teachers analyze classroom artifacts (for example: student work samples).
□	Teachers analyze science instructional materials (for example: textbooks or modules).

50. To what extent have these science-focused **teacher study groups** addressed deepening teacher understanding of each of the following? [Select one on each row.]

	Not at all		Somewhat		To a great extent
a. Science content	①	②	③	④	⑤
b. State science standards	①	②	③	④	⑤
c. How to use particular science instructional materials (for example: textbooks or modules)	①	②	③	④	⑤
d. How students think about various science ideas	①	②	③	④	⑤
e. How to monitor student understanding during science instruction	①	②	③	④	⑤
f. How to adapt science instruction to address student misconceptions	①	②	③	④	⑤
g. How to use technology in science instruction	①	②	③	④	⑤
h. How to use investigation-oriented science teaching strategies	①	②	③	④	⑤
i. How to teach science to students who are English language learners	①	②	③	④	⑤
j. How to provide alternative science learning experiences for students with special needs	①	②	③	④	⑤

51. Have there been designated leaders for these science-focused **teacher study groups**?

○	Yes
○	No ***[Skip to Q53]***

52. The designated leaders of these science-focused **teacher study groups** were from: [Select all that apply.]

□	This school
□	Elsewhere in this district/diocese ***[Not presented to non-Catholic private schools]***
□	College or University
□	External consultants
□	Other (please specify: ____________________)

53. Thinking about last school year, which of the following were used to provide teachers in this school with time for in-service (professional development) workshops/teacher study groups *that included a focus on science content and/or science instruction*, regardless of whether they were offered by your school and/or district/diocese? [Select all that apply.]

□	Early dismissal and/or late start for students
□	Professional days/teacher work days during the students' school year
□	Professional days/teacher work days before and/or after the students' school year
□	Common planning time for teachers
□	Substitute teachers to cover teachers' classes while they attend professional development
□	None of the above

54. Do any teachers in your school have access to one-on-one "coaching" focused on improving their science instruction?

○	Yes
○	No *[Skip to End]*

55. ***[Presented only to schools that include any grades K–5]***
Are teachers of grades K-5 science classes required to receive one-on-one science-focused coaching?

○	Yes
○	No

56. ***[Presented only to schools that include any grades 6–8]***
Are teachers of grades 6-8 science classes required to receive one-on-one science-focused coaching?

○	Yes
○	No

57. ***[Presented only to schools that include any grades 9–12]***
Are teachers of grades 9-12 science classes required to receive one-on-one science-focused coaching?

○	Yes
○	No

58. To what extent is science-focused one-on-one coaching in your school provided by each of the following? [Select one on each row.]

	Not at all		Somewhat		To a great extent
a. The principal of your school	①	②	③	④	⑤
b. An assistant principal at your school	①	②	③	④	⑤
c. District/Diocese administrators including science supervisors/coordinators ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤
d. Teachers/coaches who do not have classroom teaching responsibilities	①	②	③	④	⑤
e. Teachers/coaches who have part-time classroom teaching responsibilities	①	②	③	④	⑤
f. Teachers/coaches who have full-time classroom teaching responsibilities	①	②	③	④	⑤

Thank you!

2012 National Survey of Science and Mathematics Education
Mathematics Program Questionnaire

This questionnaire asks a number of questions about "mathematics teachers." In responding, unless otherwise specified, consider ALL teachers of mathematics in your school, including self-contained teachers who teach mathematics and other subjects to the same group of students.

1. Which of the following describe your position? [Select all that apply.]

□	Mathematics department chair
□	Mathematics lead teacher or coach
□	Regular classroom teacher
□	Principal
□	Assistant principal
□	Other (please specify: _______________)

School Programs and Practices

2. ***[Presented only to schools that include self-contained teachers]***
Indicate whether each of the following programs and/or practices is currently being implemented in your school. [Select one on each row.]

		Yes	**No**
a.	Students in self-contained classes receive mathematics instruction from a mathematics specialist *instead of* their regular teacher.	○	○
b.	Students in self-contained classes receive mathematics instruction from a mathematics specialist *in addition* to their regular teacher.	○	○
c.	Students in self-contained classes pulled out for remedial instruction in mathematics.	○	○
d.	Students in self-contained classes pulled out for enrichment in mathematics.	○	○
e.	Students in self-contained classes pulled out from mathematics instruction for additional instruction in other content areas.	○	○

3. ***[Presented only to schools that include any grades 9–12]***
Indicate whether each of the following programs and/or practices is currently being implemented in your school. [Select one on each row.]

		Yes	**No**
a.	Algebra 1 course offered over two years or as two separate block courses (for example: Algebra A and Algebra B)	○	○
b.	Calculus courses (beyond pre-Calculus) offered this school year or in alternating years, on or off site	○	○
c.	Students go to a Career and Technical Education (CTE) Center for mathematics instruction	○	○
d.	Mathematics courses offered by telecommunications	○	○
e.	Students go to another K–12 school for mathematics courses	○	○
f.	Students go to a college or university for mathematics courses	○	○

4. Which of the following are provided to teachers considered in need of special assistance in mathematics teaching (for example: new teachers)? [Select all that apply.]

□	Seminars, classes, and/or study groups
□	Guidance from a formally designated mentor or coach
□	A higher level of supervision than for other teachers

5. Indicate whether your school does each of the following to enhance students' interest and/or achievement in mathematics. [Select one on each row.]

	Yes	No
a. Holds family math nights	○	○
b. Offers after-school help in mathematics (for example: tutoring)	○	○
c. Offers formal after-school programs for enrichment in mathematics	○	○
d. Offers one or more mathematics clubs	○	○
e. Participates in a local or regional mathematics fair	○	○
f. Has one or more teams participating in mathematics competitions (for example: Math Counts)	○	○
g. Encourages students to participate in mathematics summer programs or camps offered by community colleges, universities, museums or mathematics centers	○	○
h. Sponsors visits to business, industry, and/or research sites related to mathematics	○	○
i. Sponsors meetings with adult mentors who work in mathematics fields	○	○

Your State Standards

6. Please provide your opinion about each of the following statements in regard to your current state standards for mathematics. [Select one on each row.]

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
a. State mathematics standards have been thoroughly discussed by mathematics teachers in this school	①	②	③	④	⑤
b. There is a school-wide effort to align mathematics instruction with the state mathematics standards	①	②	③	④	⑤
c. Most mathematics teachers in this school teach to the state standards	①	②	③	④	⑤
d. Your district/diocese organizes mathematics professional development based on state standards ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤

Student Enrollment in Mathematics Courses

7. ***[Presented only to schools that include grade 8]***
Approximately how many of this year's 8th grade students will have completed Algebra 1 prior to 9th grade? [Enter your response as a whole number (for example: 15).] ______________________

8. *[Presented only to schools that include grade 8]*
Approximately how many of this year's 8th grade students will have completed Geometry prior to 9th grade? [Enter your response as a whole number (for example: 15).] ____________________

9. *[Presented only to schools that include any grades 9–12]*
Approximately how many grades 9-12 students in this school will **not** take a mathematics course this year? [Enter your response as a whole number (for example: 1500); do not use a comma.]
____

Mathematics Courses Offered in Your School

[Questions 10–16 presented only to schools that include any grades 9–12; schools that do not include any of these grades skip to Q19]

10. What types of mathematics courses are offered in your school this year? [Select all that apply.]

□	Single-subject mathematics courses (for example: Algebra, Geometry)
□	Integrated mathematics courses

11. How many sections of courses in each of the following categories will be offered to grades 9-12 students in this school this year? [Enter each response as a whole number (for example: 15).]

	Number of sections
a. Non-college prep mathematics courses *Example courses*: Developmental Math; High School Arithmetic; Remedial Math; General Math; Vocational Math; Consumer Math; Basic Math; Business Math; Career Math; Practical Math; Essential Math; Pre-Algebra; Introductory Algebra; Algebra 1 Part 1; Algebra 1A; Math A; Basic Geometry; Informal Geometry; Practical Geometry	
b. Formal/College-prep Mathematics Level 1 courses *Example courses:* Algebra 1; Integrated Math 1; Unified Math I; Algebra 1 Part 2; Algebra 1B; Math B	
c. Formal/College-prep Mathematics Level 2 courses *Example courses:* Geometry; Plane Geometry; Solid Geometry; Integrated Math 2; Unified Math II; Math C	
d. Formal/College-prep Mathematics Level 3 courses *Example courses:* Algebra 2; Intermediate Algebra; Algebra and Trigonometry; Advanced Algebra; Integrated Math 3; Unified Math III	
e. Formal/College-prep Mathematics Level 4 courses *Example courses:* Algebra 3; Trigonometry; Pre-Calculus; Analytic/Advanced Geometry; Elementary Functions; Integrated Math 4, Unified Math IV; Calculus (not including college level/AP); any other College Prep Senior Math with Algebra 2 as a prerequisite	
f. Mathematics courses that might qualify for college credit *Example courses:* Advanced Placement Calculus (AB, BC); Advanced Placement Statistics; IB Mathematics standard level; IB Mathematics higher level; concurrent college and high school credit/dual enrollment	

12. Does this school offer one or more courses focused specifically on probability and/or statistics? (Include both courses that are offered every year and those offered in alternating years.)

○	Yes
○	No *[Skip to Q14]*

13. What probability and/or statistics courses does this school offer? [Select all that apply.]

□	Probability and Statistics combined
□	Probability
□	Statistics

14. Does your school offer each of the following types of mathematics courses that might qualify for college credit? (Include both courses that are offered every year and those offered in alternating years.) [Select one on each row.]

	Yes	No
a. Advanced Placement (AP) mathematics courses	○	○
b. International Baccalaureate (IB) mathematics courses	○	○
c. Concurrent college and high school credit/dual enrollment mathematics courses	○	○

15. ***[Presented only to schools that answered "Yes" to Q14c]***
When are concurrent college and high school credit/dual enrollment mathematics courses offered in this school?

○	Not offered this school year, but offered in alternating years
○	Offered this school year

16. ***[Q16a–c presented only to schools that answered "Yes" to Q14a; Q16d–g presented only to schools that answered "Yes" to Q14b]***
Is each of the following mathematics courses offered in this school? [Select one on each row.]

	Not offered at all	Not offered this school year, but offered in alternating years	Offered this school year
a. AP Calculus AB	○	○	○
b. AP Calculus BC	○	○	○
c. AP Statistics	○	○	○
d. IB Mathematical studies standard level	○	○	○
e. IB Mathematics standard level	○	○	○
f. IB Mathematics higher level	○	○	○
g. IB Further mathematics standard level	○	○	○

Mathematics Requirements

17. ***[Presented only to schools that include grade 12]***
In order to graduate from this high school, how many years of grades 9–12 mathematics are students required to take?

1 year	2 years	3 years	4 years
○	○	○	○

18. ***[Presented only to schools that include grade 12]***
How many years of mathematics are required for entry into a four-year college or university in your state university system? If your state university system has multiple tiers, answer for the lowest tier that awards four-year degrees, not including community colleges that might include four-year programs.

1 year	2 years	3 years	4 years
○	○	○	○

Budget for Mathematics Instruction

19. For this school, how much money was spent on each of the following during the most recently completed budget year? (If you don't know the exact amount, please provide your best estimates.) [Enter each response as a whole dollar amount (for example: 1500); do not include commas or dollar signs.]

a. Consumable supplies for mathematics instruction (for example: graph paper) _____
b. Non-consumable items for mathematics instruction such as calculators, protractors, manipulatives, etc. (Do not include computers) _____
c. Software specific to mathematics instruction (for example: dynamic geometry software) _____

Influences on Mathematics Instruction

20. Please rate the effect of each of the following on the quality of mathematics instruction in your school. [Select one on each row.]

	Inhibits effective instruction		**Neutral or mixed**		**Promotes effective instruction**	**N/A or Don't Know**
a. District/Diocese mathematics professional development policies and practices ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤	○
b. Time provided for teacher professional development in mathematics	①	②	③	④	⑤	○
c. Importance that the school places on mathematics	①	②	③	④	⑤	○
d. Public attitudes toward mathematics instruction	①	②	③	④	⑤	○
e. Conflict between efforts to improve mathematics instruction and other school and/or district/diocese initiatives	①	②	③	④	⑤	○
f. Equipment and supplies and/or manipulatives for teaching mathematics (for example: materials for students to draw, cut and build in order to make sense of problems)	①	②	③	④	⑤	○

21. In your opinion, how great a problem is each of the following for mathematics instruction **in your school as a whole**? [Select one on each row.]

	Not a significant problem	Somewhat of a problem	Serious problem
a. Inadequate funds for purchasing mathematics equipment and supplies	○	○	○
b. Inadequate supply of mathematics textbooks/programs	○	○	○
c. Inadequate materials for individualizing mathematics instruction	○	○	○
d. Low student interest in mathematics	○	○	○
e. Low student reading abilities	○	○	○
f. Lack of teacher interest in mathematics	○	○	○
g. Inadequate teacher preparation to teach mathematics	○	○	○
h. Insufficient time to teach mathematics	○	○	○
i. Lack of opportunities for mathematics teachers to share ideas	○	○	○
j. Inadequate mathematics-related professional development opportunities	○	○	○
k. Interruptions for announcements, assemblies, and other school activities	○	○	○
l. Large class sizes	○	○	○
m. High student absenteeism	○	○	○
n. Inappropriate student behavior	○	○	○
o. Lack of parental support for mathematics education	○	○	○

Mathematics Teacher Turnover

22. ***[Presented only to schools that include any grades 6–12]***
How many middle and/or high school mathematics teachers who taught in your school last year (2010–11) did not return to teach mathematics in your school this year (2011–12)? [Enter your response as a whole number (for example: 15). Please enter "0" if all teachers who taught mathematics returned this school year.] __________ ***[If "0" Skip to Q24]***

23. ***[Presented only to schools that include any grades 6–12]***
How many of those teachers did not return for each of the following reasons? [Enter each response as a whole number (for example: 15). Please enter "0" for categories in which there were not any mathematics teachers who did not return for that reason.]

e. Left voluntarily, including mathematics teachers who moved to another department or school, left the profession, or retired __________
f. Were reassigned to another position, department, or school in the district/diocese ________
g. Were dismissed or not rehired for poor performance ________
h. Were dismissed or not rehired because of budget constraints __________

24. ***[Presented only to schools that include any grades 6–12]***
For the 2011–12 school year, how difficult was it to fill middle and/or high school mathematics teacher vacancies in your school with fully qualified teachers?

○	There were no vacancies for mathematics teachers
○	Easy
○	Somewhat difficult
○	Very difficult
○	Could not fill the vacancies

Mathematics Professional Development Opportunities

25. This question is about in-service (professional development) programs offered by your school and/or district/diocese, possibly in conjunction with other organizations (for example: other school districts/dioceses, colleges or universities, museums, professional associations, commercial vendors).

In the last three years, has your school and/or district/diocese offered in-service **workshops** specifically focused on mathematics or mathematics teaching?

○	Yes
○	No ***[Skip to Q27]***

26. Please indicate the extent to which in-service **workshops** offered by your school and/or district/diocese **in the last three years** addressed deepening teacher understanding of each of the following: [Select one on each row.]

	Not at all		**Somewhat**		**To a great extent**
a. Mathematics content	①	②	③	④	⑤
b. State mathematics standards	①	②	③	④	⑤
c. How to use particular mathematics instructional materials (for example: textbooks or programs)	①	②	③	④	⑤
d. How students think about various mathematical ideas	①	②	③	④	⑤
e. How to monitor student understanding during mathematics instruction	①	②	③	④	⑤
f. How to adapt mathematics instruction to address student misconceptions	①	②	③	④	⑤
g. How to use technology in mathematics instruction	①	②	③	④	⑤
h. How to use investigation-oriented tasks in mathematics instruction	①	②	③	④	⑤
i. How to teach mathematics to students who are English language learners	①	②	③	④	⑤
j. How to provide alternative mathematics learning experiences for students with special needs	①	②	③	④	⑤

27. In the last three years, has your school offered **teacher study groups** where teachers meet on a regular basis to discuss teaching and learning of mathematics, and possibly other content areas as well (sometimes referred to as Professional Learning Communities, PLCs, or lesson study)?

○	Yes
○	No ***[Skip to Q39]***

28. ***[Presented only to schools that include any grades K–5]***
Are teachers of grades K-5 mathematics classes required to participate in these mathematics-focused **teacher study groups**?

○	Yes
○	No

29. ***[Presented only to schools that include any grades 6–8]***
Are teachers of grades 6-8 mathematics classes required to participate in these mathematics-focused **teacher study groups**?

○	Yes
○	No

30. ***[Presented only to schools that include any grades 9–12]***
Are teachers of grades 9-12 mathematics classes required to participate in these mathematics -focused **teacher study groups**?

○	Yes
○	No

31. Has your school specified a schedule for when these mathematics-focused **teacher study groups** are expected to meet?

○	Yes
○	No ***[Skip to Q34]***

32. Over what period of time were these mathematics-focused **teacher study groups** typically expected to meet?

○	The entire school year
○	One semester
○	Less than one semester

33. How often have these mathematics-focused **teacher study groups** typically been expected to meet?

○	Less than once a month
○	Once a month
○	Twice a month
○	More than twice a month

34. Which of the following describe the typical mathematics-focused **teacher study groups** in this school? [Select all that apply.]

□	Organized by grade level
□	Include teachers from multiple grade levels
□	Limited to teachers from this school
□	Include teachers from other schools in the district/diocese ***[Not presented to non-Catholic private schools]***
□	Include teachers from other schools outside of your district/diocese
□	Include school and/or district/diocese administrators
□	Include parents/guardians or other community members
□	Include higher education faculty or other "consultants"

35. Which of the following describe the typical mathematics-focused **teacher study groups** in this school? [Select all that apply.]

□	Teachers engage in mathematics investigations.
□	Teachers plan mathematics lessons together.
□	Teachers analyze student mathematics assessment results.
□	Teachers analyze classroom artifacts (for example: student work samples).
□	Teachers analyze mathematics instructional materials (for example: textbooks or programs).

36. To what extent have these mathematics-focused **teacher study groups** addressed deepening teacher understanding of each of the following? [Select one on each row.]

	Not at all		**Somewhat**		**To a great extent**
a. Mathematics content	①	②	③	④	⑤
b. State mathematics standards	①	②	③	④	⑤
c. How to use particular mathematics instructional materials (for example: textbooks or programs)	①	②	③	④	⑤
d. How students think about various mathematical ideas	①	②	③	④	⑤
e. How to monitor student understanding during mathematics instruction	①	②	③	④	⑤
f. How to adapt mathematics instruction to address student misconceptions	①	②	③	④	⑤
g. How to use technology in mathematics instruction	①	②	③	④	⑤
h. How to use investigation-oriented tasks in mathematics instruction	①	②	③	④	⑤
i. How to teach mathematics to students who are English language learners	①	②	③	④	⑤
j. How to provide alternative mathematics learning experiences for students with special needs	①	②	③	④	⑤

37. Have there been designated leaders for these mathematics-focused **teacher study groups**?

○	Yes
○	No ***[Skip to Q39]***

38. The designated leaders of these mathematics-focused **teacher study groups** were from: [Select all that apply.]

□	This school
□	Elsewhere in this district/diocese ***[Not presented to non-Catholic private schools]***
□	College or University
□	External consultants
□	Other (please specify: ____________________)

39. Thinking about last school year, which of the following were used to provide teachers in this school with time for in-service (professional development) workshops/teacher study groups *that included a focus on mathematics content and/or mathematics instruction*, regardless of whether they were offered by your school and/or district/diocese? [Select all that apply.]

□	Early dismissal and/or late start for students
□	Professional days/teacher work days during the students' school year
□	Professional days/teacher work days before and/or after the students' school year
□	Common planning time for teachers
□	Substitute teachers to cover teachers' classes while they attend professional development
□	None of the above

40. Do any teachers in your school have access to one-on-one "coaching" focused on improving their mathematics instruction?

○	Yes
○	No ***[Skip to End]***

41. ***[Presented only to schools that include any grades K–5]***
Are teachers of grades K-5 mathematics classes required to receive one-on-one mathematics-focused coaching?

○	Yes
○	No

42. ***[Presented only to schools that include any grades 6–8]***
Are teachers of grades 6-8 mathematics classes required to receive one-on-one mathematics-focused coaching?

○	Yes
○	No

43. ***[Presented only to schools that include any grades 9–12]***
Are teachers of grades 9-12 mathematics classes required to receive one-on-one mathematics-focused coaching?

○	Yes
○	No

44. To what extent is one-on-one mathematics-focused coaching in your school provided by each of the following? [Select one on each row.]

	Not at all		**Somewhat**		**To a great extent**
a. The principal of your school	①	②	③	④	⑤
b. An assistant principal at your school	①	②	③	④	⑤
c. District/Diocese administrators including mathematics supervisors/coordinators ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤
d. Teachers/coaches who do not have classroom teaching responsibilities	①	②	③	④	⑤
e. Teachers/coaches who have part-time classroom teaching responsibilities	①	②	③	④	⑤
f. Teachers/coaches who have full-time classroom teaching responsibilities	①	②	③	④	⑤

Thank you!

2012 National Survey of Science and Mathematics Education
Science Teacher Questionnaire

Section A. Teacher Background and Opinions

1. How many years have you taught prior to this school year: [Enter each response as a whole number (for example: 15).]

a. any subject at the K-12 level? _____
b. science at the K-12 level? _____
c. at this school, any subject? _____

2. At what grade levels do you currently teach science? [Select all that apply.]

□	K-5
□	6-8
□	9-12
□	You do not currently teach science

3. ***[Presented to self-contained teachers only]***
Which best describes the science instruction provided to the entire class?

- Do not consider pull-out instruction that some students may receive for remediation or enrichment.
- Do not consider instruction provided to individual or small groups of students, for example by an English-language specialist, special educator, or teacher assistant.

○	This class receives science instruction ***only*** from you. ***[Presented only to teachers who answered in Q2 that they teach science]***
○	This class receives science instruction from you and another teacher (for example: a science specialist or a teacher you team with). ***[Presented only to teachers who answered in Q2 that they teach science]***

4. ***[Presented to self-contained teachers only]***
Which best describes your science teaching?

○	I teach science all or most days, every week of the year.
○	I teach science every week, but typically three or fewer days each week.
○	I teach science some weeks, but typically not every week. ***[Skip to Q6]***

5. ***[Presented to self-contained teachers only]***
In a typical week, how many days do you teach lessons on each of the following subjects and how many minutes per week are spent on each subject? [Enter each response as a whole number (for example: 5, 150).]

	Number of days per week	**Total number of minutes per week**
a. Mathematics		
b. Science		
c. Social Studies		
d. Reading/Language Arts		

6. ***[Presented to self-contained teachers only]***
In a typical year, how many weeks do you teach lessons on each of the following subjects and how many minutes per week are spent on each subject? [Enter each response as a whole number (for example: 36, 150).]

	Number of weeks per year	**Average number of minutes per week when taught**
a. Mathematics		
b. Science		
c. Social Studies		
d. Reading/Language Arts		

7. ***[Presented to non-self-contained teachers only]***
In a typical week, how many different classes of each of the following do you teach?

- If you meet with the *same class of students* multiple times per week, count that class only once.
- If you teach the *same science or engineering course* to multiple classes of students, count each class separately.
- Select one on each row.

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Science (may include some engineering content)	○	○	○	○	○	○	○	○	○	○	○
Engineering (may include some science content)	○	○	○	○	○	○	○	○	○	○	○

8. ***[Presented to non-self-contained teachers only]***
For each science class you teach, select the course type and enter the number of students enrolled. Enter the classes in the order that you teach them. For teachers on an alternating day block schedule, please order your classes starting with the first class you teach this week. [Select one course type on each row and enter the number of students as a whole number (for example: 25).]

Class	**Course Type**	**Number of Students**
Your 1st science class:		
Your 2nd science class:		
…		
Your Nth science class:		

Course Type List	
1	Science (Grades K - 5)
2	Life Science (Grades 6 - 8)
3	Earth Science (Grades 6 - 8)
4	Physical Science (Grades 6 - 8)
5	General or Integrated Science (Grades 6 - 8)
6	Coordinated or Integrated Science including General Science and Physical Science (Grades 9 - 12)
7	Earth/Space Science (Grades 9 - 12)
8	Life Science/Biology (Grades 9 - 12)
9	Environmental Science/Ecology (Grades 9 - 12)
10	Chemistry (Grades 9 - 12)
11	Physics (Grades 9 - 12)

9. ***[Presented to non-self-contained grades 9–12 teachers only]***
For each grades 9-12 science class you teach, select the level that best describes the content addressed in that class.

- Use the descriptions below to help identify the level.
- Select one on each row.

Level	Description
Non-college Prep	A course that does not count towards the entrance requirements of a 4-year college. For example: Life Science.
1st Year College Prep, Including Honors	The first course in a discipline that counts towards the entrance requirements of a 4-year college. For example: Biology, Chemistry I.
2nd Year Advanced	A course typically taken after a 1st year college prep course. For example: Anatomy and Physiology, Advanced Chemistry, Physics II. Include Advanced Placement, International Baccalaureate, and concurrent college and high school credit/dual enrollment.

Class	Course Type	Non-college Prep	1st Year College Prep, Including Honors	2nd Year Advanced
Your 1st science class:	[*course type(s) teacher selected in Q8*]	○	○	○
Your 2nd science class:		○	○	○
…				
Your Nth science class:		○	○	○

10. ***[Presented to non-self-contained teachers only]***
Later in this questionnaire, we will ask you questions about your randomly selected science class, which you indicated was [*level and course type teacher selected in Q8/9*]. What is your school's title for this course? ________________________________

11. Have you been awarded one or more bachelor's and/or graduate degrees in the following fields? (With regard to bachelor's degrees, count only areas in which you majored.) [Select one on each row.]

	Yes	No
a. Education, including science education	○	○
b. Natural Sciences and/or Engineering	○	○
c. Other, please specify ____________________	○	○

12. ***[Presented only to teachers that answered "Yes" to Q11a]***
What type of education degree do you have? (With regard to bachelor's degrees, count only areas in which you majored.) [Select all that apply.]

□	Elementary Education
□	Mathematics Education
□	Science Education
□	Other Education, please specify. ___________

13. ***[Presented only to teachers that answered "Yes" to Q11b]***
What type of natural science and/or engineering degree do you have? (With regard to bachelor's degrees, count only areas in which you majored.) [Select all that apply.]

□	Biology/Life Science
□	Chemistry
□	Earth/Space Science
□	Engineering
□	Environmental Science/Ecology
□	Physics
□	Other natural science, please specify ________________

14. Did you complete any of the following types of biology/life science courses at the undergraduate or graduate level? [Select one on each row.]

		Yes	**No**
a.	General/introductory biology/life science courses (for example: Biology I, Introduction to Biology)	○	○
b.	Biology/life science courses beyond the general/introductory level	○	○
c.	Biology/life science education courses	○	○

15. ***[Presented only to teachers that answered "Yes" to Q14b]***
Please indicate which of the following biology/life science courses you completed (beyond a general/introductory course) at the undergraduate or graduate level. [Select all that apply.]

□	Anatomy/Physiology
□	Biochemistry
□	Botany
□	Cell Biology
□	Ecology
□	Evolution
□	Genetics
□	Microbiology
□	Zoology
□	Other biology/life science beyond the general/introductory level

16. Did you complete any of the following types of chemistry courses at the undergraduate or graduate level? [Select one on each row.]

		Yes	**No**
a.	General/introductory chemistry courses (for example: Chemistry I, Introduction to Chemistry)	○	○
b.	Chemistry courses beyond the general/introductory level	○	○
c.	Chemistry education courses	○	○

17. ***[Presented only to teachers that answered "Yes" to Q16b]***
Please indicate which of the following chemistry courses you completed (beyond a general/introductory course) at the undergraduate or graduate level. [Select all that apply.]

□	Analytical Chemistry
□	Biochemistry
□	Inorganic Chemistry
□	Organic Chemistry
□	Physical Chemistry
□	Quantum Chemistry
□	Other chemistry beyond the general/introductory level

18. Did you complete any of the following types of physics courses at the undergraduate or graduate level? [Select one on each row.]

	Yes	No
a. General/introductory physics courses (for example: Physics I, Introduction to Physics)	○	○
b. Physics courses beyond the general/introductory level	○	○
c. Physics education courses	○	○

19. ***[Presented only to teachers that answered "Yes" to Q18b]***
Please indicate which of the following physics courses you completed (beyond a general/introductory course) at the undergraduate or graduate level. [Select all that apply.]

□	Electricity and Magnetism
□	Heat and Thermodynamics
□	Mechanics
□	Modern or Quantum Physics
□	Nuclear Physics
□	Optics
□	Other physics beyond the general/introductory level

20. Did you complete any of the following types of Earth/space science courses at the undergraduate or graduate level? [Select one on each row.]

	Yes	No
a. General/introductory Earth/space science courses (for example: Earth Science I, Introduction to Earth Science)	○	○
b. Earth/space science courses beyond the general/introductory level	○	○
c. Earth/space science education courses	○	○

21. ***[Presented only to teachers that answered "Yes" to Q20b]***
Please indicate which of the following Earth/space science courses you completed (beyond a general/introductory course) at the undergraduate or graduate level. [Select all that apply.]

□	Astronomy
□	Geology
□	Meteorology
□	Oceanography
□	Physical Geography
□	Other Earth/space science beyond the general/introductory level

22. Did you complete any of the following types of environmental science courses at the undergraduate or graduate level? [Select one on each row.]

	Yes	No
a. General/introductory environmental science courses (for example: Environmental Science I, Introduction to Environmental Science)	○	○
b. Environmental science courses beyond the general/introductory level	○	○
c. Environmental science education courses	○	○

23. ***[Presented only to teachers that answered "Yes" to Q22b]***
Please indicate which of the following environmental science courses you completed (beyond a general/introductory course) at the undergraduate or graduate level. [Select all that apply.]

□	Conservation Biology
□	Ecology
□	Forestry
□	Hydrology
□	Oceanography
□	Toxicology
□	Other environmental science beyond the general/introductory level

24. Did you complete one or more engineering courses at the undergraduate or graduate level?

○	Yes
○	No

25. ***[Presented only to teachers that answered "Yes" to Q24b]***
Please indicate which of the following types of engineering courses you completed at the undergraduate or graduate level. [Select all that apply.]

