NSTA’s Mission is to promote excellence and innovation in science teaching and learning for all.

NSTA Web Seminar Facts
• Live interactive learning at your desktop since 2004
• Tonight’s program is the 290th NSTA Web Seminar
• 12,000 participants to date
NAEP 101:
Learning More about the NAEP 2009 Science Results

Arnold Goldstein, National Center for Education Statistics
Emmanuel Sikali, National Center for Education Statistics
January 25, 2011
Presentation Outline

- NAEP Overview
- Science 2009 Results
  - Assessment Overview
  - Grade 4
  - Grade 8
  - Grade 12
- NAEP Resources
Poll Question

Did you attend the web presentation about the release earlier today?

√ Yes
X No
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
Scale Scores

• Indicate what students know and can do

• Reported on a scale that varies with assessment subjects
  • 0-300 or 0-500 scale

• Scores are presented for the assessment year, and over time (when possible)
Achievement Levels

• Developed by the National Assessment Governing Board

• Set standards for what students should 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
Contextual Questionnaires

- Provide context for reporting student performance
  - **Student factors**
    - Demographic characteristics, classroom experiences, and educational support
  - **Teacher factors**
    - Credentials, educational background, teacher certification, instructional practices
  - **School factors**
    - Whether school receives Title I funding, type of school, percentage of students absent
Let’s pause for questions from the audience
Science 2009 Results
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)
• 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
Students assessed in three science content areas

<table>
<thead>
<tr>
<th></th>
<th>Grade 4</th>
<th>Grade 8</th>
<th>Grade 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Science</td>
<td>$33\frac{1}{3}%$</td>
<td>30%</td>
<td>$37\frac{1}{2}%$</td>
</tr>
<tr>
<td>Life Science</td>
<td>$33\frac{1}{3}%$</td>
<td>30%</td>
<td>$37\frac{1}{2}%$</td>
</tr>
<tr>
<td>Earth and Space Sciences</td>
<td>$33\frac{1}{3}%$</td>
<td>40%</td>
<td>25%</td>
</tr>
</tbody>
</table>
Let’s pause for questions from the audience
• Thirty-four percent of fourth-graders perform at or above Proficient.

• Seventy-two percent perform at or above Basic.
White students score higher than other racial/ethnic groups

NOTE: Detail may not sum to totals because results are not shown for students whose race/ethnicity was unclassified.
Male students score higher than female students.
Private school students outperform public school students

<table>
<thead>
<tr>
<th>Type of school</th>
<th>Percentage of students</th>
<th>Scale score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>91</td>
<td>149</td>
</tr>
<tr>
<td>Private</td>
<td>9</td>
<td>163</td>
</tr>
<tr>
<td>Catholic</td>
<td>4</td>
<td>164</td>
</tr>
</tbody>
</table>

NOTE: Private schools include Catholic, other religious, and nonsectarian private schools.
Grade 4 Results

Students in city schools score lower than students in other locations

<table>
<thead>
<tr>
<th>School location</th>
<th>Percentage of students</th>
<th>Scale score</th>
</tr>
</thead>
<tbody>
<tr>
<td>City</td>
<td>31</td>
<td>142</td>
</tr>
<tr>
<td>Suburb</td>
<td>36</td>
<td>154</td>
</tr>
<tr>
<td>Town</td>
<td>11</td>
<td>150</td>
</tr>
<tr>
<td>Rural</td>
<td>21</td>
<td>155</td>
</tr>
</tbody>
</table>

NOTE: Detail may not sum to totals because of rounding.
Student performance varies by family income

<table>
<thead>
<tr>
<th>Eligibility status</th>
<th>Percentage of students</th>
<th>Scale score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligible for free lunch</td>
<td>38</td>
<td>132</td>
</tr>
<tr>
<td>Eligible for reduced-price lunch</td>
<td>6</td>
<td>145</td>
</tr>
<tr>
<td>Not eligible</td>
<td>49</td>
<td>163</td>
</tr>
</tbody>
</table>

NOTE: Detail may not sum to totals because results are not shown for the “information not available” category.
Which states do you think scored higher than the national average?
Scores in 24 states higher than the national average
Maryland: Black and Hispanic fourth-graders score above their peers

Percentage of students and average scores in NAEP science for public school students at grade 4 in the nation and Maryland, by selected racial/ethnic groups: 2009

* Significantly different (p < .05) from the nation.

NOTE: Black includes African American, and Hispanic includes Latino. Race categories exclude Hispanic.
State gaps smaller than the nation

Both White students and Hispanic students scored higher

Hispanic students scored comparably and White students scored lower

Hispanic students scored higher

* The score is significantly different ($p < .05$) from the nation.

