2012 National Survey of Science and Mathematics Education

Status of High School Biology

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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/programs, and how are they used?

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

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

The 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 high school (grades 9–12) biology instruction based on the responses of 695 biology teachers.[1] For comparison purposes, many of the tables include data from the 1,023 respondents who do not teach biology; i.e., all other high school science teachers. These data include responses from high school chemistry, Earth science, physics, and physical science teachers.

[1] A biology teacher is defined as someone who teaches at least one class of non-college prep, 1st year college prep, or 2nd year advanced biology.

Technical detail on the survey sample design, as well as data collection and analysis procedures, is included in the *Report of the 2012 National Survey of Science and Mathematics Education*.[2] The standard errors for the estimates presented in this report are included in parentheses in the tables. The narrative sections of the report generally point out only those differences that are substantial as well as statistically significant at the 0.05 level.

This status report of high school biology teaching is organized into major topical areas:

- Characteristics of the biology teaching force;
- Professional development of biology teachers;
- Biology classes offered;
- Biology instruction, in terms of time spent, objectives, and activities;
- Resources available for biology instruction; and
- Factors affecting biology instruction.

CHARACTERISTICS OF THE HIGH SCHOOL BIOLOGY TEACHING FORCE

General Demographics

Over 60 percent of biology teachers are female, a higher proportion than in other high school sciences. Similar to the other sciences, however, the overwhelming majority of biology teachers are white (see Table 1). Judging by the age of biology teachers, it appears that many may be nearing retirement in the next 10 years.

Biology teachers are more likely to teach multiple subjects (e.g., biology, chemistry, physics) within science than are other high school science teachers; only 43 percent of biology teachers have just one preparation, compared to 62 percent of all other high school science teachers.

[2] 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.

Table 1
Characteristics of the High School Science Teaching Force

	Percent of Teachers			
	All Other Sciences		Biology	
Sex				
Male	54	(2.1)	38	(2.3)
Female	46	(2.1)	62	(2.3)
Race				
White	92	(0.9)	94	(1.0)
Black or African American	3	(0.5)	3	(0.7)
Hispanic or Latino	3	(0.8)	3	(0.8)
Asian	3	(0.7)	1	(0.4)
American Indian/Alaska Native	0	(0.2)	1	(0.3)
Native Hawaiian/Other Pacific Islander	0	(0.2)	0	(0.2)
Two or more races	1	(0.3)	1	(0.5)
Age				
≤ 30	14	(1.6)	17	(2.1)
31–40	30	(1.9)	32	(1.8)
41–50	26	(2.0)	23	(1.7)
51–60	22	(1.8)	22	(1.9)
61+	8	(1.1)	6	(1.5)
Experience Teaching Science at the K–12 Level				
0–2 years	15	(1.8)	11	(1.6)
3–5 years	15	(1.7)	15	(1.6)
6–10 years	20	(1.9)	24	(2.0)
11–20 years	30	(1.8)	31	(2.2)
≥ 21 years	19	(1.5)	18	(1.8)
Number of Science Subjects Taught				
1	62	(2.5)	43	(2.1)
2	33	(2.1)	42	(2.0)
3 or more	5	(1.3)	15	(1.8)

About 6 in 10 biology teachers have a college degree in science or engineering, roughly equal to teachers of other sciences; just over one-half have a degree in science education, more than teachers of other sciences (see Table 2). Similar to other high school science teachers, the vast majority of biology teachers have had formal preparation for teaching leading to a teacher credential (see Table 3). Most biology teachers received their teaching credential as part of their undergraduate program or a non-master's post-baccalaureate program.

Table 2
High School Science Teacher Degrees

	Percent of Teachers			
	All Other Sciences		Biology	
Science/Engineering	61	(2.4)	62	(2.3)
Science Education	43	(2.0)	53	(2.3)
Science/Engineering or Science Education	80	(2.3)	85	(1.7)

Table 3
High School Science Teachers' Paths to Certification

	Percent of Teachers	
	All Other Sciences	**Biology**
An undergraduate program leading to a bachelor's degree and a teaching credential	34 (2.5)	35 (3.2)
A post-baccalaureate credentialing program (no master's degree awarded)	31 (2.6)	29 (2.9)
A master's program that also awarded a teaching credential	27 (2.2)	29 (3.2)
No formal teacher preparation	8 (1.3)	6 (1.4)

Content Preparedness

In terms of the number of college courses they have taken in their subject, biology teachers tend to be better prepared than other science teachers are in their respective subjects. Fifty-four percent of biology teachers have a degree in their subject, compared to 22 percent of other science teachers (see Table 4).

Table 4
High School Science Teachers with Varying Levels of Background in the Subject of Randomly Selected Class

	Percent of Teachers	
	All Other Sciences	**Biology**
Degree in Field	22 (1.2)	54 (3.0)
No Degree in Field, but 3+ Courses beyond Introductory	41 (1.9)	39 (2.8)
No Degree in Field, but 1–2 Courses beyond Introductory	16 (1.4)	3 (0.9)
No Degree in Field or Courses beyond Introductory	21 (1.9)	4 (1.4)

As can be seen in Table 5, teachers assigned to biology classes are about as likely as the rest of the secondary science teaching force to have taken a science education course, but are more likely to have student taught in science. Not surprisingly, biology teachers are more likely to have completed college coursework in biology/life science than are other high school science teachers. Ninety-eight percent of biology teachers have taken an introductory biology/life science course, and 70 percent or more have taken a course in genetics, anatomy/physiology, and cell biology.

