

Massachusetts



Department of
Education

Results for Massachusetts: NAEP 2000 Science

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Massachusetts Department of Education

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Massachusetts Department of Education

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What Is NAEP?

The National Assessment of Educational Progress (NAEP), also known as ‘the Nation's Report Card’, is the only nationally representative and continuing assessment of what America's students know and can do in various subject areas. Since 1969, assessments have been conducted periodically in reading, mathematics, science, writing, US history, civics, geography, and the arts.

Under the current structure, the Commissioner of Education Statistics, who heads the National Center for Education Statistics in the US Department of Education, is responsible by law for carrying out the NAEP project. The National Assessment Governing Board (NAGB), appointed by the Secretary of Education but independent of the department, governs the program.

NAEP does not provide scores for individual students or schools; instead, it offers results regarding subject-matter achievement, instructional experiences, and school environment for populations of students (e.g., fourth-graders) and subgroups of those populations (e.g., female students, Hispanic students). NAEP results are based on a sample of student populations of interest.

National NAEP

National NAEP reports information for the nation and specific geographic regions of the country. It includes students drawn from both public and nonpublic schools and reports results for student achievement at grades 4, 8 and 12.

These assessments follow the curriculum frameworks developed by the NAGB and use the latest advances in assessment methodology. For example, NAEP assessments include a large percentage of constructed-response questions and questions that require the use of calculators and other materials. Innovative types of questions have been used in assessments such as the arts (theatre, music, and visual arts) and science to measure students' ability to perform hands-on tasks.

As the content and nature of the NAEP instruments evolve to match instructional practice, we reduce the ability of the assessment to measure change over time in student performance. While short-term trends can be measured in many of the NAEP subjects (e.g., Science, reading), the more reliable instrument of change over time is the NAEP long-term trend assessment.

State NAEP

Since 1990, NAEP assessments have also been conducted on the state level. States that choose to participate receive assessment results that report on the performance of students in that state. In its content, the state assessment is identical to the assessment conducted nationally. However, because the national NAEP samples were not, and are not currently designed to support the reporting of accurate and representative state-level results, separate representative samples of students are selected for each participating jurisdiction/state.

The NAEP science assessment was administered in 1996 and 2000. The 1996 NAEP science assessment was administered to grade 8, and the 2000 NAEP science assessment was administered to grades 4 and 8. Massachusetts fully participated in the 1996 and 2000 NAEP

science assessments, and thus this report contains NAEP science results that allow 1996-2000 comparisons for grade 8, but not for grade 4.

In the 2000, 45 states and other jurisdictions participated in NAEP science assessment.

The 2000 NAEP Science Test

The NAEP 2000 Science Assessment framework was based on two major dimensions, (1) the three major fields of science: earth science, physical, and life science, and (2) the three elements of knowing and doing science: conceptual understanding, scientific investigation, and practical reasoning. Each question on the test measures one element on knowing and doing within one of the fields of science.

The NAEP 2000 Science Assessment consisted of three question types described below.

- *multiple-choice questions* that assess students' knowledge of important facts and concepts and that probe their analytical reasoning skills;
- *constructed-response questions* that explore students' abilities to explain, integrate, apply, reason about, plan, design, evaluate, and communicate science information; and
- *hands-on tasks* that probe students' abilities to use materials to make observations, perform investigations, evaluate experimental results, and apply problem-solving skills.

Student performance is indicated in two ways, scale scores and achievement levels.

The scale score range for the NAEP 2000 Science Assessment is from 0 to 300. Scale scores for grades 4 and 8 were developed independently and thus scale scores cannot be compared across grades.

Student science performance is also reported in terms of three achievement levels: *Basic*, *Proficient*, and *Advanced*. The three achievement levels are broadly defined as follows:

- **Basic - Partial mastery** of prerequisite knowledge and skills that are fundamental for proficient work at each grade. Students must attain a scale score of 138 in Grade 4 or 143 in Grade 8 to be considered at the *Basic level*.
- **Proficient - 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. Students must attain a scale score of 170 in Grade 4 or 170 in Grade 8 to be considered at the *Proficient level*.
- **Advanced - Superior performance**. Students must attain a scale score of 205 in Grade 4 or 208 in Grade 8 to be considered at the *Advanced level*.

