Applying ECD Principles: Developing a NGSS Assessment Argument

NSTA Professional Development Institute

Wednesday, March 11, 2015
What we will do...

• Build an assessment argument to guide task (re)design
• Use your assessment argument to refine tasks and construct rubrics

Part 1

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 min</td>
<td>Introduction to assessment arguments</td>
</tr>
<tr>
<td>20 min</td>
<td>Constructing assessment arguments: <em>Evidence Statements</em></td>
</tr>
</tbody>
</table>
Building Toward Tasks
What the NGSS Do and Don’t Do for Us

+ Opportunities to support coherence in science learning
Identification of essential science and engineering practices
High-leverage intersections of disciplinary core ideas, practices and crosscutting concepts (Performance Expectations)

? What is evidence of meeting a Performance Expectation?
What are critical task features to elicit evidence of the Performance Expectation?
What are culturally relevant and motivating phenomena to engage students in applying ideas?
Design Approach

1. Identify Performance Expectations

2a. Unpack Science Practices
2b. Unpack Disciplinary Core Ideas
2c. Unpack Crosscutting Concepts

3. Assessment Argument
   - Performance Expectations (PEs)
     - Evidence Statements for Each PE
     - Task Design Features to Elicit Desired Evidence

4. Tasks and Rubrics
   - Task Authoring Environment and Delivery Requirements
Assessment Argument

*Three Basic Questions*

- What do we want students to be able to know and do? (Described by PEs)
- What kinds of evidence will students need to provide to demonstrate proficiency?
- What kinds of contexts and task features will elicit the desired evidence?

When we have logical and coherent answers to these three questions, we have an Assessment Argument.
Value of an Assessment Argument

- Develop a shared vision about assessments with colleagues
- Document design decisions for reuse
- Create more well-aligned tasks
- Tool to generate a family of tasks that meet a performance expectation
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.

**Readiness Assumptions / Prior Knowledge and Skills**

- 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents
- Knowledge of key concepts: particles, motion, temperature, energy
- Experience with developing models
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.

Components of Modeling

- Model elements
- Relationships
- Correspondence
- Limitations
- Explanation/prediction
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.

Components of Modeling

• **Model elements**
• **Relationships**
• **Correspondence**
• **Limitations**
• **Explanation/prediction**
Assessment Argument

Evidence Statements

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.

Components of Modeling

• **Model elements:** Substances represented as same-sized particles, Arrows for speed/direction; Model elements are labeled
• **Relationships:** Arrows show faster and slower particle motion
• **Correspondence:** Model illustrates faster moving particles as thermal energy increases
• **Explanation/prediction:** Accurate prediction that as thermal energy increases particles will move faster
Building an Assessment Argument (15 min)

Steps 1 and 2

With a partner…

• **Step 1.1.** Select one of the two PEs from the task analysis. Think about specific claims

• **Step 1.2.** Identify readiness assumptions

• **Step 2.1.** Use evidence statements from practices unpacking to specify evidence statements for the PE
Lunch

We’ll reconvene at 1 PM...
### Where We’ve Been and Where We’re Headed

<table>
<thead>
<tr>
<th>Before Lunch</th>
<th>Constructing assessment arguments (Part 1): Evidence statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 min</td>
<td>Recap on Evidence Statements</td>
</tr>
<tr>
<td>10 min</td>
<td>Constructing assessment arguments (Part 2): Intro to Task Features</td>
</tr>
<tr>
<td>15 min</td>
<td>Develop Task Features</td>
</tr>
<tr>
<td>1 hour</td>
<td>Revise Tasks and Develop Rubrics</td>
</tr>
</tbody>
</table>
The evidence statements are intended to identify clear, measurable components that, if met, fully satisfy each PE described within the NGSS. They are not meant to limit or dictate instruction and were written to allow for multiple methods and contexts of assessment, including assessing multiple related PEs together at the same time.

The evidence statements were developed by educators and scientists, including many members of the NGSS writing team. Evidence statements for the K-8 NGSS PEs are coming soon. For more information, see the Overview.

