2012 National Survey of Science and Mathematics Education

Status of Elementary School Science

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Disclaimer

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INTRODUCTION

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, a response rate of 77 percent. The research questions addressed by the study 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/modules, 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 2012 National Survey is based on a national probability sample of schools and science and mathematics 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.

This report describes the status of elementary (grades K–5) science education based on the responses of 881 teachers, 438 of whom teach grades K–2 and 443 of whom teach grades 3–5. Details on the survey sample design, as well as data collection and analysis procedures, are included in the *Report of the 2012 National Survey of Science and Mathematics Education*.[1] The standard errors for the estimates presented in this report are included in parentheses in the tables,

[1] Banilower, E. R., Smith, P. S., Weiss, I. R., Malzahn, K. A., Campbell, K. M., & Weis, A. M. (2013). *Report of the 2012 national survey of science and mathematics education.* Chapel Hill, NC: Horizon Research, Inc.

and 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]

This status report of elementary school science teaching is organized into major topical areas:

- Characteristics of the elementary school science teaching force;
- Professional development of elementary school science teachers;
- Elementary school science instruction, in terms of time spent, objectives, and activities;
- Resources available for elementary school science instruction; and
- Factors affecting elementary school science instruction.

CHARACTERISTICS OF THE ELEMENTARY SCHOOL SCIENCE TEACHING FORCE

General Demographics

Elementary science teachers are predominately female, and about 9 in 10 characterize themselves as white (see Table 1). Although a majority of elementary science teachers are over 40 years old, one-third have five or fewer years of experience teaching science.

[2] The False Discovery Rate was used to control the Type I error rate when comparing multiple groups on the same outcome. Benjamini, Y. & 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.

Table 1
Characteristics of the Elementary Science Teaching Force

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Sex						
Male	6	(0.8)	2	(0.8)	11	(1.6)
Female	94	(0.8)	98	(0.8)	89	(1.6)
Race						
White	91	(1.5)	92	(1.7)	91	(1.9)
Hispanic or Latino	8	(1.4)	8	(1.8)	9	(1.8)
Black or African American	5	(1.1)	5	(1.3)	6	(1.4)
Asian	2	(0.4)	1	(0.6)	2	(0.5)
American Indian or Alaska Native	1	(0.3)	0	(0.3)	1	(0.6)
Native Hawaiian or Other Pacific Islander	0	(0.2)	0	(0.2)	0	(0.2)
Two or more races	1	(0.4)	1	(0.6)	1	(0.4)
Age						
≤ 30	18	(1.5)	19	(2.1)	17	(2.0)
31–40	29	(1.8)	27	(2.6)	32	(2.5)
41–50	25	(1.8)	24	(2.1)	26	(2.4)
51–60	20	(1.4)	20	(2.0)	20	(2.1)
61+	8	(1.1)	10	(1.9)	5	(1.1)
Experience Teaching Science at the K–12 Level						
0–2 years	16	(1.4)	16	(1.9)	17	(2.0)
3–5 years	17	(1.6)	15	(2.1)	20	(2.2)
6–10 years	21	(1.5)	21	(2.3)	21	(2.2)
11–20 years	28	(1.7)	29	(2.4)	28	(2.6)
≥ 21 years	17	(1.5)	19	(2.4)	14	(1.9)

As can be seen in Table 2, very few elementary science teachers have college or graduate degrees in science/engineering or science education. However, the vast majority have had formal preparation for teaching leading to a teacher credential (see Table 3). About 6 in 10 received their teaching credential as part of their undergraduate program.

Table 2
Elementary Science Teacher Degrees

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Science/Engineering	4	(0.7)	2	(0.7)	5	(1.1)
Science Education	2	(0.5)	1	(0.6)	3	(0.7)
Science/Engineering or Science Education	5	(0.8)	3	(0.9)	7	(1.2)

Table 3
Elementary Science Teachers' Paths to Certification

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
An undergraduate program leading to a bachelor's degree and a teaching credential	61	(2.6)	69	(3.6)	52	(3.7)
A master's program that also awarded a teaching credential	25	(2.3)	24	(3.3)	27	(2.9)
A post-baccalaureate credentialing program (no master's degree awarded)	13	(1.8)	7	(2.3)	19	(2.6)
No formal teacher preparation	1	(0.5)	0	(0.2)	2	(1.0)

Content Preparedness

If teachers are to help students learn science, they must themselves have a good understanding of the content and the discipline as a way of knowing. As can be seen in Table 4, 90 percent of elementary science teachers have taken college coursework in life science, and approximately 65 percent have had coursework in Earth science. In contrast, fewer than half have had at least one college course in either chemistry or physics, and almost none have had coursework in engineering.

Table 4
Elementary Science Teachers Completing Various College Courses

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Life Science	90	(1.1)	92	(1.4)	87	(1.6)
Earth/Space Science	65	(2.0)	66	(2.1)	65	(3.1)
Chemistry	47	(1.8)	47	(2.6)	47	(2.8)
Environmental Science	33	(1.8)	33	(3.0)	34	(2.4)
Physics	32	(1.7)	31	(2.5)	34	(2.4)
Engineering	1	(0.4)	1	(0.4)	2	(0.7)
Science Education	89	(1.1)	88	(1.6)	91	(1.7)
Student teaching in science	70	(1.6)	72	(2.1)	68	(2.3)

Because elementary science teachers are typically responsible for instruction across science disciplines, the National Science Teachers Association (NSTA) has recommended that they demonstrate competency in life science, Earth science, and physical science. As can be seen in Table 5, 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 teachers have not had courses in any of these three areas.

Table 5
Elementary Science Teachers Meeting NSTA Course-Background Standards

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Courses in life, Earth, and physical science[†]	36	(1.6)	36	(2.2)	36	(2.5)
Courses in two of the three areas	38	(1.7)	41	(2.3)	36	(2.6)
Courses in one of the three areas	20	(1.3)	18	(1.9)	23	(2.0)
No courses in any of the three areas	6	(0.9)	5	(1.2)	6	(1.3)

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

Because elementary teachers are typically responsible for teaching not only science, but also mathematics, reading/language arts, and other academic subjects to one group of students, the 2012 National Survey asked them to rate their content preparedness in each of those subjects (see Table 6). It is clear that elementary school teachers do not feel equally well prepared to teach all

academic subjects, with perceptions of preparedness to teach science paling in comparison to reading/language arts and mathematics. However, it is somewhat surprising that elementary teachers feel as well prepared to teach science as they do despite their lack of college coursework.

