



## 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
<b>Sex</b>			
Male	6 (0.8)	30 (2.0)	46 (1.4)
Female	94 (0.8)	70 (2.0)	54 (1.4)
<b>Race</b>			
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)
<b>Age</b>			
≤ 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)
<b>Experience Teaching any Subject at the K–12 Level</b>			
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)
<b>Experience Teaching Science at the K–12 Level</b>			
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)
<b>Experience Teaching at this School, any Subject</b>			
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
<b>Sex</b>			
Male	8 (1.0)	24 (1.9)	44 (1.7)
Female	92 (1.0)	76 (1.9)	56 (1.7)
<b>Race</b>			
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)
<b>Age</b>			
≤ 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)
<b>Experience Teaching any Subject at the K–12 Level</b>			
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)
<b>Experience Teaching Mathematics at the K–12 Level</b>			
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)
<b>Experience Teaching at this School, any Subject</b>			
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
<b>Experience Teaching Science</b>				
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)
<b>Experience Teaching Mathematics</b>				
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
<b>Science Teachers</b>			
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)
<b>Mathematics Teachers</b>			
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
<b>Introductory biology/life science</b>	<b>96 (0.9)</b>	<b>91 (0.9)</b>
<b>One or more biology/life science courses beyond the introductory level</b>	<b>65 (2.6)</b>	<b>79 (1.2)</b>
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
<b>Introductory chemistry</b>	<b>72 (2.3)</b>	<b>93 (1.1)</b>
<b>One or more chemistry courses beyond the introductory level</b>	<b>35 (2.3)</b>	<b>74 (1.3)</b>
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
<b>Introductory physics</b>	<b>61 (2.3)</b>	<b>86 (1.1)</b>
<b>One or more physics courses beyond the introductory level</b>	<b>15 (1.5)</b>	<b>36 (1.6)</b>
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
<b>Introductory Earth/space science</b>	<b>75 (2.3)</b>	<b>61 (1.7)</b>
<b>One or more Earth/space science courses beyond the introductory level</b>	<b>28 (1.8)</b>	<b>30 (1.4)</b>
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
<b>Introductory environmental science</b>	<b>57 (2.5)</b>	<b>56 (1.1)</b>
<b>One or more environmental science courses beyond the introductory level</b>	<b>23 (1.7)</b>	<b>27 (1.3)</b>
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
<b>One or more engineering courses</b>	<b>7 (1.1)</b>	<b>14 (1.0)</b>
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<sup>†</sup> 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)

<sup>†</sup> 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 <sup>†</sup>	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)

<sup>†</sup> 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<sup>†</sup>**

	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
<b>Middle</b>				
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)
<b>High</b>				
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)

<sup>†</sup> 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<sup>†</sup> in Subject of Selected Class, by Equity Factors**

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

<sup>†</sup> 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**

	<b>Percent of Teachers</b>
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
<b>Science</b>			
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)
<b>Mathematics</b>			
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,<sup>3</sup> 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.

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<sup>3</sup> 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<sup>†</sup> 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)

<sup>†</sup> 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<sup>†</sup> 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)

<sup>†</sup> 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 <sup>†</sup>			
	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)

<sup>†</sup> 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 <sup>†</sup>			
	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)

<sup>†</sup> 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 <sup>†</sup>			
	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)

<sup>†</sup> 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 <sup>†</sup>	
	Middle	High
<b>Earth/Space Science</b>		
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)
<b>Biology/Life Science</b>		
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)
<b>Chemistry</b>		
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)
<b>Physics</b>		
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)
<b>Other</b>		
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)

<sup>†</sup> 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 <sup>†</sup>	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)

<sup>†</sup>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 <sup>†</sup>	Implement Instruction in Particular Unit
<b>Prior Achievement Level of Class</b>				
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)
<b>Percent of Non-Asian Minority Students in Class</b>				
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)
<b>Percent of Students in School Eligible for FRL</b>				
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)

<sup>†</sup> 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 <sup>†</sup>	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)

<sup>†</sup> 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 <sup>†</sup>	Implement Instruction in Particular Unit
<b>Prior Achievement Level of Class</b>				
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)
<b>Percent of Non-Asian Minority Students in Class</b>				
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)
<b>Percent of Students in School Eligible for FRL</b>				
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)

<sup>†</sup> 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).