Table 5
High School Science Teachers Completing Various College Courses

	Percent of Teachers	
	All Other Sciences	**Biology**
Science Education	83 (2.0)	88 (2.0)
Student teaching in science	68 (2.2)	78 (2.4)
Introductory Biology/Life Science	84 (1.8)	98 (1.0)
Genetics	33 (1.9)	74 (2.2)
Anatomy/Physiology	34 (2.1)	73 (2.0)
Cell Biology	27 (1.8)	70 (2.6)
Ecology	30 (2.1)	68 (2.5)
Microbiology	29 (2.0)	66 (2.7)
Botany	28 (2.0)	59 (2.4)
Zoology	24 (2.0)	56 (2.3)
Biochemistry	31 (2.0)	54 (2.3)
Evolution	15 (1.4)	37 (2.0)

The survey also asked biology teachers to rate how well prepared they feel to teach each of a number of fundamental topics in biology. A large majority of biology teachers feel very well prepared to teach about cell biology, genetics, and structures and functions of organisms (see Table 6). Few biology teachers feel not adequately prepared in any of these areas.

Table 6
High School Biology Teachers' Perceptions of Preparedness to Teach Each of a Number of Topics

	Percent of Biology Teachers			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Cell biology	1 (0.6)	5 (1.5)	19 (1.8)	75 (2.7)
Genetics	2 (0.6)	4 (1.2)	25 (2.3)	70 (2.8)
Structures and functions of organisms	1 (0.8)	4 (2.2)	24 (2.5)	70 (2.9)
Ecology/ecosystems	1 (0.6)	8 (1.6)	29 (2.2)	61 (2.6)
Evolution	3 (1.3)	8 (1.8)	31 (2.5)	57 (3.0)

Data from items asking teachers how well prepared they feel to teach the content of a randomly selected course were combined into a composite variable called Perceptions of Preparedness to Teach Science Content.[3] As can be seen in Table 7, biology teachers feel equally prepared to teach biology as teachers of the other sciences feel to teach their specific discipline.

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

Table 7
High School Science Teacher Mean Scores for the Perceptions of Preparedness to Teach Science Content Composite

	Mean Score
All Other Sciences[†]	86 (1.2)
Biology	86 (1.4)

[†] Composite score is based on the content of each teacher's randomly selected class.

Pedagogical Beliefs

Teachers were asked about their beliefs regarding effective teaching and learning in science. As can be seen in Table 8, biology teachers hold a number of views that are in alignment with what is known about effective science instruction. For example, a large majority of biology teachers agree that: (1) most class periods should provide opportunities for students to share their thinking and reasoning, (2) students should be provided with the purpose for a lesson as it begins, (3) most class periods should conclude with a summary of the key ideas addressed, and (4) most class periods should include some review of previously covered ideas and skills. In addition, only about 4 in 10 biology teachers agree that teachers should explain an idea to students before having them consider evidence that relates to the idea.

However, many biology teachers also hold views that are inconsistent with effective science instruction. Nearly three-fourths of biology teachers believe that students should be provided with definitions for new vocabulary at the beginning of instruction on a science idea, and about two-thirds believe that students learn best in classes with students of similar abilities. In addition, more than half of biology teachers think that hands-on/laboratory activities should be used primarily to reinforce a science idea.

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

	Percent of Teachers	
	All Other Sciences	**Biology**
Most class periods should provide opportunities for students to share their thinking and reasoning	91 (1.6)	92 (1.2)
Students should be provided with the purpose for a lesson as it begins	86 (1.7)	90 (1.2)
Most class periods should conclude with a summary of the key ideas addressed	86 (1.8)	90 (1.1)
Most class periods should include some review of previously covered ideas and skills	83 (2.0)	88 (1.7)
Inadequacies in students' science background can be overcome by effective teaching	83 (2.0)	85 (1.5)
It is better for science instruction to focus on ideas in depth, even if that means covering fewer topics	74 (1.9)	72 (1.9)
At the beginning of instruction on a science idea, students should be provided with definitions for new scientific vocabulary that will be used	67 (2.1)	72 (2.1)
Students learn science best in classes with students of similar abilities	65 (2.3)	66 (2.3)
Hands-on/laboratory activities should be used primarily to reinforce a science idea that the students have already learned	55 (2.5)	55 (2.5)
Students should be assigned homework most days	53 (2.0)	42 (2.4)
Teachers should explain an idea to students before having them consider evidence that relates to the idea	37 (2.3)	39 (2.5)

† 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 the randomly selected class.

As can be seen in Table 9, more than half of biology teachers feel very well prepared to manage classroom discipline, encourage the participation of females in science/engineering, and encourage students' interest in science/engineering. About one-third or fewer biology teachers feel very well prepared to differentiate instruction.

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

	Percent of Teachers	
	All Other Sciences	Biology
Manage classroom discipline	59 (3.0)	60 (3.5)
Encourage participation of females in science and/or engineering	56 (2.8)	56 (4.1)
Encourage students' interest in science and/or engineering	53 (2.8)	55 (4.3)
Encourage participation of racial or ethnic minorities in science and/or engineering	45 (2.7)	41 (4.3)
Encourage participation of students from low socioeconomic backgrounds in science and/or engineering	45 (2.7)	39 (4.3)
Plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	40 (2.4)	33 (3.4)
Provide enrichment experiences for gifted students	35 (2.4)	28 (3.5)
Teach science to students who have physical disabilities	22 (2.0)	15 (2.5)
Teach science to students who have learning disabilities	23 (2.0)	12 (1.8)
Teach science to English-language learners	15 (1.8)	11 (2.4)

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. In the majority of high school biology classes, teachers feel very well prepared to assess student understanding at the end of a unit, to monitor student understanding during instruction, and to implement their designated textbook. In more than 4 out of 10 biology classes, teachers feel very well prepared to anticipate student difficulties and to elicit students' prior ideas about a topic.

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

	Percent of Classes	
	All Other Sciences	Biology
Assess student understanding at the conclusion of this unit	63 (2.0)	64 (3.1)
Monitor student understanding during this unit	57 (2.0)	56 (3.1)
Implement the science textbook/module to be used during this unit†	53 (2.7)	51 (4.1)
Anticipate difficulties that students may have with particular science ideas and procedures in this unit	48 (2.0)	49 (3.0)
Find out what students thought or already knew about the key science ideas	41 (1.7)	42 (3.4)

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

PROFESSIONAL DEVELOPMENT OF HIGH SCHOOL BIOLOGY TEACHERS

One important measure of teachers' continuing education is how long it has been since they participated in professional development. As can be seen in Table 11, 90 percent of biology teachers have participated in science-focused professional development (i.e., focused on science content or the teaching of science) in the last three years.