Table 6
Elementary Science Teachers' Perceptions of Preparedness to Teach Each Subject

	Percent of Teachers[†]			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Grades K–5				
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)
Science	2 (0.5)	15 (1.4)	44 (1.8)	40 (2.1)
Social Studies	1 (0.3)	12 (0.9)	41 (1.5)	47 (1.5)
Grades K–2				
Reading/Language Arts	0 (0.2)	1 (0.2)	13 (1.1)	86 (1.1)
Mathematics	1 (0.6)	4 (1.0)	17 (1.9)	78 (2.1)
Science	2 (0.6)	12 (1.4)	43 (2.1)	44 (2.5)
Social Studies	1 (0.3)	10 (1.0)	40 (2.0)	48 (2.0)
Grades 3–5				
Reading/Language Arts	0 (0.0)	3 (0.8)	23 (1.7)	74 (1.8)
Mathematics	1 (0.5)	2 (0.6)	21 (2.7)	76 (2.8)
Science	3 (1.1)	19 (2.4)	44 (2.8)	33 (3.0)
Social Studies	2 (0.5)	13 (1.3)	41 (2.2)	44 (2.2)

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

Teachers were also asked about their preparedness to teach various disciplines within science, as well as engineering. As can be seen in Table 7, approximately one-quarter of elementary science teachers feel very well prepared to teach life science; a similar proportion feel very well prepared to teach Earth science. Only 17 percent feel very well prepared to teach physical science. Engineering stands out as the area where elementary teachers feel least prepared.

Table 7
Elementary Science Teachers' Perceptions of Preparedness to Teach Various Science Disciplines

	Percent of Teachers[†]			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Grades K–5				
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)
Grades K–2				
Life Science	4 (0.8)	20 (2.2)	45 (2.7)	32 (2.7)
Earth Science	4 (0.9)	26 (2.6)	42 (2.5)	28 (2.3)
Physical Science	9 (1.5)	31 (3.0)	44 (2.6)	16 (1.7)
Engineering	77 (2.1)	14 (1.8)	6 (1.2)	3 (0.9)
Grades 3–5				
Life Science	4 (1.0)	22 (2.3)	48 (2.8)	26 (2.3)
Earth Science	4 (0.8)	25 (2.4)	48 (2.4)	23 (2.0)
Physical Science	7 (1.3)	35 (2.8)	39 (2.9)	19 (2.1)
Engineering	69 (2.5)	22 (2.3)	5 (1.3)	4 (1.0)

[†] Includes only teachers assigned to teach mathematics, reading/language arts, science, and social studies to a single class of students in grades K–5.

Pedagogical Beliefs

Teachers were asked about their beliefs regarding effective teaching and learning in science. As can be seen in Table 8, elementary science teachers hold a number of views that align with what is known about effective science instruction. For example, more than 90 percent of elementary teachers agree that: (1) most class periods should provide opportunities for students to share their thinking and reasoning, (2) most class periods should conclude with a summary of the key ideas addressed, (3) students should be provided with the purpose for a lesson as it begins, and (4) most class periods should include some review of previously covered ideas and skills. In addition, 65 percent of grade K–2 teachers and 79 percent of grade 3–5 teachers agreed that it is better to focus on ideas in depth even if it means covering fewer topics, which is one of the central tenets of calls for reform in science education.

Inconsistent with what the field knows about effective teaching, 45 percent of elementary teachers agree that teachers should explain an idea to students before having them consider evidence for that idea, and more than half think that hands-on/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, 85 percent agree that students should be given definitions for new vocabulary at the beginning of instruction on an idea.

Table 8
Elementary Science Teachers Agreeing† with Various Statements about Teaching and Learning

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Most class periods should provide opportunities for students to share their thinking and reasoning	98	(0.5)	97	(0.9)	99	(0.5)
Most class periods should conclude with a summary of the key ideas addressed	96	(0.7)	96	(1.1)	96	(0.8)
Students should be provided with the purpose for a lesson as it begins	93	(1.0)	93	(1.3)	92	(1.3)
Most class periods should include some review of previously covered ideas and skills	91	(1.1)	92	(1.3)	91	(1.8)
Inadequacies in students' science background can be overcome by effective teaching	89	(1.2)	88	(1.7)	90	(1.5)
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)	86	(1.7)	84	(2.2)
It is better for science instruction to focus on ideas in depth, even if that means covering fewer topics	72	(1.6)	65	(2.3)	79	(1.9)
Hands-on/laboratory activities should be used primarily to reinforce a science idea that the students have already learned	53	(1.9)	53	(2.6)	54	(2.5)
Teachers should explain an idea to students before having them consider evidence that relates to the idea	45	(1.9)	49	(3.0)	41	(2.4)
Students should be assigned homework most days	38	(2.2)	37	(2.6)	38	(3.1)
Students learn science best in classes with students of similar abilities	32	(1.7)	27	(2.4)	37	(2.3)

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

Pedagogical Preparedness

The survey asked teachers two series of items focused on their preparedness for a number of tasks associated with instruction. First, they were asked how well prepared they feel to address diverse learners in their instruction. Second, they were asked how well prepared they feel to monitor and address student understanding, focusing on a specific unit in a randomly selected class.

Nearly all elementary science teachers feel very well prepared to manage classroom discipline (see Table 9). More than two-thirds feel very well prepared to encourage students' interest in science and the participation of students from groups historically underrepresented in science/engineering (e.g., females). About half feel very well prepared to teach science to students who have learning or physical disabilities, or to students who are English-language learners.

Table 9
Elementary Science Teachers Considering Themselves Very Well Prepared for Each of a Number of Tasks

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Manage classroom discipline	97	(1.2)	97	(1.3)	96	(2.1)
Encourage participation of students from low socioeconomic backgrounds in science and/or engineering	71	(2.2)	72	(2.9)	69	(3.1)
Encourage participation of females in science and/or engineering	70	(2.2)	72	(2.9)	68	(3.1)
Plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	68	(2.5)	70	(3.2)	66	(3.7)
Encourage participation of racial or ethnic minorities in science and/or engineering	68	(2.4)	71	(3.1)	65	(3.2)
Encourage students' interest in science and/or engineering	67	(2.3)	66	(3.2)	67	(3.5)
Provide enrichment experiences for gifted students	58	(2.7)	57	(3.2)	58	(4.2)
Teach science to students who have learning disabilities	53	(2.7)	55	(3.5)	52	(3.8)
Teach science to English-language learners	50	(2.5)	53	(3.8)	48	(3.6)
Teach science to students who have physical disabilities	43	(2.7)	41	(3.1)	45	(4.0)

Table 10 shows the percentage of classes taught by teachers who feel very well prepared for each of a number of tasks related to instruction. Teachers in less than half of the elementary classes feel very well prepared to assess student understanding, at the beginning of, during, or at the end of instruction on a unit. In addition, only about one-quarter feel very well prepared to anticipate difficulties students may have in science.

