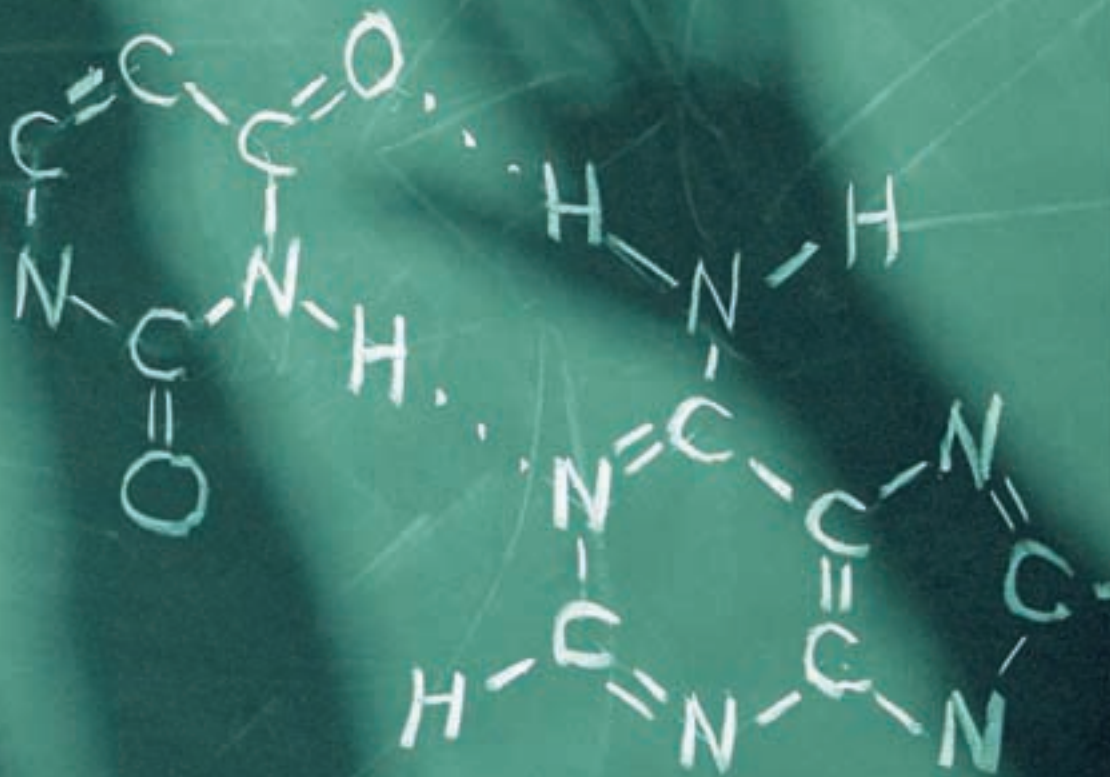


U.S. Department of Education
NCES 2006-466



The 
Nation's
Report Card

Science 2005

ASSESSMENT OF STUDENT PERFORMANCE IN GRADES 4, 8, AND 12

Contents

MAY 2006

- 1** Executive Summary
- 2** Understanding the Results
- 4** Reporting the Results
- 6** 4th Grade
- 18** 8th Grade
- 30** 12th Grade
- 40** Technical Notes



What is the Nation's Report Card™?

The Nation's Report Card™ informs the public about the academic achievement of elementary and secondary students in the United States. Report cards communicate the findings of the National Assessment of Educational Progress (NAEP), a continuing and nationally representative measure of achievement in various subjects over time. The Nation's Report Card™ compares performance among states, urban districts, public and private schools, and student demographic groups.

For over three decades, NAEP assessments have been conducted periodically in reading, mathematics, science, writing, history, geography, and other subjects. By making objective information available on student performance at the national, state, and local levels, NAEP is an integral part of our nation's evaluation of the condition and progress of education. Only information related to academic achievement and relevant variables is collected. The privacy of individual students is protected, and the identities of participating schools are not released.

NAEP is a congressionally mandated project of the National Center for Education Statistics (NCES) within the Institute of Education Sciences of the U.S. Department of Education. The Commissioner of Education Statistics is responsible for carrying out the NAEP project. The National Assessment Governing Board (NAGB) oversees and sets policy for NAEP.

Executive Summary

Compared to middle and high school students, younger students are making the most progress in science. In 2005, a representative sample of more than 300,000 students in grades 4, 8, and 12 was assessed in science. This report presents national results for all three grades, and state results for grades 4 and 8. The 2005 results are compared to those from 1996 and 2000. Sample questions are presented to illustrate the types of skills and knowledge that were assessed at each grade.

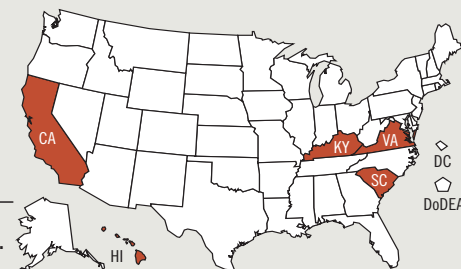
At grade 4, the average science score was higher in 2005 than in earlier years. The percentage of students performing at or above the *Basic* achievement level increased from 63 percent in 1996 and 2000 to 68 percent in 2005. An example of the knowledge associated with the *Basic* level is identifying two organs in the human body that work together to supply oxygen. Twenty-nine percent performed at or above the *Proficient* level. Relating the amount of time a candle burns to the amount of air available is an example of the knowledge and skills at the *Proficient* level.

At grade 8, there was no overall improvement. In 2005, 59 percent of students scored at or above the *Basic* level. An example of the knowledge and skills at the *Basic* level is being able to compare changes in heart rate before, during, and after exercise. Twenty-nine percent performed at or above the *Proficient* level. Identifying the energy conversions that occur in an electric fan is an example of the knowledge and skills at the *Proficient* level.

At grade 12, the average score declined since 1996. In 2005, 54 percent of students scored at or above the *Basic* level. Knowing the function of a neuron is an example of knowledge at the *Basic* level. Eighteen percent performed at or above the *Proficient* level. Identifying the source of heat energy released in a combustion reaction is an example of knowledge at the *Proficient* level.

Five states take the lead in science score gains

Most states showed no improvement at grades 4 and 8. Five of the 37 participating states, however, did improve between 2000 and 2005—and did so at both grades.



¹ Department of Defense Education Activity.

Those states were California, Hawaii, Kentucky, South Carolina, and Virginia. At grade 4, Virginia was also among the top seven jurisdictions in 2005.

Since 2000...

- 9 states improved at grade 4
- 11 states improved and 4 declined at grade 8

Differential patterns were found when results were examined by science content area. For example, only three of the nine states that showed overall gains at grade 4 also showed gains in each of the three fields of science.

MINORITY STUDENTS ARE MAKING GAINS AT GRADES 4 AND 8

Minority students in grades 4 and 8 are making progress. At grade 4, average scores increased by 7 points for Black students, and by 11 points for Hispanic students, since 2000. White and Asian/Pacific Islander fourth-graders also improved since 1996, as did Hispanic and Black students. At grade 8, Black students were the only racial/ethnic group to make gains since 1996, and no racial/ethnic group showed improvement since 2000.

SCORE GAPS NARROWED BETWEEN YOUNGER WHITE, BLACK, AND HISPANIC STUDENTS

Due largely to gains made by minority students, the score gaps between fourth-grade White students and their Black and Hispanic peers were smaller in 2005 than in 2000. The gap between White and Black students narrowed by 4 points since 2000, while the gap between White and Hispanic students narrowed by 8 points. The gap between White and Black twelfth-graders, however, widened during the same time period.

- ↑ Indicates the score was higher or the gap increased in 2005
- ↓ Indicates the score was lower or the gap decreased in 2005
- ↔ Indicates there was no significant change in the score or the gap in 2005

	4th Grade Across the board improvements		8th Grade Scores remain flat		12th Grade Scores steady from 2000, but lower than in 1996	
	Since 1996	Since 2000	Since 1996	Since 2000	Since 1996	Since 2000
Overall	↑	↑	↔	↔	↓	↔
White	↑	↑	↔	↔	↔	↔
Black	↑	↑	↑	↔	↔	↔
Hispanic	↑	↑	↔	↔	↔	↔
Gaps						
White – Black	↓	↓	↔	↔	↔	↑
White – Hispanic	↔	↓	↔	↔	↔	↔

Understanding the Results

NAEP science results contribute information for monitoring the nation's progress toward achieving science literacy for all students. Comparisons across assessment years are possible because the assessments were developed under the same framework and share a common set of science questions. To understand the results, it is important to consider the major features of the NAEP science framework and the types of questions in the assessment.

THE SCIENCE FRAMEWORK

Like every NAEP assessment, the science assessment is based on a blueprint called a “framework,” which specifies what should be assessed at grades 4, 8, and 12. Under the direction of the National Assessment Governing Board (NAGB), the framework was developed in a comprehensive and inclusive process, including subject experts, scientists, school administrators, policymakers, teachers, parents, and others. Believing that science literacy is necessary in contemporary life, the developers specified that NAEP emphasize assessing science concepts and application of scientific knowledge and skills over assessing factual knowledge.

The current science framework was used to guide the 1996, 2000, and 2005 assessments. A new framework, approved in 2005, will be used to direct future assessments. For more information on the framework, see <http://www.nagb.org/pubs/pubs.html>.

The current science framework requires assessment in three broad fields—Earth science, physical science, and life science—and three elements of knowing and doing science—conceptual understanding, scientific investigation, and practical reasoning. This science framework also specifies that some

Elements of Knowing and Doing Science

Conceptual understanding means understanding the principles of science used to explain and predict observations of the natural world.

Scientific investigation means using scientific knowledge and skills to plan investigations and acquire new knowledge.

Practical reasoning means using science understanding to solve everyday problems.

questions and tasks should assess students' understanding of the nature of science and key organizing themes of science. The nature of science encompasses the historical developments and habits of mind that characterize science and technology, and methods of scientific inquiry and problem solving. The themes of science are ideas that transcend the scientific disciplines and give scientists tools for investigating the natural world. Themes included in the framework are systems, models, and patterns of change.

The Fields of Science

Earth science includes concepts related to solid Earth, water, air, and Earth in space.

Physical science (physics and chemistry) includes matter and its transformations, energy and its transformations, and motion.

Life science includes the nature and function of living things.

SCIENCE QUESTIONS

Because of the breadth of content covered in the NAEP science assessment, each student took just a portion of the questions, answering two 25-minute sections of subject-area questions. All of the data from the questions that students answered are combined to produce an average score for the nation and the states.

Students were asked multiple-choice questions and constructed-response questions that require them to produce their own answers. Some students were required to undertake actual experiments using materials provided to them, and to record their observations and conclusions in their test booklets.

Each question on the science assessment measures one type of knowing and doing within a field of science. The full assessment includes questions in all areas of the matrix shown to the right. Only selected questions, as indicated in figure 1, are included in this report.

BACKGROUND QUESTIONS

In addition to answering subject-area questions, students participating in NAEP answered a short questionnaire that asked about their background and home or school experiences related to science achievement. This background information helps to provide additional context for understanding and interpreting the results.

Figure 1 Selected examples of questions by elements of knowing and doing science in each field

		Earth	Physical	Life
Knowing and doing science	Conceptual understanding	Moon craters, grade 4, page 11 Mechanical weathering, grade 12, page 38	No examples included. ¹	Genetic material, grade 8, page 23 Function of a neuron, grade 12, page 37
	Scientific investigation	No examples included. ¹	Salt water, grade 8, page 24	No examples included. ¹
	Practical reasoning	No examples included. ¹	Balls in water, grade 4, page 12	No examples included. ¹

¹ Additional sample items may be found on the NAEP Questions Tool at <http://nces.ed.gov/nationsreportcard/itmrsl/>.





Reporting the Results

The students who are selected to take the NAEP assessment represent hundreds of other students like them in their state and across the U.S. By participating, they play an important role in improving education in the country and in their own state and school. These valuable data can only be obtained with the cooperation of schools, teachers, and students nationwide. The NAEP program extends its thanks to all those who participated.

In This Report:

- National Performance at Grades 4, 8, and 12
- Overall and Subscale Performance by State at Grades 4 and 8
- Results for Selected Student Groups
- Coursetaking Patterns at Grade 12

Representative samples of schools and students participated in the 2005 NAEP science assessment at each grade. The results provide estimates of performance of all students in the target grades. The national results reflect the performance of students in public schools, private schools, Bureau of Indian Affairs schools, and Department of Defense schools. The numbers of schools and students participating at grades 4 and 8 were larger than at grade 12 in order to report results for individual states. The state results reflect the performance of students in public schools only.

Table 1 Participating schools and students in 2005 NAEP science assessment

	Number of schools	Number of students
Grade 4	8,500	147,700
Grade 8	6,400	143,400
Grade 12	900	13,700

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

SCALE SCORES

NAEP science results are reported on a 0–300 scale. An examination of scores at different percentiles along the scale shows whether lower-, middle-, and higher-performing students are showing the same trends as the national average.

Scores are also reported for each of the three fields of science—Earth, physical, and life. These subscale results are also reported on the 0–300 scale for each grade and allow a comparison of student performance in each field of science with overall achievement and progress.

ACHIEVEMENT LEVELS

Achievement levels for science are performance standards showing what students know and can do. NAEP results are reported as percentages of students performing at or above three achievement levels: *Basic*, *Proficient*, and *Advanced*. Percentages below *Basic* are also reported.

NAGB sets specific achievement levels for each subject area and grade, based on recommendations from panels of educators and members of the public, to provide a context for interpreting student performance on NAEP. As provided by law, NCES, upon review of congressionally mandated evaluations of NAEP, has determined that achievement levels are to be used on a trial basis and should be interpreted with caution. However, NCES and NAGB have affirmed the usefulness of these performance standards for understanding trends in achievement. NAEP achievement levels have been widely used by national and state officials.

Descriptions of the NAEP science achievement levels for each grade can be found in the grade sections of this report. More detailed descriptions of NAEP science achievement levels for each grade can be found in appendix A of the Science Framework for the 2005 NAEP at the NAGB website, <http://www.nagb.org/pubs/pubs.html>.

INTERPRETING RESULTS

NAEP uses widely accepted statistical standards in analyzing data. The text of this report discusses only findings that are statistically significant at the .05 level. In the tables and charts of this report, the symbol (*) is used to indicate that scores or percentages are significantly different from each other.

Scales have been established for science achievement overall and by each content area at each grade. Because scales were set separately for each content area within each grade, direct comparisons cannot be made from one scale to another.

In addition to overall results, performance at the national level is presented for students categorized by different demographic and educational background characteristics (for example, by gender or science coursetaking). Not all of the data for results discussed in the text are presented in corresponding tables or graphics (e.g., achievement-level data for student groups), but can be found on the NAEP website at <http://nces.ed.gov/nationsreportcard/nde>. Similar results at the state level are also available on the website. These simple breakdowns cannot be used to establish a cause-and-effect relationship between background characteristics and achievement. A complex mix of educational and socioeconomic factors may interact to affect student performance.

For additional information, see the Technical Notes on page 40 or <http://nationsreportcard.gov>.

The three NAEP achievement levels, from lowest to highest, are

Basic—denotes partial mastery of the knowledge and skills that are fundamental for proficient work at a given grade.

Proficient—represents solid academic performance. Students reaching this level have demonstrated competency over challenging subject matter.

Advanced—signifies superior performance.

4TH

G R A D E



Scores rise for all student groups, gaps narrow

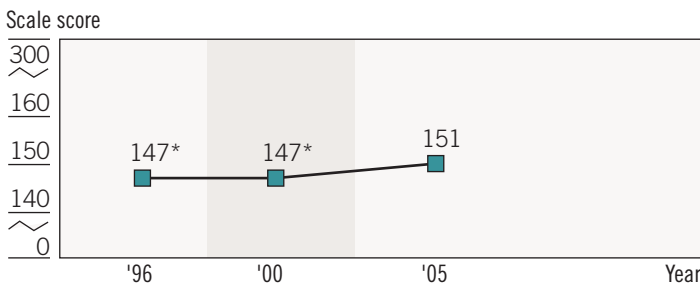
In 2005, the average fourth-grade science score was higher than in previous assessment years, with minorities and lower-income students making significant gains. From 2000 to 2005, Black and Hispanic students' science scores improved, and the gaps between White and Black and White and Hispanic students narrowed.

Most of the 37 states and jurisdictions that participated in both 2000 and 2005 showed no significant change. Nine states, however, did make gains in average scores during this time period. The score gap between White and Black students remained unchanged in 35 states—and narrowed in only two.

Lowest performing students make the largest gains

As shown in figure 2, the average score for fourth-graders was higher in 2005 than in 1996 and 2000. Figure 3 shows trends for students performing at higher, middle, and lower levels on the NAEP science scale. As can be seen by the trend line toward the bottom of the scale, students performing at the lowest level made the largest gains, up 10 points since 2000. Scores for higher-performing students at the 75th and 90th percentiles were not significantly different from previous assessment years.

