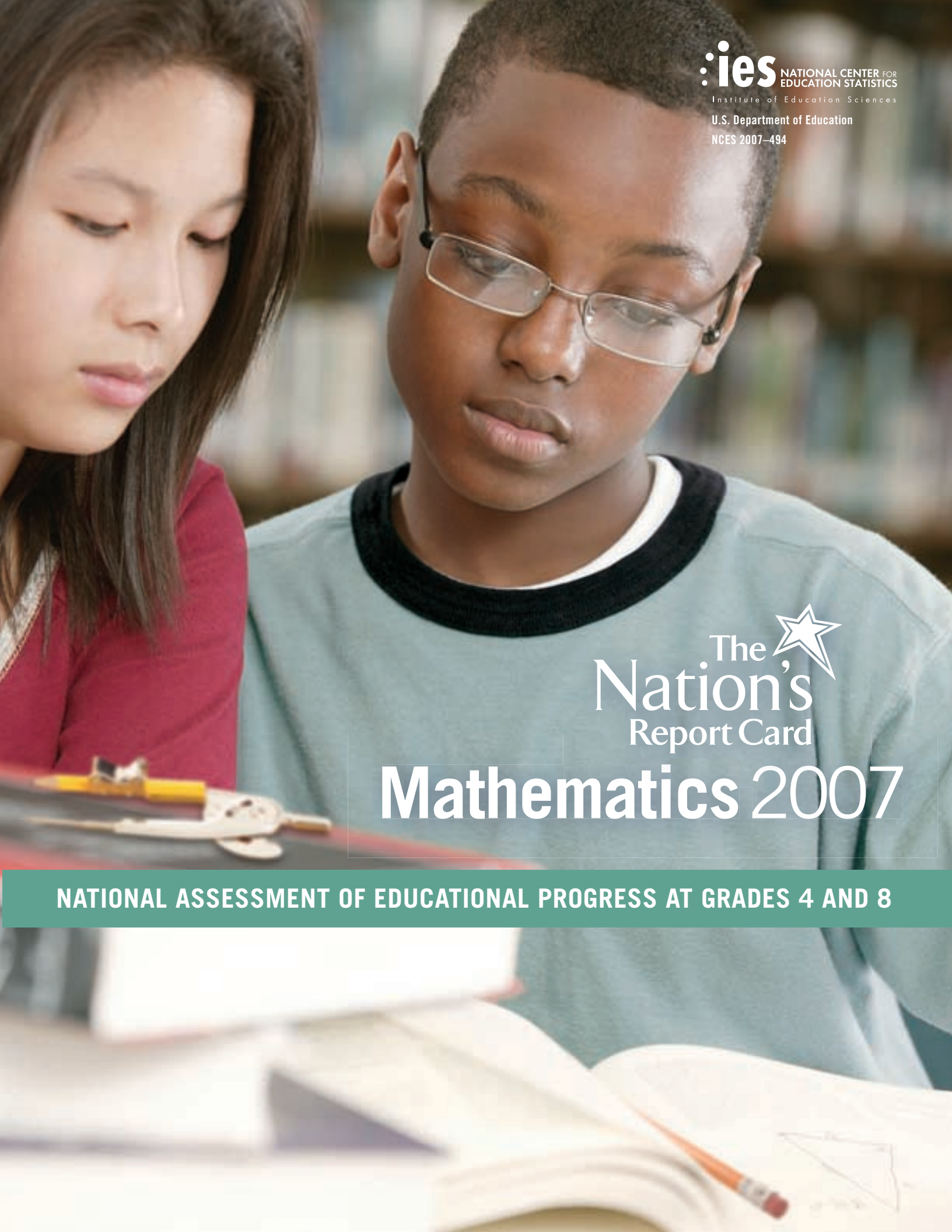
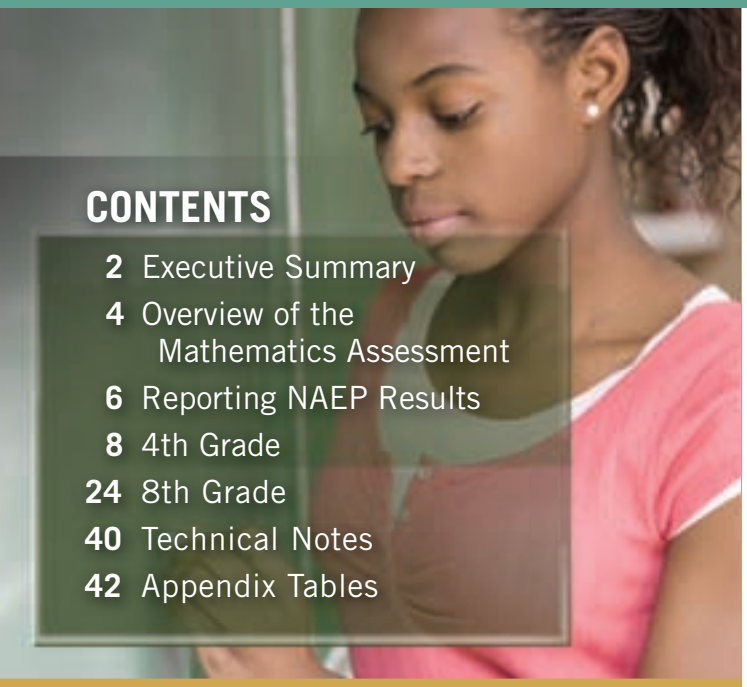