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

NOTE: The score difference between White and Hispanic students in Mississippi is not significantly different.
State gaps larger than the nation

* The score is significantly different (p < .05) from the nation.
Skills demonstrated by students performing at different levels

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

<table>
<thead>
<tr>
<th>Score</th>
<th>Subject</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>264</td>
<td>Physical science</td>
<td>Determine the source of sound during an investigation about the pitch of sounds</td>
</tr>
<tr>
<td>169</td>
<td>Physical science</td>
<td>Explain an example of heat (thermal energy) transfer</td>
</tr>
<tr>
<td>138</td>
<td>Physical science</td>
<td>Recognize an example of a change of state</td>
</tr>
<tr>
<td>118</td>
<td>Physical science</td>
<td>Identify the data on a chart</td>
</tr>
</tbody>
</table>
Sample Question: Physical Science

A thermometer shows that the outside air temperature is colder than the temperature at which water turns to ice. However, ice on the sidewalk melts.

What probably caused this?

A) The air heating the sidewalk
B) The sidewalk reflecting sunlight into the air
C) The wind causing ice on the sidewalk to melt
D) The sunlight making the sidewalk warmer than the air.
A thermometer shows that the outside air temperature is colder than the temperature at which water turns to ice. However, ice on the sidewalk melts. What probably caused this?

A. The air heating the sidewalk  
B. The sidewalk reflecting sunlight into the air  
C. The wind causing the ice on the sidewalk to melt  
D. The sunlight making the sidewalk warmer than the air

- 64% of fourth-graders were able to explain an example of heat transfer

<table>
<thead>
<tr>
<th>Percentage correct</th>
<th>Overall</th>
<th>Below Basic</th>
<th>At Basic</th>
<th>At Proficient</th>
<th>At Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>64%</td>
<td>44%</td>
<td>65%</td>
<td>80%</td>
<td>91%</td>
</tr>
</tbody>
</table>
Let’s pause for questions from the audience
Grade 8 Results

- Thirty percent of eighth-graders perform at or above **Proficient**
- Sixty-three percent perform at or above **Basic**
Scores in 25 states higher than the national average
Florida: Hispanic eighth-graders score above their peers

Percentage of students and average scores in NAEP science for public school students at grade 8 in the nation and Florida, by selected racial/ethnic groups: 2009

- Overall:
  - Nation: 149
  - Florida: 146*

- Hispanic:
  - Nation: 131
  - Florida: 139*

* Significantly different (p < .05) from the nation.

NOTE: Hispanic includes Latino.
State gaps smaller than the nation

- Both White students and Black students scored higher.
- White students scored lower and Black students scored comparably.
- Black students scored higher.

* The score is significantly different (p < .05) from the nation.

1 Department of Defense Education Activity (overseas and domestic schools).
White-Black State Gaps

State gaps larger than the nation

Nation (public)

Arkansas

Illinois

Wisconsin

Black 125 111* 118* 120*
Gap 36 43 44 44
White 161 154* 162 165*

Scale score

0 100 110 120 130 140 150 160 170 180 190 300
## Grade 8 Results

Skills demonstrated by students performing at different levels

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

0
Skills demonstrated by students performing at different levels

<table>
<thead>
<tr>
<th>Score</th>
<th>Subject</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>223</td>
<td>Earth and space sciences</td>
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</tr>
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<td>201</td>
<td>Earth and space sciences</td>
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</tr>
<tr>
<td>148</td>
<td>Earth and space sciences</td>
<td>Identify the mechanism of a weather pattern</td>
</tr>
<tr>
<td>140</td>
<td>Earth and space sciences</td>
<td>Identify sequence of formation of Earth features</td>
</tr>
</tbody>
</table>
You try it!

Sample Question: Earth and Space Sciences

Three funnels were filled with equal volumes of pebbles, fine sand, and coarse sand, as shown in the diagram below. The same amount of water was poured into each funnel.

Which correctly lists the order in which the water passed through the funnels, from fastest to slowest?

A) Pebbles, fine sand, coarse sand
B) Pebbles, coarse sand, fine sand
C) Fine sand, coarse sand, pebbles
D) Coarse sand, pebbles, fine sand
Sample Question: Earth and Space Sciences

Three funnels were filled with equal volumes of pebbles, fine sand, and coarse sand, as shown in the diagram below. The same amount of water was poured into each funnel.

Which correctly lists the order in which the water passed through the funnels, from fastest to slowest?

A) Pebbles, fine sand, coarse sand
B) Pebbles, coarse sand, fine sand
C) Fine sand, coarse sand, pebbles
D) Coarse sand, pebbles, fine sand

- 45% of eighth-graders were able to identify the correct order of soils according to the rate that water flowed through them.
Let’s pause for questions from the audience
• Twenty-one percent of twelfth-graders perform at or above Proficient

• Sixty percent perform at or above Basic
## Grade 12 Results

Skills demonstrated by students performing at different levels

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

<table>
<thead>
<tr>
<th>No.</th>
<th>Life science</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>269</td>
<td>Critique a conclusion about photosynthesis based on observations</td>
<td></td>
</tr>
<tr>
<td>186</td>
<td>Evaluate two methods to help control an invasive species</td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>Determine relationships between species based on an evolutionary tree</td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>Draw a conclusion about population growth based on data</td>
<td></td>
</tr>
</tbody>
</table>
An experiment was conducted to determine which wavelengths of visible light are most effective for photosynthesis. The units shown here are in nanometers (nm).