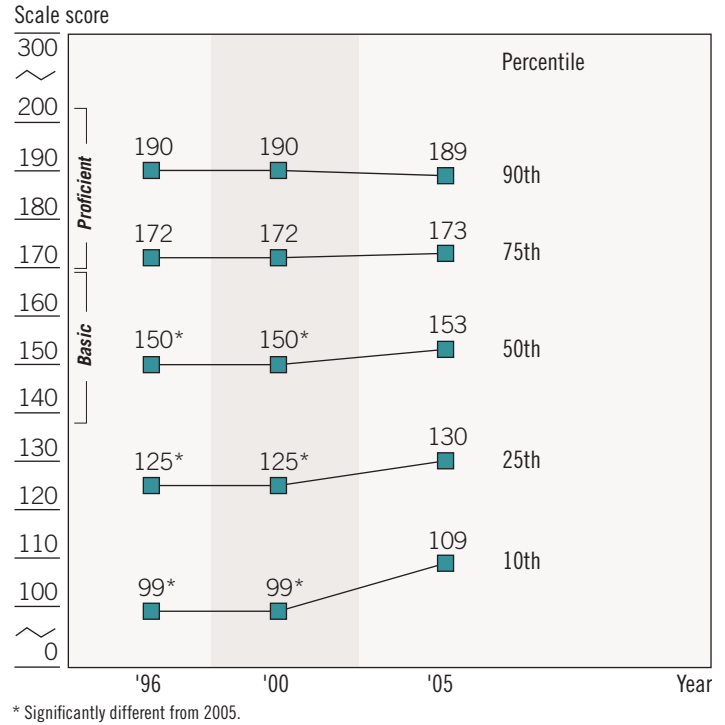
Figure 2 Trend in fourth-grade average NAEP science scores



* Significantly different from 2005.

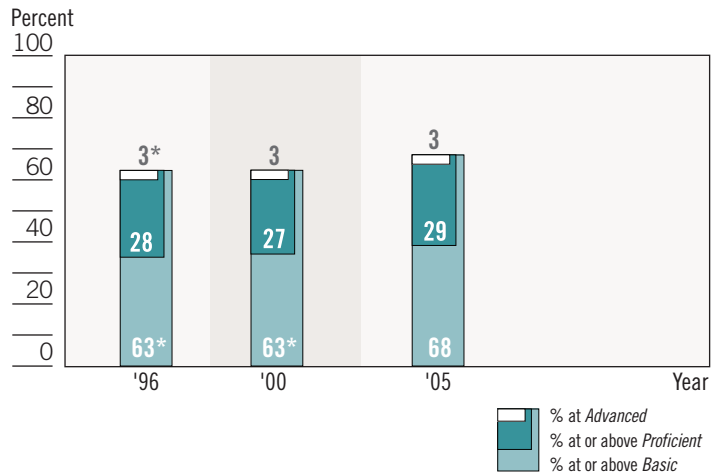
Figure 4 shows the percentage of students scoring at or above the *Basic* achievement level, indicating they have achieved at least partial mastery of the fundamental skills and knowledge in science. The percentage of students reaching the *Basic* level and above increased from 63 percent in 1996 and 2000 to 68 percent in 2005, while there was no significant change in the percentage of students performing at or above *Proficient*. One explanation for this can be seen in figure 3, which shows where in the performance distribution gains were being made. The only significant increases were in the lower half of the scale. The gains made by students in this area of the scale resulted in more fourth-graders moving into the *Basic* range.

Figure 3 Trend in fourth-grade NAEP science percentile scores



* Significantly different from 2005.

Figure 4 Trend in fourth-grade NAEP science achievement-level performance



* Significantly different from 2005. The percentage at *Advanced* was lower in 2005 (2.54) than in 1996 (3.27).
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996, 2000, and 2005 Science Assessments.

Minority students make gains

As shown in table 2, the percentage of White students in the population declined between 1996 and 2005, and the percentage of Hispanic students increased. Figure 5 shows that the trend of higher performance overall in 2005 was also seen for Black and Hispanic students as well as for White students. The average score for Asian/Pacific Islander students increased from 144 in 1996 to 158 in 2005.

Table 2 Percentage of fourth-grade students in the population, by race/ethnicity

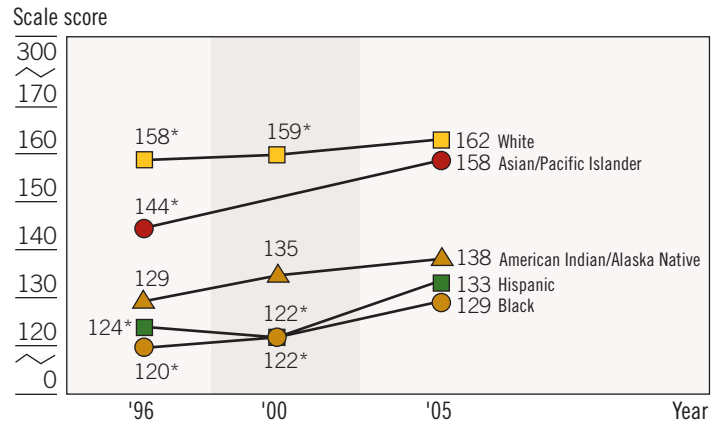
	1996	2000	2005
White	67*	63*	59
Black	17	16	16
Hispanic	10*	15*	19
Asian/Pacific Islander	5	4	4
American Indian/Alaska Native	2	1*	1

* Significantly different from 2005. The percentage of American Indian/Alaska Native students was higher in 2005 (1.18) than in 2000 (0.69).

NOTE: Percentages for the unclassified race/ethnicity category are not included in the table. Race categories exclude Hispanic origin.

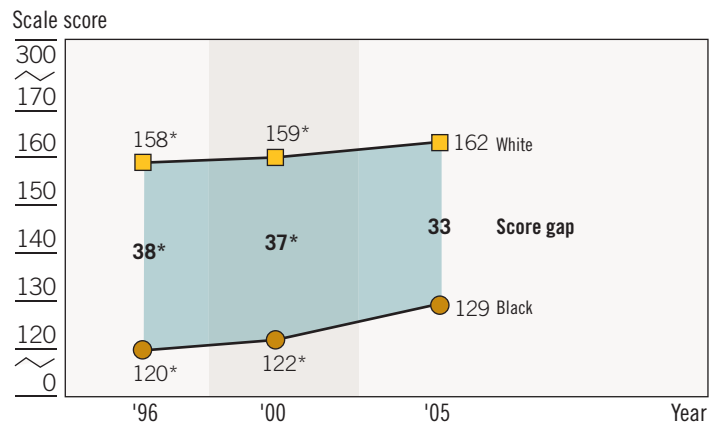
Score gains made by minority students contributed to a narrowing of the gaps between White students and their Black and Hispanic peers. Figures 6 and 7 show that in 2005, the White – Black gap was smaller than in either previous year, and the White – Hispanic gap was smaller than in 2000.

Figure 5 Trend in fourth-grade average NAEP science scores, by race/ethnicity



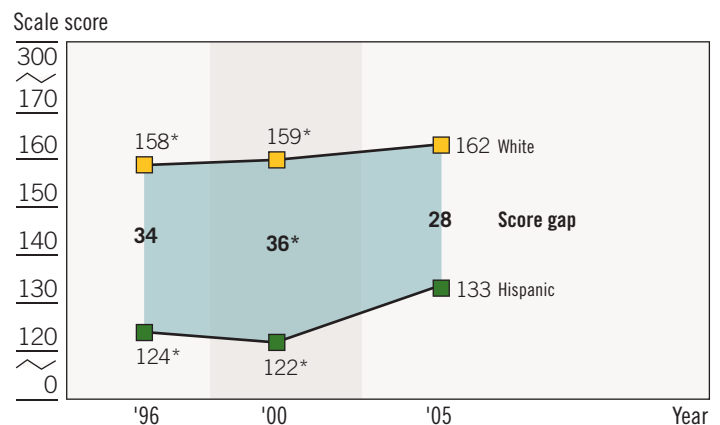
* Significantly different from 2005.

Figure 6 White – Black fourth-grade NAEP science score gap



* Significantly different from 2005.

Figure 7 White – Hispanic fourth-grade NAEP science score gap



* Significantly different from 2005.

NOTE: Score gaps are calculated based on differences between unrounded average scores. Race categories exclude Hispanic origin.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996, 2000, and 2005 Science Assessments.



Both male and female students make gains since 2000

As figure 8 shows, the average scores for male and female students were higher in 2005 than in 2000. Although scores increased from 2000 to 2005 for both groups, there continued to be a gap.

Low-income students make gains

A student's eligibility for free or reduced-price school lunch is used as an indicator of socioeconomic status; students from low-income families are typically eligible. Figure 9 shows that the average fourth-grade science scores were higher in 2005 than in previous assessment years for students both eligible and not eligible for free or reduced-price lunch. The average score for eligible students increased 8 points since 2000, twice that for not eligible students.

While not shown in the graphics, as a result of improved performance, the percentage of eligible students at or above *Basic* increased from 39 percent in 2000 to 48 percent in 2005.

Table 3 Percentage of fourth-grade students in the population, by eligibility for free/reduced-price school lunch

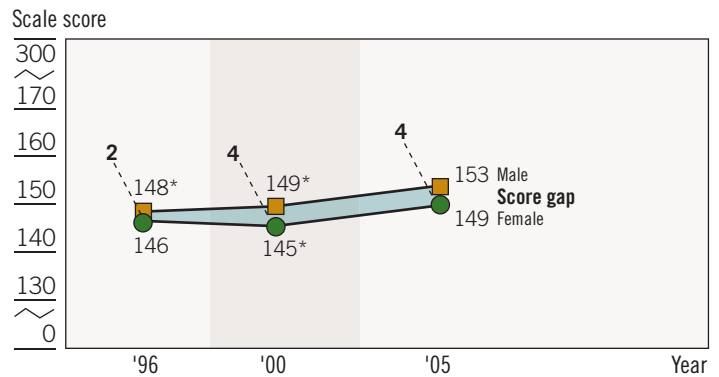
	1996	2000	2005
● Eligible	35*	37*	42
■ Not eligible	51	46*	51
Information not available	14*	17*	8

* Significantly different from 2005.
NOTE: Percentages may not add to 100 due to rounding.

Who is below *Basic*?

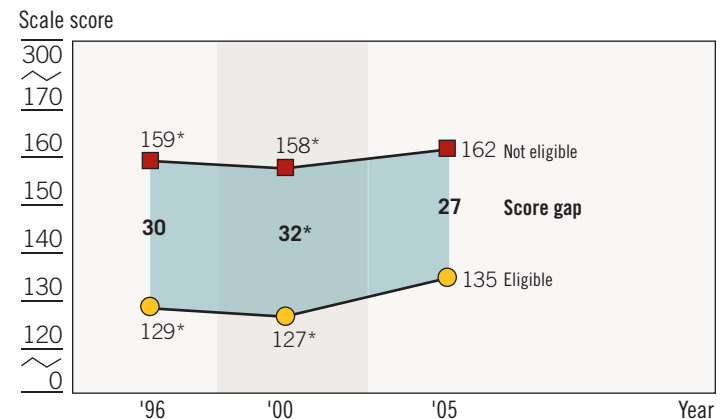
- 32% White; 30% Black; 32% Hispanic; 3% Asian/Pacific Islander; 2% American Indian/Alaska Native
- 67% eligible for free/reduced-price school lunch
- 42% in central city schools

Figure 8 Trend in fourth-grade average NAEP science scores, by gender



* Significantly different from 2005.

Figure 9 Trend in fourth-grade average NAEP science scores, by eligibility for free/reduced-price school lunch



* Significantly different from 2005.

NOTE: Score gaps are calculated based on differences between unrounded average scores.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996, 2000, and 2005 Science Assessments.

The percentages shown below provide a profile of two groups of students: those who scored below *Basic* and those who scored at or above *Proficient*. For example, the percentages presented below show that, of all the students who performed below the *Basic* level, 32 percent were White, while 81 percent of all the students at or above the *Proficient* level were White.

Who is at or above *Proficient*?

- 81% White; 4% Black; 7% Hispanic; 6% Asian/Pacific Islander; 1% American Indian/Alaska Native
- 17% eligible for free/reduced-price school lunch
- 25% in central city schools

Assessment Content at Grade 4

The content of the assessment varies for each grade to reflect what students should know and be able to do. The percentage of the assessment dedicated to each of the fields of science and the elements of knowing and doing science is specified for each grade. To interpret the overall results and the student group results in this report, it is important to understand the content of the assessment at each grade.

At grade 4, one-third of the assessment was devoted to each of three science fields—Earth, physical, and life science. The framework specifies that 45 percent of assessment time should be devoted to conceptual understanding, 45 percent to scientific investigation, and 10 percent to practical reasoning.

Fourth-graders were presented with two 25-minute sections, each containing 9 to 17 multiple-choice questions and constructed-response questions, which require students to produce their own answers. One-half of the students

in each school received one of three hands-on tasks and related questions. For example, fourth-grade students who participated in the 1996 science assessment were asked to determine whether an unknown sample of water was fresh water or salt water after observing the levels at which a pencil floated in each type of water. (Examples of hands-on tasks from the 2005 assessment have not yet been released.) Fourth-graders spent an additional 20 minutes to complete the hands-on portion of the assessment.

Science Achievement Levels at Grade 4

The science achievement levels at grade 4 represent what fourth-graders know and can do in science at each level. The following are excerpts of the science achievement-level descriptions with the corresponding cut scores noted in parentheses. The full descriptions can be found at http://www.nagb.org/pubs/s_framework_05/761907-ScienceFramework.pdf.

Basic (138): Students performing at the *Basic* level demonstrate some of the knowledge and reasoning required for understanding the Earth, physical, and life sciences at a level appropriate to grade 4. For example, they can carry out simple investigations and read uncomplicated graphs and diagrams. Students at this level also show a beginning understanding of classification, simple relationships, and energy.

Proficient (170): Students performing at the *Proficient* level demonstrate the knowledge and reasoning required for understanding the Earth, physical, and life sciences at a level appropriate to grade 4. For example, they understand concepts relating to the Earth's features, physical properties, structure, and function. In addition, students can formulate solutions to familiar problems as well as show a beginning awareness of issues associated with technology.

Advanced (205): Students performing at the *Advanced* level demonstrate a solid understanding of the Earth, physical, and life sciences as well as the ability to apply their understanding to practical situations at a level appropriate to grade 4. For example, they can perform and critique simple investigations, make connections from one or more of the sciences to predict or conclude, and apply fundamental concepts to practical applications.

Sample Grade 4 Multiple-Choice Question

The following multiple-choice question from the fourth-grade science assessment required conceptual understanding in the field of Earth science.

The percentages above the question to the right indicate how students performed on the question. In addition to the overall percentage of students who answered the question correctly, the percentage of students at each achievement level who answered correctly is presented. For example, 46 percent of the students scoring at the *Basic* level answered this question correctly, and 90 percent of the students at the *Advanced* level answered correctly.

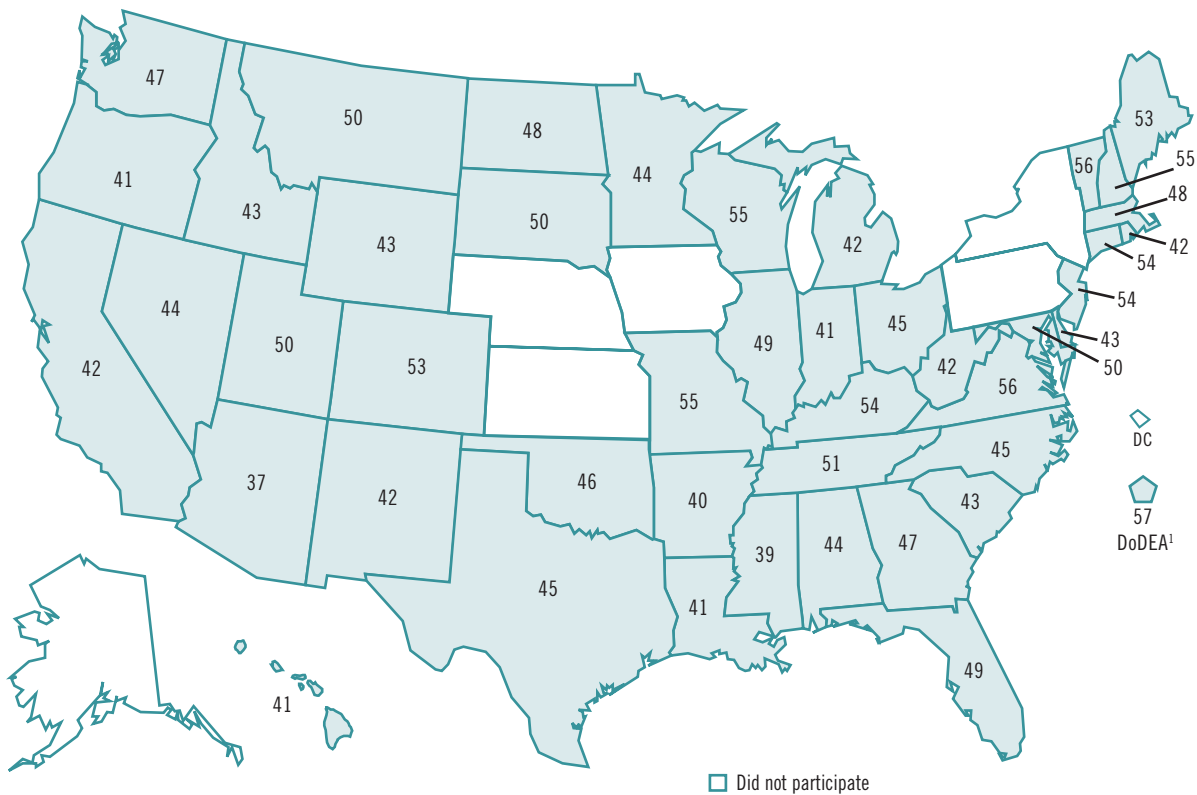
National percentage correct in 2005

Overall	Below <i>Basic</i>	At <i>Basic</i>	At <i>Proficient</i>	At <i>Advanced</i>
47	22	46	73	90

The surface of the Moon is covered with craters. Most of these craters were formed by

- A eruptions of active volcanoes
- B the impacts of many meteoroids
- C shifting rock on the Moon's surface ("moonquakes")
- D tidal forces caused by the Earth and Sun

Percentage of correct fourth-grade student responses on question above in 2005, by state



¹ Department of Defense Education Activity.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

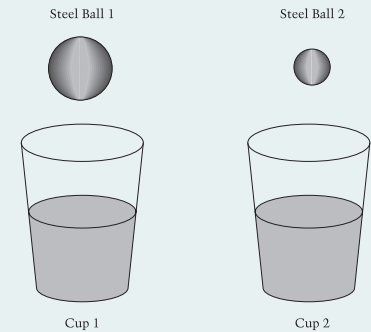
Sample Grade 4 Short Constructed-Response Question

The following is a constructed-response question requiring practical reasoning in the field of physical science. Responses were rated using a three-level scoring guide. Responses which stated that the water level goes up more in cup 1 and gave a correct explanation were rated “Complete.” Responses which stated that the water level goes up more in cup 1, but had an inadequate explanation were rated “Partial.” Responses which stated that the water level goes up more in cup 2, or that ball 2 pushes the water level higher in cup 2 were rated as “Incorrect.” The sample student response shown here was “Complete.”