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

	Percent of Teachers	
	All Other Sciences	Biology
In the last 3 years	82 (2.1)	90 (1.2)
4–6 years ago	9 (1.4)	5 (0.8)
7–10 years ago	2 (0.4)	1 (0.4)
More than 10 years ago	2 (1.0)	1 (0.4)
Never	6 (1.6)	3 (0.7)

† Includes professional development focused on science or science teaching.

However, biology teachers, like high school science teachers in general, report low levels of participation in professional development specific to science teaching. Only about one-third of teachers have spent more than 35 hours in science-related professional development in the last three years (see Table 12).

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

	Percent of Teachers	
	All Other Sciences	Biology
Less than 6 hours	27 (2.3)	18 (2.3)
6–15 hours	18 (1.5)	22 (1.8)
16–35 hours	19 (1.9)	22 (2.1)
More than 35 hours	36 (1.9)	37 (2.1)

As to how this time is spent, the workshop is by far the most common form of professional development, with 92 percent of biology teachers having attended one in the previous three years (see Table 13). Just over two-thirds of biology teachers have participated in a professional learning community or other type of teacher study group.

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

	Percent of Teachers	
	All Other Sciences	Biology
Attended a workshop on science or science teaching	88 (2.0)	92 (1.7)
Participated in a professional learning community/lesson study/teacher study group focused on science or science teaching	75 (2.0)	70 (2.4)
Received feedback about your science teaching from a mentor/coach formally assigned by the school/district/diocese†	51 (3.9)	58 (3.5)
Attended a national, state, or regional science teacher association meeting	45 (2.4)	43 (2.6)

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

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

As can be seen in Table 14, over half of biology teachers have had substantial opportunities to work closely with other teachers from their school and/or subject. Forty-four percent have had substantial opportunities to engage in science investigations; only 32 percent have had substantial opportunities to examine classroom artifacts. Across these activities, biology teachers' professional development experiences are similar to those of other science teachers.

Table 14
High School Science Teachers Whose Professional Development in the Last Three Years Had Each of a Number of Characteristics to a Substantial Extent†

	Percent of Teachers	
	All Other Sciences	Biology
Worked closely with other science teachers from your school	60 (3.7)	65 (4.0)
Worked closely with other science teachers who taught the same grade and/or subject whether or not they were from your school	59 (3.8)	57 (3.9)
Had opportunities to try out what you learned in your classroom and then talk about it as part of the professional development	49 (3.5)	46 (3.8)
Had opportunities to engage in science investigations	46 (3.4)	44 (4.0)
Had opportunities to examine classroom artifacts (e.g., student work samples)	35 (3.2)	32 (4.0)
The professional development was a waste of time	6 (1.5)	8 (1.8)

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

College courses have the potential to address content in more depth than may be possible in other professional development venues, such as workshops. As another indicator of the extent to which teachers are staying current in their field, the 2012 National Survey asked teachers when they had last taken a formal course for college credit in both science and how to teach science. As can be seen in Table 15, just over a quarter of biology teachers took their most recent course for college credit in either science or the teaching of science more than 10 years ago.

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

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & 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 15
High School Science Teachers' Most Recent College Coursework in Field

	Percent of Teachers	
	All Other Sciences	**Biology**
Science		
In the last 3 years	24 (1.8)	25 (2.0)
4–6 years ago	20 (1.7)	18 (1.5)
7–10 years ago	14 (1.2)	22 (1.9)
More than 10 years ago	42 (2.0)	34 (1.9)
Never	0 (0.3)	1 (0.9)
The Teaching of Science		
In the last 3 years	25 (2.2)	25 (2.2)
4–6 years ago	15 (1.7)	18 (1.7)
7–10 years ago	12 (1.3)	15 (1.7)
More than 10 years ago	30 (1.8)	28 (2.1)
Never	18 (2.1)	13 (2.1)
Science or the Teaching of Science		
In the last 3 years	34 (2.1)	32 (2.2)
4–6 years ago	20 (1.7)	20 (1.7)
7–10 years ago	13 (1.1)	18 (1.9)
More than 10 years ago	34 (1.9)	28 (1.9)
Never	0 (0.3)	1 (0.9)

Another series of items asked about the focus of opportunities teachers had to learn about content and the teaching of that content in the last three years, whether through professional development or college coursework. More than half of biology teachers indicated that their professional growth opportunities gave heavy emphasis to assessing students at the end of instruction, planning instruction for students at different levels of achievement, monitoring student understanding during instruction, and learning about difficulties students may have in science (see Table 16).

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

	Percent of Teachers	
	All Other Sciences	Biology
Assessing student understanding at the conclusion of instruction on a topic	57 (3.1)	59 (3.2)
Planning instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	56 (3.0)	57 (3.0)
Monitoring student understanding during science instruction	55 (2.9)	56 (3.9)
Learning about difficulties that students may have with particular science ideas and procedures	47 (3.5)	51 (3.7)
Deepening your own science content knowledge	49 (3.0)	48 (4.1)
Finding out what students think or already know about the key science ideas prior to instruction on those ideas	43 (3.3)	45 (3.0)
Providing enrichment experiences for gifted students	32 (3.2)	35 (3.4)
Implementing the science textbook/module to be used in your classroom	26 (2.3)	33 (3.0)
Providing alternative science learning experiences for students with special needs	28 (2.5)	29 (3.3)
Teaching science to English-language learners	20 (2.4)	17 (2.7)

† 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 as participants in professional development, the survey asked teachers whether they had served in various leadership roles in the profession in the last three years. As can be seen in Table 17, biology teachers are more likely than other science teachers to have supervised a student teacher. Similar to other science teachers, about one-fourth of biology teachers led a teacher study group or served as a formally assigned mentor/coach.

