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NAEP National Assessment of Educational Progress
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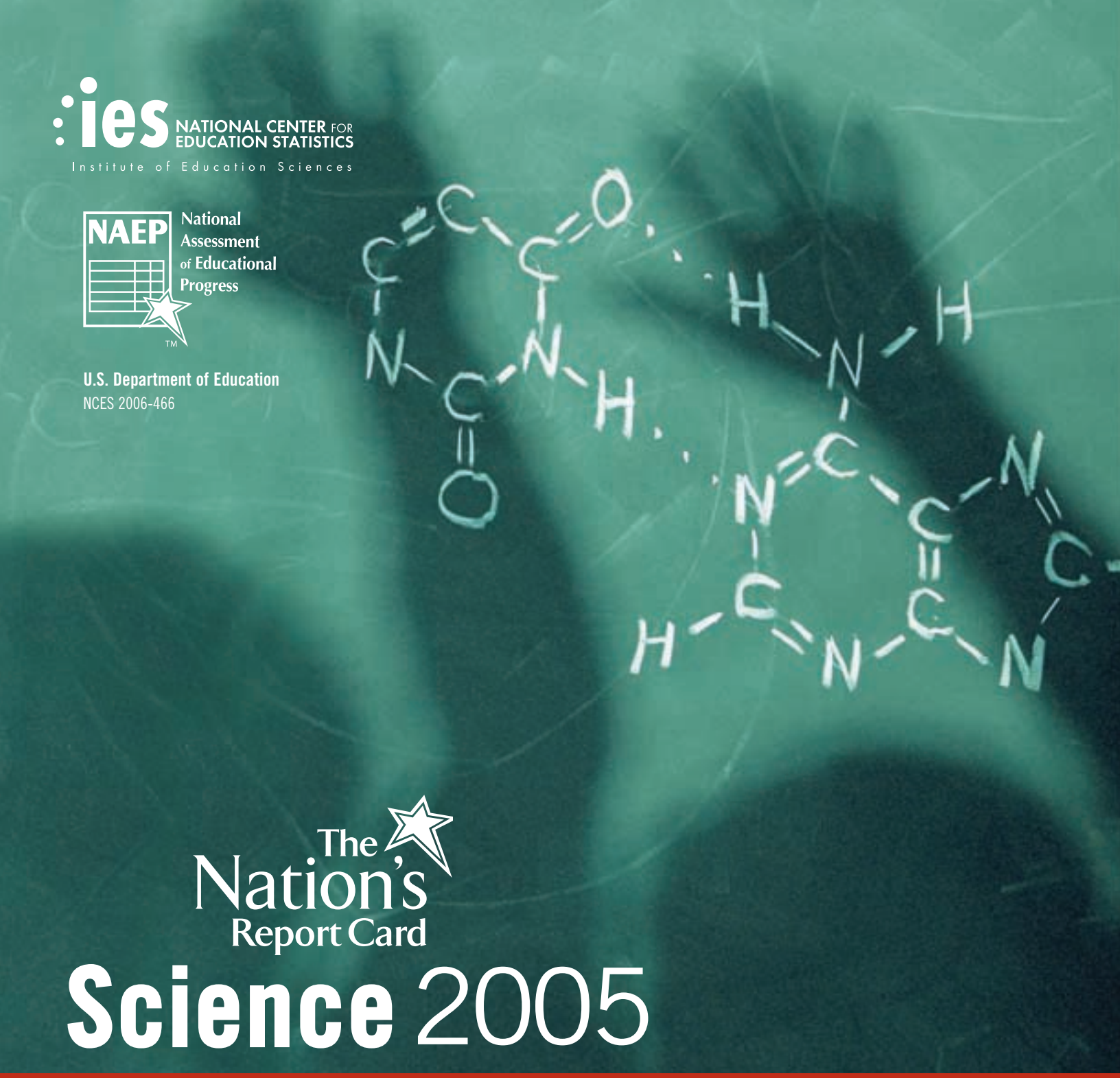


The Nation's Report Card

Science 2005

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

Contents

MAY 2006

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.

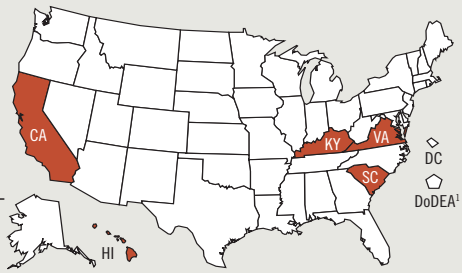
At grade 8, there was no overall improvement. In 2005, 59 percent of students scored at or above the *Basic* level. An example of the knowledge and skills at the *Basic* level is being able to compare changes in heart rate before, during, and after exercise. Twenty-nine percent performed at or above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

	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	↔	↓	↔	↔	↔	↔

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



[1] Department of Defense Education Activity.

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

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 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.

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.

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

Knowing and doing science

	Earth	Physical	Life
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/itmrls/.

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.