Mathematics Highlights

The Nation's Report Card 2000

National Center for Education Statistics

INSIDE THIS ISSUE

	Page
Average Scale Scores	1
Students Reaching NAEP Achievement Levels	2
Percentiles and Mathematics Performance	3
2000 Assessment	3
State Results	4
Student Subgroup Findings	8
Home and School Factors	11
Sample Test Questions	13
NAEP on the Web	16

National Assessment of Educational Progress

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).

NAEP 2000 Mathematics Assessment Results Released

Results for the 2000 National Assessment of Educational Progress (NAEP) mathematics assessment show overall gains in fourth-, eighth-, and twelfth-graders' average scores since 1990, the first year in which the current mathematics assessment was administered. Twelfth-graders' performance, however, has declined since 1996.

✪ Significantly different from 2000.

NOTE: The average scores are based on the NAEP math scale, which ranges from 0-500.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990–2000 Math Assessments.

National scores in 2000 were higher* than in 1996, 1992, or 1990 for fourth- and eighth-graders. This was not the case for twelfth-graders. The average score for high school seniors was lower in 2000 than in 1996. However, twelfth-graders' average score was higher in 2000 than in 1990.

* Only statistically significant differences are cited in this report.

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

NCES 2001-518

Achievement Levels Provide Yardstick of Student Performance

Achievement levels provide a context for interpreting students' performance on NAEP. These performance standards, set by NAGB 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.

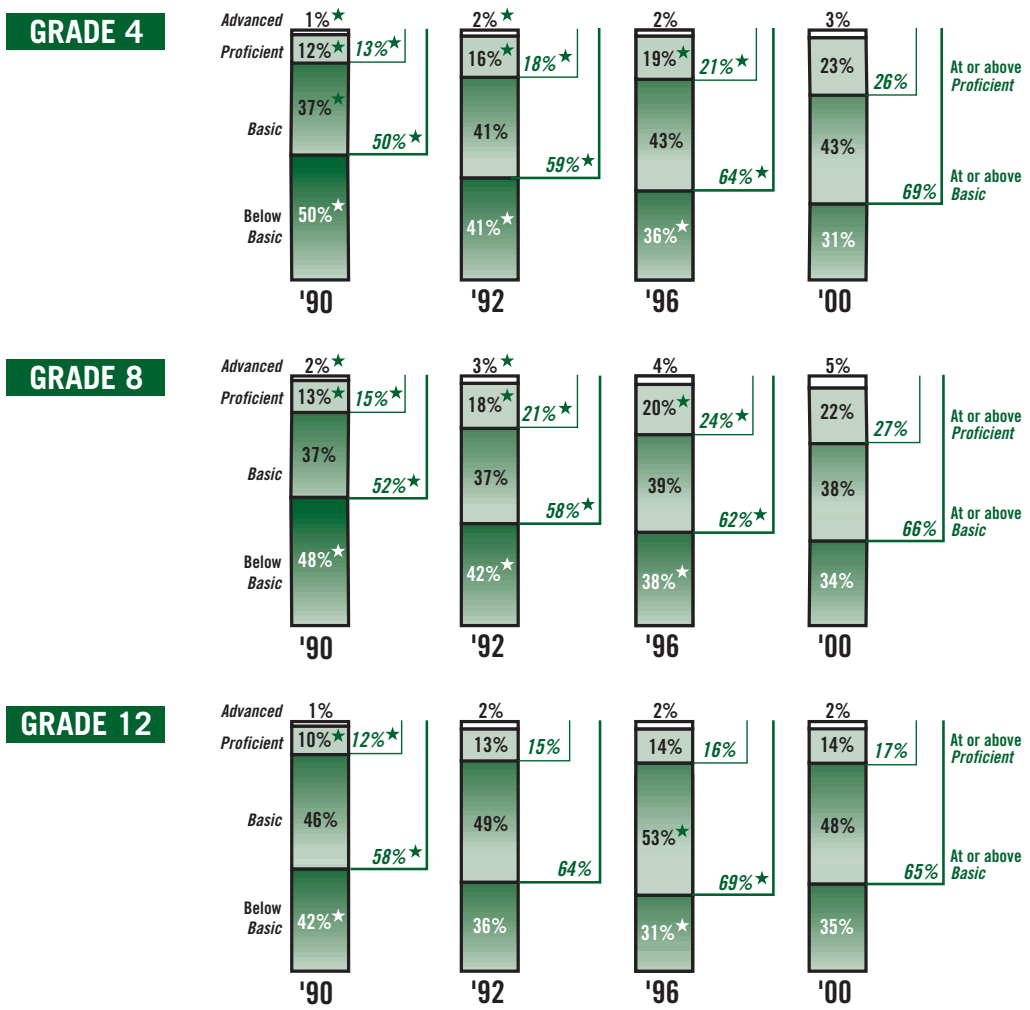
As provided by law, the Acting Commissioner of Education Statistics, upon review of a congressionally mandated evaluation of NAEP, has determined that the achievement levels are to be considered developmental and should be interpreted and used with caution.

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.

More Fourth- and Eighth-Graders Attain Higher Achievement Levels; Results Mixed for Twelfth-Graders

The percentages of fourth- and eighth-graders at or above *Basic* and at or above *Proficient* have increased across the decade, reaching their highest levels in both grades in 2000. At grade 12, the results are mixed. From 1996 to 2000 there was a decrease in the percentage at or above *Basic*. However, the percentage of twelfth-graders at or above both *Basic* and *Proficient* was higher in 2000 than in 1990.

Percentage of Students Within and at or Above Achievement Levels, Grades 4, 8, and 12: 1990–2000



★ Significantly different from 2000.

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

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.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990–2000 Mathematics 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.

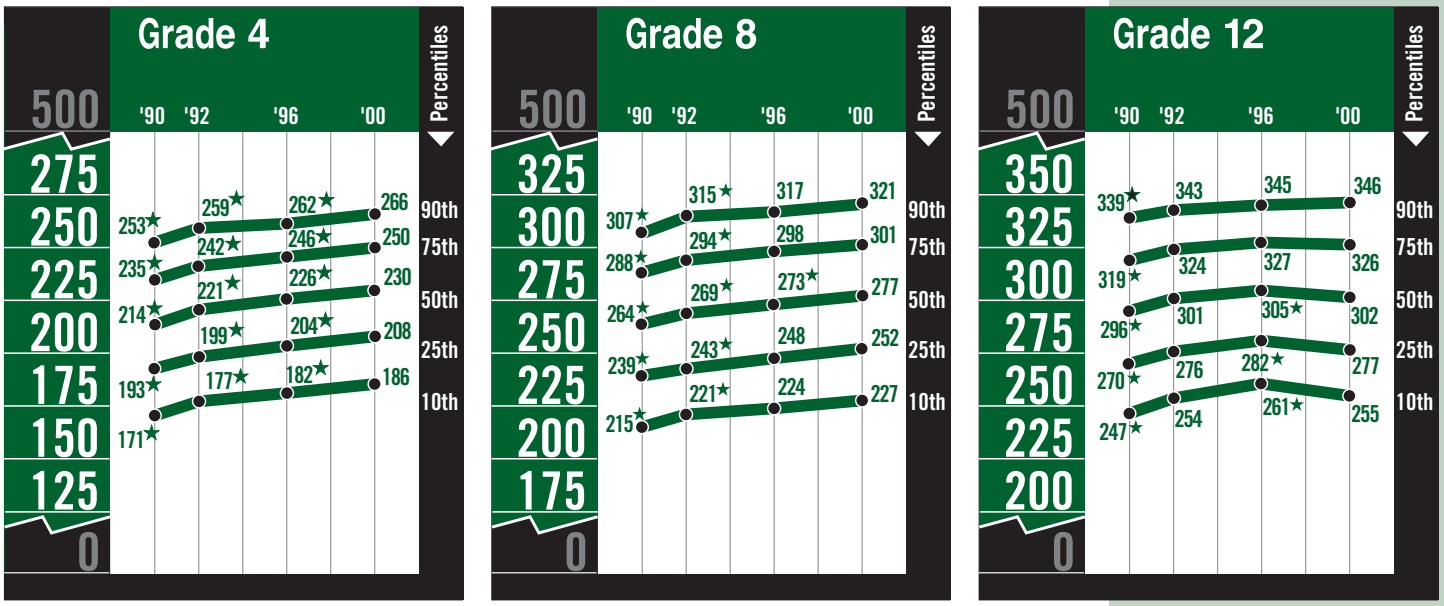
Advanced: This level signifies superior performance.

