National Center for Education Statistics

Science Highlights 2000

The Nation's Report Card

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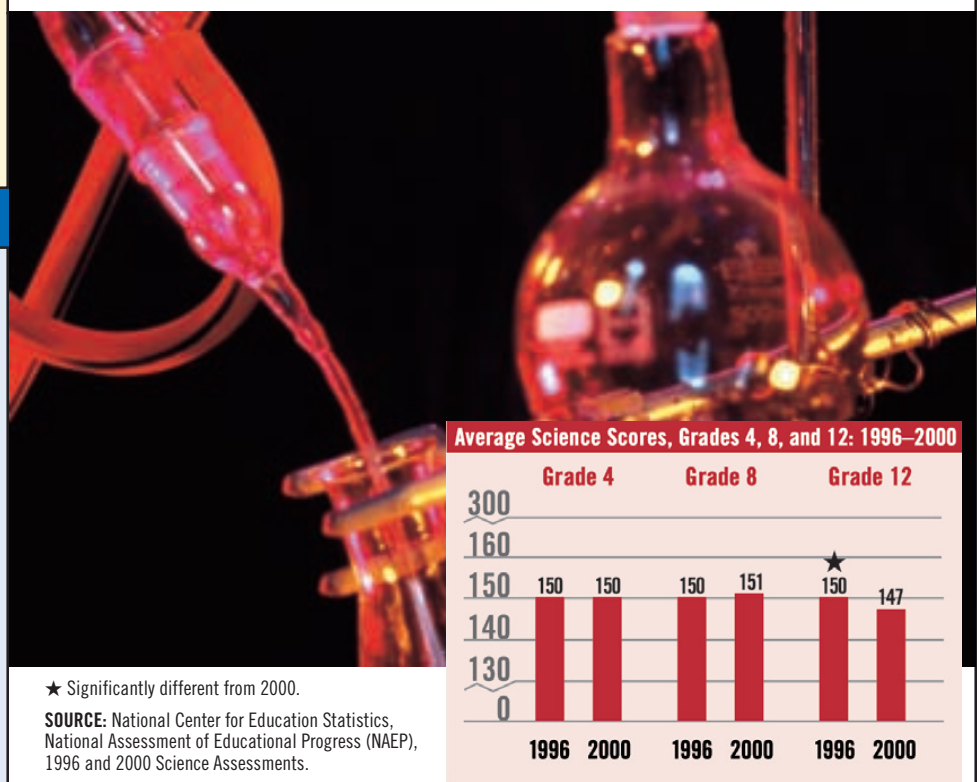
National Assessment of Educational Progress

NAEP 2000 Science Assessment Results Released

Results for the 2000 National Assessment of Educational Progress (NAEP) science assessment show no significant change in grades 4 and 8, and a decline in performance at grade 12 since 1996.



★ Significantly different from 2000.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 and 2000 Science Assessments.

This science assessment was first administered to nationally representative samples of fourth-, eighth-, and twelfth-grade students in 1996. The figure above shows national average scores in 1996 and 2000 based on the 0-to-300 NAEP science scale at each grade.

In 2000, the average scores of fourth- and eighth-graders were essentially unchanged from 1996. The only significant change in average score results occurred at grade 12, where there was a three-point decline in students' average score.

It should be noted that every test score has a standard error of measurement—a range of a few points plus or minus the score. Therefore, when tests of statistical significance are used to compare scores between years, factoring in this standard error may yield apparently small differences that are statistically significant or, conversely, large differences that are not. Only statistically significant differences are cited in this report.

An Important Indicator of Educational Progress

Since 1969, NAEP has been the sole, ongoing national indicator of what American students know and can do in major academic subjects.

Over the years, NAEP has measured students' achievement in many subjects, including reading, mathematics, science, writing, history, civics, geography, and the arts. In 2000, NAEP conducted assessments in reading at grade 4 and in mathematics and science at grades 4, 8, and 12. In addition, NAEP conducted state-by-state assessments in mathematics and science at grades 4 and 8.

NAEP is a project of the National Center for Education Statistics (NCES) in the U.S. Department of Education and is overseen by the National Assessment Governing Board (NAGB).

U.S. Department of Education
Office of Educational Research and Improvement

NCES 2002–452

Achievement Levels Provide Yardstick of Student Performance

Achievement levels provide a context for interpreting students' performance on NAEP. These performance standards, set by NAGB and based on recommendations from broadly representative panels of educators and members of the public, determine what students should know and be able to do for the *Basic, Proficient,* and *Advanced* levels of performance in each subject area and grade level assessed.

As provided by law, the Acting Commissioner of Education Statistics, upon review of a congressionally mandated evaluation of NAEP, has determined that the achievement levels are to be considered developmental and should be interpreted and used with caution.

However, both the Acting Commissioner and NAGB believe that these performance standards are useful for understanding trends in student achievement. NAEP achievement levels have been widely used by national and state officials, including the National Education Goals Panel.

Detailed science achievement-level descriptions can be found on the Web at http://nces.ed.gov/nationsreportcard

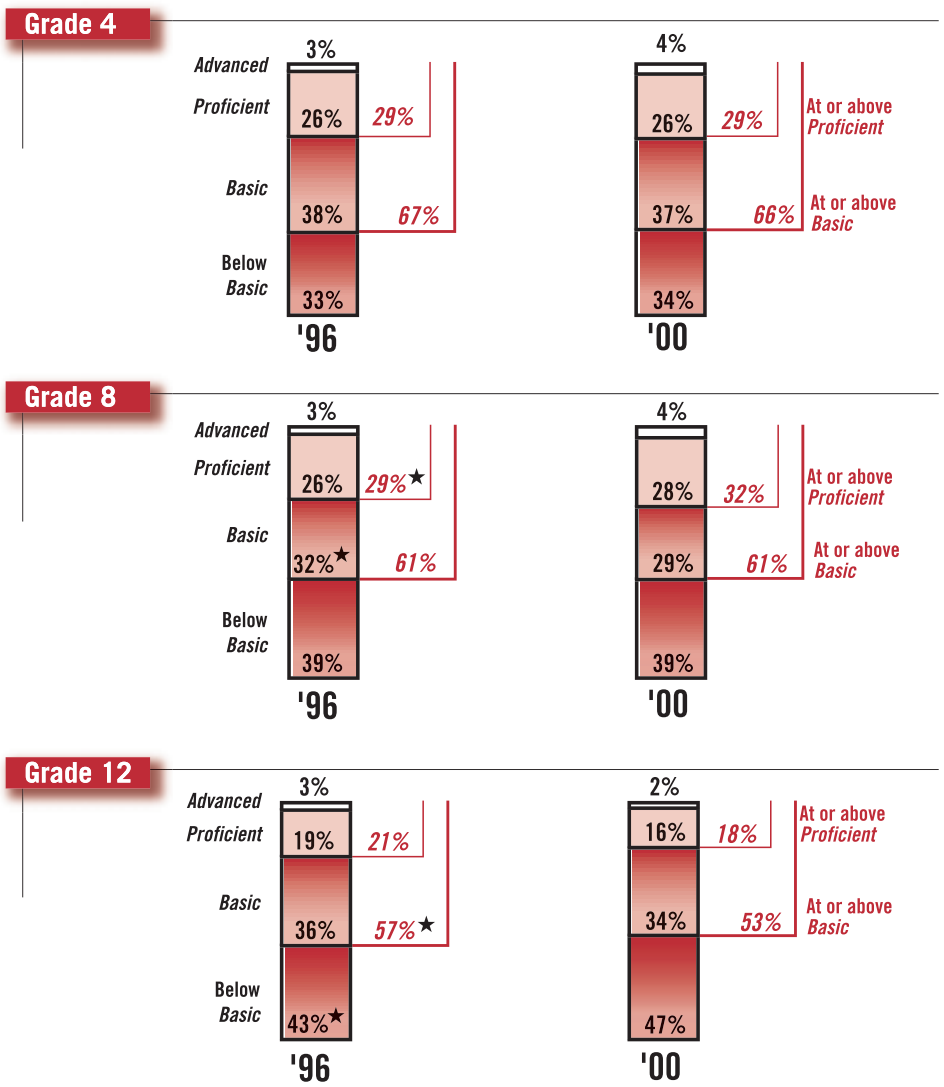
Few Changes Seen in Students' 2000 Achievement-Level Performance

The 2000 science assessment results show few changes since 1996 in the percentages of students at or above any of the NAEP achievement levels. At grade 4, there was no change between 1996 and 2000 in the percentage of students attaining any of the achievement levels. At grade 8, however, between 1996 and 2000 there was an increase in the percentage of students reaching the *Proficient* level or above. At grade 12, the percentage of students at or above *Basic* declined between 1996 and 2000.