Table 10
Elementary Science Classes in which Teachers Feel Very Well Prepared for Each of a Number of Tasks in the Most Recent Unit

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Assess student understanding at the conclusion of this unit	46	(2.2)	46	(2.6)	46	(2.9)
Monitor student understanding during this unit	46	(2.2)	49	(2.7)	43	(3.1)
Implement the science textbook/module to be used during this unit[†]	39	(2.7)	43	(4.2)	36	(3.6)
Find out what students thought or already knew about the key science ideas	38	(1.8)	45	(2.6)	31	(2.6)
Anticipate difficulties that students may have with particular science ideas and procedures in this unit	27	(1.7)	32	(2.5)	23	(2.6)

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

PROFESSIONAL DEVELOPMENT OF ELEMENTARY SCHOOL SCIENCE TEACHERS

Science 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 content. However, staying up-to-date is particularly challenging for teachers at the elementary level, as they typically teach multiple subjects. As can be seen in Table 11, 59 percent of

elementary teachers have participated in science-focused professional development in the last three years. At the other end of the spectrum, 15 percent of elementary science teachers have never participated in science-focused professional development.

Table 11
Elementary Teachers' Most Recent
Participation in Science-Focused† Professional Development

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
In the last 3 years	59	(2.0)	56	(2.6)	62	(2.7)
4–6 years ago	16	(1.4)	18	(2.0)	15	(1.8)
7–10 years ago	5	(0.8)	6	(1.0)	5	(1.4)
More than 10 years ago	5	(0.8)	5	(1.3)	4	(0.9)
Never	15	(1.4)	16	(1.9)	14	(2.1)

† Includes professional development focused on science or science teaching.

Although some involvement in professional development is better than none, brief exposure of a few hours over several years is not likely 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 teaching. As can be seen in Table 12, 65 percent of elementary teachers have spent less than six hours in science-related professional development in the last three years; only 4 percent have had more than 35 hours.

Table 12
Time Spent on Professional Development in the Last Three Years

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Less than 6 hours	65	(1.9)	68	(2.3)	62	(2.3)
6–15 hours	22	(1.7)	22	(2.2)	23	(2.0)
16–35 hours	8	(0.9)	7	(1.2)	9	(1.4)
More than 35 hours	4	(0.7)	3	(0.8)	6	(1.0)

Teachers who participated in professional development were asked about the nature of those activities. The vast majority of these elementary teachers have attended a workshop on science or science teaching (see Table 13). In addition, over half have participated in professional learning communities or other types of teacher study groups.

Table 13
Elementary Science Teachers Participating in Various Professional Development Activities in the Last Three Years

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Attended a workshop on science or science teaching	84	(1.8)	85	(2.4)	84	(2.3)
Participated in a professional learning community/lesson study/teacher study group focused on science or science teaching	55	(2.4)	54	(3.0)	55	(3.5)
Received feedback about your science teaching from a mentor/coach formally assigned by the school/district/diocese†	23	(2.5)	22	(3.4)	25	(3.3)
Attended a national, state, or regional science teacher association meeting	7	(1.2)	4	(1.3)	11	(1.9)

† 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.[3] Accordingly, teachers who 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 Table 14, less than half of elementary science teachers have had substantial opportunities to engage in science investigations in their professional development, though grade 3–5 teachers are more likely than grade K–2 teachers to have had this opportunity (56 percent vs. 41 percent). Only about a third of elementary teachers have had substantial opportunities to work with other science teachers in the same grade and/or subject or from their school, try out what they learned and then talk about it, and examine classroom artifacts in their professional development.

[3] 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., & 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 14
Elementary Science Teachers Whose Professional Development in the Last Three Years Had Each of a Number of Characteristics to a Substantial Extent[†]

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Had opportunities to engage in science investigations	48	(3.5)	41	(4.5)	56	(4.5)
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)	33	(5.0)	41	(4.3)
Worked closely with other science teachers from your school	34	(3.5)	29	(5.0)	40	(4.8)
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)	34	(4.6)	34	(4.1)
Had opportunities to examine classroom artifacts (e.g., student work samples)	31	(3.5)	32	(4.8)	31	(4.1)
The professional development was a waste of time	8	(2.0)	7	(2.5)	9	(2.8)

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

Because college courses have the potential to address science content in-depth, the 2012 National Survey asked elementary teachers when they had last taken a formal course for college credit in both science content and science teaching. As can be seen in Table 15, 53 percent of elementary science teachers have not taken a course for college credit in either science or science teaching in the last 10 years. Only about 1 in 10 has taken a course in either science or science teaching in the last three years.

Table 15
Elementary Science Teachers' Most Recent College Coursework in Field

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Science						
In the last 3 years	8	(0.9)	7	(1.1)	9	(1.4)
4–6 years ago	17	(1.6)	16	(2.3)	17	(2.0)
7–10 years ago	17	(1.4)	16	(1.9)	19	(2.0)
More than 10 years ago	57	(2.0)	60	(2.8)	54	(2.7)
Never	1	(0.3)	1	(0.5)	1	(0.3)
The Teaching of Science						
In the last 3 years	11	(1.1)	8	(1.3)	13	(1.8)
4–6 years ago	15	(1.5)	15	(2.3)	15	(2.2)
7–10 years ago	14	(1.4)	13	(1.7)	14	(1.9)
More than 10 years ago	49	(1.9)	51	(3.0)	47	(2.7)
Never	11	(1.1)	13	(1.6)	10	(1.8)
Science or the Teaching of Science						
In the last 3 years	12	(1.2)	9	(1.4)	15	(2.0)
4–6 years ago	19	(1.5)	19	(2.4)	19	(2.2)
7–10 years ago	16	(1.4)	16	(1.7)	17	(2.0)
More than 10 years ago	52	(2.1)	55	(3.0)	49	(2.7)
Never	1	(0.3)	1	(0.4)	0	(0.3)

Another series of items asked teachers about the focus of their recent professional development/ coursework. For almost half of elementary teachers, these experiences heavily emphasized assessing student understanding at the end of instruction on a topic, planning instruction to

enable students at different levels of achievement to enhance their understanding of the targeted ideas, and monitoring student understanding during instruction (see Table 16).

Table 16
Elementary Science Teachers Reporting that their Professional Development/ Coursework in the Last Three Years Gave Heavy Emphasis† to Various Areas

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Assessing student understanding at the conclusion of instruction on a topic	47	(3.1)	45	(4.3)	49	(3.8)
Planning instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	47	(3.1)	48	(5.0)	46	(4.3)
Monitoring student understanding during science instruction	45	(3.0)	45	(5.2)	44	(3.9)
Finding out what students think or already know about the key science ideas prior to instruction on those ideas	41	(2.8)	46	(4.1)	37	(4.2)
Implementing the science textbook/module to be used in your classroom	39	(3.5)	40	(4.9)	39	(4.3)
Deepening your own science content knowledge	37	(2.9)	39	(4.6)	36	(3.0)
Providing enrichment experiences for gifted students	32	(2.7)	29	(3.6)	35	(3.7)
Learning about difficulties that students may have with particular science ideas and procedures	30	(2.6)	29	(3.8)	32	(3.9)
Providing alternative science learning experiences for students with special needs	22	(2.5)	21	(3.6)	22	(3.5)
Teaching science to English-language learners	21	(2.5)	20	(3.5)	21	(3.1)

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

In addition to asking teachers about their involvement 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 Table 17, nearly 40 percent of elementary science teachers have supervised a student teacher. Five percent or fewer have served as a mentor/coach of other teachers, led a teacher study group, or taught in-service workshops focused on science.