Both Higher- and Lower-Performing Students Show Overall Improvement

The gains in average mathematics scores at all three grades since 1990 are reflected in students' performance across the score distribution. Lower-, middle-, and higher-performing students had higher scores in 2000 than in 1990. This finding is the result of analyzing scores at percentiles, or points across the score distribution, on the NAEP mathematics scale.

The score increases seen since 1990 for fourth-, eighth-, and twelfth-graders were evident across the score distribution (the 10th, 25th, 50th, 75th, and 90th percentiles). However, the decline at grade 12 since 1996 occurred in the lower and middle points of the distribution (the 10th, 25th, and 50th percentiles).

Percentile Scores, Grades 4, 8, and 12: 1990–2000



★ Significantly different from 2000.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990–2000 Mathematics Assessments.

2000 Assessment Designed to Study Students' Mathematical Knowledge and Abilities

The NAEP Mathematics Framework specifies that each question be classified as belonging to one of five content strands:

1) number sense, properties, and operations;
2) measurement;
3) geometry and spatial sense;
4) data analysis, statistics, and probability; and
5) algebra and functions.

The design of the 2000 mathematics assessment allowed for the reporting of results that included performance data for special-needs students (that is, students identified by their school as having a disability or being limited-English proficient) who took the NAEP with accommodations as well as for those students who took the NAEP without accommodations. Results that include the performance of special-needs students who were assessed with accommodations are discussed in detail in *The Nation's Report Card: Mathematics 2000*. The results presented in this *Highlights* do not include results for students who participated with accommodations. This was done so that comparisons can be made to past assessment results, which did not include accommodated students.

The 2000 mathematics assessment was conducted nationally at grades 4, 8, and 12 and state-by-state at grades 4 and 8. The national assessment included representative samples of both public and nonpublic schools, while the state-by-state assessment included public schools only.

2000 Assessment Includes Results for Participating States and Other Jurisdictions

In addition to national results on students' mathematics performance, the 2000 assessment collected performance data for fourth- and eighth-graders who attended public schools in states and other jurisdictions (including U.S. territories, such as the Virgin Islands, Guam, and American Samoa; Department of Defense domestic and overseas schools; and the District of Columbia). In 2000, 40 states and 6 other jurisdictions participated at grade 4 and 39 states and 5 other jurisdictions participated at grade 8.

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 participated in the assessment, beginning with 1992 for grade 4 and 1990 for grade 8. It is important to note that results are presented for students attending public schools only, and that those results represent only those students who were assessed under standard conditions—whether or not they were identified as special-needs students. Results that include the performance of special-needs students who were assessed with accommodations are presented in *The Nation's Report Card: Mathematics 2000*.

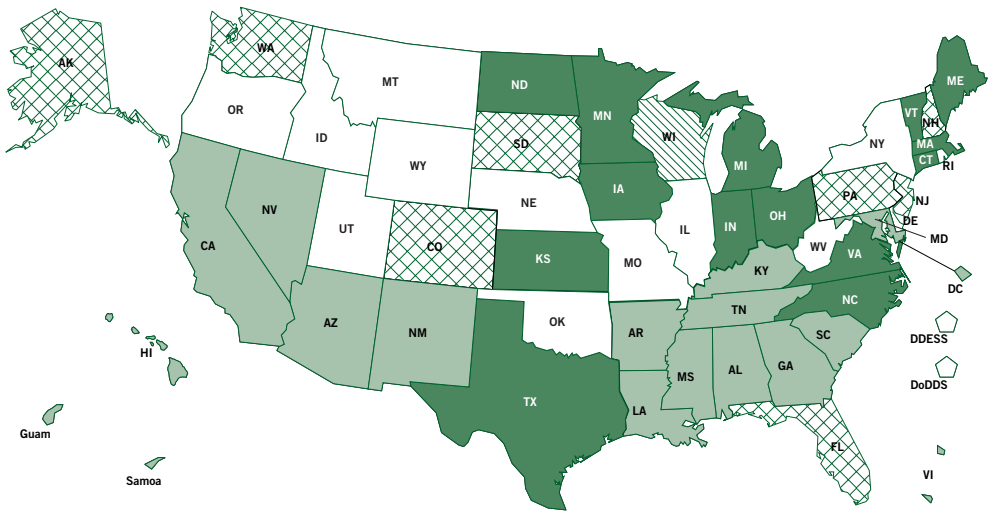
continued ▶

Table A: State Average Score Results, Grade 4 Public Schools: 1992–2000

	1992	1996	2000
Nation–public schools	219 *	222 *	226
Alabama	208 ‡	212 ‡	218
Alaska	—	224	—
Arizona	215	218	219
Arkansas	210 ‡	216	217
California †	208 ‡	209	214
Colorado	221	226	—
Connecticut	227 ‡	232	234
Delaware	218	215	—
Florida	214	216	—
Georgia	216 ‡	215 *	220
Hawaii	214	215	216
Idaho †	222 ‡	—	227
Illinois †	—	—	225
Indiana †	221 ‡	229 ‡	234
Iowa †	230	229 *	233
Kansas †	—	—	232
Kentucky	215 ‡	220	221
Louisiana	204 ‡	209 ‡	218
Maine †	232	232	231
Maryland	217 ‡	221	222
Massachusetts	227 ‡	229 ‡	235
Michigan †	220 ‡	226 *	231
Minnesota †	228 ‡	232	235
Mississippi	202 ‡	208	211
Missouri	222 ‡	225 *	229
Montana †	—	228	230
Nebraska	225	228	226
Nevada	—	218	220
New Hampshire	230	—	—
New Jersey	227	227	—
New Mexico	213	214	214
New York †	218 ‡	223 *	227
North Carolina	213 ‡	224 ‡	232
North Dakota	229	231	231
Ohio †	219 ‡	—	231
Oklahoma	220 ‡	—	225
Oregon †	—	223	227
Pennsylvania	224	226	—
Rhode Island	215 ‡	220 *	225
South Carolina	212 ‡	213 ‡	220
Tennessee	211 ‡	219	220
Texas	218 ‡	229 *	233
Utah	224 *	227	227
Vermont †	—	225 ‡	232
Virginia	221 ‡	223 ‡	230
Washington	—	225	—
West Virginia	215 ‡	223	225
Wisconsin †	229	231	—
Wyoming	225 ‡	223 ‡	229
Other Jurisdictions			
American Samoa	—	—	157
District of Columbia	193	187 ‡	193
DDESS	—	224 *	228
DoDDS	—	223 ‡	228
Guam	193 ‡	188	184
Virgin Islands	—	—	183

* 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.
† 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.
NOTE: Comparative performance results may be affected by 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), 1992–2000 Mathematics Assessments.

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



NOTE: Caution should be exercised when interpreting comparisons among states and other jurisdictions. NAEP performance estimates are not adjusted to account for the socioeconomic, demographic, or geographic differences among states and jurisdictions.

DDESS: Department of Defense Domestic Dependent Elementary and Secondary Schools. DoDDS: Department of Defense Dependent 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 Mathematics Assessment.

Average Score Results

Table A and figure A on page 4 present average score results for fourth-graders. Table A shows scores for those states and other jurisdictions that participated in the 1992, 1996, and 2000 assessments. For 2000, the nine highest-scoring states whose scores did not differ from one another include Connecticut, Indiana, Iowa, Kansas, Massachusetts, Minnesota, North Carolina, Texas, and Vermont.

Figure A indicates states' and other jurisdictions' 2000 average score performance in comparison to the nation. Of the 46 states and jurisdictions that participated in the 2000 assessment, 14 had scores that were higher than the national average score, 14 had scores that were not different from the national average, and 18 had scores that were lower than the national average.

Table B and figure B on this page present average score results for eighth-graders. Table B shows the scores for states and other jurisdictions that participated in the 1990, 1992, 1996, and 2000 assessments. In 2000, the three highest-performing states whose scores did not differ from each other were Kansas, Minnesota, and Montana.