Percentage of Students Within and at or Above Achievement Levels, Grades 4, 8, and 12: 1996–2000

HOW TO READ THESE FIGURES:

- The italicized percentages to the right of the shaded bars represent the percentages of students at or above *Basic* and *Proficient.*
- The percentages in the shaded bars represent the percentages of students within each achievement level.



★ Significantly different from 2000.

NOTE: Percentages within each science achievement-level range may not add to 100, or to the exact percentages at or above achievement levels, due to rounding.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 and 2000 Science Assessments.

Achievement Levels

Basic: This level denotes partial mastery of prerequisite knowledge and skills that are fundamental for proficient work at each grade.

Proficient: This level represents solid academic performance for each grade assessed. Students reaching this level have demonstrated competency over challenging subject matter, including subject-matter knowledge, application of such knowledge to real-world situations, and analytical skills appropriate to the subject matter.

Advanced: This level signifies superior performance.

Gain for Highest-Performing Eighth-Graders and Decline for Middle-Performing Twelfth-Graders

An examination of scores at different percentiles on the 0-to-300 scale at each grade indicates whether or not the few changes seen in the national average science score results are reflected in the performance of lower-, middle-, and higher-performing students.

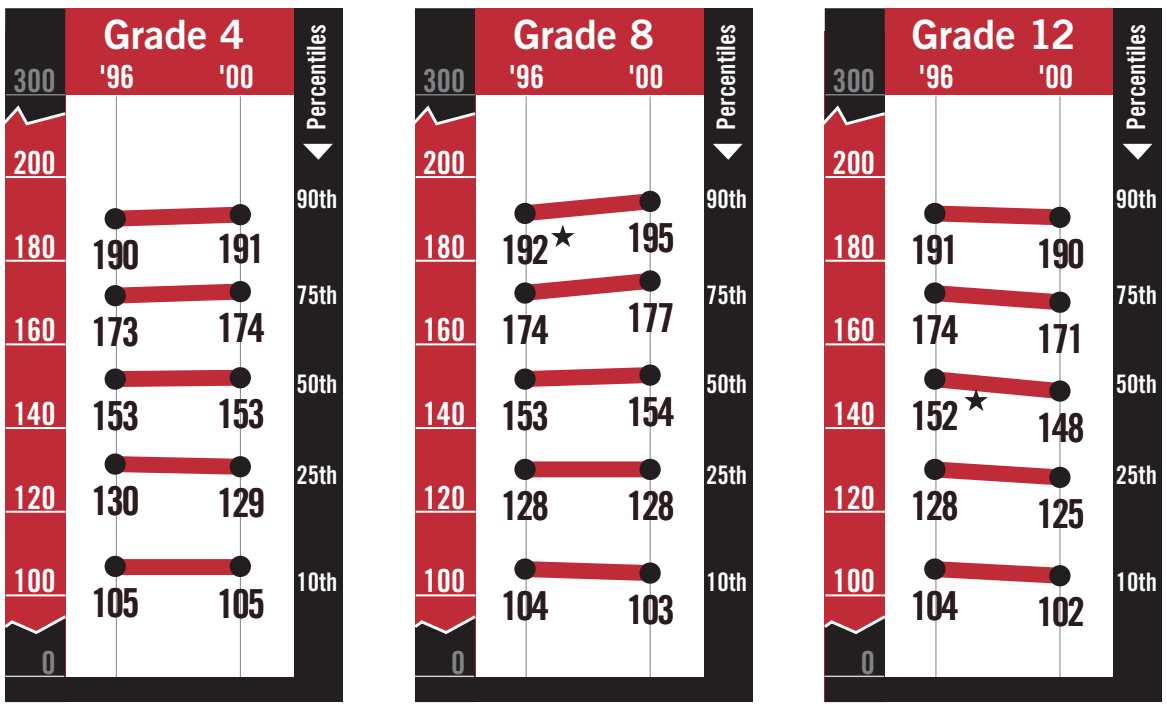
As shown in the figures below, few changes occurred between 1996 and 2000 in scores across the performance distribution.

At grade 4, the percentile scores remained relatively unchanged—indicating little or no shift in the performance distribution since 1996.

At grade 8, although the national average score did not change between 1996 and 2000, there was an increase in the 90th percentile score. This finding indicates that some improvement occurred among the highest-performing eighth-graders.

At grade 12, consistent with the average score results, the 50th percentile score declined between 1996 and 2000. Apparent changes in the other percentile scores, however, were not statistically significant.

Percentile Scores, Grades 4, 8, and 12: 1996–2000



★ Significantly different from 2000.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 and 2000 Science Assessments.

NAEP 2000 Science Assessment Design: Framework, Accommodations, and Samples

The NAEP Science Framework used to develop the 2000 assessment (as well as the 1996 science assessment) is organized according to two dimensions: Fields of Science, and Ways of Knowing and Doing Science. Three fields of science are addressed in the framework: earth, physical, and life sciences. The ways of knowing and doing science are conceptual understanding, scientific investigation, and practical reasoning.

The design of the 2000 science assessment allowed for the reporting of results that included performance data for special-needs students (that is, students identified by their school as being either students with disabilities or limited-English-proficient students) who were assessed by NAEP using accommodations as well as for those students who took the NAEP without accommodations.

The 2000 science assessment was conducted nationally at grades 4, 8, and 12 and state by state at grades 4 and 8. National results are based on the national sample and not a combination of the state samples. The national assessment included representative samples of both public and nonpublic schools, while the state-by-state assessments included public schools only. In total, 47,000 students from 2,100 schools were assessed in the national sample and 180,000 students from 7,500 schools in the state samples.

Results for Participating States and Jurisdictions

In addition to national results on students' science performance, the 2000 assessment collected performance data for fourth- and eighth-graders who attended public schools in states and other jurisdictions that volunteered to participate. In 2000, 40 states and 5 other jurisdictions participated at grade 4, and 39 states and 5 other jurisdictions participated at grade 8. Not all jurisdictions met minimum school participation guidelines for reporting their results in 2000 (see technical notes on the NAEP Web Site).

The following pages present information about students' average score and achievement-level performance in these states and jurisdictions. Data are presented for each jurisdiction that met minimum participation guidelines at grade 4 in 2000 and at grade 8 in 1996 and/or 2000. The science state-by-state assessment was not conducted at grade 4 in 1996.

It is important to note that results are presented for students attending public schools only. The results represent students assessed without accommodations—whether or not they were identified as special-needs students. Results that include the performance of special-needs students assessed

