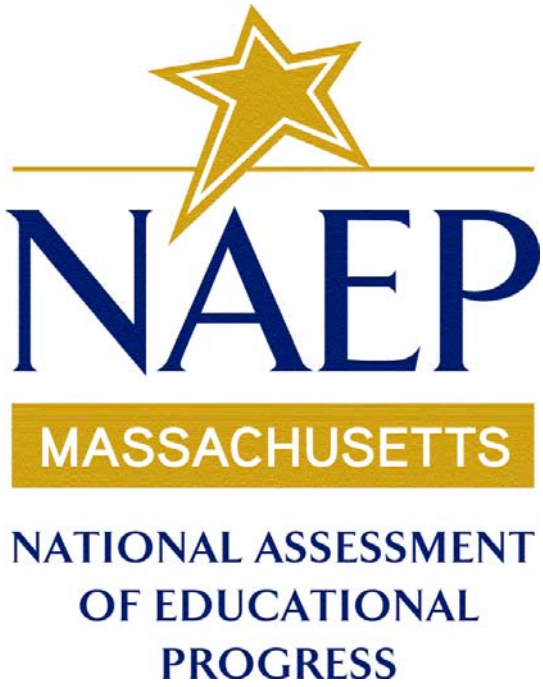

2009 NAEP Science: Summary of State Results

May 2011

Massachusetts Department of Elementary and Secondary Education
75 Pleasant Street, Malden, MA 02148
Phone 781-338-3000 TTY: N.E.T. Relay 800-439-2370
www.doe.mass.edu

This document was prepared by the
Massachusetts Department of Elementary and Secondary Education
Mitchell D. Chester, Ed.D.
Commissioner

Massachusetts Department of Elementary and Secondary Education
75 Pleasant Street, Malden, MA 02148-4906
Phone 781-338-3000 TTY: N.E.T. Relay 800-439-2370
http://www.doe.mass.edu/

Table of Contents

I. Executive Summary of the 2009 NAEP State Results in Science

Forty-six states took part in the 2009 state administration of the National Assessment of Educational Progress (NAEP) science assessment at grades 4 and 8. In Massachusetts, grade 4 students from 218 schools and grade 8 students from152 schools participated in the 2009 NAEP state assessments; 7,400 students were assessed in science (3,700 at each grade level). This report provides state-level results for the science assessment.

□ 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 on the *population* of Massachusetts students. In analyzing the results, tests of significance were used to determine differences in the data that could be confidently characterized as *not occurring by chance*. This type of difference is commonly referred to as a statistically *significant* difference. In the report's tables, an asterisk is used to denote a value that is significantly different from the value for the nation's public schools.

□ Overall Performance

Massachusetts tied for first among all states on the grade 4 science assessment and tied for second on the grade 8 science assessment.

- Based on average scale scores, Massachusetts tied for first in the nation at grade 4 with 9 other states. At grade 8, Massachusetts tied for second in the nation with 10 states. One state (North Dakota) had an average scale score at grade 8 that was higher than the average scale score for Massachusetts.
- In science at grade 4, the percentage of Massachusetts students scoring at or above the *Proficient* level was higher than the percentage of students at or above the *Proficient* level in 34 states and no different from the percentage of students at or above the *Proficient* level in the remaining 11 states. At grade 8, the percentage of Massachusetts students scoring at or above the *Proficient* level in science was higher than the percentage of students at or above the *Proficient* level in 36 states and no different from the percentage of students at or above the *Proficient* level in the remaining 9 states.

Students in Massachusetts outperformed students nationally on the NAEP science tests.

- The average scale score of Massachusetts fourth-grade students on the science assessment was 160, higher than the national average of 149. Eighth-grade Massachusetts students (160) also outscored their counterparts nationwide (149).
- Forty-five percent of Massachusetts fourth-grade students and 41 percent of eighth-grade students scored at or above the *Proficient* level. These percentages were higher than the comparable percentages of students nationally who scored at or above the *Proficient* level (32 percent at grade 4 and 29 percent at grade 8).

