Science in Action: Understanding what students know and can do in the classroom, in the lab, and with virtual simulations

Presented by: Dr. Arnold Goldstein, Dr. Emmanuel Sikali, and Zipporah Miller

June 20, 2012
Welcome

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

Live interactive learning at your desktop since 2004
Science in Action:
Understanding what students know and can do in the classroom, in the lab, and with virtual simulations

Arnold Goldstein, National Center for Education Statistics
Emmanuel Sikali, National Center for Education Statistics
June 20, 2012
Presentation Outline

- NAEP Overview
- NAEP in the News
- Results
  - Science 2011 (8th grade, paper-and-pencil)
  - Science In Action 2009 (grade 4, 8, and 12, hands-on and computer tasks)
  - Demographics and gaps
- NAEP contextual information
- Demonstration of NAEP resources
NAEP Overview
Poll Question

Do you think students are being taught a sufficient amount of science?

✔ Yes
❌ 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
**NAEP Science In the News**

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**Education Week**

*Published Online: May 10, 2012*

**Most 8th Graders Fall Short on NAEP Science Test**

By Sarah D. Sparks

Fewer than one-third of American 8th graders are proficient in science, but most are improving, and achievement gaps are closing between students who are black, Hispanic and their white peers, a special administration of the test known as “the report card” shows.

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**Wall Street Journal**

**Science Scores Draw Concern**

By Stephanie Banchero

U.S. eighth-graders made modest gains on the latest national assessment of Educational Progress, and that 32% of students were proficient in the science exam was administered, in a cluster showing prompted concern from some educators that schools are leaving American children...
About the NAEP Science Assessments

- **Science 2011**
  - National sample of eighth-graders
  - Results available for
    - Nation and 52 states/jurisdictions

- **Science in Action 2009**
  - Hands-on tasks
  - Interactive computer tasks
  - National sample of fourth-, eighth, and twelfth-graders
Science Results
Scores higher than in 2009

- Eighth-graders score 2 points higher than in 2009

- Scores higher for all but the 90th percentile

* Significantly different (p < .05) from 2011.
Science 2011 Results

Higher percentages of students perform at or above Basic and Proficient in 2011

![Bar chart showing percentage of students at or above Basic and Proficient levels](chart.png)

* Significantly different ($p < .05$) from 2011.
Science 2011 Achievement Gaps

Racial/ethnic gaps narrow from 2009

* Significantly different (p < .05) from 2011.

NOTE: Black includes African American, and Hispanic includes Latino. Race categories exclude Hispanic origin. Score gaps are calculated based on differences between unrounded average scores.
Male students score 5 points higher than female students in 2011.

* Significantly different ($p < .05$) from 2011.
Bottling Honey

- Interactive computer task
- Grade 4
Science In Action 2009 Results

Three Key Findings

1. Students were successful on parts of investigations that involved limited sets of data and making straightforward observations of that data.

2. Students were challenged by parts of investigations that contained more variables to manipulate or involved strategic decision making to collect appropriate data.

3. The percentage of students who could select correct conclusions from an investigation was higher than for those students who could select correct conclusions and also explain their results.
How did students perform on the tasks?

<table>
<thead>
<tr>
<th></th>
<th>Number of items across grades and assessment type</th>
<th>Percent correct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>Key Discovery 1</td>
<td>12</td>
<td>42</td>
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<tr>
<td>Key Discovery 2</td>
<td>11</td>
<td>22</td>
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<tr>
<td>Key Discovery 3:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct Conclusion</td>
<td>9</td>
<td>35</td>
</tr>
<tr>
<td>Explain Results</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>
What else did we learn?

There was **no score gap** between White and Asian/Pacific Islander students on the interactive computer or hands-on tasks.

However, on the main science assessment White students **scored higher** at grades 4 and 8 than Asian/Pacific Islander students.

Females **outscored** males on the hands-on tasks, though males **scored higher** than females on the main science assessment.

There was **no gender gap** in interactive computer tasks.
Questions?
Contextual Information:
A Look at Science Classrooms
Do you have your students work on their scientific writing skills in class?

✔ Yes
✖ No
In 2009

- 39% of fourth-graders and 57% of eighth-graders had teachers who reported at least a moderate emphasis on developing scientific writing skills.

- 28% of twelfth-graders reported writing a report on a science project at least once a week.
What 12th-grade students who took NAEP are doing in the classroom

- Reported taking a science course: 47%
- Reported designing a science experiment at least once every few weeks: 51%
- Reported writing a report on a science project at least once every few weeks: 28%
Do you have your students perform hands-on tasks in class?