For more details regarding the achievement levels see the appendix *NAEP Science Achievement Levels* at the end of this report.

Testing Accommodations: Two Samples

Many educators have expressed concern that students with special needs were not accurately represented in previous NAEP samples at the state and national levels. Rules for test accommodations were changed to allow greater participation by student with special needs and to be consistent with assessment requirements under Title I and the Individual with Disabilities Education Act (IDEA). The results of the 2000 NAEP assessments are reported for two samples. The *sample in which accommodations were not permitted* can be used to examine trends since the program's commencement, because it is most like the samples in previous NAEP

administrations. The *sample in which accommodations were permitted* includes more students with special needs, and will be used to examine trends from 2000 onward.

Interpreting this Report

When reviewing this report it is important to keep in mind that the NAEP results are based on a *sample* of students across Massachusetts and not the *population* of Massachusetts students. In analyzing the data, tests of significance were employed to determine what differences in the data could be confidently characterized as *not occurring by chance* (within an acceptable probability). This type of difference is commonly referred to as a *significant* difference. **In this report, any comparison where one number is described as higher or above another indicates a significant difference.** This report generally uses the term “significant” only when describing differences that are *not* statistically significant, yet might appear significant based on the magnitude of difference reported. Tables denote significant differences using an asterisk.

Highlights: State Results on NAEP 2000 Grade 4 Science

- For the sample in which accommodations were not permitted, public school students in Massachusetts performed above the national average on the NAEP 2000 State Assessment in Science. The average scale score for Massachusetts was 162, which was higher than the national average of 148.
- For the sample in which accommodations were permitted, public school students in Massachusetts performed above the national average on the NAEP 2000 State Assessment in Science. The average scale score for Massachusetts was 161, which was higher than the national average of 147.
- Based on average scale scores, Massachusetts was one of the top states/jurisdictions on the grade 4 Science assessment for both samples. Massachusetts students scored, on average, higher than students in 38 states/jurisdictions and not significantly different from students in 5 states/jurisdictions.
 - For the sample in which accommodations were not permitted, Massachusetts performed comparably to Iowa, Maine, Montana, North Dakota, and Vermont.
 - For the sample in which accommodations were permitted, Massachusetts performed comparably to Iowa, Maine, Minnesota, Montana, North Dakota, and Vermont.
 - All participating states/jurisdictions other than those mentioned above scored lower than Massachusetts on the grade 4 Science assessment in both samples.

Average Scale And Achievement Level Results For Public School Students At Grade 4

		Average Scale Score	Below <i>Basic</i>	At or Above <i>Basic</i>	At or Above <i>Proficient</i>	<i>Advanced</i>
2000	Massachusetts	162	19%	81%	43%	6%
	Northeast	152	32%	68%	31%	4%
	Nation	148	36%	64%	28%	3%

Gender: Grade 4. Results are reported by gender for the Massachusetts sample in which accommodations were not permitted.

- Males in Massachusetts had an average scale score of 164, which was higher than the national average for males (151) and the Massachusetts female average (159).
- Forty six percent of males in Massachusetts scored at or above the *Proficient* level, which was higher than the national average for males (31%).
- Females in Massachusetts had an average scale score of 159, which was higher than the national average for females (146).
- Thirty eight percent of females in Massachusetts scored at or above the *Proficient* level, which was higher than the national average for males (24%).
- In Massachusetts, significantly more male students, than female students, scored at or above the *Proficient* level.

NAEP Science Assessment				
Grade 4 Sample with No Accommodations				
Scale Score and Performance Level Results for Massachusetts and the Nation, by Gender				
		Percent of Students	Average Scale Score	Percent at or Above <i>Proficient</i>
Male				
2000	MA	52%	164	46%
	US	50%	151	31%
Female				
2000	MA	48%	159	38%
	US	50%	146	24%

Race/Ethnicity: Grade 4. Results are reported by race/ethnicity for the Massachusetts sample in which accommodations were not permitted.