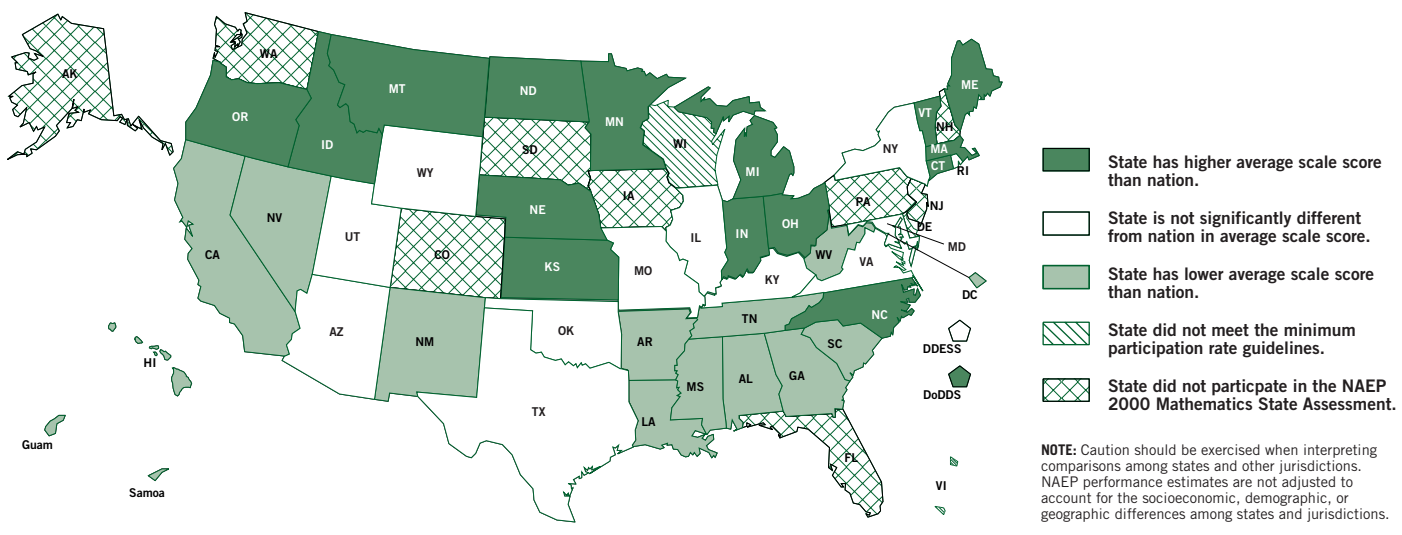
Figure B shows that of the 44 states and other jurisdictions that participated in the 2000 assessment, 16 had scores that were higher than the national average score, 13 had scores that were not different from the national average, and 15 had scores that were lower than the national average.

Table B: State Average Score Results, Grade 8 Public Schools: 1990–2000

	1990	1992	1996	2000
Nation–public schools	262 *	267 *	271 *	274
Alabama	253 ‡	252 ‡	257	262
Alaska	—	—	278	—
Arizona †	260 ‡	265 ‡	268	271
Arkansas	256 ‡	256 ‡	262	261
California †	256 ‡	261	263	262
Colorado	267	272	276	—
Connecticut	270 ‡	274 ‡	280	282
Delaware	261	263	267	—
Florida	255	260	264	—
Georgia	259 ‡	259 ‡	262	266
Hawaii	251 ‡	257 ‡	262	263
Idaho †	271 ‡	275	—	278
Illinois †	261 ‡	—	—	277
Indiana †	267 ‡	270 ‡	276 ‡	283
Iowa	278	283	284	—
Kansas †	—	—	—	284
Kentucky	257 ‡	262 ‡	267 ‡	272
Louisiana	246 ‡	250 ‡	252 ‡	259
Maine †	—	279 ‡	284	284
Maryland	261 ‡	265 ‡	270 ‡	276
Massachusetts	—	273 ‡	278 ‡	283
Michigan †	264 ‡	267 ‡	277	278
Minnesota †	275 ‡	282 ‡	284	288
Mississippi	—	246 ‡	250 *	254
Missouri	—	271	273	274
Montana †	280 ‡	—	283 *	287
Nebraska	276 ‡	278	283	281
Nevada	—	—	—	268
New Hampshire	273	278	—	—
New Jersey	270	272	—	—
New Mexico	256	260	262	260
New York †	261 ‡	266 ‡	270 *	276
North Carolina	250 ‡	258 ‡	268 ‡	280
North Dakota	281	283	284	283
Ohio	264 ‡	268 ‡	—	283
Oklahoma	263 ‡	268	—	272
Oregon †	271 ‡	—	276	281
Pennsylvania	266	271	—	—
Rhode Island	260 ‡	266 ‡	269 ‡	273
South Carolina	—	261 ‡	261 ‡	266
Tennessee	—	259 *	263	263
Texas	258 ‡	265 ‡	270 *	275
Utah	—	274	277	275
Vermont †	—	—	279 ‡	283
Virginia	264 ‡	268 ‡	270 ‡	277
Washington	—	—	276	—
West Virginia	256 ‡	259 ‡	265 ‡	271
Wisconsin †	274	278	283	—
Wyoming	272 ‡	275	275	277
Other Jurisdictions				
American Samoa	—	—	—	195
District of Columbia	231	235	233	234
DDESS	—	—	269 ‡	277
DoDDS	—	—	275 ‡	278
Guam	232	235	239	233
Virgin Islands †	219	223	—	—

* 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.
† 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.
NOTE: Comparative performance results may be affected by 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), 1990–2000 Mathematics Assessments.

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



NOTE: Caution should be exercised when interpreting comparisons among states and other jurisdictions. NAEP performance estimates are not adjusted to account for the socioeconomic, demographic, or geographic differences among states and jurisdictions.

DDESS: Department of Defense Domestic Dependent Elementary and Secondary Schools. DoDDS: Department of Defense Dependent 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 Mathematics Assessment.