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

	Percent of Teachers	
	All Other Sciences	Biology
Supervised a student teacher	18 (1.9)	27 (2.8)
Led a teacher study group focused on science teaching	29 (2.7)	26 (3.1)
Served as a formally assigned mentor/coach for science teaching	24 (2.9)	26 (3.2)
Taught in-service workshops on science or science teaching	19 (2.5)	16 (2.3)

HIGH SCHOOL BIOLOGY CLASSES OFFERED

Of the high schools (schools including grades 9, 10, 11, and 12) in the United States, almost all (98 percent) offer at least one biology course (see Table 18). Eighty-nine percent of high schools offer a 1st year biology course and nearly two-thirds offer a 2nd year course. Only about 4 in 10 high schools offer Advanced Placement (AP) Biology. There is a large disparity between the percentage of high schools offering AP Biology and the percentage of high school students with access to the course, most likely due to the fact that large schools are more likely than small ones to offer advanced biology courses, and that small schools outnumber large schools in the United States.

Table 18
Availability of Biology Courses at High Schools

	Percent of High Schools Offering	Percent of High School Students with Access
Any level	98 (0.9)	99 (0.4)
Non-college prep	73 (2.7)	69 (1.9)
1st year college prep, including honors	89 (1.9)	98 (0.5)
2nd year advanced, including AP	64 (3.4)	87 (1.4)
AP Biology	43 (2.8)	74 (1.7)

In terms of the percentage of classes offered in the nation, biology (any level) is the most commonly offered high school science subject and accounts for 39 percent of all science classes (see Table 19).

Table 19
Most Commonly Offered High School Science Courses

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

The typical biology class has approximately 22 students; two-thirds of the classes have between 15 and 28 students. Forty-nine percent of biology students are female, similar to the 51 percent in chemistry and 49 percent in physics (see Table 20). Thirty-three percent of students who take 1st year biology are from race/ethnic groups historically underrepresented in science.[5] Although biology classes are about as likely as chemistry and physics classes to be heterogeneously grouped, when homogenously grouped they are more likely to be composed of low-achieving students than are chemistry and physics classes (see Table 21).

Table 20
Demographics of Students in 1st Year High School Science Courses

	Percent of Students: Female		Percent of Students: Historically Underrepresented	
1st Year Biology	49	(1.6)	33	(2.7)
1st Year Chemistry	51	(1.4)	30	(1.8)
1st Year Physics	49	(1.8)	23	(2.7)

[5] Includes students identified as American Indian or Alaskan Native, Black, Hispanic or Latino, or Native Hawaiian or Other Pacific Islander.

Table 21
Prior-Achievement Grouping in 1st Year High School Science Classes

	Percent of Classes			
	Mostly Low Achievers	Mostly Average Achievers	Mostly High Achievers	A Mixture of Levels
1st Year Biology	16 (2.7)	31 (3.0)	22 (2.9)	31 (3.7)
1st Year Chemistry	6 (1.2)	36 (3.3)	28 (2.6)	30 (2.9)
1st Year Physics	4 (1.8)	19 (2.9)	48 (5.0)	30 (4.2)

HIGH SCHOOL BIOLOGY INSTRUCTION

Each teacher responding to the survey was asked to provide detailed information about a randomly selected class. Science teachers who were assigned to teach both biology and other science classes may have been asked about any of those classes. Accordingly, the number of biology classes included in the analyses reported below (481) is smaller than the number of responding teachers of biology. Generally, the larger standard errors are a reflection of the reduced sample size. The data reported in the "All Other Sciences" column are based on 1,237 non-biology high school science classes.

The next three sections draw on teachers' descriptions of what transpires in biology classrooms, in terms of teachers' autonomy for making decisions regarding the content and pedagogy of their classes, instructional objectives, and class activities.

Teachers' Perceptions of their Decision Making Autonomy

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

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

	Percent of Classes	
	All Other Sciences	Biology
Determining the amount of homework to be assigned	78 (2.2)	75 (3.4)
Selecting teaching techniques	75 (2.0)	72 (3.8)
Choosing criteria for grading student performance	61 (2.5)	62 (3.7)
Selecting content, topics, and skills to be taught	32 (3.0)	41 (4.6)
Determining course goals and objectives	34 (2.8)	40 (4.5)
Selecting textbooks/modules	32 (2.9)	36 (4.9)

These items were combined into two composite variables: Curriculum Control and Pedagogical Control. Scores on both composites are not significantly different from the mean scores for all other science classes (see Table 23).

Table 23
High School Science Class Mean Scores for
Curriculum Control and Pedagogical Control Composites

	Mean Score	
	All Other Sciences	**Biology**
Pedagogical Control	90 (0.8)	89 (1.4)
Curriculum Control	58 (2.0)	63 (2.9)

Instructional Objectives

Teachers were given a list of potential objectives and asked to rate each in terms of the emphasis they receive in the randomly selected class. As can be seen in Table 24, biology classes are more likely than other science classes to emphasize increasing students' interest in science (54 percent vs. 46 percent) and learning about real-life applications of science (51 percent vs. 41 percent). Biology classes are also much more likely than other science classes to emphasize memorizing science vocabulary and/or facts (21 percent vs. 9 percent). Biology classes are somewhat less likely than other science classes to emphasize learning science process skills (43 percent vs. 52 percent).