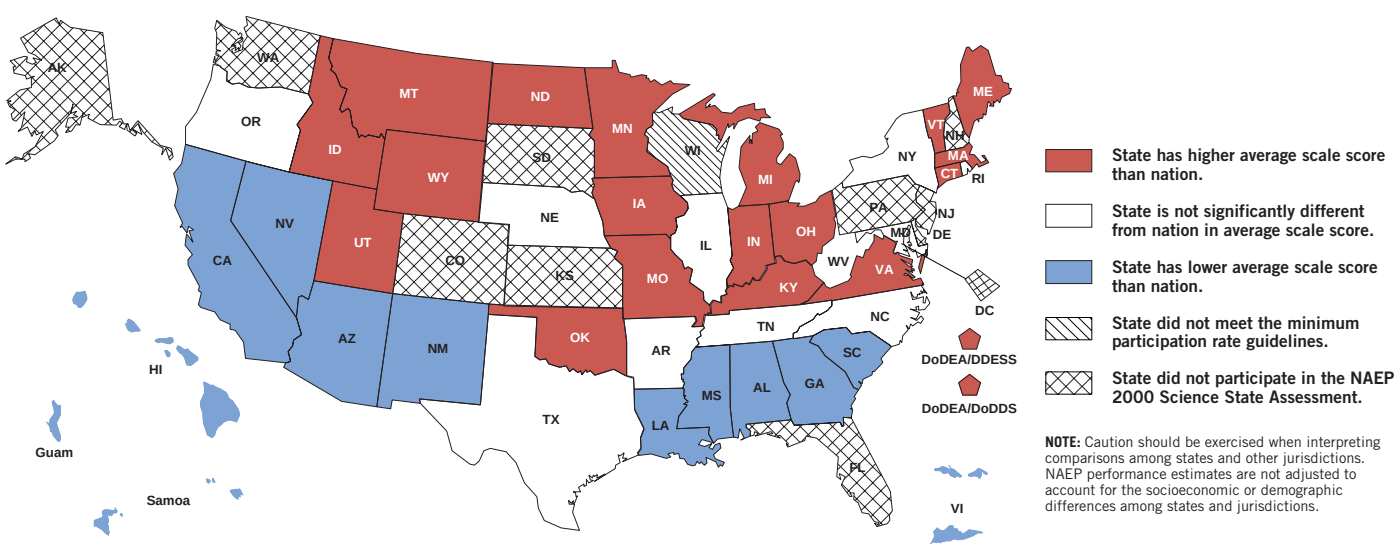
continued ▶

Table A: State Average Score Results, Grade 4 Public Schools: 2000

Nation–public schools	**148**						
Alabama	143	Maine †	161	North Dakota	160	Wyoming	158
Arizona	141	Maryland	146	Ohio †	154		
Arkansas	144	Massachusetts	162	Oklahoma	152		
California †	131	Michigan †	154	Oregon †	150	**Other jurisdictions**	
Connecticut	156	Minnesota †	157	Rhode Island	148	American Samoa	51
Georgia	143	Mississippi	133	South Carolina	141	DoDEA/DDESS	157
Hawaii	136	Missouri	156	Tennessee	147	DoDEA/DoDDS	156
Idaho †	153	Montana †	160	Texas	147	Guam	110
Illinois †	151	Nebraska	150	Utah	155	Virgin Islands	116
Indiana †	155	Nevada	142	Vermont †	159		
Iowa †	160	New Mexico	138	Virginia	156		
Kentucky	152	New York †	149	West Virginia	150		
Louisiana	139	North Carolina	148	Wisconsin †	—		

† Indicates that the jurisdiction did not meet one or more of the guidelines for school participation.
— Indicates that the jurisdiction did not meet the minimum guidelines for participation.
DoDEA/DDESS: Department of Defense Education Activities/Department of Defense Domestic Dependent Elementary and Secondary Schools. **DoDEA/DoDDS:** Department of Defense Education Activities/Department of Defense Dependents Schools (Overseas).
NOTE: Comparative performance results may be affected by variations in exclusion rates for students with disabilities and limited-English-proficient students in the NAEP sample.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

Figure A: State v. National Average Score, Grade 4 Public Schools: 2000



DoDEA/DDESS: Department of Defense Education Activities/Department of Defense Domestic Dependent Elementary and Secondary Schools.
DoDEA/DoDDS: Department of Defense Education Activities/Department of Defense Dependents Schools (Overseas).
NOTE: National results are based on the national sample, not on aggregated state assessment samples.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

with accommodations are available on the NAEP Web Site at http://nces.ed.gov/nationsreportcard.

Average Score Results

Table A and figure A on page 4 present average score results for fourth-graders. Table A shows scores for the states and jurisdictions that participated in the 2000 assessment.

Figure A shows states' and other jurisdictions' 2000 average score performance in comparison to the national average score for public schools. Of the 44 states and other jurisdictions that participated in the 2000 assessment, 20 had scores that were higher than the national average score, 11 had scores that were not different from the national average, and 13 had scores that were lower than the national average.

Table B and figure B present average score results for eighth-graders. Table B shows the scores for states and other jurisdictions that participated in the 1996 and 2000 assessments.

One state and two other jurisdictions showed significant score gains since 1996: Missouri, and the domestic and overseas Department of Defense Schools.

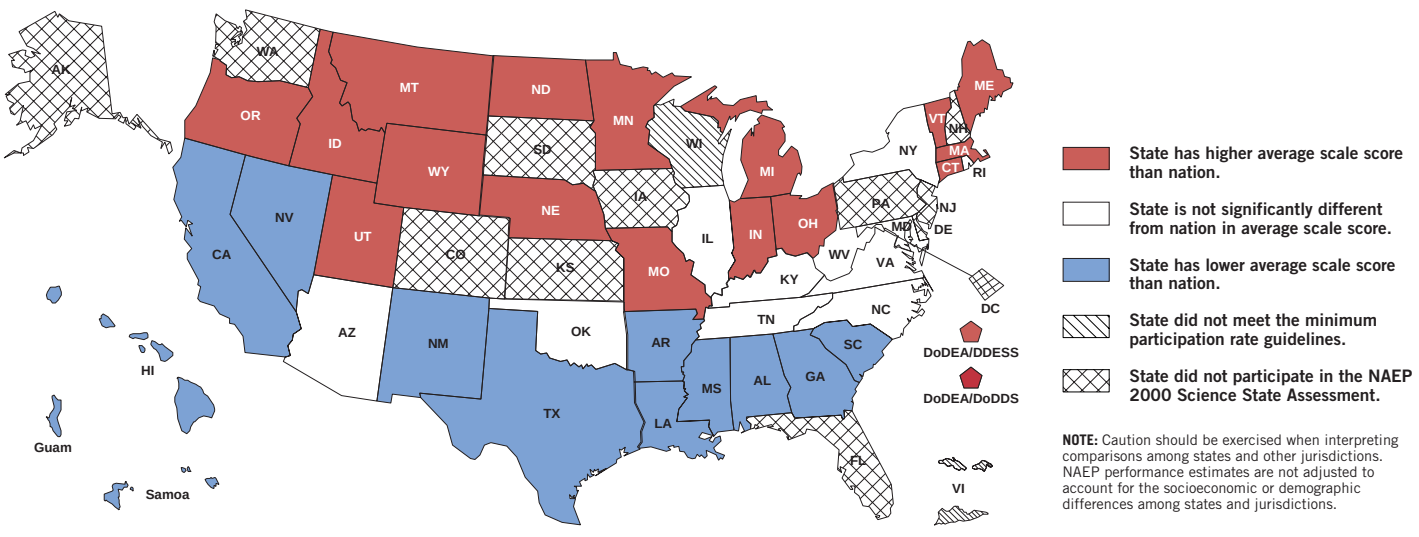
Figure B shows that of the 42 states and other jurisdictions that participated in the 2000 assessment 18 had scores that were higher than the national average score, 11 had scores that did not differ from the national average, and 13 had scores that were lower than the national average.

Table B: State Average Score Results, Grade 8 Public Schools: 1996–2000

	1996	2000		1996	2000		1996	2000
Nation–public schools	**148**	**149**						
Alabama	139	141	Maine †	163 *	160	South Carolina	139	142
Alaska	153	—	Maryland	145	149	Tennessee	143	146
Arizona †	145	146	Massachusetts	157	161	Texas	145	144
Arkansas	144	143	Michigan †	153	156	Utah	156	155
California †	138 *	132	Minnesota †	159	160	Vermont †	157 *	161
Colorado	155	—	Mississippi	133	134	Virginia	149	152
Connecticut	155	154	Missouri	151 ‡	156	Washington	150	—
Delaware	142	—	Montana †	162	165	West Virginia	147	150
Florida	142	—	Nebraska	157	157	Wisconsin †	160	—
Georgia	142	144	Nevada	—	143	Wyoming	158	158
Hawaii	135	132	New Mexico	141	140			
Idaho †	—	159	New York †	146	149	**Other jurisdictions**		
Illinois †	—	150	North Carolina	147	147	American Samoa	—	72
Indiana †	153	156	North Dakota	162	161	District of Columbia	113	—
Iowa	158	—	Ohio	—	161	DoDEA/DDESS	153 ‡	159
Kentucky	147 *	152	Oklahoma	—	149	DoDEA/DoDDS	155 ‡	159
Louisiana	132	136	Oregon †	155	154	Guam	120	114
			Rhode Island	149	150	Virgin Islands †	—	—

* Significantly different from 2000 if only one jurisdiction or the nation is being examined.
‡ Significantly different from 2000 when examining only one jurisdiction and when using a multiple-comparison procedure based on all jurisdictions that participated both years. (See Technical Notes on the NAEP Web Site)
† Indicates that the jurisdiction did not meet one or more of the guidelines for school participation in 2000.
— Indicates that the jurisdiction did not participate or did not meet the minimum guidelines for participation.
DoDEA/DDESS: Department of Defense Education Activities/Department of Defense Domestic Dependent Elementary and Secondary Schools. **DoDEA/DoDDS:** Department of Defense Education Activities/Department of Defense Dependents Schools (Overseas).
NOTE: Comparative performance results may be affected by variations or changes in exclusion rates for students with disabilities and limited-English-proficient students in the NAEP samples.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 and 2000 Science Assessments.