□	Aerospace Engineering
□	Bioengineering/Biomedical Engineering
□	Chemical Engineering
□	Civil Engineering
□	Computer Engineering
□	Electrical Engineering
□	Industrial/Manufacturing Engineering
□	Mechanical Engineering
□	Other types of engineering courses

26. For each of the following areas, indicate the number of semester and/or quarter courses you completed.

- Count *courses* **not** credit hours.
- Include courses taken at the graduate or undergraduate level, as well as courses for which you received college credit while you were in high school.
- Count each course taken in high school for college credit as a one semester college course.
- Count courses that lasted multiple semesters or quarters as multiple courses.
- If your transcripts are not available, provide your best estimates.
- Enter your responses as whole numbers (for example: 3). You may either enter 0 (zero) or leave the box empty wherever applicable.

	Number of SEMESTER college courses	**Number of QUARTER college courses**
a. Interdisciplinary science (a single course that addresses content across ***multiple*** science subjects, such as biology, chemistry, physics and/or Earth science)		
b. Biology/Life science		
c. Chemistry		
d. Physics		
e. Earth/Space science		
f. Environmental science		
g. Engineering		
h. Mathematics		

27. How many of the undergraduate and graduate level science courses you completed were taken at each of the following types of institutions? (Please do not include science education courses.) [Enter each response as a whole number (for example: 15).]

a. Two-year college, community college, and/or technical school _______

b. Four-year college and/or university _______

28. Which of the following best describes your teacher certification program?

○	An undergraduate program leading to a bachelor's degree and a teaching credential
○	A post-baccalaureate credentialing program (no master's degree awarded)
○	A master's program that also awarded a teaching credential
○	You did not have any formal teacher preparation

29. When did you **last participate** in professional development (sometimes called in-service education) focused on science or science teaching? (Include attendance at professional meetings, workshops, and conferences, as well as professional learning communities/lesson studies/teacher study groups. **Do not** include formal courses for which you received college credit or time you spent **providing** professional development for other teachers.)

○	In the last 3 years	
○	4–6 years ago	} *Skip to 33*
○	7–10 years ago	
○	More than 10 years ago	
○	Never	

30. **In the last 3 years** have you… [Select one on each row.]

	Yes	**No**
a. attended a workshop on science or science teaching?	○	○
b. attended a national, state, or regional science teacher association meeting?	○	○
c. participated in a professional learning community/lesson study/teacher study group focused on science or science teaching?	○	○

31. What is the **total** amount of time you have spent on professional development in science or science teaching **in the last 3 years**? (Include attendance at professional meetings, workshops, and conferences, as well as professional learning communities/lesson studies/teacher study groups. **Do not** include formal courses for which you received college credit or time you spent **providing** professional development for other teachers.)

○	Less than 6 hours
○	6-15 hours
○	16-35 hours
○	More than 35 hours

32. Thinking about all of your science-related professional development **in the last 3 years**, to what extent does each of the following describe your experiences? [Select one on each row.]

	Not at all		**Somewhat**		**To a great extent**
a. You had opportunities to engage in science investigations.	①	②	③	④	⑤
b. You had opportunities to examine classroom artifacts (for example: student work samples).	①	②	③	④	⑤
c. You had opportunities to try out what you learned in your classroom ***and*** then talk about it as part of the professional development.	①	②	③	④	⑤
d. You worked closely with other science teachers from your school.	①	②	③	④	⑤
e. You worked closely with other science teachers who taught the same grade and/or subject whether or not they were from your school.	①	②	③	④	⑤
f. The professional development was a waste of your time.	①	②	③	④	⑤

33. When did you last take a formal course for **college credit** in each of the following areas? Do not count courses for which you received only Continuing Education Units. [Select one on each row.]

	In the last 3 years	**4 – 6 years ago**	**7 – 10 years ago**	**More than 10 years ago**	**Never**
a. Science	○	○	○	○	○
b. How to teach science	○	○	○	○	○
c. Student teaching in science	○	○	○	○	○
d. Student teaching in other subjects	○	○	○	○	○

34. ***[Presented only to teachers that have participated in professional development in the last three years as indicated in Q29, OR took a course in "Science" or "How to teach science" in the last three years as indicated in q33a/b]***

Considering all the opportunities to learn about science or the teaching of science (professional development and coursework) **in the last 3 years**, how much was each of the following emphasized? [Select one on each row.]

	Not at all		**Somewhat**		**To a great extent**
a. Deepening your own science content knowledge	①	②	③	④	⑤
b. Learning about difficulties that students may have with particular science ideas and procedures	①	②	③	④	⑤
c. Finding out what students think or already know about the key science ideas prior to instruction on those ideas	①	②	③	④	⑤
d. Implementing the science textbook/module to be used in your classroom	①	②	③	④	⑤
e. Planning instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	①	②	③	④	⑤
f. Monitoring student understanding during science instruction	①	②	③	④	⑤
g. Providing enrichment experiences for gifted students	①	②	③	④	⑤
h. Providing alternative science learning experiences for students with special needs	①	②	③	④	⑤
i. Teaching science to English-language learners	①	②	③	④	⑤
j. Assessing student understanding at the conclusion of instruction on a topic	①	②	③	④	⑤

35. In the last 3 years have you… [Select one on each row.]

	Yes	No
a. received feedback about your science teaching from a mentor/coach **formally assigned** by the school or district/diocese?	○	○
b. served as a **formally-assigned** mentor/coach for science teaching? (Please do not include supervision of student teachers.)	○	○
c. supervised a student teacher in your classroom?	○	○
d. taught in-service workshops on science or science teaching?	○	○
e. led a professional learning community/lesson study/teacher study group focused on science or science teaching?	○	○

36. ***[Presented only to grades K–5 teachers; sub-items e, f, and g for self-contained teachers only]***
Many teachers feel better prepared to teach some subject areas than others. How well prepared 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 teaching responsibilities? [Select one on each row.]

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Life Science	①	②	③	④
b. Earth Science	①	②	③	④
c. Physical Science	①	②	③	④
d. Engineering	①	②	③	④
e. Mathematics	①	②	③	④
f. Reading/Language Arts	①	②	③	④
g. Social Studies	①	②	③	④

37. ***[Presented only to grades 6–12 teachers; non-self-contained teachers shown only topics related to their randomly selected class and engineering; self-contained teachers shown all topics]***

Within science many teachers feel better prepared to teach some topics than others. How well prepared 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 teaching responsibilities? [Select one on each row.]

	Not adequately prepared	**Somewhat prepared**	**Fairly well prepared**	**Very well prepared**
a. Earth/Space Science				
i. Earth's features and physical processes	①	②	③	④
ii. The solar system and the universe	①	②	③	④
iii. Climate and weather	①	②	③	④
b. Biology/Life Science				
i. Cell biology	①	②	③	④
ii. Structures and functions of organisms	①	②	③	④
iii. Ecology/ecosystems	①	②	③	④
iv. Genetics	①	②	③	④
v. Evolution	①	②	③	④
c. Chemistry				
i. Atomic structure	①	②	③	④
ii. Chemical bonding, equations, nomenclature, and reactions	①	②	③	④
iii. Elements, compounds, and mixtures	①	②	③	④
iv. The Periodic Table	①	②	③	④
v. Properties of solutions	①	②	③	④
vi. States, classes, and properties of matter	①	②	③	④
d. Physics				
i. Forces and motion	①	②	③	④
ii. Energy transfers, transformations, and conservation	①	②	③	④
iii. Properties and behaviors of waves	①	②	③	④
iv. Electricity and magnetism	①	②	③	④
v. Modern physics (for example: special relativity)	①	②	③	④
e. Engineering (for example: nature of engineering and technology, design processes, analyzing and improving technological systems, interactions between technology and society)	①	②	③	④
f. Environmental and resource issues (for example: land and water use, energy resources and consumption, sources and impacts of pollution)	①	②	③	④

38. How well prepared do you feel to do each of the following in your science instruction? [Select one on each row.]

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	①	②	③	④
b. Teach science to students who have learning disabilities	①	②	③	④
c. Teach science to students who have physical disabilities	①	②	③	④
d. Teach science to English-language learners	①	②	③	④
e. Provide enrichment experiences for gifted students	①	②	③	④
f. Encourage students' interest in science and/or engineering	①	②	③	④
g. Encourage participation of females in science and/or engineering	①	②	③	④
h. Encourage participation of racial or ethnic minorities in science and/or engineering	①	②	③	④
i. Encourage participation of students from low socioeconomic backgrounds in science and/or engineering	①	②	③	④
j. Manage classroom discipline	①	②	③	④

39. Please provide your opinion about each of the following statements. [Select one on each row.]

	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. Inadequacies in students' science background can be overcome by effective teaching.	①	②	③	④	⑤
c. It is better for science instruction to focus on ideas in depth, even if that means covering fewer topics.	①	②	③	④	⑤
d. Students should be provided with the purpose for a lesson as it begins.	①	②	③	④	⑤
e. At the beginning of instruction on a science idea, students should be provided with definitions for new scientific vocabulary that will be used.	①	②	③	④	⑤
f. Teachers should explain an idea to students before having them consider evidence that relates to the idea.	①	②	③	④	⑤
g. Most class periods should include some review of previously covered ideas and skills.	①	②	③	④	⑤
h. Most class periods should provide opportunities for students to share their thinking and reasoning.	①	②	③	④	⑤
i. Hands-on/laboratory activities should be used primarily to reinforce a science idea that the students have already learned.	①	②	③	④	⑤
j. Students should be assigned homework most days.	①	②	③	④	⑤
k. Most class periods should conclude with a summary of the key ideas addressed.	①	②	③	④	⑤

Section B. Your Science Instruction

The rest of this questionnaire is about your science instruction in this class.

40. ***[Presented to non-self-contained teachers only]***
On average, how many minutes per week does this class meet? [Enter your response as a whole number (for example: 300).] _________

41. Enter the number of students for each grade represented in this class. [Enter each response as a whole number (for example: 15).]

Kindergarten	
1st grade	
2nd grade	
3rd grade	
4th grade	
5th grade	
6th grade	
7th grade	
8th grade	
9th grade	
10th grade	
11th grade	
12th grade	

42. For the students in this class, indicate the number of males and females in this class in each of the following categories of race/ethnicity. [Enter each response as a whole number (for example: 15).]

	Males	**Females**
a. American Indian or Alaska Native		
b. Asian		
c. Black or African American		
d. Hispanic/Latino		
e. Native Hawaiian or Other Pacific Islander		
f. White		
g. Two or more races		

43. Which of the following best describes the prior science achievement levels of the students in this class relative to other students in this school?

○	Mostly low achievers
○	Mostly average achievers
○	Mostly high achievers
○	A mixture of levels

44. How much control do you have over each of the following aspects of science instruction in this class? [Select one on each row.]

	No Control		**Moderate Control**		**Strong Control**
a. Determining course goals and objectives	①	②	③	④	⑤
b. Selecting textbooks/modules	①	②	③	④	⑤
c. Selecting content, topics, and skills to be taught	①	②	③	④	⑤
d. Selecting teaching techniques	①	②	③	④	⑤
e. Determining the amount of homework to be assigned	①	②	③	④	⑤
f. Choosing criteria for grading student performance	①	②	③	④	⑤

45. Think about your plans for this class for the entire course/year. By the end of the course/year, how much emphasis will each of the following student objectives receive? [Select one on each row.]

	None	**Minimal emphasis**	**Moderate emphasis**	**Heavy emphasis**
a. Memorizing science vocabulary and/or facts	①	②	③	④
b. Understanding science concepts	①	②	③	④
c. Learning science process skills (for example: observing, measuring)	①	②	③	④
d. Learning about real-life applications of science	①	②	③	④
e. Increasing students' interest in science	①	②	③	④
f. Preparing for further study in science	①	②	③	④
g. Learning test taking skills/strategies	①	②	③	④

46. How often do you do each of the following in your science instruction in this class? [Select one on each row.]

	Never	Rarely (for example: A few times a year)	Sometimes (for example: Once or twice a month)	Often (for example: Once or twice a week)	All or almost all science lessons
a. Explain science ideas to the whole class	①	②	③	④	⑤
b. Engage the whole class in discussions	①	②	③	④	⑤
c. Have students work in small groups	①	②	③	④	⑤
d. Do hands-on/laboratory activities	①	②	③	④	⑤
e. Engage the class in project-based learning (PBL) activities	①	②	③	④	⑤
f. Have students read from a science textbook, module, or other science-related material in class, either aloud or to themselves	①	②	③	④	⑤
g. Have students represent and/or analyze data using tables, charts, or graphs	①	②	③	④	⑤
h. Require students to supply evidence in support of their claims	①	②	③	④	⑤
i. Have students make formal presentations to the rest of the class (for example: on individual or group projects)	①	②	③	④	⑤
j. Have students write their reflections (for example: in their journals) in class or for homework	①	②	③	④	⑤
k. Give tests and/or quizzes that are predominantly short-answer (for example: multiple choice, true /false, fill in the blank)	①	②	③	④	⑤
l. Give tests and/or quizzes that include constructed-response/open-ended items	①	②	③	④	⑤
m. Focus on literacy skills (for example: informational reading or writing strategies)	①	②	③	④	⑤
n. Have students practice for standardized tests	①	②	③	④	⑤
o. Have students attend presentations by guest speakers focused on science and/or engineering in the workplace	①	②	③	④	⑤

47. Which best describes the availability of each of the following for small group (4-5 students) work in this class? [Select one on each row.]

	Do not have one per group available	At least one per group available upon request or in another room	At least one per group located in your classroom
a. Personal computers, including laptops	○	○	○
b. Hand-held computers (for example: PDAs, tablets, smartphones, iPads)	○	○	○
c. Internet access	○	○	○
d. Graphing calculators	○	○	○
e. Other calculators	○	○	○
f. Probes for collecting data (for example: motion sensors, temperature probes)	○	○	○
g. Microscopes	○	○	○
h. Classroom response system or "Clickers" (handheld devices used to respond electronically to questions in class)	○	○	○

48. For each of the following, are students expected to provide their own for use in this science class? [Select one on each row.]

	Yes	No
a. Laptop computers	○	○
b. Hand-held computers	○	○
c. Graphing calculators	○	○
d. Other calculators	○	○

49. How often do students use each of the following instructional technologies in this science class? [Select one on each row.]

	Never	Rarely (for example: A few times a year)	Sometimes (for example: Once or twice a month)	Often (for example: Once or twice a week)	All or almost all science lessons
a. Personal computers, including laptops	①	②	③	④	⑤
b. Hand-held computers	①	②	③	④	⑤
c. Internet	①	②	③	④	⑤
d. Calculators ***[Presented to grades K–5 teachers only]***	①	②	③	④	⑤
e. Graphing calculators ***[Presented to grades 6–12 teachers only]***	①	②	③	④	⑤
f. Probes for collecting data	①	②	③	④	⑤
g. Classroom response system or "Clickers"	①	②	③	④	⑤

50. Please indicate the availability of each of the following for your science instruction in this class. [Select one on each row.]

	Not available	Available in another room	Located in your classroom
a. Lab tables	○	○	○
b. Electric outlets	○	○	○
c. Faucets and sinks	○	○	○
d. Gas for burners ***[Presented to grades 9–12 teachers only]***	○	○	○
e. Fume hoods ***[Presented to grades 9–12 teachers only]***	○	○	○

51. How often are students in this class required to take science tests that you did not develop yourself, for example state assessments or district benchmarks? (Do not include Advanced Placement or International Baccalaureate exams or students retaking a test because of failure.)

○	Never
○	Once a year
○	Twice a year
○	Three or four times a year
○	Five or more times a year

52. How much science homework do you assign to this class in a typical **week**? (Do not include time that the class spends getting started on homework during class.)

○	Fewer than 15 minutes per week
○	15-30 minutes per week
○	31-60 minutes per week
○	61-90 minutes per week
○	91-120 minutes per week
○	2 to 3 hours per week
○	3-4 hours per week
○	More than 4 hours per week

53. Which best describes the instructional materials students **most frequently** use in this class?

Mainly commercially-published textbook(s)	
○	One textbook
○	Multiple textbooks
Mainly commercially-published modules	
○	Modules from a single publisher
○	Modules from multiple publishers
Other	
○	A roughly equal mix of commercially-published textbooks and commercially-published modules most of the time
○	Non-commercially-published materials most of the time ***[Skip to Q58]***

54. Please indicate the title, author, most recent copyright year, and ISBN code of the textbook/module used by the students in this class.

- The 10- or 13-character ISBN code can be found on the copyright page and/or the back cover of the textbook/module.
- Do not include the dashes when entering the ISBN.
- An example of the location of the ISBN is shown to the right.

Title:
First Author:
Year:
ISBN:

55. How would you rate the overall quality of this textbook/the modules used from this publisher?

○	Very poor
○	Poor
○	Fair
○	Good
○	Very good
○	Excellent

56. ***[Presented only to teachers who indicated using one commercially-published textbook or modules from a single publisher in Q53]***
Over the course of the school year, approximately what percentage of the science **instructional time** will students in this class spend using this textbook/these modules?

○	Less than 25%
○	25-49%
○	50-74%
○	75-90%
○	More than 90%

57. ***[Presented only to teachers who indicated using one commercially-published textbook in Q53]***
Approximately what percentage of the chapters in this textbook will students in this class engage with during the school year?

○	Less than 25%
○	25-49%
○	50-74%
○	75-90%
○	More than 90%

58. Science courses may benefit from the availability of particular kinds of ***equipment*** (for example: microscopes, beakers, photogate timers, Bunsen burners). How adequate is the ***equipment*** you have available for teaching this science class?

○	Not adequate
○	
○	Somewhat adequate
○	
○	Adequate

59. Science courses may benefit from the availability of particular kinds of ***instructional technology*** (for example: calculators, computers, probes/sensors). How adequate is the ***instructional technology*** you have available for teaching this science class?

○	Not adequate
○	
○	Somewhat adequate
○	
○	Adequate

60. Science courses may benefit from the availability of particular kinds of ***consumable supplies*** (for example: chemicals, living organisms, batteries). How adequate are the ***consumable supplies*** you have available for teaching this science class?

○	Not adequate
○	
○	Somewhat adequate
○	
○	Adequate

61. Science courses may benefit from the availability of particular kinds of ***facilities*** (for example: lab tables, electric outlets, faucets and sinks). How adequate are the ***facilities*** you have available for teaching this science class?

○	Not adequate
○	
○	Somewhat adequate
○	
○	Adequate

62. In your opinion, how great a problem is each of the following for your science instruction in this class? [Select one on each row.]

	Not a significant problem	**Somewhat of a problem**	**Serious problem**
a. Lack of access to computers	○	○	○
b. Old age of computers	○	○	○
c. Lack of access to the Internet	○	○	○
d. Unreliability of the Internet connection	○	○	○
e. Slow speed of the Internet connection	○	○	○
f. Lack of availability of appropriate computer software	○	○	○
g. Lack of availability of technology support	○	○	○

63. Please rate the effect of each of the following on your science instruction in this class. [Select one on each row.]

	Inhibits effective instruction		**Neutral or Mixed**		**Promotes effective instruction**	**N/A or Don't Know**
a. Current state standards	①	②	③	④	⑤	○
b. District/Diocese curriculum frameworks ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤	○
c. District/Diocese and/or school pacing guides	①	②	③	④	⑤	○
d. State testing/accountability policies ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤	○
e. District/Diocese testing/accountability policies ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤	○
f. Textbook/module selection policies	①	②	③	④	⑤	○
g. Teacher evaluation policies	①	②	③	④	⑤	○
h. College entrance requirements ***[Presented to grades 9–12 teachers only]***	①	②	③	④	⑤	○
i. Students' motivation, interest, and effort in science	①	②	③	④	⑤	○
j. Students' reading abilities	①	②	③	④	⑤	○
k. Community views on science instruction	①	②	③	④	⑤	○
l. Parent expectations and involvement	①	②	③	④	⑤	○
m. Principal support	①	②	③	④	⑤	○
n. Time for you to plan, individually and with colleagues	①	②	③	④	⑤	○
o. Time available for your professional development	①	②	③	④	⑤	○

Section C. Your Most Recently Completed Science Unit in this Class

The questions in this section are about the most recently completed science unit in this class.

- Depending on the structure of your class and the instructional materials you use, a unit may range from a few to many class periods.
- Do not be concerned if this unit was not typical of your instruction.

64. How many class periods were devoted to instruction on the **most recently completed science unit**? [Enter your response as a whole number (for example: 15).] ____________________

65. Which of the following best describes the content of this unit?

○	Earth/Space Science
○	Life Science/Biology
○	Environmental Science/Ecology
○	Chemistry
○	Physics
○	Engineering

66. What science ideas and/or skills were addressed in this unit? __________________________________

67. ***[Presented only to teachers who indicated using commercially-published textbooks/modules in Q53]***
Was this unit based primarily on the commercially-published textbook/modules you described earlier as the one used most often in this class?

○	Yes ***[Skip to Q70]***
○	No

68. Was this unit based on a commercially-published textbook/module?

○	Yes
○	No ***[Skip to Q74]***

69. Please indicate the title, author, most recent copyright year, and ISBN code of that textbook/module.

- The 10- or 13-character ISBN code can be found on the copyright page and/or the back cover of the textbook/module.
- Do not include the dashes when entering the ISBN.
- An example of the location of the ISBN is shown to the right.

Title:
First Author:
Year:
ISBN:

70. Please indicate the extent to which you did each of the following while teaching this unit. [Select one on each row.]

	Not at all		Somewhat		To a great extent
a. You used the textbook/module to guide the overall structure and content emphasis of the unit.	①	②	③	④	⑤
b. You followed the textbook/module to guide the detailed structure and content emphasis of the unit.	①	②	③	④	⑤
c. You picked what is important from the textbook/module and skipped the rest.	①	②	③	④	⑤
d. You incorporated activities (for example: problems, investigations, readings) from other sources to supplement what the textbook/module was lacking.	①	②	③	④	⑤

71. ***[Presented only to teachers who answered "2–5" in Q70c]***
During this unit, when you skipped activities (for example: problems, investigations, readings) in your textbook/module, how much was each of the following a factor in your decisions? [Select one on each row.]

	Not a factor	A minor factor	A major factor
a. The science ideas addressed in the activities you skipped are not included in your pacing guide and/or current state standards.	①	②	③
b. You did not have the materials needed to implement the activities you skipped.	①	②	③
c. The activities you skipped were too difficult for your students.	①	②	③
d. Your students already knew the science ideas or were able to learn them without the activities you skipped.	①	②	③
e. You have different activities for those science ideas that work better than the ones you skipped.	①	②	③

72. ***[Presented only to teachers who answered "2–5" in Q70d]***
During this unit, when you supplemented the textbook/module with additional activities, how much was each of the following a factor in your decisions? [Select one on each row.]

	Not a factor	A minor factor	A major factor
a. Your pacing guide indicated that you should use supplemental activities.	①	②	③
b. Supplemental activities were needed to prepare students for standardized tests.	①	②	③
c. Supplemental activities were needed to provide students with additional practice.	①	②	③
d. Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity.	①	②	③

73. How well prepared did you feel to do each of the following as part of your instruction on this particular unit? [Select one on each row.]

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Anticipate difficulties that students may have with particular science ideas and procedures in this unit	①	②	③	④
b. Find out what students thought or already knew about the key science ideas	①	②	③	④
c. Implement the science textbook/module to be used during this unit ***[Presented only to teachers who indicated using commercially-published textbooks/modules in Q67/68]***	①	②	③	④
d. Monitor student understanding during this unit	①	②	③	④
e. Assess student understanding at the conclusion of this unit	①	②	③	④

74. Which of the following did you do during this unit? [Select all that apply.]

□	Administered an assessment, task, or probe at the beginning of the unit to find out what students thought or already knew about the key science ideas
□	Questioned individual students during class activities to see if they were "getting it"
□	Used information from informal assessments of the entire class (for example: asking for a show of hands, thumbs up/thumbs down, clickers, exit tickets) to see if students were "getting it"
□	Reviewed student work (for example: homework, notebooks, journals, portfolios, projects) to see if they were "getting it"
□	Administered one or more quizzes and/or tests to see if students were "getting it"
□	Had students use rubrics to examine their own or their classmates' work
□	Assigned grades to student work (for example: homework, notebooks, journals, portfolios, projects)
□	Administered one or more quizzes and/or tests to assign grades
□	Went over the correct answers to assignments, quizzes, and/or tests with the class as a whole

Section D. Your Most Recent Science Lesson in this Class

The next three questions refer to the most recent science lesson in this class, whether or not that instruction was part of the unit you've just been describing. Do not be concerned if this lesson included activities and/or interruptions that are not typical (for example: a test, students working on projects, a fire drill).

75. How many minutes was that lesson? [Enter your response as a non-zero whole number (for example: 50).] __________

76. Of these minutes, how many were spent on the following: [Enter each response as a whole number (for example: 15).]

a. Non-instructional activities (for example: attendance taking, interruptions) ____
b. Whole class activities (for example: lectures, explanations, discussions)____
c. Small group work ___
d. Students working individually (for example: reading textbooks, completing worksheets, taking a test or quiz) ___

77. Which of the following activities took place during that science lesson? [Select all that apply.]

□	Teacher explaining a science idea to the whole class
□	Whole class discussion
□	Students completing textbook/worksheet problems
□	Teacher conducting a demonstration while students watched
□	Students doing hands-on/laboratory activities
□	Students reading about science
□	Students using instructional technology
□	Practicing for standardized tests
□	Test or quiz
□	None of the above

Section E. Demographic Information

78. Indicate your sex:

○	Male
○	Female

79. Are you of Hispanic or Latino origin?

○	Yes
○	No

80. What is your race? [Select all that apply.]

□	American Indian or Alaska Native
□	Asian
□	Black or African American
□	Native Hawaiian or Other Pacific Islander
□	White

81. In what year were you born? [Enter your response as a whole number (for example: 1969). Do not use commas.] __________

Thank you!

2012 National Survey of Science and Mathematics Education
Mathematics Teacher Questionnaire

Section A. Teacher Background and Opinions

1. How many years have you taught prior to this school year: [Enter each response as a whole number (for example: 15).]

a. any subject at the K-12 level? _____
b. mathematics at the K-12 level? _____
c. at this school, any subject? _____

2. At what grade levels do you currently teach mathematics? [Select all that apply.]

◻	K-5
◻	6-8
◻	9-12
◻	You do not currently teach mathematics

3. ***[Presented to self-contained teachers only]***
Which best describes the mathematics instruction provided to the entire class?

- Do not consider pull-out instruction that some students may receive for remediation or enrichment.
- Do not consider instruction provided to individual or small groups of students, for example by an English-language specialist, special educator, or teacher assistant.

○	This class receives mathematics instruction ***only*** from you. ***[Presented only to teachers who answered in Q2 that they teach mathematics]***
○	This class receives mathematics instruction from you and another teacher (for example: a mathematics specialist or a teacher you team with). ***[Presented only to teachers who answered in Q2 that they teach mathematics]***

4. ***[Presented to self-contained teachers only]***
Which best describes your mathematics teaching?

○	I teach mathematics all or most days, every week of the year.
○	I teach mathematics every week, but typically three or fewer days each week.
○	I teach mathematics some weeks, but typically not every week.

5. ***[Presented to self-contained teachers only]***
Which best describes your science teaching?

○	I teach science all or most days, every week of the year.
○	I teach science every week, but typically three or fewer days each week.
○	I teach science some weeks, but typically not every week. ***[Skip to Q7]***
○	I do not teach science.

6. ***[Presented to self-contained teachers only]***
In a typical week, how many days do you teach lessons on each of the following subjects and how many minutes per week are spent on each subject? [Enter each response as a whole number (for example: 5, 150).]

	Number of days per week	**Total number of minutes per week**
a. Mathematics		
b. Science		
c. Social Studies		
d. Reading/Language Arts		

[SKIP to Q8]

7. ***[Presented to self-contained teachers only]*** In a typical year, how many weeks do you teach lessons on each of the following subjects and how many minutes per week are spent on each subject? [Enter each response as a whole number (for example: 36, 150).]

	Number of weeks per year	**Average number of minutes per week when taught**
a. Mathematics		
b. Science		
c. Social Studies		
d. Reading/Language Arts		

8. ***[Presented to non-self-contained teachers only]***
I***n a typical week***, how many different mathematics classes do you teach?

- If you meet with the *same class of students* multiple times per week, count that class only once.
- If you teach the *same mathematics course* to multiple classes of students, count each class separately.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
○	○	○	○	○	○	○	○	○	○

9. ***[Presented to non-self-contained teachers only]***
For each mathematics class you teach, select the course type and enter the number of students enrolled in the class.

Grades 9-12 Course Type	**Example Courses**
Non-college prep mathematics courses	Developmental Math; High School Arithmetic; Remedial Math; General Math; Vocational Math; Consumer Math; Basic Math; Business Math; Career Math; Practical Math; Essential Math; Pre-Algebra; Introductory Algebra; Algebra 1 Part 1; Algebra 1A; Math A; Basic Geometry; Informal Geometry; Practical Geometry
Formal/College-prep Mathematics Level 1 courses	Algebra 1; Integrated Math 1; Unified Math I; Algebra 1 Part 2; Algebra 1B; Math B
Formal/College-prep Mathematics Level 2 courses	Geometry; Plane Geometry; Solid Geometry; Integrated Math 2; Unified Math II; Math C
Formal/College-prep Mathematics Level 3 courses	Algebra 2; Intermediate Algebra; Algebra and Trigonometry; Advanced Algebra; Integrated Math 3; Unified Math III
Formal/College-prep Mathematics Level 4 courses	Algebra 3; Trigonometry; Pre-Calculus; Analytic/Advanced Geometry; Elementary Functions; Integrated Math 4; Unified Math IV; Calculus (not including college level/AP); any other College Prep Senior Math with Algebra 2 as a prerequisite
Mathematics courses that might qualify for college	Advanced Placement Calculus (AB, BC); Advanced Placement Statistics; IB Mathematics standard level; IB Mathematics higher level; concurrent college and high school credit/dual

credit	enrollment

Class	**Course Type**	**Number of Students**
Your 1st mathematics class:		
Your 2nd mathematics class:		
…		
Your Nth mathematics class:		

Course Type List	
1	Mathematics (Grades K - 5)
2	Remedial Mathematics 6
3	Regular Mathematics 6
4	Accelerated/Pre-Algebra Mathematics 6
5	Remedial Mathematics 7
6	Regular Mathematics 7
7	Accelerated Mathematics 7
8	Remedial Mathematics 8
9	Regular Mathematics 8
10	Accelerated Mathematics 8
11	Algebra 1, Grade 7 or 8
12	Non-college prep mathematics course (Grades 9 - 12)
13	Formal/College-prep Mathematics Level 1 course (Grades 9 - 12)
14	Formal/College-prep Mathematics Level 2 course (Grades 9 - 12)
15	Formal/College-prep Mathematics Level 3 course (Grades 9 - 12)
16	Formal/College-prep Mathematics Level 4 course (Grades 9 - 12)
17	Mathematics course that might qualify for college credit (Grades 9 - 12)

10. ***[Presented to non-self-contained teachers only]***
Later in this questionnaire, we will ask you questions about your randomly selected mathematics class, which you indicated was [*course type teacher selected in Q9*]. What is your school's title for this course? _________________

11. Have you been awarded one or more bachelor's and/or graduate degrees in the following fields? (With regard to bachelor's degrees, count only areas in which you majored.) [Select one on each row.]

