Chapter 4
Science

State Standards

The state standards documents for science share significant areas of agreement encompassing both scientific knowledge (content knowledge drawn from life science, physical science, Earth/space science, biology, chemistry, and physics) and scientific processes. The EPAS Science Tests directly assess students' ability to comprehend, interpret, and use scientific information presented in a variety of ways. These skills include interpreting data; understanding scientific processes; and evaluating experiments, models, and assertions. Grade-level appropriate background knowledge covered in general, introductory science courses is needed to answer some of the questions. So the EPAS Science Tests continue to reflect state science standards—as well as the science standards in major documents from the American Association for the Advancement of Science (1989, 1993), the National Science Teachers Association (1992, 1995), and the National Research Council of the National Academy of Sciences (1995). In addition, the EPAS Science Tests closely align with the National Assessment of Educational Progress Science Framework in emphasizing similar content and cognitive dimensions of science, and in including the major topic areas and concepts identified in the framework.

There are a few scientific process skills within the state standards that are not directly measured on the EPAS Science Tests. These include designing and conducting experiments, communicating scientifically (oral and written), making judgments about the value of science, and understanding the impact of science on technology and society. However, the evidence is clear that the EPAS Tests have maintained the alignment with state curricula that was established during the redevelopment of the ACT Assessment through Project Silver (1980s) and that has continued to be verified by subsequent ACT National Curriculum Surveys.

Educator Surveys

ACT developed 10 Science curriculum surveys: 1 for middle school/junior high teachers, 4 (biology, chemistry, Earth/space science, and physics) for high school teachers, 1 for secondary science department chairs, and 4 (biology, chemistry, Earth science, and physics) for college faculty who teach entry-level courses. The primary source used in selecting these samples was Market Data Retrieval (MDR), a company specializing in the education market. Recipients were sampled from the MDR database using selection criteria provided by ACT to ensure that a variety of geographic regions and schools were represented.

Table 4.1 lists the Science courses that ACT requested MDR use as selection criteria. ACT mailed curriculum surveys to the number of teachers, faculty members, and department chairs indicated in the table. Altogether, 6,496 Science surveys were mailed across the 10 sample groups.

Table 4.1
Science Courses Used as MDR Sample Selection Criteria

Sample	Courses	Sample Size
Middle School/Junior High	*Science, Physical Science*	1,197
High School Biology	*Biology*	600
High School Chemistry	*Chemistry*	600
High School Earth Science	*Earth Science*	600
High School Physics	*Physics*	600
Postsecondary Biology	*Introduction to Biology, Introduction to Life Sciences, Introduction to Biology for Majors, Introduction to Biology for Nonmajors*	600
Postsecondary Chemistry	*General Chemistry for Majors, General Chemistry for Nonmajors, Introduction to Chemistry*	600
Postsecondary Earth/Space Science	*Geology and Human Ecology, Introduction to Earth Sciences, Introduction to Geology, Principles of Geology, Introduction to Astronomy*	600
Postsecondary Physics	*Fundamentals of Physics, General Physics, General Physics with Calculus Prerequisite, Introduction to Physical Science, Introduction to Physics, Physics for Nonmajors*	600
Department Chairs	*Middle School/Junior High Science, High School Science*	499

The survey respondents included individuals from all 50 states and the District of Columbia. The representation of the total respondent pool by region was 36.5% from the East, 32.4% from the Midwest, 12.4% from the Southwest, and 18.7% from the West. Analyses of the middle school/junior high, high school, and postsecondary respondent pools determined that they represented a wide variety of geographic locations and institutions. The department chair respondent pool, however, was found to be biased toward smaller schools. For this reason, survey results for the department chairs are not included in the discussion that follows. The numbers of surveys sent and the response rates are given in Table 4.2.

Table 4.2
Science Survey Types and Response Rates

Survey type	Number mailed	Number returned	Response rate
Middle School/Junior High	1,197	286	24%
High School	2,400	750	31%
Postsecondary	2,400	737	31%
Department Chairs	499	133	27%
Total	6,496	1,906	29%

ACT obtained the survey results, which are discussed below and are given in detail in Tables 4.6 and 4.7, by the following means. Respondents to all 10 surveys were provided with a list of 15 science skills related to scientific inquiry (e.g., *Translating data/information into a graph or diagram*). The first 11 skills on the survey are those directly assessed on the EPAS tests. The last 4 science skills were new to the 2003 curriculum survey. They are: *Designing a scientific investigation, Formulating models and predictions using scientific data, Communicating the results of a scientific investigation through writing properly organized reports,* and *Understanding and applying concepts of statistics and data analysis to the results of a scientific investigation.* These skills have been seen in many recent versions of state science standards documents and were added to the science skills section of the survey to get feedback from educators about their importance in secondary and postsecondary classes.

All of the surveys except the department chairs' survey also included a section that listed content topics. The middle school/junior high teachers responded to 202 content topics for three content areas: 68 for life science, 46 for Earth/space science, and 88 for physical science. The high school teachers and the college faculty responded to content topics for one of four content areas: biology (30 topics), chemistry (56 topics), Earth/space science (41 topics), or physics (57 topics).

For each science skill and content topic, the Grade 7–12 teachers were asked to indicate whether the skill or topic is taught and, if taught, to rate its importance on a scale of 1 to 5, where 1 represented *not important,* 3 represented *moderately important,* and 5 represented *very important.*

The task for the college faculty respondents was a bit different. Because the ACT Assessment is used for placement decisions and as a predictor of success during the first year of college, the expectations of the faculty of freshman-level courses regarding prerequisite science skills are important. To evaluate how well the ACT Assessment Science Test assesses the skills considered prerequisites to success in freshman-level courses, the college faculty were asked to reference one freshman-level science course they teach and to rate the importance of each listed skill as a prerequisite for that course, using the 5-point scale described above.

The Science surveys also asked respondents a variety of background questions. The middle school/junior high and high school respondents were asked to indicate the grade level of the students they taught and which course they taught (e.g., *Life Science, Earth or Earth/Space Science,* or *Physical Science* in middle school, or *Biology I, Chemistry I,* etc. in high school). Both groups were also asked how many years they had been teaching, the title of the primary textbook series they used, and how much time each week their students spent doing laboratory activities in their classes. Postsecondary science faculty were asked to indicate the course they taught (biology for non-science majors, biology for science majors, etc.), the general format of the course (e.g., lecture only, laboratory only, lecture and laboratory), and the primary textbook used in the course.

Science Skills and Content Topics. The **middle school/junior high teachers** indicated that all of the 15 science skills are more than moderately important (mean rating at or above 3), and that 10 of the 15 skills are more than quite important (mean rating at or above 4) in their classes. The science skills median rating is 4.17. Obviously, these respondents believe that the science skills listed on the survey are significant components of their classes.

In all three middle school/junior high subject areas (i.e., life science, Earth/space science, and physical science), the number of content topics listed on the survey that are taught by more than 80% of respondents is quite small. Only six topics, all in physical science, are taught by more than 80% of respondents. The six topics are scientific measurements and the metric system; physical and chemical changes; elements, compounds, and molecules; chemical symbols and formulas; mass, volume, and density; and mass and weight. However, all of the topics listed in all three subject areas were rated as more than moderately important (mean rating at or above 3), and large fractions of the total number of topics in each discipline were rated as more than quite important (mean rating at or above 4).

