The Real Story on Middle School Math Achievement

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This presentation is archived at
http://ceep.indiana.edu/ImplicationsFromNAEP
International Assessment Data

• How do U.S. eight graders’ mathematics skills compare to those of students in other countries?
2007 TIMSS Comparison: 8th Grade Math

Average Scale Scores

- United States: 508
- International: 500
2003 TIMSS Comparison: 8th Grade Math

Average Scale Scores

- **Indiana (10th)**: 508
- **United States (15th)**: 504
- **International**: 466
Main NAEP – grades 4, 8, and 12; results are representative of the entire US population (results available for each state for grades 4 and 8)

Long-Term Trend NAEP – uses different items and testing schedule, national sample only, ages 9, 13, 17
NAEP Item Formats

• **Multiple Choice Format**
  
  4th grade – Four choices  
  8th grade – Five choices  
  12th grade – Five choices

• **Short Constructed Response**
  
  Two types:  
  1. Students write their answers in the space provided  
  2. Multiple questions or a brief rationale (Main NAEP only)

• **Extended Constructed Response**
  
  Multi-part, scored with focused holistic rubrics (Main NAEP only)
• The number of items used for each administration of Main NAEP at grade 8 varies from 180 to 200. Each student completes 30 to 40 items so overall results are found by pooling the scores of all students who completed the assessment.

• Because each student only takes a relatively small fraction of the items, there is no reporting of individual student scores on NAEP.
Reporting Results: Scale Scores and Achievement Levels

- **Scale Scores (Main and LTT NAEP)**
  - Mathematics scores can range from 0 to 500 (except grade 12 after 2000)
  - Available by content strand
  - Available by demographic characteristics (gender, race/ethnicity, rural vs. urban, etc.)

- **Achievement Levels (Main NAEP only)**
  - Basic, Proficient, and Advanced
  - Setting of achievement levels is controversial (proficient level is very ambitious)
Main NAEP Content Strands in Mathematics

- Number sense, Properties, and Operations
- Measurement
- Geometry and Spatial Sense
- Data Analysis, Statistics, and Probability
- Algebra and Functions
At grade 8, a gain of 7 points is approximately one grade level and thus the 18 point gain from 1990 to 2007 is a bit more than two grade levels.
The *No Child Left Behind* law requires that all students meet the proficient level by 2014. Although state rather than NAEP proficiency levels are used, is it likely that we’ll get all 8th graders to required state levels by 2014?
NAEP Mathematics Long-Term Trend (Age 13)
At grade 4, a gain of 12 points is approximately one grade level and thus the 27 point gain from 1990 to 2007 is a bit more than two grade levels.
NAEP Mathematics Long-Term Trend (Age 9)
NAEP Mathematics Long-Term Trend (Age 17)
LTT Items

- Items did not change from 1978 to 2004
- 57 items at age 9, 82 items at age 13, 75 items at age 17
- 20 items used at ages 9 and 13
- 29 items used at ages 13 and 17
- Items assess mathematics taught in the 1970s
- Items released in 2004 and 2008 can be found online using the NAEP Questions Tool
LTT Sample

• Each student takes only a portion of the items (results are pooled to get overall scale scores)
• In the early years (e.g., 1978) samples were as high as 20,000 per age but are now around 6,000 per age
• Sample is representative of the U.S. as a whole
• Periodic – now every 4 years
Add two 2-digit numbers

3. \[ \begin{align*}
35 & \quad +42 \\
\text{ANSWER:} & 
\end{align*} \] 

Age 13 - % Correct

<table>
<thead>
<tr>
<th>Year</th>
<th>% Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>96.3</td>
</tr>
<tr>
<td>1994</td>
<td>96.7</td>
</tr>
<tr>
<td>2004</td>
<td>96.2</td>
</tr>
</tbody>
</table>
Add two 2-digit numbers w/ regrouping

4. 55
+37
ANSWER: __________

Age 13 - % Correct

1982 1994 2004
95.3 96.0 94.7
Add four 2-digit numbers

59
46
82
+68

ANSWER: _____
Add four 2-digit numbers

59
46
82
+68

ANSWER: ______

Age 13 - % Correct

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>85.7</td>
</tr>
<tr>
<td>1994</td>
<td>78.1</td>
</tr>
<tr>
<td>2004</td>
<td>79.0</td>
</tr>
</tbody>
</table>
# Addition & Subtraction