National percentage “Complete” in 2005

Overall	Below <i>Basic</i>	At <i>Basic</i>	At <i>Proficient</i>	At <i>Advanced</i>
62	51	64	72	79

As shown in the picture, Christina has two identical cups that are filled to the same level with water. She also has two solid steel balls.



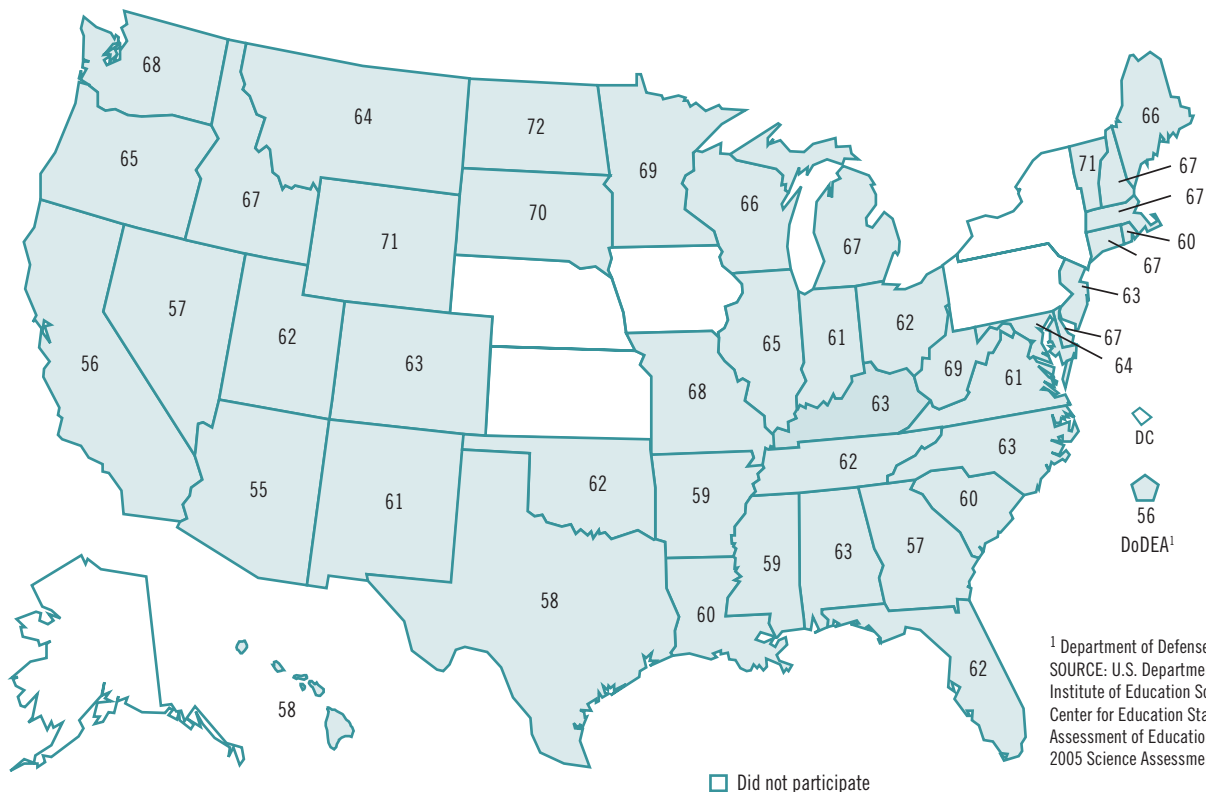
Christina puts ball 1 in cup 1 and ball 2 in cup 2. In which cup will the water level rise the most?

Cup One

Tell why you think so.

Cup ones water level will rise more because the steel ball one takes up more space because it is bigger then ball two.

Percentage of fourth-grade student responses rated “Complete” on question above in 2005, by state



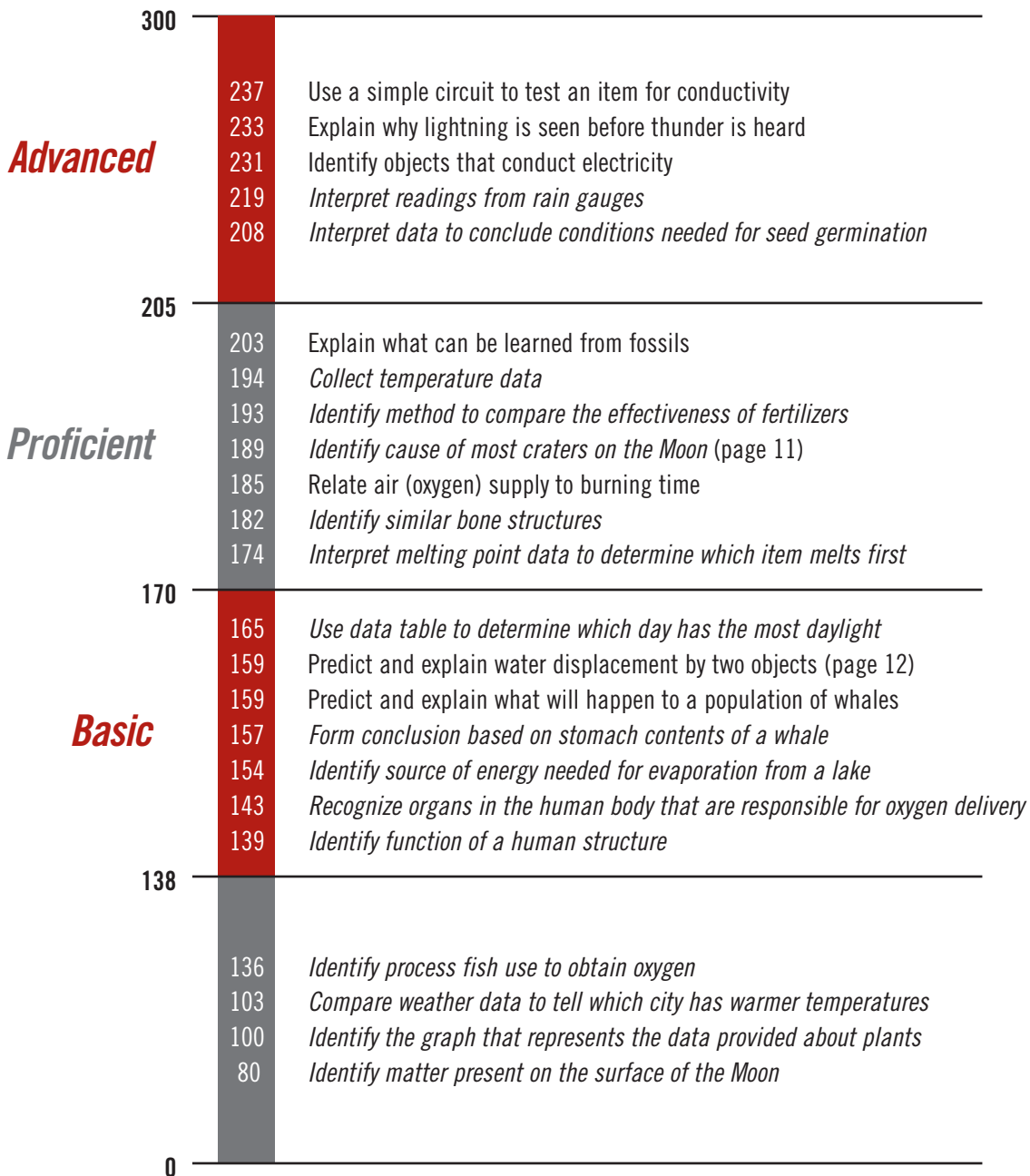
¹ Department of Defense Education Activity. SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

Range of Science Performance at Grade 4

The item map below provides another way to interpret the scale score and achievement-level results for fourth-graders. The left side of the item map shows the scores that define the lower boundaries of the *Basic*, *Proficient*, and *Advanced* achievement levels. The right side lists descriptions of some selected assessment questions that fall at various levels of difficulty on the 0–300 scale.

The map is a useful tool for understanding what it means to perform at different levels on the scale. For example, the map shows that students performing toward the lower end of the *Basic* achievement-level range were likely to be able to identify the organs that are responsible for oxygen delivery (143). Students performing at the *Proficient* level were likely to identify similar bone structures (182) and relate air supply to burning time (185).

Grade 4 Science Item Map



The position of a question on the scale represents the average scale score attained by students who had a 65 percent probability of successfully answering a constructed-response question, or a 74 percent probability of correctly answering a four-option multiple-choice question. Scale score ranges for science achievement levels are referenced on the map. For constructed-response questions, the question description represents students' performance rated as completely correct.

NOTE: Regular type denotes a constructed-response question. *Italic* type denotes a multiple-choice question.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

State Performance

In 2005, 44 states and the Department of Defense Education Activity (DoDEA) schools had representative samples of fourth-graders large enough for reporting state-level results. These data provide a common comparison point of their state's performance to other states and to the nation as a whole. Thirty-seven of the states and jurisdictions that participated in 2005 also participated in 2000, allowing comparisons over time.

When making comparisons, it is important to remember that performance results may be affected by differences in demographic makeup and exclusion rates for students with disabilities and English language learners, which may vary considerably across states as well as across years (see the Technical Notes on page 40 for more information).

STATE CHANGES AT GRADE 4

Since 2000, the nation's fourth-graders have increased their overall average scale score by 4 points, a statistically significant gain. A state-by-state analysis reveals that while most showed no significant change, one out of every four states that participated in both years increased its overall score from 2000 to 2005, and that no state performed lower over that time period.

Of the nine states that saw a significant increase in scores from 2000 to 2005, gains in three states—Kentucky, South Carolina, and Tennessee—were driven by increased scores for both Black and White students.

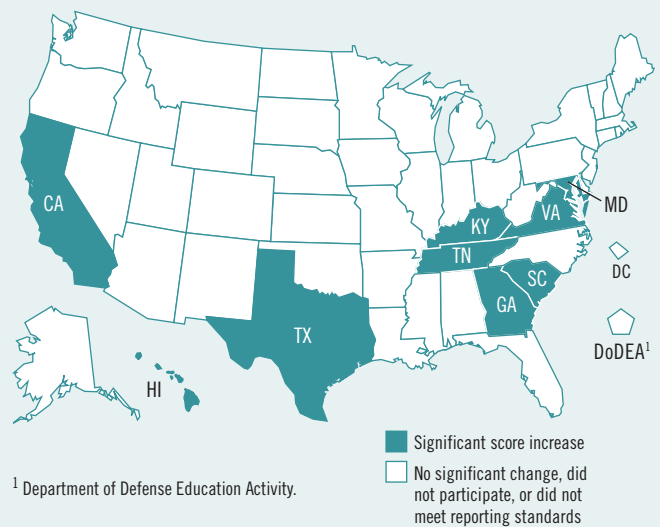


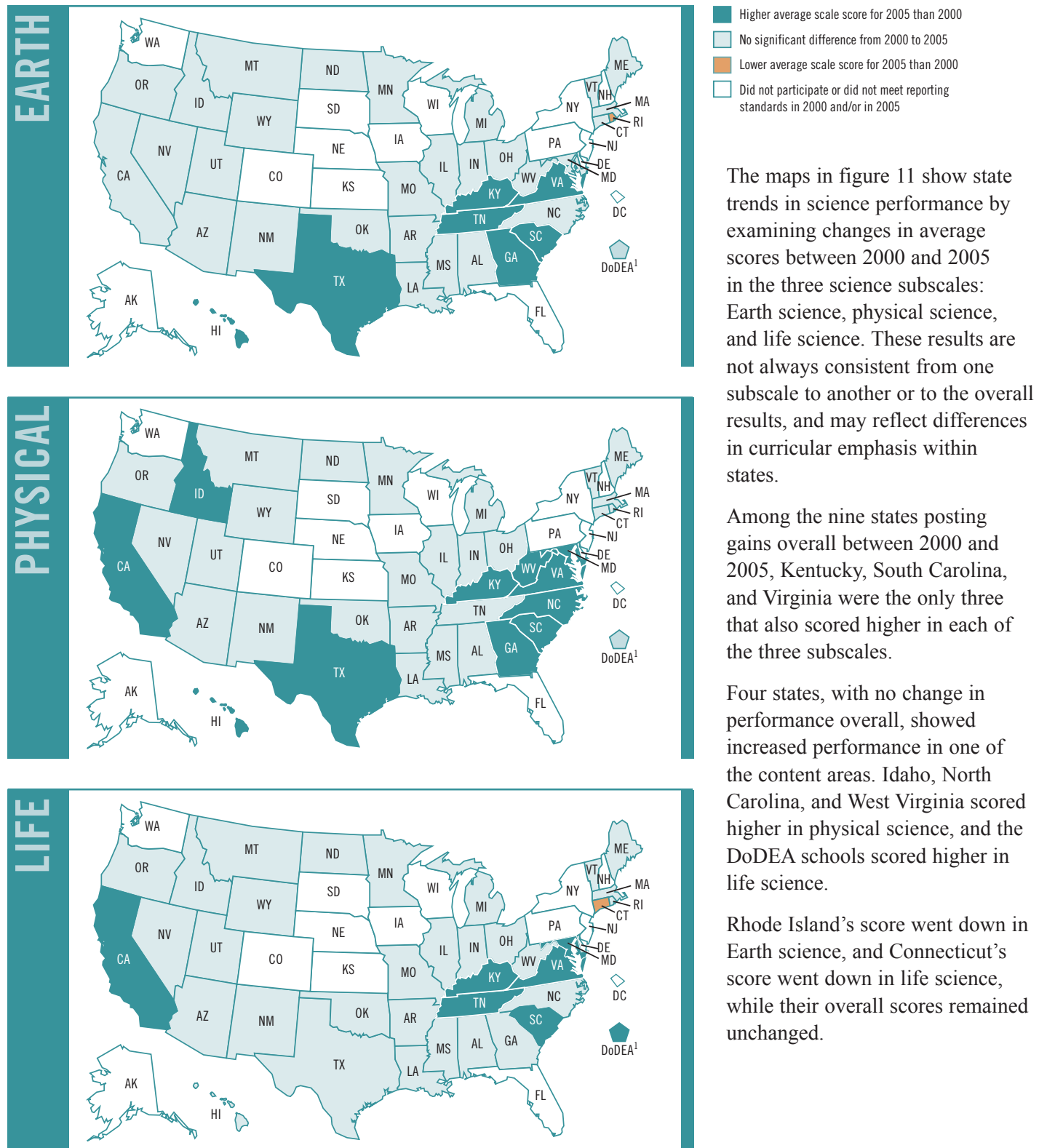
Figure 10 State changes in NAEP science performance from 2000 to 2005 at grade 4

Higher average scores	Higher percentage of students at or above <i>Basic</i>	Higher percentage of students at or above <i>Proficient</i>	Lower average score or percentages at or above <i>Basic</i> or <i>Proficient</i>
California Georgia Hawaii Kentucky Maryland South Carolina Tennessee Texas Virginia	Georgia Hawaii Kentucky South Carolina Tennessee Virginia	California Kentucky South Carolina Virginia	None

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 and 2005 Science Assessments.

Increases in a state's average score do not always translate into increases in the percentages of students performing at or above the *Basic* or *Proficient* levels. For example, a state's average score may increase even if most of the gains are observed in the lower end of the performance distribution. In this case, the percentage of students at or above *Basic* may increase, while the percentage at or above *Proficient* does not.