The **high school teachers** reported that all of the 15 science skills are more than moderately important in their classes (mean rating at or above 3) and that 14 of the 15 skills are more than quite important in their classes (mean rating at or above 4). Thus, the science skills' median rating is very high, at 4.32.

The high school teachers in each of the four disciplines (i.e., biology, chemistry, Earth/space science, and physics) reported that all of the topics listed are more than moderately important (mean rating at or above 3) in their classes. And large fractions of the total number of topics in each discipline were rated as more than quite important (mean rating at or above 4). Thus, all four of the content topics' median ratings are high, two of them (chemistry and physics) are above 4, and the other two are just below 4, at 3.90 and 3.77. The number of content topics reported to be taught by 70% or more respondents was quite small in biology (9 of the 30 topics) but much greater in chemistry (23 of the 56 topics), Earth/space science (24 of the 41 topics), and physics (31 of the 57 topics).

College faculty overall rated 11 of the 15 science skills as more than moderately important (mean rating at or above 3) as prerequisite knowledge for their freshman-level courses. Although college faculty generally rated the importance of the skills lower than did the other respondent groups, the overall median rating of the science skills by the college faculty was still fairly high, at 3.34.

College faculty in each of the four disciplines (i.e., biology, chemistry, Earth/space science, and physics) generally rated the majority of the topics listed as less than moderately important (mean rating below 3) as prerequisite knowledge for their freshman-level courses. Thus, all four of the content topics' overall median ratings are low: biology topics 2.46, chemistry topics 2.64, Earth science topics 2.59, and physics topics 2.80.

Table 4.3 presents the rank order of all 15 of the science skills for all three respondent groups. As can be seen, there is only a slight variation in the rankings of the top 5 skills.

Table 4.3
Ranking of Science Skills, by Respondent Group

Rank (1 = most important)	Middle school/ junior high school teachers	High school teachers	College faculty
1	Understanding basic scientific concepts or assumptions underlying given information	Translating data/information into a graph or diagram	Understanding the basic features of, or data points in, tables or graphs
2	Understanding the components of an experimental design or procedure (e.g., identify the control)	Understanding the basic features of, or data points in, tables or graphs	Understanding basic scientific concepts or assumptions underlying given information (tied with) Translating data/information into a graph or diagram
3	Understanding the basic features of, or data points in, tables or graphs	Determining whether data/information supports or is consistent with a stated hypothesis or conclusion	
4	Translating data/information into a graph or diagram	Understanding basic scientific concepts or assumptions underlying given information	Determining whether data/information supports or is consistent with a stated hypothesis or conclusion
5	Determining whether data/information supports or is consistent with a stated hypothesis or conclusion	Understanding the components of an experimental design or procedure (e.g., identify the control)	Selecting a hypothesis or conclusion that supports or is consistent with given data/information
6	Designing a scientific investigation	Selecting a hypothesis or conclusion that supports or is consistent with given data/information	Understanding the components of an experimental design or procedure (e.g., identify the control) (tied with) Predicting outcomes on the basis of data/information
7	Predicting outcomes on the basis of data/information	Communicating the results of a scientific investigation through writing properly organized reports	
8	Selecting a hypothesis or conclusion that supports or is consistent with given data/information	Predicting outcomes on the basis of data/information	Communicating the results of a scientific investigation through writing properly organized reports
9	Communicating the results of a scientific investigation through writing properly organized reports	Extending scientific concepts, hypotheses, or experimental procedures to new situations to gain new information	Extending scientific concepts, hypotheses, or experimental procedures to new situations to gain new information
10	Extending scientific concepts, hypotheses, or experimental procedures to new situations to gain new information	Designing a scientific investigation	Evaluating the similarities and differences, or the strengths and weaknesses, of experimental procedures or scientific viewpoints
11	Formulating models and predictions using scientific data	Formulating models and predictions using scientific data	Selecting a generalization or model that is consistent with given data/information
12	Understanding and applying concepts of statistics and data analysis to the results of a scientific investigation	Evaluating the similarities and differences, or the strengths and weaknesses, of experimental procedures or scientific viewpoints	Identifying an alternative way of testing a hypothesis or scientific viewpoint, or proposing an alternative way of producing the same experimental results
13	Selecting a generalization or model that is consistent with given data/information	Selecting a generalization or model that is consistent with given data/information	Designing a scientific investigation
14	Evaluating the similarities and differences, or the strengths and weaknesses, of experimental procedures or scientific viewpoints	Understanding and applying concepts of statistics and data analysis to the results of a scientific investigation	Formulating models and predictions using scientific data
15	Identifying an alternative way of testing a hypothesis or scientific viewpoint, or proposing an alternative way of producing the same experimental results	Identifying an alternative way of testing a hypothesis or scientific viewpoint, or proposing an alternative way of producing the same experimental results	Understanding and applying concepts of statistics and data analysis to the results of a scientific investigation

The survey results indicate that the science skills that the majority of respondents think are central to work in the classroom and lab are generally those that receive emphasis in the EPAS Science Tests. Although the design of the 2003 surveys differs from that of their 1998 predecessors, the 2003 results appear to be in fundamental agreement with the 1998 results on what knowledge and skills are important. A comparison of the 1998 and 2003 median ratings for science content topics for each science discipline revealed that there has been almost no change in those ratings between 1998 and 2003.

These data suggest that the high school and college science educators who responded to this survey believe that science skills, as a whole, are more important for success in their high school classes, or as prerequisites for entry-level college science classes, than are the content topics. Given that the EPAS tests give more emphasis to testing science skills, the data suggest that the EPAS tests assess what the survey respondents say is important for success in college.

Curriculum Consultants

ACT selected seven science educators from around the country to review the survey data. The reviewers were asked to study the tables of raw data, then answer five guiding questions about the survey results. Names of potential reviewers were solicited from ACT staff. Reviewer candidates were college science faculty and secondary science educators from across the country, some of whom had done work for ACT reviewing EPAS Science Test materials for content, fairness, or grade-level appropriateness. Other candidates were unfamiliar, or less familiar, with the EPAS tests. Table 4.4 lists the seven science reviewers.

The reviewers agreed that the content and science skills assessed on the EPAS Science Tests reflect the current Grades 7–12 science curricula. They also agreed that the EPAS Science Tests assess science skills and cover content topics important for success in college. However, there was some disagreement about whether the EPAS Science Tests, as they exist today, can adequately test both science skills and content knowledge. Some reviewers suggested using the current passage-based, multiple-choice exam, but limiting the amount of science content tested. Others thought content should be tested with a separate, discrete multiple-choice exam, while keeping the present EPAS tests in their current format to test science skills. Some other reviewers suggested adding a writing component to assess a student's ability to *"Communicate the results of a scientific investigation through writing properly organized reports."*

The reviewers also emphasized that, given the continuing evolution of science education and the technological changes affecting it, ACT must continue to closely monitor science curricula and standards if it is to maintain its commitment to the content validity of the EPAS Science Tests. Some curriculum trends mentioned by the reviewers included a change in the middle school curricula from single-discipline, full-year science courses to three-year sequences of integrated science classes. Another significant trend at the middle school level is the incorporation of more inquiry-based, "hands-on" science activities and a reduction in lecture-based classes.

Several reviewers expressed general concerns about the uses of large-scale assessments. They felt that these assessments should be used for more than just showing accountability. Such exams should be designed primarily to assess student achievement, as do the EPAS Science Tests.