□ **Students Performing at or above the *Proficient* level in the Top Performing States**

The following table lists the top performing states on the 2009 science assessment according to the ordinal rank of the percentage of students in each state who scored at or above the *Proficient* level.

Table 1. 2009 NAEP Science Assessment
Percentage of Students at or above *Proficient* in the Top 10 States

Grade 4		Grade 8	
New Hampshire	48	Montana	43
Massachusetts	**45**	**Massachusetts**	**42**
Kentucky	45	North Dakota	42
North Dakota	45	Minnesota	40
Virginia	45	South Dakota	40
Minnesota	43	New Hampshire	39
Maine	42	Utah	39
Montana	42	Idaho	37
Connecticut	41	Ohio	37
Iowa	41	Wisconsin	37
Ohio	41	Virginia	36
Nation	33	Nation	29

□ **Student Subgroup Performance in Science in Massachusetts Compared to the Nation**

- Race/Ethnicity: In 2009, grade 4 White and African American/Black students in Massachusetts outperformed their counterparts nationally. The performance of Massachusetts Hispanic and Asian students at grade 4 did not differ significantly from the performance or their counterparts nationally. At grade 8, Massachusetts White, African American/Black, and Asian students outperformed their counterparts nationally. The performance of Massachusetts Hispanic students at grade 8 did not differ significantly from the performance of their counterparts nationally.
- Gender: At grades 4 and 8, both female and male students in Massachusetts outscored their counterparts nationally.
- Student Status: At grade 4, students with disabilities, students eligible for free/reduced lunch, and English language learner students in Massachusetts outscored their counterparts nationally. At grade 8, students with disabilities in Massachusetts scored higher than their counterparts nationally, but there was no significant difference between the performance of students eligible for free/reduced lunch or English language learner students in Massachusetts and across the nation.

II. Background Information on the NAEP Science Assessment

Although participation in NAEP state assessments in reading and mathematics at grades 4 and 8 is mandated by the No Child Left Behind (NCLB) Act, participation in NAEP state science assessments is voluntary, depending upon applicable state laws. Students from 46 states participated in the 2009 NAEP state assessments in science. Alaska, Kansas, Nebraska, and Vermont chose not to participate in the science assessments. Across the nation, roughly 151,500 fourth-grade students and 146,300 eighth-grade students were assessed in science in 2009.

□ Test Content of the Science Assessment

The 2009 NAEP science framework approved by the National Assessment Governing Board replaces the framework used for the 1996, 2000, and 2005 science assessments. A variety of factors made it necessary to create a new framework to guide the assessment of science in 2009 and beyond: the publication of *National Standards* for science literacy, advances in both science and cognitive research, the growth of national and international science assessments, advances in innovative assessment approaches, and the need to fairly assess the widest possible range of students.

The science content for the 2009 NAEP is defined by a series of statements that describe key facts, concepts, principles, laws, and theories in three broad areas: Earth and Space Sciences; Physical Science; and Life Science.

Table 2. 2009 NAEP Science Assessment
Distribution of Questions Across the Test

Field of Science	Grade 4	Grade 8
Earth and space sciences include concepts related to objects in the universe, the history of the earth, properties of Earth materials, tectonics, energy in Earth systems, climate and weather, and biogeochemical cycles.	33%	40%
Physical science includes concepts related to properties and changes of matter, forms of energy, energy transfer and conservation, position and motion of objects, and forces affecting motion.	33%	30%
Life science includes concepts related to organization and development, matter and energy transformations, interdependence, heredity and reproduction, and evolution and diversity.	33%	30%

□ Type of Questions on the Science Assessment

The NAEP science assessment contained three types of questions, or items: multiple-choice, short constructed-response, and extended constructed-response. In addition, some students were asked to complete hands-on performance or interactive computer tasks to further probe their abilities to combine their understanding with the investigative skills that reflect science practices as specified in the 2009 framework. The hands-on and interactive computer tasks in the 2009 science assessment were administered as part of a NAEP research study. Results for these tasks did not contribute to the results in this report and will be reported separately.

