Measuring Success: Assessing Student Learning

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Assessment Purposes
- Teachers
  - Measure knowledge
  - Measure gain in knowledge
  - Sorting (Grading)
- Students/Parents
  - Measure preparation (predict success)
- School District/State Education Department
  - Degree requirements (benchmarks)
- Others…

Curriculum Standards
- Frameworks
- Syllabi
- Guides
- Blueprints
- Benchmarks
- Objective tests
- Performance assessments
- Portfolios
- Teacher Observations
- Group Activities
- Program Evaluations

Instructional Program
- Instructional styles
- Print materials
- Equipment
- Facilities
- Technology
- Community

Assessment/Evaluation System
validity
alignment
correlation
### NJ Core Curriculum Content Standards for Science

<table>
<thead>
<tr>
<th>Standard</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Scientific Processes (Habits of Mind, Inquiry, Safety)</td>
</tr>
<tr>
<td>5.2</td>
<td>Science and Society (Cultural, Historical Perspectives)</td>
</tr>
<tr>
<td>5.3</td>
<td>Mathematical Applications (Operations, Geometry, Measurement, Patterns, Algebra, Data Analysis and Probability)</td>
</tr>
<tr>
<td>5.5</td>
<td>Life Science (Matter, Energy, and Organization, Diversity, Evolution, Reproduction and Heredity)</td>
</tr>
<tr>
<td>5.6</td>
<td>Physical Science – Chemistry (Structure and Properties of Matter, Chemical Reactions)</td>
</tr>
<tr>
<td>5.7</td>
<td>Physical Science – Physics (Energy, Force, Energy Transformation)</td>
</tr>
<tr>
<td>5.8</td>
<td>Earth Science (Properties and Materials, Atmosphere and Weather, Processes, Study)</td>
</tr>
<tr>
<td>5.9</td>
<td>Astronomy and Space Science – Exoplanets Systems, Solar System, Stars, Galaxies and Universe</td>
</tr>
<tr>
<td>5.10</td>
<td>Environmental Studies (Natural Systems and Interactions, Human Interactions and Impact)</td>
</tr>
</tbody>
</table>

### Assessment Formats

- **Statewide Assessments**
  - Multiple Choice
  - Short Constructed Response
  - Open-Ended
- **Classroom Measures (NJ Science Curriculum Framework)**
  - Matching pre- and post-module assessments
  - Embedded assessments
  - Prediction activities
  - Final assessments (hands-on, pencil-and-paper, notebooks) **[Summative]**
  - Informal assessments **[Formative]**
  - Documentation and record keeping

### Sample Item - Earth Science

**Earth Science Cluster/Structure and Dynamics of Complex Systems**

**Theory of Plate Tectonics and Earth’s Interior**

A set of data for mapping the relationship between the age of ocean crust and the distance from the Mid-Atlantic Ridge is shown above.

- **Task**
  - In your answer booklet, draw a graph showing the expected trend between distance and age.
  - Use the theory of plate tectonics to explain your answer.
Sample Item - Earth Science

- According to the theory of plate tectonics, new crust is formed at subduction ridges. This pushes older crust from the edge. As the plates move apart from each other, magma from beneath Earth's surface rises up, fills the gap, and hardens into crust. New crust is continually being formed in this manner. Thus, the greater the distance from the subduction ridge, the older the crust.

Note: The graph could be either two straight lines bent upward or two curved lines bent upward.

Sample Item - Student Response

At the subduction ridge, molten material from the Earth's mantle rises and solidifies to form new crust. The new crust pushes the old.

Sample Item - Student Response

The mid-ocean ridge is formed by two plates moving apart. The movement causes new rock to form on the Earth's surface through which magma rises. The movement is caused by two forces: the pull of gravity and the thermal expansion of the crust. As the rock moves away, it becomes further away from the ridge.
“Capturing” Student Thinking

- Exam summaries provided by...
- Error analysis of classroom exams
- Use of specific items as journal questions, exit or entrance slips, or homework assignments (Answer and explain...)

Concepts

- Difficulty – Percentage or proportion that are successful on an item
- Discrimination – How well does an item differentiate between students who understand the subject and those who do not?
- Validity – Does an item measure student understanding of the intended concept?

Concepts (Continued)

- Reliability – can the results be replicated?
  - Inter-rater
  - Test/Re-test
  - Internal Consistency
- Criterion referenced tests
- Latency
Types of Analysis

- Traditional
  - Difficulty
  - Discrimination
  - Response pattern
- Rasch Analysis
  - Item difficulty equated to student ability
  - Standard setting benchmark’s essential

Types of Analysis (Continued)

- Cognitive Level - Bloom’s taxonomy
  - Knowing
  - Using
  - Integrating
- Alignment
  - Curriculum and Assessment
  - Andrew Porter
  - Item format

Types of Analysis (Continued)

Teacher Review (Biology Mentor Network)

- Difficulties analyzed in the context of:
  - Student issues
  - Testing issues
  - Instructional issues
- Use of formative techniques to support conjectures
Student Difficulty?
- Content Knowledge?
- Literacy/Reading Comprehension?
- Question interpretation Skills?
- Misconception?
  - From previous instruction?
  - From culture contexts?
  - Insufficient reinforcement?
- Effort?

Test Difficulty?
- Difficulty (Facility) Level?
- Discrimination?
- Placement on exam?
- Visual distraction by nearby (graphic) items?
- Style of Question?
- Flawed item?