	Yes	**No**
a. Education, including mathematics education	○	○
b. Mathematics	○	○
c. Computer Science	○	○
d. Engineering	○	○
e. Other, please specify.____________	○	○

12. ***[Presented only to teachers that answered "Yes" to Q11a]***
What type of education degree do you have? (With regard to bachelor's degrees, count only areas in which you majored.) [Select all that apply.]

□	Elementary Education
□	Mathematics Education
□	Science Education
□	Other Education, please specify. _____________

13. For each of the following areas, indicate the number of semester and/or quarter mathematics courses you completed.

- Count *courses* **not** credit hours.
- Include courses taken at the graduate or undergraduate level, as well as courses for which you received college credit while you were in high school.
- Count each course taken in high school for college credit as a one semester college course.
- Count courses that lasted multiple semesters or quarters as multiple courses.
- If your transcripts are not available, provide your best estimates.
- Enter your responses as whole numbers (for example: 3). You may either enter 0 (zero) or leave the box empty wherever applicable.

	Number of SEMESTER college courses	**Number of QUARTER college courses**
a. Mathematics content for elementary school teachers		
b. Mathematics content for middle school teachers		
c. Mathematics content for high school teachers		
d. Integrated mathematics (a single course that addresses content across ***multiple*** mathematics subjects, such as algebra and geometry)		
e. College algebra/trigonometry/functions		
f. Abstract algebra (for example: groups, rings, ideals, fields) ***[Presented to grades 6–12 teachers only]***		
g. Linear algebra (for example: vectors, matrices, eigenvalues) ***[Presented to grades 6–12 teachers only]***		
h. Calculus		
i. Advanced calculus ***[Presented to grades 6–12 teachers only]***		
j. Real analysis ***[Presented to grades 6–12 teachers only]***		
k. Differential equations ***[Presented to grades 6–12 teachers only]***		
l. Analytic/Coordinate Geometry (for example: transformations or isometries, conic sections) ***[Presented to grades 6–12 teachers only]***		
m. Axiomatic Geometry (Euclidean or non-Euclidean) ***[Presented to grades 6–12 teachers only]***		
n. College geometry ***[Presented to grades K–5 teachers only]***		
o. Probability		
p. Statistics		
q. Number theory (for example: divisibility theorems, properties of prime numbers) ***[Presented to grades 6–12 teachers only]***		
r. Discrete mathematics (for example: combinatorics, graph theory, game theory)		
s. Other upper division mathematics		

14. For each of the following areas, indicate the number of semester and/or quarter courses you completed.

- Count *courses* **not** credit hours.
- Include courses taken at the graduate or undergraduate level, as well as courses for which you received college credit while you were in high school.
- Count each course taken in high school for college credit as a one semester college course.
- Count courses that lasted multiple semesters or quarters as multiple courses.
- If your transcripts are not available, provide your best estimates.
- Enter your responses as whole numbers (for example: 3). You may either enter 0 (zero) or leave the box empty wherever applicable.

	Number of SEMESTER college courses	**Number of QUARTER college courses**
a. Computer science		
b. Engineering		
c. Science		

15. How many of the undergraduate and graduate level mathematics courses you completed were taken at each of the following types of institutions? (Please do not include mathematics education courses.) [Enter each response as a whole number (for example: 15).]

a. Two-year college, community college, and/or technical school _______

b. Four-year college and/or university _______

16. Which of the following best describes your teacher certification program?

○	An undergraduate program leading to a bachelor's degree and a teaching credential
○	A post-baccalaureate credentialing program (no master's degree awarded)
○	A master's program that also awarded a teaching credential
○	You do not have any formal teacher preparation

17. When did you **last participate** in professional development (sometimes called in-service education) focused on mathematics or mathematics teaching? (Include attendance at professional meetings, workshops, and conferences, as well as professional learning communities/lesson studies/teacher study groups. **Do not** include formal courses for which you received college credit or time spent **providing** professional development for other teachers.)

○	In the last 3 years	
○	4–6 years ago	} *Skip to Q21*
○	7–10 years ago	} *Skip to Q21*
○	More than 10 years ago	} *Skip to Q21*
○	Never	} *Skip to Q21*

18. In the last 3 years have you… [Select one on each row.]

	Yes	**No**
a. attended a workshop on mathematics or mathematics teaching?	○	○
b. attended a national, state, or regional mathematics teacher association meeting?	○	○
c. participated in a professional learning community/lesson study/teacher study group focused on mathematics or mathematics teaching?	○	○

19. What is the **total** amount of time you have spent on professional development in mathematics or mathematics teaching **in the last 3 years**? (Include attendance at professional meetings, workshops, and conferences, as well as professional learning communities/lesson studies/teacher study groups. **Do not** include formal courses for which you received college credit or time spent **providing** professional development for other teachers.)

○	Less than 6 hours
○	6-15 hours
○	16-35 hours
○	More than 35 hours

20. Thinking about all of your mathematics-related professional development **in the last 3 years**, to what extent does each of the following describe your experiences? [Select one on each row.]

	Not at all		**Somewhat**		**To a great extent**
a. You had opportunities to engage in mathematics investigations.	①	②	③	④	⑤
b. You had opportunities to examine classroom artifacts (for example: student work samples).	①	②	③	④	⑤
c. You had opportunities to try out what you learned in your classroom ***and*** then talk about it as part of the professional development.	①	②	③	④	⑤
d. You worked closely with other mathematics teachers from your school.	①	②	③	④	⑤
e. You worked closely with other mathematics teachers who taught the same grade and/or subject whether or not they were from your school.	①	②	③	④	⑤
f. The professional development was a waste of your time.	①	②	③	④	⑤

21. When did you last take a formal course for **college credit** in each of the following areas? Do not count courses for which you received only Continuing Education Units. [Select one on each row.]

	In the last 3 years	**4 – 6 years ago**	**7 – 10 years ago**	**More than 10 years ago**	**Never**
a. Mathematics	○	○	○	○	○
b. How to teach mathematics	○	○	○	○	○
c. Student teaching in mathematics	○	○	○	○	○
d. Student teaching in other subjects	○	○	○	○	○

22. ***[Presented only to teachers that have participated in professional development in the last three years as indicated in Q17, OR took a course in "Mathematics" or "How to teach mathematics" in the last three years as indicated in q21a/b]***

Considering all the opportunities to learn about mathematics or the teaching of mathematics (professional development and coursework) **in the last 3 years**, how much was each of the following emphasized? [Select one on each row.]

	Not at all		Somewhat		To a great extent
a. Deepening your own mathematics content knowledge	①	②	③	④	⑤
b. Learning how to use hands-on activities/manipulatives for mathematics instruction	①	②	③	④	⑤
c. Learning about difficulties that students may have with particular mathematical ideas and procedures	①	②	③	④	⑤
d. Finding out what students think or already know about the key mathematical ideas prior to instruction on those ideas	①	②	③	④	⑤
e. Implementing the mathematics textbook/program to be used in your classroom	①	②	③	④	⑤
f. Planning instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	①	②	③	④	⑤
g. Monitoring student understanding during mathematics instruction	①	②	③	④	⑤
h. Providing enrichment experiences for gifted students	①	②	③	④	⑤
i. Providing alternative mathematics learning experiences for students with special needs	①	②	③	④	⑤
j. Teaching mathematics to English-language learners	①	②	③	④	⑤
k. Assessing student understanding at the conclusion of instruction on a topic	①	②	③	④	⑤

23. In the last 3 years have you… [Select one on each row.]

	Yes	No
a. received feedback about your mathematics teaching from a mentor/coach **formally assigned** by the school or district/diocese?	○	○
b. served as a **formally assigned** mentor/coach for mathematics teaching? (Please do not include supervision of student teachers.)	○	○
c. supervised a student teacher in your classroom?	○	○
d. taught in-service workshops on mathematics or mathematics teaching ?	○	○
e. led a professional learning community/lesson study/teacher study group focused on mathematics or mathematics teaching?	○	○

24. ***[Presented to self-contained teachers only]***

Many teachers feel better prepared to teach some subjects/topics than others. How well prepared do you feel to teach each of the following **at the grade level(s) you teach**, whether or not they are currently included in your teaching responsibilities? [Select one on each row.]

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Number and Operations	①	②	③	④
b. Early Algebra	①	②	③	④
c. Geometry	①	②	③	④
d. Measurement and Data Representation	①	②	③	④
e. Science	①	②	③	④
f. Reading/Language Arts	①	②	③	④
g. Social Studies	①	②	③	④

25. ***[Presented to non-self-contained teachers only]***

Within mathematics many teachers feel better prepared to teach some topics than others. How prepared 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? [Select one on each row.]

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. The number system and operations	①	②	③	④
b. Algebraic thinking	①	②	③	④
c. Functions	①	②	③	④
d. Modeling	①	②	③	④
e. Measurement	①	②	③	④
f. Geometry	①	②	③	④
g. Statistics and probability	①	②	③	④
h. Discrete mathematics	①	②	③	④

26. How well prepared do you feel to do each of the following in your mathematics instruction? [Select one on each row.]

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	①	②	③	④
b. Teach mathematics to students who have learning disabilities	①	②	③	④
c. Teach mathematics to students who have physical disabilities	①	②	③	④
d. Teach mathematics to English-language learners	①	②	③	④
e. Provide enrichment opportunities for gifted students	①	②	③	④
f. Encourage students' interest in mathematics	①	②	③	④
g. Encourage participation of females in mathematics	①	②	③	④
h. Encourage participation of racial or ethnic minorities in mathematics	①	②	③	④
i. Encourage participation of students from low socioeconomic backgrounds in mathematics	①	②	③	④
j. Manage classroom discipline	①	②	③	④

27. Please provide your opinion about each of the following statements. [Select one on each row.]

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
a. Students learn mathematics best in classes with students of similar abilities.	①	②	③	④	⑤
b. Inadequacies in students' mathematics background can be overcome by effective teaching.	①	②	③	④	⑤
c. It is better for mathematics instruction to focus on ideas in depth, even if that means covering fewer topics.	①	②	③	④	⑤
d. Students should be provided with the purpose for a lesson as it begins.	①	②	③	④	⑤
e. At the beginning of instruction on a mathematical idea, students should be provided with definitions for new vocabulary that will be used.	①	②	③	④	⑤
f. Teachers should explain an idea to students before having them investigate the idea.	①	②	③	④	⑤
g. Most class periods should include some review of previously covered ideas and skills.	①	②	③	④	⑤
h. Most class periods should provide opportunities for students to share their thinking and reasoning.	①	②	③	④	⑤
i. Hands-on activities/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned.	①	②	③	④	⑤
j. Students should be assigned homework most days.	①	②	③	④	⑤
k. Most class periods should conclude with a summary of the key ideas addressed.	①	②	③	④	⑤

Section B. Your Mathematics Instruction

The rest of this questionnaire is about your mathematics instruction in this class.

28. ***[Presented to non-self-contained teachers only]***
On average, how many minutes per week does this class meet? [Enter your response as a whole number (for example: 300).] __________

29. Enter the number of students for each grade represented in this class. [Enter each response as a whole number (for example: 15).]

Kindergarten	
1st grade	
2nd grade	
3rd grade	
4th grade	
5th grade	
6th grade	
7th grade	
8th grade	
9th grade	
10th grade	
11th grade	
12th grade	

30. For the students in this class, indicate the number of males and females in each of the following categories of race/ethnicity. [Enter each response as a whole number (for example: 15).]

	Males	**Females**
a. American Indian or Alaska Native		
b. Asian		
c. Black or African American		
d. Hispanic/Latino		
e. Native Hawaiian or Other Pacific Islander		
f. White		
g. Two or more races		

31. Which of the following best describes the prior mathematics achievement levels of the students in this class relative to other students in this school?

○	Mostly low achievers
○	Mostly average achievers
○	Mostly high achievers
○	A mixture of levels

32. How much control do you have over each of the following aspects of mathematics instruction in this class? [Select one on each row.]

	No Control		**Moderate Control**		**Strong Control**
a. Determining course goals and objectives	①	②	③	④	⑤
b. Selecting textbooks/modules	①	②	③	④	⑤
c. Selecting content, topics, and skills to be taught	①	②	③	④	⑤
d. Selecting teaching techniques	①	②	③	④	⑤
e. Determining the amount of homework to be assigned	①	②	③	④	⑤
f. Choosing criteria for grading student performance	①	②	③	④	⑤

33. Think about your plans for this class for the entire course/year. By the end of the course/year, how much emphasis will each of the following student objectives receive? [Select one on each row.]

	None	**Minimal emphasis**	**Moderate emphasis**	**Heavy emphasis**
a. Learning mathematical procedures and/or algorithms	①	②	③	④
b. Learning to perform computations with speed and accuracy	①	②	③	④
c. Understanding mathematical ideas	①	②	③	④
d. Learning mathematical practices (for example: considering how to approach a problem, justifying solutions)	①	②	③	④
e. Learning about real-life applications of mathematics	①	②	③	④
f. Increasing students' interest in mathematics	①	②	③	④
g. Preparing for further study in mathematics	①	②	③	④
h. Learning test taking skills/strategies	①	②	③	④

34. How often do you do each of the following in your mathematics instruction in this class? [Select one on each row.]

	Never	Rarely (for example: a few times a year)	Sometimes (for example: once or twice a month)	Often (for example: once or twice a week)	All or almost all mathematics lessons
a. Explain mathematical ideas to the whole class	①	②	③	④	⑤
b. Engage the whole class in discussions	①	②	③	④	⑤
c. Have students work in small groups	①	②	③	④	⑤
d. Provide manipulatives for students to use in problem-solving/investigations	①	②	③	④	⑤
e. Have students read from a mathematics textbook/program or other mathematics-related material in class, either aloud or to themselves	①	②	③	④	⑤
f. Have students consider multiple representations in solving a problem (for example: numbers, tables, graphs, pictures)	①	②	③	④	⑤
g. Have students explain and justify their method for solving a problem	①	②	③	④	⑤
h. Have students compare and contrast different methods for solving a problem	①	②	③	④	⑤
i. Have students develop mathematical proofs	①	②	③	④	⑤
j. Have students present their solution strategies to the rest of the class	①	②	③	④	⑤
k. Have students write their reflections (for example: in their journals) in class or for homework	①	②	③	④	⑤
l. Give tests and/or quizzes that are predominantly short-answer (for example: multiple choice, true/false, fill in the blank)	①	②	③	④	⑤
m. Give tests and/or quizzes that include constructed-response/open-ended items	①	②	③	④	⑤
n. Focus on literacy skills (for example: informational reading or writing strategies)	①	②	③	④	⑤
o. Have students practice for standardized tests	①	②	③	④	⑤
p. Have students attend presentations by guest speakers focused on mathematics in the workplace	①	②	③	④	⑤

35. Which best describes the availability of each of the following for small group (4-5 students) work in this class? [Select one on each row.]

	Do not have one per group available	At least one per group available upon request or in another room	At least one per group located in your classroom
a. Personal computers, including laptops	○	○	○
b. Hand-held computers (for example: PDAs, tablets, smartphones, iPads)	○	○	○
c. Internet access	○	○	○
d. Four-function calculators	○	○	○
e. Scientific calculators	○	○	○
f. Graphing calculators	○	○	○
g. Probes for collecting data (for example: motion sensors, temperature probes)	○	○	○
h. Classroom response system or "Clickers" (handheld devices used to respond electronically to questions in class)	○	○	○

36. For each of the following, are students expected to provide their own for use in this mathematics class? [Select one on each row.]

	Yes	No
a. Laptop computers	○	○
b. Hand-held computers	○	○
c. Four-function calculators	○	○
d. Scientific calculators	○	○
e. Graphing calculators	○	○

37. How often do students use each of the following instructional technologies in this mathematics class? [Select one on each row.]

	Never	Rarely (for example: A few times a year)	Sometimes (for example: once or twice a month)	Often (for example: once or twice a week)	All or almost all mathematics lessons
a. Personal computers, including laptops	①	②	③	④	⑤
b. Hand-held computers	①	②	③	④	⑤
c. Internet	①	②	③	④	⑤
d. Four-function calculators	①	②	③	④	⑤
e. Scientific calculators	①	②	③	④	⑤
f. Graphing calculators	①	②	③	④	⑤
g. Probes for collecting data	①	②	③	④	⑤
h. Classroom response system or “Clickers”	①	②	③	④	⑤

38. How often are students in this class required to take mathematics tests that you did **not** develop yourself, for example state assessments or district benchmarks? Do **not** include Advanced Placement or International Baccalaureate exams or students retaking a test because of failure.

○	Never
○	Once a year
○	Twice a year
○	Three or four times a year
○	Five or more times a year

39. How much mathematics homework do you assign to this class in a typical **week**? (Do not include time that the class spends getting started on homework during class.)

○	Fewer than 15 minutes per week
○	15-30 minutes per week
○	31-60 minutes per week
○	61-90 minutes per week
○	91-120 minutes per week
○	2 to 3 hours per week
○	3-4 hours per week
○	More than 4 hours per week

40. Which best describes the instructional materials students **most frequently** use in this class?

○	One commercially-published textbook or program most of the time
○	Multiple commercially-published textbooks/programs most of the time ***[Skip to Q42]***
○	Non-commercially-published instructional materials most of the time ***[Skip to Q46]***

41. Please indicate the title, author, most recent copyright year, and ISBN code of the textbook/program used by the students in this class.

- The 10- or 13-character ISBN code can be found on the copyright page and/or the back cover of your textbook/program.
- Do not include the dashes when entering the ISBN.
- An example of the location of the ISBN is shown to the right.

Title:
First Author:
Year:
ISBN:
[Skip to Q43]

42. Please indicate the title, author, most recent copyright year, and ISBN code of the commercially-published textbook/program used most often by the students in this class.

- The 10- or 13-character ISBN code can be found on the copyright page and/or the back cover of your textbook/program.
- Do not include the dashes when entering the ISBN.
- An example of the location of the ISBN is shown to the right.

Title:
First Author:
Year:
ISBN:

43. How would you rate the overall quality of this textbook/program?

○	Very poor
○	Poor
○	Fair
○	Good
○	Very good
○	Excellent

44. ***[Presented only to teachers who indicated using one commercially-published textbook/program in Q40]***

Over the course of the school year, approximately what percentage of the mathematics **instructional time** will students in this class spend using this textbook/program?

○	Less than 25%
○	25-49%
○	50-74%
○	75-90%
○	More than 90%

45. ***[Presented only to teachers who indicated using one commercially-published textbook/program in Q40]***

Approximately what percentage of the chapters/units in this textbook/program will students in this class engage with during the school year?

○	Less than 25%
○	25-49%
○	50-74%
○	75-90%
○	More than 90%

46. Mathematics courses may benefit from the availability of particular resources. Considering what you have available, how adequate is each of the following for teaching this mathematics class? [Select one on each row.]

	Not Adequate		Somewhat Adequate		Adequate
a. Instructional technology (for example: calculators, computers, probes/sensors)	①	②	③	④	⑤
b. Measurement tools (for example: protractors, rulers)	①	②	③	④	⑤
c. Manipulatives (for example: pattern blocks, algebra tiles)	①	②	③	④	⑤
d. Consumable supplies (for example: graphing paper, batteries)	①	②	③	④	⑤

47. In your opinion, how great a problem is each of the following for your mathematics instruction in this class? [Select one on each row.]

	Not a significant problem	Somewhat of a problem	Serious problem
a. Lack of access to computers	○	○	○
b. Old age of computers	○	○	○
c. Lack of access to the Internet	○	○	○
d. Unreliability of the Internet connection	○	○	○
e. Slow speed of the Internet connection	○	○	○
f. Lack of availability of appropriate computer software	○	○	○
g. Lack of availability of technology support	○	○	○

48. Please rate the effect of each of the following on your mathematics instruction in this class. [Select one on each row.]

	Inhibits effective instruction		Neutral or Mixed		Promotes effective instruction	N/A or Don't Know
a. Current state standards	①	②	③	④	⑤	○
b. District/Diocese curriculum frameworks ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤	○
c. District/Diocese and/or school pacing guides	①	②	③	④	⑤	○
d. State testing/accountability policies ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤	○
e. District/Diocese testing/accountability policies ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤	○
f. Textbook/program selection policies	①	②	③	④	⑤	○
g. Teacher evaluation policies	①	②	③	④	⑤	○
h. College entrance requirements ***[Presented to grades 9–12 teachers only]***	①	②	③	④	⑤	○
i. Students' motivation, interest, and effort in mathematics	①	②	③	④	⑤	○
j. Students' reading abilities	①	②	③	④	⑤	○
k. Community views on mathematics instruction	①	②	③	④	⑤	○
l. Parent expectations and involvement	①	②	③	④	⑤	○
m. Principal support	①	②	③	④	⑤	○
n. Time for you to plan, individually and with colleagues	①	②	③	④	⑤	○
o. Time available for your professional development	①	②	③	④	⑤	○

Section C. Your Most Recently Completed Mathematics Unit in this Class

The questions in this section are about the most recently completed mathematics unit in this class.

- Depending on the structure of your class and the instructional materials you use, a unit may range from a few to many class periods.
- Do not be concerned if this unit was not typical of your instruction.

49. How many class periods were devoted to instruction on the **most recently completed mathematics unit**? [Enter your response as a whole number (for example: 15).] ____________

50. Which of the following best describes the content focus of this unit?

○	Number and Operations
○	Measurement and Data Representation
○	Algebra
○	Geometry
○	Probability
○	Statistics
○	Trigonometry
○	Calculus

51. What mathematical ideas and/or skills were addressed in this unit? ____________________________

52. ***[Presented only to teachers who indicated using commercially-published textbooks/programs in Q40]***
Was this unit based primarily on the commercially-published textbook/program you described earlier as the one most used in this class?

○	Yes ***[Skip to Q55]***
○	No

53. Was this unit based on a commercially-published textbook/program?

○	Yes
○	No ***[Skip to Q59]***

54. Please indicate the title, author, most recent copyright year, and ISBN code of that textbook/program.

- The 10- or 13-character ISBN code can be found on the copyright page and/or the back cover of the textbook/module.
- Do not include the dashes when entering the ISBN.
- An example of the location of the ISBN is shown to the right.

Title:
First Author:
Year:
ISBN:

55. Please indicate the extent to which you did each of the following while teaching this unit. [Select one on each row.]

	Not at all		Somewhat		To a great extent
a. You used the textbook/program to guide the overall structure and content emphasis of the unit.	①	②	③	④	⑤
b. You followed the textbook/program to guide the detailed structure and content emphasis of the unit.	①	②	③	④	⑤
c. You picked what is important from the textbook/program and skipped the rest.	①	②	③	④	⑤
d. You incorporated activities (for example: problems, investigations, readings) from other sources to supplement what the textbook/program was lacking.	①	②	③	④	⑤

56. ***[Presented only to teachers who answered "2–5" in Q55c]***
During this unit, when you skipped activities (for example: problems, investigations, readings) in your textbook/program, how much was each of the following a factor in your decisions? [Select one on each row.]

	Not a factor	A minor factor	A major factor
a. The mathematical ideas addressed in the activities you skipped are not included in your pacing guide and/or current state standards.	①	②	③
b. You did not have the materials needed to implement the activities you skipped.	①	②	③
c. The activities you skipped were too difficult for your students.	①	②	③
d. Your students already knew the mathematical ideas or were able to learn them without the activities you skipped.	①	②	③
e. You have different activities for those mathematical ideas that work better than the ones you skipped.	①	②	③

57. ***[Presented only to teachers who answered "2–5" in Q55d]***
During this unit, when you supplemented the textbook/program with additional activities, how much was each of the following a factor in your decisions? [Select one on each row.]

	Not a factor	A minor factor	A major factor
a. Your pacing guide indicated that you should use supplemental activities.	①	②	③
b. Supplemental activities were needed to prepare students for standardized tests.	①	②	③
c. Supplemental activities were needed to provide students with additional practice.	①	②	③
d. Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity.	①	②	③

58. How well prepared did you feel to do each of the following as part of your instruction on this particular unit? [Select one on each row.]

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Anticipate difficulties that students will have with particular mathematical ideas and procedures in this unit	①	②	③	④
b. Find out what students thought or already knew about the key mathematical ideas	①	②	③	④
c. Implement the mathematics textbook/ program to be used during this unit ***[Presented only to teachers who indicated using a commercially-published textbook/program in Q52/53]***	①	②	③	④
d. Monitor student understanding during this unit	①	②	③	④
e. Assess student understanding at the conclusion of this unit	①	②	③	④

59. Which of the following did you do during this unit? [Select all that apply.]

□	Administered an assessment, task, or probe at the beginning of the unit to find out what students thought or already knew about the key mathematical ideas
□	Questioned individual students during class activities to see if they were “getting it”
□	Used information from informal assessments of the entire class (for example: asking for a show of hands, thumbs up/thumbs down, clickers, exit tickets) to see if students were “getting it”
□	Reviewed student work (for example: homework, notebooks, journals, portfolios, projects) to see if they were “getting it”
□	Administered one or more quizzes and/or tests to see if students were “getting it”
□	Had students use rubrics to examine their own or their classmates’ work
□	Assigned grades to student work (for example: homework, notebooks, journals, portfolios, projects)
□	Administered one or more quizzes and/or tests to assign grades
□	Went over the correct answers to assignments, quizzes, and/or tests with the class as a whole

Section D. Your Most Recent Mathematics Lesson in this Class

The next three questions refer to the most recent mathematics lesson in this class, whether or not that instruction was part of the unit you’ve just been describing. Do not be concerned if this lesson included activities and/or interruptions that are not typical (for example: a test, students working on projects, a fire drill).

60. How many minutes was that lesson? [Enter your response as a non-zero whole number (for example: 50).] ____________________

61. Of these minutes, how many were spent on the following: [Enter each response as a whole number (for example: 15).]

a. Non-instructional activities (for example: attendance taking, interruptions) ____
b. Whole class activities (for example: lectures, explanations, discussions) ____
c. Small group work ___
d. Students working individually (for example: reading textbooks, completing worksheets, taking a test or quiz) ___

62. Which of the following activities took place during that mathematics lesson? [Select all that apply.]

◻	Teacher explaining a mathematical idea to the whole class
◻	Whole class discussion
◻	Students completing textbook/worksheet problems
◻	Teacher conducting a demonstration while students watched
◻	Students doing hands-on/manipulative activities
◻	Students reading about mathematics
◻	Students using instructional technology
◻	Practicing for standardized tests
◻	Test or quiz
◻	None of the above

Section E. Demographic Information

63. Indicate your sex:

○	Male
○	Female

64. Are you of Hispanic or Latino origin?

○	Yes
○	No

65. What is your race? [Select all that apply.]

◻	American Indian or Alaska Native
◻	Asian
◻	Black or African American
◻	Native Hawaiian or Other Pacific Islander
◻	White

66. In what year were you born? [Enter your response as a whole number (for example: 1969). Do not use commas.] __________

Thank you!

APPENDIX C

Pre-Data Collection Communication

State Chief Letter

District Superintendent Letter

Principal Letter

Study Description

How to Designate a School Coordinator

E-mail Message to School Coordinator

Teacher Listing Form

Teacher Listing Form Instructions

School Coordinator Questionnaire

Endorsed By:

- American Association of Physics Teachers
- American Chemical Society, Education Division
- American Federation of Teachers
- Association of Mathematics Teacher Educators
- Association of State Supervisors of Mathematics
- Center for the Study of Mathematics Curriculum
- Council of State Science Supervisors
- National Association of Biology Teachers
- National Association of Elementary School Principals
- National Association of Secondary School Principals
- National Catholic Education Association
- National Council of Supervisors of Mathematics
- National Council of Teachers of Mathematics
- National Earth Science Teachers Association
- National Education Association
- National School Boards Association
- National Science Education Leadership Association
- National Science Teachers Association

State Chief Letter

[Date]

[State chief name]
[Title]
[Address]

Dear [Mr./Ms.] [State Chief last name]:

I am writing to let you know about the 2012 National Survey of Science and Mathematics Education being conducted by Horizon Research, Inc. This study is the fifth in a series dating back to a 1977 study commissioned by the National Science Foundation. The 2012 National Survey will assess changes over time and provide current national estimates on essential elements of the science and mathematics education system, which will inform future education policy and practice. A one-page summary of the study is enclosed. The survey has been endorsed by a number of professional organizations, including the Association of State Supervisors of Mathematics and the Council of State Science Supervisors; these groups are providing input into the content of the questionnaire and will be involved in the dissemination of the study results.

A nationally representative sample of 2,000 schools has been selected to participate. We will begin contacting district superintendents and principals for permission in January 2011 and compiling lists of mathematics and science teachers in the sampled schools in September 2011. Questionnaire administration will begin in November 2011; a random sample of five teachers in each sampled school will be asked to complete a 30–40 minute web-based survey focused on either mathematics or science instruction. Each teacher will receive a $25 honorarium. *No data will be collected from students, and there will be no intrusion on the instructional day.*

We are excited to begin this important national study and look forward to working with the sampled schools in «Statename». If you have any questions about the study, I hope you will not hesitate to contact me by phone (toll free, 877-297-6829) or email (nssme@horizon-research.com).

Best regards,

Iris R. Weiss
President
Principal Investigator for the 2012 NSSME

District Superintendent Letter

[Date]

[Superintendent name]
[Professional Title]
[District name]
[District address]

Dear [Mr./Ms.] [principal last name] (or current Superintendent):

I am writing to inform you about the 2012 National Survey of Science and Mathematics Education being conducted by Horizon Research, Inc. This study is the fifth in a series dating back to a 1977 study commissioned by the National Science Foundation. The 2012 National Survey will assess change over time and provide current data on essential elements of the science and mathematics education system, which will inform future education policy and practice. A one-page summary of the study is enclosed.