Table 24
High School Science Classes with Heavy Emphasis on Various Instructional Objectives

	Percent of Classes	
	All Other Sciences	**Biology**
Understanding science concepts	81 (1.4)	80 (2.7)
Increasing students' interest in science	46 (1.6)	54 (3.0)
Learning about real-life applications of science	41 (1.7)	51 (3.0)
Preparing for further study in science	44 (1.8)	48 (2.9)
Learning science process skills (e.g., observing, measuring)	52 (1.8)	43 (2.6)
Learning test taking skills/strategies	21 (1.5)	21 (2.0)
Memorizing science vocabulary and/or facts	9 (1.2)	21 (2.9)

Class Activities

The 2012 National Survey included several items that provide information about how biology is taught at the high school level. One series of items listed various instructional strategies and asked teachers to indicate the frequency with which they used each in a randomly selected class. As can be seen in Table 25, the vast majority of biology classes include the teacher explaining science ideas, students working in small groups, and whole class discussions on a weekly basis. Although about 7 in 10 biology and non-biology classes engage students in hands-on/laboratory activities at least once a week, biology classes are less likely to require students to support their claims with evidence. Conversely, biology classes are more likely than other science classes to have students read from their textbook. It is somewhat striking that, in contrast to what is known from learning theory about the importance of reflection, only 21 percent of biology classes have students write reflections on what they are learning.

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

	Percent of Classes	
	All Other Sciences	**Biology**
Explain science ideas to the whole class	94 (1.1)	97 (0.8)
Have students work in small groups	84 (1.5)	83 (2.1)
Engage the whole class in discussions	82 (1.3)	82 (2.4)
Do hands-on/laboratory activities	70 (1.7)	71 (3.1)
Require students to supply evidence in support of their claims	63 (2.0)	56 (2.9)
Have students represent and/or analyze data using tables, charts, or graphs	60 (1.8)	54 (2.8)
Give tests and/or quizzes that are predominantly short-answer (e.g., multiple choice, true /false, fill in the blank)	37 (1.8)	53 (2.9)
Have students read from a science textbook, module, or other science-related material in class, either aloud or to themselves	31 (1.7)	46 (3.1)
Give tests and/or quizzes that include constructed-response/open-ended items	38 (1.8)	43 (2.8)
Focus on literacy skills (e.g., informational reading or writing strategies)	21 (1.5)	30 (3.2)
Have students practice for standardized tests	18 (1.4)	22 (2.5)
Have students write their reflections (e.g., in their journals) in class or for homework	20 (1.6)	21 (2.2)
Engage the class in project-based learning (PBL) activities	17 (1.3)	19 (2.0)
Have students make formal presentations to the rest of the class (e.g., on individual or group projects)	9 (1.1)	8 (1.5)
Have students attend presentations by guest speakers focused on science and/or engineering in the workplace	2 (0.4)	3 (1.1)

Personal computers and the Internet are the most commonly used instructional technologies in biology classes (see Table 26). However, instructional technologies do not appear to play a big role in biology instruction; scores on a composite measuring the frequency of use of instructional technology were lower for biology classes than for non-biology classes (see Table 27).

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

	Percent of Classes	
	All Other Sciences	**Biology**
Internet	36 (2.5)	35 (3.7)
Personal computers, including laptops	34 (2.6)	27 (3.3)
Hand-held computers	10 (1.8)	6 (1.7)
Classroom response system or “Clickers”	5 (0.9)	6 (1.8)
Graphing calculators	27 (2.5)	5 (1.5)
Probes for collecting data	10 (1.4)	4 (1.4)

Table 27
High School Science Class Mean Scores for Use of Instructional Technology Composite

	Mean Score	
	All Other Sciences	**Biology**
Use of Instructional Technology	37 (1.0)	29 (1.3)

In addition to asking about class activities in the course as a whole, the 2012 National Survey asked teachers about activities that took place during their most recent science lesson in the randomly selected class. Ninety-one percent of biology classes include the teacher explaining a science idea to the whole class in the most recent lesson (see Table 28). Whole class discussion and students completing textbook/worksheet problems occur in 69 percent and 54 percent of biology lessons, respectively. Students reading about science is more common and the use of teacher demonstrations is less common in biology classes than in other science classes.

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

	Percent of Classes	
	All Other Sciences	**Biology**
Teacher explaining a science idea to the whole class	89 (1.1)	91 (1.7)
Whole class discussion	64 (1.9)	69 (3.0)
Students completing textbook/worksheet problems	63 (1.6)	54 (3.0)
Students reading about science	30 (1.7)	43 (3.1)
Students doing hands-on/laboratory activities	38 (1.9)	41 (2.7)
Students using instructional technology	26 (1.8)	28 (2.2)
Teacher conducting a demonstration while students watched	35 (1.6)	26 (2.4)
Test or quiz	17 (1.5)	21 (2.7)
Practicing for standardized tests	9 (1.1)	11 (1.5)

The survey also asked teachers to estimate the time spent on each of a number of types of activities in this most recent science lesson. There is essentially no difference between biology and non-biology classes (see Table 29). Forty-four percent of class time is spent on whole class activities, 29 percent on small group work, and 18 percent on students working individually. Non-instructional activities, including attendance taking and interruptions, account for less than 10 percent of science class time.

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

	Average Percent of Class Time	
	All Other Sciences	Biology
Whole class activities (e.g., lectures, explanations, discussions)	42 (0.8)	44 (1.2)
Small group work	31 (1.0)	29 (1.3)
Students working individually (e.g., reading textbooks, completing worksheets, taking a test or quiz)	18 (0.8)	18 (1.0)
Non-instructional activities (e.g., attendance taking, interruptions)	9 (0.4)	9 (0.3)

Homework and Assessment Practices

Teachers were asked about the amount of homework assigned per week in the randomly selected class. As can be seen in Table 30, about two-thirds of biology classes assign between 31 and 90 minutes of homework per week.

Table 30
Amount of Homework Assigned in High School Science Classes per Week

	Percent of Classes	
	All Other Sciences	Biology
Fewer than 15 minutes per week	9 (1.7)	6 (1.6)
15–30 minutes per week	18 (2.0)	17 (2.9)
31–60 minutes per week	31 (2.5)	39 (4.7)
61–90 minutes per week	23 (1.9)	25 (3.7)
91–120 minutes per week	8 (1.6)	5 (1.7)
More than 120 minutes per week	9 (1.4)	8 (1.8)

Teachers were also given a list of ways that they might assess student progress and asked to describe which practices they used in the most recently completed unit in the randomly selected class. The vast majority of biology and non-biology classes included informal assessment practices during the unit to see if students were "getting it" (see Table 31). For example, 96 percent of high school biology classes involved the teacher questioning students during activities to monitor understanding. Using whole class informal assessments such as "thumbs up/thumbs down" was another common practice, used by 80 percent of biology classes.