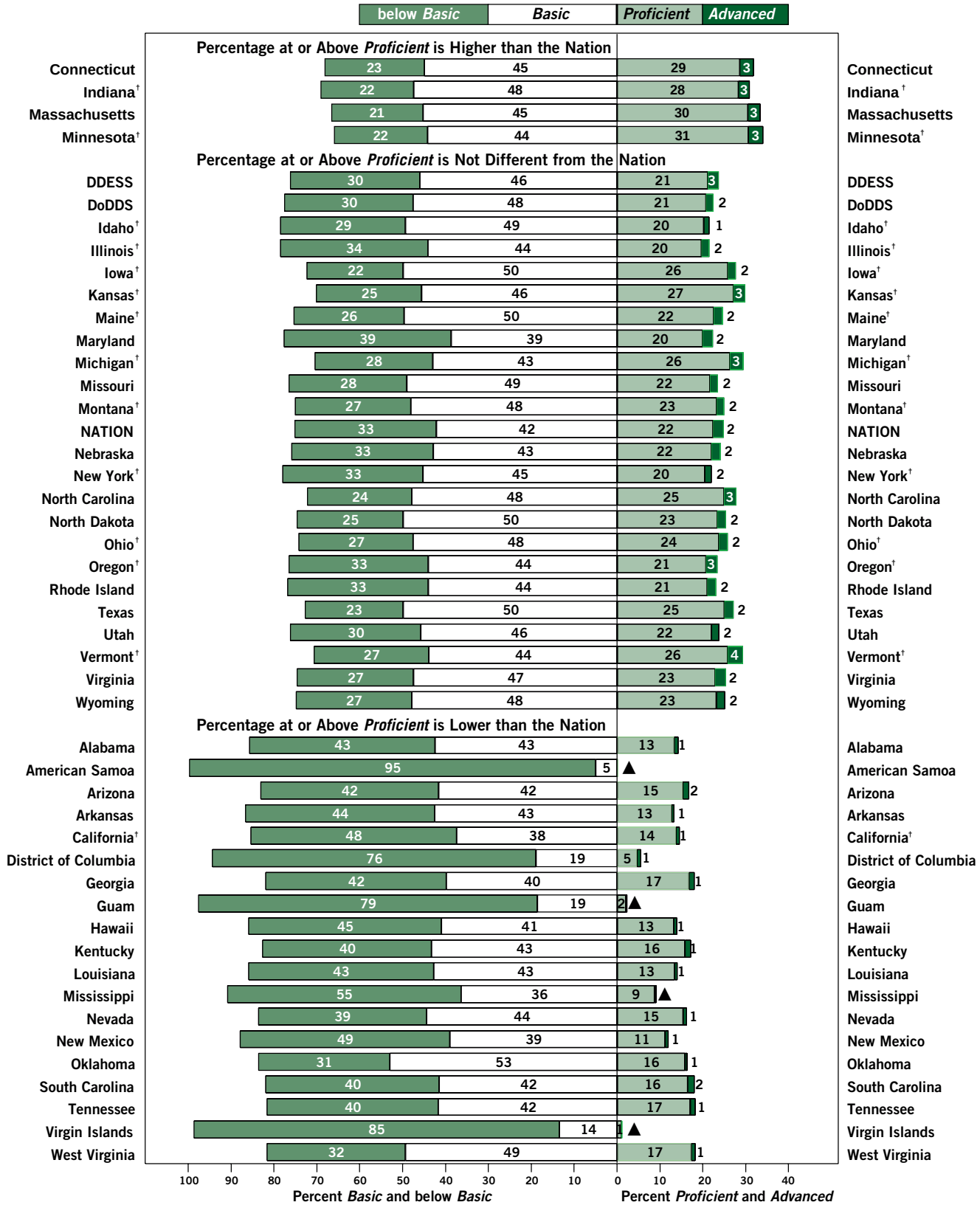
Achievement Level Results

Figures C and D present the achievement level results for the states and other jurisdictions that participated in the 2000 mathematics 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 level ranges: *Basic*, *Proficient*, and *Advanced* as well as the students 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 of states' and other jurisdictions' percentages of

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 mathematics achievement category. Each population of students is aligned at the point where the *Proficient* category begins, so that they may be compared at *Proficient* and above.



† 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.
DDESS: Department of Defense Domestic Dependent Elementary and Secondary Schools.
DoDDS: Department of Defense Dependents Schools (Overseas).
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment.

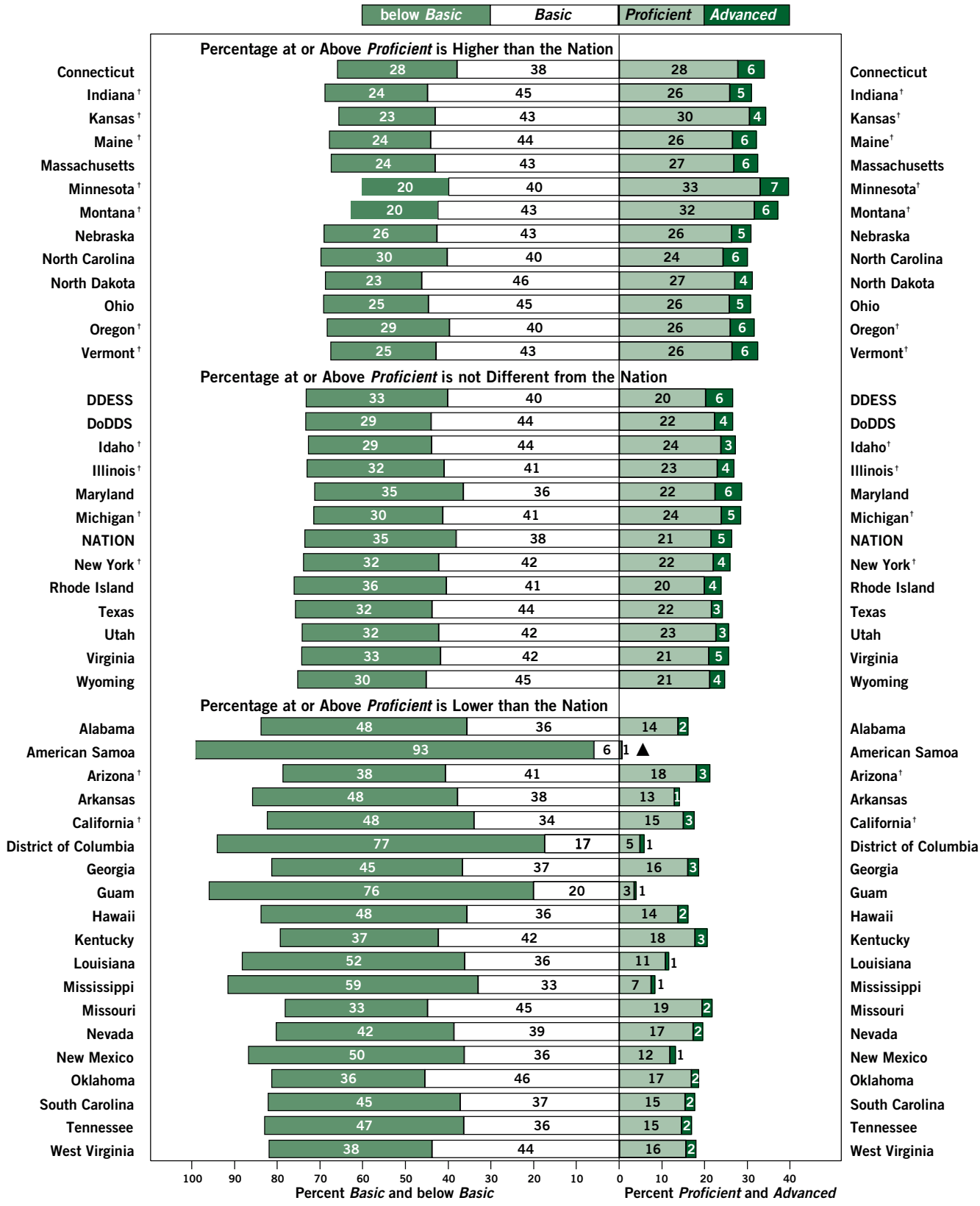
students at or above *Proficient*—the achievement level identified by the National Assessment Governing Board as the standard all students should reach.

At grade 4, as shown in figure C, 4 states and other jurisdictions had higher percentages of students at or above *Proficient* than the nation, 23 had percentages that were not different from that for the nation, and 19 had percentages that were lower than the nation.

At grade 8, as shown in figure D, 13 states and other jurisdictions had higher percentages of students at or above *Proficient* than the nation, 12 had percentages that were not different from the nation, and 19 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 mathematics achievement category. Each population of students is aligned at the point where the *Proficient* category begins, so that they may be compared at *Proficient* and above.



† 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.
DDESS: Department of Defense Domestic Dependent Elementary and Secondary Schools.
DoDDS: Department of Defense Dependents Schools (Overseas).
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment.

