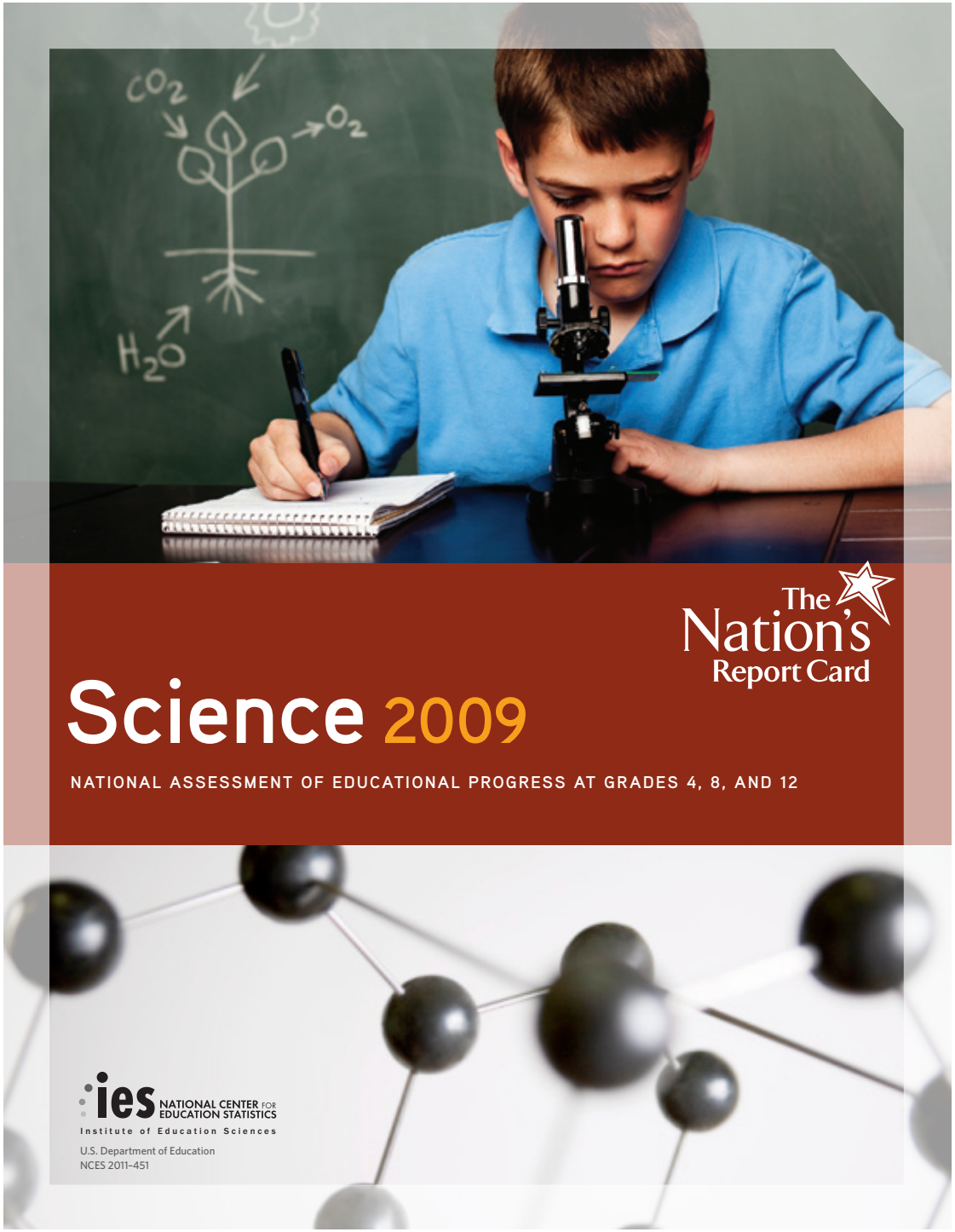

NAEP 2009 Science Assessment

A Presentation to the NOAA Education Council

Informational

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Climate Program Office

February 9, 2011

- Update and brief the Council on the new 2009 NAEP science assessment measures students' knowledge of physical science, life science, and Earth and space sciences

- To request the NOAA Education Council to:
  1. Be aware of the new 2009 NAEP assessment
  2. Understand the changes in the 2009 assessment
  3. Understand the "current snapshot of what the nation's fourth-, eighth-, and twelfth-graders know and can do in science that will serve as the basis for comparisons on future science assessments."