A nationally representative sample of approximately 2,000 schools has been selected to participate, including the school(s) in [District Name] listed on the enclosed page. We plan to begin contacting school principals in the coming weeks and compiling lists of mathematics and science teachers in the sampled schools in September 2011. We will randomly sample approximately five teachers from each school. Data collection with teachers will begin in December 2011.

We want to assure you that *no data will be collected from students, and there will be no intrusion on the instructional day*. Each teacher will receive a $25 honorarium for completing the questionnaire.

We are excited to begin this important national study and look forward to working with the sampled schools in [District Name]. If you have any questions about the study, please call [Staff Assigned] (toll free, 877-297-6829) or email (nssme@horizon-research.com).

Best regards,

Kiira Campbell
Research Associate
2012 National Survey of Science and Mathematics Education

Principal Letter

[Date]

[principal name]
Principal
[school name]
[school address]

Dear [Mr./Ms.] [principal last name] (or current Principal):

I am writing to let you know that [school name] has been randomly selected to participate in the 2012 National Survey of Science and Mathematics Education (NSSME). A total of 2,000 public and private schools and 10,000 K–12 teachers throughout the United States will be involved in the study. The 2012 NSSME is the fifth in a series of surveys dating back to a 1977 study commissioned by the National Science Foundation. The 2012 NSSME, conducted by Horizon Research, Inc. under the direction of Dr. Iris Weiss, will assess changes over time and provide current data on essential elements of the science and mathematics education system. A one-page summary of the study is enclosed.

We have designed the study to strictly avoid intrusions on the instructional day and to place minimal burden on principals and teachers. In addition, ***no data will be collected from students***. Approximately five teachers per school will be asked to complete a web-based questionnaire, which we anticipate will take 30–40 minutes. (Teachers will have the option of requesting a paper-and-pencil version of the questionnaire.) Each teacher will receive a $25 honorarium for completing the survey.

At this time, we are asking you to designate a school coordinator, who will receive a stipend of up to $200 to provide a list of science and mathematics teachers and facilitate communication with sampled teachers during the data collection phase of the study. (See instructions for designating a coordinator on the enclosed page.) In September 2011, we will ask the coordinator to list all teachers at the school whose assignment includes mathematics or science. Using this list, we will randomly select teachers to complete the questionnaire. In November 2011, we will begin administering the web-based questionnaires.

Your participation is voluntary, but very important and greatly appreciated. If you have any questions about the study, please call me (toll free, 877-297-6829) or email (nssme@horizon-research.com).

Sincerely,

Kiira Campbell
Research Associate

Enc.

2012 National Survey of Science and Mathematics Education
Study Description

In response to numerous requests for information regarding the status of science and mathematics education in the United States, Horizon Research, Inc. is conducting the 2012 National Survey of Science and Mathematics Education (NSSME). This study is the fifth in a series of surveys dating back to a 1977 study commissioned by the National Science Foundation. The 2012 NSSME will assess changes over time and provide current data on essential elements of the science and mathematics education system that will inform future education policy and practice.

Focus of the Study
The study will address the following research questions:

1. To what extent do science and mathematics instruction and ongoing assessment mirror current understanding of learning?
2. What influences teachers' decisions about content and pedagogy?
3. What are the characteristics of the mathematics/science teaching force in terms of race, gender, age, content background, beliefs about teaching and learning, and perceptions of preparedness?
4. What are the most commonly used textbooks/programs, and how are they used?
5. What formal and informal opportunities do mathematics/science teachers have for ongoing development of their knowledge and skills?
6. How are resources for mathematics/science education, including well-prepared teachers and course offerings, distributed among schools in different types of communities and different socioeconomic levels?

In order to answer these questions, the study will collect survey information on teacher content background and demographics, textbook/program usage; science and mathematics course offerings and enrollments, instructional strategies, formative assessment, and the influences of particular policies such as the No Child Left Behind legislation on science and mathematics education. No information that would identify a teacher, school, district, or state will be released or reported.

Minimal Burden on Principals and Teachers
We have designed the study to avoid intrusions on the instructional day and to place minimal burden on principals and teachers; ***no data will be collected from students***. Principals will designate a school coordinator, who will receive a stipend of up to $200 to provide lists of teachers, facilitate communication during the data collection phase of the study, and identify individuals to complete program-level questionnaires for science and mathematics. Teachers (approximately five per school) will be asked to fill out a web-based questionnaire, which we anticipate will take most teachers 30–40 minutes to complete. They will have the option of requesting a paper-and-pencil version of the questionnaire. Each teacher will receive a $25 stipend for completing the survey.

Timeline
Contact with schools will begin in February 2011, and teacher data collection will take place from September 2011 to May 2012.

Benefit to Science and Mathematics Education
The 2012 NSSME will help monitor trends in key areas, collect data on emerging policy issues, determine how science and mathematics teachers compare to teachers overall, and delve deeper in selected areas such as the nature of instruction. The results of the study will inform policy, programmatic decisions, and future education research. In order to reach a broad audience, survey findings will be disseminated through technical reports, research journals, and publications aimed at education practitioners and policy makers.

How to Designate a School Coordinator

[school name]

After you have designated a school coordinator for the 2012 National Survey of Science and Mathematics Education (NSSME) and confirmed his or her willingness to serve in this capacity, please visit the following website to provide the individual's contact information:

www.nssme.org

The site will prompt you for a username and password.

Username: [username]

Password: [password]

If you have problems accessing the site or completing the form, please call me (toll free, 877-297-6829 ext.) or email (nssme@horizon-research.com).

Thank you for participating in the 2012 National Survey of Science and Mathematics Education!

E-mail Message to School Coordinator

Dear [title] [lastname]:

As you may recall, [school name] was selected to participate in the 2012 National Survey of Science and Mathematics Education (NSSME). You can read about the study at www.horizon-research.com/2012nssme. Please print this email message and keep it handy, as it includes several important details about the study.

According to our records, you were designated as the school coordinator for the study. Coordinators will receive up to $200 for providing information about the school and for facilitating communication with teachers. This honorarium will come to you in several installments.

Within the next two weeks, we ask that you do three things: 1) provide a list of all the teachers in your school who teach mathematics, science, and/or engineering (We will use this list to randomly sample approximately five teachers to complete the teacher questionnaire later in the school year.); 2) designate individuals to complete the Mathematics Program Questionnaire and the Science Program Questionnaire; and 3) complete a brief questionnaire about the school. We will send you a check for $100 (the first installment of your honorarium) within four weeks of completing these three tasks.

The form for providing this information is online. To access this form and instructions for completing it, please click the link below or copy and paste it into your web browser. Please make note of your user name and password (password is case-sensitive).

www.nssme.org
user name: [username]
password: [password]

Sampled teachers will receive a $25 honorarium for completing the teacher questionnaire. We will ask you to communicate with teachers and encourage them to respond to the questionnaire. At the conclusion of data collection, you will receive $10 for each completed teacher questionnaire. Individuals who complete the Mathematics and/or Science Program Questionnaires will receive a $15 honorarium, and you will receive an additional $10 for each of these completed questionnaires.

I hope you will not hesitate to contact me by email [staff email address] or by phone Monday through Friday between 8:30 AM and 5:00 PM EST (toll free, 877-297-6829). I look forward to working with you on this important national study.

[staff name]

Teacher Listing Form

2012 National Survey of Science and Mathematics Education
[School Name]
Coordinator: [Coordinator Name]

You should have received, or will receive shortly, an email explaining the responsibilities of the study coordinator. Please refer to that email before continuing.

Our records show [Coordinator Name] as the coordinator for this school. If this has changed, please contact Kiira Campbell, via email at nssme@horizon-research.com or (toll free) 877-297-6829 ext. 206 before completing this form so that we can note the change.

Throughout this form, you can hover the cursor over highlighted text[1] for definitions and examples.

On the next several screens, you will be asked to enter the names of all mathematics, science, and engineering teachers in your school. Additionally, you will indicate whether each person is a self-contained teacher,[2] and the subjects s/he teaches. We will use this teacher list to randomly select a sample of approximately seven (7) teachers to receive a questionnaire.

Before clicking "Continue," it is important that you view and print this one page set of instructions[3]. (The instructions are in PDF format, which requires Adobe Acrobat Reader. If you don't already have Acrobat Reader, you can download it for free from Adobe's website.)

[Continue]

Next Screen

Responses are required for all items on this page.

Do you [Coordinator Name] teach one or more classes of K–12 mathematics, science, and/or engineering[4] at this school during the 2011-2012 school year?

- o Yes
- o No

Does the principal [Principal Name] teach one or more classes of K–12 mathematics, science, and/or engineering at this school during the 2011–2012 school year?

- o Yes
- o No

---

[1] The content of hover text is included as footnotes. For example, this hover text said "Definitions and Examples."
[2] A *self-contained* teacher teaches multiple subjects to a single class of students all or most of the day.
[3] One page instructions were included as a link to a PDF in the online form. See "Teacher Listing Form Instructions" for the instructions page.
[4] Includes K–12 teachers expected to teach mathematics, science, and/or engineering regardless of how much instructional time they devote to these subjects. It does **not** include pre-kindergarten teachers, teacher assistants, 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.

What grades are included in this school?

- ☐ Pre-K
- ☐ K
- ☐ 1st
- ☐ 2nd
- ☐ 3rd
- ☐ 4th
- ☐ 5th
- ☐ 6th
- ☐ 7th
- ☐ 8th
- ☐ 9th
- ☐ 10th
- ☐ 11th
- ☐ 12th

[Save and Continue]

Next Screen

Teacher Listing Form

You indicated that you are responsible for <u>teaching K–12 mathematics, science, and/or engineering</u> during the 2011-2012 school year. Please indicate the type(s) of class(es) you teach.

Teacher Name
Personal title: [**Personal title]**
First name: [**First name]**
Last name: [**Last name]**

Teaching Responsibilities
Self-contained (any grade), select all that apply:
Typically, these are elementary teachers. A self-contained teacher teaches multiple subjects to a single class of students all or most of the day.

- ☐ Mathematics
- ☐ Science

Not self-contained (often referred to as "departmentalized"), select all that apply:
Typically, these are middle and high-school teachers. A teacher who is not self-contained teaches mathematics, science and/or engineering (and perhaps other subjects) to several different classes of students all or most of the day.

- ☐ High School Physics or Chemistry[5]
- ☐ Other Science[6]
- ☐ Engineering[7]
- ☐ High School Calculus or Advanced Mathematics[8]
- ☐ Other Mathematics[9]

[Save and Continue]

Next Screen

Teacher Listing Form

You indicated that the principal is responsible for teaching K–12 mathematics, science, and/or engineering during the 2011-2012 school year. Please indicate the type(s) of class(es) s/he teaches.

Teacher Name
Personal Title[10]: [Blank field for entering personal title]
First name: [Blank field for entering first name]
Last name: [Blank field for entering last name]

Teaching Responsibilities
Self-contained (any grade), select all that apply:
Typically, these are elementary teachers. A self-contained teacher teaches multiple subjects to a single class of students all or most of the day.

- ☐ Mathematics
- ☐ Science

[5] This category includes such courses as: First-year Chemistry, Advanced Chemistry, Advanced Placement Chemistry, Physics I and Advanced Physics.
[6] This category includes such courses as: Biology, Earth Science, Physical Science, Integrated Science, and General Science.
[7] This category includes such courses as: Engineering and Computer Applications, Engineering Design, Principles of Engineering, Technological Systems, and Technology and Society.
[8] This category includes such courses as: Pre-Calculus, Calculus, Algebra 3, Analytic Geometry, Trigonometry, Math IV, and any other College Prep Senior Math with Algebra 2 as a prerequisite.
[9] This category includes such courses as: General Math, Basic Math, Algebra 1, Algebra 2, Geometry, Integrated Math I-III, and Unified Math I-III.
[10] (For example, Dr., Ms.)

Not self-contained (often referred to as "departmentalized"), select all that apply:
Typically, these are middle and high-school teachers. A teacher who is not self-contained teaches mathematics, science and/or engineering (and perhaps other subjects) to several different classes of students all or most of the day.

- ☐ High School Physics or Chemistry
- ☐ Other Science
- ☐ Engineering
- ☐ High School Calculus or Advanced Mathematics
- ☐ Other Mathematics

[Save and Continue] [Save, all eligible teachers are entered]

Teacher list so far...

	Self-contained (Any Grades)		NOT Self-contained					
Teacher	Mathematics	Science	High School Physics or Chemistry	Other Science	Engineering	High School Calculus or Advanced Mathematics	Other Mathematics	
[Coordinator Name]						X	X	Edit

Next Screen

Teacher Listing Form

Success: Teacher's data were saved

Enter all K–12 teachers **at this school** who are expected to teach mathematics, science, and/or engineering regardless of how much instructional time they devote to these subjects. Do **not** include pre-Kindergarten teachers, teacher assistants, or teachers responsible only for special education or "pull-out" classes for remediation or enrichment of students who also receive science/mathematics instructions from the regular class room teacher.

For the purposes of this survey, the following are ***not*** considered science or mathematics courses: Computer Science, Health, Hygiene, Technology Education, Business, Career-technical education (CTE) courses that cover such things as automotive repair or audio/video production.

Teacher Name
Personal Title: [Blank field for entering personal title]
First name: [Blank field for entering first name]
Last name: [Blank field for entering last name]

Teaching Responsibilities
Self-contained (any grade), select all that apply:
Typically, these are elementary teachers. A self-contained teacher teaches multiple subjects to a single class of students all or most of the day.

- ☐ Mathematics
- ☐ Science

Not self-contained (often referred to as "departmentalized"), select all that apply:
Typically, these are middle and high-school teachers. A teacher who is not self-contained teaches mathematics, science and/or engineering (and perhaps other subjects) to several different classes of students all or most of the day.

- ☐ High School Physics or Chemistry
- ☐ Other Science
- ☐ Engineering
- ☐ High School Calculus or Advanced Mathematics
- ☐ Other Mathematics

[Save and Continue] [Save, all eligible teachers are entered]

Teacher list so far...

	Self-contained (Any Grades)		NOT Self-contained					
Teacher	Mathematics	Science	High School Physics or Chemistry	Other Science	Engineering	High School Calculus or Advanced Mathematics	Other Mathematics	
[Coordinator Name]						X	X	Edit
[Principal Name]			X	X				Edit

Next Screen

Teacher Listing Form

Review and Confirm
You provided information for [Number of teachers] teacher(s) including yourself. Please review.
If the list is correct and complete, click "List is correct. Continue."
If you need to make corrections, click "Make corrections".

	Self-contained (Any Grades)		NOT Self-contained						
Teacher	Mathematics	Science	High School Physics or Chemistry	Other Science	Engineering	High School Calculus or Advanced Mathematics	Other Mathematics		
[Coordinator Name]						X	X	Edit	
[Principal Name]			X	X				Edit	
[Teacher 1]					X			Edit	Delete
[Teacher 2]				X			X	Edit	Delete

[Make Corrections] [List is correct. Continue.]

Mathematics Program Questionnaire

Please designate someone to complete the Mathematics Program Questionnaire. If possible, this questionnaire should be completed by the mathematics department chair or a mathematics lead teacher. The person completing this questionnaire should have a broad understanding of mathematics instruction within your school. You may select someone from the list below, or select "other" and enter a new name.

Response required.

MATHEMATICS Program Questionnaire Designee:

- [Coordinator Name]
- [Principal Name]
- [Teacher 1]
- [Teacher 2]
- Other (please specify below):

First name: [Blank field for entering first name]
Last name: [Blank field for entering last name]

[Save and Continue]

Next Screen

Science Program Questionnaire

Success: Mathematics Program Questionnaire designation saved.

Please designate someone to complete the Science Program Questionnaire. If possible, this questionnaire should be completed by the science department chair or a science lead teacher. The person completing this questionnaire should have a broad understanding of science instruction within your school. You may select someone from the list below, or select "other" and enter a new name.

Response required.

SCIENCE Program Questionnaire Designee:

- o [Coordinator Name]
- o [Principal Name]
- o [Teacher 1]
- o [Teacher 2]
- o Other (please specify below):

First name: [Blank field for entering first name]
Last name: [Blank field for entering last name]

[Save and Continue]

Teacher Listing Form Instructions

Instructions for Completing the Teacher List

1. *Include* all K–12 teachers who are expected to teach mathematics, science, and/or engineering, regardless of how much instructional time they devote to these subjects. Only these teachers are *eligible* to complete the survey.
2. *Do not include* pre-Kindergarten teachers, teacher assistants, 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. These teachers are *ineligible* for the survey.
3. For the purposes of this study, *the following are not considered science or mathematics courses*: Computer Science, Health, Hygiene, Technology Education, Business, Career-technical education (CTE) courses that cover such things as automotive repair or audio/video production.

Important Terms

"Self-contained" vs. "Not Self-contained"
A *self-contained* teacher teaches multiple subjects to a single class of students all or most of the day. Elementary teachers often are self-contained. A teacher who is *not self-contained* (sometimes called "departmentalized") teaches mathematics, science and/or engineering (and perhaps other subjects) to several different classes of students all or most of the day. Middle and high school teachers typically are *not* self-contained.

"High School Calculus or Advanced Mathematics"
This category includes such courses as: Pre-Calculus, Calculus, Algebra 3, Analytic Geometry, Trigonometry, Math IV, and any other College Prep Senior Math with Algebra 2 as a prerequisite.

"Other Mathematics"
This category includes such courses as: General Math, Basic Math, Algebra 1, Algebra 2, Geometry, Integrated Math I-III, and Unified Math I-III.

"High School Physics or Chemistry"
This category includes such courses as: First-year Chemistry, Advanced Chemistry, Advanced Placement Chemistry, Physics I and Advanced Physics.

"Other Science"
This category includes such courses as: Biology, Earth Science, Physical Science, Integrated Science, and General Science.

"Engineering"
This category includes such courses as: Engineering and Computer Applications, Engineering Design, Principles of Engineering, Technological Systems, and Technology and Society.

School Coordinator Questionnaire
PREVIEW VERSION

If you make a mistake while completing the web-based questionnaire and are unable to correct it, please email Kiira Campbell at nssme@horizon-research.com or call her toll-free at 877-297-6829.

1. How many students are currently enrolled in each of the following grades in your school?

	Number of Students
Pre-Kindergarten	
Kindergarten	
1st grade	
2nd grade	
3rd grade	
4th grade	
5th grade	
6th grade	
7th grade	
8th grade	
9th grade	
10th grade	
11th grade	
12th grade	
Ungraded	

2. Please indicate the number of students in this school in each of the following categories: (Please count each student only once.)

	Number of Students
American Indian or Alaska Native	
Asian	
Black or African American	
Hispanic/Latino	
Native Hawaiian or Other Pacific Islander	
White	
Two or more races	

3. How many…

	Number
a. students in your school are eligible for free or reduced-price lunch?	
b. students in this school have an Individualized Education Plan (IEP)?	
c. students in your school receive special education services for learning disabilities?	
d. students in your school are classified as English-language learners?	
e. languages other than English are spoken by families of students in this school?	

4. **Which of the following best describes your school?** Select one. *[Public Schools Only]*

○	A regular school (not including magnet or charter school) *Skip to Question 7*
○	A charter school (a school that is in accordance with an enabling state statute, has been granted a charter exempting it from selected state or local rules and regulations)
○	A special program school or magnet school (such as a foreign language immersion school)

5. **Does your school have a special focus on one or more of the STEM fields: science, technology, engineering, mathematics?** Select one. *[Public Schools Only]*

○ Yes	
○ No	*Skip to Question 7*

6. **On which of the following is your school's special program or magnet focused?** Select all that apply. *[Public Schools Only]*

□	Engineering.
□	Mathematics.
□	Science, including health professions.
□	Technology, including Tech Prep.

7. **Does your school use block scheduling (class periods scheduled to create extended blocks of instructional time) to organize most classes?** Select one.

○ Yes
○ No

8. **Does your school have one or more computer labs?** Select one.

○ Yes	
○ No	*Skip to Question 10*

9. **How many computers are in the computer lab(s) (do not include computers that do not work)?** (If there is more than one lab, enter the total across all labs. Do not include computers that do not work.) Select one.

1–5	6–10	11 – 15	16–20	21–25	26–30	31+
○	○	○	○	○	○	○

10. **Does your school have…** Select one on each row.

	Yes	No
a. laptop carts available for teachers to use with their classes?	○	○
b. Wi-Fi?	○	○

Thank You!

APPENDIX D

Description of Data Collection

Study Endorsements

Advance Notification

School Recruitment

Teacher and Program Surveys

Prompting Respondents

Response Rates

Data Retrieval

Data Cleaning

Description of Data Collection

Study Endorsements

Prior to school recruitment, study endorsements were solicited from many national professional organizations in an effort to encourage participation. In the fall of 2010, each organization was sent a letter briefly describing the study and asking for input on the survey instruments. The letter included a link to a website where representatives could view the surveys. The following organizations provided letters of endorsement, and their names were included on the study stationery.

American Association of Physics Teachers
American Chemical Society, Education Division
American Federation of Teachers
Association of Mathematics Teacher Educators
Association of State Supervisors of Mathematics
Center for the Study of Mathematics Curriculum
Council of State Science Supervisors
National Association of Biology Teachers
National Association of Elementary School Principals
National Association of Secondary School Principals
National Catholic Education Association
National Council of Supervisors of Mathematics
National Council of Teachers of Mathematics
National Earth Science Teachers Association
National Education Association
National School Boards Association
National Science Education Leadership Association
National Science Teachers Association

Advance Notification

In January 2011, notification letters were mailed to the Chief State School Officers, advising them of the format and schedule of the study. 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 HRI if they had any questions or concerns.

HRI identified 154 school districts in the sample that had a formal research approval process. HRI prepared and submitted research applications according to each district's requirements and then followed up with research coordinators throughout the approval process. Of the 154 districts, 114 approved the study. Those that declined cited lack of time and misalignment with the district's own research priorities as reasons.

School Recruitment

In February 2011, a pre-survey packet was sent to the principal of each sampled school that had not refused participation at the district level. The pre-survey packet consisted of a cover letter from HRI describing the school's involvement, a one-page summary of the study, and instructions for logging on to the study website and designating a school contact person or "school coordinator." The school coordinator designation page was designed to confirm the principal's contact information as well as to obtain the name, title, phone number, and email address of the coordinator. As an incentive, school coordinators were offered an honorarium of up to $200 ($100 for completing a teacher list and school questionnaire, $15 for completing each program questionnaire (optional), and $10 for each completed teacher questionnaire). Teachers were offered a $25 honorarium for completing the teacher questionnaire.

A small percentage of schools responded to the letter by going to the study website and designating a coordinator. Anticipating the lack of response, HRI contracted with a telephone call center to follow up with non-responding schools. If a principal had not responded within two weeks of receiving the letter, the call center began calling the school. Generally, a series of telephone calls was needed to determine whether anyone had received the letter, 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.

A few school officials directly refused to participate at this stage, generally citing competing priorities and overburdened teachers. When this occurred, telephone prompters attempted to change the principal's mind. Although this method was effective in some cases, most direct refusers did not change their mind.

Once a principal agreed to participate and designated a school coordinator, the coordinator was sent an automated email indicating that s/he had been designated by their principal as the survey contact and detailing the coordinator role in the study. Beginning in September 2011, each coordinator was asked to complete three initial tasks online: (1) submit a list of science and mathematics teachers; (2) designate individuals to complete program-level questionnaires; and (3) respond to the School Coordinator Questionnaire (a brief survey asking about school demographics). Coordinators were asked to complete these tasks within a two-week period and were sent the first installment of their honorarium ($100) within four weeks of completion.

Non-responding coordinators received an email reminder three weeks after the initial email was sent. Following an additional week of non-response, coordinators were contacted by phone and prompted to complete the three tasks. After a series of eight reminder phone calls, a second reminder email was sent to each coordinator. One week later, if a coordinator had still not responded, the school principal was contacted and asked either to encourage the current coordinator to respond or to consider designating someone new to serve in this capacity.

Table D-1 summarizes the school participation rates by stratum. A total of 35 schools were identified as ineligible; due to either being closed or merged with another school to create a new school. In total, 1,504 schools chose to participate for the remaining 1,965 slots, an overall response rate of 77 percent.

Table D-1
School Participation, by Stratum

	Stratum 1	Stratum 2	Stratum 3	TOTAL
Response Rate	80%	76%	70%	77%
Participated	819	359	326	1,504
Non-Response	207	111	143	461
Ineligible	19	6	10	35
TOTAL	1,045	476	479	2,000

The school coordinator questionnaire was programmed to check for the accuracy of certain information as it was submitted. For instance, the survey checked whether student enrollment overall matched student enrollment by race/ethnicity. Coordinators were asked to correct any mismatches before proceeding with the survey.

The teacher lists resulted in a file of 27,888 teachers. From this frame, a sample of 10,226 science and mathematics teachers was drawn. Seven teachers were sampled from each list, unless the list contained fewer than seven, in which case all were selected. The number of teachers sampled per school ranged from 1 to 7, with a mean of 6.8 teachers and a median of 7. Teachers were sampled on a rolling basis so that late responders to the pre-survey would not delay the main data collection effort.

Teacher and Program Surveys

In January 2012, HRI staff mailed program and teacher questionnaire invitations by first class mail to 30 schools in the sample. This first small group served as a "soft launch" to test survey administration procedures and the functionality of the data collection website. After three weeks, additional mailings were sent to batches of 300–500 schools each week until the sample was exhausted. The packets contained:

- A personalized cover letter from HRI; and
- A "how to" page explaining how to access the online survey using unique login information.

Many of the individuals designated to respond for the program questionnaires were teachers and, consequently, had been randomly sampled to complete the teacher questionnaire as well. These individuals received both the teacher questionnaire invitation and the program questionnaire packet (mailed in separate envelopes). Because the program questionnaire requested information that the respondent was not likely to know, the mailing included a paper copy of the survey, so that respondents could gather data before completing the on-line version.

Prompting Respondents

A series of steps was taken to increase the response rate, primarily through email follow-up with school coordinators. Reminder emails were sent to coordinators at schools with less than 100 percent response at three, five, seven, and nine weeks following the survey invitation mailing. Five weeks after the initial mailing, schools with no respondents received a phone call in addition to the reminder email. At seven weeks, any school with less than 50 percent completion received a phone call in addition to the reminder email. In some instances, schools indicated that they had not received survey invitations, in which case materials were re-mailed or re-sent via email.

During the survey administration phase, school coordinators were given access to a real-time “completion status report,” which summarized survey response for their school. The report listed the surveys to be completed at the school, the name of the person designated and/or sampled to complete each one, and whether the survey was “not started,” “started,” or “completed.” Coordinators were asked to use the report to follow up with non-respondents to encourage them to complete their questionnaires.

Response Rates

A total of 2,505 completed program questionnaires were received out of the 3,008 possible, for a response rate of 83 percent. A total of 7,752 out of 10,012 eligible teachers[1] took part in the survey, for a response rate of 77 percent. 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	Completed	Response Rate (Percent)
Stratum 1	**1,638**	**290**	**1,348**	**82**
Science	819	144	675	82
Mathematics	819	146	673	82
Stratum 2	**718**	**134**	**584**	**81**
Science	359	56	303	84
Mathematics	359	78	281	78
Stratum 3	**652**	**79**	**573**	**88**
Science	326	42	284	87
Mathematics	326	37	289	89
TOTAL	**3,008**	**503**	**2,505**	**83**

[1] During data collection, it was determined that a small number of teachers were not eligible to participate in the study (e.g., after the school submitted its teacher list, the teacher retired, went on maternity leave, changed teaching assignment). These teachers are not included in the denominator when calculating response rates.

Table D-3
Results of Teacher Questionnaires, by Stratum and Subject

	Sampled	Non-Response	Ineligible	Completed	Response Rate (Percent)
Stratum 1	**5,545**	**1,271**	**100**	**4,174**	**77**
Science	2,719	638	55	2,026	76
Mathematics	2,826	633	45	2,148	77
Stratum 2	**2,435**	**572**	**44**	**1,819**	**76**
Science	1,120	239	20	861	78
Mathematics	1,315	333	24	958	74
Stratum 3	**2,230**	**417**	**54**	**1,759**	**81**
Science	1,038	196	28	814	81
Mathematics	1,192	221	26	945	81
TOTAL	**10,210**	**2,260**	**198**	**7,752**	**77**

Data Retrieval

The web-based format minimized the need for data retrieval. Critical items were identified during questionnaire development, and the surveys were programmed such that respondents could not proceed without answering these questions. In addition, the surveys were programmed with a number of "soft checks" for potentially incorrect responses. For example, on the School Coordinator Questionnaire, if the number of students in the various demographic categories did not sum to the total enrollment reported, the survey prompted coordinators to double check their numbers.

Data Cleaning

Questionnaire responses were captured through the data collection website. Data were screened by researchers for missing data, out-of-range answers, and logical inconsistencies. After data-cleaning decisions regarding these issues were made, the data were updated to reflect the decisions. Additional variables needed for analysis were created using data from survey answers and other sources.

The data about instructional materials used (e.g., titles, ISBNs) were used to mine additional information about textbooks (e.g., the publisher, whether NSF funded the development of the materials) and to resolve inconsistencies in title and author information.

APPENDIX E

Description of Reporting Variables

Description of Reporting Variables

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

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

Percent of Students in School Eligible for Free/Reduced-Price Lunch

Each school was classified into one of four categories based on the proportion of students eligible for free/reduced-price lunch (FRL). Defining common categories across grades K–12 would have been misleading, as students tend to select out of the FRL program as they advance in grade due to perceived social stigma. Therefore, the categories were defined as quartiles within groups of schools serving the same grades (e.g., schools with grades K–5, schools with grades 6–8).

School Size

Schools were classified into one of four categories based on the number of students served in the school. Defining common categories across grades K–12 would have been misleading, as average school size tends to increase from elementary to middle to high school. Therefore, the categories were defined as quartiles within groups of schools serving the same grades (e.g., schools with grades K–5, schools with grades 6–8).

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 elementary, middle, and high with teachers and classes being categorized based on the grade range information provided by the teacher. Elementary was defined as grades K–5 plus 6^{th} grade self-contained; middle was defined as 6^{th} grade non-self-contained and grades 7–8; high was defined as grades 9–12.

Percent of Non-Asian Minority Students in Class

Each randomly selected class was classified into one of four categories based on the proportion of students in the class identified as non-Asian minorities. As this proportion is similar in schools regardless of grades served, the categories were defined as quartiles across all classes.