□ Student Participation

Each student selected for NAEP participates in only one subject-area test, and he/she takes only a portion of the entire test in that subject area. For instance, a student chosen for the 2009 science test took two 25-minute blocks or sets of test items out of a total of 13 blocks of items at that grade level.

NAEP spirals blocks of items into different test booklets, administers them to representative samples of students, and combines the results in order to produce average scale scores for the entire group and for subgroups of student populations. This approach reduces the burden on each individual student.

□ Reporting

Student performance on NAEP is indicated in two ways—scale scores and achievement levels. The NAEP science assessment scale ranges from 0 to 300. Performance for each grade is scaled separately. Therefore, average scale scores cannot be compared across grades.

Achievement levels are used to describe expectations for student performance according to a set of standards for what students should know and be able to do. The three achievement levels are *Basic*, *Proficient*, and *Advanced*.

- *Basic* denotes partial mastery of prerequisite knowledge and skills that are fundamental for proficient work at a given grade. Examples of skills demonstrated by students performing at the *Basic* level:
  - Explain the benefit of an adaptation for an organism.
  - Recognize how the Sun affects the Earth's surface.
  - Predict the relative motion of an object based on a diagram.
- *Proficient* represents solid academic performance. Students reaching this level have demonstrated competency over challenging subject matter. Examples of skills demonstrated by students performing at the *Proficient* level:
  - Predict an environmental effect of the use of a chemical.
  - Recognize the cycle of Moon phases.
  - Predict the motion of an object when different forces act on it.

- *Advanced* represents superior performance. Examples of skills demonstrated by students performing at the *Advanced* level:
  - Identify what an organism needs to live.
  - Predict the shape of the Moon.
  - Investigate the speed of a runner.

III. 2009 NAEP Science Results by Subgroup

Student performance data are reported for public school students in Massachusetts and the nation according to the following demographic characteristics:

- Race/ethnicity
- Gender
- Student eligibility for the National School Lunch Program
- Type of school location
- Parents' highest level of education

Results for each of the variables are reported in tables that include the percentage of students in each subgroup in the first column. The columns to the right show the average scale score and the percentage of students at each achievement level.

The reader is cautioned against making causal inferences about subgroup differences, as a complex mix of educational and socioeconomic factors may affect student performance.

□ Race/Ethnicity

The race/ethnicity of each student was reported by the schools. Tables 3-A and 3-B show average scale scores, achievement level data, and population percentages for public school students at grades 4 and 8 in Massachusetts and the nation by race/ethnicity.

Table 3-A. 2009 NAEP Science Assessment
Grade 4 Performance by Race/Ethnicity

				Percentage of Students			
Race/ethnicity		**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
White							
	Nation	54*	162*	14*	86*	46*	1*
	Massachusetts	68	169	8	92	56	1
African American/Black							
	Nation	16*	127*	54*	46*	10*	#
	Massachusetts	8	138	39	61	17	#
Hispanic							
	Nation	22*	130	48	52	13	#
	Massachusetts	17	132	44	56	12	#
Asian/Pacific Islander							
	Nation	5	160	20	80	45	2
	Massachusetts	5	167	14	86	53	4

Rounds to zero
* Value is significantly different from the value for the same subgroup in Massachusetts due to the larger national sample size.

Table 3-B. 2009 NAEP Science Assessment:
Grade 8 Performance by Race/Ethnicity

				Percentage of Students			
Race/ethnicity		**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
White							
	Nation	56*	161*	23*	77*	41*	2*
	Massachusetts	73	167	18	82	48	4
African American/Black							
	Nation	16*	125*	68*	32*	8*	#
	Massachusetts	8	132	58	42	13	1
Hispanic							
	Nation	21*	131	59	41	12	#
	Massachusetts	11	131	57	43	14	#
Asian/Pacific Islander							
	Nation	5	159*	28	72	40	3
	Massachusetts	6	168	22	78	49	10

Rounds to zero
* Value is significantly different from the value for the same subgroup in Massachusetts

□ Gender

Information on student gender is reported by the student's school when rosters of the students eligible to be assessed are submitted to NAEP. Tables 4-A and 4-B show average scale scores, achievement level data, and population percentages for public school students at grades 4 and 8 in Massachusetts and the nation by gender.