- White students' average scale score was 169. The percentage of White students at or above *Proficient* (50%) in Massachusetts was higher than the national average for White students (37%). Whites students' average scale score (169) was significantly higher than the average scores for Black (137) and Hispanic (130) students.
- Black students' average scale score was 137. The percentage of Black students at or above *Proficient* (13%) in Massachusetts was *not significantly different* than the national average for Black students (6%).
- Hispanic students' average scale score was 130. The percentage of Hispanic students at or above *Proficient* (11%) in Massachusetts was *not significantly different* than the national average for Hispanic students (10%).
- Asian/Pacific Islander students' average scale score was 161. The percentage of Asian/Pacific Islander students at or above *Proficient* in Massachusetts was 41%. The 2000 national results for Asian/Pacific Islander students are not reported.

NAEP 2000 Science Assessment				
Grade 4 Sample with No Accommodations				
Scale Score and Performance Level Results for Massachusetts and the Nation by Race/Ethnicity				
		Percent of Students	Average Scale Score	Percent at or Above Proficient
White				
2000	MA	76%	169	50%
	US	64%	159	37%
Black				
2000	MA	6%	137	13%
	US	15%	124	6%
Hispanic				
2000	MA	13%	130	11%
	US	16%	127	10%
Asian/Pacific Islander				
2000	MA	4%	161	41%
	US		Not reported	

Highlights: State Results on NAEP 2000 Grade 8 Science

- For the sample in which accommodations were not permitted, public school students in Massachusetts performed above the national average on the NAEP 2000 State Assessment in Science. The average scale score for Massachusetts was 161, which was higher than the national average of 149.
- For the sample in which accommodations were permitted, public school students in Massachusetts performed **above** the national average on the NAEP 2000 State Assessment in Science. The average scale score for Massachusetts was 158, which was higher than the national average of 149.
- The average scale score for Massachusetts on grade 8 NAEP 2000 State Assessment in Science did not significantly increase from 1996 (157) to 2000 (161). Similarly, the national average on the grade 8 NAEP State Assessment in Science did not significantly increase from 1996 (148) to 2000 (149).
- Based on average scale scores, Massachusetts was one of the top states/jurisdictions on the grade 8 State Assessment in Science for both samples.
 - For the sample in which accommodations were not permitted, only one state—Montana (165)—had a higher average scale score than Massachusetts (161). Massachusetts performed comparably to Idaho, Maine, Minnesota, Nebraska, North Dakota, Ohio, Vermont, and Wyoming. All states/jurisdictions not mentioned above scored lower than Massachusetts.
 - For the sample in which accommodations were permitted, only one state—Montana (164)—had a higher average scale score than Massachusetts (158). Massachusetts performed comparably to Idaho, Indiana, Maine, Michigan, Minnesota, Nebraska, North Dakota, Ohio, Oregon, Vermont, Wyoming and Department of Defense Activity schools (Overseas). All states/jurisdictions not mentioned above scored lower than Massachusetts.

Average Scale And Achievement Level Results For Public School Students At Grade 8

		Average Scale Score	Below <i>Basic</i>	At or Above <i>Basic</i>	At or Above <i>Proficient</i>	<i>Advanced</i>
2000	Massachusetts	161	26%	74%	42%	5%
	Northeast	152	39%	61%	33%	5%
	Nation	149	41%	59%	30%	4%
1996	Massachusetts	157	31%	69%	37%	4%
	Northeast	149	40%	60%	28%	2%
	Nation	148	40%	60%	27%	3%

Gender: Grade 8. Results are reported by gender for the Massachusetts sample in which accommodations were not permitted.

- Males in Massachusetts had an average scale score of 162, which was higher than the national average for males (153), but *not significantly different* than the 1996 scale score for males in Massachusetts (159).
- Forty four percent of males in Massachusetts scored at or above the *Proficient* level. This was *not statistically different from 1996* (40%).
- Females in Massachusetts had an average scale score of 160, which was higher than the national average for females (146) and the 1996 average scale score for females in Massachusetts (154).
- Forty percent of females in Massachusetts scored at or above the *Proficient* level. This was *not statistically different from 1996* (33%).
- The two-point difference between males' and females' performance in 2000 was *not statistically significant*.

NAEP Science Assessment				
Grade 8 Sample with No Accommodations				
Scale Score and Performance Level Results for Massachusetts and the Nation by Gender				
		Percent of Students	Average Scale Score	Percent at or Above <i>Proficient</i>
Male				
2000	MA	49%	162	44%
	US	51%	153	35%
1996	MA	52%	159	40%
	US	51%	149*	29%*
Female				
2000	MA	51%	160	40%
	US	49%	146	26%
1996	MA	48%	154*	33%
	US	49%	148	26%

*= significant difference from 2000.