ies NATIONAL CENTER FOR EDUCATION STATISTICS
Institute of Education Sciences
U.S. Department of Education
NCES 2007–494

The Nation's Report Card

Mathematics 2007

NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS AT GRADES 4 AND 8



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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.

For over three decades, NAEP assessments have been conducted periodically in reading, mathematics, science, writing, U.S. history, civics, geography, and other subjects. By collecting and reporting information 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 and their families is protected, and the identities of participating schools are not released.

NAEP is a congressionally authorized 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 oversees and sets policy for NAEP.

Executive Summary

Both fourth- and eighth-graders reached a higher level of performance in 2007 compared to earlier assessment years.

The 2007 National Assessment of Educational Progress (NAEP) evaluated students' understanding of mathematics concepts and their ability to apply mathematics to everyday situations. Students demonstrated their knowledge of these critical skills by responding to questions about number properties and operations, measurement, geometry, data analysis and probability, and algebra.

A nationally representative sample of more than 350,000 students at grades 4 and 8 participated in the 2007 mathematics assessment. Comparing these results to results from previous years shows the progress fourth- and eighth-graders are making both in the nation and in individual states.

The average score for fourth-graders increased 27 points over the past 17 years, and the score for eighth-graders increased 19 points. Students at all levels of performance made gains, resulting in higher percentages of students at or above the *Basic* and *Proficient* achievement levels.

Student groups make gains, few gaps narrow

As indicated in the chart on the following page, improvements for minority students did not always result in narrower achievement gaps with White students. White, Black, and Hispanic students at both grades showed a better understanding of mathematics in 2007 when compared to all previous assessment years. However, when compared to the first assessment year in 1990, only the White – Black score gap at grade 4 narrowed in 2007. The White – Black score gap at grade 8 narrowed between 2005 and 2007.

The mathematics score for Asian/Pacific Islander students was higher in 2007 than in previous assessment years for grade 4, but at grade 8 showed no significant change from 2005 to 2007.

Student groups	Grade 4		Grade 8	
	Since 1990	Since 2005	Since 1990	Since 2005
Overall	↑	↑	↑	↑
White	↑	↑	↑	↑
Black	↑	↑	↑	↑
Hispanic	↑	↑	↑	↑
Asian/Pacific Islander	↑	↑	↑	↔
American Indian/ Alaska Native	‡	↔	‡	↔
Gaps				
White – Black	↓	↔	↔	↓
White – Hispanic	↔	↔	↔	↔

↑ Indicates the score was higher or the gap increased in 2007.

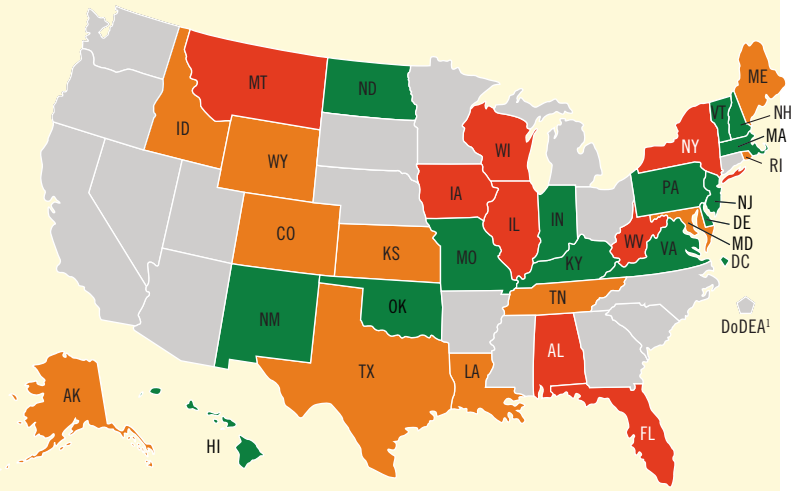
↓ Indicates the score was lower or the gap decreased in 2007.