Figure 11 Changes in fourth-grade average NAEP science subscale scores between 2000 and 2005

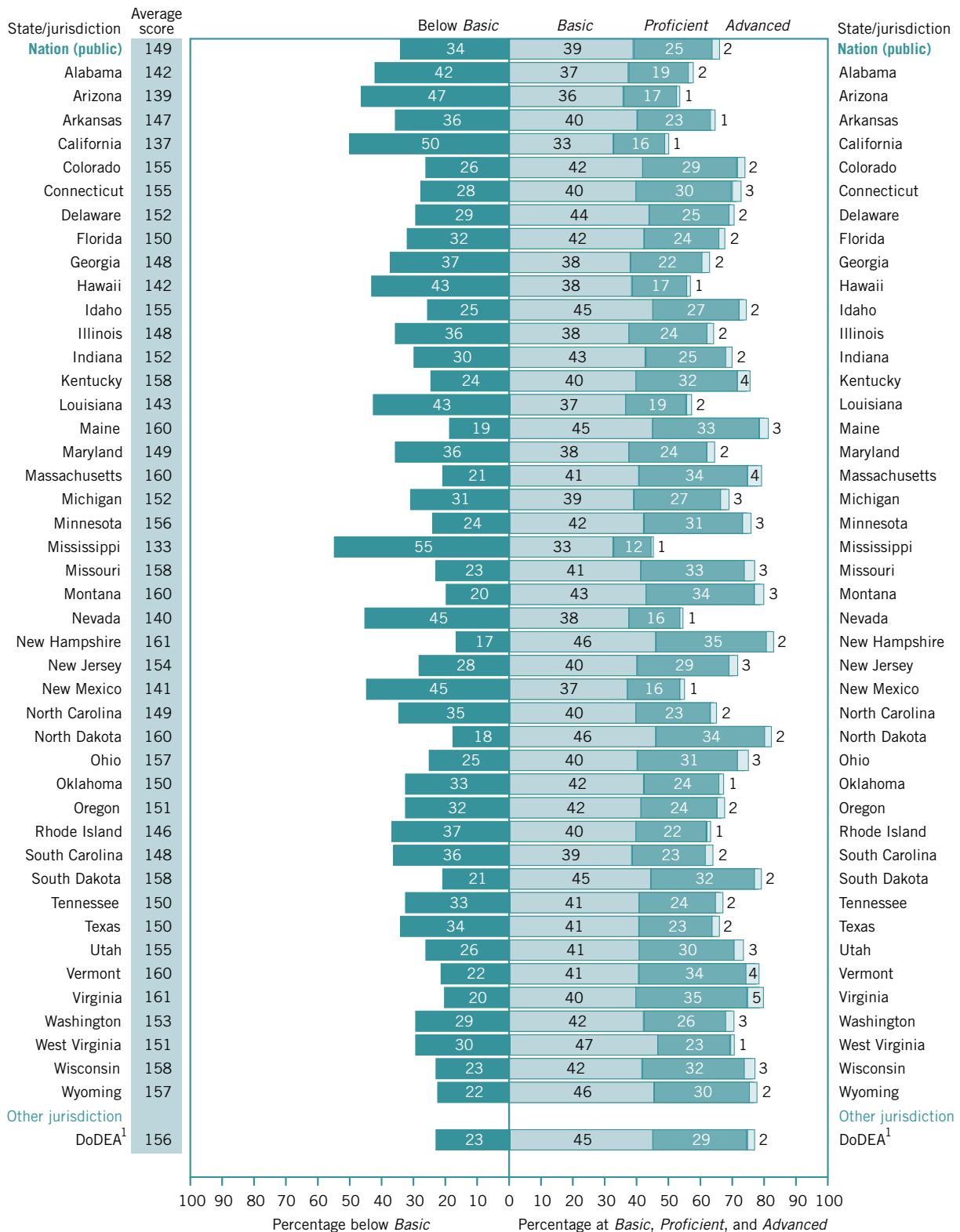


¹ Department of Defense Education Activity.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 and 2005 Science Assessments.

State Results

Figure 12 Average fourth-grade NAEP science scores and percentage of students in each achievement level in 2005, by state



¹ Department of Defense Education Activity.

NOTE: The shaded bars are graphed using unrounded numbers. Percentages may not add to 100 due to rounding.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

Table 4 Average fourth-grade NAEP science scores and achievement-level performance, by state

State/jurisdiction	Average scale score		Percentage of students					
			At or above <i>Basic</i>		At or above <i>Proficient</i>		At <i>Advanced</i>	
	2000	2005	2000	2005	2000	2005	2000	2005
Nation (public)	145*	149	61*	66	26	27	3	2
Alabama	143	142	58	58	22	21	2	2
Alaska	—	—	—	—	—	—	—	—
Arizona	140	139	55	53	22	18	2	1
Arkansas	145	147	62	64	23	24	2	1
California	129*	137	45	50	13*	17	1	1
Colorado	—	155	—	74	—	32	—	2
Connecticut	156	155	75	72	35	33	3	3
Delaware	—	152	—	71	—	27	—	2
Florida	—	150	—	68	—	26	—	2
Georgia	142*	148	57*	63	23	25	3	2
Hawaii	136*	142	51*	57	16	19	1	1
Idaho	152	155	74	75	29	29	2	2
Illinois	150	148	68	64	31	27	3	2
Indiana	154	152	74	70	32	27	3	2
Iowa	159	—	79	—	36	—	3	—
Kansas	—	—	—	—	—	—	—	—
Kentucky	152*	158	69*	76	28*	36	2*	4
Louisiana	139	143	54	57	18	20	2	2
Maine	161	160	82	81	37	36	4	3
Maryland	145*	149	61	64	24	27	3	2
Massachusetts	161	160	81	79	42	38	5	4
Michigan	152	152	70	69	32	30	3	3
Minnesota	157	156	78	76	34	33	3	3
Mississippi	133	133	46	45	13	12	1	1
Missouri	157	158	76	77	34	36	3	3
Montana	160	160	80	80	36	37	3	3
Nebraska	150	—	68	—	26	—	2	—
Nevada	142	140	58	55	19	17	1	1
New Hampshire	—	161	—	83	—	37	—	2
New Jersey	—	154	—	72	—	32	—	3
New Mexico	140	141	54	55	17	18	1	1
New York	148	—	66	—	24	—	2	—
North Carolina	147	149	63	65	23	25	2	2
North Dakota	160	160	81	82	36	36	3	2
Ohio	155	157	73	75	31	35	3	3
Oklahoma	151	150	70	67	26	25	2	1
Oregon	148	151	66	68	27	26	3	2
Pennsylvania	—	—	—	—	—	—	—	—
Rhode Island	148	146	65	63	25	23	2*	1
South Carolina	140*	148	54*	64	20*	25	2	2
South Dakota	—	158	—	79	—	35	—	2
Tennessee	145*	150	61*	67	24	26	2	2
Texas	145*	150	62	66	23	25	2	2
Utah	154	155	73	74	31	33	3	3
Vermont	160	160	79	78	38	38	4	4
Virginia	155*	161	72*	80	32*	40	3	5
Washington	—	153	—	71	—	28	—	3
West Virginia	149	151	68	70	24	24	2	1
Wisconsin	‡	158	‡	77	‡	35	‡	3
Wyoming	156	157	77	78	31	32	2	2
Other jurisdictions								
District of Columbia	—	—	—	—	—	—	—	—
DoDEA ¹	156	156	76	77	30	32	3	2

— Not available. The jurisdiction did not participate.

‡ Reporting standards not met.

* Significantly different from 2005 when only one jurisdiction or the nation is being examined.

¹ Department of Defense Education Activity. Before 2005, DoDEA overseas and domestic schools were separate jurisdictions in NAEP. For this table, 2000 data were recalculated for comparability.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 and 2005 Science Assessments.

8TH

G R A D E



Science scores unchanged overall, Black students show gains

While the overall average score for eighth-grade students in 2005 showed no significant difference compared to the results in 1996 and 2000, there were some changes in student group performance. Black students showed an increase of 3 score points since the 1996 assessment. This gain for Black students was the only score increase among all racial/ethnic groups at grade 8. Additionally, students who were eligible for the school lunch program showed a gain from 2000 to 2005.

However, significant score gaps still persisted between White and minority students, and between students eligible and not eligible for the school lunch program. Male students also continued to outperform female students in 2005.

Of the 37 states and jurisdictions that participated in both the 1996 and 2005 assessments, 9 increased in average scores, and 5 decreased.

Overall performance unchanged

Figure 13 shows that since 1996, overall science scores for eighth-graders have remained unchanged at 149.

As might be expected, the achievement-level results are similar to the score results. As shown in figure 14, there have been no significant changes in the percentages of students performing at or above the *Proficient* level and at or above the *Basic* level compared with either previous assessment year.

Figure 13 Trend in eighth-grade average NAEP science scores

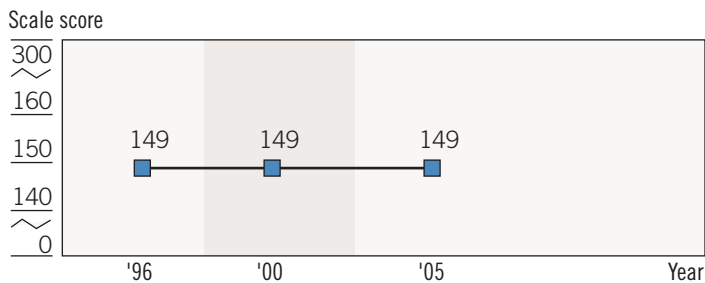
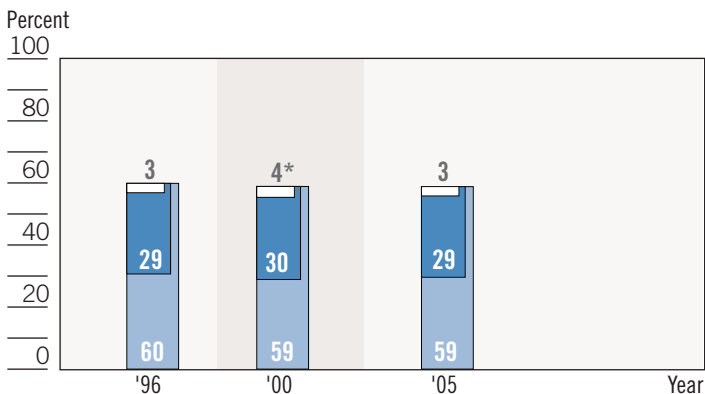


Figure 14 Trend in eighth-grade NAEP science achievement-level performance



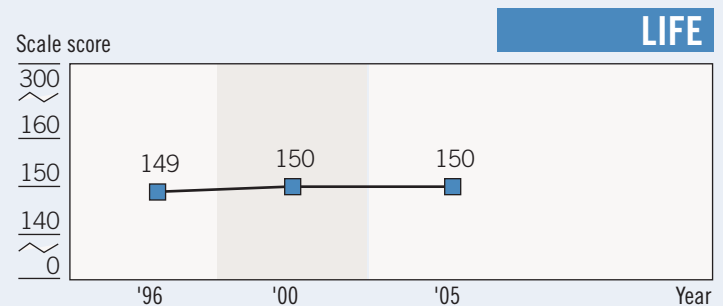
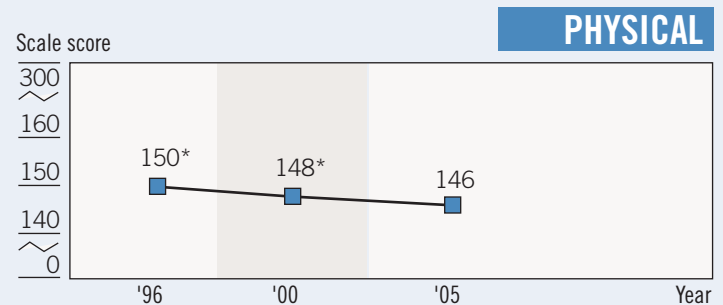
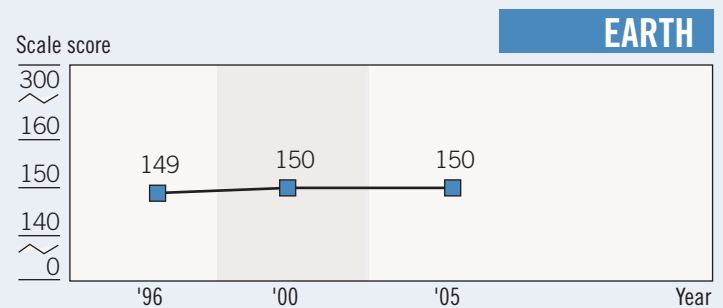
* Significantly different from 2005.

■ % at Advanced
■ % at or above Proficient
■ % at or above Basic

Changes detected in results by field of science

In addition to overall average scores, results are also available for each of the three fields of science. Figure 15 shows that, while the performance of eighth-graders overall was unchanged in 2005 compared to 1996 and 2000, the average score for physical science in 2005 was lower than in previous assessment years.

Figure 15 Trend in eighth-grade average NAEP science scores, by field of science



* Significantly different from 2005.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996, 2000, and 2005 Science Assessments.



Black students make gains

Figure 16 shows that Black students were the only racial/ethnic group to make significant gains, increasing from 121 in 1996 to 124 in 2005. Although not shown, the percentage of Black students performing at or above *Basic* also increased from 23 percent in 1996 to 28 percent in 2005.

Table 5 Percentage of eighth-grade students in the population, by race/ethnicity

	1996	2000	2005
White	68*	66*	61
Black	17	16	17
Hispanic	10*	13*	16
Asian/Pacific Islander	3	4	4
American Indian/Alaska Native	1	1	1

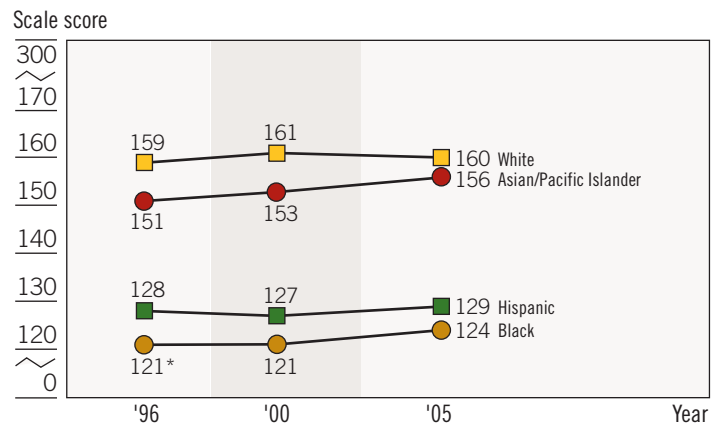
* Significantly different from 2005.

NOTE: Percentages for the unclassified race/ethnicity category are not included in the table. Race categories exclude Hispanic origin.

Gaps remain unchanged

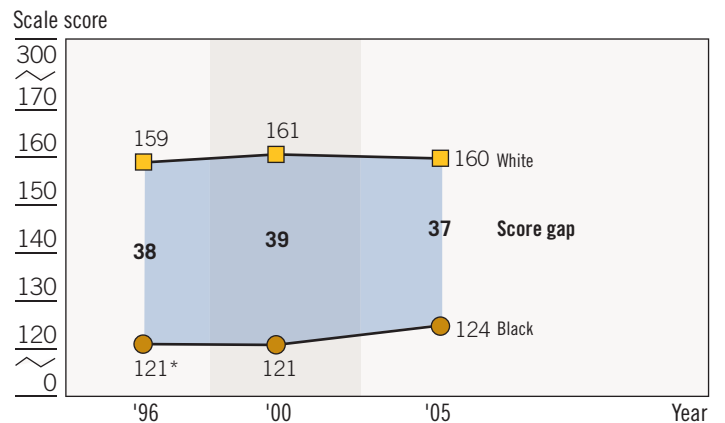
While Black students have shown improvement, score gaps between White and Black students still exist (see figure 17). The 37-point gap in 2005 was not significantly different from previous years. Similarly, the 32-point gap between White students and Hispanic students was not significantly different from 1996 and 2000 as shown in figure 18.

Figure 16 Trend in eighth-grade average NAEP science scores, by race/ethnicity



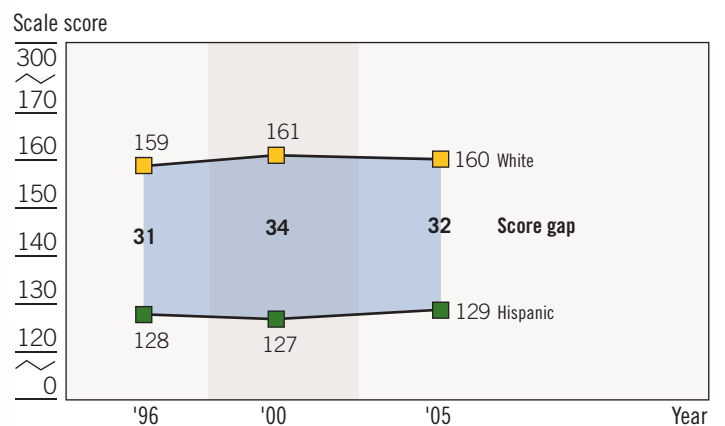
* Significantly different from 2005.

Figure 17 White – Black eighth-grade NAEP science score gap



* Significantly different from 2005.

Figure 18 White – Hispanic eighth-grade NAEP science score gap



NOTE: Score gaps are calculated based on differences between unrounded average scores. Race categories exclude Hispanic origin.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996, 2000, and 2005 Science Assessments.

Lower-income students make gains

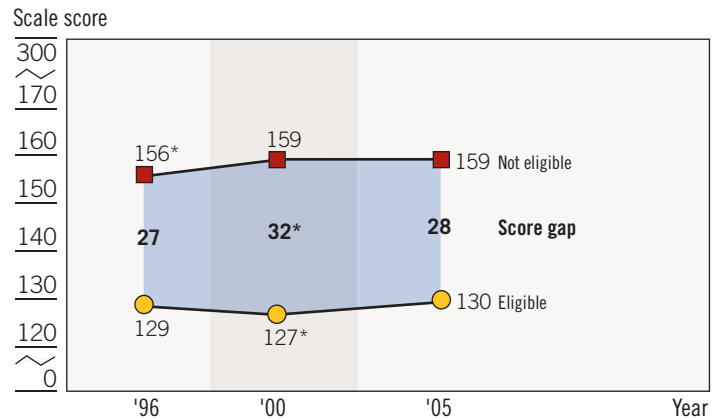
Figure 19 shows that students from low-income families, as indicated by students' eligibility for free or reduced-price school lunch, had a higher average score in 2005 compared with the score in 2000, resulting in a narrowing of the score gap between eligible and not eligible students. However, there was no significant change in the gap in 2005 when compared to the gap in 1996. Although not shown, the percentage of eligible students performing at or above *Basic* increased from 32 percent in 2000 to 37 percent in 2005.

Table 6 Percentage of eighth-grade students in the population, by eligibility for free/reduced-price school lunch

	1996	2000	2005
● Eligible	26*	27*	37
■ Not eligible	54	52	55
Information not available	20*	21*	8

* Significantly different from 2005.

Figure 19 Trend in eighth-grade average NAEP science scores, by eligibility for free/reduced-price school lunch



* Significantly different from 2005.

NOTE: Score gaps are calculated based on differences between unrounded average scores.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996, 2000, and 2005 Science Assessments.

Who is below *Basic*?