Race/Ethnicity: Grade 8. Results are reported by race/ethnicity for the Massachusetts sample in which accommodations were not permitted.

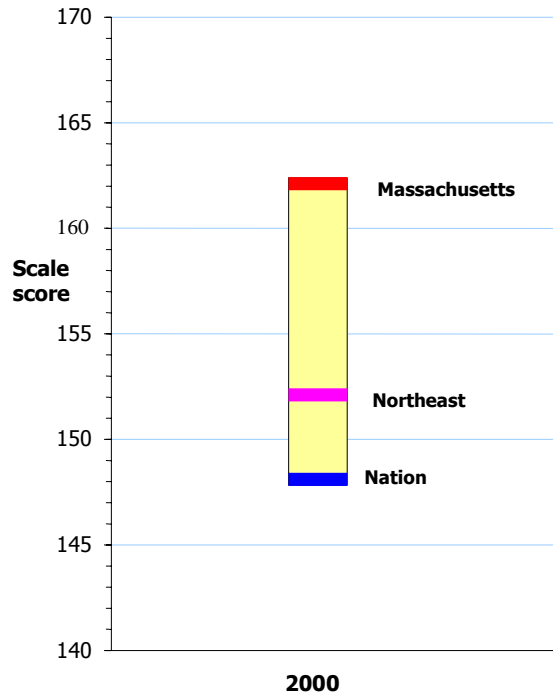
- White students' average scale score in 2000 (168) was higher than in 1996 (163). The percentage of White students at or above *Proficient* (49%) in 2000 was higher than in 1996 (41%). Whites students' average scale score (168) was significantly higher than the average scores for Black (134) and Hispanic (128) students.
- Black students' average scale score was 134. The percentage of Black students at or above *Proficient* (12%) in Massachusetts was *not significantly different* than the national average for Black students (6%).
- Hispanic students' average scale score was 128. The percentage of Hispanic students at or above *Proficient* (12%) in Massachusetts was *not significantly different* than the national average for Hispanic students (10%).
- Asian/Pacific Islander students' average scale score was 165. The percentage of Asian/Pacific Islander students at or above *Proficient* (46%) in Massachusetts was *not significantly different* than the national average (36%).

NAEP Science Assessment				
Grade 8 Sample with No Accommodations				
Scale Score and Performance Level Results for Massachusetts and the Nation by Race/Ethnicity				
		Percent of Students	Average Scale Score	Percent at or Above Proficient
White				
2000	MA	76%	168	49%
	US	66%	160	40%
1996	MA	81%	163*	41%*
	US	68%*	159*	36%
Black				
2000	MA	8%	134	12%
	US	14%	121	6%
1996	MA	6%	126	9%
	US	15%*	120	4%
Hispanic				
2000	MA	10%	128	12%
	US	14%	127	11%
1996	MA	8%	126	11%
	US	12%*	127	10%
Asian/Pacific Islander				
2000	MA	5%	165	46%
	US	4%	154	36%
1996	MA	4%	152!	38%
	US	2%	150	27%

* significant difference from 2000.

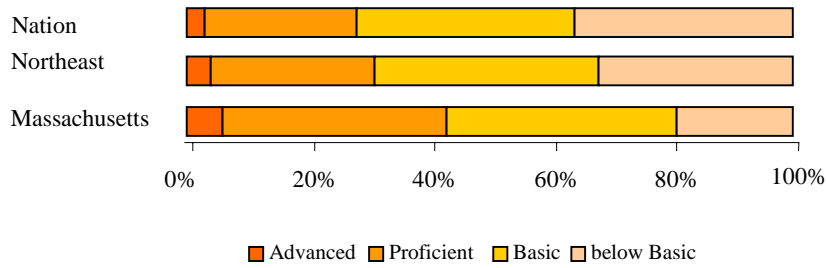
! Interpret with caution – the nature of the sample does not allow accurate determination of the variability of this statistic

Differences in Mean Scale Scores on NAEP Grade 4 Science, 1996-2000: Massachusetts, Northeast and Nation