Table 4-A. 2009 NAEP Science Assessment:
Grade 4 Performance by Gender

				Percentage of Students			
Gender		**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
Male							
	Nation	51*	149*	29*	71*	34*	1
	Massachusetts	50	162	16	84	47	1
Female							
	Nation	49*	148*	29*	71*	31*	#
	Massachusetts	50	159	18	82	43	1

Rounds to zero
* Value is significantly different from the value for the same subgroup in Massachusetts

Table 4-B. 2009 NAEP Science Assessment:
Grade 8 Performance by Gender

				Percentage of Students			
Gender		**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
Male							
	Nation	51	151*	36*	64*	32*	2*
	Massachusetts	50	162	26	74	44	5
Female							
	Nation	49	147*	40*	60*	26*	1*
	Massachusetts	50	158	26	74	38	2

Rounds to zero
* Value is significantly different from the value for the same subgroup in Massachusetts

□ Free/Reduced-Price Lunch

NAEP collects data on eligibility for the federal program providing free or reduced-price school lunches. The free/reduced-price lunch component of the National School Lunch Program (NSLP) offered through the U.S. Department of Agriculture (USDA) is designed to ensure that children near or below the poverty line receive nourishing meals. Eligibility is determined through the USDA's Income Eligibility Guidelines, and is included as an indicator of lower family income. Tables 5-A and 5-B show average scale scores, achievement level data, and population percentages for public school students at grades 4 and 8 in Massachusetts and the nation by eligibility for the NSLP.

Table 5-A. 2009 NAEP Science Assessment:
Grade 4 Performance by Free/Reduced Lunch Eligibility

				Percentage of Students			
Eligibility Status		**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
Eligible							
	Nation	48*	134*	44*	56*	16	#
	Massachusetts	34	140	36	64	19	#
Not Eligible							
	Nation	51*	163*	14*	86*	48*	1
	Massachusetts	66	171	7	93	59	1

Rounds to zero
* Value is significantly different from the value for the same subgroup in Massachusetts

Table 5-B. 2009 NAEP Science Assessment:
Grade 8 Performance by Free/Reduced Lunch Eligibility

				Percentage of Students			
Eligibility Status		**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
Eligible							
	Nation	43*	133	57	43	14	#
	Massachusetts	30	137	51	49	17	#
Not Eligible							
	Nation	56*	161*	24*	76*	41*	2*
	Massachusetts	70	169	16	84	51	5

Rounds to zero
* Value is significantly different from the value for the same subgroup in Massachusetts

□ Students with Disabilities and/or English Language Learners

To ensure that samples are representative, NAEP has established policies and procedures to maximize the inclusion of all students in the assessment. Every effort is made to ensure that all selected students who are capable of participating meaningfully in the assessment are assessed. While some students with disabilities (SD) and/or English language learner (ELL) students can be assessed without any special procedures, others require accommodations to participate in NAEP. Still other SD and/or ELL students selected by NAEP may not be able to participate.

Tables 6-A and 6-B show average scale scores, achievement level data, and population percentages for public school students at grades 4 and 8 in Massachusetts and the nation by disability status. Tables 7-A and 7-B show average scale scores, achievement level data, and population percentages for public school students at grades 4 and 8 in Massachusetts and the nation by ELL status.

Table 6-A. 2009 NAEP Science Assessment:
Grade 4 Performance by Disability Status

				Percentage of Students			
Disability Status		**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
SD							
	Nation	12*	129*	50*	50*	16	#
	Massachusetts	16	139	39	61	19	#
Not SD							
	Nation	88*	151*	26*	74*	35*	1
	Massachusetts	84	164	13	87	50	1

Rounds to zero
* Value is significantly different from the value for the same subgroup in Massachusetts

Table 6-B. 2009 NAEP Science Assessment:
Grade 8 Performance by Disability Status