In addition, the use of formal assessment techniques such as grading student work, quizzes, and tests, as well as reviewing the correct answers to assignments were also prevalent features of science units in both biology and non-biology classes. Teachers in roughly 9 out of 10 high school science classes administered a test or quiz to assign grades and assigned grades to student work. Probing student thinking at the beginning of a unit was included in only about half of high school science classes.

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

	Percent of Classes	
	All Other Sciences	Biology
Questioned individual students during class activities to see if they were "getting it"	98 (0.6)	96 (1.0)
Reviewed student work (e.g., homework, notebooks, journals, portfolios, projects) to see if they were "getting it"	95 (0.7)	95 (1.3)
Assigned grades to student work (e.g., homework, notebooks, journals, portfolios, projects)	93 (0.8)	93 (1.5)
Administered one or more quizzes and/or tests to assign grades	91 (1.1)	92 (1.4)
Went over the correct answers to assignments, quizzes, and/or tests with the class as a whole	88 (1.2)	87 (2.0)
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"	81 (1.5)	80 (2.5)
Administered one or more quizzes and/or tests to see if students were "getting it"	81 (1.4)	79 (2.9)
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	51 (1.6)	54 (2.9)
Had students use rubrics to examine their own or their classmates' work	16 (1.5)	21 (2.0)

The survey asked how often students in the randomly selected class were required to take assessments the teachers did not develop, such as state or district benchmark assessments. About three-quarters of biology classes are required to take such an assessment at least once a year compared to only about two-thirds of all other science classes (see Table 32).

Table 32
Frequency of Required External Testing in High School Science Classes

	Percent of Classes	
	All Other Sciences	Biology
Never	36 (1.9)	23 (2.4)
Once a year	32 (1.7)	39 (2.8)
Twice a year	13 (1.1)	12 (1.9)
Three or four times a year	11 (1.1)	17 (1.9)
Five or more times a year	8 (1.2)	9 (1.4)

RESOURCES AVAILABLE FOR HIGH SCHOOL BIOLOGY INSTRUCTION

Instructional Materials

The 2012 National Survey collected data on the use of instructional materials in science classes. Biology classes are more likely than non-biology classes to use commercially published materials; 84 percent and 72 percent, respectively (see Table 33).

Table 33
High School Science Classes Using
Commercially Published Instructional Materials

	Percent of Classes
All Other Sciences	72 (1.8)
Biology	84 (1.6)

The survey also asked if one textbook/module is used all or most of the time, or if multiple materials are used. Biology classes are more likely than other high school science classes to use a single textbook (see Table 34).

Table 34
Instructional Materials Used in High School Science Classes

	Percent of Classes	
	All Other Sciences	**Biology**
Mainly commercially published textbook(s)		
One textbook	48 (2.0)	58 (2.9)
Multiple textbooks	7 (1.0)	5 (1.3)
Mainly commercially published modules		
Modules from a single publisher	2 (0.5)	2 (0.6)
Modules from multiple publishers	2 (0.5)	2 (0.8)
Other		
A roughly equal mix of commercially published textbooks and commercially published modules most of the time	13 (1.2)	17 (2.4)
Non-commercially published materials most of the time	28 (1.8)	16 (1.6)

Teachers who indicated that the randomly selected class used commercially published materials 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. The most commonly used biology materials are:

- *Biology* (Pearson);
- *Biology* (Houghton Mifflin Harcourt);
- *Biology* (McGraw-Hill); and
- *Biology – The Dynamics of Life* (McGraw-Hill).

Table 35 shows the publication year of commercially published instructional materials used. In 2012, more than half of high school biology classes were using materials published prior to 2007.

Table 35
Publication Year of
Instructional Materials Used in High School Science Classes

	Percent of Classes†			
	All Other Sciences		Biology	
2006 or earlier	65	(2.3)	52	(3.5)
2007–09	24	(2.0)	29	(3.4)
2010–12	11	(1.5)	19	(2.4)

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

It is interesting to note that while national experts in science and mathematics education are often critical of textbook quality,[6] most biology teachers consider their instructional materials to be of relatively high quality, as those in over three-quarters of biology classes rated their materials as good or better (see Table 36).

Table 36
Perceived Quality of
Instructional Materials Used in High School Science Classes

	Percent of Classes†			
	All Other Sciences		Biology	
Very Poor	0	(0.4)	1	(1.0)
Poor	3	(1.0)	2	(1.2)
Fair	19	(2.3)	20	(4.8)
Good	34	(3.1)	32	(3.9)
Very Good	31	(3.0)	36	(4.8)
Excellent	12	(2.3)	8	(2.2)

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

Despite these ratings, there does seem to be an issue with the number of topics in biology materials. Only 38 percent of biology classes address three-fourths or more of their instructional materials, possibly a reflection of publishers' efforts to meet as many state and district criteria as possible by including all of the content anyone might seek (see Table 37). Furthermore, nearly half of high school biology classes spend less than 25 percent of their instructional time using the materials (see Table 38).

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

Table 37
Percentage of Instructional Materials Covered during High School Science Courses

	Percent of Classes[†]	
	All Other Sciences	**Biology**
Less than 25 percent	6 (1.9)	11 (3.8)
25–49 percent	17 (3.0)	19 (4.0)
50–74 percent	34 (3.3)	32 (5.0)
75 percent or more	43 (4.2)	38 (7.0)

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

Table 38
Percentage of Instructional Time Spent Using Instructional Materials during High School Science Courses

	Percent of Classes[†]	
	All Other Sciences	**Biology**
Less than 25 percent	45 (3.0)	49 (4.8)
25–49 percent	30 (2.9)	22 (3.6)
50–74 percent	16 (2.8)	14 (3.7)
75 percent or more	9 (2.4)	15 (3.6)

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

A similar story emerges from responses to questions asking teachers to describe how they used their textbook/module in their most recent unit. As can be seen in Table 39, teachers in 77 percent of biology classes using published materials indicate that they supplemented their textbook/module; 51 percent indicated that they picked what was important from the materials and skipped the rest. Still, in 70 percent of biology classes using published materials, teachers use the textbook/module to guide the overall structure and content emphasis of their units.