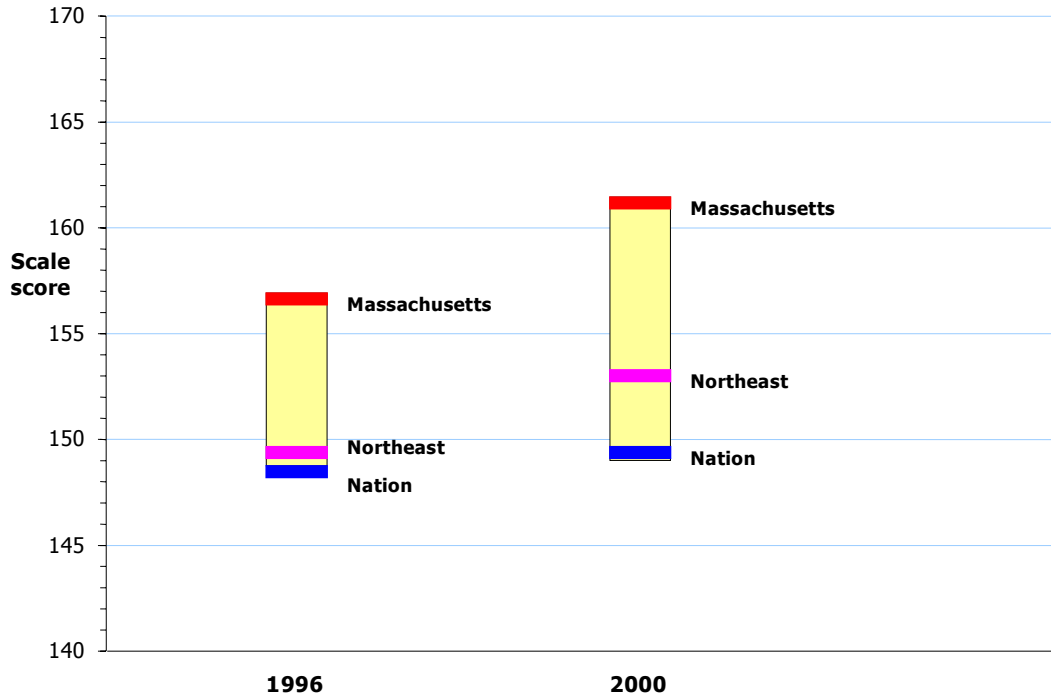


Distribution of Achievement Levels on NAEP Grade 8 Science, 1996-2000: Massachusetts, Northeast, and Nation

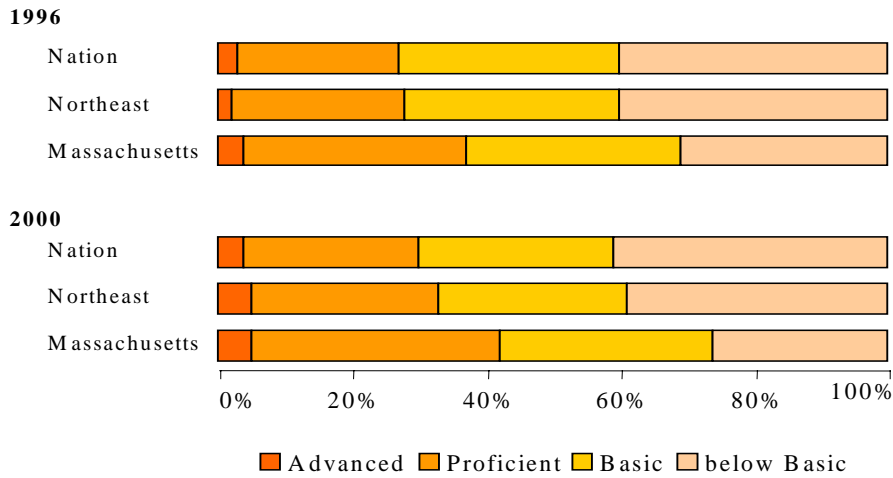
2000



Differences in Mean Scale Scores on NAEP Grade 8 Science, 1996 and 2000: Massachusetts, Northeast and Nation

