NGSS-FOCUSED SUMMATIVE CLASSROOM ASSESSMENTS OF THREE-DIMENSIONAL LEARNING

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NSTA – Engage: Spring21
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Agenda

• Project introduction
• Anatomy of 3D Assessments
  • Earth
  • Life
  • Physical
• How to participate, if you are interested
Assessment Project Overview

- Lawrence Hall of Science Project, led by SEPUP
  - FOSS, LDG, and Research staff are also participating
- Two-phase project (four years total), started January 2018
- Funded by Carnegie Corporation of New York
  - This work was made possible by a grant from the Carnegie Corporation of New York. The statements made and view expressed are solely the responsibility of the authors.
Assessment Project Overview

- **Goal:** Develop 2D and 3D summative curriculum-independent assessments similar in nature to those SEPUP developed for the *Disruptions in Ecosystems* Unit.

- **Piloting:** Work with teachers to obtain input and pilot assessments in their classrooms.

- **Expert review:** Teachers, curriculum and assessment experts.

- **Availability:** When complete, items will be widely available for use and modification.
Item Development Process

- Based on published approaches for Evidence-Centered Design of NGSS Assessment Development (Harris et al. 2016)

- Steps of the process include:
  - “Unpacking” the NGSS elements: SEP, CCC, and DCI
  - Development of Learning Performances (LPs)
  - Development of design patterns for the items, including
    - The nature of information provided in the prompt
    - Possible relevant phenomena/problems/scenarios
    - Possible supports to promote equity
  - Development of the specific items

Collecting Evidence about Validity and Reliability

- Review of items by representatives from three curriculum groups at the Lawrence Hall of Science
- Review of items by classroom teachers
- Review from additional curriculum groups
- Student cognitive labs (think-alouds)*
- Piloting with approximately 150 students*
- Additional expert review
Earth Science

MS ESS2-4: Earth’s Systems

Students who demonstrate understanding can:

MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]

The performance expectation above was developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices
Developing and Using Models
- Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to describe unobservable mechanisms.

Disciplinary Core Ideas
ESS2.C: The Roles of Water in Earth’s Surface Processes
- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.
- Global movements of water and its changes in form are propelled by sunlight and gravity.

Crosscutting Concepts
Energy and Matter
- Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.

Example Learning Performance: Students create a model that shows how water gets from the surface to the atmosphere, from the atmosphere to a mountain or area of high elevation, and then to an area of low elevation.
The diagram above shows a reservoir, a large body of water built by people in the mountains.

How does the snow in the mountains end up as water in the reservoir? Add arrows and labels to the diagram to show your ideas:

- Show the phase the water was in along the way and any changes
- Explain any process that was driven by gravity
- Explain any process that was driven by a transfer of energy
The diagram above shows a reservoir, a large body of water built by people in the mountains.

How does the snow in the mountains end up as water in the reservoir? **Add arrows and labels** to the diagram to show your ideas:

- Show the **phase the water** was in along the way and any changes
- Explain any process that was driven by **gravity**
- Explain any process that was driven by **transfer of energy**

SEP: Modeling
DCI: Water Cycle (sunlight, gravity)
CCC: Energy & Matter
How does the snow in the mountains end up as water in the reservoir? Add arrows and labels to the diagram to show your ideas:

- Show the phase the water was in along the way and any changes
- Explain any process that was driven by gravity
- Explain any process that was driven by transfer of energy
In the chat box…

- What challenges might students encounter?
- What supports might students need to engage in three-dimensional sensemaking as they respond?
Example Learning Performance: Given evidence about variations in the growth of a sample of plants, students construct an explanation for how both genetic and environmental factors might explain the differences observed.
Samira and her father go to the plant nursery and find 12 young plants that are labeled “yellow snapdragons.” They plant them in a sunny part of the garden and give them the same amount of water.

After 4 weeks, all the plants are healthy. But they are different heights and shades of yellow, as shown in the picture below. About half of them are dark yellow and short (about 18 cm), while the other half are light yellow and tall (about 45 cm). Since all the plants grew under the same conditions, what might cause the differences in the plants? Explain your answer.
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Sample Student Response

Since the plants are all grown in the same conditions, the different heights and colors don’t seem to be caused by the environment, so they might be caused by different genes. Genes can affect an organism’s growth and appearance.
## Scoring guide for LP2

What to look for:
- Response includes relevant evidence, disciplinary core ideas, and crosscutting concepts.
- Response logically links evidence and concepts to develop a causal mechanism for a phenomenon.

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<tr>
<th>Level</th>
<th>Description</th>
<th>Level 2</th>
<th>On the way</th>
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| Level 4 Complete and correct | The student’s explanation
- is supported by sufficient use of appropriate evidence and concepts* AND
- links the evidence and concepts to provide a clear and complete causal mechanism for the phenomenon. | The student’s explanation
- includes clearly explains that the difference is unlikely to be due to the environment or way they are grown since all are healthy, and
- links concludes that the cause of the two kinds of plants is likely to be genetic (or because they came from different parent plants) or comes up with some other plausible explanation. |
| Level 3 Almost there | The student’s explanation is supported by sufficient use of appropriate evidence and concepts* BUT does not link the evidence and concept to provide a clear and complete causal mechanism for the phenomenon. |  |
| Level 2 On the way | The student’s response includes some use of evidence and concepts relevant to the phenomenon, BUT some key pieces of evidence and/or concepts are missing. | The student proposes a genetic mechanism but does not explain how they reached this suggestion. |
LP: Students can develop and use models to describe the force between objects due to the unobservable gravitational interactions.
The diagram above shows a rock in space. The diagram also shows that the force of gravity acting on that rock is strong and to the left.

A news reporter wants to explain what is happening with the rock to her audience. She claims that the reason this force is strong and to the left is that there is another object to the left, and that object has a large mass.

Could this claim explain why the force of gravity is strong and to the left? What is your evidence, and why does it support or go against her claim?
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Could this claim explain why the force of gravity is strong and to the left? What is your evidence, and why does it support or go against her claim?
Sample Student Response:
Yes, that claim would explain why the force of gravity is strong and to the left. My evidence that there is an object to the left is that the force is to the left. Gravity is an attractive force between objects that have mass, so if the force is to the left, that means an object must be that way. My evidence that the other object has a large mass is that the force is strong. Gravity is stronger when masses are larger, and since the mass of the rock is small, the force must be large because the other object has a large mass.
Lessons Learned/Revisited

- Multiple item parts to elicit response to all 3D of PE
- Very rarely use multiple choice
- Models work best when students have a starting point and *very* clear instructions on what to include. Also:
  - Improve or correct an existing model
  - Add captions to models
- Choices:
  - Choose the next step in an investigation and explain why
  - Choose the best two pieces of evidence and explain why
- Scaffolds:
  - Use language cues
  - Ask clearly for each aspect you are assessing
Questions so far?

Contact
• Maia Binding at mbinding@berkeley.edu
  • With any questions
  • To be put on a notification list for release of item sets

Copy of Slides
• sepuplhs.org/news.html
Research Study

Purpose
To develop high-quality assessments to monitor students’ progress towards understanding the Next Generation Science Standards (NGSS).

Who can participate?
Teachers currently teaching the NGSS in person in your middle school science classroom at a public or private school. Additionally, your principal or district must agree that we can conduct research in your classroom.

Interested in participating?
Please contact us!

• SEPUP Studies
  • Phone: (510) 643-3429
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