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Type</th>
<th>1982</th>
<th>1994</th>
<th>2004</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtract 2-digit from 2-digit number with regrouping</td>
<td>CR</td>
<td>95.4</td>
<td>92.8</td>
<td>91.3</td>
<td>-4.1</td>
</tr>
<tr>
<td>Subtract 3-digit number from 3-digit number with 2 regroupings</td>
<td>CR</td>
<td>86.3</td>
<td>80.8</td>
<td>79.3</td>
<td>-7.0</td>
</tr>
<tr>
<td>Subtract 3-digit number from 3-digit number with 2 regroupings</td>
<td>CR</td>
<td>88.0</td>
<td>85.8</td>
<td>81.6</td>
<td>-6.4</td>
</tr>
<tr>
<td>Subtract 2-digit from 2-digit number, no regrouping</td>
<td>CR</td>
<td>96.2</td>
<td>95.6</td>
<td>95.5</td>
<td>-0.7</td>
</tr>
<tr>
<td>Subtract 2-digit from 2-digit number, no regrouping</td>
<td>CR</td>
<td>96.1</td>
<td>96.2</td>
<td>95.0</td>
<td>-1.1</td>
</tr>
<tr>
<td>Subtract 1-digit from 2-digit number with regrouping</td>
<td>CR</td>
<td>93.7</td>
<td>92.3</td>
<td>90.1</td>
<td>-3.6</td>
</tr>
<tr>
<td>Word problem requiring addition of two 2-digit numbers</td>
<td>MC</td>
<td>97.6</td>
<td>96.0</td>
<td>96.4</td>
<td>-1.2</td>
</tr>
</tbody>
</table>

**Note:** Under Type, MC means Multiple-Choice and CR means Constructed Response. Change refers to the difference between percentage correct on the last administration of the item and first administration of the item.
Convert mixed number to improper fraction

Write the following mixed numeral as an improper fraction

\[ 1 \frac{1}{4} = \text{_______________} \]
Convert mixed number to improper fraction

Write the following mixed numeral as an improper fraction

1 ¼ = ________________

Age 13 - % Correct

<table>
<thead>
<tr>
<th>Year</th>
<th>% Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>67.3</td>
</tr>
<tr>
<td>1994</td>
<td>69.3</td>
</tr>
<tr>
<td>2004</td>
<td>73.3</td>
</tr>
</tbody>
</table>
Identify greatest decimal number

Which number is GREATEST?
A. 0.35
B. 0.035
C. 0.305
D. 0.03500
Identify greatest decimal number

Which number is GREATEST?
A. 0.35
B. 0.035
C. 0.305
D. 0.03500
## Fractions & Decimals

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Type</th>
<th>1982</th>
<th>1994</th>
<th>2004</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write fraction given in hundredths as a decimal</td>
<td>CR</td>
<td>62.9</td>
<td>59.9</td>
<td>59.9</td>
<td>-3.0</td>
</tr>
<tr>
<td>Write mixed number with fractional part in tenths as decimal</td>
<td>CR</td>
<td>68.4</td>
<td>62.1</td>
<td>62.7</td>
<td>-5.7</td>
</tr>
<tr>
<td>Write fraction greater than one and given in hundredths as a decimal</td>
<td>CR</td>
<td>40.2</td>
<td>35.2</td>
<td>42.2</td>
<td>2.0</td>
</tr>
<tr>
<td>Which of the numbers shown is between two decimals each less than .1?</td>
<td>MC</td>
<td>46.6</td>
<td>48.9</td>
<td>53.9</td>
<td>7.0</td>
</tr>
</tbody>
</table>
Convert from decimal to percent

Change .35 to a percent.
A. 0.35%
B. 3.5%
C. 35%
D. 350%
Convert from decimal to percent

Change .35 to a percent.
A.  0.35%
B.  3.5%
C.  35%
D.  350%

Age 13 - % Correct

<table>
<thead>
<tr>
<th>Year</th>
<th>% Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>67.9</td>
</tr>
<tr>
<td>1994</td>
<td>67.5</td>
</tr>
<tr>
<td>2004</td>
<td>71.4</td>
</tr>
</tbody>
</table>
Convert from percent to decimal

Which of the following means .7%?
A. .7
B. 7%
C. .007
D. 70
Convert from percent to decimal

Which of the following means .7%?
A. .7
B. 7%
C. .007
D. 70

Age 13 - % Correct

<table>
<thead>
<tr>
<th>Year</th>
<th>17.1</th>
<th>28.5</th>
<th>37.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Find percent given part and whole

7 is what percent of 175?