Figure B: State v. National Average Score, Grade 8 Public Schools: 2000



DoDEA/DDESS: Department of Defense Education Activities/Department of Defense Domestic Dependent Elementary and Secondary Schools.
DoDEA/DoDDS: Department of Defense Education Activities/Department of Defense Dependents Schools (Overseas).
NOTE: National results are based on the national sample, not on aggregated state assessment samples.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

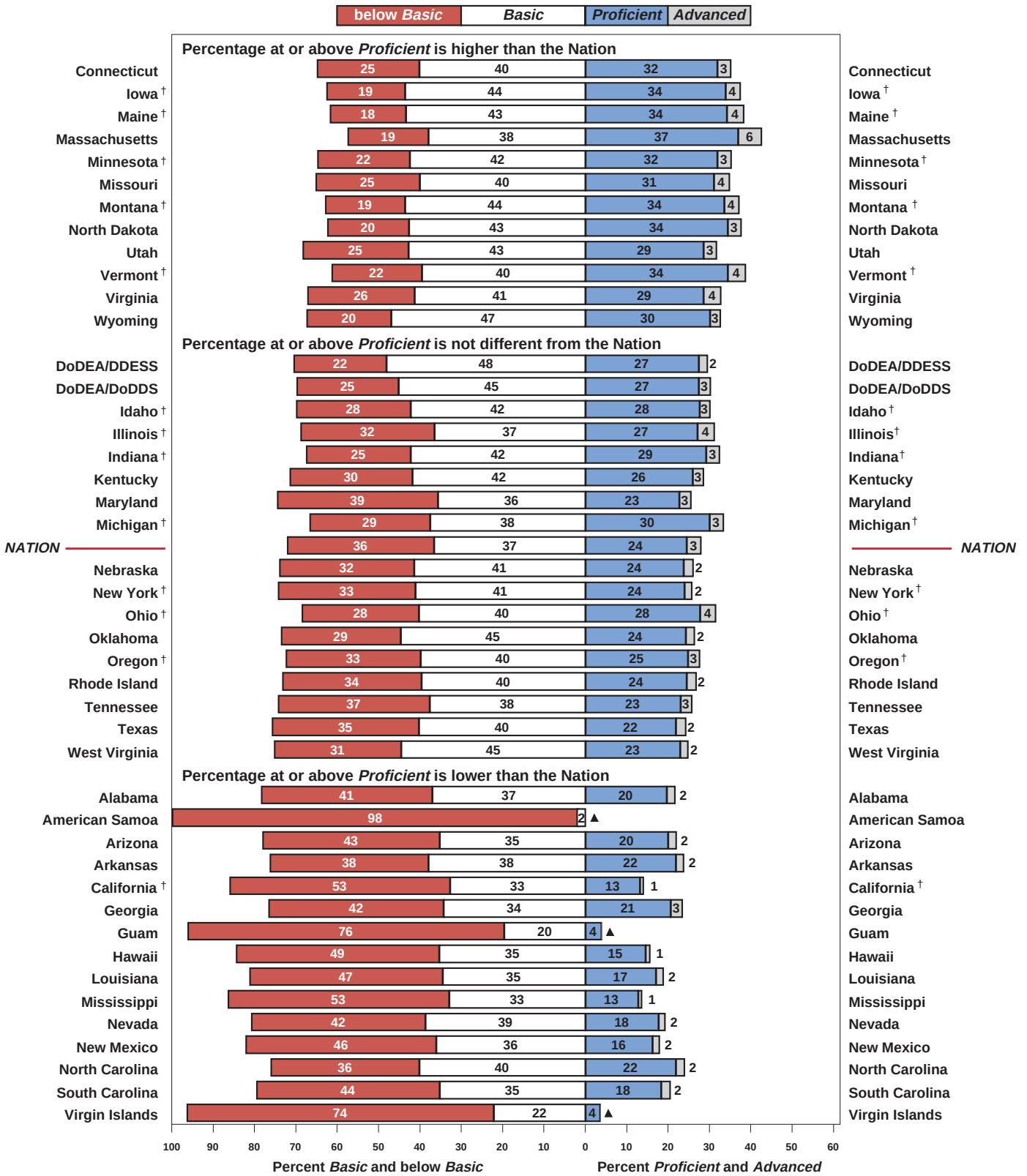
Achievement-Level Results

The following figures show the percentages of fourth- and eighth-graders at each achievement level for the states and jurisdictions that participated in the 2000 science assessment. Figure C shows this information for grade 4; figure D for grade 8. In both figures, the shaded bars represent the proportion of students in each of three achievement levels: *Basic*, *Proficient*, and *Advanced* — as well as the proportion below *Basic*. The central vertical line divides the proportion of students who fell below the *Proficient* level (i.e., at *Basic* or below *Basic*) from those who performed at or above the *Proficient* achievement level (i.e., at *Proficient* or at *Advanced*). Scanning down the horizontal bars to the right of the vertical line allows for easy comparison

continued ▶

Figure C: Percentage of Students Within Achievement Levels by State, Grade 4 Public Schools: 2000

The bars below indicate the percentages of students in each NAEP science achievement level. Each population of students is aligned at the point where the *Proficient* level begins, so that they may be compared at *Proficient* and above. States are listed alphabetically within three groups: the percentage at or above *Proficient* is higher than, not different from, or lower than the nation.



† Indicates that the jurisdiction did not meet one or more of the guidelines for school participation.
▲ Percentage is between 0.0 and 0.5.
NOTE: Percentages within each achievement-level range may not add to 100, or to the exact percentages at or above achievement levels, due to rounding. National results are based on the national sample, not on aggregated state assessment samples.
Comparative performance results may be affected by variations in exclusion rates for students with disabilities and limited-English-proficient students in the NAEP sample.
DoDEA/DDESS: Department of Defense Education Activities/Department of Defense Domestic Dependent Elementary and Secondary Schools.
DoDEA/DDESS: Department of Defense Education Activities/Department of Defense Dependents Schools (Overseas).
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

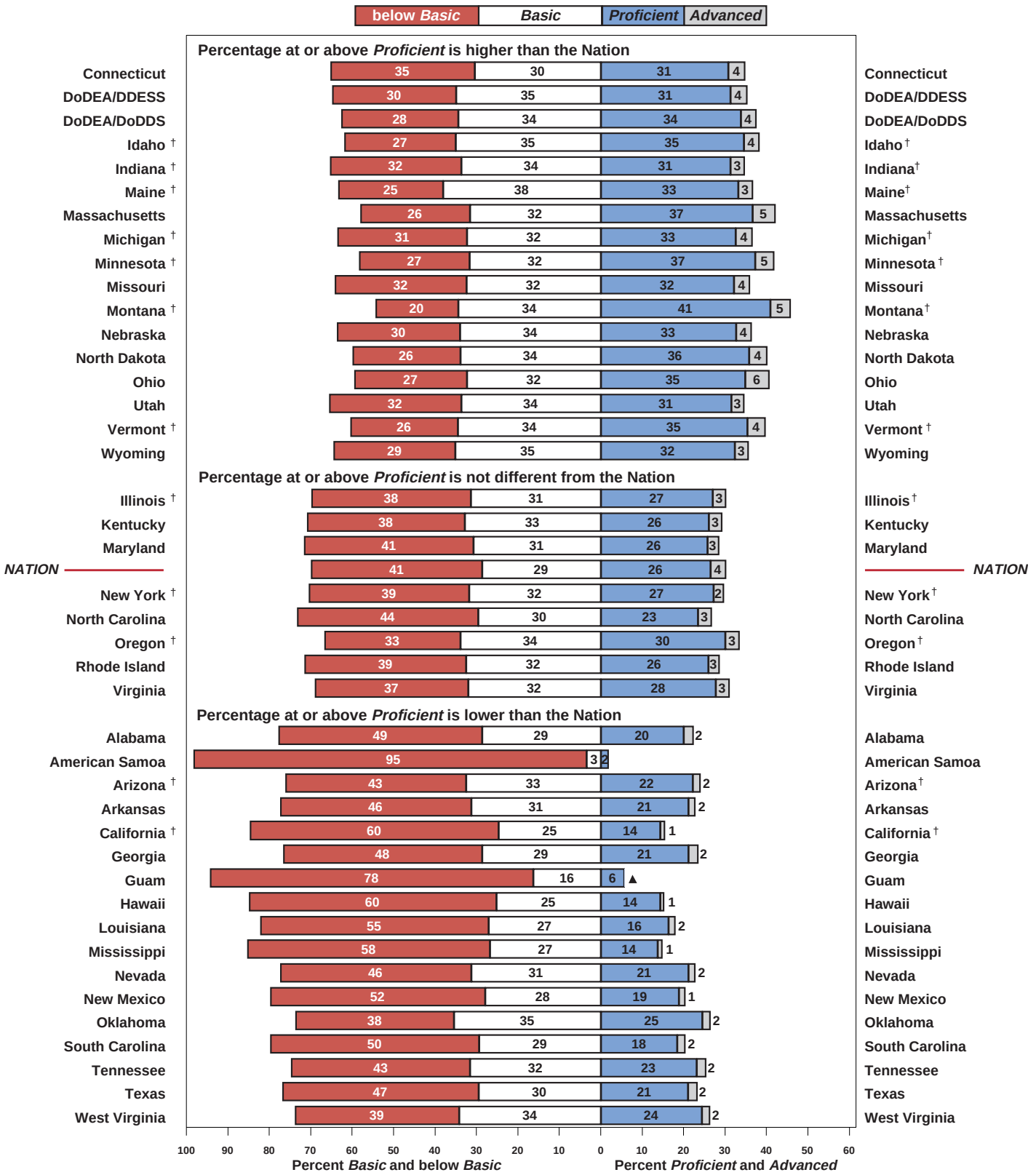
of states' and other jurisdictions' percentages of students at or above *Proficient*—the achievement level identified by the National Assessment Governing Board (NAGB) as the standard all students should reach.