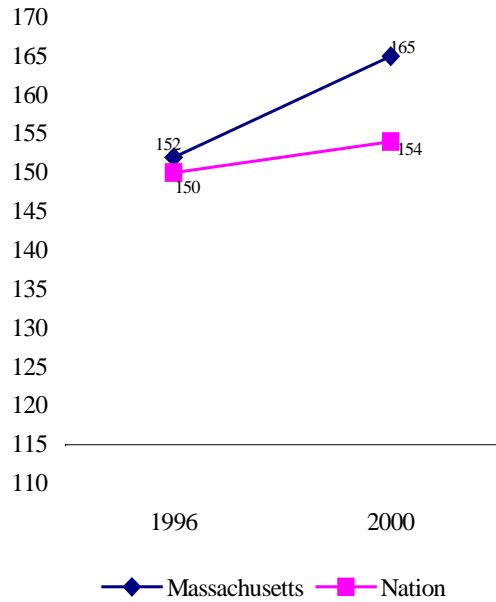


Distribution of Achievement Levels on NAEP Grade 8 Science, 1996-2000: Massachusetts, Northeast, and Nation

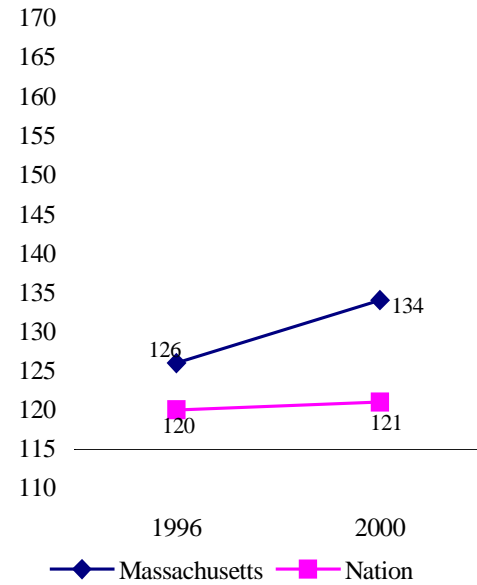


Changes in Average Scale Scores on Grade 8 NAEP Science, 1996-2000, by Race/Ethnicity: Massachusetts and Nation

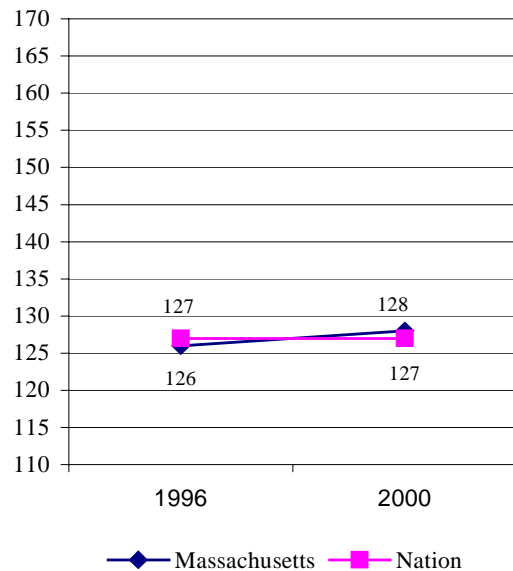
Asian/Pacific Islander §



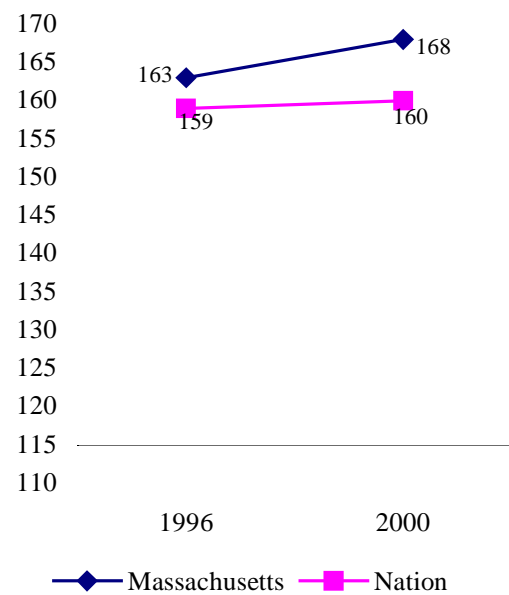
Black



Hispanic



White



§ The nature of the sample does not allow accurate determination of the variability of this statistic.

NAEP Science Achievement Levels

This information is taken directly from the NAEP website.