### Executive Summary

### Introduction and Overview

### Download all high school evidence statements

<table>
<thead>
<tr>
<th>Physical Sciences</th>
<th>Life Sciences</th>
<th>Earth and Space Sciences</th>
<th>Engineering, Technology, and Applications of Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full PS PDF</td>
<td>Full LS PDF</td>
<td>Full ESS PDF</td>
<td>Full ETS1 PDF</td>
</tr>
<tr>
<td>Full PS1 PDF</td>
<td>HS-LS1-1</td>
<td>HS-ESS1-1</td>
<td>HS-ETS1-1</td>
</tr>
<tr>
<td>HS-PS1-2</td>
<td>HS-LS1-2</td>
<td>HS-ESS1-2</td>
<td>HS-ETS1-2</td>
</tr>
<tr>
<td>HS-PS1-3</td>
<td>HS-LS1-3</td>
<td>HS-ESS1-3</td>
<td>HS-ETS1-3</td>
</tr>
<tr>
<td>HS-PS1-4</td>
<td>HS-LS1-4</td>
<td>HS-ESS1-4</td>
<td></td>
</tr>
<tr>
<td>HS-PS1-5</td>
<td>HS-LS1-5</td>
<td>HS-ESS1-5</td>
<td></td>
</tr>
<tr>
<td>HS-PS1-6</td>
<td>HS-LS1-6</td>
<td>HS-ESS1-6</td>
<td></td>
</tr>
<tr>
<td>HS-PS1-7</td>
<td>HS-LS1-7</td>
<td>Full ESS2 PDF</td>
<td></td>
</tr>
<tr>
<td>HS-PS1-8</td>
<td>Full LS2 PDF</td>
<td>HS-ESS2-1</td>
<td></td>
</tr>
<tr>
<td>Full PS2 PDF</td>
<td>HS-LS2-1</td>
<td>HS-ESS2-2</td>
<td></td>
</tr>
<tr>
<td>HS-PS2-1</td>
<td>HS-LS2-2</td>
<td>HS-ESS2-3</td>
<td></td>
</tr>
<tr>
<td>HS-PS2-2</td>
<td>HS-LS2-3</td>
<td>HS-ESS2-4</td>
<td></td>
</tr>
<tr>
<td>HS-PS2-3</td>
<td>HS-LS2-4</td>
<td>HS-ESS2-5</td>
<td></td>
</tr>
<tr>
<td>HS-PS2-4</td>
<td>HS-LS2-5</td>
<td>HS-ESS2-6</td>
<td></td>
</tr>
<tr>
<td>HS-PS2-5</td>
<td>HS-LS2-6</td>
<td>HS-ESS2-7</td>
<td></td>
</tr>
</tbody>
</table>
## NGSS Evidence Statements

**http://www.nextgenscience.org/ngss-high-school-evidence-statements**

### HS-LS2-1

**Students who HS-LS2-1.**

### Observable features of the student performance by the end of the course:

<table>
<thead>
<tr>
<th></th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Students identify and describe the components in the given mathematical and/or computational representations (e.g., trends, averages, histograms, graphs, spreadsheets) that are relevant to supporting given explanations of factors that affect carrying capacities of ecosystems at different scales. The components include:</strong></td>
</tr>
<tr>
<td></td>
<td>i. The population changes gathered from historical data or simulations of ecosystems at different scales; and</td>
</tr>
<tr>
<td></td>
<td>ii. Data on numbers and types of organisms as well as boundaries, resources, and climate.</td>
</tr>
<tr>
<td></td>
<td><strong>Students identify the given explanation(s) to be supported, which include the following ideas:</strong></td>
</tr>
<tr>
<td></td>
<td>Factors (including boundaries, resources, climate, and competition) affect carrying capacity of an ecosystem, and:</td>
</tr>
<tr>
<td></td>
<td>i. Some factors have larger effects than do other factors.</td>
</tr>
<tr>
<td></td>
<td>ii. Factors are interrelated.</td>
</tr>
<tr>
<td></td>
<td>iii. The significance of a factor is dependent on the scale (e.g., a pond vs. an ocean) at which it occurs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Mathematical and/or computational modeling</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td><strong>Students use given mathematical and/or computational representations (e.g., trends, averages, histograms, graphs, spreadsheets) of ecosystem factors to identify changes over time in the numbers and types of organisms in ecosystems of different scales.</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td><strong>Students analyze and use the given mathematical and/or computational representations</strong></td>
</tr>
<tr>
<td></td>
<td>i. To identify the interdependence of factors (both living and nonliving) and resulting effect on carrying capacity; and</td>
</tr>
<tr>
<td></td>
<td>ii. As evidence to support the explanation and identify the factors that have the largest effect on the carrying capacity of an ecosystem for a given population.</td>
</tr>
</tbody>
</table>
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.