Table 17
Elementary Science Teachers Serving in Various Leadership Roles in the Last Three Years

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Supervised a student teacher	38	(2.5)	39	(3.4)	38	(3.6)
Served as a formally assigned mentor/coach for science teaching	5	(1.0)	5	(1.5)	6	(1.5)
Led a teacher study group focused on science teaching	4	(1.0)	2	(0.9)	7	(2.0)
Taught in-service workshops on science or science teaching	3	(0.9)	2	(1.2)	4	(1.4)

ELEMENTARY SCHOOL SCIENCE INSTRUCTION

Time Spent

Teachers were asked how often they teach science. As can be seen in Table 18, only 19 percent of grade K–2 classes and 30 percent of grade 3–5 classes receive science instruction all or most days every week of the school year. A substantial percentage of elementary classes receive science instruction only a few days a week or during some weeks of the year.

Table 18
Frequency with which Self-Contained Elementary Classes Receive Science Instruction

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
All/Most days, every week	24 (1.4)	19 (1.6)	30 (2.1)
Three or fewer days, every week	37 (1.4)	40 (1.6)	33 (2.0)
Some weeks, but not every week	39 (1.6)	41 (2.0)	36 (2.2)

The survey also asked about the approximate number of minutes typically spent on teaching mathematics, reading/language arts, science, and social studies in self-contained classes. Classes in grades K–2 spend an average of 18 minutes per day on science, compared to 90 minutes on reading/language arts and 52 minutes on mathematics (see Table 19). A similar trend is seen in grades 3–5 as science is taught an average of 22 minutes per day compared to 84 minutes for reading/language arts and 60 minutes for mathematics.

Table 19
Average Number of Minutes per Day Spent
Teaching Each Subject in Self-Contained Classes†

	Number of Minutes		
	Grades K–5	Grades K–2	Grades 3–5
Reading/Language Arts	88 (1.3)	90 (2.0)	84 (1.8)
Mathematics	55 (0.8)	52 (1.1)	60 (1.0)
Science	20 (0.4)	18 (0.5)	22 (0.7)
Social Studies	17 (0.4)	16 (0.5)	19 (0.6)

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

Class Characteristics

The typical elementary science class has 22 students; two-thirds of classes have between 17 and 25 students. Demographic data for elementary science students are shown in Table 20.

Table 20
Demographics of Students in Elementary Science Classes

	Percent of Students		
	Grades K–5	**Grades K–2**	**Grades 3–5**
Sex			
Male	52 (0.5)	52 (0.7)	52 (0.8)
Female	48 (0.5)	48 (0.7)	48 (0.8)
Race/Ethnicity			
White	57 (1.8)	58 (2.4)	55 (2.3)
Black or African American	14 (1.1)	14 (1.4)	14 (1.5)
Hispanic or Latino	20 (1.7)	19 (2.1)	20 (2.2)
Asian	3 (0.3)	3 (0.3)	3 (0.4)
American Indian or Alaska Native	1 (0.2)	1 (0.3)	1 (0.3)
Native Hawaiian or Other Pacific Islander	1 (0.3)	1 (0.3)	1 (0.4)
Two or more races	5 (0.7)	4 (0.6)	5 (1.2)

As can be seen in Table 21, students in a majority of elementary science classes appear to be grouped by prior-achievement level. Forty-five percent of classes consist of mixed prior-achievement levels.

Table 21
Prior-Achievement Grouping in Elementary Science Classes

	Percent of Classes			
	Mostly Low Achievers	**Mostly Average Achievers**	**Mostly High Achievers**	**A Mixture of Levels**
Grades K–5	10 (1.3)	36 (1.8)	9 (1.1)	45 (1.9)
Grades K–2	7 (1.3)	37 (2.4)	7 (1.2)	49 (2.4)
Grades 3–5	12 (2.3)	36 (2.8)	10 (1.8)	42 (2.9)

Teachers' Perceptions of Their Decision Making Autonomy

Teachers were asked the extent to which they have control over a number of curriculum and instruction decisions for their classes. In elementary science classes, teachers are more likely to perceive themselves as having strong control over the amount of homework, teaching techniques, and choosing criteria for grading student performance (see Table 22). In fewer classes, teachers perceive themselves as having strong control over determining course goals and objectives, selecting content, topics and skills to be taught, and selecting textbooks/modules.

Table 22
Elementary Science Classes in which Teachers Report Having Strong Control Over Various Curriculum and Instruction Decisions

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Determining the amount of homework to be assigned	64	(2.7)	64	(3.9)	65	(4.5)
Selecting teaching techniques	53	(2.5)	56	(3.5)	51	(3.9)
Choosing criteria for grading student performance	43	(3.3)	40	(3.6)	46	(4.7)
Determining course goals and objectives	14	(2.0)	14	(3.3)	14	(2.8)
Selecting content, topics, and skills to be taught	10	(1.8)	9	(2.4)	11	(2.6)
Selecting textbooks/modules	5	(1.2)	5	(1.8)	5	(1.6)

The items in Table 22 were combined into two composite variables: Curriculum Control and Pedagogical Control.[4] As can be seen in Table 23, elementary teachers perceive much more control over decisions related to pedagogy than curriculum.

Table 23
Elementary Science Class Mean Scores for the Curriculum Control and Pedagogical Control Composites

	Mean Score					
	Grades K–5		Grades K–2		Grades 3–5	
Pedagogical Control	81	(1.2)	81	(1.5)	80	(1.9)
Curriculum Control	32	(1.7)	32	(2.3)	33	(2.3)

Instructional Objectives

The survey provided a list of possible objectives of science instruction and asked teachers how much emphasis each would receive over an entire year. As can be seen in Table 24, understanding science concepts is more likely to be heavily emphasized in grade 3–5 classes (69 percent) than grade K–2 classes (47 percent). Grade 3–5 classes are also more likely than grade K–2 classes to focus on learning test taking skills/strategies (30 and 13 percent, respectively), likely because most state accountability systems begin testing in 3rd grade. Increasing students' interest in science, learning science process skills, and learning about real-life applications of science are heavily emphasized in roughly half of elementary science classes.

[4] The body of this report includes data on selected composite variables. Data for all composite variables are available in the Appendix.