At grade 4, as shown in figure C, 12 states and other jurisdictions had higher percentages of students at or above *Proficient* than the nation, 17 had percentages that were not different from the nation, and 15 had percentages that were lower than the nation.

At grade 8, as shown in figure D, 17 states and other jurisdictions had higher percentages of students at or above *Proficient* than the nation, 8 had percentages that were not different from the nation, and 17 had percentages that were lower than the nation.

Figure D: Percentage of Students Within Achievement Levels by State, Grade 8 Public Schools: 2000

The bars below indicate the percentages of students in each NAEP science achievement level. Each population of students is aligned at the point where the *Proficient* level begins, so that they may be compared at *Proficient* and above. States are listed alphabetically within three groups: the percentage at or above *Proficient* is higher than, not different from, or lower than the nation.



† Indicates that the jurisdiction did not meet one or more of the guidelines for school participation.
▲ Percentage is between 0.0 and 0.5.
NOTE: Percentages within each achievement-level range may not add to 100, or to the exact percentages at or above achievement levels, due to rounding. National results are based on the national sample, not on aggregated state assessment samples.
Comparative performance results may be affected by variations in exclusion rates for students with disabilities and limited-English-proficient students in the NAEP sample.
DoDEA/DDESS: Department of Defense Education Activities/Department of Defense Domestic Dependent Elementary and Secondary Schools.
DoDEA/DDESS: Department of Defense Education Activities/Department of Defense Dependents Schools (Overseas).
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

race/ethnicity

Subgroup Data Reveal How Various Groups of Students Performed on NAEP

In addition to reporting information on all students' performance on its assessments, NAEP also studies the performance of various subgroups of students. Studying the science achievement of subgroups of students in 2000 reveals whether they have progressed since 1996 as well as how they have performed in comparison to one another in 2000.

When reading these subgroup results, it is important to keep in mind that there is no simple, causal relationship between membership in a subgroup and science achievement. A complex mix of educational and socioeconomic factors may interact to affect student performance.

Science Scores by Race/Ethnicity

Average scores on the NAEP science assessment are examined for five major racial/ethnic subgroups: White, Black, Hispanic, Asian/Pacific Islander, and American Indian. For most of these subgroups, average scores in 2000 were not significantly different than in 1996 across the three grades tested. However, scores for two subgroups of students have declined. American Indian students at grade 8 and White students at grade 12 both had lower scores in 2000 than in 1996.

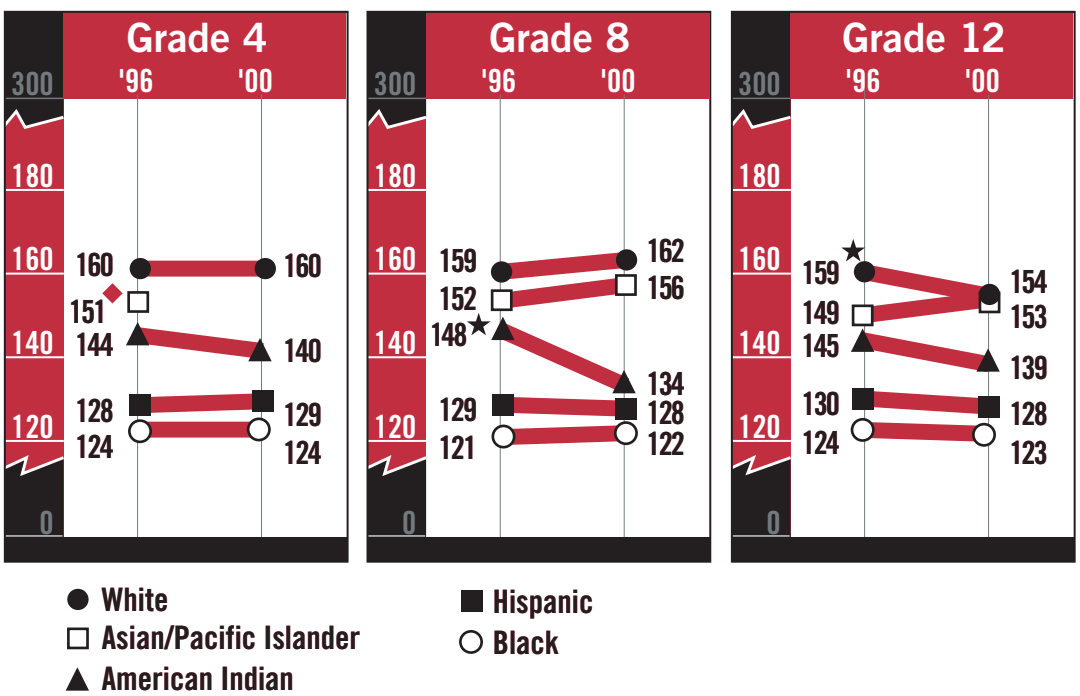
Comparing students' 2000 performance across subgroups indicates that some subgroups had higher average scores than others.

At grade 4, White students scored higher than Black, Hispanic, or American Indian students. American Indian students also scored higher than Black students and Hispanic students.

At grade 8, White students had a higher average score than any of the other subgroups. Asian/Pacific Islander eighth-graders scored higher than Black, Hispanic, or American Indian eighth-graders. Both Hispanic and American Indian eighth-graders scored higher than Black eighth-graders.

At grade 12, White students and Asian/Pacific Islander students both scored higher than Black, Hispanic, or American Indian students. American Indian twelfth-graders had a higher average score than that of either Black or Hispanic twelfth-graders.

Average Science Scores by Race/Ethnicity, Grades 4, 8, and 12: 1996–2000



★ Significantly different from 2000.

◆ Special analyses raised concerns about the accuracy and precision of national grade 4 Asian/Pacific Islander results in 2000. As a result, they are omitted here. (See technical notes on the NAEP Web Site.)

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 and 2000 Science Assessments.

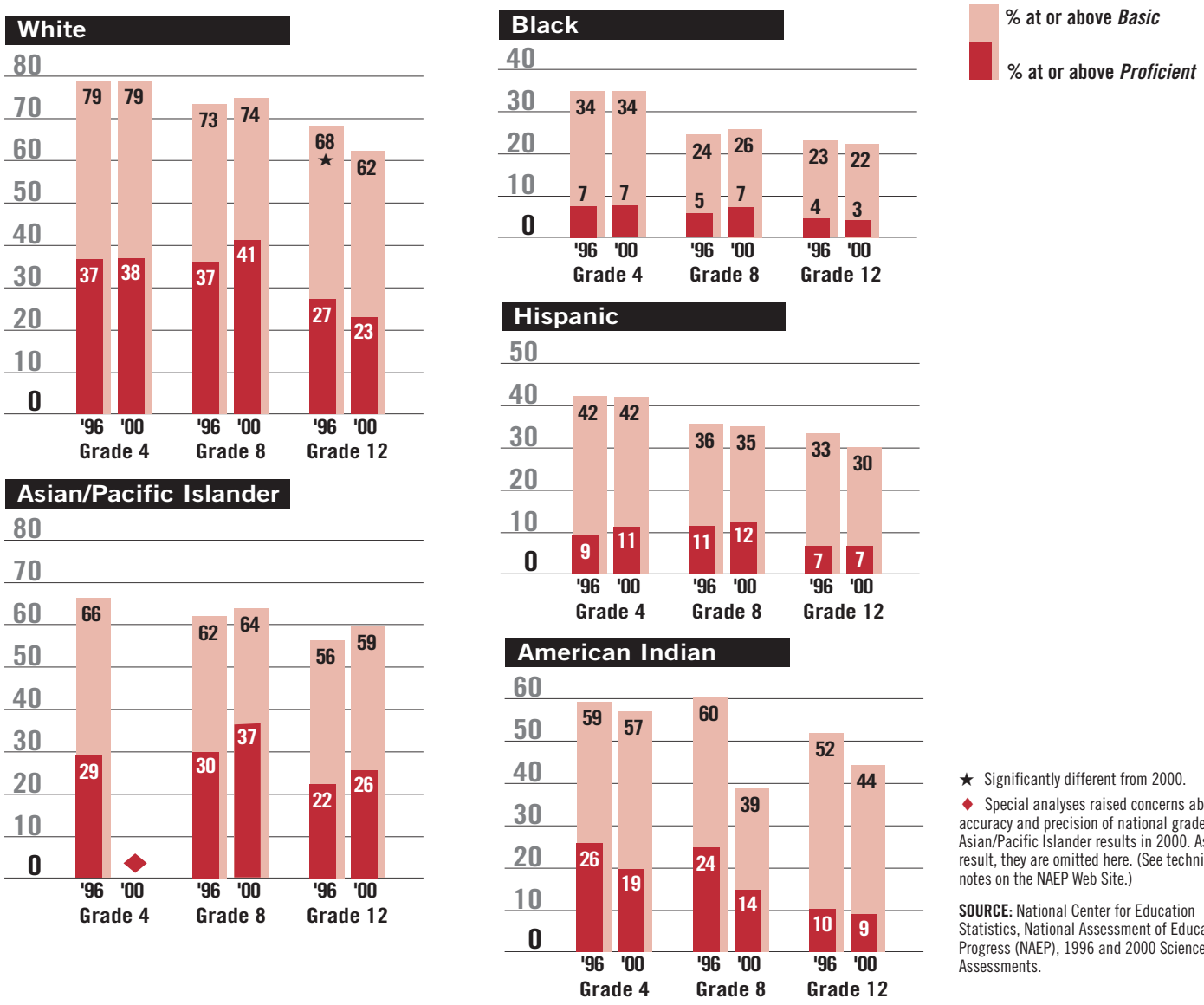
Achievement-Level Results by Race/Ethnicity