Achievement Levels

- Developed by the National Assessment Governing Board
- Set standards for what students <u>should</u> know and be able to do
- Achievement levels:
  - ***Basic:*** partial mastery of fundamental knowledge and skills
  - ***Proficient:*** competency over challenging subject matter
  - ***Advanced:*** superior academic performance

NAEP Science Assessment Overview

- Assessment based on a new science framework
  - Four science practices describe how students use their scientific knowledge
  - Increased focus on conceptual understanding of science principles
  - Shift in emphasis in content areas at grades 8 and 12

Introductio

Results from the 2009 NAEP science asse
fourth-, eighth-, and twelfth-graders kno
assessment is based on a new framework,
previous assessments but instead will pro
on future NAEP science assessments.

The New Science Framework

The National Assessment Governing Board oversees the development of NAEP frameworks that describe the speci knowledge and skills that should be assessed in each subj Frameworks incorporate ideas and input from subject-are experts, educators, policymakers, parents, and others. The NAEP science assessment is a key measure in informing t nation on how well the goal of scientific literacy for all stu dents is being met. Thus, the new *Science Framework for th 2009 National Assessment of Educational Progress* was deve oped to keep the assessment content current with key developments in science standards (including the *Nationa Science Education Standards*[1] and *Benchmarks for Science Literacy*[2]), innovative assessment approaches, and recent research in both science and cognition. The 2009 framew therefore, replaces the framework that was used for earlie NAEP science assessments in 1996, 2000, and 2005.

In contrast to the earlier framework, the 2009 science fra work employs crosscutting questions, that is, questions classified as one content area that also require knowledge one or both of the other content areas. In addition, the fra work gives greater emphasis to Earth and space sciences the eighth-grade assessment and to life and physical scie in the twelfth-grade assessment. It defines four science

[1] National Research Council (1996). *National Science Education Standards.* Coordinating Council for Education, National Committee on Science Education Standards and Assessment. Washington, DC: National Academy Press.
[2] American Association for the Advancement of Science (1993). *Benchmarks for Science Literacy.* New York: Oxford University Press.

Science content

The 2009 framework organizes science content into three broad content areas, physical science, life science, and Earth

Science Content Areas

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.

Life science includes concepts related to organization and development, matter and energy transformations, interdependence, heredity and reproduction, and evolution and diversity.

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.

materials, tectonics, energy in Earth systems, climate and weather, and biogeochemical cycles.

NAEP Science Assessment Overview

Students assessed in three science content areas

	Grade 4	Grade 8	Grade 12
Physical Science	$33\frac{1}{3}\%$	30%	$37\frac{1}{2}\%$
Life Science	$33\frac{1}{3}\%$	30%	$37\frac{1}{2}\%$
Earth and Space Sciences	$33\frac{1}{3}\%$	40%	25%

Grade 4 Results

Skills demonstrated by students performing at different levels

	Scale score	Content area	Question description
Advanced	300 //		
	264	**Physical science**	Determine the source of sound during an investigation about the pitch of sounds
	264	**Life science**	Explain differences between related individuals
	233	**Earth and space sciences**	Draw a conclusion about differences in air temperatures based on data
	224		
Proficient	222	**Life science**	Describe the different stages of the life cycle of an organism
	190	**Earth and space sciences**	Relate the calendar to amount of daylight
	169	**Physical science**	Explain an example of heat (thermal energy) transfer
	167		
Basic	161	**Earth and space sciences**	Explain the choice of material based on protection of the environment
	146	**Life science**	Explain the benefit of an adaptation for an organism
	138	**Physical science**	Recognize an example of a change of state
	131		
Below Basic	128	**Life science**	Identify the organism with a change in habitat from young to adult
	118	**Physical science**	Identify the data on a chart
	113	**Earth and space sciences**	Recognize a renewable source of energy
	// 0		