Table 24
Elementary Science Classes with Heavy Emphasis on Various Instructional Objectives

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Understanding science concepts	59 (2.2)	47 (3.1)	69 (2.3)
Increasing students' interest in science	55 (2.0)	55 (2.8)	56 (2.5)
Learning science process skills (e.g., observing, measuring)	47 (2.1)	45 (2.6)	49 (2.7)
Learning about real-life applications of science	46 (2.3)	47 (2.8)	45 (3.0)
Preparing for further study in science	35 (2.0)	34 (2.9)	35 (2.9)
Learning test taking skills/strategies	22 (1.6)	13 (1.4)	30 (2.4)
Memorizing science vocabulary and/or facts	10 (1.3)	6 (1.3)	14 (2.1)

Class Activities

The 2012 National Survey included several items that provide information about how science is taught at the elementary school level. One series of items listed various instructional strategies and asked teachers to indicate the frequency with which they used each in their science class. As can be seen in Table 25, three instructional activities occur at least once a week in most elementary science classes: explaining science ideas to the whole class, engaging the whole class in discussions, and having students work in small groups. Conversely, several activities occur weekly in less than half of elementary science classes, including: having students represent and/or analyze data using tables, charts, or graphs; engaging the class in project-based learning (PBL) activities; and having students make formal presentations to the rest of the class.

A number of class activities are much more common in grades 3–5 than in grades K–2 including: requiring students to support their claims with evidence (62 percent vs. 46 percent), having students read from science-related materials (55 percent vs. 39 percent), and having student write reflections in their journals (48 percent vs. 38 percent). There is also more emphasis on formal assessment in grade 3–5 classes than grade K–2 classes, as evidenced by the fact that grade 3–5 classes are more likely to be given tests and quizzes (both short answer and constructed response) and practice for standardized tests.

Table 25
Elementary Science Classes in which Teachers Report Using Various Activities at Least Once a Week

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Engage the whole class in discussions	90 (0.9)	90 (1.4)	91 (1.4)
Explain science ideas to the whole class	88 (1.3)	87 (1.7)	89 (1.6)
Have students work in small groups	72 (1.8)	65 (2.4)	79 (2.4)
Do hands-on/laboratory activities	55 (1.9)	54 (2.5)	55 (3.2)
Require students to supply evidence in support of their claims	54 (2.0)	46 (2.5)	62 (3.2)
Have students read from a science textbook, module, or other science-related material in class, either aloud or to themselves	48 (2.4)	39 (3.0)	55 (3.3)
Focus on literacy skills (e.g., informational reading or writing strategies)	48 (2.0)	45 (2.8)	51 (2.6)
Have students write their reflections (e.g., in their journals) in class or for homework	44 (2.0)	38 (2.7)	48 (2.8)
Have students represent and/or analyze data using tables, charts, or graphs	44 (2.0)	42 (2.5)	46 (3.0)
Give tests and/or quizzes that are predominantly short-answer (e.g., multiple choice, true /false, fill in the blank)	31 (2.0)	19 (2.5)	41 (3.1)
Engage the class in project-based learning (PBL) activities	30 (1.7)	31 (2.4)	29 (2.5)
Give tests and/or quizzes that include constructed-response/open-ended items	21 (1.7)	12 (1.9)	29 (2.6)
Have students practice for standardized tests	19 (1.7)	10 (1.6)	28 (2.7)
Have students make formal presentations to the rest of the class (e.g., on individual or group projects)	12 (1.2)	10 (1.5)	14 (2.0)
Have students attend presentations by guest speakers focused on science and/or engineering in the workplace	3 (0.6)	2 (0.8)	4 (1.0)

Teachers were also asked about the frequency with which they use various instructional technologies in their science classes. Technology use is low across elementary classes, with about 30 percent of elementary science classes using the Internet and 20 percent of classes using personal computers at least once a week (see Table 26).

Table 26
Elementary Science Classes in which Teachers Report that Students Use Various Instructional Technologies at Least Once a Week

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Internet	31 (2.9)	27 (3.9)	35 (4.0)
Personal computers, including laptops	21 (3.0)	15 (2.7)	26 (4.8)
Classroom response system or "Clickers"	8 (2.8)	2 (1.0)	13 (4.5)
Calculators	8 (1.7)	6 (1.8)	9 (2.7)
Probes for collecting data	7 (2.1)	4 (1.4)	10 (3.7)
Hand-held computers	2 (0.8)	2 (1.2)	3 (1.2)

Two composite variables were created from the class activities 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) and "use of instructional technology." As can be seen in Table 27, the use of reform-oriented teaching practices is somewhat less prevalent in grade K–2 classes than in grade 3–5 classes. Additionally, although the use of instructional technology is rare in all elementary classes, composite mean scores are even lower for grade K–2 classes than grade 3–5 classes.

Table 27
Elementary Science Class Mean Scores for the Teaching Practice Composites

	Mean Score		
	Grades K–5	Grades K–2	Grades 3–5
Use of Reform-Oriented Teaching Practices	60 (0.7)	58 (0.9)	62 (0.9)
Use of Instructional Technology	25 (1.1)	19 (1.3)	29 (1.6)

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. About 90 percent of lessons include whole class discussion and the teacher explaining a science idea to the whole class (see Table 28). In addition, about half of elementary lessons include students reading about science and doing hands-on/laboratory activities.

There are some notable differences in class activities between the grade bands. Grade 3–5 classes are more likely to read about science (59 percent vs. 46 percent) and complete textbook/worksheet problems (47 percent vs. 37 percent), while grade K–2 classes are more likely to do hands-on/laboratory activities (57 percent vs. 48 percent).

Table 28
Elementary Science Classes Participating in Various Activities in the Most Recent Lesson

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Whole class discussion	91 (1.1)	93 (1.3)	89 (1.7)
Teacher explaining a science idea to the whole class	89 (1.2)	92 (1.5)	87 (1.7)
Students reading about science	53 (2.2)	46 (3.0)	59 (3.4)
Students doing hands-on/laboratory activities	52 (1.9)	57 (2.4)	48 (2.8)
Students completing textbook/worksheet problems	43 (1.8)	37 (2.5)	47 (2.6)
Teacher conducting a demonstration while students watched	40 (2.0)	44 (2.9)	36 (2.7)
Students using instructional technology	22 (1.5)	19 (2.2)	24 (2.2)
Test or quiz	12 (1.2)	8 (1.4)	16 (2.1)
Practicing for standardized tests	5 (0.8)	2 (0.8)	7 (1.3)

The survey also asked teachers to estimate the time spent on a number of types of activities in their most recent science lesson. As can be seen in Table 29, the majority of class time was spent on whole class activities and small group work.