A. 4%
B. 12.25%
C. 25%
D. 40%
Find percent given part and whole

7 is what percent of 175?
A. 4%
B. 12.25%
C. 25%
D. 40%

Age 13 - % Correct

- 1982: 22.5%
- 1994: 30.8%
- 2004: 37.6%
## Percents

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Type</th>
<th>1982</th>
<th>1994</th>
<th>2004</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine whether percent of a number is greater or less than 10</td>
<td>MC</td>
<td>51.7</td>
<td>50.3</td>
<td>60.3</td>
<td>8.6</td>
</tr>
<tr>
<td>Determine whether percent of a number is greater or less than 10</td>
<td>MC</td>
<td>52.8</td>
<td>50.0</td>
<td>54.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Convert percent less than 100 to a decimal</td>
<td>MC</td>
<td>31.0</td>
<td>38.1</td>
<td>47.7</td>
<td>16.4</td>
</tr>
<tr>
<td>Find percent of a number less than 100</td>
<td>CR</td>
<td>50.6</td>
<td>58.4</td>
<td>65.9</td>
<td>15.3</td>
</tr>
<tr>
<td>Find percent of a number less than 100</td>
<td>CR</td>
<td>32.7</td>
<td>41.5</td>
<td>45.5</td>
<td>12.8</td>
</tr>
<tr>
<td>Find percent of a number less than 100 when percent is over 100</td>
<td>MC</td>
<td>28.9</td>
<td>37.5</td>
<td>43.4</td>
<td>14.5</td>
</tr>
</tbody>
</table>
Determine length of object pictured above ruler

What is the length of this pencil to the nearest quarter inch?
A. 3 ¼ inches
B. 3 ¾ inches
C. 4 ¼ inches
D. 4 inches
Determine length of object pictured above ruler

What is the length of this pencil to the nearest quarter inch?
A. 3 ¼ inches
B. 3 ¾ inches
C. 4 ¼ inches
D. 4 inches

Age 13 - % Correct

<table>
<thead>
<tr>
<th>Year</th>
<th>% Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>83.8</td>
</tr>
<tr>
<td>1994</td>
<td>84.2</td>
</tr>
<tr>
<td>2004</td>
<td>84.9</td>
</tr>
</tbody>
</table>
Determine length of line segment above ruler in nonstandard position

How long is this line segment?
A. 2 cm
B. 5 cm
C. 6 cm
D. 7 cm
E. 9 cm
Determine length of line segment above ruler in nonstandard position

How long is this line segment?
A. 2 cm
B. 5 cm
C. 6 cm
D. 7 cm
E. 9 cm

Age 13 - % Correct

<table>
<thead>
<tr>
<th>Year</th>
<th>% Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>58.4</td>
</tr>
<tr>
<td>1994</td>
<td>58.4</td>
</tr>
<tr>
<td>2004</td>
<td>57.8</td>
</tr>
</tbody>
</table>
Identify appropriate unit of metric measure

Which unit would you use to measure the length of a pencil?
A. centimeter
B. meter
C. kilometer
Identify appropriate unit of metric measure

Which unit would you use to measure the length of a pencil?
A. centimeter
B. meter
C. kilometer

Age 13 - % Correct

<table>
<thead>
<tr>
<th>Year</th>
<th>1982</th>
<th>1994</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>87.2</td>
<td>92.9</td>
<td>94.3</td>
</tr>
</tbody>
</table>
Identify appropriate unit of metric measure

Which unit would you use to measure the weight of a car?
A. milligram
B. gram
C. kilogram
D. liter
Identify appropriate unit of metric measure

Which unit would you use to measure the weight of a car?
A. milligram
B. gram
C. kilogram
D. liter

Age 13 - % Correct

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>70.5</td>
</tr>
<tr>
<td>1994</td>
<td>72.8</td>
</tr>
<tr>
<td>2004</td>
<td>69.8</td>
</tr>
</tbody>
</table>
Convert from liters to milliliters

One liter is how many milliliters?