Grade 8 Results

Skills demonstrated by students performing at different levels

	Scale score	Content area	Question description
Advanced	300		
	//		
	266	**Physical science**	Describe the evidence for chemical change
	246	**Life science**	Form a conclusion based on data about the behavior of an organism
	223	**Earth and space sciences**	Predict the Sun's position in the sky
	215		
Proficient	201	**Earth and space sciences**	List soils in order of permeability
	194	**Physical science**	Determine a controlled variable of a chemistry investigation
	186	**Life science**	Recognize that plants produce their own food
	170		
Basic	163	**Life science**	Recognize the role of decomposers
	152	**Physical science**	Critique and improve an investigation about forces
	148	**Earth and space sciences**	Identify the mechanism of a weather pattern
	141		
Below Basic	140	**Earth and space sciences**	Identify sequence of formation of Earth features
	130	**Life science**	Predict the effect of an environmental change on an organism
	119	**Physical science**	Describe part of a valid experiment to compare heating rates of different materials
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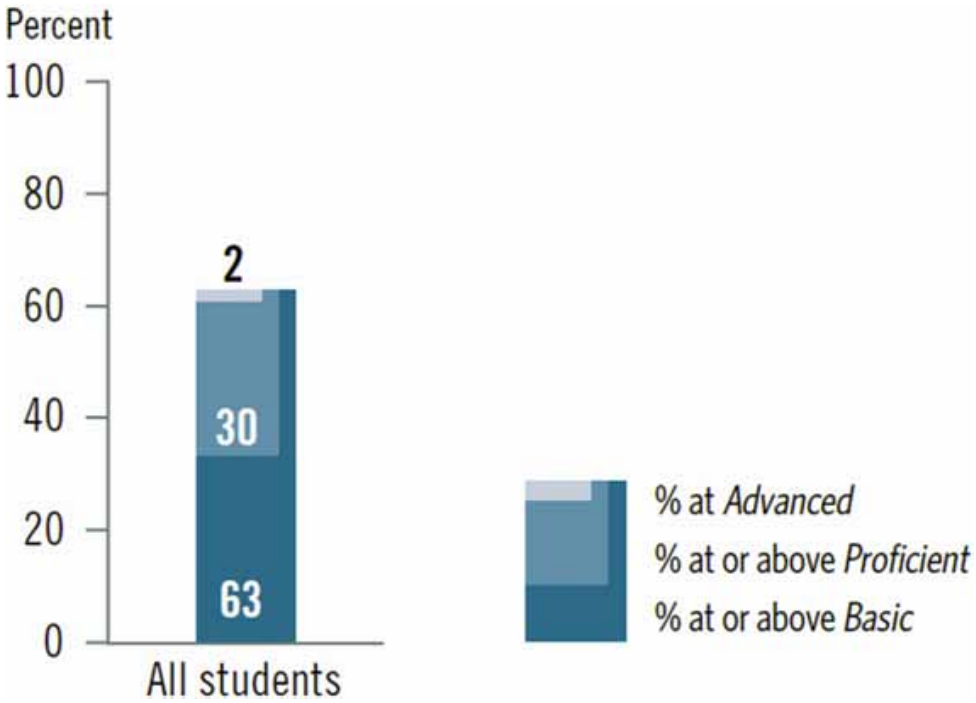
Grade 8 Results

- Thirty percent of eighth-graders perform at or above *Proficient*
- Sixty-three percent perform at or above *Basic*



GRADE 8

NAEP Science Achievement-Level Descriptions fo

The specific descriptions of what eighth-graders should know and be able to do at the *Basic, Pr* levels are presented below. (Note: Shaded text is a short, general summary to describe perfor achievement levels are cumulative; therefore, student performance at the *Proficient* level includ *Basic* level, and the *Advanced* level also includes the skills and knowledge associated with both score indicating the lower end of the score range for each level is noted in parentheses.