What kinds of contexts and task features will elicit the desired evidence?
An analogy...
Assessment Argument

Characteristic and Variable Task Features
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.

What are the limits / bounds to consider?
What task features are needed to elicit the desired evidence?
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.

What are the limits / bounds to consider?

- Focus on qualitative molecular-level models
- Only pure substances
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.

**What task features are needed to elicit the desired evidence?**

- Prompts to develop the model and use the model to predict/describe
- Grade-appropriate language (reading/writing) demands
- Materials to construct a model
Assessment Argument

Variable Task Features

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of pure substances could include water, carbon dioxide, and helium.

What are options/choices for

• relevant and motivating contexts and phenomena?
• incorporating links to ELA and mathematics?
• making tasks accessible to all students?
What are options for relevant and motivating contexts and phenomena?

- Why molten liquid rock can flow but solid rock cannot
- Playground balls: more inflated outside in sun than in cold gym
- Cooking
- Why a hairdryer works
What are options for incorporating links to ELA and mathematics?

CCSS.ELA-LITERACY.W.6.1.C. Use words, phrases, and clauses to clarify the relationships among claim(s) and reasons.

CCSS.MATH.CONTENT.6.NS.C.5. Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature...)

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.
What are options for making tasks accessible to all students?

- Type of model to construct: drawings, technology-supported models
- Use of visual diagrams and exemplars
- Scaffolds to support model construction
- Heighten relevance: connect to an investigation
Assessment Argument (20 min)

**Characteristic and Variable Task Features**

With your partner...

**Describe Characteristic Features**
- **Step 3.1.** Limits / bounds
- **Step 3.2.** Essential task features

**Describe Variable Features**
- **Step 4.1.** Phenomena and contexts
- **Step 4.2.** Links to ELA and mathematics
- **Step 4.3.** Accessibility strategies

---

**Step 3. Describe Characteristic Task Features**

3.1. What are the limits or bounds to consider?

3.2. What task features are needed to elicit the desired evidence?

**Step 4. Describe Variable Task Features**

4.1. What are options for relevant and motivating phenomena (contexts)?

4.2. What are options for incorporating links to ELA and mathematics?

4.3. What are options for making tasks accessible for all students?
Your assessment argument is complete!
Your assessment argument is complete!

You can use it to:

1. Improve existing tasks
2. Design a family of tasks for the PE
3. Communicate your ideas about assessment design to your colleagues
Your assessment argument is complete!

You can use it to:

1. **Improve existing tasks**
2. Design a family of tasks for the PE
3. Communicate your ideas about assessment design with your colleagues
1. **Select Task.** Select one of the tasks from this morning that did not meet the NGSS Performance Expectation

2. **Refine Task.** Work with a partner or small group and use your assessment argument to improve the task’s alignment to the NGSS

3. **Begin Rubric Development.** Use your evidence statements to describe what students will need to say/do on this task to get full credit
Reflection and Revision (20 min)

**Presenters**

- Introduce your task and rubric with another group.
- Describe how elements of the assessment argument are reflected in your task and rubric.
- Share challenges and how you addressed challenges.

**Reviewers**

- Which task features are applied in the task redesign?
- Are there other task features that might be considered to improve the task?
- How does the early rubric development correspond to evidence statement?