NGSS Large Scale Assessment Alignment: Expectations, Challenges, and Solutions

June 26, 2019
CCSSO NCSA
Introduction

How well can large scale assessment measure what is valued about the NGSS?

• Alignment in the context of NGSS

Leverage states’ experience in developing NGSS aligned assessments to advance NGSS alignment thinking.
Delaware’s Philosophy

A Systems Approach To Assessment

- Curriculum
- Ongoing Assessment
- Instruction
- Professional Learning

NGSS

College & Career Ready
- **Formative in nature**
  - Used by teachers and students as part of instruction and learning in real time. [How can you use the knowledge you’ve just learned?]
  - Results for use at the local level

- **Benchmark Assessments**
  - Students apply NGSS to contexts similar to those encountered during a specific instructional unit (3 per year grades 3-10)
  - Near term transfer of knowledge and skills. [how can what you learned in this unit be used to solve similar problems]
  - Results used at local level and collectively for Coalition curriculum and professional learning decision making.

- **Summative Assessments**
  - Students integrate, transfer and apply NGSS to unique phenomena (grades 5, 8 and Biology).
  - Long term transfer of knowledge and skills. [how can what you’ve learned by used to solve new problems]
  - Results used for Federal Accountability measures.
Driving Claim: *Students can make sense of a novel phenomenon by accurately engaging the three dimensions of scientific inquiry: disciplinary core ideas, practices and crosscutting concepts.*
Requirements:

• All items must be aligned to at least 2 of the 3 dimensions (Exception: ER must be 3-D)

• Items are limited by the assessment boundary statement associated with a PE, when present.

• Item clusters are typically developed to align to a PE bundle of 2–3 PEs. The items that compose an item cluster must, as a set of items, include alignments to all three dimensions of each PE in the PE bundle.

• Additional Science and Engineering Practices (SEPs) and Crosscutting Concepts (CCCs), beyond those specified in the PEs in the PE bundle, may be included in the alignment of items in an item cluster.
Alignment begins at the PE level.

- At the dimension level, the sub-bullets (elements) of the specific dimensions represented in a PE should be the basis of alignment decisions.
- Dimension decisions should also be informed by the progressions documents (NGSS appendices E, F, and G),
- SEPs and CCCs, outside the specified PEs, can—and, in many cases, should—be included in the alignment. Any additional alignment(s) should be captured as metadata.
<table>
<thead>
<tr>
<th></th>
<th>RIC (Regular Item Cluster)</th>
<th>IIC (Intergrative Item Cluster)</th>
<th>SAI (Stand Alone Items)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Online formats</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Animations</td>
<td>Simulations (2)</td>
<td>Static graphics</td>
</tr>
<tr>
<td></td>
<td>Static Graphics</td>
<td>Animations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Static graphics</td>
<td>Static graphics</td>
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<tr>
<td><strong>Stimulus</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stimulus all upfront (light)</td>
<td>Heavy stimulus</td>
<td>No external stimulus</td>
</tr>
<tr>
<td></td>
<td>Limited storyline</td>
<td>Progressive storyline</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stimulus can build with items</td>
<td></td>
</tr>
<tr>
<td><strong>Item Sequence</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Random</td>
<td>Prescribed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not interdependent</td>
<td>Interdependent items</td>
<td></td>
</tr>
<tr>
<td><strong>Number of Items/Points</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 items (develop 8-10)</td>
<td>6 items</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7 points (operational)</td>
<td>10-13 (operational)</td>
<td></td>
</tr>
<tr>
<td><strong>Allowable Item Types</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SR (1 point)</td>
<td>SR (1 point)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two-part (2 points)</td>
<td>Two-part (2 points)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CR (2 points)</td>
<td>ER (4 points)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TEI (1 or 2 points)</td>
<td>TEI (1 or 2 points)</td>
<td></td>
</tr>
<tr>
<td><strong>Time to complete</strong></td>
<td>13-16 minutes</td>
<td>20-24 minutes</td>
<td>1-3 minutes</td>
</tr>
</tbody>
</table>
Alignment Considerations
Michigan Assessment
“The idea of an assessment system begins with a commonsense point: no one assessment – or assessment occasion – can meet all the needs for information about what student know and can do in science” (p.21 NASEM, 2017).
Evidence Centered Design: Michigan Science Assessment Claims

**Equity Claim**: Non-dominant and dominant groups of students have the opportunity to demonstrate grade band proficiency through the use of engineering, local contexts, and relevant phenomena.