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 example, 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. Composites values were not computed for participants who respond to fewer than two-thirds of the items that form the composite.

The composites were derived through a multi-stage process. As a first step, to test whether the items intended to target the same underlying construct indeed showed similar response patterns, an exploratory factor analysis was conducted on a subset of the data. (The complete dataset was split randomly into two subsets to allow for independent exploratory and confirmatory factor analyses.) Using Mplus version 6 and applying the appropriate weights (teacher, class, or school weights), several different factor solutions were produced and scree plots, eigenvalues, and factor patterns were examined. Based on item fit and conceptual coherence, preliminary composite definitions were created. Next, the preliminary composite definitions were applied to a different subset of the data and a confirmatory factor analysis was performed, again using Mplus. When analyzing data from a complex sample design, Mplus provides only two fit indices to evaluate the model: the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). The psychometric literature provides multiple criteria for judging acceptable model fit using these indices, ranging from 0.05–0.10 for both the RMSEA and SRMR.[1] The obtained values from final models[2] are presented in the tables, allowing the reader to apply his or her preferred criteria for evaluating fit. Lastly, to further aid in the assessment of the composites, Cronbach's coefficient alpha, a common measure of reliability, was calculated and is presented in the tables. An alpha of 0.6–0.8 is evidence of moderate reliability and a value over 0.8 is considered evidence of strong reliability.

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.

[1] Browne, M.W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods & Research, 21*, 230–258.

Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fi t indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1–55.

Marsh, H.W., Wen, Z., & Hau, K-T. (2004). Structural equation models of latent interactions: Evaluation of alternative estimation strategies and indicator construction. *Psychological Methods, 9*, 275–300.

[2] Final models were occasionally adjusted to allow for correlated errors among individual items, typically when the items were worded similarly and the modification indices suggested that the proposed correlations would lead to substantially better fit. Multi-factor models were used in situations when a single-factor specification would result in an over-identified model.

Teacher Background and Opinions

These composites estimate the extent to which teachers feel prepared in both science and mathematics content and pedagogy.

Table E-1
Quality of Professional Development†

	Science	Mathematics
You had opportunities to engage in science investigations‡	Q32a	
You had opportunities to engage in mathematics investigations‡		Q20a
You had opportunities to examine classroom artifacts (e.g., student work samples)	Q32b	Q20b
You had opportunities to try out what you learned in your classroom *and* then talk about it as part of the professional development	Q32c	Q20c
You worked closely with other science teachers from your school‡	Q32d	
You worked closely with other mathematics teachers from your school‡		Q20d
You worked closely with other science teachers who taught the same grade and/or subject whether or not they were from your school‡	Q32e	
You worked closely with other mathematics teachers who taught the same grade and/or subject whether or not they were from your school‡		Q20e
The professional development was a waste of your time§	Q32f	Q20f
Number of Items in Composite	**6**	**6**
Reliability – Cronbach's Coefficient Alpha	**0.72**	**0.75**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.07**	**0.09**
Confirmatory Factor Analysis Fit Index – SRMR	**0.03**	**0.03**

† These items were presented only to teachers who participated in science/mathematics-related professional development in the last three years.
‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.
§ Responses were flipped when computing the composite to account for the negative polarity of the item.

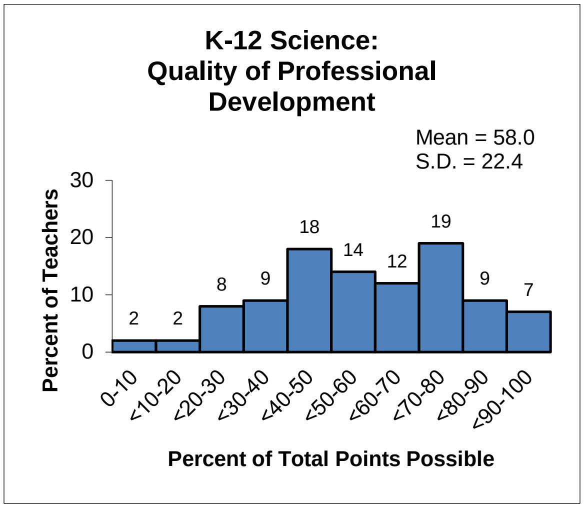


Figure E-1

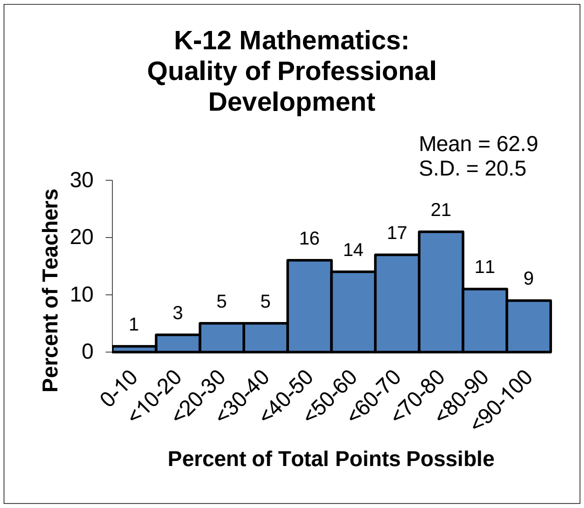


Figure E-2

Table E-2
Extent to Which Professional
Development/Coursework Focused on Student-Centered Instruction†

	Science	Mathematics
Finding out what students think or already know about the key science ideas prior to instruction on those ideas‡	Q34c	
Finding out what students think or already know about the key mathematical ideas prior to instruction on those ideas‡		Q22d
Planning instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	Q34e	Q22f
Monitoring student understanding during science instruction‡	Q34f	
Monitoring student understanding during mathematics instruction‡		Q22g
Assessing student understanding at the conclusion of instruction on a topic	Q34j	Q22k
Number of Items in Composite	**4**	**4**
Reliability – Cronbach's Coefficient Alpha	**0.86**	**0.82**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.07**	**0.01**
Confirmatory Factor Analysis Fit Index – SRMR	**0.01**	**0.01**

† These items were presented only to teachers who participated in science/mathematics-related professional development or coursework within the last three years.

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

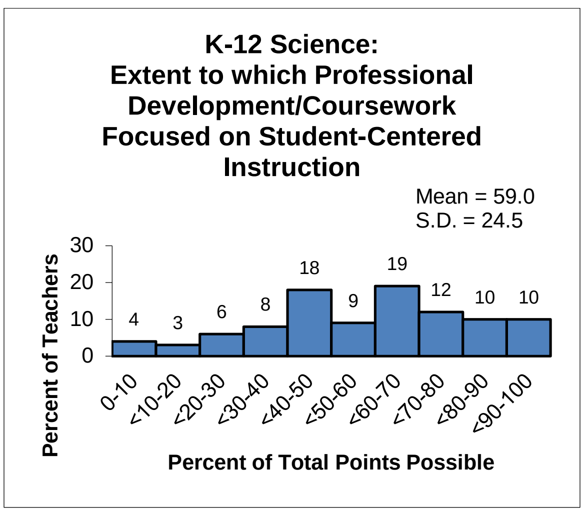


Figure E-3

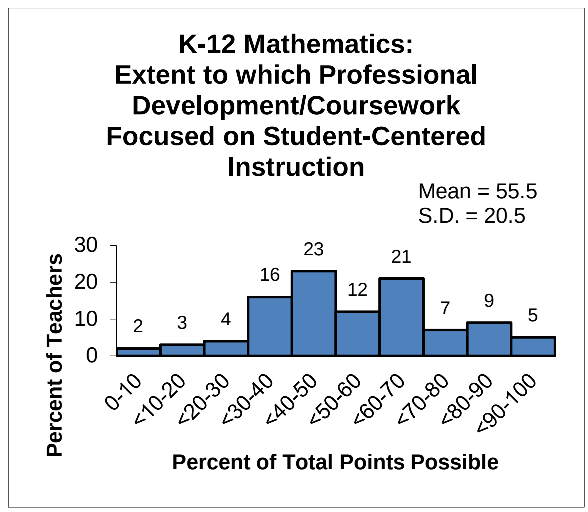


Figure E-4

Table E-3S
Perceptions of Content Preparedness: Science†

	Biology/ Life Science	Chemistry	Earth Science	Integrated/ General Science	Physical Science	Physics
Earth's features and physical processes			Q37ai	Q37ai		
The solar system and the universe			Q37aii	Q37aii		
Climate and weather			Q37aiii	Q37aiii		
Cell biology	Q37bi			Q37bi		
Structures and functions of organisms	Q37bii			Q37bii		
Ecology/ecosystems	Q37biii			Q37biii		
Genetics	Q37biv			Q37biv		
Evolution	Q37bv			Q37bv		
Atomic structure		Q37ci		Q37ci	Q37ci	
Chemical bonding, equations, nomenclature, and reactions		Q37cii		Q37cii	Q37cii	
Elements, compounds, and mixtures		Q37ciii		Q37ciii	Q37ciii	
The Periodic Table		Q37civ		Q37civ	Q37civ	
Properties of solutions		Q37cv		Q37cv	Q37cv	
States, classes, and properties of matter		Q37cvi		Q37cvi	Q37cvi	
Forces and motion				Q37di	Q37di	Q37di
Energy transfers, transformations, and conservation				Q37dii	Q37dii	Q37dii
Properties and behaviors of waves				Q37diii	Q37diii	Q37diii
Electricity and magnetism				Q37div	Q37div	Q37div
Modern physics (e.g., special relativity)				Q37dv	Q37dv	Q37dv
Environmental and resource issues (e.g., land and water use, energy resources and consumption, sources and impacts of pollution)				Q37f		
Number of Items in Composite	**5**	**6**	**3**	**20**	**11**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.89**	**0.95**	**0.83**	**0.90**	**0.92**	**0.88**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.08**	**0.08**	**0.08**	**0.16**	**0.15**	**0.08**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**	**0.06**	**0.06**	**0.13**	**0.10**	**0.06**

† Items in these composites were presented only to non-self-contained teachers.

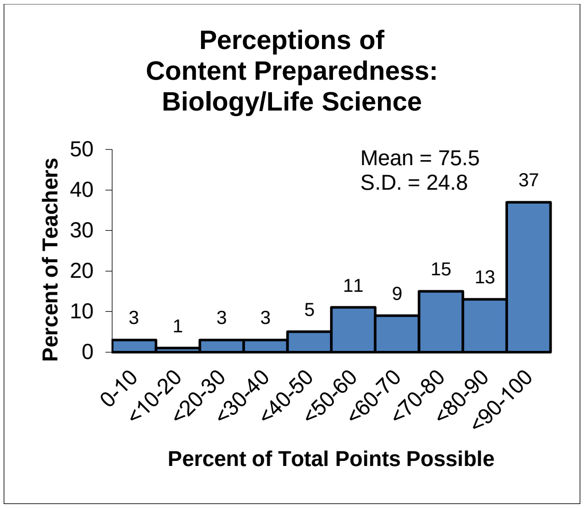


Figure E-5

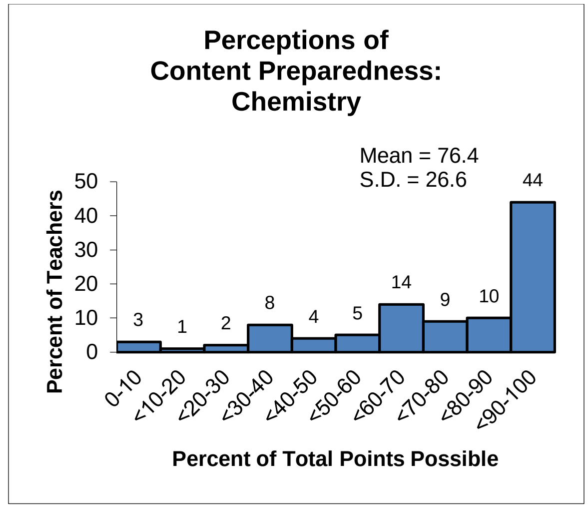


Figure E-6

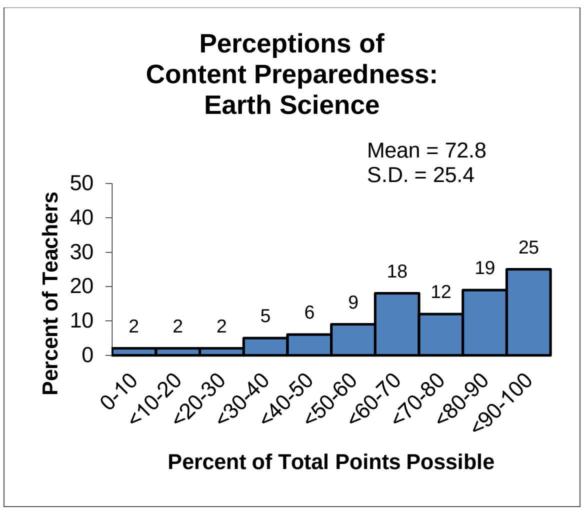
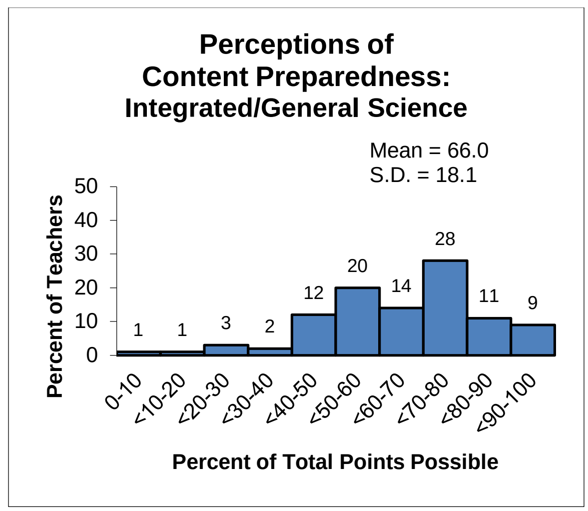


Figure E-7



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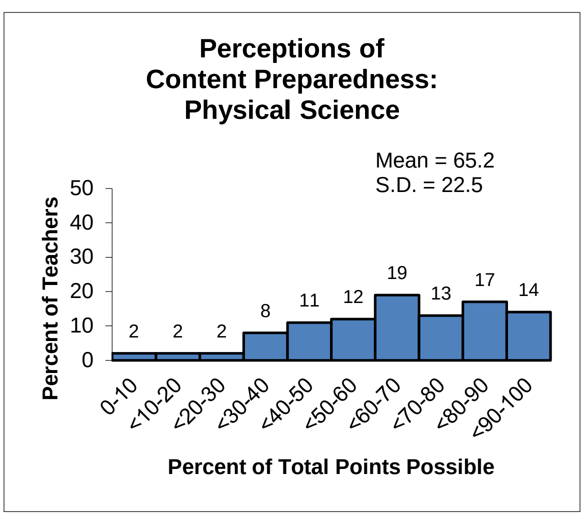

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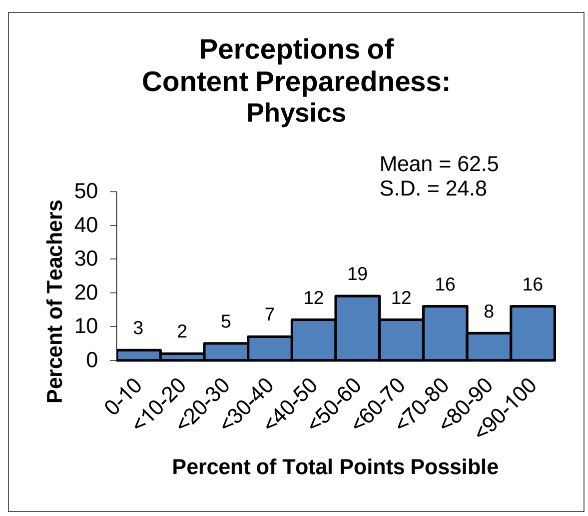


Figure E-10

Table E-3M
Perceptions of Content Preparedness: Mathematics†

	Mathematics
The number system and operations	Q25a
Algebraic thinking	Q25b
Functions	Q25c
Modeling	Q25d
Measurement	Q25e
Geometry	Q25f
Statistics and probability	Q25g
Discrete mathematics	Q25h
Number of Items in Composite	**8**
Reliability – Cronbach's Coefficient Alpha	**0.79**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.09**
Confirmatory Factor Analysis Fit Index – SRMR	**0.04**

† These items were presented only to non-self-contained teachers.

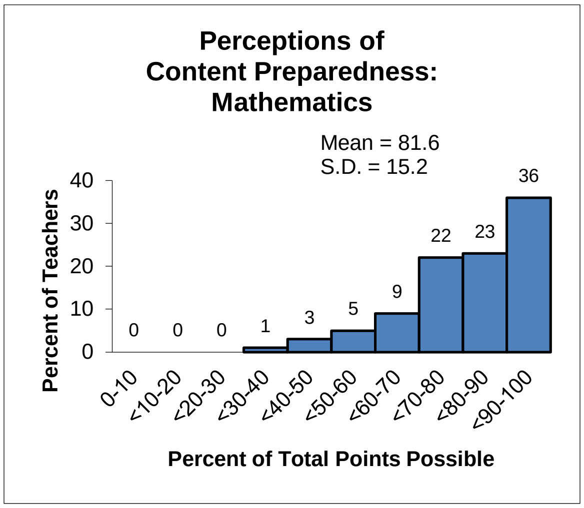


Figure E-11

Table E-4
Perceptions of Preparedness to Teach Diverse Learners

	Science	Mathematics
Plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	Q38a	Q26a
Teach science to students who have learning disabilities‡	Q38b	
Teach mathematics to students who have learning disabilities‡		Q26b
Teach science to students who have physical disabilities‡	Q38c	
Teach mathematics to students who have physical disabilities‡		Q26c
Teach science to English-language learners‡	Q38d	
Teach mathematics to English-language learners‡		Q26d
Provide enrichment experiences for gifted students	Q38e	Q26e
Number of Items in Composite	**5**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.80**	**0.76**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.05**	**0.12**
Confirmatory Factor Analysis Fit Index – SRMR	**0.02**	**0.03**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

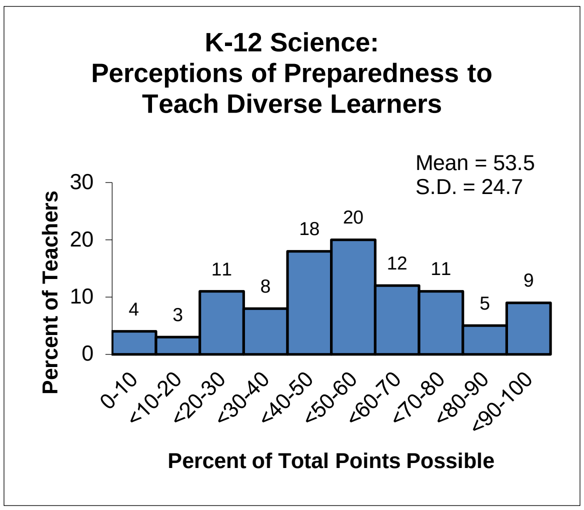


Figure E-12

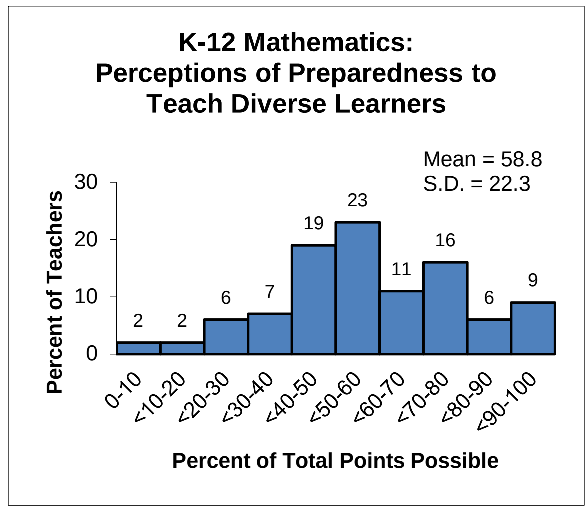


Figure E-13

Table E-5
Perceptions of Preparedness to Encourage Students‡

	Science	Mathematics
Encourage students' interest in science and/or engineering	Q38f	
Encourage students' interest in mathematics		Q26f
Encourage participation of females in science and/or engineering	Q38g	
Encourage participation of females in mathematics		Q26g
Encourage participation of racial or ethnic minorities in science and/or engineering	Q38h	
Encourage participation of racial or ethnic minorities in mathematics		Q26h
Encourage participation of students from low socioeconomic backgrounds in science and/or engineering	Q38i	
Encourage participation of students from low socioeconomic backgrounds in mathematics		Q26i
Number of Items in Composite	**4**	**4**
Reliability – Cronbach's Coefficient Alpha	**0.92**	**0.89**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.12**	**0.24**
Confirmatory Factor Analysis Fit Index – SRMR	**0.01**	**0.03**

‡ The science and mathematics versions of these items are considered equivalent, worded appropriately for that discipline.

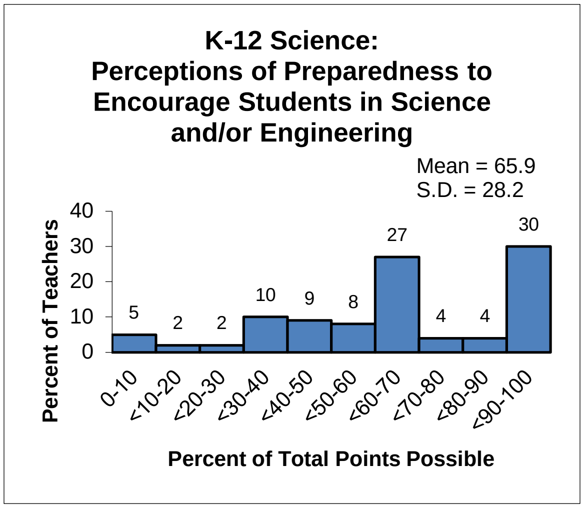


Figure E-14

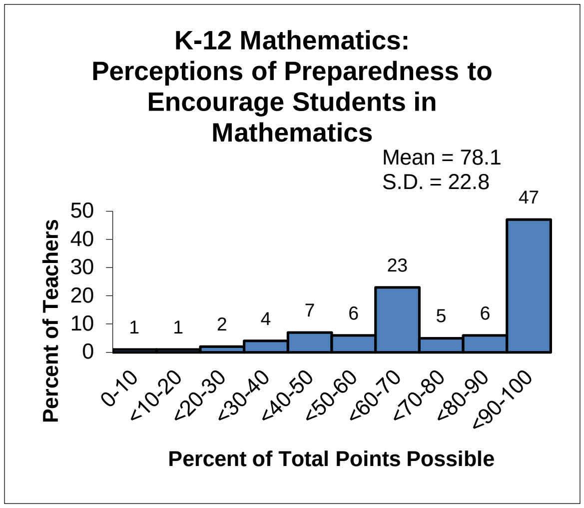
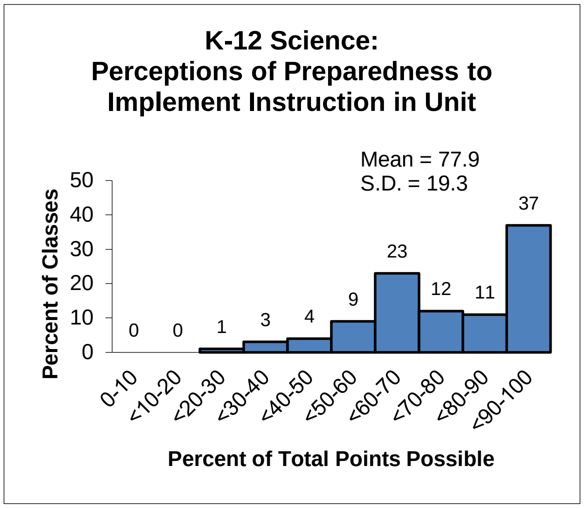


Figure E-15

Table E-6
Perceptions of Preparedness to Implement Instruction in Particular Unit

	Science	Mathematics
Anticipate difficulties that students will have with particular science ideas and procedures in this unit‡	Q73a	
Anticipate difficulties that students will have with particular mathematical ideas and procedures in this unit‡		Q58a
Find out what students thought or already knew about the key science ideas‡	Q73b	
Find out what students thought or already knew about the key mathematical ideas‡		Q58b
Implement the science textbook/ module to be used during this unit‡	Q73c	
Implement the mathematics textbook/ program to be used during this unit‡		Q58c
Monitor student understanding during this unit	Q73d	Q58d
Assess student understanding at the conclusion of this unit	Q73e	Q58e
Number of Items in Composite	**5**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.88**	**0.84**
Confirmatory Factor Analysis Fit Index – RMSEA	**<0.01**	**0.04**
Confirmatory Factor Analysis Fit Index – SRMR	**<0.01**	**0.01**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.



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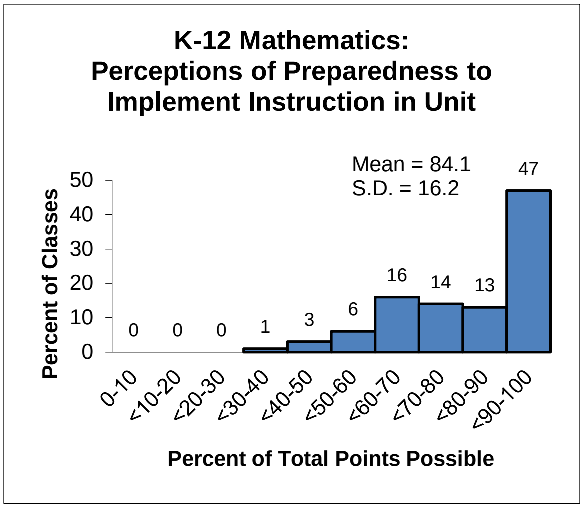


Figure E-17

Decision-Making Autonomy

These composites estimate the level of control teachers perceive having over curriculum and pedagogy decisions for their classrooms.

Table E-7
Curriculum Control

	Science	Mathematics
Determining course goals and objectives	Q44a	Q32a
Selecting textbooks/modules	Q44b	Q32b
Selecting content, topics, and skills to be taught	Q44c	Q32c
Number of Items in Composite	**3**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.80**	**0.84**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.09**	**0.08**
Confirmatory Factor Analysis Fit Index – SRMR	**0.04**	**0.04**

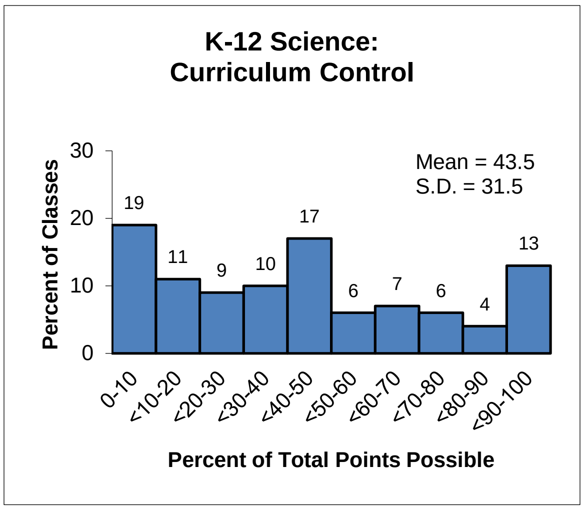


Figure E-18

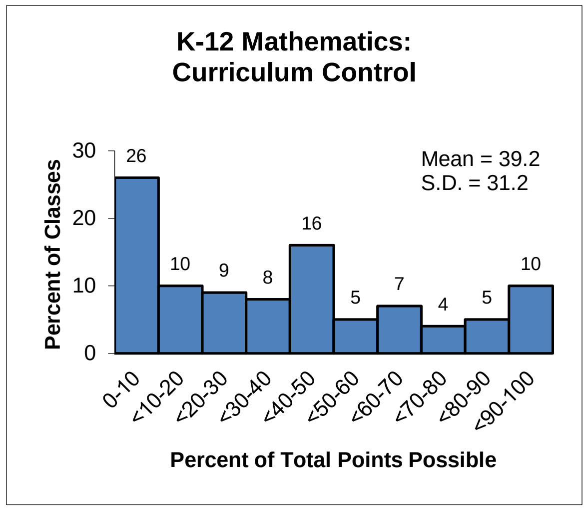


Figure E-19

Table E-8
Pedagogical Control

	Science	Mathematics
Selecting teaching techniques	Q44d	Q32d
Determining the amount of homework to be assigned	Q44e	Q32e
Choosing criteria for grading student performance	Q44f	Q32f
Number of Items in Composite	**3**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.73**	**0.71**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.09**	**0.08**
Confirmatory Factor Analysis Fit Index – SRMR	**0.04**	**0.04**

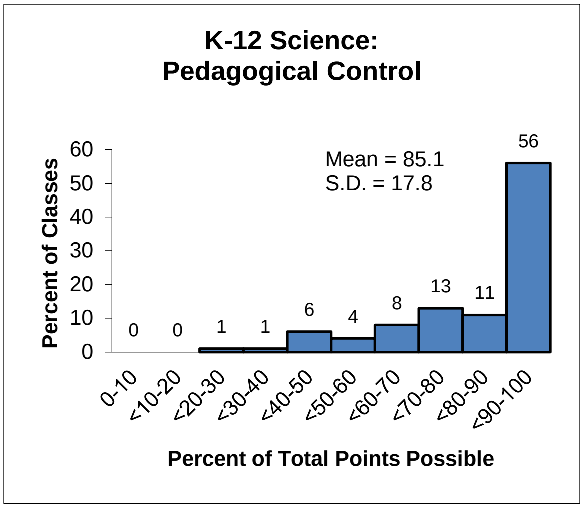


Figure E-20

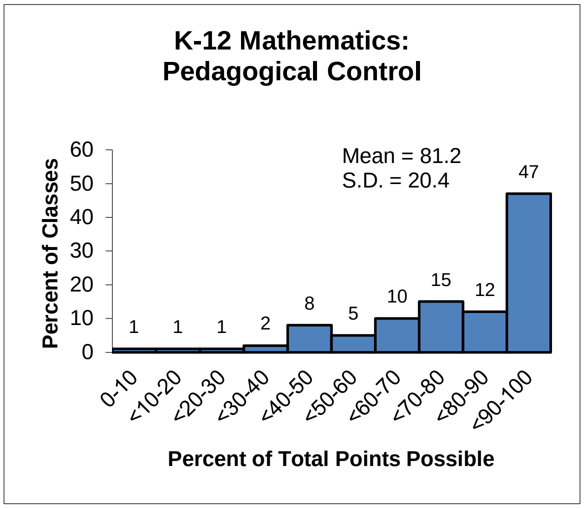


Figure E-21

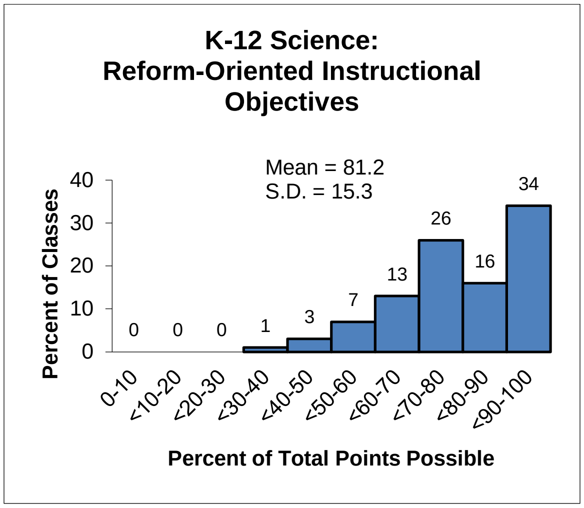
Instructional Objectives

These composites estimate the amount of emphasis teachers place on reform-oriented instructional objectives.