A. 10
B. 100
C. 1000
Convert from liters to milliliters

One liter is how many milliliters?
A. 10
B. 100
C. 1000

Age 13 - % Correct

<table>
<thead>
<tr>
<th>Year</th>
<th>% Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>37.9</td>
</tr>
<tr>
<td>1994</td>
<td>43.1</td>
</tr>
<tr>
<td>2004</td>
<td>37.0</td>
</tr>
</tbody>
</table>
Find perimeter of a rectangle given length and width

What is the PERIMETER of this rectangle?
A. 13 meters  
B. 26 meters  
C. 40 meters  
D. 80 meters

70.5
Find perimeter of a rectangle given length and width.

What is the PERIMETER of this rectangle?
A. 13 meters
B. 26 meters
C. 40 meters
D. 80 meters

Age 13 - % Correct

<table>
<thead>
<tr>
<th>Year</th>
<th>% Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>50.3</td>
</tr>
<tr>
<td>1994</td>
<td>60.3</td>
</tr>
<tr>
<td>2004</td>
<td>70.5</td>
</tr>
</tbody>
</table>
## Measurement & Additional Items

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Type</th>
<th>1982</th>
<th>1994</th>
<th>2004</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify conversion factor between 2 metric units of mass</td>
<td>MC</td>
<td>37.9</td>
<td>43.1</td>
<td>37.8*</td>
<td>-0.1</td>
</tr>
<tr>
<td>Identify greatest metric length unit</td>
<td>MC</td>
<td>73.7</td>
<td>76.5</td>
<td>70.6*</td>
<td>-3.1</td>
</tr>
<tr>
<td>Identify chance of drawing a certain color from a set of objects</td>
<td>MC</td>
<td>86.2</td>
<td>85.5</td>
<td>87.9</td>
<td>1.7</td>
</tr>
<tr>
<td>Identify chance in a coin tossing situation</td>
<td>MC</td>
<td>65.6</td>
<td>64.0</td>
<td>66.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Find the average of several values each less than 10</td>
<td>MC</td>
<td>52.7</td>
<td>58.3</td>
<td>54.3</td>
<td>1.6</td>
</tr>
<tr>
<td>Choose common factor of numbers less than 30</td>
<td>MC</td>
<td>79.5</td>
<td>83.0</td>
<td>82.6*</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Note: An asterisk (*) next to the percent correct indicates 1999 data (2004 not available)
Identify number sequence that models story problem

Kathleen is packing baseballs into boxes. Each box holds 6 baseballs. She has 24 balls. Which number sentence will help her find out how many boxes she will need?

A. 24 – 6 =
B. 24 / 6 =
C. 24 + 6 =
D. 24 x 6 =
Identify number sequence that models story problem

Kathleen is packing baseballs into boxes. Each box holds 6 baseballs. She has 24 balls. Which number sentence will help her find out how many boxes she will need?

A. $24 - 6 =$  
B. $24 / 6 =$  
C. $24 + 6 =$  
D. $24 \times 6 =$  

**Age 13 - % Correct**

<table>
<thead>
<tr>
<th>Year</th>
<th>% Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>80.4</td>
</tr>
<tr>
<td>1994</td>
<td>79.1</td>
</tr>
<tr>
<td>2004</td>
<td>81.5</td>
</tr>
</tbody>
</table>
Simplify algebraic expression

2x + 3y + 4x =
A. 9xy
B. 9x^2y
C. 5xy + 4x
D. 6x + 3y
Simplify algebraic expression

\[ 2x + 3y + 4x = \]
A. \(9xy\)
B. \(9x^2y\)
C. \(5xy + 4x\)
D. \(6x + 3y\)

![Bar chart showing age 13 percentage correct over years 1982, 1994, and 2004.](chart.png)
## Foundations of Algebra

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Type</th>
<th>1982</th>
<th>1994</th>
<th>2004</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add a positive 1-digit and a negative 2-digit number</td>
<td>MC</td>
<td>45.4</td>
<td>61.8</td>
<td>73.4</td>
<td>28.0</td>
</tr>
<tr>
<td>Divide negative 2-digit number by a negative 1-digit number</td>
<td>MC</td>
<td>30.0</td>
<td>34.6</td>
<td>50.7</td>
<td>20.7</td>
</tr>
<tr>
<td>Divide positive 2-digit number by a negative 1-digit number</td>
<td>MC</td>
<td>26.9</td>
<td>28.9</td>
<td>40.5</td>
<td>13.6</td>
</tr>
<tr>
<td>Evaluate a simple algebraic expression</td>
<td>CR</td>
<td>78.8</td>
<td>84.1</td>
<td>89.1</td>
<td>10.3</td>
</tr>
<tr>
<td>Identify a valid algebraic identity</td>
<td>MC</td>
<td>41.5</td>
<td>49.0</td>
<td>53.9</td>
<td>12.4</td>
</tr>
</tbody>
</table>
Identify perpendicular lines