race/ethnicity

Subgroup Data Reveal How Various Groups of Students Performed on NAEP

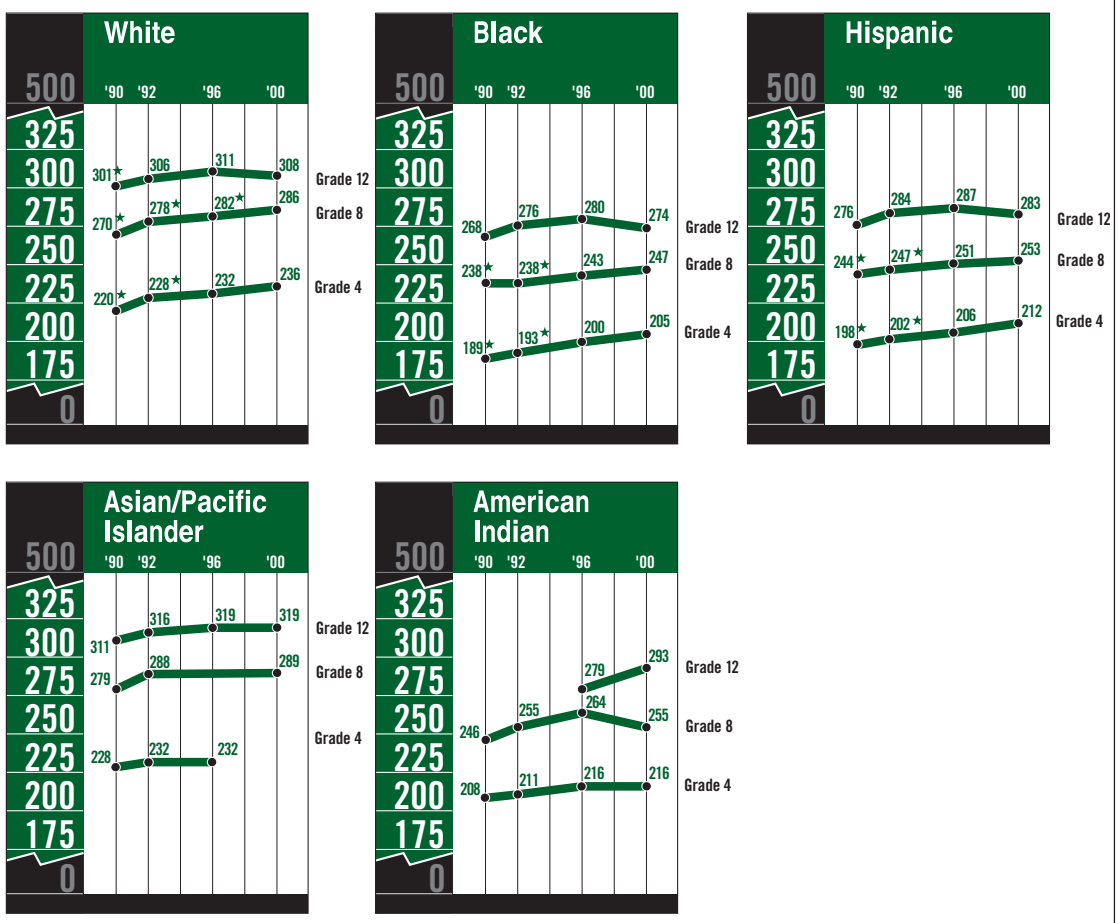
In addition to presenting information about all students' performance, NAEP also looks at the achievement of various subgroups of students. The performance of various racial/ethnic subgroups, and of males and females reveals how these students have done in comparison to each other in the year 2000 and whether they have progressed over the past decade.

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

Mathematics Scores by Race/Ethnicity

Of the five racial/ethnic subgroups of students identified in the 2000 mathematics assessment, three—white, black, and Hispanic—had average scores that showed overall gains since 1990. While white students were the only subgroup whose average scores were higher in 2000 than 1990 at all three grades, black and Hispanic students' average scores were higher than in 1990 at grades 4 and 8. Comparing performance across the subgroups of students in 2000 shows that white and Asian/Pacific Islander students scored higher, on average, than black, Hispanic, and American Indian students at grades 8 and 12, and Asian/Pacific Islander students scored higher than white students at grade 12.

Average Mathematics Scores by Race/Ethnicity, Grades 4,8, and 12: 1990–2000



★ Significantly different from 2000.

NOTE: Sample size was insufficient to permit a reliable estimate for American Indian students in 1990 and 1992 at grade 12.

Special analyses raised concerns about the accuracy and precision of national grade 8 Asian/Pacific Islander results in 1996, and grade 4 Asian/Pacific Islander results in 2000. As a result, they are omitted from this report. See the 2000 mathematics report card for a more detailed discussion.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990–2000 Mathematics Assessments.

Achievement Level Results by Race/Ethnicity

The mathematics achievement of students in the racial/ethnic subgroups is similar to their average score performance—while there have been improvements over the past 10 years, not all groups have improved in all grades.

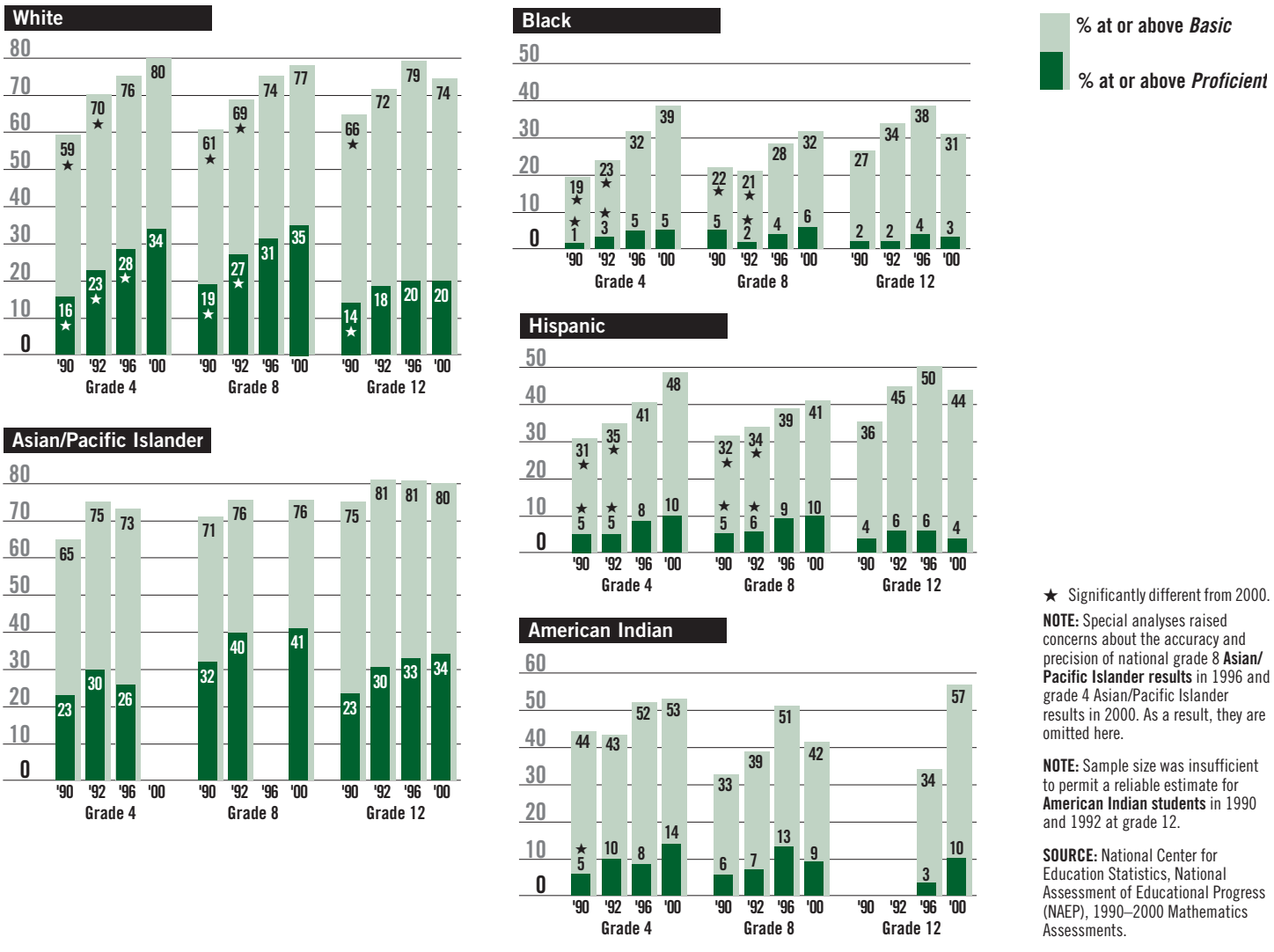
At grade 4, higher percentages of white, black, Hispanic, and American Indian students performed at or above the *Proficient* level in 2000 than in 1990. There were also higher percentages of white, black, and Hispanic at or above the *Basic* level in 2000 than in 1990 or 1992.

At grade 8, more white and Hispanic students were at or above *Proficient* in 2000 in comparison to 1990, and more white, black, and Hispanic students were at or above *Proficient* in 2000 than in 1992. At or above the *Basic* level, there were higher percentages of white, black, and Hispanic eighth-graders in 2000 than in 1990 or 1992.

There were few changes over the decade for twelfth-graders; only white students had higher percentages at or above the *Proficient* level in 2000 than in 1990. There were also higher percentages of white students at or above the *Basic* level in 2000 than in 1990.

Comparing the subgroups' 2000 performance shows that, in general, more white and Asian/Pacific Islander students performed at or above the *Basic* achievement level than the other subgroups of students.

Percentage of Students at or above *Basic* and *Proficient* by Race/Ethnicity, Grades 4,8, and 12: 1990–2000



★ Significantly different from 2000.