				Percentage of Students			
Disability Status		**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
SD							
	Nation	11*	122*	67*	33*	11*	#
	Massachusetts	16	138	51	49	20	1
Not SD							
	Nation	89*	152*	34*	66*	31*	2*
	Massachusetts	84	164	21	79	45	4

Rounds to zero
* Value is significantly different from the value for the same subgroup in Massachusetts

Table 7-A. NAEP 2009 Science Assessment:
Grade 4 Performance by ELL Status

				Percentage of Students			
ELL Status		**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
ELL							
	Nation	10*	114*	67	33	5	#
	Massachusetts	7	120	60	40	7	#
Not ELL							
	Nation	90*	153*	25*	75*	35*	1
	Massachusetts	93	163	14	86	48	1

Table 7-B. NAEP 2009 Science Assessment:
Grade 8 Performance by ELL Status

				Percentage of Students			
ELL Status		**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
ELL							
	Nation	5*	103	86	14	2	#
	Massachusetts	2	93	86	14	3	#
Not ELL							
	Nation	95*	151*	35*	65*	31*	1*
	Massachusetts	98	161	25	75	42	4

Rounds to zero
* Value is significantly different from the value for the same subgroup in Massachusetts

IV. 2009 NAEP Science Results by School Location

Schools that participated in the assessment were classified as being located in four mutually exclusive types of communities: city, suburb, town, and rural. These categories indicate the geographic locations of schools. Tables 8-A and 8-B show average scale scores, achievement-level data, and population percentages for public school students at grades 4 and 8 in Massachusetts and the nation, by type of location.

Table 8-A. NAEP 2009 Science Assessment: Grade 4 Performance by School Location

				Percentage of Students			
Location		**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
City							
	Nation	30*	140*	39*	61*	24	1
	Massachusetts	21	149	28	72	31	1
Suburb							
	Nation	36*	153*	25*	75*	36*	1
	Massachusetts	68	163	15	85	49	1
Town							
	Nation	12*	149	27	73	32	#
	Massachusetts	2	‡	‡	‡	‡	‡
Rural							
	Nation	22*	154*	22*	78*	36*	#
	Massachusetts	9	166	10	90	51	#

Table 8-B. NAEP 2009 Science Assessment: Grade 8 Performance by School Location

				Percentage of Students			
Location		**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
City							
	Nation	27*	139	50	50	21	1
	Massachusetts	18	140	47	53	21	1
Suburb							
	Nation	37*	152*	34*	66*	33*	2*
	Massachusetts	67	164	22	78	45	4
Town							
	Nation	14*	149	37	63	28	1
	Massachusetts	3	‡	‡	‡	‡	‡
Rural							
	Nation	23*	154*	31*	69*	33*	1
	Massachusetts	11	168	15	85	50	3

Rounds to zero
* Value is significantly different from the value for the same subgroup in Massachusetts
‡ Reporting standards not met

V. 2009 NAEP Science Results by Parent's Level of Education

Eighth-grade students who participated in the NAEP 2009 assessment were asked to indicate the highest level of education they thought their father and mother had completed. Five response options—did not finish high school, graduated from high school, some education after high school, graduated from college, and "I don't know"—were offered. The highest level of education reported for either parent was used in the analysis. The results by highest level of parental education are shown in Table 9.

Fourth-graders were not asked about their parents' education level because their responses in previous NAEP assessments were not reliable, and a large percentage of them chose the "I don't know" option.

Table 9. NAEP 2009 Science Assessment:
Grade 8 Performance by Parents' Level of Education

			Percentage of Students			
Parent Education	**Percentage of Students**	**Average Scale Score**	**Below Basic**	**At or Above Basic**	**At or Above Proficient**	**At Advanced**
Did Not Finish High School						
Nation	8*	131	59	41	11	#
Massachusetts	5	133	57	43	13	#
Graduated High School						
Nation	17	139*	50*	50*	17*	#
Massachusetts	16	147	39	61	25	#
Graduated College						
Nation	47*	160*	26*	74*	41*	3*
Massachusetts	58	170	16	84	54	6
Unknown						
Nation	11*	129*	61*	39*	12*	#
Massachusetts	9	141	45	55	22	1

Rounds to zero
* Value is significantly different from the value for the same subgroup in Massachusetts

VI. 2009 NAEP Science Achievement Level Descriptions for Grade 4

NAEP achievement levels are cumulative; therefore, student performance at the *Proficient* level includes the competencies associated with the *Basic* level, and the *Advanced* level also includes the skills and knowledge associated with both the *Basic* and the *Proficient* levels. The cut score indicating the lower end of the score range for each level is noted in parentheses.