Table E-9
Reform-Oriented Instructional Objectives

	Science	Mathematics
Understanding science concepts‡	Q45b	
Understanding mathematical ideas‡		Q33c
Learning science process skills (e.g., observing, measuring) ‡	Q45c	
Learning mathematical practices (e.g., considering how to approach a problem, justifying solutions) ‡		Q33d
Learning about real-life applications of science‡	Q45d	
Learning about real-life applications of mathematics‡		Q33e
Increasing students' interest in science‡	Q45e	
Increasing students' interest in mathematics‡		Q33f
Preparing for further study in science‡	Q45f	
Preparing for further study in mathematics‡		Q33g
Number of Items in Composite	**5**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.72**	**0.71**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.07**	**0.11**
Confirmatory Factor Analysis Fit Index – SRMR	**0.02**	**0.03**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.



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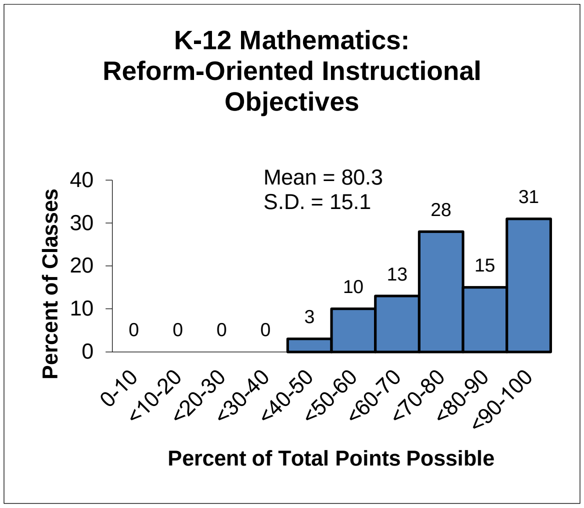


Figure E-23

Teaching Practices

These composites estimate the extent to which teachers use reform-oriented teaching practices and instructional technology.

Table X-10S
Use of Reform-Oriented Teaching Practices: Science

	Science
Have students work in small groups	Q46c
Do hands-on/laboratory activities	Q46d
Engage the class in project-based learning (PBL) activities	Q46e
Have students represent and/or analyze data using tables, charts, or graphs	Q46g
Require students to supply evidence in support of their claims	Q46h
Have students write their reflections (e.g., in their journals) in class or for homework	Q46j
Number of Items in Composite	**6**
Reliability – Cronbach's Coefficient Alpha	**0.72**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.06**
Confirmatory Factor Analysis Fit Index – SRMR	**0.03**

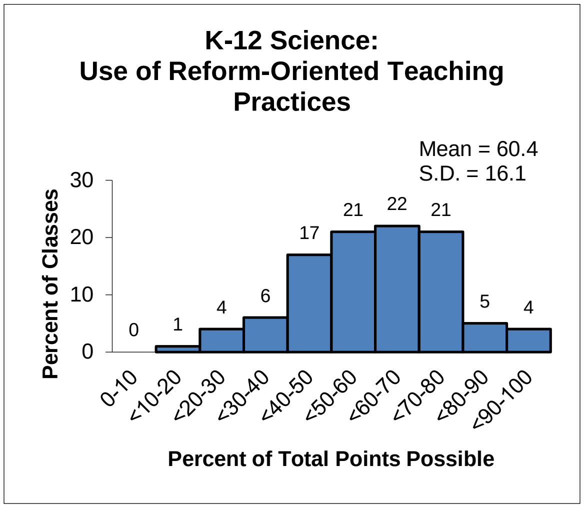


Figure E-24

Table E-10M
Use of Reform-Oriented Teaching Practices: Mathematics

	Mathematics
Have students consider multiple representations in solving a problem (e.g., numbers, tables, graphs, pictures)	Q34f
Have students explain and justify their method for solving a problem	Q34g
Have students compare and contrast different methods for solving a problem	Q34h
Have students present their solution strategies to the rest of the class	Q34j
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.77**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.04**
Confirmatory Factor Analysis Fit Index – SRMR	**0.01**

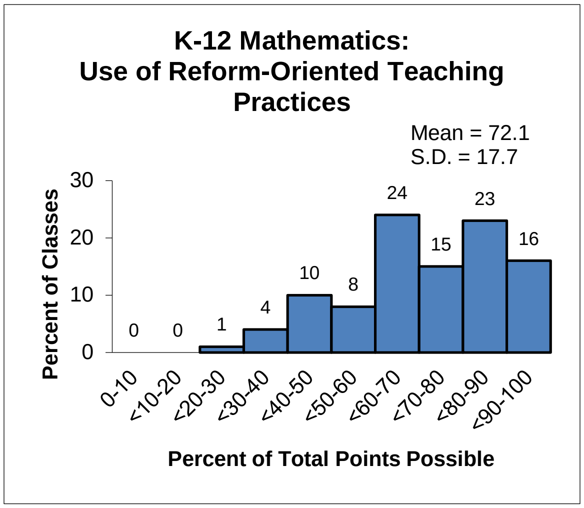
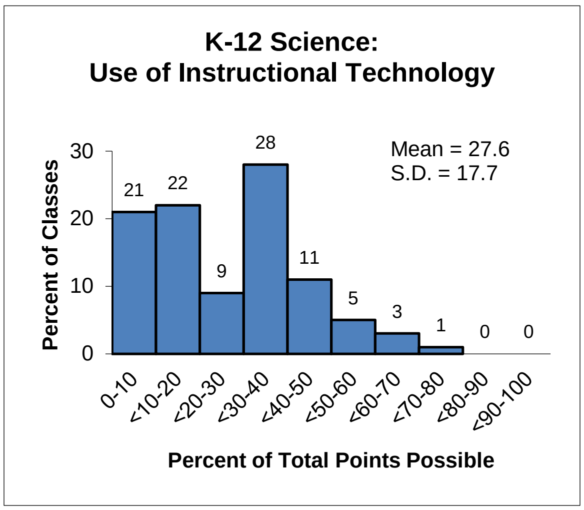


Figure E-25

Table E-11
Use of Instructional Technology

	Science	Mathematics
Personal computers, including laptops	Q49a	Q37a
Hand-held computers	Q49b	Q37b
Internet	Q49c	Q37c
Calculators/Graphing Calculators†	Q49d/e	—
Probes for collecting data	Q49f	—
Number of Items in Composite	**5**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.70**	**0.70**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.04**	**0.07**
Confirmatory Factor Analysis Fit Index – SRMR	**0.05**	**0.05**

† Elementary teachers were asked about their use of "calculators," middle and high school teachers were asked about their use of "graphing calculators."



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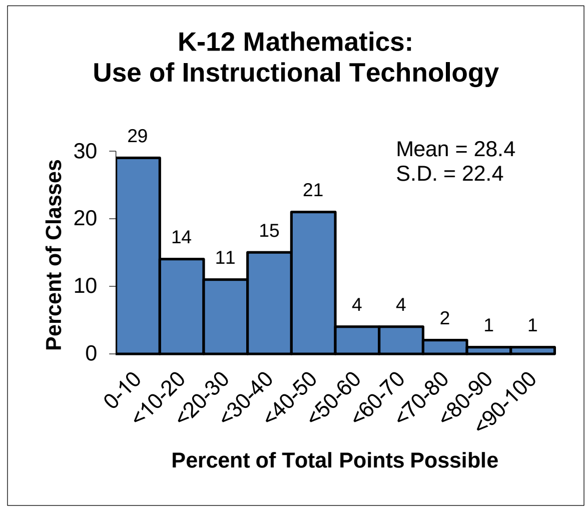


Figure E-27

Influences on Instruction

These composites estimate the extent to which teachers perceive various factors as promoting/ inhibiting effective instruction.

Table E-12S
Adequacy of Resources for Instruction: Science

	Science
Science courses may benefit from the availability of particular kinds of equipment (e.g., microscopes, beakers, photogate timers, Bunsen burners). How adequate is the equipment you have available for teaching this science class?	Q58
Science courses may benefit from the availability of particular kinds of instructional technology (e.g., calculators, computers, probes/sensors). How adequate is the instructional technology you have available for teaching this science class?	Q59
Science courses may benefit from the availability of particular kinds of consumable supplies (e.g., chemicals, living organisms, batteries). How adequate are the consumable supplies you have available for teaching this science class?	Q60
Science courses may benefit from the availability of particular kinds of facilities (e.g., lab tables, electric outlets, faucets and sinks). How adequate are the facilities you have available for teaching this science class?	Q61
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.84**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.03**
Confirmatory Factor Analysis Fit Index – SRMR	**0.01**

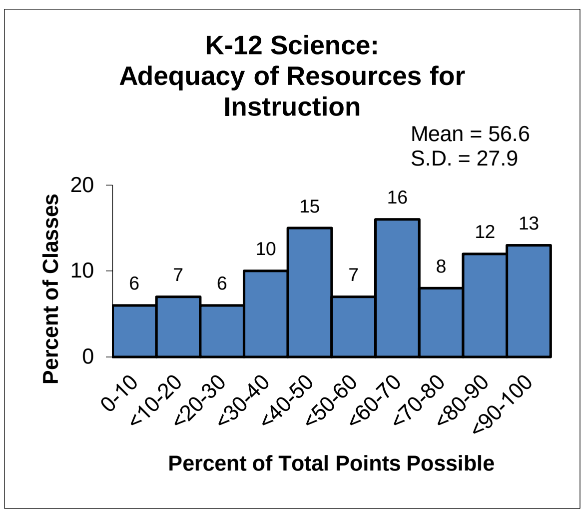


Figure E-28

Table E-12M
Adequacy of Resources for Instruction: Mathematics

	Mathematics
Instructional technology (e.g., calculators, computers, probes/sensors)	Q46a
Measurement tools (e.g., protractors, rulers)	Q46b
Manipulatives (e.g., pattern blocks, algebra tiles)	Q46c
Consumable supplies (e.g., graphing paper, batteries)	Q46d
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.74**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.14**
Confirmatory Factor Analysis Fit Index – SRMR	**0.03**

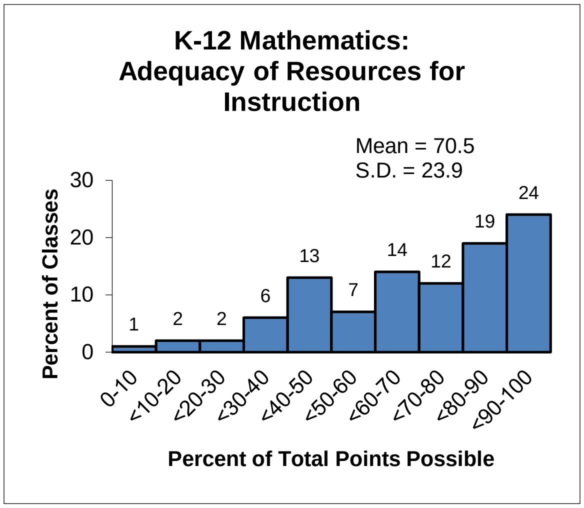
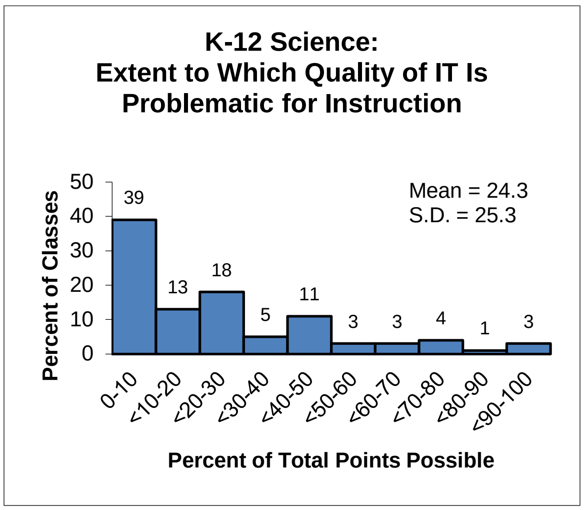


Figure E-29

Table E-13
Extent to Which the Quality of Instructional Technology Is Problematic for Instruction

	Science	Mathematics
Lack of access to computers	Q62a	Q47a
Old age of computers	Q62b	Q47b
Lack of access to the Internet	Q62c	Q47c
Unreliability of the Internet connection	Q62d	Q47d
Slow speed of the Internet connection	Q62e	Q47e
Lack of availability of appropriate computer software	Q62f	Q47f
Lack of availability of technology support	Q62g	Q47g
Number of Items in Composite	**7**	**7**
Reliability – Cronbach's Coefficient Alpha	**0.86**	**0.87**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.10**	**0.11**
Confirmatory Factor Analysis Fit Index – SRMR	**0.03**	**0.03**



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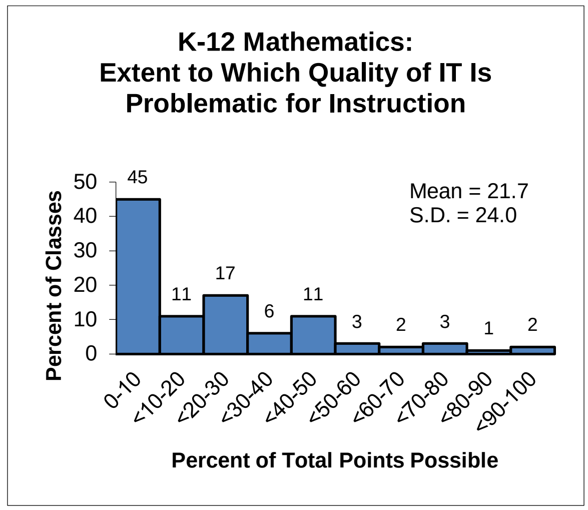

Figure E-31

Table E-14
Extent to Which the Policy Environment Promotes Effective Instruction

	Science	Mathematics
Current state standards	Q63a	Q48a
District/Diocese curriculum frameworks†	Q63b	Q48b
School/District/Diocese pacing guides	Q63c	Q48c
State testing/accountability policies†	Q63d	Q48d
District/Diocese testing/accountability policies†	Q63e	Q48e
Textbook/module selection policies‡	Q63f	
Textbook/program selection policies‡		Q48f
Teacher evaluation policies	Q63g	Q48g
Number of Items in Composite	**7**	**7**
Reliability – Cronbach's Coefficient Alpha	**0.88**	**0.89**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.08**	**0.08**
Confirmatory Factor Analysis Fit Index – SRMR	**0.05**	**0.04**

† This item was presented only to teachers in public and Catholic schools.
‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

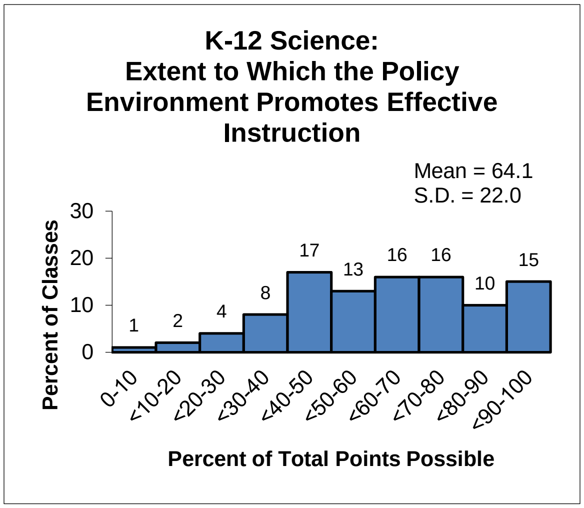

Figure E-32

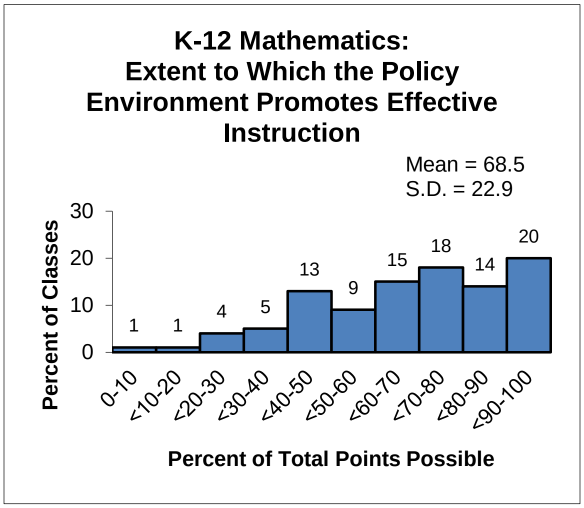

Figure E-33

Table E-15
Extent to Which Stakeholders Promote Effective Instruction

	Science	Mathematics
Students' motivation, interest, and effort in science‡	Q63i	
Students' motivation, interest, and effort in mathematics‡		Q48i
Students' reading abilities	Q63j	Q48j
Community views on science instruction‡	Q63k	
Community views on mathematics instruction‡		Q48k
Parent expectations and involvement	Q63l	Q48l
Number of Items in Composite	**4**	**4**
Reliability – Cronbach's Coefficient Alpha	**0.84**	**0.87**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.08**	**0.08**
Confirmatory Factor Analysis Fit Index – SRMR	**0.05**	**0.04**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

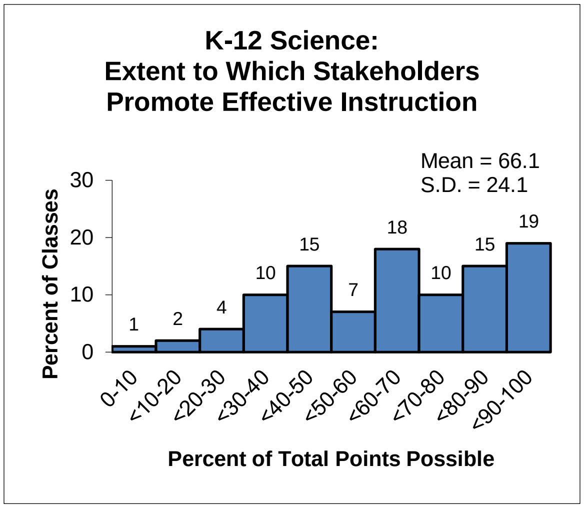

Figure E-34

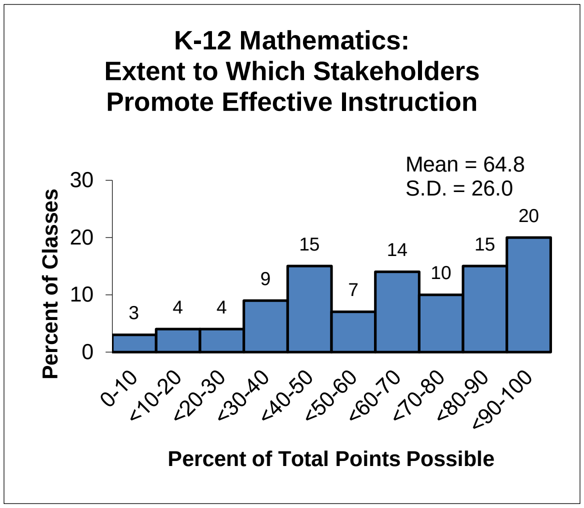

Figure E-35

Table E-16
Extent to Which School Support Promotes Effective Instruction

	Science	Mathematics
Time for you to plan, individually and with colleagues	Q63n	Q48n
Time available for your professional development	Q63o	Q48o
Number of Items in Composite	**2**	**2**
Reliability – Cronbach's Coefficient Alpha	**0.85**	**0.86**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.08**	**0.08**
Confirmatory Factor Analysis Fit Index – SRMR	**0.05**	**0.04**

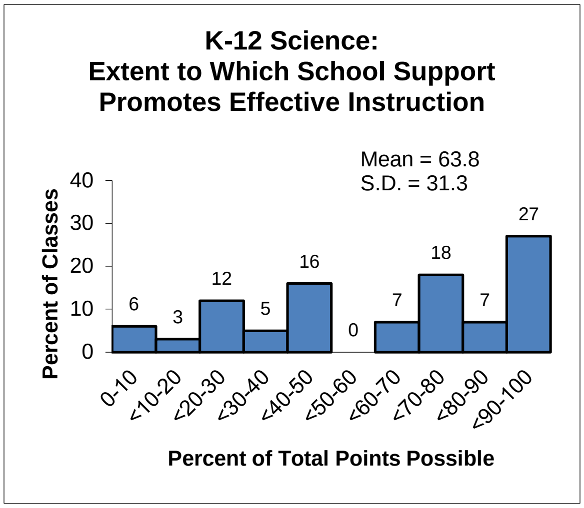

Figure E-36

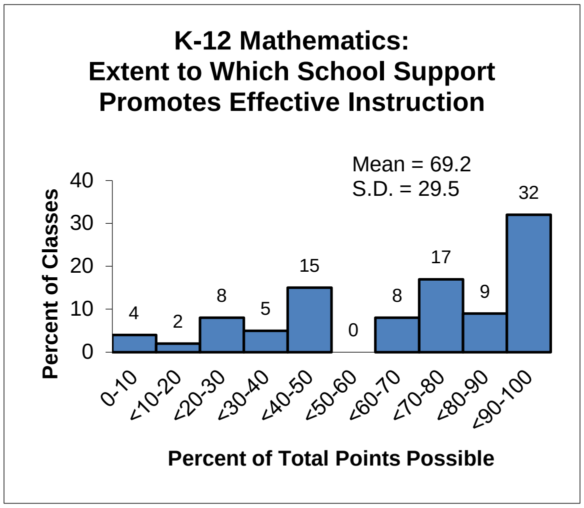

Figure E-37

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.

State Standards for Science and Mathematics Education

These composites estimate the level of attention to state standards given by teachers and other stakeholders.

Table E-17
Focus on State Science/Mathematics Standards

	Science	Mathematics
State science standards have been thoroughly discussed by science teachers in this school‡	Q6a	
State mathematics standards have been thoroughly discussed by mathematics teachers in this school‡		Q6a
There is a school-wide effort to align science instruction with the state science standards‡	Q6b	
There is a school-wide effort to align mathematics instruction with the state mathematics standards‡		Q6b
Most science teachers in this school teach to the state standards‡	Q6c	
Most mathematics teachers in this school teach to the state standards‡		Q6c
Your district/diocese organizes science professional development based on state standards†, ‡	Q6d	
Your district/diocese organizes mathematics professional development based on state standards†, ‡		Q6d
Number of Items in Composite	**4**	**4**
Reliability – Cronbach's Coefficient Alpha	**0.81**	**0.84**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.08**	**0.06**
Confirmatory Factor Analysis Fit Index – SRMR	**0.02**	**0.01**

† This item was presented only to teachers in public and Catholic schools.
‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

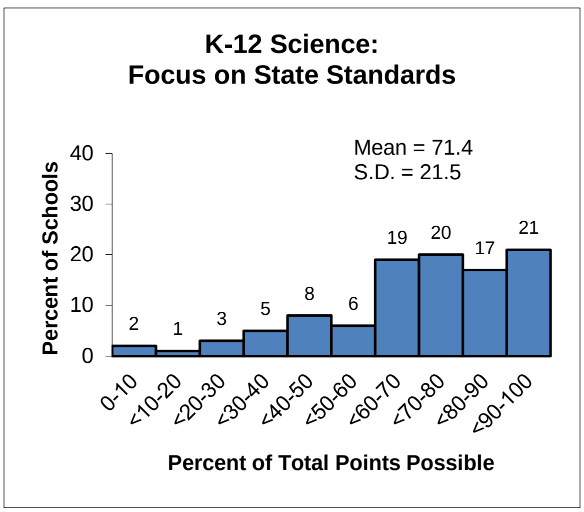

Figure E-38

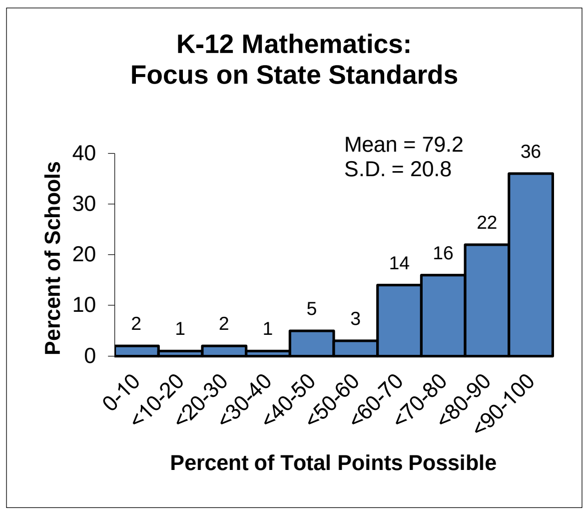

Figure E-39

Factors Affecting Instruction

These composites estimate the extent to which various factors impact science/mathematics instruction in schools.