NOTE: Special analyses raised concerns about the accuracy and precision of national grade 8 **Asian/Pacific Islander results** in 1996 and grade 4 Asian/Pacific Islander results in 2000. As a result, they are omitted here.

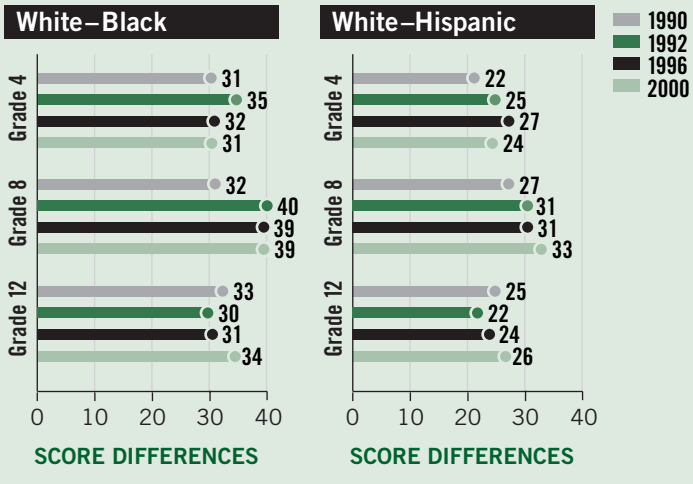
NOTE: Sample size was insufficient to permit a reliable estimate for **American Indian students** in 1990 and 1992 at grade 12.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990–2000 Mathematics Assessments.

Trends in Average Score Gaps Between Selected Racial/Ethnic Subgroups

In 2000, white students had higher scores, on average, than black or Hispanic students. These large gaps between subgroups' performance have remained relatively unchanged since 1990.

This finding is determined by subtracting a subgroup's (in this case, black or Hispanic students) unrounded average score from that of white students.



SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990–2000 Mathematics Assessments.

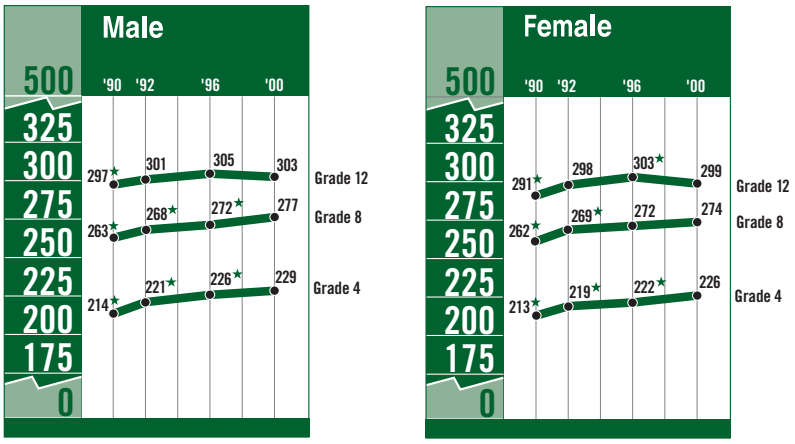
gender

Mathematics Scores by Gender

The figures below present average scores for males and females across the four mathematics assessments from 1990 to 2000. At all three grades, both boys and girls had higher scores in 2000 than they did in 1990 and, at fourth grade, they both have shown relatively steady improvement across the four assessments. In 2000, boys outperformed girls in mathematics at grades 8 and 12. There was no significant difference between boys' and girls' average scores at grade 4.

The gap between the average scale scores of males and females is quite small at all three grades and has fluctuated only slightly over the past 10 years.

Average Mathematics Scores by Gender, Grades 4,8, and 12: 1990–2000



SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990–2000 Mathematics Assessments.

Achievement Level Results by Gender

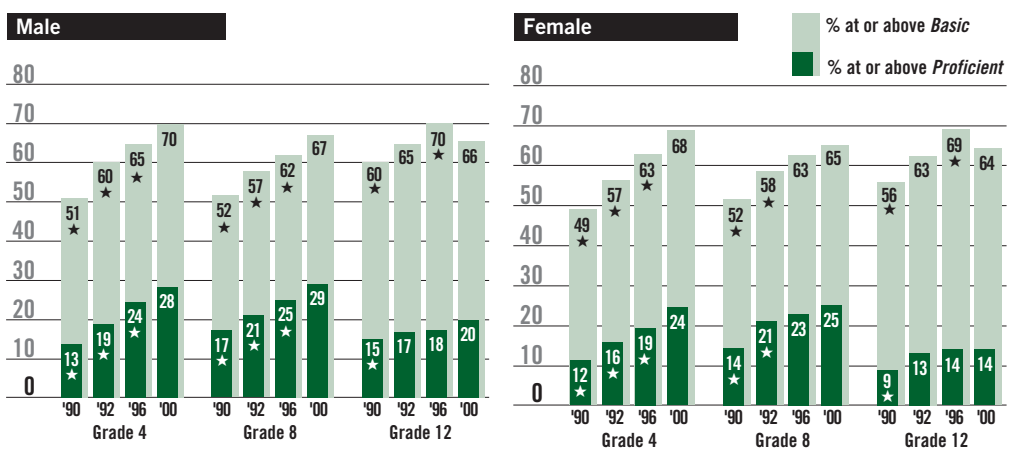
The following two figures compare the percentages of males and females at or above the *Proficient* level and at or above the *Basic* level across assessment years.

At grade 4 there were higher percentages of both males and females at or above *Proficient* and at or above *Basic* in 2000 than in 1990, 1992, or 1996.

At grade 8, there were higher percentages of both males and females at or above *Proficient* in 2000 than in 1990 and 1992, and a higher percentage of males at or above *Proficient* than in 1996. There were also more male and female eighth-graders at or above *Basic* in 2000 than in 1990 or 1992.

At grade 12, there were higher percentages of males and females at or above *Proficient* in 2000 than in 1990. There was a decline in the percentage of both male and female twelfth-graders at or above *Basic* in 2000 compared to 1996, although both groups' percentages were up in 2000 over 1990. A comparison of males' and females' results shows that there were higher percentages of males at or above *Proficient* at grades 4, 8 and 12.

Percentage of Students at or above *Basic* and *Proficient* by Gender, Grades 4,8, and 12: 1990–2000



★ Significantly different from 2000.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990–2000 Mathematics Assessments.

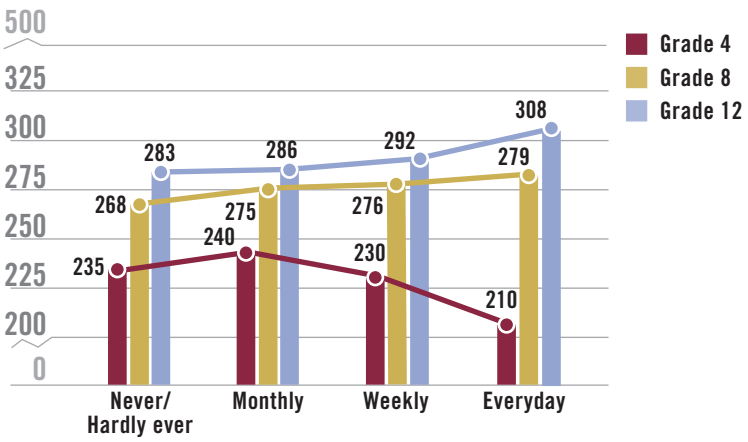
Home and School Factors Play a Role in Mathematics Performance

Many factors influence students' learning. Activities that take place while students are either at school or at home as well as the attitudes they develop about learning mathematics may enhance or detract from their ability to do math. The NAEP 2000 mathematics assessment focused on students' performance in light of responses to questions about mathematics activities at school and at home and attitudes toward mathematics. While these findings may suggest a positive or negative relationship between performance on the mathematics assessment and certain activities or attitudes, it is important to remember that the relationships are not necessarily causal—there are many factors that play a role in mathematics performance.