Two organisms were used: filamentous algae, which are capable of photosynthesis, and some aerobic bacteria, which are not capable of photosynthesis.

Both organisms were suspended in a water droplet and placed on a microscope slide. The slide was exposed to light that was passed through a crystal prism. (The prism was used to separate visible light into its wavelengths.)

The diagram on the right illustrates what was seen on the microscope slide before and one hour after exposure to light that was passed through the prism.
The diagram below illustrates what was seen on the microscope slide one hour after exposure to light that was passed through a prism. The colors associated with the wavelengths of light are also indicated.

AFTER EXPOSURE TO LIGHT PASSED THROUGH PRISM

Aerobic Bacteria  Filamentous Algae

400 450 500 550 600 650 700 Wavelength (nm)

Violet, Blue, Green, Yellow, Orange, Red

Based on the results of the experiment, a student concludes that the scientist used algae that was green. Do you agree with the student’s conclusion?

A  Yes
B  No

Refer to the results from the experiment to support your answer.
The diagram below illustrates what was seen on the microscope slide one hour after exposure to light that was passed through a prism. The colors associated with the wavelengths of light are also indicated.

Based on the results of the experiment, a student concludes that the scientist used algae that was green. Do you agree with the student’s conclusion?

A  Yes  
B  No

Refer to the results from the experiment to support your answer.
About one-third of students report taking biology, chemistry, and physics.
Let’s pause for questions from the audience
NAEP Resources
NAEP Data Tools

- NAEP Data Explorer
  - Analyze NAEP data and create tables and graphics.

- NAEP Questions Tool
  - Search, sort, and print sample NAEP questions.

- State Comparisons
  - Compare state performance by various demographic groups.

- State & District Profiles
  - See NAEP performance results and student demographics for each state.

- Test Yourself
  - Try out actual questions administered to students in the NAEP assessments.

- NAEP Item Maps
  - See what students at each achievement level are likely to know and can do.
To see how one value compares with the others, read across the row for that value. The displayed symbols indicate whether that value is significantly higher, significantly lower, or not significantly different than the value associated with that column. In some cases the significance test may have not been possible for statistical reasons.

<table>
<thead>
<tr>
<th>Science, grade 8, overall science scale</th>
<th>Difference in average scale scores between variables for race/ethnicity (from school records) [SDRACE] 2009, National</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>White</strong></td>
<td><strong>Black</strong></td>
</tr>
</tbody>
</table>
|                                        | < Diff = 36  
P-value = 0.0000  
Family size = 3 | > Diff = 30  
P-value = 0.0000  
Family size = 3 |
|                                        | < Diff = -36  
P-value = 0.0000  
Family size = 3 | < Diff = -6  
P-value = 0.0000  
Family size = 2 |
|                                        | < Diff = -30  
P-value = 0.0000  
Family size = 3 | > Diff = 6  
P-value = 0.0000  
Family size = 3 |

**LEGEND:**

- ~ Significantly lower.
- > Significantly higher.
- × No significant difference.

**NOTE:** All comparisons are independent tests with an alpha level of 0.05 adjusted for multiple pairwise comparisons according to the False Discovery Rate procedure. For comparisons between two jurisdictions, a dependent test is performed for cases where one jurisdiction is contained in the other. For more detailed information about the procedures and family sizes see the Help document. Black includes African American, Hispanic includes Latino, Pacific Islander includes Native Hawaiian, and American Indian includes Alaska Native. Race categories exclude Hispanic origin unless specified.

**SOURCE:** U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.
Average scale scores for science overall science scale, grade 8, by Race/ethnicity (from school records) [SDRACE] for year and jurisdiction: 2009

2009, National

Scale score

162
126
132
160
137
151

White
Black
Hispanic
Asian/Pacific Island
American Indian
Unclassified

NOTE: Black includes African American, Hispanic includes Latino, Pacific Islander includes Native Hawaiian, and American Indian includes Alaska Native. Race category Hispanic origin unless specified. The NAEP Science scale ranges from 0 to 300. Some apparent differences between estimates may not be statistically significant.

Desktop Share Demonstration
For More Information...

http://nationsreportcard.gov

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Let’s pause for questions from the audience
NSTA Response

Comments by Dr. Francis Eberle
Thank you to the sponsor of tonight's Web Seminar:
http://learningcenter.nsta.org
http://www.elluminate.com
National Science Teachers Association
Dr. Francis Q. Eberle, Executive Director
Zipporah Miller, Associate Executive Director
Conferences and Programs
Al Byers, Assistant Executive Director e-Learning

NSTA Web Seminars
Paul Tingler, Director
Jeff Layman, Technical Coordinator

LIVE INTERACTIVE LEARNING @ YOUR DESKTOP