↔ Indicates there was no significant change in the score or the gap in 2007.

‡ Reporting standards not met. Sample size was insufficient to permit a reliable estimate.

At both grades 4 and 8, scores rose for students regardless of their eligibility for the free and reduced-price school lunch program, a measure of socioeconomic status. Average scores were higher in 2007 than in 2005 for students who were eligible as well as for students who were not eligible.

FIFTEEN STATES AND JURISDICTIONS MAKE GAINS AT BOTH GRADES



[1] Department of Defense Education Activity (overseas and domestic schools).

Compared with 2005,

- 14 states and the District of Columbia improved at both grades,
- 8 states improved at grade 4 only,
- 11 states improved at grade 8 only, and
- 17 states and Department of Defense schools showed no significant change at either grade.

No states showed score decreases.

Differing patterns emerged when results were examined by different mathematics content areas. For example, 9 of the 29 states and jurisdictions that showed no change in overall performance at grade 4 did show a gain in at least one of the five content areas.

EXAMPLES OF WHAT STUDENTS CAN DO IN MATHEMATICS

GRADE 4

80% identified a fraction modeled by a picture

64% determined the probability of a specific outcome

43% explained how to find the perimeter of a given shape

GRADE 8

71% estimated time given a rate and a distance

54% computed the measure of an angle in a figure

25% identified the graph of a linear equation

Overview of the Mathematics Assessment

With the belief that mathematics proficiency is integral to contemporary life, the NAEP mathematics assessment was designed to measure students' knowledge and skills in mathematics and their ability to apply their knowledge and skills in problem-solving situations.

The Mathematics Framework

The NAEP mathematics framework serves as the blueprint for the assessment, describing the specific mathematical skills that should be assessed at grades 4 and 8. Developed under the direction of the National Assessment Governing Board, the framework incorporates ideas and input from mathematicians, school administrators, policymakers, teachers, parents, and others.

The current NAEP mathematics framework was first used to guide the development of the 1990 assessment and has continued to be used through 2007. Updates to the framework over the years have provided more detail regarding the assessment design but did not change the content, allowing students' performance in 2007 to be compared with previous years. For more information on the framework, visit http://www.nagb.org/frameworks/math_07.pdf.

The framework details the mathematics objectives appropriate for grades 4 and 8. The topics covered by the framework include properties of numbers and operations, proportional reasoning, systems of measurement, relationships between geometric figures, data representation, probability, algebraic representations, equations and inequalities, and mathematical reasoning in various content areas.

Two dimensions of mathematics, *content areas* and *mathematical complexity*, are used to guide the assessment. Each item is designed to measure one of the five content areas. However, certain aspects of mathematics, such as computation, occur in all content areas. The level of complexity of a mathematics question is determined by the cognitive demands that it places on students.

MATHEMATICS CONTENT AREAS

Number properties and operations measures students' understanding of ways to represent, calculate, and estimate with numbers.

Measurement measures students' knowledge of measurement attributes, such as capacity and temperature, and geometric attributes, such as length, area, and volume.

Geometry measures students' knowledge and understanding of shapes in a plane and in space.

Data analysis and probability measures students' understanding of data representation, characteristics of data sets, experiments and samples, and probability.

Algebra measures students' understanding of patterns, using variables, algebraic representation, and functions.

LEVELS OF MATHEMATICAL COMPLEXITY

Low complexity questions typically specify what a student is to do, which is often to carry out a routine mathematical procedure.

Moderate complexity questions involve more flexibility of thinking and often require a response with multiple steps.

High complexity questions make heavier demands and often require abstract reasoning or analysis in a novel situation.