- 39% White; 29% Black; 25% Hispanic; 4% Asian/Pacific Islander; 2% American Indian/Alaska Native
- 56% eligible for free/reduced-price school lunch
- 20% report always speaking a language other than English in the home

Who is at or above *Proficient*?

- 83% White; 4% Black; 6% Hispanic; 5% Asian/Pacific Islander; 1% American Indian/Alaska Native
- 16% eligible for free/reduced-price school lunch
- 7% report always speaking a language other than English in the home

The percentages shown here provide a profile of two groups of students: those who scored below *Basic* and those who scored at or above *Proficient*. For example, the percentages presented here show that, of all the students who performed below the *Basic* level, 56 percent were eligible for free/reduced-price school lunch, while 16 percent of the students at or above *Proficient* were eligible.



Assessment Content at Grade 8

At grade 8, a larger proportion of the assessment focused on life science (40 percent). Thirty percent was devoted to Earth science and 30 percent to physical science. The framework specifies that 45 percent of assessment time should be devoted to conceptual understanding, 30 percent to scientific investigation, and 25 percent to practical reasoning.

Eighth-graders were presented with two 25-minute sections, each containing 10 to 19 multiple-choice and

constructed-response questions. An example of one of the hands-on tasks administered in 1996 asked students to estimate the unknown concentration of salt in a solution after plotting the data obtained by observing the levels at which a pencil floats in distilled water and in the same amount of a 25 percent salt solution. (Examples of hands-on tasks from the 2005 assessment have not yet been released.) One-half of the eighth-graders assessed spent an additional 30 minutes on the hands-on activity.

Science Achievement Levels at Grade 8

The science achievement levels at grade 8 represent what eighth-graders know and can do in science at each level. Excerpts of the achievement-level descriptions for science at grade 8 along with the corresponding cut score for each are provided below. For complete information about achievement levels, visit http://www.nagb.org/pubs/s_framework_05/761907-ScienceFramework.pdf.

Basic (143): Students performing at the *Basic* level demonstrate some of the knowledge and reasoning required for understanding the Earth, physical, and life sciences at a level appropriate to grade 8. For example, they can carry out investigations and obtain information from graphs, diagrams, and tables. In addition, they demonstrate some understanding of concepts relating to the solar system and relative motion. Students at this level also have a beginning understanding of cause-and-effect relationships.

Proficient (170): Students performing at the *Proficient* level demonstrate much of the knowledge and many of the reasoning abilities essential for understanding the Earth, physical, and life sciences at a level appropriate to grade 8. For example, students can interpret graphic information, design simple investigations, and explain such scientific concepts as energy transfer. Students at this level also show an awareness of environmental issues, especially those addressing energy and pollution.

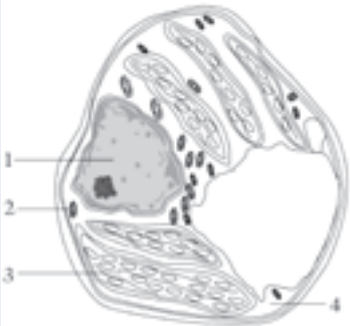
Advanced (208): Students performing at the *Advanced* level demonstrate a solid understanding of the Earth, physical, and life sciences as well as the abilities required to apply their understanding in practical situations at a level appropriate to grade 8. For example, students can perform and critique the design of investigations, relate scientific concepts to each other, explain their reasoning, and discuss the impact of human activities on the environment.

Sample Grade 8 Multiple-Choice Question

The following multiple-choice question from the eighth-grade science assessment required conceptual understanding in the field of life science.

National percentage correct in 2005

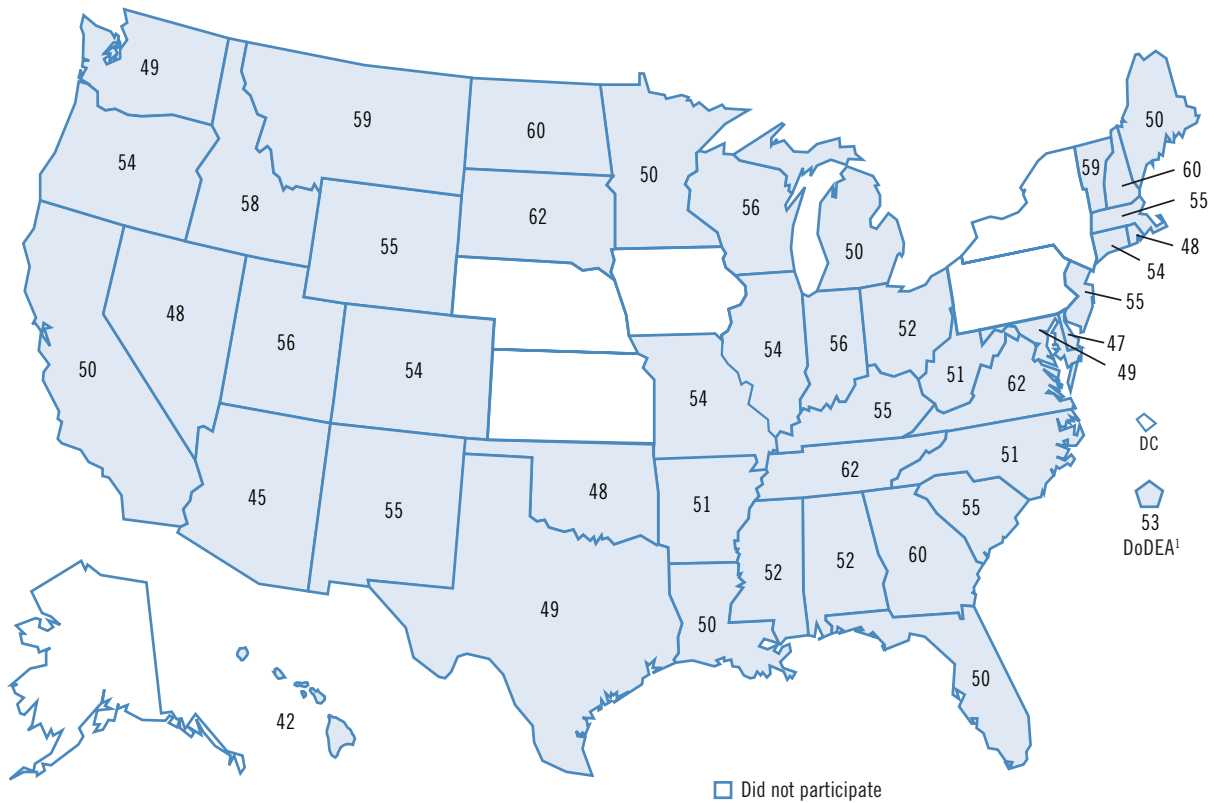
Overall	Below <i>Basic</i>	At <i>Basic</i>	At <i>Proficient</i>	At <i>Advanced</i>
53	40	54	67	83



In the picture of a cell, which label indicates the part of the cell that contains most of the cell's genetic material?

- 1
- 2
- 3
- 4

Percentage of correct eighth-grade student responses on question above in 2005, by state



¹ Department of Defense Education Activity.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

Sample Grade 8 Short Constructed-Response Question

The following constructed-response question was categorized as scientific investigation in physical science. Responses were rated using a three-level scoring guide. Responses that showed an understanding of how to distinguish fresh water from salt water by describing both a method for determining the difference and a result were rated “Complete.” Responses that showed some understanding of the difference between fresh and salt water, but provided no practical method

for distinguishing them or gave a correct method but no result, were rated “Partial.” Responses that showed no understanding of how to distinguish between fresh and salt water were rated “Incorrect.” The sample student response below was “Complete.”

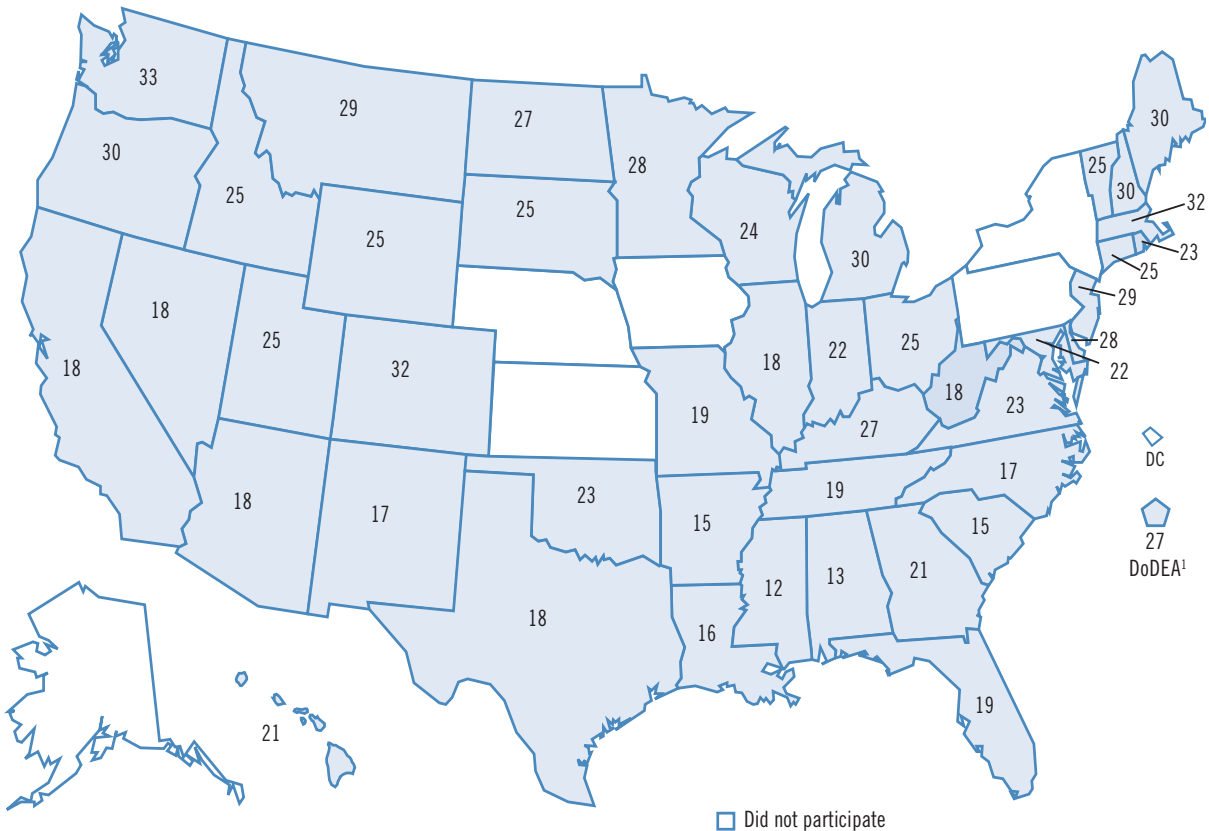
National percentage “Complete” in 2005

Overall	Below <i>Basic</i>	At <i>Basic</i>	At <i>Proficient</i>	At <i>Advanced</i>
23	8	22	42	69

Maria has one glass of pure water and one glass of salt water, which look exactly alike. Explain what Maria could do, without tasting the water, to find out which glass contains the salt water.

One thing she could do is evaporate
each glass of water. The glass with
salt water in it should have salt left
in it when the water has evaporated.

Percentage of eighth-grade student responses rated “Complete” on question above in 2005, by state



¹ Department of Defense Education Activity.

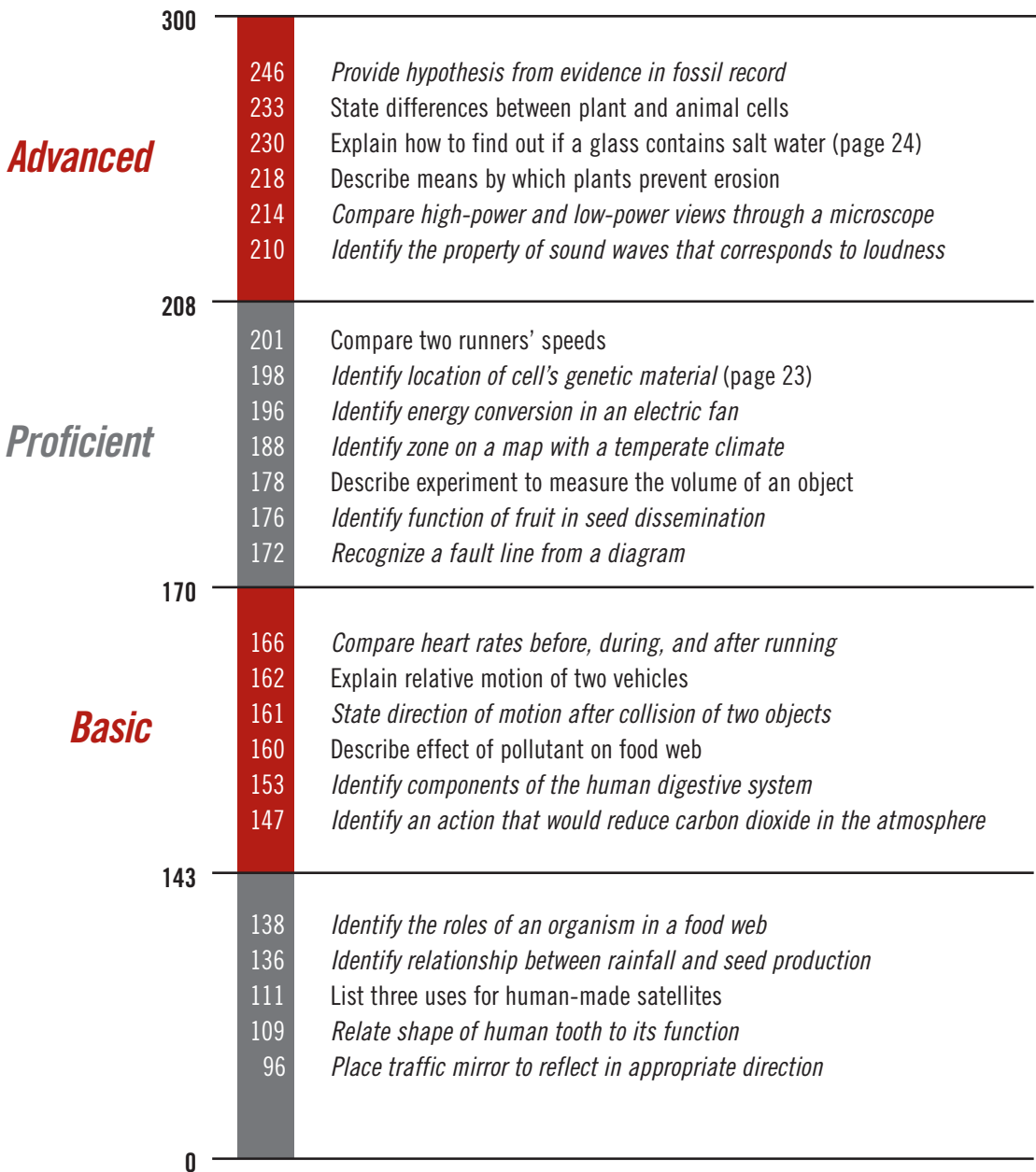
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

Range of Science Performance at Grade 8

The item map below provides another way to interpret the scale score and achievement-level results for eighth-graders. The left side shows the scores that define the lower boundaries of the *Basic*, *Proficient*, and *Advanced* achievement levels. The right side lists descriptions of some selected assessment questions that fall at various levels of difficulty on the 0–300 scale.

For example, the map shows that eighth-graders performing at the *Basic* level, especially in the upper range of this level, were likely to be able to compare heart rates before, during, and after running (166). Students performing at the *Proficient* level were likely to know the function of fruit in seed dissemination (176).

Grade 8 Science Item Map



The position of a question on the scale represents the average scale score attained by students who had a 65 percent probability of successfully answering a constructed-response question, or a 74 percent probability of correctly answering a four-option multiple-choice question. Scale score ranges for science achievement levels are referenced on the map. For constructed-response questions, the question description represents students' performance rated as completely correct.

NOTE: Regular type denotes a constructed-response question. *Italic* type denotes a multiple-choice question.
 SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

State Performance

In 2005, a total of 45 states and jurisdictions (including Department of Defense Education Activity [DoDEA] schools) had representative samples of eighth-graders for reporting state-level results. These data provide a common comparison point of their state's performance to other states and the nation as a whole.

STATE CHANGES AT GRADE 8

The map to the right reflects changes in average scores from 2000 to 2005. Scores increased in 11 states and jurisdictions, and decreased in 4 states. Of the 11 states and jurisdictions with increases, 1 showed higher scores for both White and Black students, and 2 showed increases for both White and Hispanic students.

While there was no significant change in the national average science score at grade 8 from 1996 to 2005, nine states and jurisdictions showed increases over the same period, and five states showed decreases (table 7). Although not shown here, four of the nine states and jurisdictions with increases also showed higher scores for both White and Black students, and one showed higher scores for both White and Hispanic students.