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, multicellular organisms, and 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.

Science Practices: Students performing at the *Basic* level should be able to state or recognize correct science principles; explain and predict observations of natural phenomena at multiple scales, from microscopic to global, using evidence to support their explanations and predictions; design investigations employing appropriate tools for measuring variables; and propose and critique the scientific validity of alternative individual and local community responses to design problems.

In the physical sciences, students at the *Basic* level should be able to recognize a class of chemical compounds by its properties; design an investigation to show changes in properties of reactants and products in a chemical process such as burning or rusting; describe the changes in kinetic and potential energy of an object such as a swinging pendulum; describe and compare the motions of two objects moving at different speeds from a table of their position and time data; describe the direction of all forces acting on an object; and suggest an example of a system in which forces are acting on an object but the motion of the object does not change.

In the life sciences, students at the *Basic* level should be able to identify levels of organization within cells, multicellular organisms, and ecosystems; describe how changes in an environment relate to an organism's survival; describe types of interdependence in ecosystems; identify related organisms based on hereditary traits; discuss the needs of animals and plants to support growth and metabolism; and analyze and display data showing simple patterns in population growth.

In the Earth and space sciences, students at the *Basic* level should be able to describe a Sun-centered model of the solar system that illustrates how gravity keeps the objects in regular motion; describe how fossils and rock formations can be used as evidence to infer events in Earth's history; relate major geologic events, such as earthquakes, volcanoes, and mountain building to the movement of lithospheric plates; use weather data to identify major weather events; and describe the processes of the water cycle including changes in the physical state of water.

Proficient (170)

Students performing at th
relationships among clos
able to identify evidence
motions of objects using
growth, and reproduction
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regions of the world. They
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Science Practices: Studer
able to demonstrate relat
principles; explain and pr
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solutions and predict the
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In the life sciences, stude
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effects of heredity and en
and survival; use samplin
ecosystems; and suggest
organisms.

In the Earth and space sc
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used for relative dating; u
lithospheric plate movem
using the properties of rocks and soils; identify recurring patterns of weather phenomena; and predict surface and groundwater movement in different regions of the world.

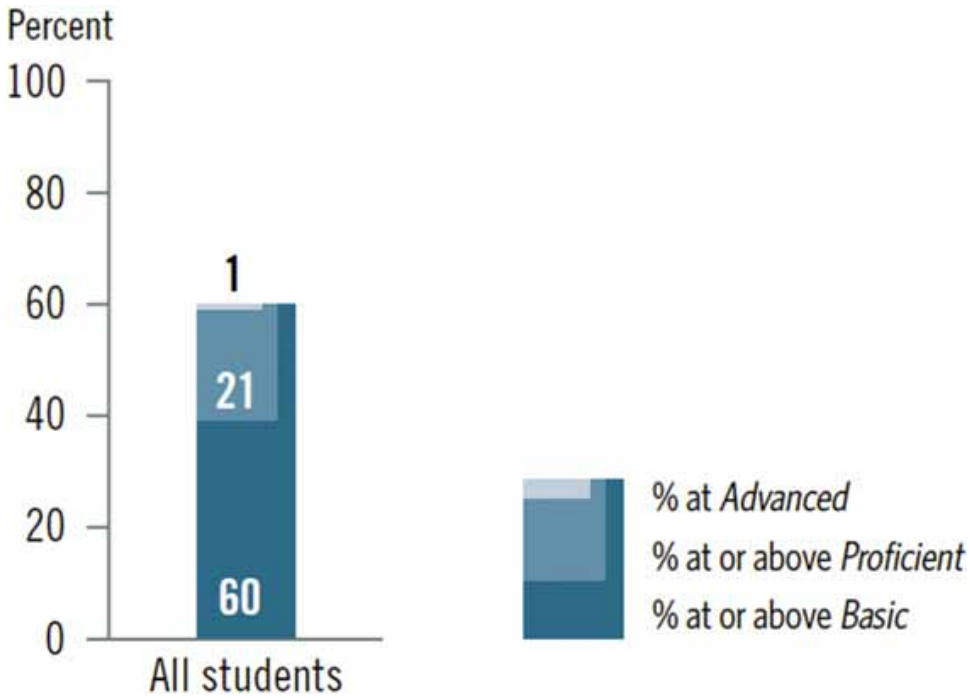
Proficient (170)