**Scientific Literacy Claim**: Students demonstrate grade band proficiency in using the three dimensions to critically evaluate scientific and technological information in order to design solutions to problems and investigate phenomena.

**Student Level Claim**: Student has demonstrated grade band proficiency in:
- **Life Science**,
- **Earth Science**, &
- **Physical Science**
Topic Bundles using all dimensions represented in the standards.

**District/State Level Claim**: Students have demonstrated grade band proficiency to explain the presented phenomenon (local or global) and design solutions to problems using all dimensions represented in the given topic bundle.
Space Systems

HS-ESS1-1 Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun’s core to release energy that eventually reaches Earth in the form of radiation.

HS-ESS1-2 Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.

HS-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements.

HS-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

<table>
<thead>
<tr>
<th>Dev/Use Models</th>
<th>ESS1.A Universe and Stars</th>
<th>Patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicate</td>
<td></td>
<td>Systems/Sytm. Models</td>
</tr>
<tr>
<td>Math and Comp Thk.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Example Item Cluster Map

**Topic Bundle**
Structure and Properties of Matter

5-LS1-1
- LS1.C  SEP 7  CC 5

5-LS2-1
- LS2.A  SEP 2  CC 4
- LS2.B  SEP 2  CC 4

5-PS3-1
- PS3.D  SEP 2  CC 5
- LS1.C  SEP 2  CC 4

**Stimulus**
- Item 1: LS1.C  CC 5  SEP 2
- Item 2: PS3.D  CC 5  SEP 2
- Item 3: LS1.C  CC 4  SEP 2
- Item 4: LS2.A  CC 4  SEP 2
- Item 5: LS2.B  CC 4  SEP 7
Alignment is at the Topic Bundle Level

All items must be at least 2D

All Stimuli must present a phenomenon

Alignment is not bound to PEs
2020 Operational Test

- Multiple forms per grade (5, 8, 11)
- 7-8 Item Clusters per form
  - 2-Physical Science
  - 2- Earth Science
  - 2- Life Science
  - 1-2 – Field Test Item Cluster(s)
- Estimated Time: 10-15 minutes per cluster
Questions for States

Q&A focused on alignment to clarify the states’ contexts.
Foundational Alignment Questions

1. What is the overarching claim for the test?
2. What are we aligning to?
3. What is the role of an item specifications document?
4. What is the question that we are asking to determine alignment?
5. What is the process of making an alignment judgment?
General Alignment Questions

1. What is the overarching claim for the test?
2. What are we aligning to?
3. What is the role of an item specifications document?

<table>
<thead>
<tr>
<th></th>
<th>Delaware</th>
<th>Michigan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blueprints</td>
<td>Elem 3 clusters 10 SAI; Secondary 4 clusters 14 SAI</td>
<td>6 Clusters + 1-2 FT Clusters</td>
</tr>
<tr>
<td>Item Specifications</td>
<td>PE Bundles</td>
<td>Topic Bundles</td>
</tr>
<tr>
<td>Sampling Plan</td>
<td>Tiered Assessment System—Summative=Single form 5, 8, Bio</td>
<td>4 forms; matrix by student</td>
</tr>
<tr>
<td>Reporting Categories</td>
<td>Single score</td>
<td>Life, Physical, Earth</td>
</tr>
</tbody>
</table>
General Alignment Questions

4. What are the questions that we are asking to determine alignment?

5. What is the process of making an alignment judgment?
What do you think?

Intended Alignment

PS1.A – Each pure substance has characteristic physical and chemical properties that can be used to identify it.

PS1.B – Substances react chemically in characteristic ways. In a chemical process, the atom that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.

SEP 4 – Analyzing and Interpreting Data

CCC 1 – Patterns

**Item Level Claim:** The student uses the data table to determine if a chemical reaction occurred and provides the evidence to support their determination.
How do Hand Warmers Work? (Part 1)

Two students are outside in the cold, waiting for a bus. One of the students has a package of hand warmers and offers to share them with the other student. The student opens the package and they each put a hand warmer bag in one of their gloves.

After a few minutes, the students notice that the hand warmer bags start to feel warm. The students want to know how hand warmer bags get warm. They decide to ask their science teacher if they can test the materials inside the hand warmer bags. After reading the ingredients on the hand warmer package, the students decide to focus on iron because it is the most common ingredient.