Table E-18
Supportive Context for Science/Mathematics Instruction

	Science	Mathematics
District/Diocese science professional development policies and practices†, ‡	Q32a	
District/Diocese mathematics professional development policies and practices†, ‡		Q20a
Time provided for teacher professional development in science‡	Q32b	
Time provided for teacher professional development in mathematics‡		Q20b
Importance that the school places on science‡	Q32c	
Importance that the school places on mathematics‡		Q20c
Public attitudes toward science instruction‡	Q32d	
Public attitudes toward mathematics instruction‡		Q20d
Conflict between efforts to improve science instruction and other school and/or district/diocese initiatives‡	Q32e	
Conflict between efforts to improve mathematics instruction and other school and/or district/diocese initiatives‡		Q20e
How science instructional resources are managed (e.g., distributing and refurbishing materials)	Q32f	
Equipment and supplies and/or manipulatives for teaching mathematics (e.g., materials for students to draw, cut and build in order to make sense of problems)		Q20f
Number of Items in Composite	**6**	**6**
Reliability – Cronbach's Coefficient Alpha	**0.78**	**0.75**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.10**	**0.06**
Confirmatory Factor Analysis Fit Index – SRMR	**0.03**	**0.02**

† This item was presented only to teachers in public and Catholic schools.
‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

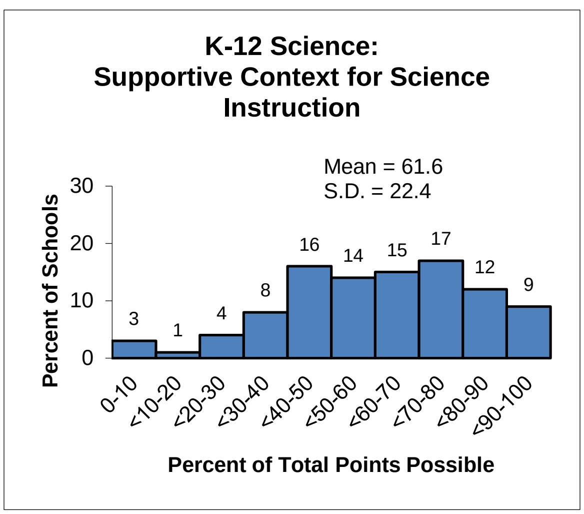

Figure E-40

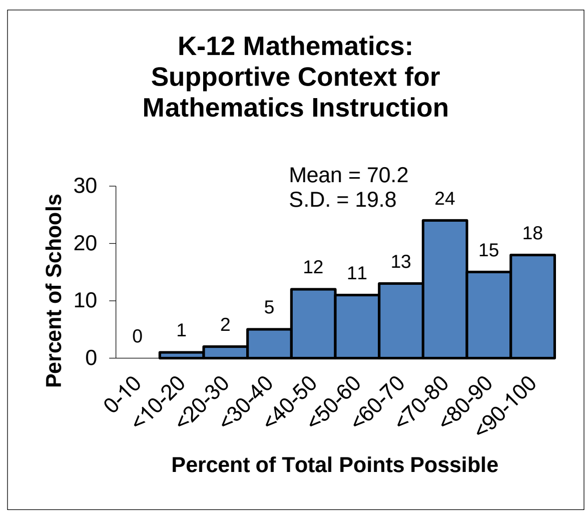

Figure E-41

Table E-19
Extent to Which a Lack of Materials and Supplies Is Problematic

	Science	Mathematics
Lack of science facilities (e.g., lab tables, electric outlets, faucets and sinks in classrooms)	Q33a	—
Inadequate funds for purchasing science equipment and supplies‡	Q33b	
Inadequate funds for purchasing mathematics equipment and supplies‡		Q21a
Inadequate supply of science textbooks/modules‡	Q33c	
Inadequate supply of mathematics textbooks/programs‡		Q21b
Inadequate materials for individualizing science instruction‡	Q33d	
Inadequate materials for individualizing mathematics instruction‡		Q21c
Number of Items in Composite	**4**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.76**	**0.75**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.07**	**0.06**
Confirmatory Factor Analysis Fit Index – SRMR	**0.04**	**0.05**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

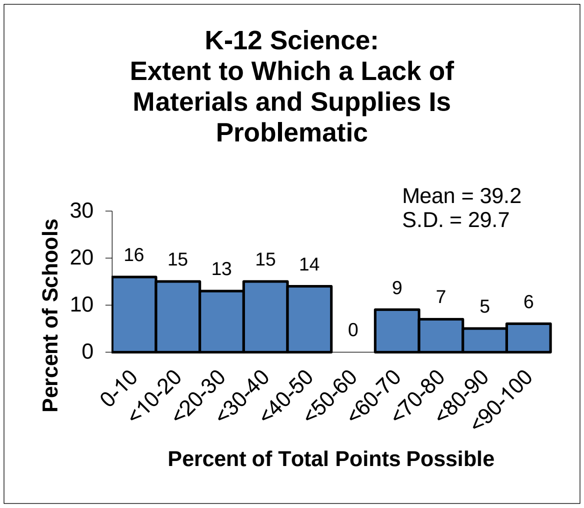

Figure E-42

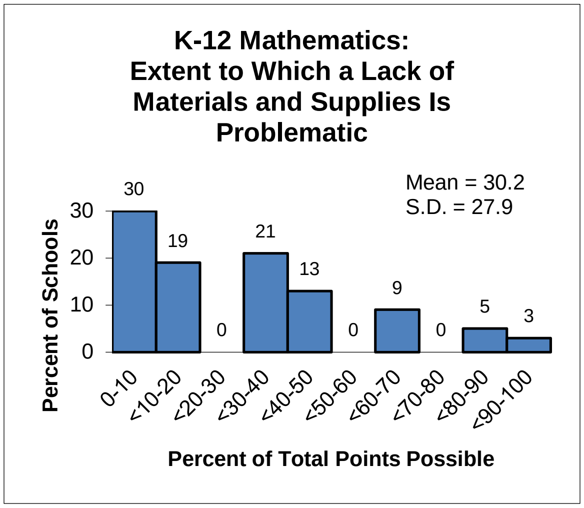

Figure E-43

Table E-20
Extent to Which Student Issues Are Problematic

	Science	Mathematics
Low student interest in science‡	Q33e	
Low student interest in mathematics‡		Q21d
Low student reading abilities	Q33f	Q21e
Large class sizes	Q33m	Q21l
High student absenteeism	Q33n	Q21m
Inappropriate student behavior	Q33o	Q21n
Number of Items in Composite	**5**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.76**	**0.78**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.07**	**0.06**
Confirmatory Factor Analysis Fit Index – SRMR	**0.04**	**0.05**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

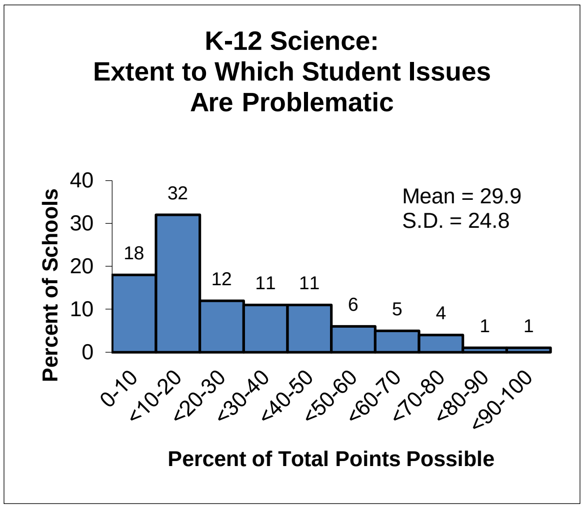

Figure E-44

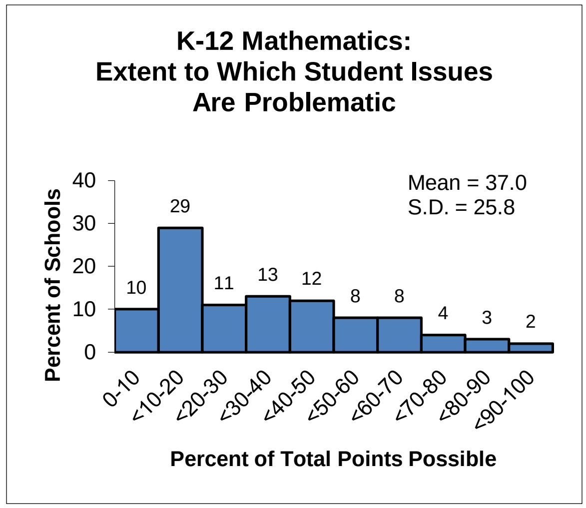

Figure E-45

Table E-21
Extent to Which Teacher Issues Are Problematic

	Science	Mathematics
Lack of teacher interest in science‡	Q33g	
Lack of teacher interest in mathematics‡		Q21f
Inadequate teacher preparation to teach science‡	Q33h	
Inadequate teacher preparation to teach mathematics‡		Q21g
Number of Items in Composite	**2**	**2**
Reliability – Cronbach's Coefficient Alpha	**0.75**	**0.70**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.07**	**0.06**
Confirmatory Factor Analysis Fit Index – SRMR	**0.04**	**0.05**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

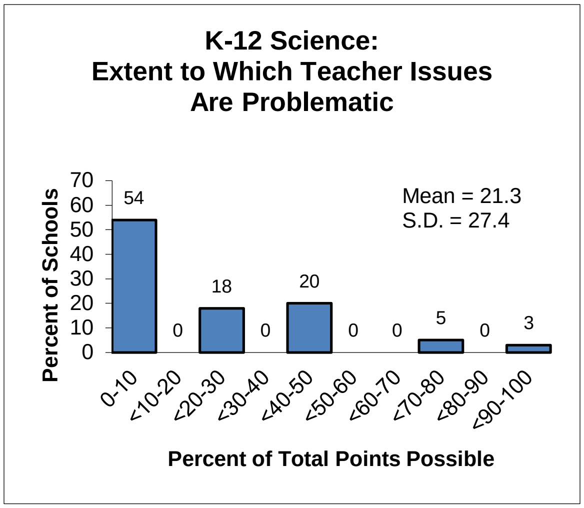

Figure E-46

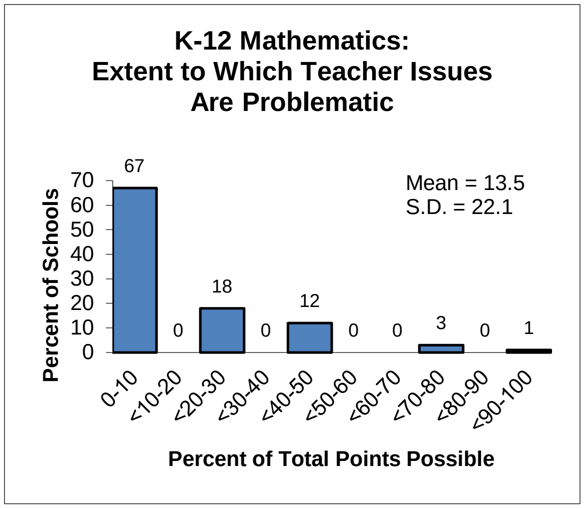

Figure E-47

Table E-22
Extent to Which a Lack of Time Is Problematic

	Science	Mathematics
Insufficient time to teach science‡	Q33i	
Insufficient time to teach mathematics‡		Q21h
Lack of opportunities for science teachers to share ideas‡	Q33j	
Lack of opportunities for mathematics teachers to share ideas‡		Q21i
Inadequate science-related professional development opportunities‡	Q33k	
Inadequate mathematics-related professional development opportunities‡		Q21j
Number of Items in Composite	**3**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.65**	**0.61**
Confirmatory Factor Analysis Fit Index – RMSEA	**0.07**	**0.06**
Confirmatory Factor Analysis Fit Index – SRMR	**0.04**	**0.05**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

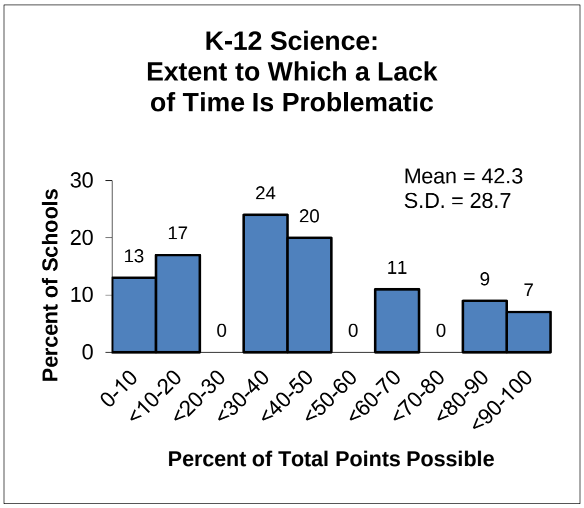

Figure E-48

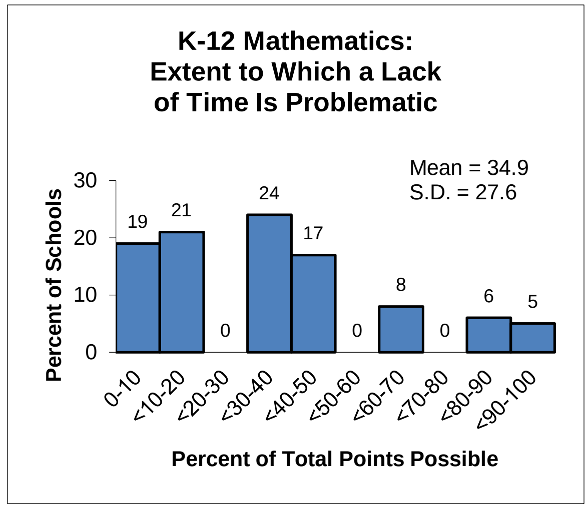

Figure E-49

APPENDIX F

Additional Equity Cross-tabulations

Additional Equity Cross-tabulations

Chapters 2–7 report data on several key indicators, disaggregated by one or more equity factors: the prior achievement level of students in the class, the percentage of non-Asian minority students in the class, the percentage of students in the school eligible for free/reduced-price lunch, school size, community type, and region. This appendix includes data on each of these indicators by all relevant equity factors. Each table title includes a reference to the related table in the body of the report.

Table F-1 (Table 2.3 – Science)
Science Classes Taught by Teachers with
Varying Experience Teaching Science, by Equity Factors

	Percent of Classes				
	0–2 years	**3–5 years**	**6–10 years**	**11–20 years**	**≥ 21 years**
Prior Achievement Level of Class					
Mostly High Achievers	12 (1.7)	13 (1.5)	24 (2.7)	31 (3.1)	21 (2.4)
Average/Mixed Achievers	15 (1.1)	17 (1.4)	23 (1.2)	29 (1.3)	16 (1.2)
Mostly Low Achievers	18 (2.8)	17 (2.7)	27 (4.2)	27 (3.7)	11 (1.8)
Percent of Non-Asian Minority Students in Class					
Lowest Quartile	14 (1.9)	15 (1.9)	20 (2.2)	32 (2.6)	19 (2.1)
Second Quartile	12 (1.5)	14 (1.8)	22 (2.6)	31 (2.2)	21 (2.6)
Third Quartile	12 (1.3)	15 (1.9)	26 (2.2)	32 (2.5)	15 (1.6)
Highest Quartile	21 (2.3)	19 (2.2)	24 (1.9)	24 (2.0)	11 (1.2)
Percent of Students in School Eligible for FRL					
Lowest Quartile	10 (1.3)	15 (1.8)	26 (2.3)	34 (2.5)	15 (1.6)
Second Quartile	11 (1.4)	16 (2.0)	23 (2.0)	30 (1.9)	20 (2.2)
Third Quartile	16 (1.7)	16 (1.7)	21 (2.0)	30 (2.0)	17 (1.6)
Highest Quartile	23 (2.6)	22 (2.5)	23 (2.1)	21 (2.2)	11 (1.4)
School Size					
Smallest Schools	14 (1.6)	17 (1.6)	24 (2.7)	29 (2.0)	16 (1.7)
Second Group	16 (1.9)	17 (2.2)	23 (2.3)	29 (1.7)	16 (1.8)
Third Group	15 (1.5)	17 (1.8)	23 (1.9)	26 (1.7)	18 (2.0)
Largest Schools	14 (2.0)	16 (1.5)	23 (2.0)	32 (2.6)	14 (1.5)
Community Type					
Rural	13 (1.1)	16 (1.5)	22 (1.8)	34 (2.2)	16 (1.7)
Suburban	15 (1.3)	16 (1.5)	25 (1.4)	28 (1.6)	16 (1.3)
Urban	16 (1.9)	18 (1.7)	23 (2.1)	27 (2.0)	16 (1.6)
Region					
Midwest	12 (1.4)	14 (1.4)	21 (1.9)	33 (2.3)	19 (1.7)
Northeast	14 (2.4)	19 (3.1)	23 (2.9)	29 (2.1)	15 (2.1)
South	18 (1.5)	17 (1.4)	24 (1.4)	26 (1.8)	15 (1.2)
West	11 (1.7)	18 (1.9)	24 (2.6)	31 (2.2)	16 (1.9)

Table F-2 (Table 2.3 – Mathematics)
Mathematics Classes Taught by Teachers with Varying Experience Teaching Mathematics, by Equity Factors

	Percent of Classes									
	0–2 years		3–5 years		6–10 years		11–20 years		≥ 21 years	
Prior Achievement Level of Class										
Mostly High Achievers	8	(1.5)	12	(1.5)	22	(2.4)	32	(2.3)	26	(1.9)
Average/Mixed Achievers	13	(1.0)	16	(1.0)	23	(1.1)	29	(1.2)	18	(1.1)
Mostly Low Achievers	15	(2.0)	14	(1.8)	22	(2.1)	33	(2.4)	16	(2.0)
Percent of Non-Asian Minority Students in Class										
Lowest Quartile	12	(1.6)	11	(1.3)	20	(1.9)	32	(2.2)	24	(2.1)
Second Quartile	8	(1.2)	14	(1.4)	24	(1.8)	34	(2.0)	20	(1.6)
Third Quartile	15	(1.8)	16	(1.6)	21	(1.6)	27	(1.9)	21	(1.8)
Highest Quartile	14	(1.8)	16	(1.5)	25	(1.8)	32	(2.1)	13	(1.4)
Percent of Students in School Eligible for FRL										
Lowest Quartile	12	(2.2)	13	(1.4)	24	(1.9)	30	(2.1)	22	(2.0)
Second Quartile	12	(1.0)	13	(1.4)	24	(1.7)	32	(2.0)	19	(1.5)
Third Quartile	12	(1.4)	16	(1.8)	22	(1.8)	30	(1.8)	21	(1.6)
Highest Quartile	14	(1.6)	19	(1.9)	21	(1.7)	31	(2.1)	15	(1.6)
School Size										
Smallest Schools	16	(1.9)	14	(1.4)	21	(1.8)	30	(2.0)	20	(1.9)
Second Group	11	(1.1)	17	(1.8)	21	(1.4)	30	(1.8)	22	(1.7)
Third Group	11	(1.4)	15	(1.6)	24	(1.6)	31	(1.8)	18	(1.6)
Largest Schools	13	(1.7)	14	(1.4)	24	(1.8)	32	(2.0)	17	(2.0)
Community Type										
Rural	13	(1.6)	15	(1.6)	21	(1.6)	31	(2.1)	20	(1.7)
Suburban	12	(1.2)	14	(1.0)	24	(1.1)	31	(1.4)	19	(1.3)
Urban	14	(1.2)	16	(1.7)	21	(1.6)	29	(1.8)	19	(1.7)
Region										
Midwest	12	(1.5)	15	(1.9)	21	(2.0)	30	(1.9)	22	(1.8)
Northeast	10	(1.6)	15	(1.7)	22	(1.9)	33	(2.2)	20	(2.4)
South	16	(1.5)	16	(1.2)	23	(1.2)	28	(1.5)	17	(1.3)
West	8	(1.0)	13	(1.5)	25	(2.0)	36	(2.5)	19	(1.7)

Table F-3 (Table 2.6)
Secondary Teachers with a Degree in Discipline, by Equity Factors

	Percent of Teachers	
	Science	Mathematics
Prior Achievement Level of Class		
Mostly High Achievers	76 (2.7)	61 (2.8)
Average/Mixed Achievers	60 (1.9)	53 (2.2)
Mostly Low Achievers	50 (4.5)	49 (2.9)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	68 (3.6)	64 (3.1)
Second Quartile	65 (3.7)	57 (3.0)
Third Quartile	62 (3.1)	54 (2.8)
Highest Quartile	58 (3.6)	44 (3.1)
Percent of Students in School Eligible for FRL		
Lowest Quartile	68 (3.1)	56 (3.5)
Second Quartile	57 (3.3)	53 (2.8)
Third Quartile	62 (3.7)	54 (3.1)
Highest Quartile	58 (3.9)	51 (3.7)
School Size		
Smallest Schools	60 (3.3)	53 (2.9)
Second Group	64 (3.5)	55 (3.3)
Third Group	63 (3.1)	56 (2.4)
Largest Schools	62 (3.9)	53 (3.4)
Community Type		
Rural	59 (2.8)	55 (3.2)
Suburban	63 (2.3)	55 (2.2)
Urban	63 (3.8)	52 (2.7)
Region		
Midwest	61 (3.9)	63 (3.4)
Northeast	68 (3.2)	61 (3.2)
South	62 (2.4)	51 (2.2)
West	60 (3.4)	43 (3.7)

Table F-4 (Table 2.19)
Secondary Science Classes Taught by Teachers with Substantial Background† in Subject of Selected Class, by Equity Factors

	Percent of Classes	
Prior Achievement Level of Class		
Mostly High Achievers	69	(2.9)
Average/Mixed Achievers	64	(2.1)
Mostly Low Achievers	57	(6.4)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	63	(4.1)
Second Quartile	69	(3.0)
Third Quartile	63	(2.9)
Highest Quartile	62	(3.6)
Percent of Students in School Eligible for FRL		
Lowest Quartile	67	(2.5)
Second Quartile	67	(3.1)
Third Quartile	61	(4.1)
Highest Quartile	65	(4.4)
School Size		
Smallest Schools	61	(3.5)
Second Group	70	(3.1)
Third Group	65	(3.1)
Largest Schools	61	(3.3)
Community Type		
Rural	66	(3.8)
Suburban	65	(2.3)
Urban	61	(2.7)
Region		
Midwest	70	(3.4)
Northeast	74	(3.1)
South	58	(2.3)
West	60	(4.5)

† Defined as having either a degree or at least three advanced courses in the subject of their selected class.

Table F-5 (Table 2.35)
Class Mean Scores for Science Teacher Perceptions of Preparedness Composites, by Equity Factors

	Mean Score			
	Teach Students from Diverse Backgrounds	Encourage Students' Interest in Science	Teach Science Content†	Implement Instruction in Particular Unit
Prior Achievement Level of Class				
Mostly High Achievers	57 (1.8)	80 (1.3)	83 (1.1)	84 (1.0)
Average/Mixed Achievers	56 (1.0)	69 (1.2)	79 (0.8)	77 (0.5)
Mostly Low Achievers	51 (2.5)	65 (2.8)	73 (3.7)	75 (1.1)
Percent of Non-Asian Minority Students in Class				
Lowest Quartile	54 (1.8)	72 (1.8)	79 (1.6)	80 (1.0)
Second Quartile	54 (1.6)	70 (1.7)	81 (1.0)	79 (0.9)
Third Quartile	57 (1.4)	72 (1.5)	80 (1.1)	79 (0.9)
Highest Quartile	55 (1.4)	65 (2.4)	79 (1.7)	76 (1.0)
Percent of Students in School Eligible for FRL				
Lowest Quartile	60 (2.0)	74 (1.9)	81 (1.0)	79 (1.0)
Second Quartile	57 (1.5)	70 (1.8)	80 (1.1)	80 (0.6)
Third Quartile	54 (1.4)	67 (2.8)	79 (1.3)	76 (0.9)
Highest Quartile	54 (1.7)	68 (1.6)	80 (1.7)	76 (1.1)
School Size				
Smallest Schools	55 (1.6)	70 (1.7)	77 (2.0)	78 (0.9)
Second Group	53 (1.7)	68 (2.1)	81 (1.1)	77 (1.1)
Third Group	59 (1.3)	73 (1.6)	80 (1.1)	79 (0.9)
Largest Schools	56 (1.2)	69 (2.4)	81 (1.8)	78 (0.9)
Community Type				
Rural	54 (1.4)	69 (1.8)	79 (1.0)	79 (0.9)
Suburban	57 (1.3)	71 (1.4)	80 (1.0)	79 (0.6)
Urban	55 (1.3)	70 (2.3)	79 (2.1)	76 (1.1)
Region				
Midwest	54 (1.4)	69 (1.7)	80 (1.4)	77 (1.1)
Northeast	56 (2.4)	73 (2.6)	81 (1.3)	79 (1.2)
South	56 (1.1)	68 (1.4)	79 (1.1)	78 (0.6)
West	57 (1.7)	73 (2.0)	79 (2.5)	77 (0.9)

† Perceptions of Preparedness to Teach Science Content score was computed only for non-self-contained classes and is based on content in the randomly selected class.

Table F-6 (Table 2.38)
Class Mean Scores for Mathematics Teacher Perceptions of Preparedness Composites, by Equity Factors

	Mean Score			
	Teach Students from Diverse Backgrounds	Encourage Students' Interest in Mathematics	Teach Mathematics Content†	Implement Instruction in Particular Unit
Prior Achievement Level of Class				
Mostly High Achievers	59 (1.4)	79 (1.3)	86 (0.5)	88 (0.7)
Average/Mixed Achievers	58 (0.8)	78 (0.8)	81 (0.6)	83 (0.5)
Mostly Low Achievers	58 (1.5)	75 (1.5)	80 (0.8)	83 (0.8)
Percent of Non-Asian Minority Students in Class				
Lowest Quartile	55 (1.5)	75 (1.4)	82 (1.0)	85 (0.7)
Second Quartile	57 (1.2)	78 (1.2)	85 (0.6)	85 (0.7)
Third Quartile	59 (1.2)	78 (1.2)	82 (0.8)	84 (0.7)
Highest Quartile	61 (1.4)	79 (1.3)	81 (0.9)	83 (0.8)
Percent of Students in School Eligible for FRL				
Lowest Quartile	58 (1.4)	76 (1.5)	85 (0.6)	86 (0.7)
Second Quartile	60 (1.3)	79 (1.3)	82 (0.9)	85 (0.6)
Third Quartile	57 (1.2)	77 (1.2)	82 (1.0)	84 (0.7)
Highest Quartile	61 (1.6)	79 (1.5)	81 (1.0)	82 (0.8)
School Size				
Smallest Schools	53 (1.1)	75 (1.4)	80 (0.9)	84 (0.8)
Second Group	57 (1.1)	78 (1.0)	82 (0.8)	84 (0.6)
Third Group	61 (1.2)	78 (1.2)	84 (0.7)	84 (0.6)
Largest Schools	62 (1.5)	80 (1.4)	83 (0.7)	85 (0.7)
Community Type				
Rural	57 (1.3)	77 (1.2)	82 (0.8)	84 (0.7)
Suburban	59 (1.0)	78 (0.9)	83 (0.5)	85 (0.4)
Urban	59 (1.2)	78 (1.3)	81 (0.8)	83 (0.7)
Region				
Midwest	55 (1.6)	76 (1.3)	83 (0.9)	83 (0.8)
Northeast	59 (1.3)	77 (1.6)	84 (1.1)	86 (0.7)
South	59 (1.0)	79 (0.9)	82 (0.6)	84 (0.6)
West	61 (1.6)	77 (1.6)	81 (1.0)	83 (0.7)

† Perceptions of Preparedness to Teach Mathematics Content score was computed only for non-self-contained classes.

Table F-7 (Table 3.4)
Classes Taught by Teachers with More than 35 Hours of Professional Development in the Last Three Years, by Subject and Equity Factors

	Percent of Classes			
	Science		Mathematics	
Prior Achievement Level of Class				
Mostly High Achievers	33	(2.6)	28	(1.8)
Average/Mixed Achievers	19	(1.0)	20	(1.0)
Mostly Low Achievers	25	(2.8)	30	(2.2)
Percent of Non-Asian Minority Students in Class				
Lowest Quartile	20	(1.9)	19	(1.6)
Second Quartile	19	(1.5)	21	(1.4)
Third Quartile	27	(2.0)	23	(1.7)
Highest Quartile	23	(2.0)	29	(1.9)
Percent of Students in School Eligible for FRL				
Lowest Quartile	23	(1.8)	21	(2.2)
Second Quartile	20	(1.9)	23	(1.9)
Third Quartile	20	(2.0)	23	(1.6)
Highest Quartile	26	(2.7)	29	(2.0)
School Size				
Smallest Schools	20	(2.1)	20	(1.8)
Second Group	19	(2.1)	22	(1.7)
Third Group	24	(1.8)	22	(1.6)
Largest Schools	25	(1.9)	30	(2.1)
Community Type				
Rural	22	(2.2)	21	(1.7)
Suburban	20	(1.1)	22	(1.2)
Urban	27	(2.1)	28	(1.9)
Region				
Midwest	18	(1.8)	17	(1.4)
Northeast	21	(2.6)	23	(2.2)
South	23	(1.4)	26	(1.4)
West	27	(2.6)	27	(2.0)

Table F-8 (Table 3.10)
Class Mean Scores for the Quality of Professional Development Composite, by Subject and Equity Factors

	Mean Score	
	Science	Mathematics
Prior Achievement Level of Class		
Mostly High Achievers	66 (2.0)	65 (1.1)
Average/Mixed Achievers	60 (0.9)	64 (0.7)
Mostly Low Achievers	60 (2.7)	64 (1.2)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	56 (2.0)	58 (1.2)
Second Quartile	61 (1.7)	64 (1.1)
Third Quartile	62 (1.5)	67 (1.5)
Highest Quartile	65 (1.5)	66 (1.1)
Percent of Students in School Eligible for FRL		
Lowest Quartile	60 (1.6)	65 (1.7)
Second Quartile	61 (1.7)	63 (1.2)
Third Quartile	64 (2.2)	64 (1.2)
Highest Quartile	62 (1.4)	65 (1.4)
School Size		
Smallest Schools	56 (2.1)	61 (1.4)
Second Group	62 (1.6)	63 (1.3)
Third Group	63 (1.3)	64 (0.9)
Largest Schools	63 (1.3)	68 (1.4)
Community Type		
Rural	59 (1.8)	62 (1.0)
Suburban	62 (1.1)	64 (0.9)
Urban	62 (1.7)	66 (1.3)
Region		
Midwest	59 (1.6)	60 (1.2)
Northeast	59 (2.4)	64 (1.3)
South	63 (1.3)	67 (1.1)
West	63 (1.5)	64 (1.5)

Table F-9 (Table 3.16)
Class Mean Scores on the Extent to Which Professional Development/Coursework Focused on Student-Centered Instruction Composite, by Subject and Equity Factors

	Mean Score	
	Science	Mathematics
Prior Achievement Level of Class		
Mostly High Achievers	59 (2.3)	45 (1.9)
Average/Mixed Achievers	48 (1.3)	48 (1.2)
Mostly Low Achievers	51 (3.8)	51 (1.5)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	45 (2.1)	42 (1.8)
Second Quartile	49 (2.1)	44 (1.7)
Third Quartile	51 (2.8)	50 (1.5)
Highest Quartile	53 (2.6)	55 (1.7)
Percent of Students in School Eligible for FRL		
Lowest Quartile	53 (2.4)	48 (1.7)
Second Quartile	47 (2.0)	49 (1.9)
Third Quartile	47 (2.9)	48 (1.6)
Highest Quartile	53 (2.6)	51 (1.8)
School Size		
Smallest Schools	49 (2.2)	41 (2.0)
Second Group	46 (2.6)	47 (1.3)
Third Group	49 (2.3)	50 (1.6)
Largest Schools	55 (2.9)	53 (1.9)
Community Type		
Rural	49 (2.2)	45 (1.9)
Suburban	48 (1.6)	49 (1.1)
Urban	54 (2.5)	49 (1.6)
Region		
Midwest	43 (2.3)	40 (1.9)
Northeast	49 (2.7)	48 (1.8)
South	56 (1.7)	54 (1.1)
West	44 (2.9)	45 (1.8)

Table F-10 (Table 3.33)
Schools Providing Various Services to Science Teachers, by Equity Factors

	Percent of Schools					
	Science-Focused Study Groups		One-on-One Science-Focused Coaching		Assistance to Science Teachers in Need†	
Percent of Students in School Eligible for FRL						
Lowest Quartile	34	(4.7)	16	(3.1)	81	(4.0)
Second Quartile	34	(4.1)	17	(3.9)	78	(3.3)
Third Quartile	49	(4.0)	18	(2.6)	79	(3.6)
Highest Quartile	40	(4.2)	28	(3.8)	86	(3.0)
School Size						
Smallest Schools	35	(4.6)	14	(2.4)	82	(2.8)
Second Group	41	(4.2)	21	(3.0)	80	(3.3)
Third Group	41	(4.1)	24	(3.1)	83	(3.5)
Largest Schools	49	(3.9)	30	(4.1)	81	(3.8)
Community Type						
Rural	42	(4.4)	11	(2.2)	80	(3.1)
Suburban	38	(3.2)	20	(2.1)	83	(2.3)
Urban	38	(4.0)	30	(2.8)	80	(3.7)
Region						
Midwest	39	(5.3)	11	(2.0)	76	(4.1)
Northeast	34	(4.6)	28	(5.0)	88	(3.0)
South	43	(3.8)	24	(2.3)	85	(2.2)
West	39	(4.5)	18	(3.5)	76	(4.1)

† Assistance defined as guidance from a formally designated mentor or coach; seminars, classes, and/or study groups; or a higher level of supervision than for other teachers.

Table F-11 (Table 3.34)
Schools Providing Various Services to Mathematics Teachers, by Equity Factors

	Percent of Schools					
	Mathematics-Focused Study Groups		One-on-One Mathematics-Focused Coaching		Assistance to Mathematics Teachers in Need†	
Percent of Students in School Eligible for FRL						
Lowest Quartile	39	(4.8)	22	(3.6)	76	(5.5)
Second Quartile	46	(4.9)	26	(4.5)	87	(4.0)
Third Quartile	56	(4.0)	29	(3.8)	90	(3.0)
Highest Quartile	61	(4.4)	41	(3.9)	81	(3.3)
School Size						
Smallest Schools	40	(4.4)	22	(3.0)	78	(4.2)
Second Group	52	(4.5)	30	(3.3)	86	(3.6)
Third Group	55	(3.8)	31	(3.5)	87	(2.8)
Largest Schools	67	(4.1)	43	(4.1)	91	(2.7)
Community Type						
Rural	48	(4.5)	18	(2.8)	84	(3.5)
Suburban	47	(3.4)	25	(2.5)	85	(3.0)
Urban	54	(4.2)	47	(4.0)	80	(3.2)
Region						
Midwest	49	(4.6)	17	(2.9)	77	(5.5)
Northeast	37	(4.9)	30	(4.9)	88	(3.5)
South	54	(3.7)	33	(3.1)	92	(1.8)
West	55	(5.1)	35	(3.7)	74	(4.6)

† Assistance defined as guidance from a formally designated mentor or coach; seminars, classes, and/or study groups; or a higher level of supervision than for other teachers.