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.

Science Practices: Students performing at the *Proficient* level should be able to demonstrate relationships among closely related science principles; 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; design investigations requiring control of variables to test a simple model, employing appropriate sampling techniques and data quality review processes, and use the evidence to communicate an argument that accepts, revises, or rejects the model; and propose and critique solutions and predict the scientific validity of alternative individual and local community responses to design problems.

Grade 12 Results

- Twenty-one percent of twelfth-graders perform at or above *Proficient*
- Sixty percent perform at or above *Basic*



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Grade 12 Results

Skills demonstrated by students performing at different levels

	Scale score	Content area	Question description
Advanced	300 //		
	269	**Life science**	Critique a conclusion about photosynthesis based on observations
	244	**Physical science**	Recognize a nuclear fission reaction
	232	**Earth and space sciences**	Compare methods for determining the age of the Earth
	222		
Proficient	212	**Earth and space sciences**	Identify a characteristic that distinguishes stars from planets
	198	**Physical science**	Relate motion to conversion of kinetic energy to potential energy
	186	**Life science**	Evaluate two methods to help control an invasive species
	179		
Basic	177	**Physical science**	Recognize atomic particles in an ion
	155	**Earth and space sciences**	Indicate a geologic event that explains a rock formation
	143	**Life science**	Determine relationships between species based on an evolutionary tree
	142		
Below Basic	135	**Earth and space sciences**	Design and evaluate a trade-off of a method to obtain drinking water
	128	**Life science**	Draw a conclusion about population growth based on data
	120	**Physical science**	Relate differences in chemical properties to differences in chemical bonds
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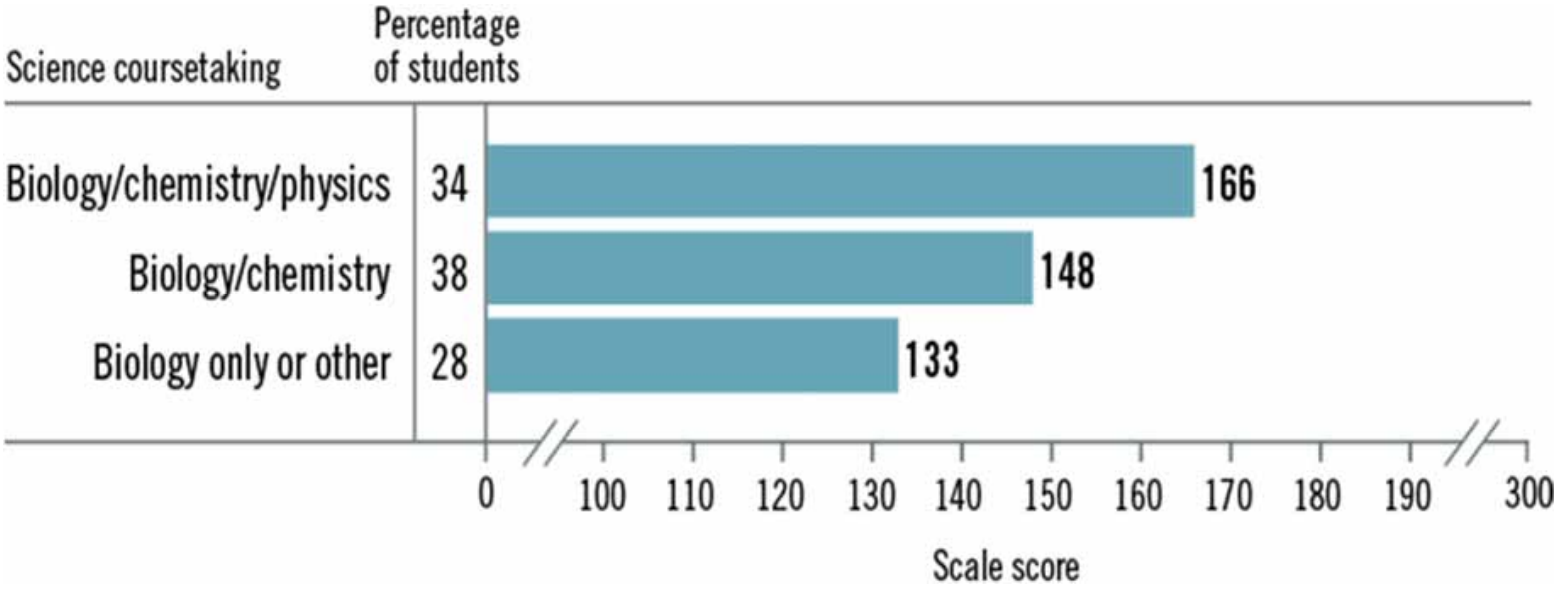
Grade 12 Results