Fill in the oval below the drawing that shows PERPENDICULAR LINES

[Diagram with options A, B, C, D]
Identify perpendicular lines

Fill in the oval below the drawing that shows PERPENDICULAR LINES

Age 13 - % Correct

<table>
<thead>
<tr>
<th>Year</th>
<th>1982</th>
<th>1994</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>37.9</td>
<td>38.9</td>
<td>33.4</td>
</tr>
<tr>
<td>Item Description</td>
<td>Type</td>
<td>1982</td>
<td>1994</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Identify solid shown</td>
<td>MC</td>
<td>71.3</td>
<td>70.2</td>
</tr>
<tr>
<td>Identify non-example of a type of figure</td>
<td>MC</td>
<td>72.3</td>
<td>69.6</td>
</tr>
<tr>
<td>Question involving parallel lines</td>
<td>MC</td>
<td>91.4</td>
<td>93.3</td>
</tr>
<tr>
<td>Find perimeter of a rectangle</td>
<td>MC</td>
<td>38.5</td>
<td>51.7</td>
</tr>
<tr>
<td>Find area of a rectangle</td>
<td>MC</td>
<td>48.4</td>
<td>59.7</td>
</tr>
<tr>
<td>Find area of a rectangle</td>
<td>MC</td>
<td>64.0</td>
<td>67.8</td>
</tr>
<tr>
<td>Find area of a square</td>
<td>CR</td>
<td>15.8</td>
<td>13.1</td>
</tr>
<tr>
<td>Determine whether segments shown can make a given figure</td>
<td>MC</td>
<td>71.7</td>
<td>73.1</td>
</tr>
<tr>
<td>Use property of vertical angles</td>
<td>MC</td>
<td>75.0</td>
<td>82.7</td>
</tr>
<tr>
<td>Use property of supplementary angles</td>
<td>MC</td>
<td>12.8</td>
<td>13.9</td>
</tr>
</tbody>
</table>

Note: An asterisk (*) next to the percent correct indicates 1999 data (2004 not available)
Identify Even Number

Which one of these numbers is an even number?
A. 5
B. 14
C. 29
D. 31
E. 127
Reason about relative ages of 3 people

Henry is older than Bill, and Bill is older than Peter. Then

A. Henry is older than Peter.
B. Henry is younger than Peter.
C. Henry is the same age as Peter.
D. there is not enough information given to tell which is true.
Reason about relative ages of 3 people

Henry is older than Bill, and Bill is older than Peter. Then

A. Henry is older than Peter.
B. Henry is younger than Peter.
C. Henry is the same age as Peter.
D. there is not enough information given to tell which is true.
## Odd/Even and Logic

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Type</th>
<th>1982</th>
<th>1994</th>
<th>2004</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify characteristic of an even number</td>
<td>MC</td>
<td>58.4</td>
<td>53.1</td>
<td>55.1</td>
<td>-3.3</td>
</tr>
<tr>
<td>Identify pattern using even numbers</td>
<td>MC</td>
<td>76.8</td>
<td>72.9</td>
<td>73.3*</td>
<td>-3.5</td>
</tr>
<tr>
<td>Identify valid conclusion about team membership</td>
<td>MC</td>
<td>67.6</td>
<td>79.5</td>
<td>80.2</td>
<td>12.6</td>
</tr>
<tr>
<td>Identify valid conclusion about team membership</td>
<td>MC</td>
<td>44.9</td>
<td>28.4</td>
<td>22.3</td>
<td>-22.6</td>
</tr>
<tr>
<td>Identify geometric figure using logic</td>
<td>MC</td>
<td>84.8</td>
<td>83.6</td>
<td>85.4</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Note: An asterisk (*) next to the percent correct indicates 1999 data (2004 not available)
Problems on “Valid Forms of Reasoning” from *Algebra: It’s Elements and Structure* (1965)

• Supply a conclusion to each of the following hypotheses so as to form a valid argument.
  – If Bill works hard, then he will become rich. Bill works hard. Therefore ….

• Classify each of the following arguments as valid or not valid. Explain your answer.
  – If you read this book, then you will be a huge success. You are a huge success.
Write number sentence based on number line diagram

Write the addition sentence shown by the arrows on the number line above.