Table 4.4
ACT's 2002 Science Curriculum Survey Reviewers

Name	Title and affiliation
Ms. Kathryn Barclay	Science Teacher, Dulles Middle School, Sugar Land, Texas
Dr. Barbara Christie-Pope	Associate Professor of Biology, Environmental Studies, Cornell College, Mount Vernon, Iowa
Dr. John Fix	Dean of the College of Science, University of Alabama at Huntsville, Huntsville, Alabama
Ms. Francisca Garner	Science Teacher, Eisenhower High School, Lawton, Oklahoma
Mr. C. Steven Storm	Mathematics & Science Instructor, Arkansas State University-Heber Springs, Heber Springs, Arkansas
Ms. Cynthia Taylor	Science Teacher, Monterey High School, Monterey, Tennessee
Dr. Richard Treptow	Professor of Chemistry, Chicago State University, Chicago, Illinois

Science Test Specifications

The EPAS Science Tests measure the student's interpretation, analysis, evaluation, reasoning, and problem-solving skills required in the natural sciences. A test for a given program is made up of five to seven test units, each of which consists of some scientific information (the stimulus) and a set of multiple-choice test items. The use of calculators is not permitted on the Science Tests. Table 4.5 summarizes the test specifications for the EXPLORE, PLAN, and ACT Assessment Science Tests. Under the "Format" heading are the numbers (and proportions) of test questions associated with each of the three types of presentations used in the three tests. Under the "Cognitive Level" heading are the distributions of questions assessing the three cognitive levels. Finally, under the "Subject Matter" heading are the distributions of test questions by content domain being assessed. The terms used in the tables are defined in the next section.

Table 4.5
Science Test Specifications

	Testing program		
Format	**EXPLORE**	**PLAN**	**ACT Assessment**
Data Representation	12 (.43)	10 (.33)	15 (.38)
Research Summaries	10 (.36)	14 (.47)	18 (.45)
Conflicting Viewpoints	6 (.21)	6 (.20)	7 (.17)
Total	**28**	**30**	**40**
Cognitive level			
Understanding	12 (.43)	9 (.30)	7 (.18)
Analysis	10 (.36)	13 (.43)	20 (.50)
Generalization	6 (.21)	8 (.27)	13 (.32)
Total	**28**	**30**	**40**
Subject matter			
Life Science	3		
Physical Science	2		
Earth/Space Science	1	1–2*	1–2*
Biology		1–2*	1–2*
Chemistry		1–2*	1–2*
Physics		1–2*	1–2*
Total	**6**	**5**	**7**

*At least one topic is required in this content area, and some test forms may have two topics. No more than two topics in a particular content area are allowed.

The following section provides detailed descriptions of the materials used in the EPAS Science Tests. These descriptions are presented in the order in which the information was summarized in Table 4.5: first the formats for the stimulus material, then the definitions of the cognitive levels being assessed, and finally lists of the content included in the fields of science covered at each test level.

Science Continuum Stimulus Material, Cognitive Level, and Content Area Descriptions

Stimulus Material

Each stimulus used in the Science Tests as the basis for the test questions follows one of three formats. These formats are very specific in their intent and style, each being used to tap a specific subset of scientific reasoning skills.

Data representation format. The data representation format is intended to test the examinee's ability to understand, evaluate, and interpret information presented in a graphic or tabular format. The information may consist of any type of data that can be presented with minimal explanation. Examples include the results of simple experiments, observations, summarized data, figures, or flowcharts.

Research summaries format. The research summaries format is intended to evaluate an examinee's abilities to comprehend, evaluate, analyze, and interpret the design of experiments. In particular, the skills to be assessed using this format include the following:

- The understanding of the premise of the experiment (observation, confirmation, or hypothesis testing)
- The relationship of the design to the premise
- The understanding of control groups
- Variations in experimental designs
- Weaknesses of the experiment due to assumptions or limitations embedded in the design

Almost anything that relates to how scientists view experiments is a valid topic in this type of format. However, since the data representation format covers the aspects of interpretation of data, the tabular or graphic presentation of the experiments alone is not a major point of consideration. The simulated research studies are of sufficient complexity to allow significant comparisons of results. Often, a number of linked, related experiments are presented that build on each other and provide an extended simulation of several research studies.

Conflicting viewpoints format. The conflicting viewpoints format is intended to test the examinee's ability to evaluate two or more alternative theories, hypotheses, or viewpoints on a specific, observable phenomenon. This phenomenon may be a simple observation or a more complex process. The alternative viewpoints disagree in some clear fashion that is plausible, but they need not necessarily be based on a contemporary scientific controversy. The main restriction is that they be logical and complete. The alternative viewpoints are based on realistic assumptions and have logical conclusions.

Cognitive Levels

The questions in the Science Tests are classified according to three primary cognitive levels: understanding, analysis, and generalization. Within each of the three major cognitive classifications there are a number of subclassifications. These are presented to clarify the types of test questions that are within the major categories, but they are not meant to provide an exhaustive list. Some of the subclassifications do not apply to some of the stimulus formats. For example, a classification referring to experimental design is not appropriate for a data representation format. The stimulus formats that support questions with each subclassification are coded at the end of each description using DR for data representation, RS for research summaries, and CV for conflicting viewpoints.

Understanding. Understanding questions test students' ability to comprehend the information presented and, to a limited extent, their understanding of how it fits into the general scheme of the particular stimulus format. Examples of this ability include comprehending how the information in a bar graph is organized, understanding the control group's function in an experiment, and identifying unstated assumptions and the concept that serves as the basis for a particular theory. A question in the understanding classification does not merely ask the student to understand what is written, but to understand how that information is related to other parts of the material provided in the stimulus. An understanding question specifically deals with only a small part of the material in the stimulus, such as a single data point, graph axis, hypothesis, or experimental step.

Understanding—The ability to:

- Explain, describe, identify, or compare the basic features of, and concepts related to, the provided information. (DR, RS, CV)
- Explain, describe, identify, or compare the components of the experimental design or process. (RS)
- Explain, describe, identify or compare the basic features or data points in graphs, charts, or tables. (DR)
- Explain, describe, or identify basic scientific concepts or assumptions underlying the provided information. (DR, RS, CV)
- Select the appropriate translation of the provided information into a graph, figure, or diagram. (DR, RS, CV)

Analysis. Analysis questions should go beyond the level of understanding questions in testing the student's ability to relate a number of components of the presented material to each other on a higher, more abstract level. Examples of this question type include relating hypotheses to experimental design or data, and evaluating how a viewpoint is related to another viewpoint or to an observable phenomenon. Essentially, the student is required to exhibit the ability to see how each piece of information in the presentation fits in with the rest of the stimulus and what importance each piece has in reference to the topic. Often, an analysis question will prompt a student to carefully pick apart the details presented and piece them back together to get an overall view of the presented topic. An analysis question typically deals with a major portion of the presented information, such as a graphed relationship, one or more experiments, or one or more viewpoints. An analysis question does not extend beyond the scope of the presented material.