About one-third of students report taking biology, chemistry, and physics



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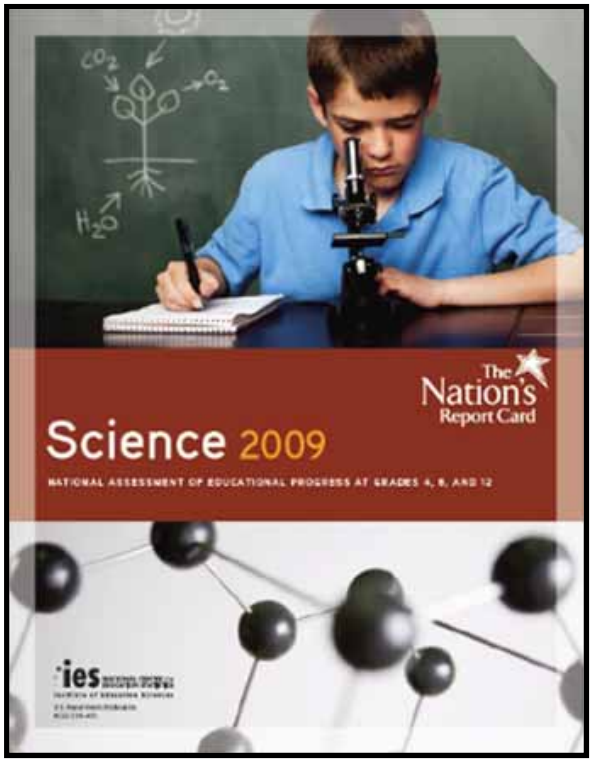
Background Slides

For More Information…



http://nationsreportcard.gov

What is NAEP?

- Largest nationally representative assessment
- Provides a common measure of student achievement across the country
- First administered in 1969
- Reports results for:
  - Nation – since 1969
  - States – since 1990
  - Selected urban districts – since 2002

What is the NAEP Science Assessment?

- Administered January through March 2009
  - 156,500 fourth-graders
  - 151,100 eighth-graders
  - 11,100 twelfth-graders
- Results available for
  - Nation at grades 4, 8, and 12
  - 46 states and Department of Defense schools at grades 4 and 8
- Performance reported as
  - Average scale scores (0–300 scale)
  - Achievement levels (*Basic*, *Proficient*, *Advanced*)