Achievement Level	Description
Basic (131)	Students performing at the *Basic* level should be able to describe, measure, and classify familiar objects in the world around them, as well as explain and make predictions about familiar processes. These processes include changes of states of matter, movements of objects, basic needs and life cycles of plants and animals, changes in shadows during the day, and changes in weather. They should be able to critique simple observational studies, communicating observations and basic measurements of familiar systems and processes, and look for patterns in their observations. With regard to scientific constraints, they should also be able to propose and critique alternative solutions to problems involving familiar systems and processes.
Proficient (167)	Students performing at the *Proficient* level should be able to demonstrate relationships among closely related science concepts, as well as analyze alternative explanations or predictions. They should be able to explain how changes in temperature cause changes of state, how forces can change motion, how adaptations help plants and animals meet their basic needs, how environmental changes can affect their growth and survival, how land formations can result from Earth processes, and how recycling can help conserve limited resources. They should be able to identify patterns in data and/or explain these patterns. They should be able to identify and critique alternative responses to design problems.
Advanced (224)	Students performing at the *Advanced* level should be able to demonstrate relationships among different representations of science principles, as well as propose alternative explanations or predictions of phenomena. They should be able to use numbers, drawings, and graphs to describe and explain motions of objects; analyze how environmental conditions affect growth and survival of plants and animals; describe changes in the Sun's path through the sky at different times of year; and describe how human uses of Earth materials affect the environment. They should be able to design studies that use sampling strategies to obtain evidence. They should be able to propose and critique alternative individual and local community responses to design problems.

VII. 2009 NAEP Science Achievement Level Descriptions for Grade 8

Achievement Level	Description
Basic (141)	Students performing at the *Basic* level should be able to state or recognize correct science principles. They should be able to explain and predict observations of natural phenomena at multiple scales, from microscopic to global. They should be able to describe properties and common physical and chemical changes in materials; describe changes in potential and kinetic energy of moving objects; describe levels of organization of living systems—cells, multi-cellular organisms, ecosystems; identify related organisms based on hereditary traits; describe a model of the solar system; and describe the processes of the water cycle. They should be able to design observational and experimental investigations employing appropriate tools for measuring variables. They should be able to propose and critique the scientific validity of alternative individual and local community responses to design problems.
Proficient (170)	Students performing at the *Proficient* level should be able to demonstrate relationships among closely related science principles. They should be able to identify evidence of chemical changes; explain and predict motions of objects using position-time graphs; explain metabolism, growth, and reproduction in cells, organisms, and ecosystems; use observations of the Sun, Earth, and Moon to explain visible motions in the sky; and predict surface and groundwater movements in different regions of the world. They should be able to explain and predict observations of phenomena at multiple scales, from microscopic to macroscopic and local to global, and to suggest examples of observations that illustrate a science principle. They should be able to use evidence from investigations in arguments that accept, revise, or reject scientific models. They should be able to use scientific criteria to propose and critique alternative individual and local community responses to design problems.
Advanced (215)	Students performing at the *Advanced* level should be able to develop alternative representations of science principles and explanations of observations. They should be able to use information from the periodic table to compare families of elements; explain changes of state in terms of energy flow; trace matter and energy through living systems at multiple scales; predict changes in populations through natural selection and reproduction; use lithospheric plate movement to explain geological phenomena; and identify relationships among regional weather and atmospheric and ocean circulation patterns. They should be able to design and critique investigations involving sampling processes, data quality review processes, and control of variables. They should be able to propose and critique alternative solutions that reflect science-based trade-offs for addressing local and regional problems.