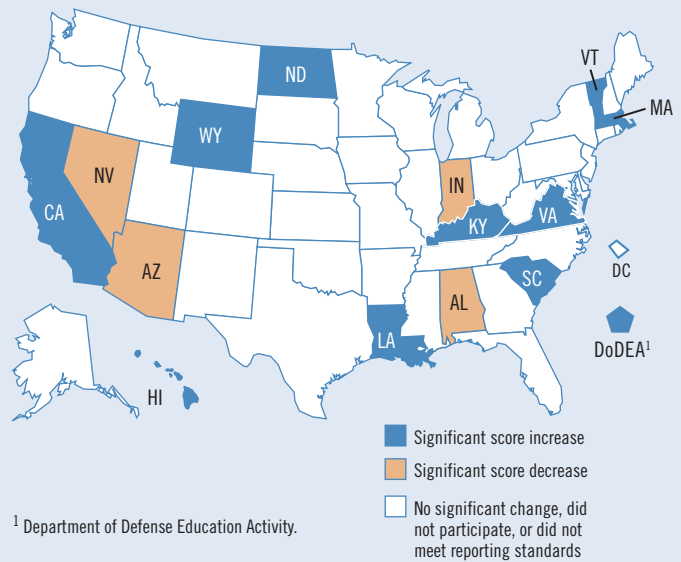
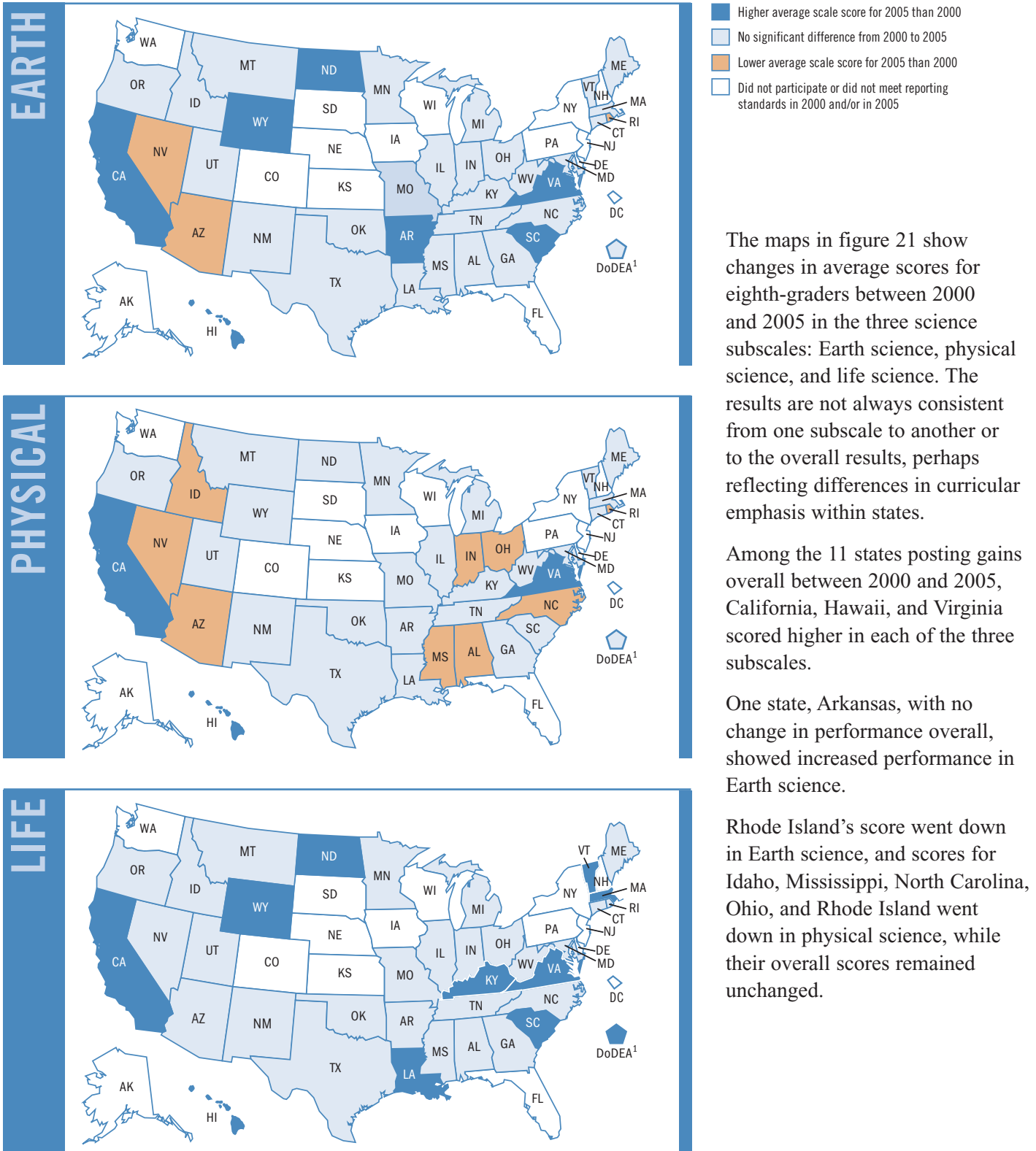


Figure 20 State changes in NAEP science performance from 2000 to 2005 at grade 8

Higher average scores	Lower average scores	Higher percentage of students at or above <i>Basic</i>	Lower percentage of students at or above <i>Basic</i>	Higher percentage of students at or above <i>Proficient</i>	Lower percentage of students at or above <i>Proficient</i>
California Hawaii Kentucky Louisiana Massachusetts North Dakota South Carolina Vermont Virginia Wyoming DoDEA	Alabama Arizona Indiana Nevada	California North Dakota South Carolina Vermont Virginia Wyoming DoDEA	Arizona	California North Dakota Virginia Wyoming	None

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 and 2005 Science Assessments.

Figure 21 Changes in eighth-grade average NAEP science subscale scores between 2000 and 2005



The maps in figure 21 show changes in average scores for eighth-graders between 2000 and 2005 in the three science subscales: Earth science, physical science, and life science. The results are not always consistent from one subscale to another or to the overall results, perhaps reflecting differences in curricular emphasis within states.

Among the 11 states posting gains overall between 2000 and 2005, California, Hawaii, and Virginia scored higher in each of the three subscales.

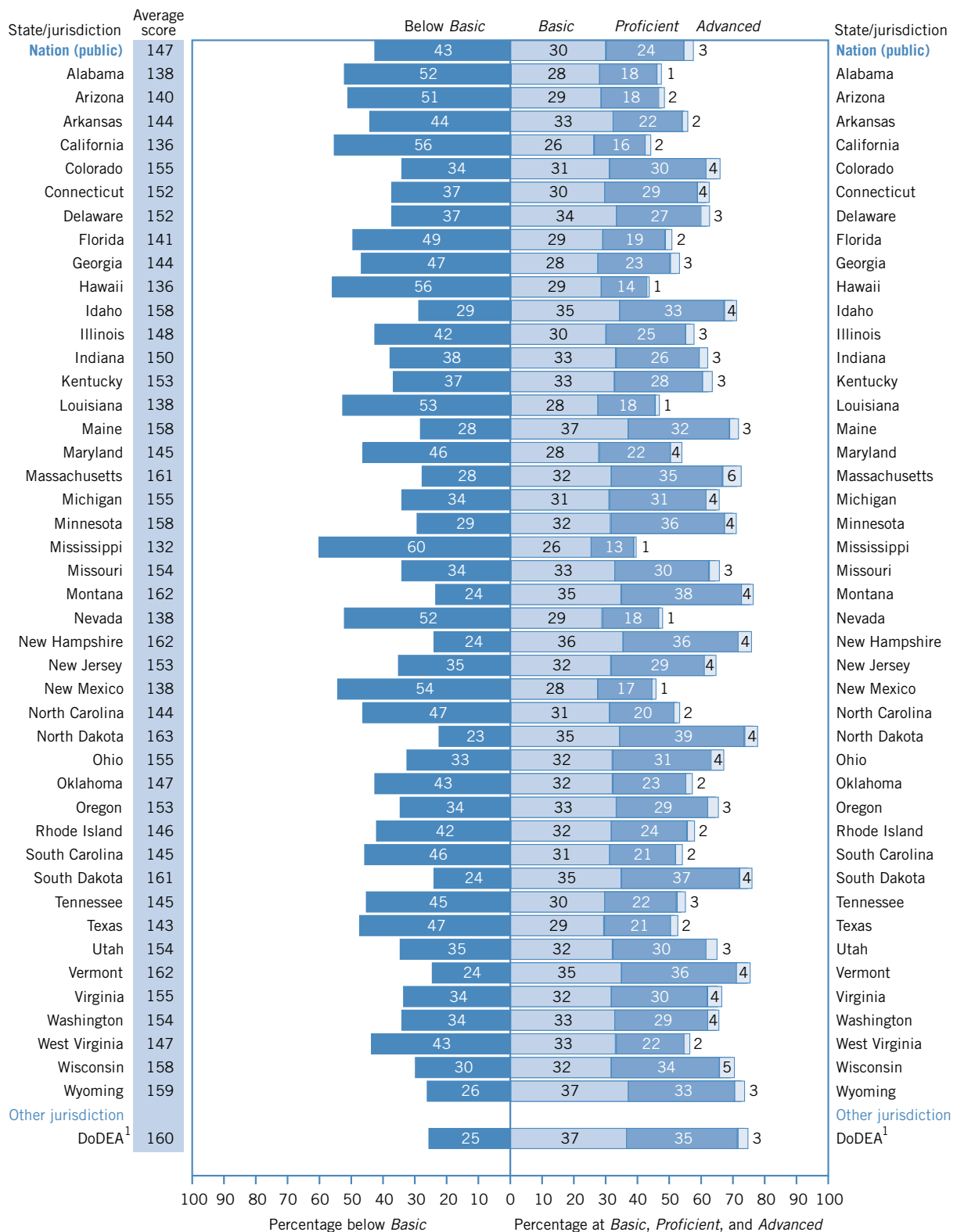
One state, Arkansas, with no change in performance overall, showed increased performance in Earth science.

Rhode Island's score went down in Earth science, and scores for Idaho, Mississippi, North Carolina, Ohio, and Rhode Island went down in physical science, while their overall scores remained unchanged.

¹ Department of Defense Education Activity.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 and 2005 Science Assessments.

State Results

Figure 22 Average eighth-grade NAEP science scores and percentage of students in each achievement level in 2005, by state



¹ Department of Defense Education Activity.

NOTE: The shaded bars are graphed using unrounded numbers. Percentages may not add to 100 due to rounding.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

Table 7 Average eighth-grade NAEP science scores and achievement-level performance, by state

State/jurisdiction	Average scale score			Percentage of students								
				At or above <i>Basic</i>			At or above <i>Proficient</i>			At <i>Advanced</i>		
	1996 ¹	2000	2005	1996 ¹	2000	2005	1996 ¹	2000	2005	1996 ¹	2000	2005
Nation (public)	148	148	147	60	57	57	27	29	27	3	4*	3
Alabama	139	143*	138	47	53	48	18	23	19	1	2	1
Alaska	153	—	—	65	—	—	31	—	—	3	—	—
Arizona	145*	145*	140	55*	55*	49	23	23	20	2	2	2
Arkansas	144	142	144	55	53	56	22	22	23	1	1	2
California	138	129*	136	47	38*	44	20	14*	18	1	1	2
Colorado	155	—	155	68	—	66	32	—	35	2*	—	4
Connecticut	155	153	152	68*	64	63	36	35	33	3	4	4
Delaware	142*	—	152	51*	—	63	21*	—	29	1*	—	3
Florida	142	—	141	51	—	51	21	—	21	1	—	2
Georgia	142	142	144	49	52	53	21*	23	25	1*	2	3
Hawaii	135	130*	136	42	40	44	15	14	15	1	1	1
Idaho	—	158	158	—	71	71	—	37	36	—	4	4
Illinois	—	148	148	—	59	58	—	29	27	—	3	3
Indiana	153	154*	150	65	66	62	30	33	29	2	3	3
Iowa	158	—	—	71	—	—	36	—	—	3	—	—
Kansas	—	—	—	—	—	—	—	—	—	—	—	—
Kentucky	147*	150*	153	58*	60	63	23*	28	31	2	3	3
Louisiana	132*	134*	138	40*	44	47	13*	18	19	1*	1	1
Maine	163*	158	158	78*	72	72	41*	35	34	4	3	3
Maryland	145	146	145	55	57	54	25	27	26	2*	3	4
Massachusetts	157*	158*	161	69	70	72	37	39	41	4*	5	6
Michigan	153	155	155	65	68	66	32	35	35	3	4	4
Minnesota	159	159	158	72	72	71	37	41	39	3	4	4
Mississippi	133	134	132	39	41	40	12	15	14	1	1	1
Missouri	151	154	154	64	66	66	28*	33	33	2	3	3
Montana	162	164	162	77	79	76	41	44	42	3	5	4
Nebraska	157	158	—	71	71	—	35	38	—	3	4	—
Nevada	‡	141*	138	‡	52	48	‡	22	19	‡	2	1
New Hampshire	‡	—	162	‡	—	76	‡	—	41	‡	—	4
New Jersey	‡	—	153	‡	—	65	‡	—	33	‡	—	4
New Mexico	141*	139	138	49	48	46	19	20	18	1	1	1
New York	146	145	—	57	58	—	27	28	—	2	2	—
North Carolina	147	145	144	56	54	53	24	25	22	2	3	2
North Dakota	162	159*	163	78	72*	77	41	38*	43	3	4	4
Ohio	—	159	155	—	72	67	—	39	35	—	5	4
Oklahoma	—	149	147	—	60	57	—	25	25	—	2	2
Oregon	155	154	153	68	68	66	32	34	32	3	3	3
Pennsylvania	—	—	—	—	—	—	—	—	—	—	—	—
Rhode Island	149*	148	146	59	58	58	26	27	26	2	2	2
South Carolina	139*	140*	145	45*	48*	54	17*	20	23	1	2	2
South Dakota	—	—	161	—	—	76	—	—	41	—	—	4
Tennessee	143	145	145	53	55	55	22	24	25	2	2	3
Texas	145	143	143	55	52	53	23	23	23	1	2	2
Utah	156*	154	154	70*	67	65	32	34	33	2*	3	3
Vermont	157*	159*	162	70*	71*	76	34*	39	41	3*	4	4
Virginia	149*	151*	155	59*	61*	66	27*	29*	35	2*	3	4
Washington	150*	—	154	61*	—	66	27*	—	33	2*	—	4
West Virginia	147	146	147	56	57	57	21	24	23	1*	2	2
Wisconsin	160	‡	158	73	‡	70	39	‡	39	4	‡	5
Wyoming	158	156*	159	71	69*	74	34	34*	37	2	3	3
Other jurisdictions												
District of Columbia	113	—	—	19	—	—	5	—	—	#	—	—
DoDEA ²	155*	158*	160	67*	71*	75	30*	36	38	2	4	3

— Not available. The jurisdiction did not participate.

The estimate rounds to zero.

‡ Reporting standards not met.

* Significantly different from 2005 when only one jurisdiction or the nation is being examined.

¹ Accommodations were not permitted for this assessment.

² Department of Defense Education Activity. Before 2005, DoDEA overseas and domestic schools were separate jurisdictions in NAEP. For this table, 1996 and 2000 data were recalculated for comparability.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996, 2000, and 2005 Science Assessments.

12TH

G R A D E



Overall performance in science declines since 1996

Performance of the nation's twelfth-graders in 2005 was unchanged from 2000; however, it was lower than that in 1996. This was true for both overall scores and scores for Earth, physical, and life sciences.

Compared with both 1996 and 2000, scores in 2005 for White, Black, and Hispanic students showed no significant change. Both male and female students scored lower in 2005 than in 1996, with male students outperforming females in both years. The score gap between White and minority students and between male and female students did not narrow between 1996 and 2005.

Twelfth-graders who took biology, chemistry, and physics scored higher than their peers who took fewer of these courses, and the percentages of White and Asian/Pacific Islander students taking all three courses were higher than those of Black and Hispanic students.

Performance down from 1996

Score trends at grade 12 are shown in figure 23. In 2005, the average science score for twelfth-graders was 3 points lower than in 1996, but statistically unchanged from 2000.

As shown in figure 24, achievement-level results mirrored the score results with a smaller percentage of students performing either at or above *Proficient* or *Basic* in 2005 than in 1996.

Figure 23 Trend in twelfth-grade average NAEP science scores

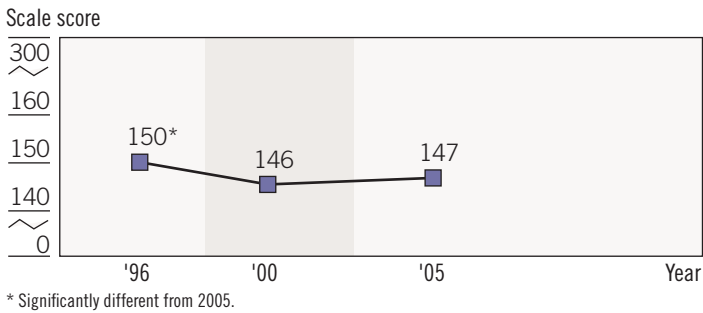
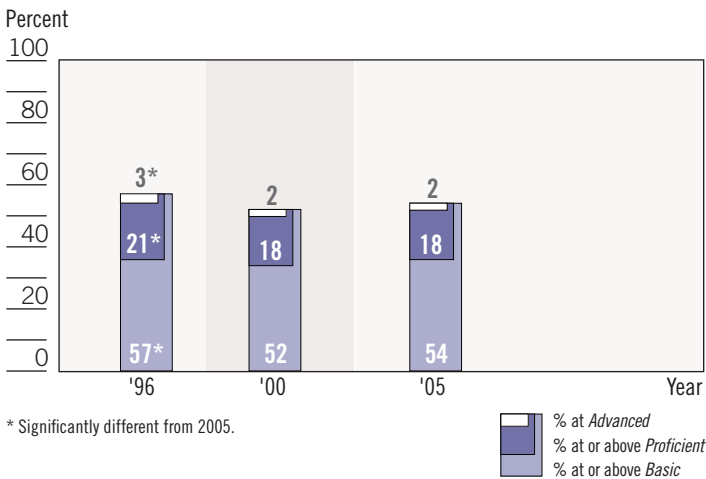


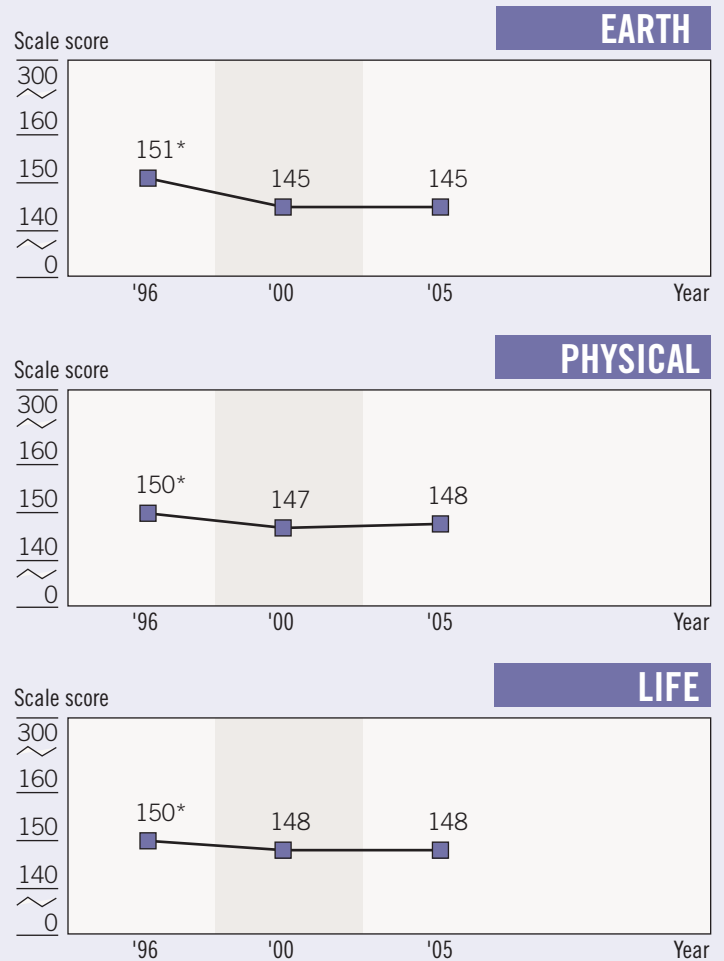
Figure 24 Trend in twelfth-grade NAEP science achievement-level performance



Declines seen in all fields of science

The score trends for Earth, physical, and life sciences are presented in figure 25. In all three cases, scores in 2005 were lower than those in 1996, but not significantly different from those in 2000. There was a 6-point score decline from 1996 to 2005 in Earth science and 2-point declines in physical and life science.