Analysis—The ability to:

Critically examine the relationships between the information provided and the conclusions drawn or the hypotheses developed. (DR, RS, CV)

Determine whether information or results support or are consistent with a point of view, hypothesis, or conclusion. (DR, RS, CV)

Determine whether a hypothesis or conclusion supports or is consistent with a point of view, the results of a single experiment, or the information presented in a single graph or table. (DR, RS, CV)

Evaluate experimental procedures, viewpoints, or theories for their strengths, weaknesses, similarities, or differences. (RS, CV)

Specify alternative ways of testing the point of view or hypothesis, or specify alternative ways of producing the same results. (RS, CV)

Generalization. Generalization questions test the student's ability to see how the stimulus material relates to the rest of the world. A generalization question may ask for a general model of a scientific concept that is embedded in the presented data (for example, deduce a gas law from a set of data), how the results of an experiment could be used to assist someone in resolving a problem in the real world, or how a theory could be modified to account for some new, unforeseen data or phenomena. While generalization questions may not always be the most difficult for a student, they are intended to demand that the student assimilate all of the material presented and extend discovered concepts to new situations.

Generalization—The ability to:

Generalize from given information to gain new information, generate a model, or make predictions. (DR, RS, CV)

Extend concepts, procedures, or hypotheses to new situations to gain new information. (RS, CV)

Generalize beyond the given information to a broader context, or generate a model consistent with the provided information. (DR, RS, CV)

Predict outcomes on the basis of the provided information. (DR, RS, CV)

Content Areas

The content areas used to assess Science skills parallel the content courses commonly taught at Grades 7–12, and at the entry level at colleges and universities. Each test activity uses stimulus materials from one of these areas. Materials are produced specifically for the Science Tests. They are required to match the level of complexity of those used in the classroom. Often, students are confronted with a new situation to engage their reasoning skills.

The topics included in each content area are summarized below.

Life Science. The stimulus materials and questions in this content area cover such topics as biology, botany, ecology, health, human behavior, and zoology.

Physical Science. The stimulus materials and questions in this content area cover such topics as simple chemical formulas and equations and other basic chemistry, weights and measures, and basic principles of physics.

Earth/Space Science. The stimulus materials and questions in this content area cover such topics as geology, meteorology, astronomy, environmental science, and oceanography.

Biology. The stimulus materials and questions in this content area cover such topics as cell biology, botany, zoology, microbiology, ecology, genetics, and evolution.

Chemistry. The stimulus materials and questions in this content area cover such topics as atomic theory, inorganic chemical reactions, chemical bonding, reaction rates, solutions, equilibriums, gas laws, electrochemistry, and properties and states of matter.

Physics. The stimulus materials and questions in this content area cover such topics as mechanics, energy, thermodynamics, electromagnetism, fluids, solids, and light waves.

Table 4.6

Science Curriculum Survey Results: Percent Taught, Mean Rating, and Rank for Each Science Skill, by Respondent Group

	Middle school/junior high				High school					College		
Science skill	% Taught	Mean rating	SD	Rank	% Taught	% Taught prior	Mean rating	SD	Rank	Mean rating	SD	Rank
Understanding the components of an experimental design or procedure (e.g., identify the control)	94	4.32	0.97	2	71	24	4.43	0.84	5	3.35	1.25	6
Understanding the basic features of, or data points in, tables or graphs	93	4.31	0.93	3	78	18	4.53	0.74	2	3.91	1.08	1
Understanding basic scientific concepts or assumptions underlying given information	95	4.34	0.86	1	78	16	4.44	0.82	4	3.78	1.12	2
Translating data/information into a graph or diagram	93	4.26	0.89	4	79	18	4.54	0.75	1	3.78	1.17	2
Determining whether data/information supports or is consistent with a stated hypothesis or conclusion	91	4.21	0.97	5	78	16	4.45	0.83	3	3.70	1.15	4
Selecting a hypothesis or conclusion that supports or is consistent with given data/information	88	4.17	1.01	8	71	21	4.40	0.86	6	3.54	1.17	5
Evaluating the similarities and differences, or the strengths and weaknesses, of experimental procedures or scientific viewpoints	70	3.69	1.07	14	59	18	4.15	1.01	12	3.12	1.18	10
Identifying an alternative way of testing a hypothesis or scientific viewpoint, or identifying an alternative way of producing the same experimental results	62	3.48	1.11	15	46	18	3.88	1.08	15	2.90	1.14	12
Selecting a generalization or model that is consistent with given data/information	75	3.76	0.96	13	57	17	4.10	1.01	13	3.10	1.14	11
Predicting outcomes on the basis of data/information	95	4.18	0.89	7	77	14	4.32	0.88	8	3.35	1.17	6
Extending scientific concepts, hypotheses, or experimental procedures to new situations to gain new information	78	4.02	1.01	10	64	12	4.24	0.97	9	3.26	1.19	9
Designing a scientific investigation	86	4.19	0.92	6	56	18	4.19	1.02	10	2.82	1.25	13
Formulating models and predictions using scientific data	81	3.98	0.96	11	60	14	4.17	0.99	11	2.80	1.14	14
Communicating the results of a scientific investigation through writing properly organized reports	81	4.12	0.99	9	72	13	4.37	0.92	7	3.34	1.31	8
Understanding and applying concepts of statistics and data analysis to the results of a scientific investigation	66	3.79	1.09	12	55	11	4.10	1.03	14	2.71	1.24	15
Science skills median rating		4.17					4.32			3.34		

Table 4.7
Science Curriculum Survey Results: Percent Taught, Mean Rating, and Rank for Each Content Topic, by Respondent Group

	Middle school/junior high				
Content topic	% Taught	% Not taught	Mean rating	SD	Rank
Life science					
Flowering plants	49	51	3.81	0.96	45
Non-flowering plants	46	54	3.67	1.06	50
Structure and function of roots	47	53	3.76	1.00	47
Structure and function of stems	47	53	3.74	0.99	49
Structure and function of leaves	48	52	3.86	0.96	41
Structure and function of flowers	48	52	3.87	0.88	39
Structure and function of seeds	48	52	3.81	0.93	44
Life cycles	60	40	4.05	0.92	31
Photosynthesis	67	33	4.37	0.80	4
Circulatory	50	50	4.45	0.84	2
Digestive	46	54	4.37	0.92	5
Excretory	40	60	4.27	0.93	12
Hormonal	36	64	4.09	1.06	26
Lymphatic	34	66	4.12	1.07	21
Muscular	44	56	4.33	0.94	7
Nervous	46	54	4.22	1.01	15
Respiratory	46	54	4.31	0.97	8
Reproductive	42	58	4.29	0.97	11
Skeletal	44	56	4.31	0.97	9
Bacteria	57	43	4.18	0.91	17
Protists	55	45	4.10	0.95	25
Fungi	54	45	4.06	0.97	28
Arthropods	46	53	3.85	1.07	42
Other invertebrates	47	53	3.88	1.06	38
Genes and chromosomes	67	33	4.35	0.97	6
DNA	64	36	4.41	0.94	3
Mendelian genetics	58	42	4.25	1.02	13
Genetic engineering	49	51	3.96	1.16	33
Ecosystems	63	37	4.11	0.98	24
Food chains, webs, and pyramids	61	39	4.13	1.00	20
Niches and habitats	56	44	3.99	1.04	32
Limiting factors	50	50	3.91	1.06	34
Succession	45	55	3.87	1.04	40
Biomes	49	51	3.89	1.08	37
Competition and predation	55	45	3.90	1.09	36
Population growth	51	49	3.85	1.14	43
Fossils	52	48	3.52	1.18	53
Geologic time	52	48	3.56	1.13	52
Adaptation	61	39	4.05	0.96	29
Natural selection	57	43	4.05	0.99	30
Nutrition	38	62	4.06	1.12	27
Immunity	42	58	4.15	1.03	19
Disease control	42	58	4.23	0.94	14
Viruses	51	49	4.19	0.99	16
Mitosis and meiosis	63	37	4.31	0.90	10
Development	53	47	4.17	0.88	18
Cell structure and function	69	31	4.49	0.76	1
Carbohydrates	46	54	3.80	1.08	46
Lipids	43	57	3.63	1.09	51
Proteins and amino acids	51	49	3.76	1.13	48
Osmosis	62	38	4.11	0.97	23
Diffusion	63	37	4.12	1.00	22
Metabolism	53	47	3.91	1.05	35
Life science topics median rating			4.06		