Table 29
Average Percentage of Time Spent on Different Activities in the Most Recent Elementary Science Lesson

	Average Percent of Class Time					
	Grades K–5		Grades K–2		Grades 3–5	
Whole class activities (e.g., lectures, explanations, discussions)	43	(0.8)	45	(1.2)	41	(1.3)
Small group work	32	(0.9)	30	(1.4)	34	(1.3)
Students working individually (e.g., reading textbooks, completing worksheets, taking a test or quiz)	19	(0.6)	20	(1.0)	19	(0.7)
Non-instructional activities (e.g., attendance taking, interruptions)	6	(0.3)	5	(0.4)	6	(0.4)

Homework and Assessment Practices

Teachers were asked about the amount of science homework assigned per week in their class. As can be seen in Table 30, 89 percent of grade K–2 classes and 61 percent of grade 3–5 classes are given fewer than 15 minutes of homework per week. These data stand in sharp contrast to mathematics, where only 29 percent of grade K–2 classes and 5 percent of grade 3–5 classes are given fewer than 15 minutes of homework per week.[5]

Table 30
Amount of Homework Assigned in Elementary Science Classes per Week

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Fewer than 15 minutes per week	73	(2.8)	89	(2.5)	61	(4.4)
15–30 minutes per week	17	(2.5)	9	(2.1)	24	(4.1)
31–60 minutes per week	7	(2.0)	2	(1.1)	11	(3.3)
61–90 minutes per week	2	(1.2)	0	---†	4	(2.1)
91–120 minutes per week	0	(0.2)	0	---†	0	(0.3)
More than 120 minutes per week	0	(0.3)	0	(0.3)	0	(0.5)

† No grade K–2 teachers 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 ways in which they assessed student progress during the most recently completed unit in their randomly selected class (see Table 31). The vast majority of elementary classes in both grade bands included informal assessment practices to see if students were "getting it," such as questioning individual students during class activities (94 percent), reviewing student work (89 percent), and using whole class informal assessments (87 percent). Other assessment practices (going over the correct answers to assignments, quizzes and/or tests; assigning grades to student work; and administering quizzes and/or tests to assign grades) were relatively common in grade 3–5 classes but less so in grade K–2 classes.

[5] Malzahn, K. A. (2013). *2012 National Survey of Science and Mathematics Education: Status of elementary school mathematics*. Chapel Hill, NC: Horizon Research, Inc.

Table 31
Elementary Science Classes in which Teachers Report Assessing Students Using Various Methods in the Most Recent Unit

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Questioned individual students during class activities to see if they were "getting it"	94	(0.9)	94	(1.3)	95	(1.2)
Reviewed student work (e.g., homework, notebooks, journals, portfolios, projects) to see if they were "getting it"	89	(1.4)	86	(1.8)	92	(1.9)
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"	87	(1.3)	88	(1.7)	87	(2.1)
Went over the correct answers to assignments, quizzes, and/or tests with the class as a whole	62	(2.2)	45	(2.6)	77	(3.1)
Assigned grades to student work (e.g., homework, notebooks, journals, portfolios, projects)	60	(1.8)	41	(2.2)	77	(2.4)
Administered one or more quizzes and/or tests to assign grades	56	(2.4)	36	(2.8)	73	(3.1)
Administered an assessment, task, or probe at the beginning of the unit to find out what students thought or already knew about the key science ideas	54	(2.0)	51	(2.8)	56	(3.0)
Administered one or more quizzes and/or tests to see if students were "getting it"	52	(2.5)	37	(2.6)	65	(3.4)
Had students use rubrics to examine their own or their classmates' work	14	(1.4)	12	(1.4)	16	(2.4)

The survey asked how often students in the randomly selected class were required to take external assessments, such as state or district benchmark assessments. As can be seen in Table 32, 74 percent of grade K–2 classes and 29 percent of grade 3–5 classes never take external assessments.

Table 32
Frequency of Required External Testing in Elementary Science Classes

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Never	50	(2.3)	74	(2.8)	29	(2.4)
Once a year	17	(1.6)	9	(1.6)	25	(2.4)
Twice a year	8	(1.2)	4	(1.1)	11	(2.0)
Three or four times a year	16	(1.6)	8	(1.6)	23	(2.5)
Five or more times a year	9	(1.6)	5	(1.5)	12	(2.5)

RESOURCES AVAILABLE FOR ELEMENTARY SCHOOL SCIENCE INSTRUCTION

Instructional Materials

The 2012 National Survey collected data on the use of commercially published instructional materials in science classes. As can be seen in Table 33, 60 percent of grade K–2 classes and 77 percent of grade 3–5 classes use commercially published materials.

Table 33
Elementary Science Classes Using
Commercially Published Instructional Materials

	Percent of Classes
Grades K–5	69 (2.1)
Grades K–2	60 (2.9)
Grades 3–5	77 (2.8)

The survey also asked if one textbook/program is used all or most of the time, or if multiple materials are used. While much elementary science instruction appears to be pulled together from multiple sources, 40 percent of grade K–2 classes and 23 percent of grade 3–5 classes use non-commercially published materials most of the time (see Table 34).

Table 34
Instructional Materials Used in Elementary Science Classes

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Mainly commercially published textbook(s)			
One textbook	26 (2.0)	21 (2.3)	30 (3.0)
Multiple textbooks	4 (0.7)	3 (0.6)	5 (1.2)
Mainly commercially published modules			
Modules from a single publisher	12 (1.5)	12 (1.8)	13 (2.0)
Modules from multiple publishers	4 (1.0)	3 (1.0)	5 (1.8)
Other			
A roughly equal mix of commercially published textbooks and commercially published modules most of the time	22 (1.7)	21 (2.1)	23 (2.6)
Non-commercially published materials most of the time	31 (2.1)	40 (2.9)	23 (2.8)

Teachers utilizing 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. Interestingly, four publishers—Houghton Mifflin Harcourt, McGraw-Hill, Pearson, and Delta Education—account for the instructional materials used in 90 percent of elementary science classes. Ten percent of elementary classes use materials developed with funding from the National Science Foundation.

Table 35 shows the publication year of science instructional materials. In 2012, nearly 60 percent of elementary classes using commercially published materials were using ones published prior to 2007.

Table 35
Publication Year of Instructional Materials in Elementary Science Classes

	Percent of Classes†					
	Grades K–5		Grades K–2		Grades 3–5	
2006 or earlier	58	(3.0)	59	(3.5)	57	(4.3)
2007–09	24	(2.7)	24	(3.6)	25	(3.3)
2010–12	18	(2.6)	17	(3.2)	19	(3.4)

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

While national experts in science education are often critical of textbook quality,[6] most teachers of elementary classes consider their instructional materials to be of relatively high quality. Teachers in 71 percent of elementary classes using commercially published materials rated those materials as good, very good, or excellent (see Table 36).

Table 36
Perceived Quality of
Instructional Materials Used in Elementary Science Classes

	Percent of Classes†					
	Grades K–5		Grades K–2		Grades 3–5	
Very poor	6	(2.6)	1	(1.1)	9	(4.2)
Poor	4	(1.4)	3	(1.5)	5	(2.0)
Fair	19	(2.6)	23	(4.1)	16	(3.1)
Good	32	(2.9)	36	(4.6)	30	(4.1)
Very good	32	(3.7)	32	(4.0)	32	(5.1)
Excellent	7	(1.8)	6	(2.0)	8	(2.7)

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

The 2012 National Survey also asked teachers about the percentage of the instructional materials covered and instructional time spent using them. As can be seen in Table 37, over half of elementary classes using commercially published materials cover 75 percent or more of their instructional materials during the year. In addition, over half use their instructional materials at least 50 percent of the time (see Table 38).