Table F-12 (Table 4.7)
Average Number of AP Science Courses Offered at High Schools, by Equity Factors

	Average Number of Courses
Percent of Students in School Eligible for FRL	
Lowest Quartile	2.0 (0.2)
Second Quartile	1.5 (0.3)
Third Quartile	1.1 (0.2)
Highest Quartile	1.1 (0.2)
School Size	
Smallest Schools	0.7 (0.1)
Second Group	1.2 (0.2)
Third Group	2.1 (0.2)
Largest Schools	2.8 (0.2)
Community Type	
Rural	0.7 (0.1)
Suburban	1.7 (0.2)
Urban	1.7 (0.3)
Region	
Midwest	0.8 (0.1)
Northeast	1.9 (0.2)
South	1.3 (0.1)
West	1.4 (0.2)

Table F-13 (Table 4.10)
Average Percentage of 8th Graders Completing
Algebra I and Geometry Prior to 9th Grade, by Equity Factors

	Percent of 8th Grade Students	
	Algebra 1	**Geometry**
Percent of Students in School Eligible for FRL		
Lowest Quartile	46 (6.1)	13 (3.4)
Second Quartile	26 (4.5)	2 (0.6)
Third Quartile	31 (5.9)	2 (0.8)
Highest Quartile	28 (3.9)	6 (1.9)
School Size		
Smallest Schools	33 (4.6)	4 (1.4)
Second Group	34 (4.1)	7 (2.3)
Third Group	39 (4.0)	5 (1.8)
Largest Schools	42 (3.1)	5 (0.7)
Community Type		
Rural	27 (4.4)	3 (1.7)
Suburban	38 (3.2)	5 (1.5)
Urban	42 (4.7)	7 (1.9)
Region		
Midwest	31 (4.4)	4 (1.5)
Northeast	42 (6.2)	7 (2.9)
South	27 (3.4)	4 (1.4)
West	46 (6.3)	6 (2.2)

Table F-14 (Table 4.14)
Average Number of AP Mathematics
Courses Offered at High Schools, by Equity Factors

	Average Number of Courses
Percent of Students in School Eligible for FRL	
Lowest Quartile	1.4 (0.2)
Second Quartile	1.1 (0.2)
Third Quartile	0.8 (0.1)
Highest Quartile	0.7 (0.1)
School Size	
Smallest Schools	0.6 (0.1)
Second Group	0.9 (0.1)
Third Group	1.6 (0.1)
Largest Schools	2.1 (0.1)
Community Type	
Rural	0.6 (0.1)
Suburban	1.2 (0.1)
Urban	1.3 (0.2)
Region	
Midwest	0.8 (0.1)
Northeast	1.3 (0.2)
South	1.0 (0.1)
West	1.0 (0.1)

Table F-15 (Table 5.7)
Science Class Mean Scores on the
Reform-Oriented Instructional Objectives Composite, by Equity Factors

	Mean Score
Prior Achievement Level of Class	
Mostly High Achievers	86 (0.6)
Average/Mixed Achievers	81 (0.4)
Mostly Low Achievers	77 (1.5)
Percent of Non-Asian Minority Students in Class	
Lowest Quartile	82 (0.8)
Second Quartile	81 (0.6)
Third Quartile	81 (0.9)
Highest Quartile	80 (0.9)
Percent of Students in School Eligible for FRL	
Lowest Quartile	84 (0.8)
Second Quartile	80 (0.8)
Third Quartile	81 (0.8)
Highest Quartile	80 (0.9)
School Size	
Smallest Schools	81 (0.7)
Second Group	81 (0.7)
Third Group	81 (0.8)
Largest Schools	82 (0.9)
Community Type	
Rural	81 (0.8)
Suburban	81 (0.6)
Urban	81 (0.7)
Region	
Midwest	80 (0.8)
Northeast	81 (0.9)
South	82 (0.6)
West	79 (0.9)

Table F-16 (Table 5.10)
Mathematics Class Mean Scores on the
Reform-Oriented Instructional Objectives Composite, by Equity Factors

	Mean Score
Prior Achievement Level of Class	
Mostly High Achievers	85 (0.6)
Average/Mixed Achievers	80 (0.4)
Mostly Low Achievers	77 (0.7)
Percent of Non-Asian Minority Students in Class	
Lowest Quartile	80 (0.7)
Second Quartile	80 (0.5)
Third Quartile	80 (0.6)
Highest Quartile	81 (0.6)
Percent of Students in School Eligible for FRL	
Lowest Quartile	82 (0.8)
Second Quartile	79 (0.6)
Third Quartile	80 (0.6)
Highest Quartile	80 (0.8)
School Size	
Smallest Schools	79 (0.8)
Second Group	79 (0.6)
Third Group	81 (0.6)
Largest Schools	82 (0.7)
Community Type	
Rural	80 (0.7)
Suburban	80 (0.4)
Urban	81 (0.7)
Region	
Midwest	79 (0.6)
Northeast	80 (0.6)
South	83 (0.5)
West	77 (0.7)

Table F-17 (Table 5.16)
Class Mean Scores on Science Teaching Practice Composites, by Equity Factors

	Mean Score	
	Use of Reform-Oriented Teaching Practices	**Use of Instructional Technology**
Prior Achievement Level of Class		
Mostly High Achievers	63 (0.8)	33 (1.6)
Average/Mixed Achievers	60 (0.4)	27 (0.8)
Mostly Low Achievers	59 (1.1)	25 (1.7)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	60 (0.6)	28 (1.2)
Second Quartile	60 (0.9)	28 (1.2)
Third Quartile	59 (0.8)	27 (1.1)
Highest Quartile	61 (0.8)	25 (1.4)
Percent of Students in School Eligible for FRL		
Lowest Quartile	63 (0.8)	29 (1.0)
Second Quartile	60 (0.9)	28 (1.3)
Third Quartile	60 (0.6)	27 (1.4)
Highest Quartile	60 (0.9)	26 (1.2)
School Size		
Smallest Schools	59 (0.9)	30 (1.1)
Second Group	60 (0.7)	25 (1.1)
Third Group	61 (0.7)	28 (1.2)
Largest Schools	61 (0.8)	27 (1.3)
Community Type		
Rural	59 (0.7)	28 (1.1)
Suburban	60 (0.7)	27 (0.8)
Urban	62 (0.7)	27 (1.3)
Region		
Midwest	58 (0.7)	27 (1.0)
Northeast	61 (1.1)	27 (1.5)
South	61 (0.6)	28 (1.1)
West	61 (1.0)	27 (1.5)

Table F-18 (Table 5.24)
Class Mean Scores on Mathematics Teaching Practice Composites, by Equity Factors

	Mean Score	
	Use of Reform-Oriented Teaching Practices	**Use of Instructional Technology**
Prior Achievement Level of Class		
Mostly High Achievers	74 (0.7)	27 (1.3)
Average/Mixed Achievers	72 (0.5)	28 (0.9)
Mostly Low Achievers	70 (0.9)	30 (1.1)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	71 (0.8)	27 (1.2)
Second Quartile	72 (0.7)	27 (1.4)
Third Quartile	72 (0.7)	30 (1.4)
Highest Quartile	73 (0.7)	29 (1.4)
Percent of Students in School Eligible for FRL		
Lowest Quartile	74 (0.8)	27 (1.4)
Second Quartile	71 (0.8)	29 (1.6)
Third Quartile	73 (0.6)	29 (1.5)
Highest Quartile	72 (0.9)	31 (1.9)
School Size		
Smallest Schools	72 (0.9)	31 (1.4)
Second Group	71 (0.9)	29 (1.5)
Third Group	72 (0.6)	28 (1.4)
Largest Schools	73 (0.9)	26 (1.7)
Community Type		
Rural	71 (0.8)	29 (1.5)
Suburban	72 (0.5)	28 (0.9)
Urban	73 (0.8)	28 (1.5)
Region		
Midwest	69 (0.7)	28 (1.5)
Northeast	75 (0.7)	28 (1.8)
South	74 (0.6)	31 (1.2)
West	68 (0.9)	23 (1.4)

Table F-19 (Table 5.31)
Classes Required to Take External Assessments Two or More Times per Year, by Subject and Equity Factors

	Percent of Classes	
	Science	**Mathematics**
Prior Achievement Level of Class		
Mostly High Achievers	36 (3.1)	60 (2.6)
Average/Mixed Achievers	36 (1.7)	71 (1.4)
Mostly Low Achievers	53 (3.6)	76 (2.2)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	26 (2.4)	56 (2.4)
Second Quartile	30 (2.6)	65 (2.0)
Third Quartile	38 (3.3)	71 (2.1)
Highest Quartile	52 (2.4)	83 (1.5)
Percent of Students in School Eligible for FRL		
Lowest Quartile	33 (2.9)	66 (2.4)
Second Quartile	35 (2.4)	73 (1.9)
Third Quartile	45 (3.5)	75 (1.9)
Highest Quartile	50 (3.0)	81 (1.7)
School Size		
Smallest Schools	30 (3.0)	61 (2.7)
Second Group	36 (3.0)	68 (2.2)
Third Group	39 (3.3)	75 (1.8)
Largest Schools	47 (2.6)	75 (1.9)
Community Type		
Rural	34 (2.6)	69 (2.0)
Suburban	39 (2.0)	68 (1.7)
Urban	40 (2.9)	74 (2.0)
Region		
Midwest	33 (2.2)	65 (2.1)
Northeast	21 (3.0)	60 (3.3)
South	50 (2.7)	75 (1.7)
West	33 (3.4)	72 (2.2)

Table F-20 (Table 6.16)
Availability† of Instructional Technologies in Science Classes, by Equity Factors

	Percent of Classes							
	Graphing Calculators		Non-graphing Calculators		Probes For Collecting Data		Microscopes	
Prior Achievement Level of Class								
Mostly High Achievers	39	(3.6)	79	(3.3)	58	(4.7)	82	(3.0)
Average/Mixed Achievers	23	(1.5)	77	(1.6)	43	(2.1)	63	(2.0)
Mostly Low Achievers	18	(3.3)	61	(6.0)	34	(4.4)	59	(5.1)
Percent of Non-Asian Minority Students in Class								
Lowest Quartile	31	(3.1)	84	(2.3)	46	(4.0)	63	(3.5)
Second Quartile	25	(2.7)	78	(2.4)	47	(3.4)	67	(3.6)
Third Quartile	17	(2.1)	79	(3.9)	43	(3.3)	72	(2.8)
Highest Quartile	23	(3.3)	65	(3.5)	39	(3.2)	57	(3.9)
Percent of Students in School Eligible for FRL								
Lowest Quartile	22	(2.4)	73	(4.5)	48	(3.8)	73	(2.7)
Second Quartile	22	(2.7)	80	(3.2)	39	(3.8)	68	(3.2)
Third Quartile	27	(3.6)	79	(2.5)	48	(3.5)	63	(3.2)
Highest Quartile	24	(2.8)	70	(3.3)	41	(3.4)	60	(3.9)
School Size								
Smallest Schools	32	(3.1)	81	(3.0)	48	(3.0)	66	(3.2)
Second Group	19	(2.4)	75	(3.3)	38	(3.6)	67	(3.4)
Third Group	23	(2.4)	75	(2.8)	50	(3.4)	67	(3.6)
Largest Schools	25	(3.4)	70	(3.2)	41	(3.5)	62	(3.6)
Community Type								
Rural	27	(2.7)	80	(2.4)	43	(3.5)	68	(2.9)
Suburban	24	(1.7)	76	(2.4)	44	(2.5)	63	(2.1)
Urban	23	(3.2)	70	(2.9)	45	(3.3)	68	(3.2)
Region								
Midwest	24	(2.6)	83	(2.7)	42	(3.4)	66	(3.7)
Northeast	26	(3.0)	79	(4.0)	40	(4.0)	65	(3.6)
South	27	(2.6)	73	(2.7)	46	(2.9)	65	(2.5)
West	16	(2.4)	66	(3.6)	45	(3.8)	66	(3.9)

† Availability defined as having at least one instructional technology per small group (4–5 students).

Table F-21 (Table 6.18)
Availability† of Instructional Technologies in Mathematics Classes, by Equity Factors

	Percent of Classes					
	Scientific Calculators		Graphing Calculators		Probes For Collecting Data	
Prior Achievement Level of Class						
Mostly High Achievers	60	(3.0)	61	(2.7)	27	(2.7)
Average/Mixed Achievers	39	(2.0)	33	(1.6)	18	(1.4)
Mostly Low Achievers	55	(3.7)	50	(3.3)	23	(2.3)
Percent of Non-Asian Minority Students in Class						
Lowest Quartile	58	(2.4)	53	(2.6)	30	(2.4)
Second Quartile	50	(3.5)	44	(3.0)	18	(2.2)
Third Quartile	43	(3.1)	39	(3.2)	20	(3.0)
Highest Quartile	37	(3.2)	34	(3.2)	16	(2.0)
Percent of Students in School Eligible for FRL						
Lowest Quartile	52	(3.5)	47	(3.0)	22	(2.9)
Second Quartile	44	(2.8)	41	(3.2)	17	(2.6)
Third Quartile	44	(3.2)	37	(3.0)	26	(2.6)
Highest Quartile	41	(2.9)	38	(3.5)	18	(2.1)
School Size						
Smallest Schools	47	(3.2)	43	(3.3)	24	(2.5)
Second Group	46	(3.0)	38	(2.5)	22	(2.2)
Third Group	46	(3.6)	43	(3.5)	19	(2.1)
Largest Schools	43	(2.9)	42	(3.3)	18	(2.9)
Community Type						
Rural	50	(3.1)	47	(3.1)	25	(2.6)
Suburban	48	(2.1)	42	(2.1)	19	(1.5)
Urban	38	(2.8)	36	(2.6)	19	(1.9)
Region						
Midwest	55	(3.7)	42	(3.6)	20	(2.2)
Northeast	48	(3.3)	42	(2.9)	20	(2.6)
South	41	(2.4)	43	(2.3)	25	(2.1)
West	42	(3.2)	37	(3.0)	12	(2.0)

† Availability defined as having at least one instructional technology per small group (4–5 students).

Table F-22 (Table 6.21)
Median Amount Schools Spend per Pupil on Science Equipment, Consumable Supplies, and Software, by Equity Factors

	Median Amount							
	Equipment		Consumable Supplies		Software		Total	
Percent of Students in School Eligible for FRL								
Lowest Quartile	$ 0.63	(0.2)	$ 1.67	(0.5)	$ 0.00	---‡	$ 3.56	(0.8)
Second Quartile	$ 0.27	(0.1)†	$ 0.98	(0.3)	$ 0.00	---‡	$ 1.85	(0.5)
Third Quartile	$ 0.57	(0.2)	$ 1.17	(0.2)	$ 0.00	---‡	$ 2.47	(0.6)
Highest Quartile	$ 0.35	(0.4)†	$ 0.65	(0.1)	$ 0.00	---‡	$ 1.54	(0.5)
School Size								
Smallest Schools	$ 0.78	(0.2)	$ 1.95	(0.4)	$ 0.00	---‡	$ 3.94	(0.5)
Second Group	$ 0.30	(0.1)†	$ 1.08	(0.2)	$ 0.00	---‡	$ 1.96	(0.4)
Third Group	$ 0.40	(0.1)	$ 0.95	(0.2)	$ 0.00	---‡	$ 1.82	(0.4)
Largest Schools	$ 0.44	(0.1)	$ 0.79	(0.2)	$ 0.00	---‡	$ 2.04	(0.4)
Community Type								
Rural	$ 0.81	(0.2)	$ 1.63	(0.3)	$ 0.00	---‡	$ 3.78	(0.4)
Suburban	$ 0.39	(0.1)	$ 1.40	(0.2)	$ 0.00	---‡	$ 2.49	(0.3)
Urban	$ 0.34	(0.2)	$ 0.98	(0.2)	$ 0.00	---‡	$ 1.91	(0.7)
Region								
Midwest	$ 0.55	(0.2)	$ 1.80	(0.5)	$ 0.00	---‡	$ 3.18	(0.7)
Northeast	$ 1.34	(0.3)	$ 1.99	(0.5)	$ 0.00	---‡	$ 4.15	(1.0)
South	$ 0.56	(0.1)	$ 0.92	(0.1)	$ 0.00	---‡	$ 2.42	(0.4)
West	$ 0.14	(0.3)†	$ 0.99	(0.2)	$ 0.00	---‡	$ 1.45	(0.5)

† Standard errors for medians are typically computed in Wesvar 5.1 using the Woodruff method. Wesvar was unable to compute a standard error for this estimate using this method; thus, the potentially less-consistent replication standard error is reported.

‡ It was not possible to compute a standard error using either the Woodruff or the replication methods.

Table F-23 (Table 6.22)
Median Amount Schools Spend per Pupil on Mathematics Equipment, Consumable Supplies, and Software, by Equity Factors

	Median Amount							
	Equipment		Consumable Supplies		Software		Total	
Percent of Students in School Eligible for FRL								
Lowest Quartile	$ 0.93	(0.2)	$ 1.06	(0.3)	$ 0.00	---‡	$ 3.60	(0.8)
Second Quartile	$ 0.82	(0.2)	$ 0.66	(0.1)	$ 0.00	---‡	$ 2.75	(0.4)
Third Quartile	$ 1.02	(0.2)	$ 0.99	(0.2)	$ 0.00	---‡	$ 3.69	(0.6)
Highest Quartile	$ 0.92	(0.1)	$ 0.65	(0.2)	$ 0.00	---‡	$ 3.37	(1.0)
School Size								
Smallest Schools	$ 1.11	(0.2)	$ 0.86	(0.2)	$ 0.00	---‡	$ 3.93	(0.8)
Second Group	$ 0.82	(0.2)	$ 0.68	(0.2)	$ 0.00	---‡	$ 3.44	(0.5)
Third Group	$ 0.66	(0.1)	$ 0.92	(0.2)	$ 0.09	(0.4)†	$ 2.75	(0.4)
Largest Schools	$ 0.68	(0.2)	$ 0.61	(0.1)	$ 0.00	---‡	$ 2.06	(0.5)
Community Type								
Rural	$ 1.29	(0.3)	$ 1.01	(0.2)	$ 0.00	---‡	$ 4.58	(0.7)
Suburban	$ 0.81	(0.1)	$ 0.89	(0.1)	$ 0.00	---‡	$ 2.98	(0.5)
Urban	$ 0.58	(0.1)	$ 0.49	(0.1)	$ 0.00	---‡	$ 2.45	(0.5)
Region								
Midwest	$ 0.72	(0.2)	$ 0.70	(0.2)	$ 0.00	---‡	$ 3.25	(0.6)
Northeast	$ 2.22	(0.5)	$ 1.11	(0.4)	$ 0.00	---‡	$ 5.18	(1.4)
South	$ 0.89	(0.2)	$ 0.64	(0.1)	$ 0.00	---‡	$ 2.93	(0.5)
West	$ 0.72	(0.2)	$ 0.91	(0.2)	$ 0.00	---‡	$ 2.19	(0.7)

† Standard errors for medians are typically computed in Wesvar 5.1 using the Woodruff method. Wesvar was unable to compute a standard error for this estimate using this method; thus, the potentially less-consistent replication standard error is reported.

‡ It was not possible to compute a standard error using either the Woodruff or the replication methods.

Table F-24 (Table 6.26)
Class Mean Scores on the Adequacy of Resources for Instruction Composite, by Equity Factors

	Mean Score	
	Science	Mathematics
Prior Achievement Level of Class		
Mostly High Achievers	69 (1.6)	74 (0.9)
Average/Mixed Achievers	56 (0.9)	70 (0.7)
Mostly Low Achievers	47 (2.4)	68 (1.4)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	60 (1.5)	73 (0.9)
Second Quartile	59 (1.5)	71 (1.1)
Third Quartile	58 (1.3)	70 (1.0)
Highest Quartile	50 (1.7)	69 (1.3)
Percent of Students in School Eligible for FRL		
Lowest Quartile	64 (1.7)	73 (1.3)
Second Quartile	55 (1.4)	71 (1.0)
Third Quartile	54 (1.5)	69 (1.1)
Highest Quartile	50 (1.7)	68 (1.4)
School Size		
Smallest Schools	55 (1.8)	71 (1.3)
Second Group	57 (1.5)	71 (1.1)
Third Group	57 (1.6)	70 (1.1)
Largest Schools	57 (1.7)	70 (1.1)
Community Type		
Rural	54 (1.5)	71 (1.2)
Suburban	58 (1.1)	71 (0.8)
Urban	57 (1.7)	70 (0.9)
Region		
Midwest	59 (1.5)	72 (1.0)
Northeast	60 (2.1)	72 (1.2)
South	55 (1.1)	71 (1.0)
West	55 (2.2)	65 (1.2)

Table F-25 (Table 7.16)
School Mean Scores for Factors Affecting Science Instruction Composites, by Equity Factors

	Mean Score				
	Supportive Context for Science Instruction	Extent to Which a Lack of Materials and Supplies is Problematic	Extent to Which Student Issues are Problematic	Extent to Which a Lack of Time for Science is Problematic	Extent to Which Teacher Issues are Problematic
Percent of Students in School Eligible for FRL					
Lowest Quartile	65 (2.0)	36 (3.8)	17 (2.2)	40 (2.4)	16 (2.1)
Second Quartile	56 (2.0)	38 (2.8)	29 (2.0)	46 (2.6)	26 (2.8)
Third Quartile	61 (1.9)	42 (2.3)	35 (1.9)	45 (2.4)	23 (2.2)
Highest Quartile	59 (2.5)	42 (3.2)	44 (2.2)	45 (3.2)	26 (2.8)
School Size					
Smallest Schools	64 (2.1)	41 (2.4)	26 (1.9)	38 (2.4)	14 (2.1)
Second Group	56 (2.1)	40 (2.4)	32 (1.7)	48 (2.7)	27 (2.3)
Third Group	64 (1.8)	36 (2.4)	32 (2.0)	41 (2.1)	24 (2.3)
Largest Schools	62 (1.6)	37 (2.1)	34 (1.9)	48 (2.4)	29 (2.2)
Community Type					
Rural	60 (1.9)	40 (2.4)	29 (1.9)	40 (2.8)	18 (2.4)
Suburban	62 (1.4)	37 (2.1)	30 (1.6)	44 (1.8)	22 (1.7)
Urban	63 (1.8)	41 (2.8)	31 (2.3)	42 (2.2)	23 (2.2)
Region					
Midwest	59 (2.1)	40 (3.1)	28 (1.8)	42 (2.2)	20 (2.0)
Northeast	62 (1.9)	35 (3.0)	29 (2.5)	43 (2.9)	23 (2.9)
South	66 (1.4)	38 (1.8)	30 (1.5)	39 (1.8)	21 (1.7)
West	58 (3.2)	45 (3.6)	35 (3.2)	47 (4.3)	24 (3.2)

Table F-26 (Table 7.17)
School Mean Scores for Factors Affecting Mathematics Instruction Composites, by Equity Factors

	Mean Score									
	Supportive Context for Mathematics Instruction		Extent to Which a Lack of Materials and Supplies is Problematic		Extent to Which Student Issues are Problematic		Extent to Which a Lack of Time for Mathematics is Problematic		Extent to Which Teacher Issues are Problematic	
Percent of Students in School Eligible for FRL										
Lowest Quartile	74	(2.4)	26	(2.9)	20	(2.1)	31	(2.0)	9	(1.2)
Second Quartile	70	(2.0)	31	(2.8)	39	(2.3)	37	(3.1)	15	(2.3)
Third Quartile	70	(1.7)	29	(2.6)	44	(2.2)	35	(2.0)	13	(1.8)
Highest Quartile	68	(1.8)	35	(2.8)	50	(1.8)	37	(2.4)	19	(1.8)
School Size										
Smallest Schools	70	(1.9)	31	(2.6)	33	(2.0)	34	(2.5)	11	(1.6)
Second Group	68	(2.0)	30	(2.3)	39	(2.1)	35	(2.4)	13	(1.6)
Third Group	71	(1.6)	31	(2.2)	41	(1.7)	36	(2.1)	16	(1.9)
Largest Schools	74	(1.7)	27	(2.6)	41	(2.0)	36	(2.8)	18	(2.4)
Community Type										
Rural	71	(1.7)	32	(2.7)	34	(2.1)	35	(2.7)	11	(1.2)
Suburban	70	(1.5)	30	(2.1)	37	(1.6)	33	(1.8)	14	(1.6)
Urban	69	(1.6)	29	(2.7)	41	(2.2)	38	(2.6)	15	(2.0)
Region										
Midwest	69	(2.5)	29	(3.0)	31	(1.9)	39	(2.9)	13	(2.0)
Northeast	67	(2.2)	28	(2.9)	38	(2.7)	32	(3.1)	13	(2.6)
South	74	(1.4)	32	(1.9)	39	(1.6)	31	(1.6)	13	(1.1)
West	68	(2.2)	32	(3.1)	42	(2.7)	39	(2.9)	15	(2.1)

Table F-27 (Table 7.24)
Class Mean Scores on Factors Affecting Science Instruction Composites, by Equity Factors

	Mean Score			
	Extent to Which the Policy Environment Promotes Effective Instruction	Extent to Which Stakeholders Promote Effective Instruction	Extent to Which School Support Promotes Effective Instruction	Extent to Which IT Quality is Problematic for Science Instruction
Prior Achievement Level of Class				
Mostly High Achievers	67 (2.3)	76 (1.6)	70 (2.1)	22 (2.1)
Average/Mixed Achievers	64 (0.7)	66 (0.9)	64 (1.2)	23 (1.0)
Mostly Low Achievers	59 (2.6)	51 (2.0)	57 (4.0)	31 (3.5)
Percent of Non-Asian Minority Students in Class				
Lowest Quartile	61 (2.2)	68 (1.7)	63 (2.3)	22 (1.7)
Second Quartile	65 (1.3)	70 (1.4)	65 (2.7)	24 (1.7)
Third Quartile	64 (1.7)	66 (1.6)	63 (2.0)	22 (1.7)
Highest Quartile	65 (1.3)	60 (1.3)	64 (1.9)	28 (2.2)
Percent of Students in School Eligible for FRL				
Lowest Quartile	66 (1.7)	75 (1.6)	67 (2.1)	25 (1.8)
Second Quartile	62 (1.8)	66 (1.5)	61 (2.3)	23 (1.5)
Third Quartile	64 (2.3)	61 (1.5)	64 (2.6)	23 (1.7)
Highest Quartile	63 (1.4)	58 (1.5)	63 (2.2)	28 (2.4)
School Size				
Smallest Schools	64 (1.8)	66 (1.8)	59 (2.3)	24 (1.9)
Second Group	63 (1.5)	66 (1.5)	65 (1.9)	23 (1.7)
Third Group	66 (1.4)	66 (1.5)	65 (2.9)	23 (1.7)
Largest Schools	62 (1.3)	66 (1.4)	66 (2.0)	27 (2.1)
Community Type				
Rural	64 (1.8)	64 (1.6)	61 (2.1)	24 (1.6)
Suburban	64 (0.8)	65 (1.0)	65 (1.4)	24 (1.1)
Urban	65 (1.8)	69 (1.2)	65 (2.6)	25 (2.3)
Region				
Midwest	63 (1.1)	67 (1.5)	61 (1.8)	24 (1.9)
Northeast	62 (2.5)	67 (2.4)	66 (2.7)	23 (1.8)
South	66 (1.3)	65 (1.1)	65 (2.1)	23 (1.4)
West	62 (1.5)	66 (1.6)	63 (3.1)	31 (2.5)

Table F-28 (Table 7.25)
Class Mean Scores on Factors Affecting Mathematics Instruction Composites, by Equity Factors

	Mean Score							
	Extent to which the Policy Environment Promotes Effective Instruction		Extent to which Stakeholders Promote Effective Instruction		Extent to which School Support Promotes Effective Instruction		Extent to Which IT Quality is Problematic for Mathematics Instruction	
Prior Achievement Level of Class								
Mostly High Achievers	68	(1.9)	76	(1.7)	72	(1.7)	17	(1.3)
Average/Mixed Achievers	70	(0.8)	66	(1.1)	69	(1.0)	22	(0.9)
Mostly Low Achievers	65	(1.6)	52	(1.6)	68	(2.4)	25	(1.7)
Percent of Non-Asian Minority Students in Class								
Lowest Quartile	71	(1.1)	66	(1.6)	66	(1.9)	20	(1.2)
Second Quartile	69	(1.2)	70	(1.3)	69	(1.5)	19	(1.4)
Third Quartile	68	(1.3)	63	(1.6)	69	(2.1)	22	(1.7)
Highest Quartile	66	(1.6)	61	(1.8)	72	(2.0)	25	(1.4)
Percent of Students in School Eligible for FRL								
Lowest Quartile	70	(1.2)	72	(1.3)	70	(2.1)	19	(1.1)
Second Quartile	69	(1.2)	65	(1.3)	70	(1.6)	23	(1.9)
Third Quartile	69	(1.4)	63	(1.9)	68	(1.9)	23	(1.8)
Highest Quartile	66	(1.8)	57	(2.1)	69	(2.1)	24	(1.4)
School Size								
Smallest Schools	70	(1.4)	63	(1.5)	65	(2.4)	23	(1.4)
Second Group	69	(1.4)	62	(1.6)	68	(1.7)	20	(1.3)
Third Group	69	(1.4)	66	(1.5)	71	(1.7)	21	(1.4)
Largest Schools	66	(1.5)	68	(1.4)	73	(1.3)	24	(1.6)
Community Type								
Rural	71	(1.1)	63	(1.2)	69	(1.5)	19	(1.4)
Suburban	68	(0.9)	65	(1.3)	68	(1.5)	21	(1.0)
Urban	67	(1.8)	65	(1.7)	71	(1.5)	25	(1.6)
Region								
Midwest	70	(1.4)	64	(1.6)	66	(1.6)	21	(1.3)
Northeast	68	(1.9)	65	(2.1)	69	(2.1)	21	(2.0)
South	69	(1.1)	66	(1.2)	71	(1.3)	22	(1.2)
West	65	(1.8)	64	(2.1)	68	(1.8)	23	(1.6)