Figure 25 Trend in twelfth-grade average NAEP science scores, by field of science



SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996, 2000, and 2005 Science Assessments.

No narrowing of gaps between White and minority students

Average scores for each of the racial/ethnic groups have not changed significantly over the period of the three assessments as shown in figure 26.

Significant gaps persist between White students and their Black and Hispanic peers as shown in figures 27 and 28. At 36 points, the White – Black student score gap in 2005 was about the same as it was in 1996, and has widened since 2000. The White – Hispanic student score gap of 28 points was not significantly different from either previous assessment.

Table 8 Percentage of twelfth-grade students in the population, by race/ethnicity

	1996	2000	2005
White	72*	73*	66
Black	14	13	14
Hispanic	9*	9*	13
Asian/Pacific Islander	4*	4	5
American Indian/Alaska Native	1	1	1

* Significantly different from 2005.

NOTE: Percentages for the unclassified race/ethnicity category are not included in the table. Race categories exclude Hispanic origin.

Figure 26 Trend in twelfth-grade average NAEP science scores, by race/ethnicity

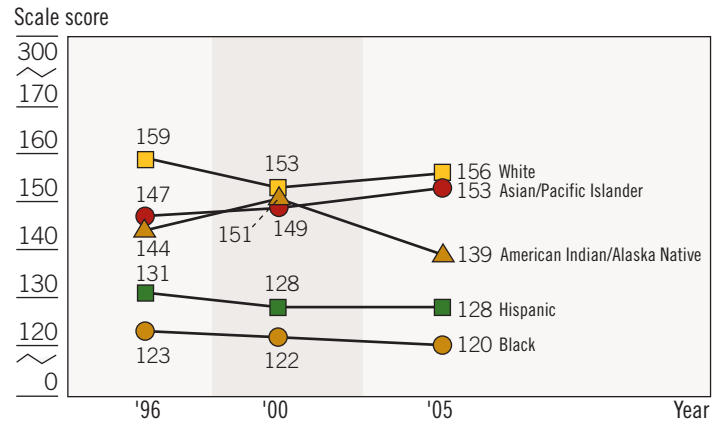
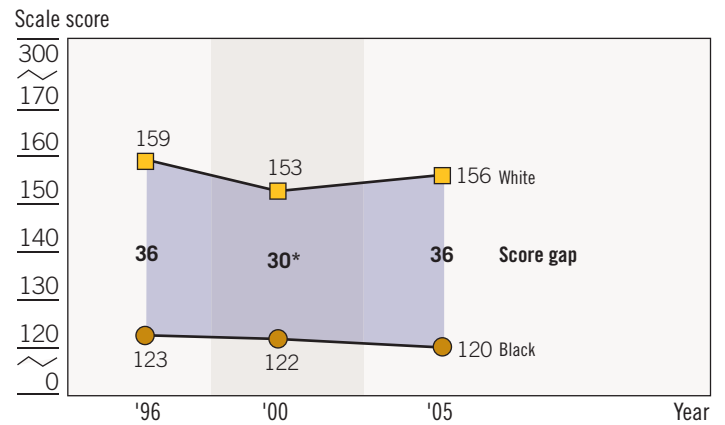
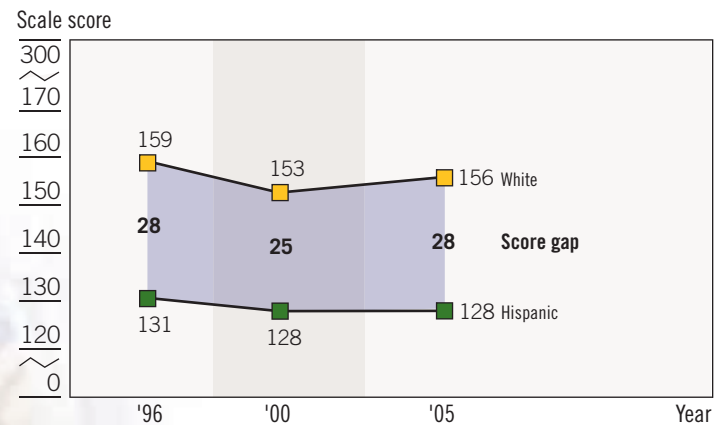


Figure 27 White – Black twelfth-grade NAEP science score gap



* Significantly different from 2005.

Figure 28 White – Hispanic twelfth-grade NAEP science score gap

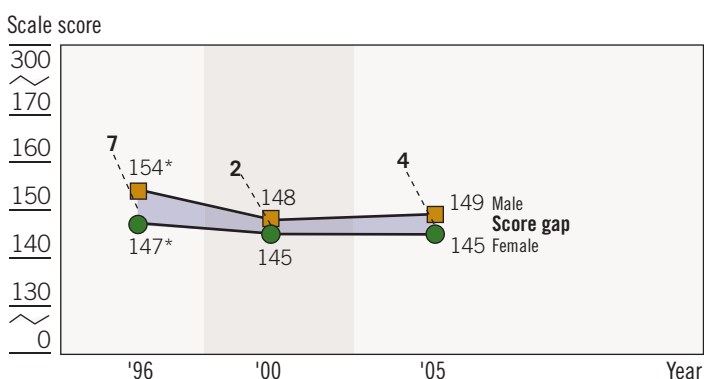


NOTE: Score gaps are calculated based on differences between unrounded average scores. Race categories exclude Hispanic origin.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996, 2000, and 2005 Science Assessments.

Male students outperform female students

Trends in performance of male and female students are shown in figure 29. Mirroring the overall results, scores for both groups in 2005 declined when compared with 1996. In all three assessments, the scores for male students were numerically higher than those of female students, but the differences were significant only in 1996 and 2005. The apparent change in score gap between 1996 and 2005 was not significant.

Figure 29 Trend in twelfth-grade average NAEP science scores, by gender



* Significantly different from 2005.

NOTE: Score gaps are calculated based on differences between unrounded average scores.

Although not shown here, achievement-level results have held steady for female students; however, the percentages of male students at or above *Proficient* and *Basic* were lower in 2005 than in 1996. The percentage of male students at or above *Proficient* decreased from 26 to 21 percent, and the percentage at or above *Basic* decreased from 60 to 56 percent.

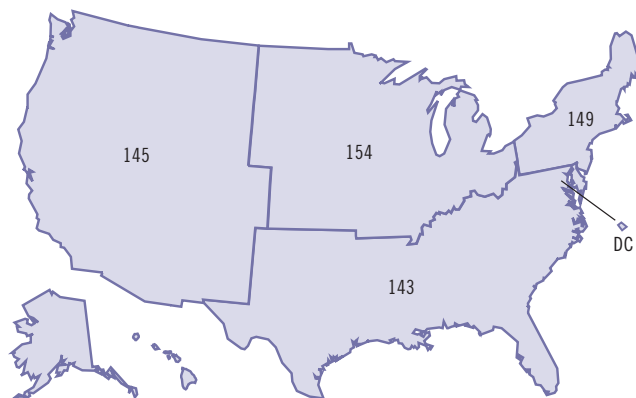
Who is below *Basic*?

- 50% White; 24% Black; 20% Hispanic; 4% Asian/Pacific Islander; 1% American Indian/Alaska Native
- 35% reported at least one parent graduated from college
- 18% have taken at least one Advanced Placement science course

Students in Midwest lead the nation

While no individual state results are available at grade 12, regional differences in average scale scores are shown in figure 30. NAEP currently reports performance for the four U.S. Census regions: Northeast, South, Midwest, and West. In earlier assessments, results were reported by different NAEP-defined regions; therefore, performance by Census region is shown only for 2005 (for more information see <http://nces.ed.gov/nationsreportcard/science/interpret-results.asp>). Twelfth-graders in the Midwest scored higher than their peers in the Northeast, and both groups scored higher than twelfth-graders in either the South or the West.

Figure 30 Average twelfth-grade NAEP science scores in 2005, by region



NOTE: Results by region do not include Department of Defense Education Activity.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

In the Northeast, the apparent difference between male and female students was not statistically significant. In all other regions, male students outperformed female students.

The percentages shown below provide a profile of two groups of students: those who scored below *Basic* and those who scored at or above *Proficient*. For example, the percentages presented here show that, of all the students who performed below the *Basic* level, 18 percent reported taking at least one Advanced Placement (AP) science course, while 40 percent of the students at or above *Proficient* took at least one AP course.

Who is at or above *Proficient*?

- 86% White; 2% Black; 4% Hispanic; 6% Asian/Pacific Islander; 1% American Indian/Alaska Native
- 68% reported at least one parent graduated from college
- 40% have taken at least one Advanced Placement science course

Coursetaking Patterns at Grade 12

A rigorous high school curriculum provides students with more options for postsecondary education, training, and employment. For that reason, many states have increased the number of courses required for high school graduation, especially in mathematics and science, as a part of their educational reform efforts.

GRADE 12 COURSETAKING

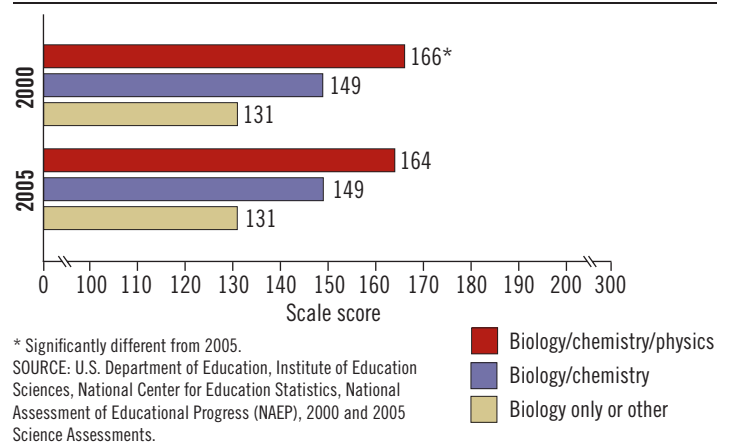
The 2005 science results show that twelfth-graders who took biology, chemistry, and physics scored higher than students who took biology and chemistry, and both groups scored higher than those who took just biology or other science courses. These results are presented in figure 31.

About one-third of students were in each category. These results are shown in the “All students” column of figure 32. Although not shown here separately, included in the 30 percent of students in the highest coursetaking level were 10 percent who took a second year of study in one or more of the three core science content areas. Among the 33 percent of students in the lowest coursetaking level, only 10 percent did not take first-year biology.

A higher percentage of twelfth-graders reported taking both biology and chemistry in 2005 than in 2000, and fewer reported taking just biology or other science courses.

Recall that science performance for twelfth-graders overall was not significantly different between 2000 and 2005; the same was true for students who took only biology or other science courses, and for students who took biology plus chemistry. However, scores declined for students who took the most science classes—biology, chemistry, and physics.

Figure 31 Average twelfth-grade NAEP science scores, by coursetaking



A higher percentage of twelfth-graders reported taking both biology and chemistry in 2005 than in 2000.

COURSETAKING BY STUDENT GROUPS

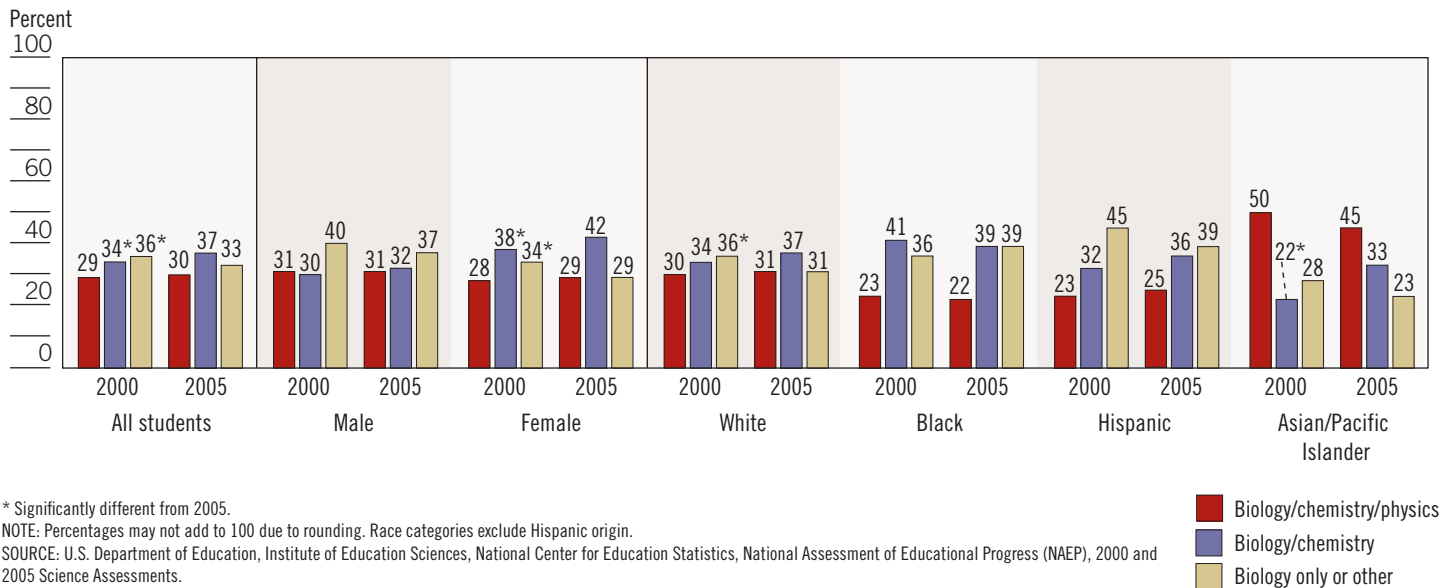
The overall relationship between coursetaking and performance was mirrored in the results by gender and race/ethnicity. Within each coursetaking level, the performance of student groups followed the same pattern as for all twelfth-graders. Male students outperformed female students. White and Asian/Pacific Islander students scored higher than Hispanic students, and Hispanic students scored higher than Black students. Asian/Pacific Islander students in the highest coursetaking level did not score differently from White students in the same curriculum, while White students scored higher than Asian/Pacific Islander students in the lower coursetaking levels. Few changes in coursetaking and science achievement were noted for specific student groups between 2000 and 2005.

Differences in the distribution of student groups across coursetaking levels are shown in figure 32. In 2005, the percentage of Asian/Pacific Islander students taking

biology, chemistry, and physics (45 percent) was greater than the percentage of White students taking the same curriculum (31 percent), which in turn was greater than the percentages of Black and Hispanic students taking all three courses (22 percent and 25 percent, respectively). The opposite pattern was seen for the distribution of students taking just biology or other science courses—the proportion of Black and Hispanic students in this curriculum level was higher than the proportion of White students, which in turn was higher than the proportion of Asian/Pacific Islander students.

The overall relationship between coursetaking and performance was mirrored in the results by gender and race/ethnicity.

Figure 32 Percentage of twelfth-grade students in science coursetaking categories, by gender and race/ethnicity



Assessment Content at Grade 12

At grade 12, the distribution of questions across the three fields of science was similar to grade 4 (i.e., one-third of assessment time was devoted to each of the three fields of science), but slightly different from grade 8, reflecting similarities and differences in curricular emphasis at the three grades. The framework specifies that 45 percent of the assessment time at grade 12 should be devoted to conceptual understanding, 30 percent to scientific investigation, and 25 percent to practical reasoning.

Twelfth-graders were presented with two 25-minute sections, each containing 8 to 20 multiple-choice and

constructed-response questions. One-half of the students assessed were given an additional 30 minutes to complete a hands-on task and related questions. In one of the hands-on tasks administered as part of the 1996 assessment, twelfth-graders were given a bag containing three different metals, sand, and salt. They were asked to separate them using a magnet, sieve, filter paper, funnel, spoon, and water. At the end, they were asked to document the steps they used to perform the task. (Examples of hands-on tasks from the 2005 assessment have not yet been released.)