ANSWER: ___________________  +  ___________________  =  ___________________
Write number sentence based on number line diagram

Write the addition sentence shown by the arrows on the number line above.
ANSWER: ______________ + ______________ = ______________
## Tables & Graphs

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Type</th>
<th>1982</th>
<th>1994</th>
<th>2004</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read value from table</td>
<td>MC</td>
<td>92.6</td>
<td>96.0</td>
<td>94.7</td>
<td>2.1</td>
</tr>
<tr>
<td>Read value from bar graph</td>
<td>MC</td>
<td>88.0</td>
<td>91.3</td>
<td>88.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Compare two pieces of information in a table</td>
<td>MC</td>
<td>76.2</td>
<td>94.3</td>
<td>82.9</td>
<td>6.7</td>
</tr>
<tr>
<td>Compare two pieces of information in a bar graph</td>
<td>MC</td>
<td>62.4</td>
<td>76.1</td>
<td>77.2</td>
<td>14.8</td>
</tr>
<tr>
<td>Add values selected from table</td>
<td>MC</td>
<td>92.4</td>
<td>92.7</td>
<td>87.9</td>
<td>-4.5</td>
</tr>
<tr>
<td>Add values selected from bar graph</td>
<td>MC</td>
<td>85.7</td>
<td>92.0</td>
<td>90.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Read value from a table</td>
<td>CR</td>
<td>50.2</td>
<td>61.9</td>
<td>59.6</td>
<td>9.4</td>
</tr>
<tr>
<td>Compare two pieces of information in a circle graph</td>
<td>MC</td>
<td>94.8</td>
<td>95.5</td>
<td>96.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Interpret information in a circle graph</td>
<td>MC</td>
<td>93.7</td>
<td>89.9</td>
<td>92.1</td>
<td>-1.6</td>
</tr>
</tbody>
</table>
## Estimation

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Type</th>
<th>1982</th>
<th>1994</th>
<th>2004</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate height of a common object</td>
<td>MC</td>
<td>76.9</td>
<td>91.0</td>
<td>78.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Estimate total weight of several identical objects</td>
<td>MC</td>
<td>32.5</td>
<td>33.8</td>
<td>31.4</td>
<td>-1.1</td>
</tr>
<tr>
<td>Estimate weight of several similar objects</td>
<td>MC</td>
<td>35.1</td>
<td>40.7</td>
<td>39.8</td>
<td>4.7</td>
</tr>
<tr>
<td>Estimate total cost given price per pound and number of pounds</td>
<td>MC</td>
<td>19.3</td>
<td>24.0</td>
<td>21.5</td>
<td>2.2</td>
</tr>
<tr>
<td>Estimate number of objects that can be bought with given funds</td>
<td>MC</td>
<td>58.8</td>
<td>76.3</td>
<td>74.4</td>
<td>15.6</td>
</tr>
<tr>
<td>Estimate sale price given % reduction</td>
<td>MC</td>
<td>38.2</td>
<td>39.1</td>
<td>36.7</td>
<td>-1.5</td>
</tr>
<tr>
<td>Estimate difference between 2 numbers</td>
<td>MC</td>
<td>56.3</td>
<td>63.7</td>
<td>63.2</td>
<td>6.9</td>
</tr>
<tr>
<td>Estimate missing value in a number sentence</td>
<td>MC</td>
<td>36.3</td>
<td>53.9</td>
<td>53.8</td>
<td>17.5</td>
</tr>
</tbody>
</table>
Trends for Age 13

• There has been substantial improvement (roughly two grade levels) in the skills of 13-year-olds over the last 20 years.

• Compared to other industrialized countries, eighth-graders are above average but significantly below the highest performing countries. (Although there are few data on how the U.S. compared in math 50 or more years ago, there is no evidence that the U.S. was ever at or near the top in any subject area or at any grade level.)
Trends for Age 13

• Whole number computation skills are stable although they were strong in the 1970s so there was little room for growth.

• There has been substantial improvement in understanding of concepts of fractions and decimals, understanding decimal place values, and converting between fractions and decimals. There were not enough items on fraction and decimal computation to draw conclusions.
Trends for Age 13

- There has been significant improvement in reading and interpreting tables and graphs.
- Although the algebra-related items on LTT NAEP are very basic, there has been substantial improvement on those items.
- Geometry items on LTT NAEP are also very basic, but like algebra, there has been substantial improvement.
Trends for Age 13

• 13-year-olds in 2004 substantially better than their counterparts from 1982 when it comes to knowing and applying perimeter and area formulas.