✔ Yes

✖ No
Students doing hands-on projects in class more frequently score higher on NAEP
Questions?
NAEP Resources
Accessing Data Tools
Using the NAEP Questions Tool (NQT)

NAEP Questions Tool

Analyze Data | Sample Questions | State Comparisons | State Profiles | District Profiles

Explore NAEP Questions

After each assessment, NAEP releases dozens of sample questions to the public—more than 2,000 questions are currently available. The tools featured here can be used to supplement classroom instruction, provide additional insight into the content of the assessment, and show what students nationally or in your state or district know and can do. Explore the tools or print a quick reference guide to find out more about NAEP.

Questions Tool >>
Explore a database of released NAEP questions.

Item Maps >>
See what students at each achievement level are likely to know and can do.

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

Scoring >>
Learn how NAEP questions are scored.

What’s New?

Results of the 2011 mathematics and reading assessments.

71 multiple-choice and 27 constructed-response mathematics questions.

34 multiple-choice and 27 constructed-response reading questions.
Using the NQT

NAEP Questions Tool

Search for Questions
To begin your search, decide which assessment to explore (main or long-term trend) and then select a subject. On the next screen, you will be able to refine your search results and use My Workspace to assemble and print questions, student responses, scoring guides, and performance data from NAEP assessments. Find out more about NAEP sample questions, and view the copyright policy.

System Requirements What’s this?

Main NAEP What’s this?
- Arts
- Civics
- Economics
- Geography
- Mathematics
- Reading
- Science
- U.S. History
- Writing

Long-Term Trend NAEP What’s this?
- Long-Term Trend Mathematics
- Long-Term Trend Reading

Accessible version
Using the NQT

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<td>1</td>
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Using the NQT

Questions 6 - 8 refer to the following information.

Most soils are a mixture of particles of different sizes. Water moves through soil at different rates, depending largely on how much of each size particle mix. The table below shows the percentage of each size particle in five different soils (A, B, C, D, E) and the rate at which water moves through each of the soils.

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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>80</td>
<td>10</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>C</td>
<td>60</td>
<td>30</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>D</td>
<td>40</td>
<td>50</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>E</td>
<td>20</td>
<td>70</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>
Using the NQT

What can I do here?

My Work

Create a Document

1. Select Content. (Choose one or more.)
   - Questions
   - Answers (keys/scoring guides)
   - Student Responses
   - Performance Summary Data

2. Select Format. (Choose one.)
   - HTML
   - Word

Search Results (123 of 342)

<table>
<thead>
<tr>
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Most soils are a mixture of particles of different sizes. Water moves through soil at different rates, depending largely on how much of each size particle makes up the soil. The table below shows the percentage of each size particle in five different soils (A, B, C, D, E) and the rate at which water moves through each of the soils.

### RATE OF WATER MOVING THROUGH DIFFERENT SOILS

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<td>0</td>
<td>21</td>
</tr>
<tr>
<td>B</td>
<td>85</td>
<td>10</td>
<td>5</td>
<td>6.1</td>
</tr>
<tr>
<td>C</td>
<td>40</td>
<td>40</td>
<td>20</td>
<td>1.3</td>
</tr>
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<td>D</td>
<td>20</td>
<td>65</td>
<td>15</td>
<td>0.69</td>
</tr>
<tr>
<td>E</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0.05</td>
</tr>
</tbody>
</table>

6. Describe the relationship between the size of the soil particles and the rate at which water moves through the soil. Use the data in the table to support your answer.
## Scoring Guide

### Score & Description

**Complete**

Student response correctly describes the relationship between the size of soil particles and the rate at which water moves through soil, referring to data in the table for support. Response demonstrates understanding that water moves faster through soil of larger size particles.

**Partial**

Student response correctly describes the relationship between particle size and rate of water movement, but does not refer to the data in the table for support.

OR

Student response provides a correct statement about the data in the table, which addresses the relationship between the size of soil particles and the rate at which water moves through the soil, but does not establish the relationship.

**Unsatisfactory/Incorrect**

Student response is inadequate or incorrect.
Using the NQT

NAEP national performance results in Science at grade 8: 2011

Draw a conclusion about soil permeability using data

Score
- Unsatisfac/Incorrect: 47%
- Partial: 32%
- Complete: 11%
- Omitted: 9%
- Off task: 1%

Percentage of Students

NOTE: These results are for public and nonpublic school students. Percentages may not add to 100 due to rounding. Off task applies to responses that do not address the question presented, are illegible, or cannot otherwise be scored.