Science Achievement Levels at Grade 12

The science achievement levels at grade 12 represent what twelfth-graders know and can do in science at each level. The following are excerpts of the science achievement-level descriptions with the corresponding cut scores noted in parentheses. The full descriptions can be found at http://www.nagb.org/pubs/s_framework_05/761907-ScienceFramework.pdf.

Basic (146): Students performing at the *Basic* level demonstrate some knowledge and certain reasoning abilities required for understanding the Earth, physical, and life sciences at a level appropriate to grade 12. In addition, they demonstrate knowledge of the themes of science (models, systems, and patterns of change) required for understanding the most basic relationships among the Earth, physical, and life sciences. They are able to conduct investigations, critique the design of investigations, and demonstrate a rudimentary understanding of scientific principles.

Proficient (178): Students performing at the *Proficient* level demonstrate the knowledge and reasoning abilities required for understanding the Earth, physical, and life sciences at a level appropriate to grade 12. In addition, they demonstrate knowledge of the themes of science (models, systems, and patterns of change) required for understanding how these themes illustrate essential relationships among the Earth, physical, and life sciences. They are able to analyze data and apply scientific principles to everyday situations.

Advanced (210): Students performing at the *Advanced* level demonstrate the knowledge and reasoning abilities required for a solid understanding of the Earth, physical, and life sciences at a level appropriate to grade 12. In addition, they demonstrate knowledge of the themes of science (models, systems, and patterns of change) required for integrating knowledge of scientific principles from the Earth, physical, and life sciences. Students can design investigations that answer questions about real-world situations and use their reasoning abilities to make predictions.



Sample Grade 12 Multiple-Choice Question

The following multiple-choice question from the twelfth-grade science assessment required conceptual understanding in the field of life science.

National percentage correct in 2005

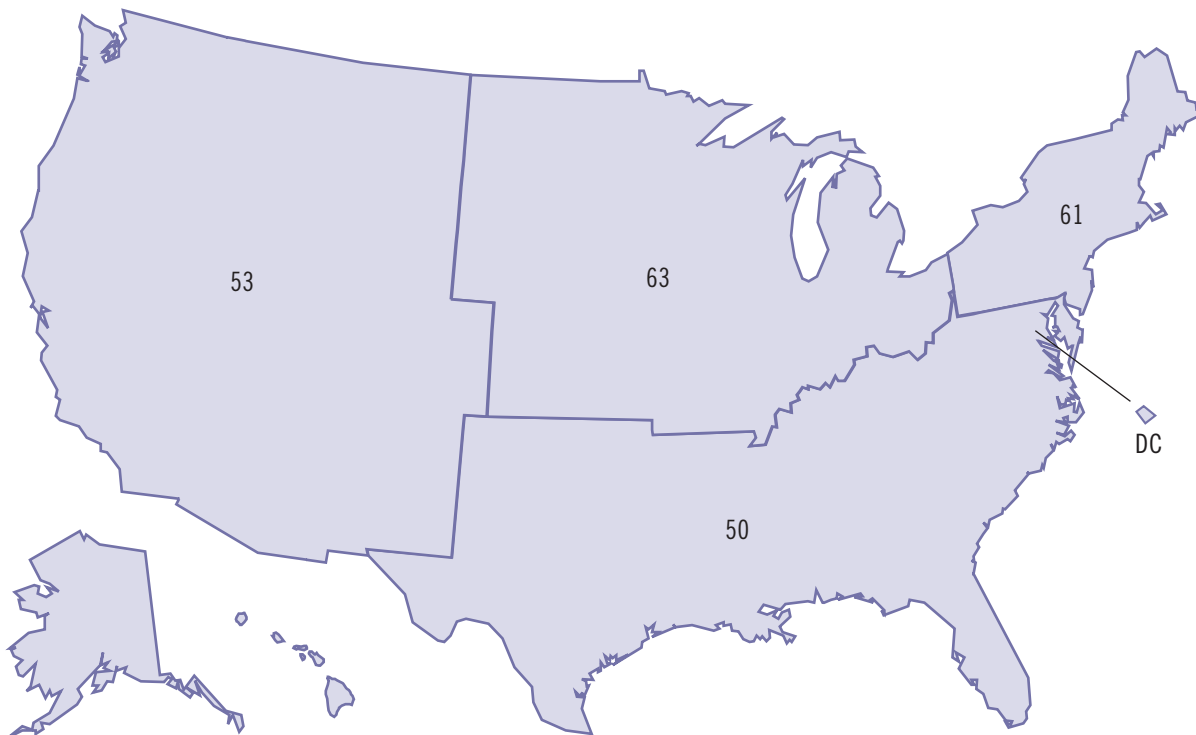
Overall	Below <i>Basic</i>	At <i>Basic</i>	At <i>Proficient</i>	At <i>Advanced</i>
56	29	69	96	‡

‡ Reporting standards not met. Sample size was insufficient.

Which is a function of a neuron?

- Ⓐ It carries oxygen to other cells.
- Ⓑ It secretes digestive enzymes.
- Ⓒ It removes foreign particles from the bloodstream.
- Ⓓ It receives signals from the internal and external environments.

Percentage of correct twelfth-grade student responses on question above in 2005, by region



NOTE: Results by region do not include Department of Defense Education Activity.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

Sample Grade 12 Short Constructed-Response Question

The following is a constructed-response question requiring conceptual understanding in the field of Earth science. Responses were rated using a three-level scoring guide. Responses that correctly identified two conditions that cause rocks to undergo physical weathering and explained their actions were rated “Complete.” Responses that correctly identified one condition and explained its action, or correctly identified one or more conditions with incorrect or no

explanations were rated “Partial.” Responses that showed no understanding of what processes cause the deterioration of rocks were rated “Incorrect.” The sample student response below was “Complete.”

National percentage “Complete” in 2005

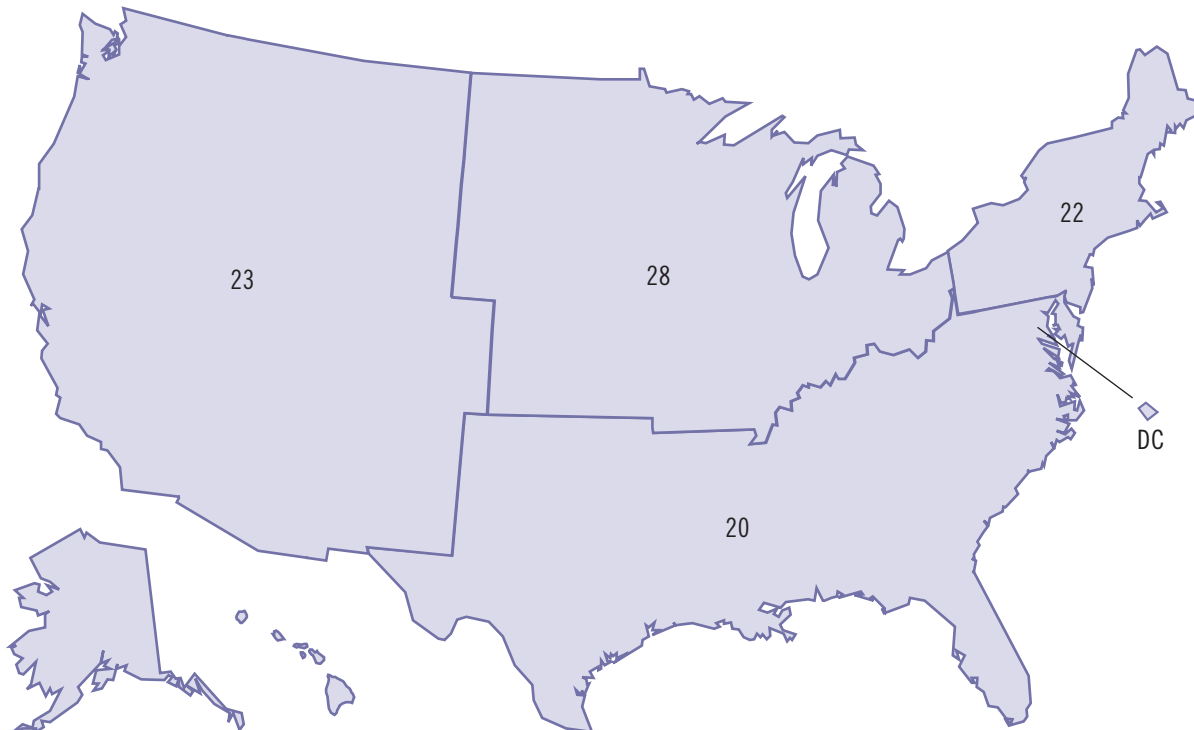
Overall	Below <i>Basic</i>	At <i>Basic</i>	At <i>Proficient</i>	At <i>Advanced</i>
23	7	27	58	‡

‡ Reporting standards not met. Sample size was insufficient.

Mechanical weathering is the physical breakdown or disintegration of rocks without a change in composition. Briefly explain two ways that rocks can undergo mechanical weathering.

1) A rock that stays in the rain can be weathered by water running over it. 2) Wind can blow dirt and sand across rocks which over a long period of time will weather it.

Percentage of twelfth-grade student responses rated “Complete” on question above in 2005, by region



NOTE: Results by region do not include Department of Defense Education Activity.

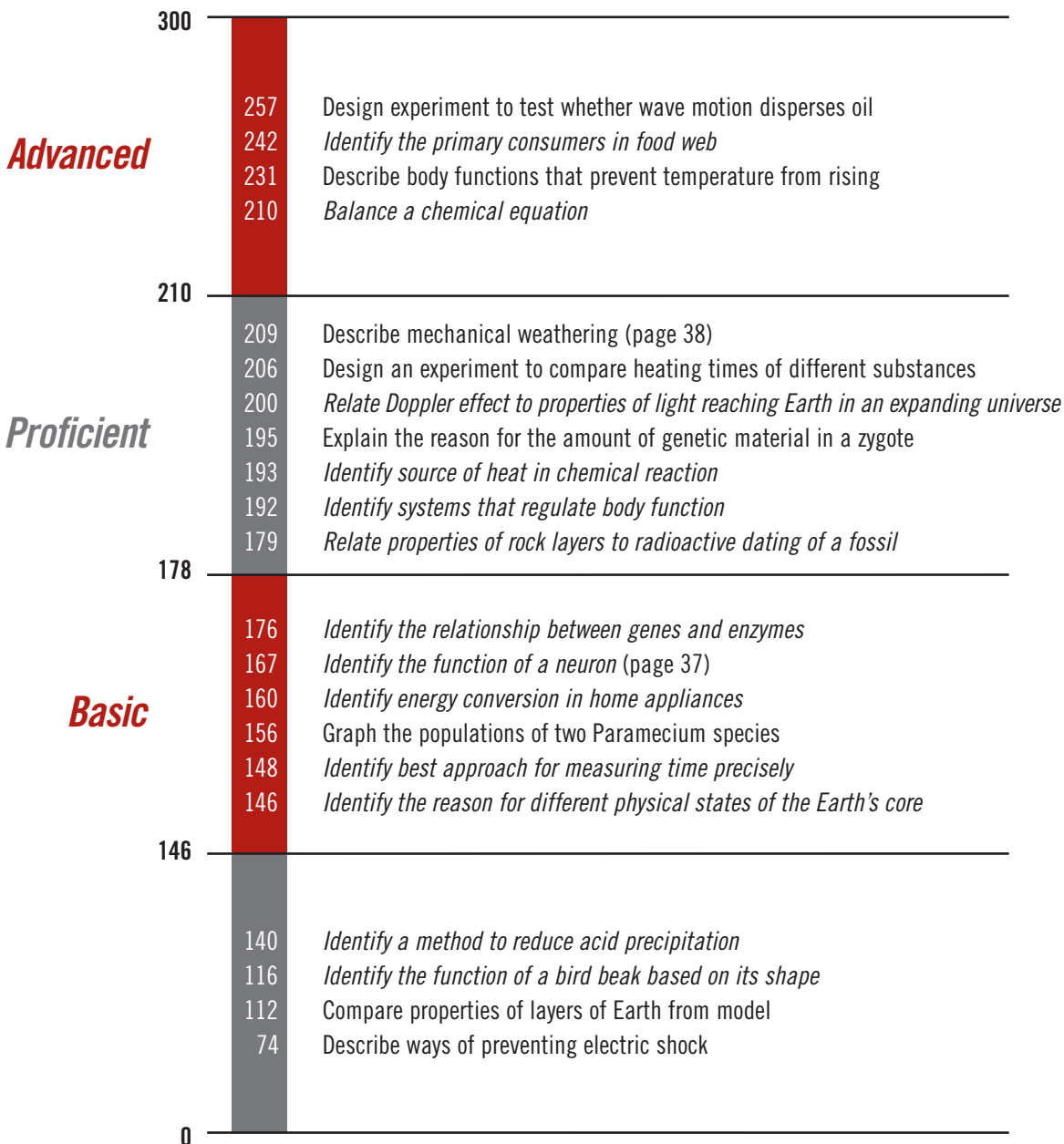
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

Range of Science Performance at Grade 12

The item map provides another way to interpret the scale score and achievement-level results for twelfth-graders. The left side of the item map shows the scores that define the lower boundaries of the *Basic*, *Proficient*, and *Advanced* achievement levels. The right side lists descriptions of some selected assessment questions that fall at various levels of difficulty on the 0–300 scale.

The map is a useful tool for understanding what it means to perform at different levels on the scale. For example, the map shows that students performing toward the lower end of the *Basic* achievement-level range were likely to be able to identify the best approach for measuring time precisely (148). Students performing at the *Proficient* level likely could relate properties of rock layers to radioactive dating of a fossil (179) and identify the source of heat in a chemical reaction (193).

Grade 12 Science Item Map



The position of a question on the scale represents the average scale score attained by students who had a 65 percent probability of successfully answering a constructed-response question, or a 74 percent probability of correctly answering a four-option multiple-choice question. Scale score ranges for science achievement levels are referenced on the map. For constructed-response questions, the question description represents students' performance rated as completely correct.

NOTE: Regular type denotes a constructed-response question. *Italic* type denotes a multiple-choice question. SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Science Assessment.

Technical Notes

SAMPLING AND WEIGHTING

At grades 4 and 8, the nationally representative sample in 2005 consisted of students assessed in each participating state, students in states that did not participate in the state-level assessment, and students from nonpublic schools.

This represents a change from previous assessments in which the national and state samples were independent.

At grade 12, the sample was chosen using a stratified two-stage design that involved sampling students from selected schools (public and nonpublic) across the country. More information on sampling can be found at <http://nces.ed.gov/nationsreportcard/about/nathow.asp>.

Results are weighted to take into account that states, and schools within states, represent different proportions of the national population. Prior to 2002, the national samples used weights that were poststratified to the census or Current Population Survey (CPS) totals for the assessed populations. Due to the change to nonpoststratified weights in 2005, national results for the 1996 and 2000 assessments at grades 4 and 8 may differ slightly from those previously reported.

Because of concerns about the accuracy of estimates for American Indian/Alaska Native eighth-graders in 2005, results for this student group are not presented in this report—although they are available on the NAEP website. The apparent unreliability of these results is likely due to the fact that this population is small, heterogeneous, and highly clustered in certain locations. These factors can lead to large sampling variability in survey results. Reporting standards were also not met for Asian/Pacific Islander students at grade 4 in 2000.

STATISTICAL SIGNIFICANCE

Comparisons over time or between groups are based on statistical tests that consider both the size of the differences and the standard errors of the statistics. Standard errors are margins of error, and estimates based on smaller groups are likely to have larger margins of error. The size of the standard errors may also be influenced by other factors such as how representative the assessed students are of the entire population. When an estimate has a large standard error, a numerical difference that seems large may not be statistically significant. For example, a 4-point difference between male and female students may be statistically significant, while a 5-point difference between Black and Hispanic students may not be. Standard errors for the estimates presented in this report are available at <http://nces.ed.gov/nationsreportcard/nde/>.

In the charts of this report, the symbol (*) is used to indicate that scores or percentages are significantly different. Statistically significant differences between groups of students in the same year are not identified in the charts, but they were tested in the same way. Any difference between scores or percentages discussed in this report are statistically significant at the .05 level with adjustments for multiple comparisons.

ACCOMMODATIONS

Procedures were introduced at the national level in 1996 that allowed the use of accommodations such as extra testing time or individual administration for students who required them to participate. These procedures were then introduced at the state level in 2000. In that year, two samples of students were assessed—one in which accommodations were permitted and one in which they were not. This made it possible to continue reporting state-level trends back to 1996 when no accommodations were permitted in the state assessments. Results for the non-accommodated samples are available at <http://nces.ed.gov/nationsreportcard/nde>.

Introducing accommodations in the NAEP program appears to have had some impact on the percentage of students excluded—at least at the fourth grade. Since 1996, the percentage of all sampled fourth-graders who were excluded has dropped from 6 percent to 3 percent. At grades 8 and 12, the exclusion rate has generally been 2 or 3 percent of the total sample in 1996, 2000, and 2005. Additional information can be found at <http://nces.ed.gov/nationsreportcard/science/whotook.asp>.

SCHOOL AND STUDENT PARTICIPATION RATES

In order to ensure unbiased samples, NCES and NAGB established participation rate standards that states and jurisdictions were required to meet in order for their results to be reported. Participation rates for the original sample needed to be at least 85 percent for schools. In the 2005 science assessment, 44 states and all Department of Defense schools met participation rate standards at both grades 4 and 8. Student response rates at grade 12 fell below 85 percent for both public and private schools. A nonresponse bias analysis showed significant differences between responding and nonresponding public school students in terms of gender, race/ethnicity, age, and English language learner identification. Although the differences are quite small, it is unlikely that nonresponse weighting adjustments completely accounted for these differences.

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