Grade 4

Basic – Grade 4

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

Fourth-grade students performing at the Basic level are able to follow simple procedures, manipulate simple materials, make observations, and record data. They are able to read simple graphs and diagrams and draw reasonable but limited conclusions based on data provided to them. These students can recognize appropriate experimental designs, although they are unable to justify their decisions.

When presented with diagrams, students at this level can identify seasons; distinguish between day and night; and place the position of the Earth, sun, and planets. They are able to recognize major energy sources and simple energy changes. In addition, they show an understanding of the relationships between sound and vibrations. These students are able to identify organisms with similar physical features. They can also describe relationships among structure, function, habitat, life cycles, and different organisms.

Proficient – Grade 4

Students performing at the Proficient level demonstrate the knowledge and reasoning required for understanding of the Earth, physical properties, structure, and function. In addition, students can formulate solutions to familiar problems as well as show a beginning awareness of issues associated with technology.

Fourth-grade students performing at the Proficient level are able to provide an explanation of day and night when given a diagram. They can recognize major features of the Earth's surface and the impact of natural forces. They are also able to recognize water in its various forms in the water cycle and can suggest ways to conserve it. These students recognize that various materials possess different properties that make them useful. Students at this level are able to explain how structure and function help living things survive. They have a beginning awareness of the benefits and challenges associated with technology and recognize some human effects on the environment. They can also make straightforward predictions and justify their position.

Advanced – Grade 4

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

Fourth-grade students performing at the Advanced level are able to combine information, data, and knowledge from one or more of the sciences to reach a conclusion or to make a valid prediction. They can also recognize, design and explain simple experimental procedures.

Students at this level recognize nonrenewable sources of energy. They also recognize that light and sound travel at different speeds. These students understand some principles of ecology and are able to compare and contrast life cycles of various common organisms. In addition, they have a developmental awareness of the benefits and challenges associated with technology.

Grade 8

Basic – Grade 8

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

Eighth-grade students performing at the Basic level are able to observe, measure, collect, record, and compute data from investigations. They can read simple graphs and tables and are able to make simple data comparisons. These students are able to follow directions and use basic science equipment to perform simple experiments. In addition, they have an emerging ability to design experiments.

Students at this level have some awareness of causal relationships. They recognize the position of planets and their movement around the sun and know basic weather-related phenomena. These students can explain changes in position and motion such as the movement of a truck in relation to that of a car. They also have emerging understanding of the interrelationships among plants, animals, and the environment.

Proficient – Grade 8

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

Eighth-grade students performing at the Proficient level are able to create, interpret, and make predictions from charts, diagrams, and graphs based on information provided to them or from their own investigations. They have the ability to design an experiment and have an emerging understanding of scientific phenomena, and can design plans to solve problems.

Students at this level can begin to identify forms of energy and describe the role of energy transformation in living and nonliving systems. They have knowledge of organization, gravity, and motion within the solar system and can identify some factors that shape the surface of the Earth. These students have some understanding of properties of materials and have an emerging understanding of the particulate nature of matter, especially the effect of temperature on states of matter. They also know that light and sound travel at different speeds and can apply their knowledge of force, speed, and motion. The students demonstrate a developmental understanding of the flow of energy from the sun through living systems, especially plants. They know that organisms reproduce and that characteristics are inherited from previous generations. These students also understand that organisms are made up of cells and that cells have sub-components with different functions. In addition, they are able to develop their own classification system based on physical characteristics. These students can list some effects of air and water pollution as well as demonstrate knowledge of the advantages and disadvantages of different energy sources in terms of how they affect the environment and the economy.

Advanced – Grade 8

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

Eighth-grade students performing at the Advanced level are able to provide an explanation for scientific results. They have a modest understanding of scale and are able to design a controlled experiment. These students have an understanding of models as representations of natural systems and can describe energy transfer in living and nonliving systems.

Students at this level are able to understand that present physical clues, including fossils and geological formations, are indications that the Earth has not always been the same and that the present is a key to understanding the past. They have a solid knowledge of forces and motions within the solar system and an emerging understanding of atmospheric pressure. These students can recognize a wide range of physical and chemical properties of matter and some of their interactions and understand some of the properties of light and sound. Also, they can infer relationships between structure and function. These students know the difference between plant and animal cells and can apply their knowledge of food as a source of energy to a practical situation. In addition, they are able to explain the impact of human activities on the environment and the economy.