Assessment Design

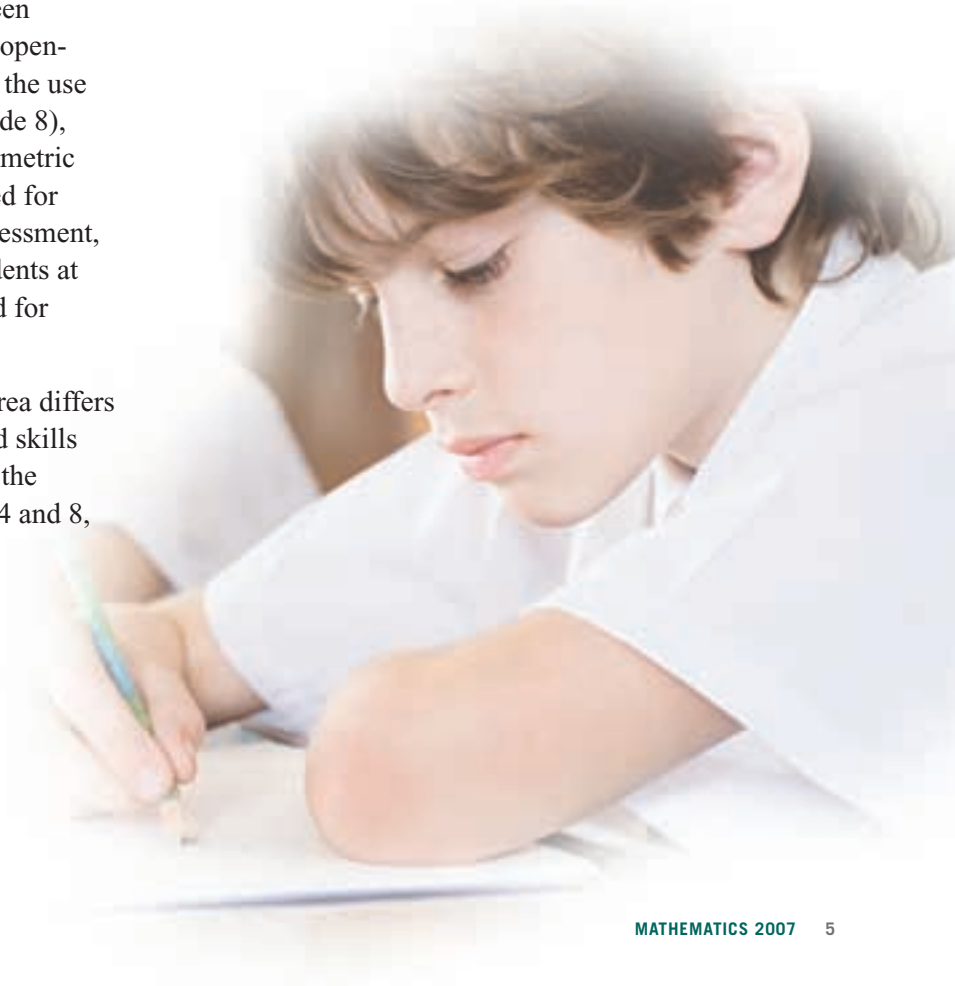
Because of the breadth of the content covered in the NAEP mathematics assessment, each student took just a portion of the test, consisting of two 25-minute sections. Testing time was divided evenly between multiple-choice and constructed-response (i.e., open-ended) questions. Some questions incorporated the use of rulers (at grade 4) or ruler/protractors (at grade 8), and some questions incorporated the use of geometric shapes or other manipulatives that were provided for students. On approximately one-third of the assessment, a four-function calculator was provided for students at grade 4, and a scientific calculator was provided for students at grade 8.

The distribution of items among each content area differs somewhat by grade to reflect the knowledge and skills appropriate for each grade level. Table 1 shows the distribution across the content areas for grades 4 and 8, as recommended in the framework.

Table 1. Target percentage distribution of NAEP mathematics questions, by grade and content area: 2007

Content area	Grade 4	Grade 8
Number properties and operations	40%	20%
Measurement	20%	15%
Geometry	15%	20%
Data analysis and probability	10%	15%
Algebra	15%	30%

SOURCE: U.S. Department of Education, National Assessment Governing Board, Mathematics Framework for the 2007 National Assessment of Educational Progress, 2006.



Reporting NAEP Results

The students selected to take the NAEP assessment represent all fourth- and eighth-grade students across the U.S. Students who participate in NAEP play an important role by demonstrating the achievement of our nation's students and representing the success of our schooling. NAEP data can only be obtained with the cooperation of schools, teachers, and students nationwide.