There has been little change in the science achievement of racial/ethnic subgroups of students between 1996 and 2000. White twelfth-graders showed a decline in the percentage of students at or above *Basic*. None of the other apparent differences between 1996 and 2000 in the percentages of students at or above *Basic* or *Proficient* were statistically significant.

Comparing the performance of students in different racial/ethnic subgroups in 2000 shows that a higher percentage of White and Asian/Pacific Islander students were at or above *Basic* and *Proficient*, compared to the other subgroups. This finding was consistent across the three grades.

Data for Asian/Pacific Islander students were not available at grade 4 in 2000 because special analyses raised concerns about the accuracy of the results.

Percentage of Students at or above *Basic* and *Proficient* by Race/Ethnicity, Grades 4, 8, and 12: 1996–2000



★ Significantly different from 2000.

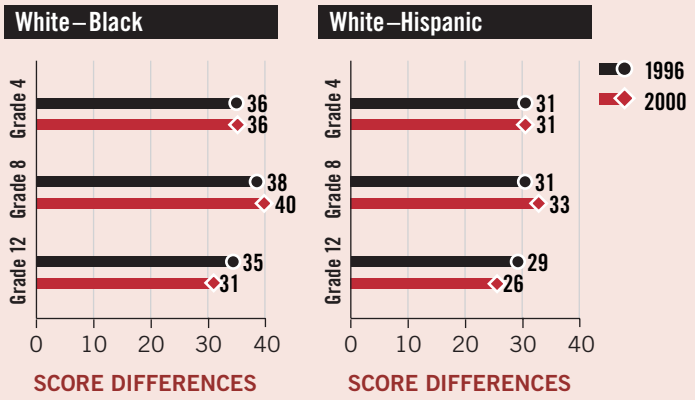
◆ Special analyses raised concerns about the accuracy and precision of national grade 4 Asian/Pacific Islander results in 2000. As a result, they are omitted here. (See technical notes on the NAEP Web Site.)

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 and 2000 Science Assessments.

Differences in Average Science Score Gaps Between Selected Racial/Ethnic Subgroups

In 2000, White students had higher average scores than Black or Hispanic students. These large gaps between subgroups' performance have remained relatively unchanged since 1996. None of the apparent differences in these gaps were statistically significant. The gaps were determined by subtracting a subgroup's (in this case, Black or Hispanic students) unrounded average score from that of White students.

Score Differences by Race/Ethnicity, Grades 4, 8, and 12: 1996–2000



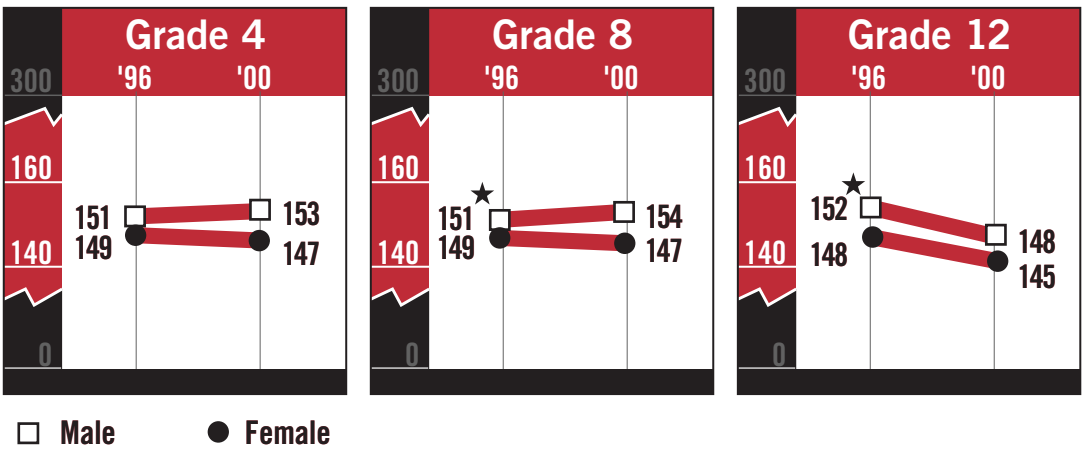
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 and 2000 Science Assessments.

gender

Science Scores by Gender

The figures below present average science scores for males and females in 1996 and 2000. At grade 8, males' average score was higher in 2000 than in 1996, while at grade 12, males' average score declined in 2000 compared to 1996. Comparing scores of males and females shows that males outscored females in 2000 at grades 4 and 8. The apparent difference at grade 12 was not statistically significant.

Average Science Scores by Gender, Grades 4, 8, and 12: 1996–2000



★ Significantly different from 2000.

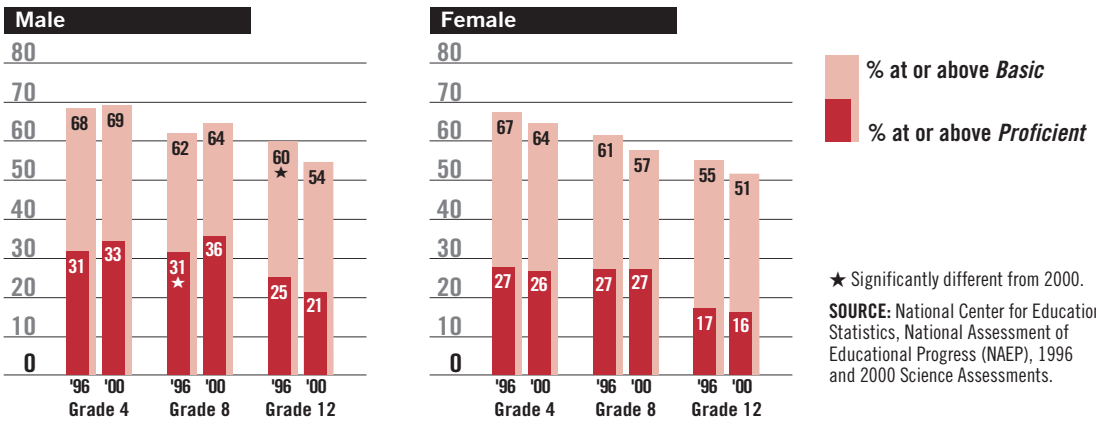
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 and 2000 Science Assessments.

Achievement-Level Results by Gender

The following figure shows few changes in the percentage of males and females at or above the *Proficient* level and at or above the *Basic* level since 1996. The only changes that occurred were among male students. At grade 8, the percentage of male students at or above *Proficient* increased between 1996 and 2000. At grade 12, however, the percentage of male students at or above *Basic* declined during the same time period.

Comparing the performance of males and females on the 2000 assessment reveals that there were higher percentages of males at or above the *Proficient* achievement level at all three grades and higher percentages of males at or above the *Basic* level at grades 4 and 8.

Percentage of Students at or above *Basic* and *Proficient* by Gender, Grades 4, 8, and 12: 1996–2000



★ Significantly different from 2000.