Table 4.7
Science Curriculum Survey Results: Percent Taught, Mean Rating, and Rank for Each Content Topic, by Respondent Group *(continued)*

	Middle school/junior high				
Content topic	% Taught	% Not taught	Mean rating	SD	Rank
Earth/space science					
Map reading and interpretation	55	45	3.96	1.06	33
The geologic time scale	57	43	3.77	1.01	44
Types of fossils and fossilization	51	49	3.70	1.02	46
Properties of matter	75	25	4.28	0.87	6
Minerals and their properties	66	33	4.17	0.92	16
Rocks and their properties	63	37	4.07	0.96	28
The rock cycle	63	37	4.21	0.92	11
Weathering processes	64	36	4.24	0.87	8
Erosion and agents of erosion	61	39	4.13	0.93	19
Deposition	60	40	4.08	0.95	27
Groundwater	54	46	4.09	0.96	26
Global plate tectonics	72	28	4.33	0.87	4
Volcanism	68	32	4.23	0.95	10
Earthquakes	68	32	4.27	0.89	7
Earth's interior	68	32	4.15	0.95	18
Types of natural resources	64	36	3.90	1.06	37
Fossil fuels	63	37	3.87	1.09	38
Alternative energy sources	59	41	3.92	1.14	35
Air, water, soil pollution	62	38	4.05	1.01	31
Recycling	60	40	3.94	1.05	34
The composition of air	66	34	4.09	1.08	25
Earth's atmosphere	64	36	4.23	0.98	9
Air pressure	61	39	4.19	1.02	13
Global and local winds	54	46	4.10	1.09	23
Relative humidity and dew point	54	46	4.07	1.02	30
Clouds and precipitation	59	41	4.12	1.03	21
Weather prediction	53	47	4.13	0.96	20
Weather patterns	57	43	4.18	1.01	14
Climate	57	43	4.02	1.05	32
Ocean currents	41	59	3.77	1.01	43
Properties of ocean water	38	62	3.78	1.02	42
Topography of the ocean floor	41	59	3.78	1.01	41
Tides	50	50	3.78	0.97	40
Waves	46	54	3.72	0.97	45
The planet Earth	67	33	4.37	0.87	2
The Earth in space	65	35	4.36	0.90	3
Our solar system's formation	64	36	4.18	0.96	15
Motions of the planets	62	38	4.16	1.05	17
Earth's Moon	64	36	4.31	0.86	5
Solar and lunar eclipses	62	38	4.21	0.88	12
Comets, asteroids, meteors	60	40	4.07	0.93	29
The Sun and its energy	65	35	4.37	0.79	1
Telescopes to study the universe	53	47	3.83	1.13	39
Galaxies	56	44	3.92	1.11	36
Stars	57	43	4.11	0.99	22
The universe and its formation	59	41	4.09	0.98	24
Earth/space science topics median rating			4.09		

Table 4.7
Science Curriculum Survey Results: Percent Taught, Mean Rating, and Rank for Each Content Topic, by Respondent Group *(continued)*

	Middle school/junior high				
Content topic	% Taught	% Not taught	Mean rating	SD	Rank
Physical science					
Scientific measurements; metric system	89	11	4.50	0.77	1
Physical and chemical changes	80	20	4.50	0.80	2
Elements, compounds, and molecules	83	16	4.44	0.86	5
Mass, volume, and density	87	13	4.49	0.84	3
Chemical symbols and formulas	80	20	4.30	0.93	12
Atoms: protons, electrons, and neutrons	79	21	4.47	0.83	4
Forces within the atom	63	37	4.03	1.07	26
Energy levels within the atom	65	35	4.13	1.03	21
Periodic table; atomic number, mass number	77	23	4.36	0.94	9
Types of chemical bonds	61	39	4.06	1.07	24
Chemical reactions: reactants and products	61	39	4.29	0.87	13
Balancing chemical equations	57	43	3.83	1.22	51
Endothermic and exothermic reactions	55	45	3.92	1.08	41
Rates of chemical reactions	42	58	3.69	1.19	59
Solutions: solubility and concentration	57	43	3.88	1.10	47
Polarity	25	75	3.27	1.40	88
Freezing point depression; boiling point elevation	39	61	3.68	1.24	62
Acids and bases; salts	49	51	3.83	1.11	50
pH scale	52	48	3.88	1.10	46
Radioactive elements and radioactivity	41	58	3.57	1.16	70
Speed, velocity, and acceleration	67	33	4.25	0.99	15
Momentum	63	37	4.14	1.07	20
Newton's three laws of motion	69	31	4.42	0.94	6
Friction	70	30	4.34	0.98	11
Gravity	76	24	4.35	0.90	10
Mass and weight	83	17	4.39	0.91	8
Projectile and orbital motion	44	56	3.71	1.16	57
Fluid pressure	40	60	3.62	1.14	67
Buoyancy; Archimedes' principle	51	49	4.00	1.09	33
Bernoulli's principle	44	56	3.75	1.25	54
Work, power, and efficiency	54	46	4.04	1.08	25
Simple machines (levers, pulleys, etc.)	50	50	4.23	1.05	16
Mechanical, heat, chemical, electromagnetic, and nuclear energy	54	46	4.10	1.02	22
Kinetic and potential energy	64	36	4.41	0.92	7
Energy conversions and conservation of energy	60	40	4.26	0.99	14
Temperature and molecular motion	61	38	4.21	0.99	17
Kelvin scale	39	61	3.40	1.20	83
Heat transfer: conduction, convection, and radiation	58	41	4.17	0.98	18
Specific heat; amount of heat gained or lost	36	64	3.69	1.09	60
Melting, freezing, and boiling points	68	32	4.15	0.89	19
Heats of fusion and vaporization	33	67	3.64	1.11	66
Thermal expansion	36	64	3.65	1.15	64
Heating and cooling systems; heat engines	25	75	3.35	1.05	85
Electric charge	39	61	4.02	1.12	29
Electric fields	32	68	3.95	1.22	38
Static electricity; charging an object	40	60	3.99	1.15	34
Conductors and insulators	42	58	4.02	1.10	30
Voltage, current, and resistance; Ohm's law	30	70	4.03	1.20	28

Table 4.7
Science Curriculum Survey Results: Percent Taught, Mean Rating, and Rank for Each Content Topic, by Respondent Group *(continued)*