The students designed the following procedure.

1. Open a new hand warmer package.
2. Cut open the hand warmer bag.

This question has two parts.

Part A

Use the data table to complete the following statement.

The students can tell that a chemical reaction involving iron [ ] because a new substance [ ] form overnight.

Part B

Choose one set of properties that best supports the completed statement in Part A.

- a) density and color
- b) color and volume
- c) volume and texture
- d) texture and mass
- e) mass and density
This question has two parts.

Part A

Use the data table to complete the following statement.

The students can tell that a chemical reaction involving iron [ ] because a new substance [ ] form overnight.

Part B

Choose one set of properties that best supports the completed statement in Part A.

- [ ] density and color
- [ ] color and volume
- [ ] volume and texture
- [ ] texture and mass
- [ ] mass and density
2. Cut open the hand warmer.
3. Separate the materials by using a magnet to attract the iron.
4. Place the iron on a dish.
5. Make initial observations and calculations to record properties of the iron.
6. Leave the iron in the dish overnight.
7. Record final observations and calculations the next day.

**Iron from Hand Warmer Bag**

**Hand Warmer Investigation Data**

<table>
<thead>
<tr>
<th>Property/Calculation</th>
<th>Initial</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Gray</td>
<td>Red</td>
</tr>
<tr>
<td>Texture</td>
<td>Powder</td>
<td>Powder</td>
</tr>
<tr>
<td>Mass</td>
<td>21 g</td>
<td>30 g</td>
</tr>
<tr>
<td>Volume</td>
<td>2.67 cm³</td>
<td>5.73 cm³</td>
</tr>
<tr>
<td>Density</td>
<td>7.87 g/cm³</td>
<td>5.24 g/cm³</td>
</tr>
</tbody>
</table>

This question has two parts.

**Part A**

Use the data table to complete the following statement.

The students can tell that a chemical reaction involving iron occurred ______ because a new substance ______ form

- occurred
- did not occur

**Part B**

Choose one set of properties that best supports the completed statement in Part A.

- a. density and color
- b. color and volume
- c. volume and texture
- d. texture and mass
- e. mass and density
What do you think?

Aligned

Not Aligned

How do you know?
Perspectives to Consider

SEP Guidance and Questions
CCC Guidance and Questions
General Expectations
1. Which practice is most specifically measured by the item in question?

2. Is the targeted practice aligned with a grade level appropriate progression(s)?
   - Appendix F: “Practices Matrix” for SEPs lists all possible practice progressions by grade band.

3. At what level is the practice being measured by this specific item?
CCC Questions

1. Are/is a CCC(s) mentioned in the wording of this item?

2. Are/is a CCC(s) alluded to within the item without requirement of CCC evidence collection for a correct response?

3. Are/is a CCC(s) directly measured through this item as a knowledge or framing construct developed by students?

Do you feel this item is “ALIGNED” with a CCC?
General Expectations

1. Sense making
   1. to what degree is the item cluster/item allowing students to sense make?

2. Phenomena
   1. to what degree is the phenomena appropriate, and meeting the expectations of a phenomena?
What do you think?

Intended Alignment

PE 05-PS3-1: Use models to describe that energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

SEP – Analyzing and Interpreting Data

CCC – Energy and matter

Item Level Claim: The student is asked to analyze data (SEP) from a figure and select a statement to construct an explanation (SEP) using the crosscutting concepts of energy and matter and applying the core idea of energy in chemical processes (DCI).
The scientists made the maps in Figure 3 to show how the amount of algae in the North Atlantic Ocean changes from February to March to April and to May. The location of Delaware is shown on each map.

**Part A**

Based on the information in Figure 3, when will the scientists most likely find whales near Delaware?

- A. February
- B. March
- C. April
- D. May

**Part B**

Which three statements explain the answer to Part A?

- A. Less sunlight is available near Delaware during that month.
- B. More energy is available for algae near Delaware during that month.
- C. More matter is stored in algae near Delaware during that month.
- D. Less energy is stored in algae near Delaware during that month.
- E. More matter is available for whales near Delaware during that month.
What do you think?

Aligned

Not Aligned

How do you know?
Final thoughts on NGSS alignment challenges
We are five years in, what is the next frontier for NGSS assessments?

Making good ones…