Table 37
Percentage of Instructional Materials
Covered in Elementary Science Classes

	Percent of Classes†					
	Grades K–5		Grades K–2		Grades 3–5	
Less than 25 percent	13	(3.3)	20	(6.2)	9	(3.5)
25–49 percent	8	(2.6)	12	(5.3)	5	(2.7)
50–74 percent	27	(4.7)	13	(4.3)	35	(6.7)
75 percent or more	52	(5.6)	54	(7.0)	51	(7.7)

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

[6] 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 38
Percentage of Instructional Time Spent Using Instructional Materials in Elementary Science Classes

	Percent of Classes[†]		
	Grades K–5	Grades K–2	Grades 3–5
Less than 25 percent	15 (3.2)	25 (5.6)	9 (2.9)
25-49 percent	27 (3.4)	25 (5.3)	28 (4.9)
50-74 percent	22 (4.0)	17 (5.5)	25 (6.2)
75 percent or more	35 (4.2)	32 (7.1)	37 (5.4)

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

Teachers were also asked to describe how they used their instructional materials in their most recent unit (see Table 39). Teachers in 77 percent of classes using commercially published materials use the textbook/module to guide the overall structure and content emphasis of the unit, and 65 percent use the textbook/module for more detailed organization. However, it is also clear that elementary science teachers deviate from their instructional materials, as many teachers skip activities or incorporate ones from other sources.

Table 39
Ways Elementary Science Teachers Substantially[†] Used Their Instructional Materials in the Most Recent Unit

	Percent of Classes[‡]		
	Grades K–5	Grades K–2	Grades 3–5
You used the textbook/module to guide the overall structure and content emphasis of the unit	77 (2.8)	73 (3.4)	79 (3.8)
You followed the textbook/module to guide the detailed structure and content emphasis of the unit	65 (2.8)	65 (4.0)	65 (3.9)
You incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what the textbook/module was lacking	65 (2.6)	65 (3.6)	64 (4.0)
You picked what is important from the textbook/module and skipped the rest	42 (2.2)	41 (3.9)	43 (3.2)

[†] 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 commercially published textbooks/modules in the most recent unit were included in these analyses.

In the vast majority of elementary science classes where instructional materials are supplemented, teachers do so to help students at different achievement levels and to provide students with additional practice (see Table 40). In addition, instructional materials are supplemented to prepare students for standardized tests in 62 percent of grade 3–5 classes and 31 percent of grade K–2 classes.

Table 40
Reasons Why Elementary Science Instructional Materials Are Supplemented

	Percent of Classes†					
	Grades K–5		Grades K–2		Grades 3–5	
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)	92	(3.0)	94	(2.0)
Supplemental activities were needed to provide students with additional practice	86	(2.1)	80	(3.9)	91	(2.6)
Your pacing guide indicated that you should use supplemental activities	58	(3.2)	59	(4.5)	58	(5.4)
Supplemental activities were needed to prepare students for standardized tests	49	(4.1)	31	(5.8)	62	(5.0)

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

Teachers who used textbooks/modules were also asked why they skipped parts of these instructional materials. As can be seen in Table 41, activities in textbook/modules are frequently skipped because teachers have other activities that work better (84 percent of elementary science classes). The majority of elementary teachers also skip activities because the ideas they cover are not addressed in their pacing guide and/or current state standards (66 percent), because they do not have the material needed to implement the activities (62 percent), or because students already know/are able to learn the science ideas without the activities (60 percent).

Table 41
Reasons Why Parts of Elementary Science Instructional Materials Are Skipped

	Percent of Classes†					
	Grades K–5		Grades K–2		Grades 3–5	
You have different activities for those science ideas that work better than the ones you skipped	84	(2.8)	87	(3.6)	81	(4.1)
The science ideas addressed in the activities you skipped are not included in your pacing guide and/or current state standards	66	(3.5)	58	(5.6)	71	(4.9)
You did not have the materials needed to implement the activities you skipped	62	(3.4)	55	(5.4)	67	(4.8)
Your students already knew the science ideas or were able to learn them without the activities you skipped	60	(3.8)	60	(5.5)	59	(5.9)
The activities you skipped were too difficult for your students	50	(4.0)	52	(5.1)	49	(5.5)

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

Facilities and Equipment

Elementary teachers were presented with a list of instructional technologies and asked about their availability in a randomly selected class. The percentages of science classes with at least some availability (either in the classroom upon request, or in another room) are shown in Table 42. Internet access is available in 84 percent of elementary science classes. Other instructional technologies are widely available in grade 3–5 classes but less so in grade K–2 classes, including non-graphing calculators, microscopes, and clickers.

Table 42
Availability† of Instructional Technologies in Elementary Science Classes

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Internet access	84	(1.9)	83	(2.9)	85	(2.8)
Non-graphing calculators	69	(2.9)	61	(3.4)	76	(4.0)
Personal computers, including laptops	69	(2.4)	68	(3.6)	70	(3.3)
Microscopes	48	(3.2)	32	(3.5)	60	(4.0)
Classroom response system or "Clickers" (handheld devices used to respond electronically to questions in class)	41	(3.8)	33	(4.0)	48	(5.1)
Probes for collecting data (e.g., motion sensors, temperature probes)	32	(3.1)	29	(3.1)	35	(4.9)
Hand-held computers (e.g., PDAs, tablets, smartphones, iPads)	20	(2.3)	21	(3.6)	19	(2.8)
Graphing calculators	9	(2.3)	7	(1.7)	11	(3.5)

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

Teachers were also asked about the adequacy of different resources for instruction. Interestingly, teachers of only about one-third of elementary science classes rated the availability of equipment, instructional technology, consumable supplies, and facilities as adequate for science instruction (see Table 43).

Table 43
Adequacy† of Resources for Elementary Science Instruction

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Equipment (e.g., microscopes, beakers, photogate timers, Bunsen burners)	37	(2.5)	34	(3.7)	38	(3.5)
Instructional technology (e.g., calculators, computers, probes/ sensors)	33	(2.5)	31	(3.6)	35	(3.2)
Consumable supplies (e.g., chemicals, living organisms, batteries)	33	(2.7)	32	(3.5)	34	(3.6)
Facilities (e.g., lab tables, electric outlets, faucets and sinks)	31	(2.5)	35	(3.4)	28	(3.6)

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

FACTORS AFFECTING ELEMENTARY SCHOOL SCIENCE INSTRUCTION

Elementary science teachers were asked about factors that affect their science instruction. As can be seen in Table 44, students' motivation, interest, and effort in science (79 percent), principal support (69 percent), and current state standards (67 percent) were most frequently mentioned as factors promoting effective science instruction in elementary classes.