• Basic measurement skills have not changed very much in either the metric or U.S. systems.

• Estimation skills of 13-year-olds are not very good in 1982 and that has not changed.
Final Observations

• Students learn what we teach.

• Skills often improve after the period they are stressed in the curriculum.
  – Amount of improvement is not uniform (some skills improve more than others)

• There was additional gain in LTT NAEP between 2004 and 2008 but that was not discussed in this presentation because some of the 2008 items were different from the 2004 items. However, the evidence is clear that the growth trend starting in the 1970s is continuing.
NAEP
Question Tool
NAEP Homepage (nces.ed.gov/nationsreportcard/)
NAEP Website Tools and Applications

The NAEP website features a number of applications designed to give users quick and easy access to questions from previous assessments, performance comparisons, and NAEP assessment data for quick or complex analyses; read a brochure, *NAEP Tools on the Web* (1107K PDF), describing the tools. See more information about each tool below, and print Quick Reference Guides if you are a new user.

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

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

The NAEP Data Explorer (NDE) creates customizable tables and graphics to display NAEP results. Watch a short video about the NDE; use the Quick Reference Guide (595K PDF). Learn about NDE features from the tutorial or access Help from every page. The International Data Explorer (IDE), a new tool that is an offshoot of the NDE, compares assessment results of our nation’s students with those of students from other nations.

The NAEP Questions Tool (NQT) provides access to over 2000 released questions from NAEP assessments in all NAEP subject areas. See students’ actual answers to constructed-response questions, with scoring comments. Bookmark questions for later use. See the tutorial and the Quick Reference Guide (553K PDF) to learn about the NQT; a Help button is on every page.
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.

- Results of the 2005 mathematics, reading, and science assessments.
- 32 multiple-choice and 20 constructed-response questions from the 2006 reading assessment.
- 54 multiple-choice and 29 constructed-response questions from the 2009 science assessment.
Questions 1-6 refer to pieces R, T, and X.

You will need two pieces labeled X to answer this question.

4. Use the pieces to make a shape that has these properties.

- It has four sides.
- No pieces overlap.
- No two sides are parallel.

In the space below, trace the shape.

Draw the line to show where the two pieces meet.
**NAEP Questions Tool**

**Question Information**
- **Description:** Use given pieces to make shape with certain properties
- **Grade:** 4
- **Year:** 2009
- **Block & Number:** Block M5 Question #4
- **Type of Question:** Short Constructed Response
- **Difficulty:** Medium (43.7% Correct)
- **Content Classification:**
  - **Content Area:** Geometry
  - **Complexity:** Moderate

**Solution:**
![Solution Diagram](image)

---

**Score & Description**

**Correct**
Correct response

**Partial**
A four-sided figure with parallel sides with meeting lines drawn. OR A correct shape but meeting line is incorrect. OR A 3-sided figure or a figure with more than four sides, and the sides are not parallel with meeting lines drawn. OR Either of the correct shapes is drawn without the line where the pieces meet.

**Incorrect**
Incorrect response
NAEP national performance results in Mathematics at grade 4: 2008
Use given pieces to make shape with certain properties

<table>
<thead>
<tr>
<th>Score</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect</td>
<td>29%</td>
</tr>
<tr>
<td>Partial</td>
<td>45%</td>
</tr>
<tr>
<td>Correct</td>
<td>21%</td>
</tr>
<tr>
<td>Omitted</td>
<td>5%</td>
</tr>
<tr>
<td>Off Task</td>
<td></td>
</tr>
</tbody>
</table>

Percentage of Students

NOTE: These results are for public and non-public school students. Percentages may not add to 100 due to rounding.
Note about Items Available on the NAEP Online Questions Tool

• The Questions Tool includes percentage correct for released items for the year they are released. These percentages are based on new sampling and testing procedure for LTT NAEP (the new procedure includes students with accommodations, students read items themselves rather than listening to recording of items, etc.) and thus the percentage correct provided online does not normally match the percentage correct reported in this presentation.
• The “What Mathematics Do Students Know” project is supported by the REESE Program of the National Science Foundation (grant number DRL-1008438). Opinions, findings, conclusions, and recommendations are those of the presenters and do not necessarily reflect the views of the National Science Foundation.