	Middle school/junior high				
Content topic	% Taught	% Not taught	Mean rating	SD	Rank
Electrochemical cells; batteries	29	71	3.70	1.27	58
Electrical circuits	32	68	4.01	1.28	31
Electrical energy and power	34	66	3.96	1.14	37
Magnetism: magnetic poles and fields	37	63	3.81	1.23	52
Earth as a magnet; compasses	39	61	3.73	1.11	55
Magnetic effects of electricity; motors	27	73	3.65	1.31	65
Electromagnetic induction; generators	23	77	3.51	1.25	75
Transformers	20	79	3.28	1.27	87
Types of waves: transverse and longitudinal	39	61	3.99	1.02	35
Amplitude, wavelength, and frequency	44	56	3.91	1.04	44
Speed of waves	42	58	3.86	1.01	49
Reflection and refraction	44	56	4.03	0.99	27
Diffraction	35	65	3.91	1.01	42
Constructive and destructive interference	25	75	3.43	1.27	82
Transmitting sound	31	69	3.53	1.22	73
Intensity and loudness	28	72	3.56	1.27	72
Frequency (pitch); sound quality (timbre)	30	70	3.62	1.22	68
Doppler effect	38	62	3.67	1.18	63
Resonance	23	77	3.45	1.25	80
Light energy: photons	28	72	3.72	1.29	56
Electromagnetic waves	41	59	4.01	1.05	32
Electromagnetic spectrum	44	56	4.08	1.09	23
Separating white light: prisms	42	58	3.86	1.05	48
Transmittance and absorbance	23	77	3.49	1.28	76
Transparent, translucent, and opaque surfaces	28	72	3.61	1.26	69
Primary and complementary colors and pigments	25	75	3.52	1.23	74
Incandescent and fluorescent light	23	77	3.46	1.19	79
Plane, concave, and convex mirrors	30	69	3.56	1.14	71
Concave and convex lenses	34	66	3.79	1.05	53
Cameras, telescopes, and microscopes	34	66	3.68	1.06	61
Lasers; fiber optics	27	73	3.47	1.19	77
Fossil fuels	58	42	3.91	1.03	43
Solar energy; wind and water power	54	46	3.93	1.13	40
Nuclear energy	49	51	3.94	1.19	39
Alternative energy sources	55	45	3.90	1.14	45
Pollution and conservation	61	39	3.98	1.06	36
Petroleum fuels and fractional distillation	21	79	3.46	1.39	78
Polymers	21	79	3.39	1.35	84
Electronic devices (transistors, integrated circuits, etc.)	14	86	3.29	1.43	86
Communication devices (telephones, computers, etc.)	22	78	3.45	1.38	81
Physical science topics median rating			3.90		

Table 4.7

Science Curriculum Survey Results: Percent Taught, Mean Rating, and Rank for Each Content Topic, by Respondent Group *(continued)*

	High school						College		
Content topic	% Taught	% Taught prior	% Not taught	Mean rating	SD	Rank	Mean rating	SD	Rank
Biology									
Structure and function of biologically important molecules (e.g., proteins, lipids, carbohydrates, and nucleic acids)	89	5	6	4.37	0.91	5	3.64	1.31	4
Structure and function of cells (e.g., organelles, membrane structure, cytoplasm)	90	9	1	4.70	0.65	1	3.89	1.21	1
Biochemistry of life processes (e.g., Krebs cycle, electron transport)	70	10	20	3.99	1.14	8	3.09	1.34	8
Structure and function of the circulatory system	62	11	27	3.91	0.95	14	2.41	1.19	17
Structure and function of the digestive system	62	12	26	3.93	0.95	12	2.38	1.20	21
Structure and function of the skeletal and muscular systems	59	13	29	3.97	0.97	10	2.32	1.16	23
Structure and function of the respiratory system	63	12	26	3.91	0.98	14	2.38	1.21	20
Structure and function of the excretory system	55	12	33	3.81	0.97	22	2.29	1.17	26
Structure and function of the nervous system	61	11	28	3.92	0.98	13	2.38	1.20	19
Structure and function of the endocrine system	52	11	37	3.75	1.02	24	2.32	1.16	23
Structure and function of the reproductive system	56	10	33	3.80	1.02	23	2.43	1.21	16
Structure and function of the immunological system	54	9	36	3.84	0.97	20	2.28	1.18	27
Sensory organs	44	14	42	3.58	1.11	29	2.24	1.13	28
Human health (e.g., nutrition, aging, diseases)	41	30	29	3.68	1.21	25	2.50	1.17	14
Microbiology (e.g., bacteria, viruses)	74	11	14	3.87	1.08	17	2.67	1.07	12
Plant anatomy (e.g., stems, roots, flowers)	61	18	20	3.67	1.16	26	2.34	1.12	22
Plant physiology (e.g., transport)	58	19	23	3.60	1.26	28	2.17	1.09	29
Plant reproduction (e.g., life cycles, pollination, seeds, growth and development)	61	19	20	3.65	1.22	27	2.31	1.10	25
Plant nutrition (e.g., essential nutrients, photosynthesis)	61	16	23	3.86	1.13	18	2.40	1.17	18
Cell division (e.g., mitosis and meiosis)	85	13	2	4.54	0.81	4	3.77	1.17	2
Embryology (e.g., fertilization, development)	59	11	30	3.85	1.06	19	2.50	1.10	15
Mendelian genetics (e.g., Mendel's Laws, genetic crosses)	82	13	5	4.66	0.65	2	3.65	1.31	3
Molecular genetics (e.g., protein synthesis, DNA replication, genetic engineering)	84	10	6	4.60	0.71	3	3.38	1.36	6
Diversity of life (e.g., kingdoms, classification systems)	83	14	3	4.12	0.97	6	3.32	1.29	7
Evolution (e.g., natural selection, adaptations, speciation)	74	15	11	4.10	1.05	7	3.54	1.41	5
Animal behavior	43	12	45	3.34	1.21	30	2.02	0.99	30
Population ecology (e.g., habitats, niches, population growth)	60	14	26	3.88	1.22	16	2.69	1.26	11
Species interactions (e.g, competition, predation, mutualism)	62	14	23	3.84	1.22	21	2.65	1.26	13
Ecosystems (e.g., food chains, energy pyramids, succession)	62	18	20	3.97	1.22	9	2.96	1.34	10
Human impact on the environment (e.g., pollution, greenhouse effect)	61	15	24	3.95	1.19	11	3.00	1.32	9
Biology content topics median rating				3.90			2.46		

Table 4.7

Science Curriculum Survey Results: Percent Taught, Mean Rating, and Rank for Each Content Topic, by Respondent Group *(continued)*