Calculator Use for Classwork and Mathematics Achievement

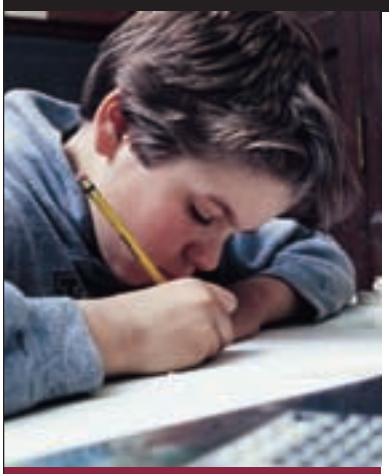
Results from the 2000 mathematics assessment suggest a relationship between student-reported calculator use for classwork and mathematics performance that is markedly different at grade 4 than at grades 8 and 12. At grade 4, more frequent calculator use was associated with lower scores, while at grades 8 and 12 the opposite was generally true: students who said they use calculators more often tended to score higher than their peers who reported using them less frequently.

Average Scores by Frequency of Calculator Use for Classwork, Grades 4, 8, and 12: 2000.



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

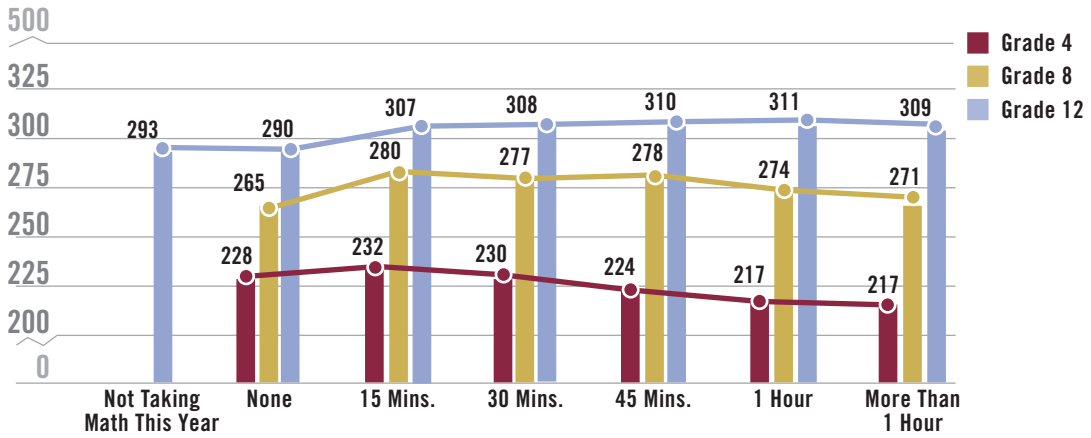
Home/school



Higher Scores for Students Who Spend a Moderate Amount of Time on Daily Homework

In mathematics as in other subjects assessed by NAEP, most students who spent time doing homework every day scored higher than those who didn't do homework. Only at grade 4, where homework demands are light in comparison to higher grades, did students who reported spending an hour or more on homework score lower than their peers who didn't do homework. How much time in general is associated with higher mathematics performance on NAEP? Results from the 2000 mathematics assessment suggest that at grades 4 and 8, a moderate amount of time—between 15 and 45 minutes depending on grade level—is associated with a higher average score on NAEP than a longer time of one hour or more. This was not the case at grade 12, where there was no statistically significant difference in the performance of students spending any time between 15 minutes and one hour or more on mathematics homework.

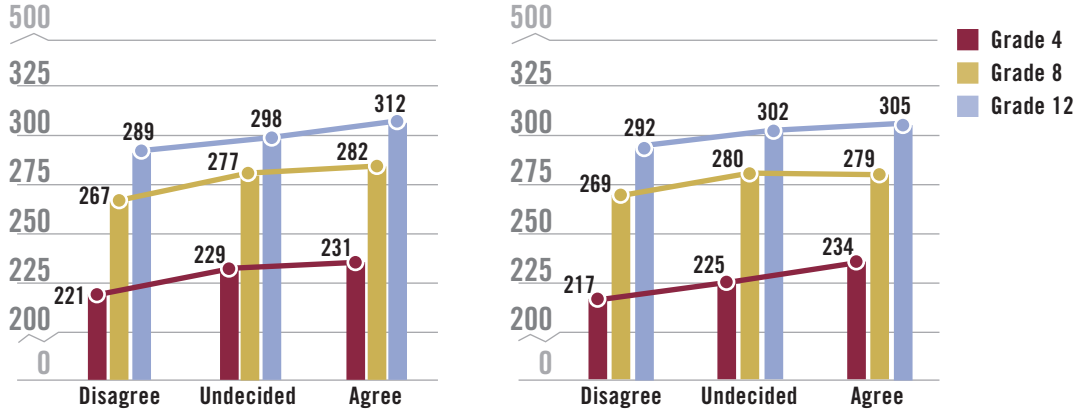
Average Scores by Time Spent Daily on Homework, Grades 4, 8, and 12: 2000



Positive Attitudes About Mathematics Associated with Higher Scores

The attitudes of students who took the NAEP mathematics assessment were strongly related to their performance. Students who participated in the 2000 assessment were asked to consider several statements about mathematics designed to gauge their attitudes toward the subject. The results for two of those statements are presented here. At all three grade levels, students who agreed that they like math and that math is useful for solving problems scored higher than students who disagreed with these statements.

Average Scores by Attitudes Toward Mathematics, Grades 4, 8, and 12: 2000



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

Sample Mathematics Questions

Sample questions from the 2000 assessment have not been released to the public so that they can be used again in a future assessment. Therefore, the questions shown here are taken from the NAEP 1996 mathematics assessment. They are similar to the questions used for the 2000 assessment because the same framework was used to develop questions in 1996 and 2000. Additional sample questions from the 1996 mathematics assessment, as well as sample questions from the 1992 and 1990 assessments are available at the NAEP web site at: http://nces.ed.gov/nationsreportcard.

Each student assessed at grade 4, 8, and 12 received a booklet that contained three 15-minute sections of mathematics questions. These questions were presented in two formats: multiple choice and constructed response. The constructed-response questions were either short, requiring students to provide answers to computation problems or describe solutions in one or two sentences or extended, requiring students to provide longer answers.

Grade 4 Sample Questions and Responses

Multiple-Choice Question

Getting Ready for Algebra

Young students are prepared for the abstract world of algebra by early exposure to concepts that help them make the transition from concrete numbers to abstract expressions. This question, which required students to recognize that N stands for the total number of stamps John had, puts the concept of a variable in a setting that fourth-graders can understand.

N stands for the number of stamps John had. He gave 12 stamps to his sister. Which expression tells how many stamps John has now?

Ⓐ $N + 12$
● $N - 12$
Ⓒ $12 - N$
Ⓓ $12 \times N$

Short Constructed-Response Question

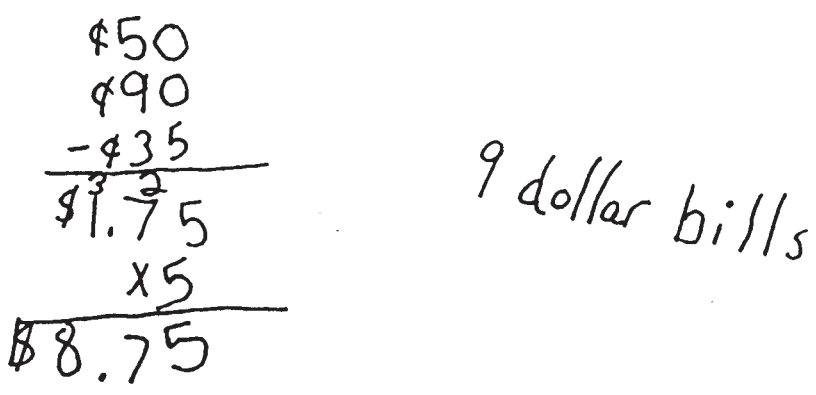
(Scored on a three-level scale: Unsatisfactory, Partial, Satisfactory)

Sam can purchase his lunch at school. Each day he wants to have juice that costs 50¢, a sandwich that costs 90¢, and fruit that costs 35¢. His mother has only $1.00 bills. What is the least number of $1.00 bills that his mother should give him so he will have enough money to buy lunch for 5 days?

Sample Short Constructed Response

Sample "Satisfactory" Response:

A "Satisfactory" response to this question gives the correct answer of nine $1.00 bills.