Table 39
Ways High School Science Teachers Substantially[†] Used their Instructional Materials in the Most Recent Unit

	Percent of Classes[‡]	
	All Other Sciences	**Biology**
You incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what the textbook/module was lacking	79 (2.0)	77 (4.0)
You used the textbook/module to guide the overall structure and content emphasis of the unit	60 (2.4)	70 (3.4)
You followed the textbook/module to guide the detailed structure and content emphasis of the unit	40 (2.4)	53 (4.2)
You picked what is important from the textbook/module and skipped the rest	52 (2.4)	51 (3.4)

[†] 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.

Teachers in nearly all biology classes that supplement their textbook/module do so to help students at different levels of achievement learn targeted ideas or provide students with additional practice (see Table 40). Many supplement to prepare students for standardized tests.

Table 40
Reasons Why High School Science Instructional Materials Are Supplemented

	Percent of Classes†	
	All Other Sciences	**Biology**
Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity	90 (2.0)	95 (2.0)
Supplemental activities were needed to provide students with additional practice	93 (2.1)	94 (2.6)
Supplemental activities were needed to prepare students for standardized tests	50 (3.7)	54 (5.0)
Your pacing guide indicated that you should use supplemental activities	38 (3.0)	35 (4.7)

† 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 were also asked why they skipped parts of their textbook/module. As can be seen in Table 41, teachers in 90 percent of these biology classes skip activities because they have other ones that work better. Other common reasons for skipping activities include the covered ideas not being in teachers' pacing guides/state standards, students already knowing the ideas, a lack of materials, or the activities were too difficult.

Table 41
Reasons Why Parts of the High School Science Instructional Materials Are Skipped

	Percent of Classes†	
	All Other Sciences	**Biology**
You have different activities for those science ideas that work better than the ones you skipped	87 (2.5)	90 (2.8)
The science ideas addressed in the activities you skipped are not included in your pacing guide and/or current state standards	58 (4.5)	62 (5.4)
Your students already knew the science ideas or were able to learn them without the activities you skipped	64 (3.3)	49 (4.6)
You did not have the materials needed to implement the activities you skipped	52 (3.9)	47 (5.1)
The activities you skipped were too difficult for your students	52 (4.0)	46 (4.9)

† 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

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

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

- At least one per group located in your classroom.

As can be seen in Table 42, not surprisingly, high school biology classes are more likely than other science classes to have access to microscopes (94 percent vs. 73 percent). Most biology classes also have access to the Internet, personal computers, and non-graphing calculators. And although a majority of biology classes have access to probes for collecting data, a smaller proportion have access than do other high school science classes (53 percent vs. 70 percent).

Table 42
Availability† of Instructional Technologies in High School Science Classes

	Percent of Classes	
	All Other Sciences	**Biology**
Microscopes	73 (2.6)	94 (4.0)
Internet access	86 (1.9)	88 (2.7)
Personal computers, including laptops	80 (1.9)	80 (3.3)
Non-graphing calculators	81 (2.1)	71 (4.8)
Probes for collecting data (e.g., motion sensors, temperature probes)	70 (2.6)	53 (4.3)
Classroom response system or "Clickers" (handheld devices used to respond electronically to questions in class)	45 (2.6)	51 (4.4)
Graphing calculators	45 (2.7)	40 (4.3)
Hand-held computers (e.g., PDAs, tablets, smartphones, iPads)	22 (1.7)	17 (2.6)

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

Although the majority of biology classes have access to non-graphing calculators, one-third expect students to provide their own (see Table 43). This expectation is more common in other science classes.

Table 43
Expectations that Students will Provide their Own Instructional Technologies

	Percent of Classes	
	All Other Sciences	**Biology**
Non-graphing calculators	53 (2.8)	33 (4.6)
Graphing calculators	29 (2.3)	16 (3.0)
Laptop computers	8 (1.5)	6 (2.0)
Hand-held computers	7 (1.2)	5 (1.7)

When asked about the adequacy of resources for instruction, teachers in the majority of high school biology classes rated their facilities and access to consumable supplies and equipment as adequate (see Table 44). Just under half of biology teachers rated their access to instructional technology as adequate.

Table 44
High School Science Classes with Adequate† Resources for Instruction

	Percent of Classes	
	All Other Sciences	**Biology**
Facilities (e.g., lab tables, electric outlets, faucets and sinks)	72 (1.9)	71 (2.6)
Equipment (e.g., microscopes, beakers, photogate timers, Bunsen burners)	64 (1.9)	61 (3.0)
Consumable supplies (e.g., chemicals, living organisms, batteries)	64 (2.1)	57 (3.2)
Instructional technology (e.g., calculators, computers, probes/sensors)	52 (2.0)	47 (3.3)

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

FACTORS AFFECTING HIGH SCHOOL BIOLOGY INSTRUCTION

Teachers were asked about factors that affect instruction in their randomly selected class. As can be seen in Table 45, in the majority of biology classes teachers think that most of the factors promote effective instruction, including principal support; students' motivation, interest and effort in science; college entrance requirements, and planning time. Pacing guides and accountability policies, among others, were seen as promoting effective instruction in a minority of biology classes.