Describe the relationship between the size of the soil particles and the rate at which water moves through the soil. Use the data in the table to support your answer.

If there are more larger particles, the water will drain more quickly. Soil A has 100% larger particles, so water moves through the soil more rapidly than Soil E, which has 100% smaller particles. Soil A’s water moves at 0.1 cm/hr and Soil E’s water moves at 0.06 cm/hr.

Describe the relationship between the size of the soil particles and the rate at which water moves through the soil. Use the data in the table to support your answer.

The more large particles it has, the faster water will go through it because Soil A has only large particles and water moves through it faster than the other soils.

Scorer Comments:
Both responses indicate that water drains faster through soil with larger particles and refer to the data in the table.
Using the NQT

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Using the NQT

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</tr>
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<tbody>
<tr>
<td>Mississippi</td>
<td>125 (2.5)</td>
<td>62 (3.0)</td>
<td>160 (2.9)</td>
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<td>2 (1.0)</td>
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† Reporting standards not met.
†† Not applicable.

NOTE: The NAEP Science scale ranges from 0 to 300. Some apparent differences between estimates may not be statistically significant. Off task applies to responses that do not address the question presented, are illegible, or cannot otherwise be scored.

Questions?
Creating a Test with the NQT
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<tr>
<td>2011</td>
<td>8</td>
<td>S11</td>
<td>16</td>
<td>MC</td>
<td>Medium</td>
<td>Predict a lunar phenomenon</td>
</tr>
<tr>
<td>2009</td>
<td>8</td>
<td>S10</td>
<td>1</td>
<td>MC</td>
<td>Easy</td>
<td>Explain what causes an object to change its motion</td>
</tr>
<tr>
<td>2009</td>
<td>8</td>
<td>S10</td>
<td>2</td>
<td>MC</td>
<td>Medium</td>
<td>Identify a characteristic of Earth's structure</td>
</tr>
<tr>
<td>2009</td>
<td>8</td>
<td>S10</td>
<td>3</td>
<td>MC</td>
<td>Easy</td>
<td>Relate oxygen level to atmospheric conditions at higher elevations</td>
</tr>
</tbody>
</table>
Creating a Test

1. Select Content. (Choose one or more.)
   - Questions
   - Answers (keys/scoring guides)
   - Student Responses
   - Performance Summary Data

2. Select Format. (Choose one.)
   - HTML
   - Word

<table>
<thead>
<tr>
<th>Year</th>
<th>Grade</th>
<th>Block</th>
<th>#</th>
<th>Type</th>
<th>Difficulty</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>8</td>
<td>S11</td>
<td>2</td>
<td>MC</td>
<td>Medium</td>
<td>Identify the atomic components of the molecule</td>
</tr>
<tr>
<td>2011</td>
<td>8</td>
<td>S11</td>
<td>4</td>
<td>MC</td>
<td>Hard</td>
<td>Identify chemically similar elements in the Periodic Table</td>
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<tr>
<td>2011</td>
<td>8</td>
<td>S11</td>
<td>6</td>
<td>SCR</td>
<td>Hard</td>
<td>Draw a conclusion about soil permeability using data</td>
</tr>
<tr>
<td>2011</td>
<td>8</td>
<td>S11</td>
<td>10</td>
<td>SCR</td>
<td>Hard</td>
<td>Form a conclusion based on data about the behavior of an organism</td>
</tr>
<tr>
<td>2011</td>
<td>8</td>
<td>S11</td>
<td>13</td>
<td>MC</td>
<td>Medium</td>
<td>Identify what type of energy moves muscles</td>
</tr>
<tr>
<td>2009</td>
<td>8</td>
<td>S10</td>
<td>1</td>
<td>MC</td>
<td>Easy</td>
<td>Explain what causes an object to change its motion</td>
</tr>
<tr>
<td>2011</td>
<td>8</td>
<td>S11</td>
<td>8</td>
<td>SCR</td>
<td>Hard</td>
<td>Explain the cause of a change in soil permeability</td>
</tr>
</tbody>
</table>
For more information...

- Use the **NAEP Web Tools** to dig deeper into NAEP data. [http://nces.ed.gov/nationsreportcard/about/naeptools.asp](http://nces.ed.gov/nationsreportcard/about/naeptools.asp)

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by

Zipporah Miller
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