Instructional Difficulty?
- You didn’t teach the associated core major understandings.
- You didn’t reinforce the core understandings enough.
- You taught the core content wrong
Test Data – Discussion and Analysis

- Collecting Data
  - Urban, suburban and rural school participation
  - Sample sizes range between 2008 (Physics) to 9232 (LE)
  - Western New York State (Buffalo area)
  - Statewide assessment data
    - commencement level exams at the conclusion of a 1 year course
  - June 2006 Exams, rating guides and documentation are available at http://www.nysed.gov

- Analysis
  - Difficulty
  - Response Pattern

Interpreting Data

<table>
<thead>
<tr>
<th>Item</th>
<th>Difficulty</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>NR</th>
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<td>1-2MC</td>
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Life Sciences

The illustration below shows an insect eating on a green leaf. The size, shape, and green color of this insect are adaptations that would most likely help the insect:
1. escape enemies
2. resist predators
3. hide from predators
4. avoid toxic mate materials

<table>
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</table>
## Life Sciences

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<tr>
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<td>4545</td>
<td>1179</td>
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</tbody>
</table>

14. Begin in a reproductive process used to produce a new animal. Certain facts are listed below.

Step 1 The animal was removed from an uncooked egg then baby A.
Step 2 The animal is placed through a special system and added it.
Step 3 The egg is inserted into the uncooked egg through baby B.
Step 4 The animal will not be implanted into the uncooked egg through baby C.
Step 5 The egg that goes back to egg D.

Which egg would be most genetically similar to egg E?
1. Egg A only.
2. Egg B only.
3. Both eggs A and B.
4. Both eggs A and C.

## Environmental Studies

<table>
<thead>
<tr>
<th>Item</th>
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<tbody>
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<td>8635</td>
</tr>
</tbody>
</table>

45. For the data for dissolved sugars on the grid. Surround each point with a small circle and connect the points. [4]

Example:

## Life Sciences

<table>
<thead>
<tr>
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<th>0</th>
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### Astronomy and Space Science

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<th>Item</th>
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<th>3</th>
<th>4</th>
<th>NR</th>
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<td>406</td>
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</table>

### Environmental Studies

The photograph below shows a segment of the Saxon Creek in Stinson, New York.

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<th>2</th>
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<tbody>
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<td>2933</td>
<td>2043</td>
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</tr>
</tbody>
</table>

### Earth Science

The question is: "What is the main component of the Earth's core?"  
Options:  
1. Iron  
2. Nickel  
3. Oxygen  
4. Silicon  
5. Water

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<tbody>
<tr>
<td>54</td>
<td>0.91</td>
<td>796</td>
<td>7863</td>
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</tr>
</tbody>
</table>
Earth Science

Two substances, A and Z, are to be identified.

Substance A can not be broken down by a chemical change. Substance Z can be broken down by a chemical change. What can be concluded about these substances?

(1) Both substances are elements.
(2) Both substances are compounds.
(3) Substance A is an element and substance Z is a compound.
(4) Substance A is a compound and substance Z is an element.

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</table>

Chemistry

19 Which balanced equation represents an endothermic reaction?

(1) \( \text{C}(s) + \text{O}_2(g) \rightarrow \text{CO}_2(g) \)
(2) \( \text{CH}_4(g) + 2\text{O}_2(g) \rightarrow \text{CO}_2(g) + 2\text{H}_2\text{O}(l) \)
(3) \( \text{N}_2(g) + 3\text{H}_2(g) \rightarrow 2\text{NH}_3(g) \)
(4) \( \text{N}_2(g) + \text{O}_2(g) \rightarrow 2\text{NO}(g) \)

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<td>0.35</td>
<td>1295</td>
<td>1593</td>
<td>25</td>
<td>1724</td>
<td>13</td>
</tr>
</tbody>
</table>
Chemistry

Given the balanced equation for an organic reaction between butane and chlorine that takes place at 300°C and 1 atm, the equation is:

\[ \text{C}_4\text{H}_{10} + \text{Cl}_2 \rightarrow \text{C}_4\text{H}_9\text{Cl} + \text{HCl} \]

61. Identify the type of organic reaction shown. [5]

<table>
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<tr>
<td>61</td>
<td>0.32</td>
<td>3379</td>
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</table>
Physics

44. A roulette ball into the air has an initial speed of 20 meters per second. Which vector best represents the angle above the horizontal that the ball should be hit to remain in the air for the greatest amount of time?

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<td>649</td>
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<td>902</td>
<td>302</td>
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</tr>
</tbody>
</table>

Physics

Base your answers to questions 44 through 46 on the information below.

A car on a straight road starts from rest and accelerates at 1.0 meter per second squared for 10 seconds. Then the car continues to travel at constant speed for an additional 20 seconds.

44. Determine the speed of the car at the end of the first 10 seconds. [1]

<table>
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<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>64</td>
<td>0.92</td>
<td>152</td>
<td>1854</td>
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</tbody>
</table>

Physics

58. If a proton were to combine with an antiproton, they would annihilate each other and become energy. Calculate the amount of energy that would be released by this annihilation. [Show all work, including the equation and substitution with units.] [2]

<table>
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<td>58</td>
<td>0.37</td>
<td>995</td>
<td>524</td>
<td>487</td>
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</tbody>
</table>
In Conclusion

- Summary of findings
  - Easier
    - Plotting points
    - Major concepts
    - Typical item formats
  - More Difficult
    - Conceptually challenging items
    - “Inscription”
    - Calculations, showing work...
- Next steps: considerations within our classrooms...

Resources from this presentation...

http://physicsed.buffalostate.edu/pubs/NJSTA/Fall06

Email: zawickjl@buffalostate.edu
Office Phone (716) 878-3800

In Conclusion

- Summary of findings
- Future directions
- Next steps...