Table 45
Factors Seen as Promoting† Effective Instruction in High School Science Classes

	Percent of Classes	
	All Other Sciences	**Biology**
Principal support	74 (2.7)	74 (3.3)
Students' motivation, interest, and effort in science	61 (2.7)	62 (3.9)
College entrance requirements	60 (2.7)	62 (3.9)
Time for you to plan, individually and with colleagues	57 (3.3)	61 (3.9)
District/Diocese curriculum frameworks‡	56 (2.5)	55 (4.4)
Current state standards	53 (2.5)	53 (3.9)
Textbook/module selection policies	45 (3.0)	53 (4.1)
Teacher evaluation policies	50 (2.8)	52 (4.9)
Time available for your professional development	49 (3.0)	52 (4.0)
Students' reading abilities	51 (2.7)	50 (4.4)
Parent expectations and involvement	53 (3.0)	49 (3.3)
Community views on science instruction	47 (2.7)	48 (3.8)
District/Diocese/School pacing guides	50 (3.0)	45 (4.3)
District/Diocese testing/accountability policies‡	35 (3.0)	33 (4.0)
State testing/accountability policies‡	31 (2.5)	28 (3.8)

† Includes those responding 4 or 5 on a 5-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction."
‡ Item presented only to public and catholic school teachers.

The teacher survey also included a series of items about technology-related issues. Teachers were asked to indicate how great a problem each posed for instruction in their randomly selected class. As can be seen in Table 46, these resources are generally not seen as problematic in biology or other high school science classes.

Table 46
Extent to which Technology Quality Is a Serious Problem for Instruction in Randomly Selected High School Science Class

	Percent of Classes	
	All Other Sciences	Biology
Slow speed of the Internet connection	9 (1.4)	17 (3.4)
Old age of computers	13 (1.9)	14 (3.5)
Lack of access to computers	11 (1.6)	14 (3.1)
Unreliability of the Internet connection	9 (1.6)	12 (3.2)
Lack of availability of technology support	12 (2.0)	11 (2.9)
Lack of availability of appropriate computer software	9 (1.6)	11 (3.4)
Lack of access to the Internet	5 (1.1)	10 (3.2)

Composites from these two series of questionnaire items were created to summarize the extent to which various factors support effective instruction. The means are shown in Table 47. Overall, these data indicate that the climate is generally supportive for high school science instruction.

Table 47
Class Mean Scores for the Factors Affecting Instruction Composites

	Mean Score	
	All Other Sciences	Biology
Extent to which School Support Promotes Effective Instruction	63 (2.0)	66 (2.4)
Extent to which Stakeholder Support Promotes Effective Instruction	65 (1.4)	65 (2.1)
Extent to which the Policy Environment Promotes Effective Instruction	61 (1.1)	62 (1.9)
Extent to which IT Quality is Problematic for Instruction	23 (1.3)	29 (2.6)

SUMMARY

Nearly all high school biology teachers are white, and over half are female. Fifty-four percent have a degree in biology, and an additional 39 percent have three or more college courses in biology beyond the introductory level. Biology teachers feel equally prepared to teach biology as other science teachers do to teach their subject. Although biology teachers hold a number of beliefs about teaching and learning that are in alignment with what is known about effective science instruction (e.g., most class periods should provide opportunities for students to share their thinking and reasoning), they also hold views that are inconsistent with this research. For example, nearly three-fourths of biology teachers believe that students should be provided with definitions for new vocabulary at the beginning of instruction on an idea.

When asked about their professional development experiences, the vast majority of high school biology teachers have participated in science-focused professional development in the last three years. However, only one-third have had sustained professional development (more than 35 hours) in that time period. In addition, biology teachers' professional development experiences have been only somewhat aligned with best practices. A majority of teachers have had professional development experiences with substantial opportunities to work with other teachers, either from their own school or those who also taught biology. In contrast, less than half have had substantial opportunities to try out what they were learning in their classroom and then discuss it in the professional development or to examine classroom artifacts.

Data on biology courses indicate that nearly all students in the nation have access to one or more biology courses at their schools. Furthermore, biology is the most commonly offered science subject, accounting for 39 percent of high school science courses. As with chemistry and physics classes, female students are just as likely as males to take biology

Data on instruction indicate that biology instruction relies heavily on lecture and discussion, with students often completing textbook/worksheet problems. However, the data indicate that students are also engaged in hands-on laboratory activities and required to use evidence to support claims fairly regularly. In addition, although 84 percent of biology classes use commercially published instructional materials, two-thirds cover less than 75 percent of the material in their textbook and spend less than half of instructional time using the text.

APPENDIX

Table A-1
Teacher Mean Scores for Composites

	Mean Score	
	All Other Sciences	**Biology**
Perceptions of Preparedness to Teach Science Content	86 (1.2)	86 (1.4)
Perceptions of Preparedness to Encourage Students' Interest in Science	76 (1.4)	78 (2.0)
Perceptions of Preparedness to Teach Students from Diverse Backgrounds	58 (1.3)	58 (1.8)
Quality of Professional Development	62 (2.3)	62 (1.5)
Extent to which PD/Coursework Focused on Student-Centered Instruction	62 (1.5)	63 (2.1)

Table A-2
Class Mean Scores for Composites

	Mean Score	
	All Other Sciences	**Biology**
Perceptions of Preparedness to Implement Instruction in Particular Unit	81 (0.8)	82 (1.0)
Curriculum Control	58 (2.0)	63 (2.9)
Pedagogical Control	90 (0.8)	89 (1.4)
Reform-Oriented Instructional Objectives	82 (0.5)	82 (0.9)
Use of Reform-Oriented Teaching Practices	59 (0.5)	59 (0.9)
Use of Instructional Technology	37 (1.0)	29 (1.3)
Adequacy of Resources for Instruction	70 (1.1)	67 (1.7)
Extent to which Stakeholder Support Promotes Effective Instruction	65 (1.4)	65 (2.1)
Extent to which the Policy Environment Promotes Effective Instruction	61 (1.1)	62 (1.9)
Extent to which School Support Promotes Effective Instruction	63 (2.0)	66 (2.4)
Extent to which IT Quality is Problematic for Instruction	23 (1.3)	29 (2.6)