Solving a Multistep Problem

To answer this constructed-response question satisfactorily, the student must complete three steps: 1) add the three amounts shown to get the total spent each day, 2) multiply by 5 to get the total needed for five days ($8.75), and 3) understand that nine $1.00 bills would be needed.

Grade 8 Sample Questions and Responses

Multiple-Choice Question

Understanding an Algebraic Expression

This question required students to translate a word problem into an algebraic expression. In a formal algebra class, students are expected to set up equations with expressions like the one in choice E (the correct answer), and then determine, for example, the value of h if the plumber's total charge was $297.

A plumber charges customers $48 for each hour worked plus an additional $9 for travel. If h represents the number of hours worked, which of the following expressions could be used to calculate the plumber's total charge in dollars?

Ⓐ $48 + 9 + h$
Ⓑ $48 \times 9 \times h$
Ⓒ $48 + (9 \times h)$
Ⓓ $(48 \times 9) + h$
● $(48 \times h) + 9$

Extended Constructed-Response Question

(Scored on a four-level scale: Unsatisfactory, Partial, Satisfactory, Complete)

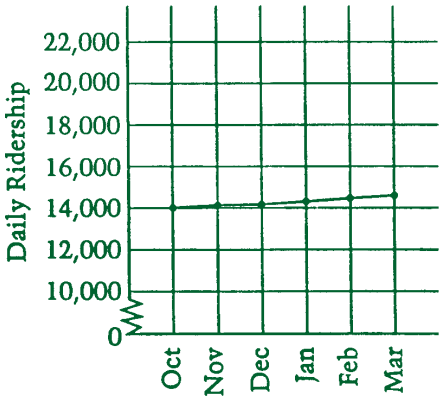
This question requires you to show your work and explain your reasoning. You may use drawings, words, and numbers in your explanation. Your answer should be clear enough so that another person could read it and understand your thinking. It is important that you show all of your work.

The data in the table to the right has been correctly represented by both graphs shown below.

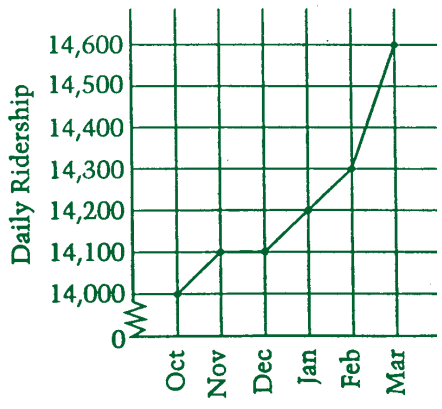
METRO RAIL COMPANY

Month	Daily Ridership
October	14,000
November	14,100
December	14,100
January	14,200
February	14,300
March	14,600

Graph A



Graph B



Which graph would be best to help convince others that the Metro Rail Company made a lot more money from ticket sales in March than in October?

Explain your reason for making this selection.

Why might people who thought that there was little difference between October and March ticket sales consider the graph you chose to be misleading?

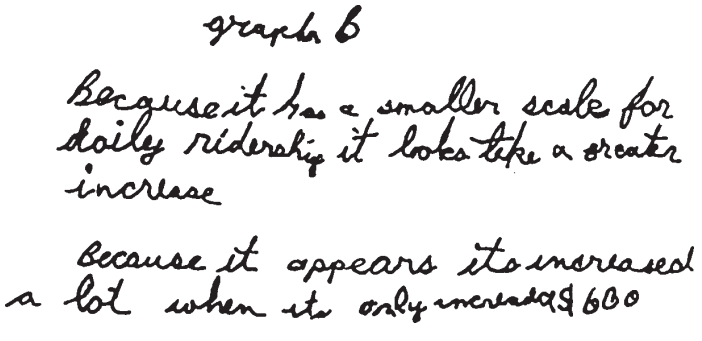
Reading and Interpreting Data

This extended constructed-response question, one of the more difficult eighth-grade questions used in 1996, required students to demonstrate skills that are an important part of the junior high school mathematics curriculum. It shows two accurately drawn graphs that appear to present very different results. A complete answer to the question indicates ability to critically evaluate information presented in a graph.

Sample Extended Constructed Responses

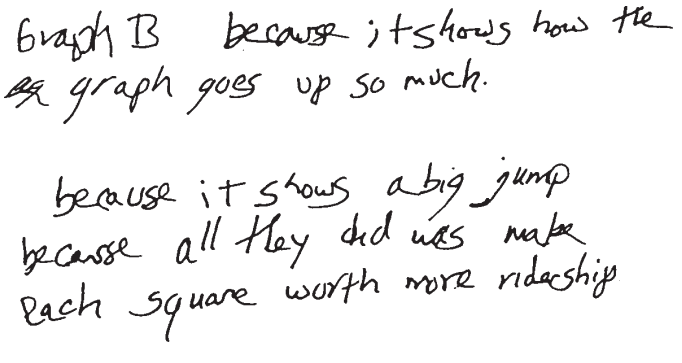
Sample "Complete" Response:

A "Complete" response to this question gives the correct response, Graph B, and provides a complete explanation.



Sample "Satisfactory" Response:

A "Satisfactory" response to this question gives the correct response, Graph B, and provides an incomplete but partially correct explanation.



Grade 12 Sample Questions and Responses

Multiple-Choice Question

Finding a Missing Value

This question, a fairly easy one for twelfth-graders, required students to find a value that would make both equations true. To solve the problem, students could either use a formal algebraic solution process or simply substitute each of the choices until they found the correct answer.

$4 \times \square = \square$ and $\square \times 3 = \square$

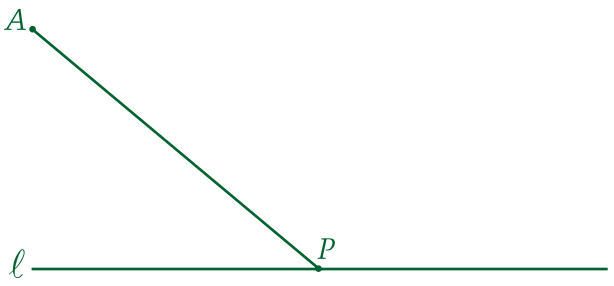
What number if placed in each box above would make both equations true?

- (A) 0
- (B) 1
- (C) 2
- (D) 3
- (E) 4

Short Constructed-Response Question

(Scored on a two-level scale: Unsatisfactory, Satisfactory)

In the figure below, use the protractor to draw a line m through point P perpendicular to segment AP. In the answer space provided, give the measure of the smaller angle formed by lines ℓ and m.



Answer: _____

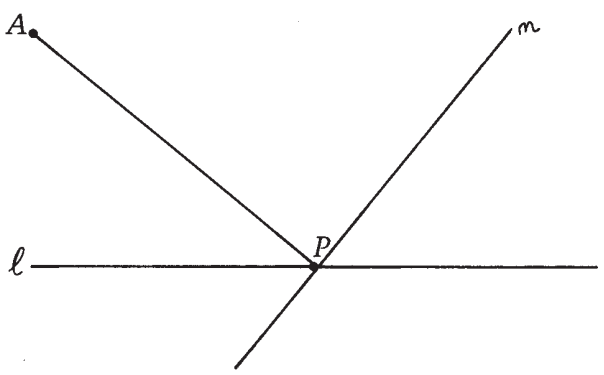
Measuring an Angle

In order to find the solution to this constructed-response question, students needed to draw a line perpendicular to a given line, and then measure one of the angles. This is an example of NAEP questions that requires students to use a tool, such as a protractor or ruler. These tools are provided to students during the assessment.

Sample Short Constructed Response

Sample "Satisfactory" Response:

The following student's response received the highest score, "Satisfactory". Both line m and the degree measure of the smaller angle are correct.



Answer: 50°

The Nation's Report Card

Mathematics Highlights 2000

National Center for Education Statistics

More Information

A detailed report on the NAEP 2000 mathematics assessment, *The Nation's Report Card: Mathematics 2000* as well as other 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

Additional information about the NAEP mathematics 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
- Calendars of current NAEP events, training, and professional development activities
- Technical assistance and online discussions with leading assessment and subject-matter experts

United States
Department of Education
ED Pubs
8242-B Sandy Court
Jessup, MD 20794-1398

Official Business Only
Penalty for Private Use, $300

Postage and Fees Paid
U.S. Department of Education
Permit No. G-17

Standard