Representative samples of schools and students at grades 4 and 8 participated in the 2007 NAEP mathematics assessment (table 2). The national results reflect the performance of all fourth- and eighth-graders in public schools, private schools, Bureau of Indian Education schools, and Department of Defense schools. The state results reflect the performance of students in public schools only.

Table 2. **Number of participating schools and students in NAEP mathematics assessment, by grade: 2007**

Grade	Schools	Students
Grade 4	7,840	197,700
Grade 8	6,910	153,000

NOTE: The numbers of schools are rounded to the nearest ten, and the numbers of students are rounded to the nearest hundred.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2007 Mathematics Assessment.

National results from the 2007 mathematics assessment are compared to results from six previous assessment years for both grades 4 and 8. The 2007 state results are compared to results from five earlier assessments at grade 4 and six earlier assessments at grade 8. Changes in students' performance over time are summarized by comparing the results in 2007 to the next most recent assessment and the first assessment, except when pointing out consistent patterns across all assessments.

Scale Scores

NAEP mathematics results are reported on a 0–500 scale, overall and for each of the five content areas. Because NAEP scales are developed independently for each subject and for each content area within a subject, the scores cannot be compared across subjects or across content areas within the same subject. Results are also reported at five percentiles (10th, 25th, 50th, 75th, and 90th) to show trends in performance for lower-, middle-, and higher-performing students.

Achievement Levels

Based on recommendations from policymakers, educators, and members of the general public, the Governing Board sets specific achievement levels for each subject area and grade. Achievement levels are performance standards showing what students should know and be able to do. They provide another perspective with which to interpret student performance. NAEP results are reported as percentages of students performing at or above the *Basic* and *Proficient* levels and at the *Advanced* level.

NAEP ACHIEVEMENT LEVELS

Basic denotes partial mastery of prerequisite 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 represents superior performance.

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. The NAEP achievement levels have been widely used by national and state officials.

Item Maps

Item maps provide another way to interpret the scale scores and achievement-level results for each grade. The item maps displayed in each grade section of this report show student performance on NAEP mathematics questions at different points on the scale.

Accommodations and Exclusions in NAEP

Testing accommodations, such as extra testing time or individual rather than group administration, are provided for students with disabilities or English language learners who could not fairly and accurately demonstrate their abilities without modified test administration procedures. Prior to 1996, no testing accommodations were provided in the NAEP mathematics assessment. This resulted in the exclusion of some students. In 1996, administration procedures were introduced at the national level allowing certain accommodations for students requiring such accommodations to participate. Accommodations for state level assessments began in 2000.

Note that most figures in this report show two data points in 1996—one permitting and the other not permitting accommodations. Both 1996 data points are presented in this report, but comparisons between 1996 and 2007 are based on accommodated samples.

Even with the availability of accommodations, there still remains a portion of students excluded from the NAEP assessment. Variations in exclusion and accommodation rates, due to differences in policies and practices regarding the identification and inclusion of students with disabilities and English language learners, should be considered when comparing students' performance over time and across states. While the effect of exclusion is not precisely known, comparisons of performance results could be affected if exclusion rates are comparatively high or vary widely over time. See appendix tables A-1 through A-5 for the percentages of students accommodated and excluded at the national and state levels. More information about NAEP's policy on inclusion of special-needs students is available at http://nces.ed.gov/nationsreportcard/about/inclusion.asp.

Interpreting Results

Changes in performance results over time may reflect not only changes in students' knowledge and skills but also other factors, such as changes in student demographics, education programs and policies (including policies on accommodations and exclusions), and teacher qualifications.

NAEP results adopt widely accepted statistical standards; findings are reported based on a statistical significance level set at .05 with appropriate adjustments for multiple comparisons. In the tables and figures of this report that present results over time, the symbol (*) is used to indicate that a score or percentage in a previous assessment year is significantly different from the comparable measure in 2007. This symbol is also used in tables to highlight differences between male and female students within 2007. As a result of larger student sample sizes beginning in 2003, smaller differences (e.g., 1 or 2 points) can be found statistically significant than would have been detected with the smaller sample sizes used in earlier assessments.

Score differences or gaps cited in this report are calculated based on differences between unrounded numbers. Therefore, the reader may find that the score difference cited in the text may not be identical to the difference obtained from subtracting the rounded values shown in the accompanying tables or figures.

Not all of the data for results discussed in this report are presented in corresponding tables or figures. These and other results can be found in the NAEP Data Explorer at http://nces.ed.gov/nationsreportcard/nde.

For additional information, visit http://nationsreportcard.gov.