Table 44
Factors Promoting† Effective Instruction in Elementary Science Classes

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Students' motivation, interest, and effort in science	79	(1.9)	83	(2.3)	76	(2.8)
Principal support	69	(2.5)	68	(4.0)	71	(3.2)
Current state standards	67	(2.6)	67	(3.5)	66	(3.8)
District/Diocese curriculum frameworks	64	(2.4)	64	(3.2)	64	(4.4)
Students' reading abilities	57	(2.5)	57	(4.3)	57	(3.1)
District/Diocese/School pacing guides	56	(2.7)	53	(3.8)	58	(4.4)
Time for you to plan, individually and with colleagues	54	(2.3)	57	(3.3)	52	(4.2)
Time available for your professional development	49	(2.4)	50	(3.4)	48	(3.8)
Teacher evaluation policies	48	(2.7)	49	(3.6)	47	(4.3)
Parent expectations and involvement	47	(2.6)	50	(4.1)	44	(3.9)
Textbook/module selection policies	43	(2.9)	40	(3.9)	46	(4.1)
District/Diocese testing/accountability policies	42	(3.3)	38	(4.2)	46	(4.5)
Community views on science instruction	42	(2.4)	46	(3.6)	39	(3.6)
State testing/accountability policies	40	(3.0)	33	(3.8)	46	(4.5)

† Includes those responding 4 or 5 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 also asked to indicate how great a problem each posed for instruction in their science class. As can be seen in Table 45, these resources are generally not problematic in elementary science classes.

Table 45
Extent to which Technology Quality Is a
Serious Problem for Instruction in Science Classes

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Lack of access to computers	12	(1.5)	13	(2.6)	11	(2.1)
Lack of availability of appropriate computer software	12	(1.8)	13	(3.1)	11	(2.0)
Old age of computers	11	(1.7)	12	(2.5)	10	(2.1)
Lack of availability of technology support	9	(1.4)	11	(2.7)	8	(1.6)
Slow speed of the Internet connection	7	(1.3)	8	(1.8)	7	(1.9)
Unreliability of the Internet connection	6	(1.2)	5	(1.6)	7	(1.8)
Lack of access to the Internet	5	(1.1)	3	(1.1)	7	(1.8)

SUMMARY

Elementary science teachers are predominately female and white. Although a majority of elementary science teachers are over 40 years old, one-third have five or fewer years of experience teaching science. In general, elementary science teachers have limited college coursework in science, particularly in chemistry, physics, and engineering. Accordingly, their perceptions of preparedness to teach science pale in comparison to reading/language arts and mathematics.

Still, elementary science teachers feel well prepared in terms of pedagogy, particularly in managing classroom discipline, and in encouraging the participation of females and students from low socioeconomic backgrounds in science and/or engineering. Elementary science teachers also hold a number of pedagogical beliefs that are well aligned with what is known about effective science teaching (e.g., providing opportunities for student to share their thinking and reasoning, concluding class periods with a summary of the key ideas addressed). However, a majority also agree with teaching practices that are inconsistent with what the field knows about effective science teaching, such as providing students with definitions for new vocabulary at the beginning of instruction on an idea and using hands-on/laboratory activities to reinforce ideas that students have already learned

In addition, elementary teachers have had limited opportunities for professional growth in science. Although the majority have participated in science-focused professional development in the last three years, only 4 percent have had sustained professional development (more than 35 hours). Furthermore, few reported that their professional development in the last three years included characteristics of effective professional development, such as working with other science teachers from their schools or examining classroom artifacts.

The frequency and duration of elementary science instruction averages only 20 minutes a day, substantially less than the amount of time devoted to reading/language arts and mathematics. Additionally, only 19 percent of grade K–2 classes and 30 percent of grade 3–5 classes receive science instruction all or most days every week of the school year. When science is taught, elementary teachers tend to emphasize reform-oriented instructional objectives, such understanding science concepts and learning science process skills. Science instruction is based largely on whole class discussion and the teacher explaining ideas to the class. Small group work is also fairly common. Students doing hands-on/laboratory activities and being required to supply evidence to support claims occurs weekly in about half of elementary science classes.

Nearly 7 in 10 elementary science classes use commercially published textbooks or modules as the basis of instruction. Of these classes, over half use these instructional materials for 50 percent or more of their science instructional time. However, much elementary science instruction appears to be pulled together from multiple sources, with 40 percent of grade K–2 classes and 23 percent of grade 3–5 classes using non-commercially published materials most of the time. Additionally, teachers in elementary classes using commercially published materials frequently supplement and skip parts of their instructional materials.

A large majority of elementary science classes have access to a number of instructional technologies, including the Internet, non-graphing calculators, and personal computers. However, when asked about resources available for science instruction, teachers in only about one-third of classes rated their access to equipment, instructional technology, consumable supplies, and facilities as adequate.

APPENDIX

Table A-1
Teacher Mean Scores for Composites

	Mean Score					
	Grades K–5		Grades K–2		Grades 3–5	
Perceptions of Preparedness to Encourage Students' Interest in Science	62	(1.8)	63	(2.0)	62	(2.8)
Perceptions of Preparedness to Teach Students from Diverse Backgrounds	52	(1.5)	53	(1.7)	52	(2.3)
Quality of Professional Development	55	(1.8)	53	(2.3)	58	(2.2)
Extent to which PD/Coursework Focused on Student-Centered Instruction	57	(1.6)	58	(2.3)	56	(2.0)

Table A-2
Class Mean Scores for Composites

	Mean Score					
	Grades K–5		Grades K–2		Grades 3–5	
Perceptions of Preparedness to Implement Instruction in Particular Unit	75	(0.8)	76	(1.1)	74	(1.1)
Curriculum Control	32	(1.7)	32	(2.3)	33	(2.3)
Pedagogical Control	81	(1.2)	81	(1.5)	80	(1.9)
Reform-Oriented Instructional Objectives	79	(0.7)	78	(1.0)	80	(0.9)
Use of Reform-Oriented Teaching Practices	60	(0.7)	58	(0.9)	62	(0.9)
Use of Instructional Technology	25	(1.1)	19	(1.3)	29	(1.6)
Adequacy of Resources for Instruction	48	(1.4)	47	(1.8)	49	(1.9)
Extent to which Stakeholder Support Promotes Effective Instruction	69	(1.0)	71	(1.5)	67	(1.5)
Extent to which the Policy Environment Promotes Effective Instruction	65	(1.3)	65	(1.8)	66	(2.3)
Extent to which School Support Promotes Effective Instruction	62	(1.6)	62	(2.3)	61	(2.8)
Extent to which IT Quality is Problematic for Instruction	21	(1.3)	20	(1.9)	21	(2.0)