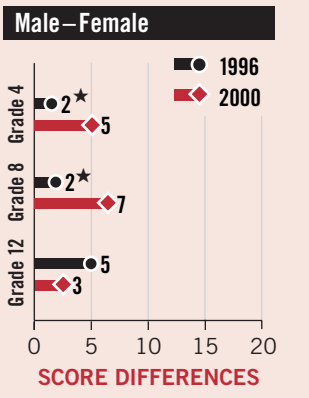
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 and 2000 Science Assessments.

Differences in Average Science Score Gaps Between Males and Females

In 2000, the score gaps favoring males over females widened by three points at grade 4 and by five points at grade 8.

At grade 12, the apparent narrowing of the gap in 2000 compared to 1996 was not statistically significant.

Score Differences by Gender, Grades 4, 8, and 12: 1996–2000



★ Significantly different from 2000.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 and 2000 Science Assessments.

school context

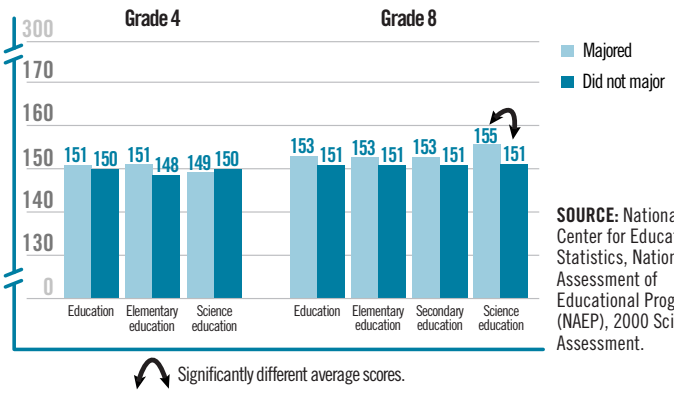
Teacher and Student Factors Play a Role in Science Performance

As part of the NAEP 2000 science assessment students and teachers were asked various questions related to their background and classroom practices. Relationships were investigated between student performance on the assessment and responses to questions about teachers' undergraduate major, how computers were used in the classroom, and student course-taking. While these findings may suggest a positive or negative relationship between performance on the science assessment and certain practices, it is important to remember that the relationships are not necessarily causal—there are many factors that play a role in science performance.

Teachers' Undergraduate Major Related to Science Achievement at Grade 8

The average scores of fourth- and eighth-grade students whose teachers reported certain undergraduate majors are displayed in the figure to the right. The results show that while teachers' undergraduate major was not related to performance at grade 4, eighth-graders whose teachers majored in science education had higher average scores than students whose teachers did not. While these results might suggest that teachers' undergraduate major has an impact on student performance at grade 8, it is also possible that teachers' educational background could influence the classes they are assigned to teach so that teachers with specialized degrees teach classes with high-performing students.

Average Scores by Teachers' Undergraduate Major, Grades 4 and 8: 2000



SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

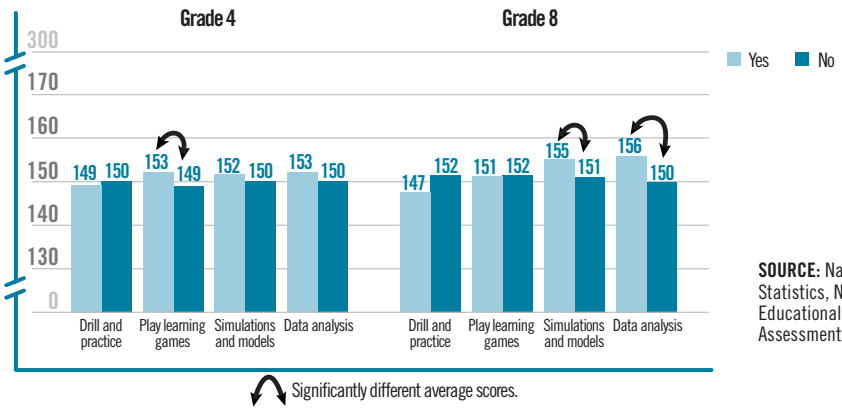
Certain Types of Computer Use in the Classroom Associated With Higher Science Scores

Finding the best ways to use computers to enhance learning has been a challenge to many educators. The average scores of fourth- and eighth-grade students whose teachers indicated that they used computers for certain activities are presented below.

At grade 4, results show that fourth-graders whose teachers reported using computers for playing learning games had higher scores than fourth-graders whose teachers did not.

At grade 8, students whose teachers used computers for simulations and models or for data analysis scored higher than students whose teachers did not indicate doing so.

Average Scores by Types of Computer Use, Grades 4 and 8: 2000

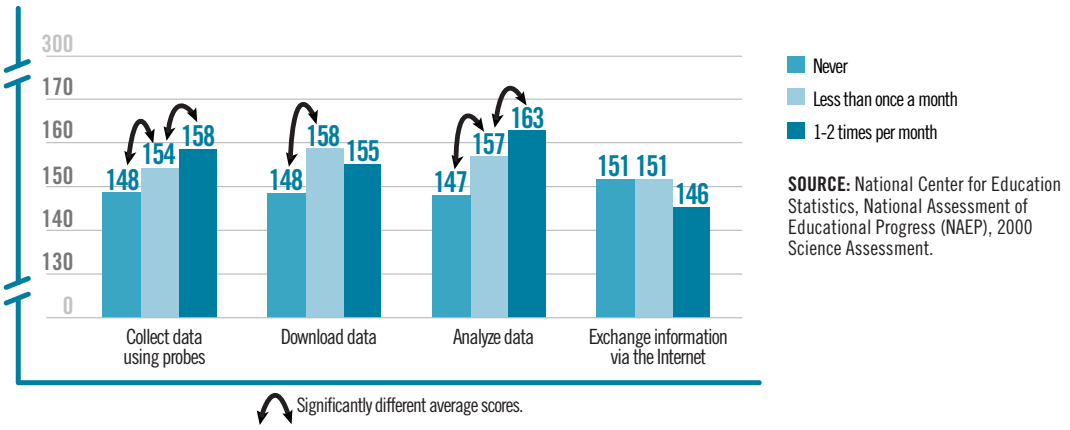


SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

school context

Twelfth-grade students were asked how frequently they used computers to collect data using probes, download data, analyze data, or exchange information via the Internet. Of the two-thirds of the twelfth-grade sample taking a science course in their senior year, those who reported using computers to collect data, download data, or analyze data had higher scores than students who reported never doing so. More frequent use (1-2 times per month) of computers to collect data or to analyze data was also associated with higher scores than less frequent use (less than once a month).

Average Scores by Types of Computer Use, Students Taking Science Courses, Grade 12: 2000

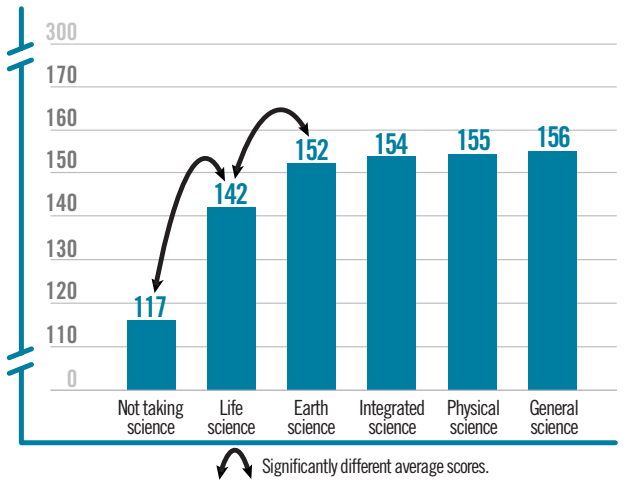


SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

Science Courses Related to Achievement at Grades 8 and 12

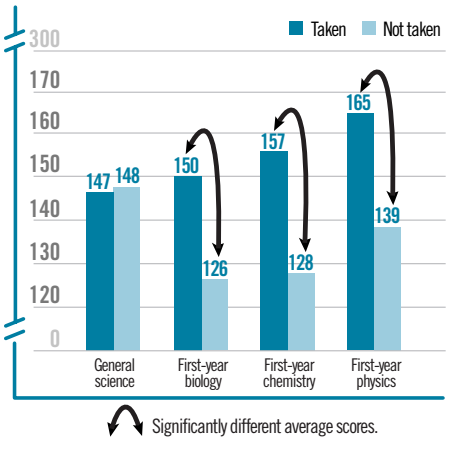
Science achievement has been shown to vary depending on the type of science courses students take. Results from the 2000 assessment show that eighth-grade students who were not taking science performed the lowest. Eighth-grade students enrolled in a life science course had lower scores than their peers enrolled in earth science, integrated science, physical science, or general science.