	High school						College		
Content topic	% Taught	% Taught prior	% Not taught	Mean rating	SD	Rank	Mean rating	SD	Rank
Chemistry									
Units of measurement; metric system	84	16	0	4.54	0.78	4	4.39	0.99	1
Classification and properties of matter	87	13	0	4.24	0.90	10	3.69	1.10	6
Density	84	16	0	4.03	0.97	21	3.61	1.06	10
Atoms, molecules, ions; mole concept	92	7	0	4.90	0.36	1	4.24	1.10	2
Chemical formulas and equations	93	7	0	4.88	0.41	2	4.12	1.15	3
Stoichiometry and percent yield	92	4	4	4.70	0.64	3	3.69	1.36	6
Heat, enthalpy, state functions	68	2	30	3.88	1.01	24	2.91	1.42	22
Ideal gas law; kinetic molecular theory	85	4	11	4.42	0.80	8	3.23	1.32	15
Electron configurations, valence electrons	93	6	1	4.43	0.82	7	3.54	1.33	12
Chemical bond formation	89	6	5	4.45	0.75	5	3.62	1.30	9
Bonding theories	76	4	20	4.07	0.99	17	3.01	1.32	21
Polarity, electronegativity	88	5	7	4.17	0.91	12	3.22	1.37	16
Kelvin temperature scale	87	9	4	4.13	0.96	15	3.56	1.24	11
Phase changes	85	7	7	4.14	0.90	14	3.20	1.22	17
Phase diagrams	65	6	29	3.49	1.02	39	2.12	1.14	43
Units of concentration	84	2	14	4.20	0.87	11	3.77	1.22	4
Colligative properties	59	3	37	3.66	1.05	32	2.61	1.24	29
Reaction rates	52	1	47	3.82	1.05	28	2.74	1.40	24
Reaction mechanisms	40	1	59	3.36	1.18	43	2.22	1.29	41
Catalysts; enzymes	55	6	40	3.49	1.05	40	2.42	1.23	36
Chemical equilibria	62	1	37	4.10	1.08	16	3.12	1.49	19
Bronsted acid/base theory	73	2	25	4.06	0.98	18	3.39	1.39	13
Lewis acid/base theory	62	3	35	3.85	1.10	26	2.72	1.36	25
pH scale	83	7	9	4.44	0.79	6	3.76	1.28	5
Acid/base reactions	83	5	12	4.34	0.82	9	3.65	1.29	8
Common ion effect and buffer solutions	36	3	60	3.56	1.16	36	2.68	1.37	27
Acid/base titration	76	2	22	4.16	0.88	13	3.18	1.32	18
Acid/base indicators	79	4	17	3.95	0.95	23	2.80	1.21	23
Solubility product	43	1	56	3.60	1.15	35	2.49	1.41	33
Qualitative analysis	44	3	52	3.61	1.18	33	2.26	1.18	40
Spontaneity and entropy	37	2	61	3.33	1.25	46	2.50	1.42	32
2nd law of thermodynamics	35	2	63	3.41	1.19	42	2.48	1.38	34
Gibbs free energy	25	2	74	3.26	1.34	49	2.45	1.48	35
Oxidation/reduction reactions	66	0	33	4.04	1.04	19	3.25	1.45	14

Table 4.7

Science Curriculum Survey Results: Percent Taught, Mean Rating, and Rank for Each Content Topic, by Respondent Group *(continued)*

	High school						College		
Content topic	% Taught	% Taught prior	% Not taught	Mean rating	SD	Rank	Mean rating	SD	Rank
Electrochemical cells	32	3	65	3.47	1.15	41	2.59	1.32	30
Batteries and storage cells	25	5	70	3.09	1.16	51	2.32	1.18	38
Electrolysis	41	4	55	3.34	1.23	45	2.29	1.23	39
Corrosion	39	3	59	3.35	1.17	44	2.02	1.04	48
Chemistry of Group 1A, 2A	77	5	17	3.87	1.08	25	2.69	1.24	26
Metals, metalloids, nonmetals	81	8	11	4.03	1.01	20	3.08	1.20	20
Chemistry of Groups 5A, 6A, 7A	70	5	24	3.85	1.12	27	2.58	1.22	31
The Noble gases	79	8	14	3.96	1.09	22	2.66	1.22	28
Basic organic nomenclature	55	3	42	3.72	1.14	29	2.08	1.30	45
Organic molecules/structures	48	3	49	3.68	1.19	31	2.15	1.34	42
Functional groups	42	2	56	3.50	1.24	38	2.06	1.34	47
Petroleum and its products	23	5	72	2.97	1.21	53	1.63	0.93	55
Molecular stereochemistry	16	2	82	2.89	1.28	56	1.88	1.17	51
Amino acids, proteins	14	10	75	2.95	1.32	54	1.78	1.22	53
Carbohydrates, nucleic acids	13	11	76	2.93	1.32	55	1.75	1.21	54
Synthetic polymers	21	4	75	2.99	1.20	52	1.63	0.93	55
Chemistry of transition metals	42	4	55	3.30	1.18	47	1.86	1.04	52
Spectroscopy/absorption	33	3	63	3.26	1.15	50	2.10	1.18	44
Nature of radioactivity	55	4	40	3.69	1.09	30	2.38	1.23	37
Rates of nuclear decay	45	4	50	3.51	1.12	37	2.08	1.16	45
Nuclear fission/fusion	50	5	45	3.61	1.08	34	2.01	1.10	49
Radiochemical dating	42	3	55	3.28	1.18	48	1.91	1.08	50
Chemistry content topics median rating				3.77			2.64		

Table 4.7

Science Curriculum Survey Results: Percent Taught, Mean Rating, and Rank for Each Content Topic, by Respondent Group *(continued)*

	High school						College		
Content topic	% Taught	% Taught prior	% Not taught	Mean rating	SD	Rank	Mean rating	SD	Rank
Earth/space science (or Earth science)									
Map reading and interpretation	80	9	11	4.23	0.95	18	2.72	1.24	17
The geologic time scale	73	9	18	3.86	1.11	34	2.76	1.41	14
Types of fossils	61	13	26	3.25	1.07	41	1.78	1.02	41
Fossilization	67	11	22	3.53	1.04	40	1.90	1.15	39
Interpretation of fossils	60	9	32	3.58	1.07	39	1.87	1.11	40
Properties of matter	59	35	6	4.15	1.12	21	3.36	1.22	1
Minerals and their properties	87	7	6	4.46	0.79	5	3.01	1.51	7
Rocks and their properties	89	7	4	4.43	0.85	7	3.07	1.53	6
The rock cycle	88	8	3	4.44	0.86	6	3.15	1.53	4
Biogeochemical cycles (carbon, nitrogen, water, etc.)	58	19	22	3.73	1.09	37	2.66	1.38	19
Weathering processes	86	8	5	4.20	0.96	20	2.97	1.41	8
Soil formation and soil properties	71	10	18	3.76	1.08	36	2.47	1.30	23
Erosion and agents of erosion	85	10	5	4.30	0.89	16	2.93	1.42	9
Deposition	83	10	7	4.04	1.03	26	2.82	1.39	12
Groundwater	80	8	12	4.25	0.99	17	2.74	1.50	16
Landform creation	82	7	10	4.08	0.94	23	2.70	1.40	18
Global plate tectonics	91	6	3	4.76	0.54	1	3.32	1.61	2
Volcanism	85	8	6	4.51	0.78	3	3.21	1.54	3
Earthquakes	90	6	4	4.67	0.60	2	3.11	1.56	5
Earth's interior	90	6	3	4.49	0.76	4	2.91	1.50	11
Types of natural resources	63	13	24	3.97	1.19	29	2.59	1.40	21
Fossil fuels	60	15	24	3.93	1.18	30	2.43	1.39	26
Alternative energy sources	55	13	32	4.02	1.11	27	2.23	1.29	33
Conservation and preservation	55	12	32	4.07	1.12	25	2.29	1.38	32
Air, water, soil pollution	67	11	22	4.10	1.09	22	2.41	1.35	27
Recycling	44	22	33	3.87	1.28	33	2.00	1.25	38
Population growth	28	24	48	3.64	1.34	38	2.20	1.32	35
The composition of air	82	11	8	4.34	0.85	13	2.77	1.54	13
Earth's atmosphere	88	6	6	4.39	0.90	10	2.92	1.59	10
Air pressure	80	13	8	4.40	0.90	8	2.51	1.47	22
Global and local winds	80	11	10	4.31	0.93	14	2.46	1.51	24
Relative humidity and dew point	78	11	11	4.37	0.82	11	2.21	1.49	34
Clouds and precipitation	82	10	8	4.39	0.82	9	2.44	1.53	25
Weather prediction	77	12	11	4.31	0.95	15	2.09	1.40	37