Average Scores by Current Science Course, Grade 8: 2000



SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

Average Scores by Enrollment Since the Eighth Grade in Science Courses, Grade 12: 2000



Twelfth-graders who had taken first-year biology, first-year chemistry, or first-year physics at some point since eighth grade had higher scores than students who had not. The performance of twelfth-grade students did not differ by whether or not they had taken general science at any time in high school.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

Sample Science Questions

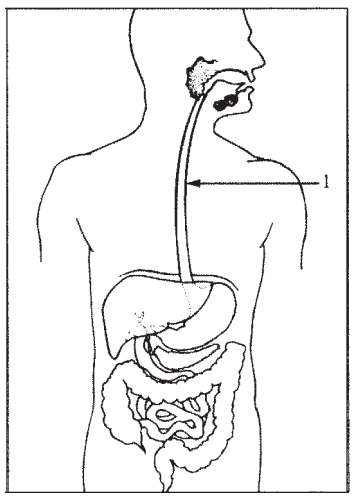
An understanding of students' performance on the NAEP 2000 science assessment can be gained by examining individual test questions and how students responded. The types of questions shown here—one multiple-choice and one constructed-response for each grade—are typical of those used in the science assessment. The tables that accompany these sample questions show two types of percentages: the overall percentage of students who answered successfully and the percentage of students in each achievement level interval who answered successfully. The oval corresponding to the correct multiple-choice response is darkened and sample student constructed responses scored "Complete" or "Essential" are provided. Additional sample questions can be viewed on the NAEP Web Site at http://nces.ed.gov/nationsreportcard.

Grade 4 Sample Questions and Responses

Multiple-Choice Question

Fourth-grade students are expected to be familiar with internal parts of the human body. This question, which probed conceptual understanding in the field of life science, required students to demonstrate an understanding of the function of the esophagus.

Overall percentage correct †	Percentage correct within achievement level intervals		
	Basic 138–169*	*Proficient* 170–203*	*Advanced* 204 and above*
55	55	75	90



Look at the picture above, which shows some of the organs that can be found inside the human body. What is the main job of the organ labeled 1?

Ⓐ *Carrying air*
Ⓒ *Carrying blood*
● *Carrying food*
Ⓓ *Carrying messages from the brain*

Short Constructed-Response Question

Scored on a three-level scale: "Unsatisfactory," "Partial," "Complete"

This question, which probed the conceptual understanding of the students in the field of earth science, required students to recognize the interaction between the Earth's atmosphere and hydrosphere as it relates to the water cycle. A "Complete" response needed to recognize that the Earth does not run out of rain because there is a repeating cycle in which rain leads to evaporation and a recurrence of rain.

This "Complete" response to the question stated the basic steps of the Earth's water cycle and demonstrated understanding that the steps repeat in a cyclical pattern.

Overall percentage "Complete"†	Percentage "Complete" within achievement level intervals		
	Basic 138–169*	*Proficient* 170–203*	*Advanced* 204 and above*
28	26	45	65

Think about where rain comes from and explain why the Earth never runs out of rain.

Sample "Complete" Response:

When we get rain it evaprates and rains again.

† Includes fourth-grade students who were below the *Basic* level.
* NAEP science composite scale range.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

Grade 8 Sample Questions and Responses

Multiple-Choice Question

Eighth-grade students are expected to be able to perform an activity separating mixtures into their components. This question, which probed the practical reasoning abilities of the student in the field of physical science, asked students to recognize the appropriate laboratory equipment needed to separate a mixture of given composition into its components.

Overall percentage correct †	Percentage correct within achievement level intervals		
	Basic 143–169*	*Proficient* 170–206*	*Advanced* 207 and above*
59	59	71	81

All of the following would be helpful in separating a mixture of sand and salt EXCEPT

● *a magnet*

Ⓑ *a glass cup*

Ⓒ *a filter paper and funnel*

Ⓓ *water*

Short Constructed-Response Question

Scored on a three-level scale: "Unsatisfactory," "Partial," "Complete"

This question, which probed the practical reasoning abilities of the student in the field of earth science, asked students to apply the concepts of weathering and erosion to a practical situation involving the deterioration of a stone monument placed in New York City.

This "Complete" response to the question stated two valid reasons for the damage to the stone monument and gave a possible way of preventing its further deterioration.

Overall percentage "Complete" †	Percentage "Complete" within achievement level intervals		
	Basic 143–169*	*Proficient* 170–206*	*Advanced* 207 and above*
28	28	47	71

Cleopatra's Needle is a large stone monument that stood in an Egyptian desert for thousands of years. Then it was moved to New York City's Central Park. After only a few years, its surface began crumbling.

Sample "Complete" Response:

What probably caused this crumbling?

Because of the polution and acid rian.

New York City wants to keep Cleopatra's Needle in the same location in Central Park. How can the city prevent further damage to the stone?

They could put roof over it or something to protect it from the rain

† Includes eighth-grade students who were below the *Basic* level.
* NAEP science composite scale range.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

Grade 12 Sample Questions and Responses

Multiple-Choice Question

Overall percentage correct †	Percentage correct within achievement level intervals: *Basic* 145–177*	*Proficient* 178–209*	*Advanced* 210 and above*
41	43	60	75

This question, which probed the conceptual understanding of students in the field of earth science, required students to understand the model of the solar system as well as to recognize the concept that an object appears larger when it is closer than when it is far away. Knowledge of both these areas was necessary for the student to apply the concept of the apparent size of an object depending on its proximity to the model of the solar system.

As observed with special instruments from Earth, the Sun appears in the sky to be slightly larger in January than in July. Which of the following accounts for this observation?

- *The Earth moves in an orbit that is not circular but is closer to the Sun in January than in July.*
- Ⓑ *The diameter of the Earth is not constant, but bulges slightly at the Equator and contracts slightly during the winter.*
- Ⓒ *The Earth's orbit is not in the same plane as the orbits of the other planets.*
- Ⓓ *The axis of rotation of the Earth is not perpendicular to the plane of its orbit but instead is tilted at an angle.*

Extended Constructed-Response Question

Overall percentage "Essential" or better†	Percentage "Essential or better" within achievement level intervals: *Basic* 145–177*	*Proficient* 178–209*	*Advanced* 210 and above*
19	18	58	89

Scored on a four-level scale: "Unsatisfactory," "Partial," "Essential," "Complete"

This question asked students to design a step-by-step procedure to determine the density of a metal ring and to specify the necessary laboratory equipment. The most common "Complete" procedure is to measure the mass and volume of the ring, and divide mass by volume to obtain the density. The question asks students to demonstrate their ability to design scientific investigations in the field of physical science.

This "Complete" response to the question specified all three steps of the procedure—measuring the ring's mass, measuring the ring's volume, and calculating the ring's density—along with the proper equipment.

This "Essential" response specified two of the three steps of the procedure—measuring the ring's mass and measuring the ring's volume—along with the proper equipment. The step involving the calculation of the ring's density was missing.

One characteristic that can be used to identify pure metals is density. If you determine the density of a pure metal, you can determine what the metal is, as shown in the table below.

Metal	Gold	Lead	Silver	Copper	Tin
Density (gram/cm^3)	19.3	11.3	10.5	8.9	7.3

Suppose that you have been given a ring and want to determine if it is made of pure gold. Design a procedure for determining the density of the ring. Explain the steps you would follow, including the equipment that you would use, and how you would use this equipment to determine the ring's density.

Sample "Complete" Response:

I would determine the objects mass by using a scale. Then I would drop the object into a beaker of water and measure its displacement, which is its volume. I would the divide the mass by the volume.

Sample "Essential" Response:

I would weigh it on a scale in grams. I would also place it in a beaker filled with water and see the displacement when it is added compared to the other rings.

† Includes twelfth-grade students who were below the *Basic* level.
* NAEP science composite scale range.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment.

The Nation's Report Card

Science Highlights 2000

National Center for Education Statistics

More Information

Additional results and detailed information about the NAEP 2000 science assessment can be found on the NAEP Web Site. Additional NAEP publications can be ordered from:

U.S. Department of Education
ED Pubs
P.O. Box 1398
Jessup, MD 20794–1398
1–877–4ED–PUBS
(1-877-433-7827)

Additional information about the NAEP science framework can be found on the National Assessment Governing Board Web Site at: http://www.nagb.org

NAEP on the Web

http://nces.ed.gov/nationsreportcard

The NAEP Web Site offers a wealth of assessment information, publications, and analysis tools, including:

- Fast "one-stop" access to free NAEP publications and assessment data
- National and state "report cards" on student achievement in core subject areas such as reading, math, and science
- Sample test questions, student responses, and scoring guides
- Interactive data analysis tool and student performance results from past NAEP assessments
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