Table 4.7

Science Curriculum Survey Results: Percent Taught, Mean Rating, and Rank for Each Content Topic, by Respondent Group *(continued)*

	High school						College		
Content topic	% Taught	% Taught prior	% Not taught	Mean rating	SD	Rank	Mean rating	SD	Rank
Weather patterns	80	12	8	4.35	0.89	12	2.31	1.46	31
Climate	75	14	11	4.21	1.02	19	2.76	1.56	14
Ocean currents	63	9	28	3.98	1.03	28	2.32	1.44	30
Properties of ocean water	52	12	35	3.84	1.18	35	2.11	1.28	36
Topography of the ocean floor	63	11	26	3.90	1.05	31	2.60	1.36	20
Tides	67	11	22	4.07	1.02	24	2.41	1.38	27
Waves	59	9	32	3.89	1.12	32	2.38	1.35	29
Earth/space science (or Earth science) content topics median rating				4.15			2.59		

Table 4.7

Science Curriculum Survey Results: Percent Taught, Mean Rating, and Rank for Each Content Topic, by Respondent Group *(continued)*

	High school						College		
Content topic	% Taught	% Taught prior	% Not taught	Mean rating	SD	Rank	Mean rating	SD	Rank
Physics									
Distance, displacement, speed, velocity, acceleration	100	0	0	4.91	0.33	2	3.71	1.45	2
Position-time graphs and velocity-time graphs	98	1	1	4.51	0.77	17	3.15	1.37	12
Newton's laws of motion	99	1	0	4.95	0.27	1	3.52	1.62	5
Static forces	94	1	5	4.38	0.81	20	2.98	1.47	20
Law of gravitation	94	1	5	4.37	0.83	21	2.92	1.52	21
Kepler's laws	56	5	39	3.40	1.22	52	2.06	1.18	51
Free fall motion	100	0	0	4.75	0.54	8	3.37	1.52	6
Projectile motion	99	0	1	4.59	0.70	14	3.06	1.52	17
Uniform circular motion: centripetal acceleration	94	0	6	4.39	0.79	19	2.92	1.50	21
Simple harmonic motion	82	0	18	3.98	1.03	36	2.67	1.49	31
Momentum and conservation of momentum	99	0	1	4.71	0.61	9	3.15	1.62	12
Kinetic energy and potential energy	99	1	0	4.82	0.47	4	3.36	1.62	7
Work and the work-energy theorem	97	0	2	4.60	0.66	12	3.15	1.63	12
Torque and rotational motion	68	0	31	3.74	1.03	44	2.66	1.53	33
Temperature scales	49	37	13	3.79	1.00	42	2.91	1.47	23
Specific heat and calorimetry	48	32	19	4.04	0.95	35	2.56	1.47	37
Heat transfer: conduction, convection, radiation	46	32	21	3.97	0.87	38	2.57	1.39	36
Thermal expansion	48	19	32	3.73	1.01	45	2.31	1.28	43
Latent heat and phases of matter: solid, liquid, gas	48	33	18	4.05	0.91	33	2.55	1.42	38
Ideal gas law	31	47	21	3.92	0.98	39	2.60	1.47	35
Kinetic theory of gases	34	42	23	3.84	1.01	41	2.30	1.37	44
Laws of thermodynamics	46	22	30	3.97	0.96	37	2.51	1.50	40
Production of waves: acceleration of charges and vibration	81	2	17	4.12	1.04	31	2.40	1.34	41
Properties of waves: wavelength, frequency, speed, amplitude	90	4	6	4.65	0.68	10	3.18	1.61	9
Electromagnetic spectrum	83	9	8	4.32	0.91	23	2.91	1.46	23
Interaction of light with matter: reflection, refraction, absorption, emission	87	2	11	4.43	0.77	18	2.80	1.45	28
Doppler effect	87	4	9	4.13	0.94	29	2.39	1.25	42
Diffraction and interference	79	3	18	4.12	0.97	30	2.64	1.53	34
Images formed by mirrors and/or lenses	73	4	23	4.20	0.96	28	2.83	1.55	27
Optical instruments: microscopes and/or telescopes	40	8	51	3.27	1.13	54	2.25	1.22	45
Lasers and holography	29	5	67	2.99	1.13	57	1.83	1.02	57
Electrostatics: Coulomb's law	82	1	16	4.60	0.72	13	3.18	1.67	9
Electric field	79	2	19	4.31	0.84	26	3.00	1.68	18
Electric potential and potential difference	80	1	19	4.55	0.70	15	2.99	1.66	19

Table 4.7

Science Curriculum Survey Results: Percent Taught, Mean Rating, and Rank for Each Content Topic, by Respondent Group *(continued)*

	High school						College		
Content topic	% Taught	% Taught prior	% Not taught	Mean rating	SD	Rank	Mean rating	SD	Rank
Current, resistance, voltage; Ohm's law	84	1	15	4.78	0.57	7	3.09	1.64	16
Conductivity: conductors and insulators	78	3	18	4.31	0.86	24	2.80	1.47	28
Capacitance and capacitors	54	1	45	3.88	1.07	40	2.55	1.50	38
DC circuits	82	2	16	4.51	0.77	16	2.87	1.53	25
AC circuits	36	4	60	3.68	1.24	47	2.19	1.35	46
Electrical energy and power	79	1	19	4.35	0.83	22	2.84	1.52	26
Magnetism and magnetic effects of current	70	3	27	4.25	0.96	27	2.79	1.53	30
Electromagnetic induction	58	2	39	4.05	0.97	32	2.67	1.57	31
Atomic structure: protons, neutrons, electrons	34	52	14	4.31	0.94	25	3.18	1.57	9
Density	34	52	14	4.05	0.99	34	3.15	1.45	12
Deformation of solids	18	23	60	3.02	1.20	56	1.93	1.08	56
Fluid behavior: hydrostatics and/or hydrodynamics	35	15	50	3.54	1.16	50	2.12	1.29	50
Nuclear decay: radioactivity	33	22	45	3.72	1.02	46	2.15	1.34	49
Nuclear reactions: fission and/or fusion	34	21	45	3.66	1.05	48	2.02	1.30	53
Wave-particle duality	52	5	43	3.76	1.09	43	2.18	1.44	47
Uncertainty principle	26	11	62	3.39	1.09	53	2.05	1.37	52
Quantum physics: atomic spectra	32	14	53	3.63	1.05	49	2.16	1.42	48
Pauli exclusion principle and the periodic table	12	27	60	3.09	1.06	55	1.97	1.32	55
Relativity (general and/or special)	36	2	61	3.44	1.03	51	1.99	1.33	54
Units of measurement; metric system	82	17	1	4.83	0.55	3	4.12	1.19	1
Vectors	95	1	3	4.79	0.53	6	3.68	1.46	3
Conversion of energy from one form to another form	95	5	1	4.62	0.70	11	3.32	1.56	8
Conservation of energy	98	2	0	4.80	0.47	5	3.54	1.60	4
Physics content topics median rating				4.13			2.80		