Inclusive Science Assessments: Supporting and Designing Equitable Formative Assessments to Build on Learners’ Interest and Knowledge (CSSS-Sponsored Session)

Entry Task:
Read this resource on the table and reflect on the implications for how you would approach formative assessment. Share your ideas at your table.

http://STEMteachingtools.org/brief/11

Implementing Meaningful STEM Education with Indigenous Students & Families
Inclusive Science Assessments: Supporting and Designing Equitable Formative Assessments to Build on Learners’ Interest and Knowledge (CSSS-Sponsored Session)

Lauren Allen, DC Public Schools
Philip Bell, University of Washington

Council of State Science Supervisors
Efforts Underway to **Develop Implementation** of New Vision for K-12 Science Education

The Framework & Standards were reviewed and refined by over 40,000 teachers, scientists, engineers, educational researchers, youth and other stakeholders in K-12 science ed.

These documents **need** to be used together!

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Info Online: tinyurl.com/ScienceFramework & nextgenscience.org
Brenda: A disconnect in science learning between formal and informal settings

✔ Fourth-grader at Granite Elementary

✔ Family structure & history:
  - Brenda is the only daughter of a single mom (Stella) and was adopted from Haiti when 10 mo. old
  - Mother emigrated to the U.S. from Haiti at 13; she works as a manager at a large health provider

✔ Brenda’s routine activity systems & interests:
  - homework, argumentation, schooling, peer conflict management, tetherball, swimming, viola, computer and board game playing, peer play, caring for animals (Yumi), perfuming
At school, Brenda routinely fails to engage in the practice of systematic mixing called for during science instruction.
But she routinely engages in that practice at home.
Sam & Engineering Design
(Bricker & Bell)

• Sam’s leading definition for science is “building technology”
• He is a consummate designer, builder, and engineer

• Sam has a troubled academic identity at school
Agency in Sustained Problem-Based Inquiry: Learning Science Through and As Innovation

Research Team: Bob Abbott, Philip Bell, John Bransford, Leslie Herrenkohl, Andrew Morozov, Andrew Shouse, Giovanna Scalone, Kari Shutt, Phonraphee Thummaphan, Carrie Tzou & Nancy Vye
Investigations build on prior interest and everyday practices
## Learner Interest & Agency Matters

<table>
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<td>0.80</td>
<td>0.70</td>
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<td>0.25</td>
<td>0.25</td>
<td>0.9500</td>
<td>0.4000</td>
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</tbody>
</table>

Vye, Shutt, Morozov, Thummaphan & Abbott (2015)
Students learn science best by engaging in science and engineering practices as part of sustained investigations. In the process, they make sense of disciplinary core ideas and cross-cutting concepts.
3D Learning is Powerful

Students learn to ‘figure out’ how to explain and model phenomena—and to design solutions
Interest

Identity

Next Gen Science Standards

Building on Learners’ Prior Interest & Identity is Key

We actually need 5D Learning!

For Meaningful Experiences

Orient teaching and learning toward equity and justice goals

Meaningful Phenomena

Science & Engineering Practices

Crosscutting Concepts

Disciplinary Core Ideas

We actually need 5D Learning!

For Meaningful Experiences

Building on Learners’ Prior Interest & Identity is Key

Orient teaching and learning toward equity and justice goals

Meaningful Phenomena
Professional Learning Resources to Support STEM Ed Improvement

- Co-designed by educators & researchers
- Tested & refined over time
- Easily shareable—over social media, email, paper

STEMteachingtools.org (web)
@STEMteachtools (twitter)
facebook.com/STEMTeachingTools
Overview of the Session Goals

1. Explore how equity and social justice goals relate to STEM education
2. Learn how cultural formative assessments can promote meaningful instruction that connects to student interest & identity
3. Learn how cognitive formative assessments can attend to the diversity of students’ ideas
4. Learn about professional learning resources available to support the development of 3D formative assessments (and other initiatives)
THE MOST IMPORTANT THING IS TO KEEP THE MOST IMPORTANT THING THE MOST IMPORTANT THING.

-Donald P. Coduto
Equity-oriented STEM education must promote a **rightful presence** for all students across the scales of justice. —Calabrese Barton & Tan (2019)

Progress frequently involves **de-settling** systems associated with historical inequities (Bang, et al., 2012) — while imagining and resourcing expansive **cultural learning pathways** (Bell, et al., 2012).

**Scales**
- Racial
- Socioeconomic
- Gender identity
- Sexual orientation
- Indigenous sovereignty
- Ability differences
- Language ideology
- Immigration history
- Geography / resources
- Religious / Secular
- Environmental
- Climate
- Multi-species
...
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1. Learning is cultural. Instruction should grow out of **everyday experience** of learners and connect to their **interests and identities**.

2. Instruction should **leverage science-related values, knowledge, and practices** of students, their families, and cultural communities.

3. Instruction should allow students to leverage their **full communicative resources** during sensemaking.
Formative Assessment as Leverage Point for Promoting Coherence and Equity
Advancing Coherent and Equitable Systems of Science Education (ACESSE)
The Formative Assessment Process
(from Beth Simpson & Amber McCulloch)

Clarify Intended Learning
Elicit Evidence
Act on Evidence
Interpret Evidence
Different Formative Assessment Interventions (Penuel & Shepard)

Data-Driven Decision-Making

<table>
<thead>
<tr>
<th>Student 1</th>
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<tbody>
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<td>Student 2</td>
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<td>Student 3</td>
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<td>Student 4</td>
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</tbody>
</table>

Strategy-Focused

<table>
<thead>
<tr>
<th>Where the learner is going</th>
<th>Where the learner is</th>
<th>How to get there</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher</td>
<td>Clarity and share learning intentions</td>
<td>Providing feedback that moves learners forward</td>
</tr>
<tr>
<td>Peer</td>
<td>Understand and share learning intentions</td>
<td>Activating learners as learning resources for one another</td>
</tr>
<tr>
<td>Learner</td>
<td>Understand learning intentions</td>
<td>Activating learners as owners of their own learning</td>
</tr>
</tbody>
</table>

Figure 1: Key aspects of formative assessment (Black and Wiliam, 2009)

Cognitive

Cultural
Formative assessment can be used to support equity & justice

How can instruction...

• be inclusive to the participation of all students?
• be personally or culturally relevant to all students?
• build on and refine student’s ideas about phenomena?
• make connections between everyday and disciplinary knowledge and ways of knowing?
• be guided by student’s unfolding questions?
A Key Take-Away

“Creating equitable learning opportunities depends critically on teachers’ skill in seeing and hearing students’ ideas and reasoning as connected to science (as opposed to being off topic, or, worse, disruptive).”

—Bang, Brown, Calabrese Barton, Rosebery & Warren (2017, p. 36)
Cultural Formative Assessment
Focused on Learner Interests & Experiences
STEM Learning Happens Across Settings

**Classroom Instruction**
(e.g., Barton et al., 2003; Bell, 2004; Davis, 2003; Linn, 2006; Newton et al., 1999; Reiser et al., 200x)

**Everyday Settings & Family Activities**
(e.g., Callanan & Oakes, 1992; Crowley & Galco, 2001; Goodwin, 2007; Bell et al., 2006)

**Designed Informal Settings**
(e.g., Allen & Gutwill, 2004; Callanan & Jipson, 2001; Rennie & McLafferty, 2002)

**Programs for Young & Old**
(e.g., Halpern, 2002; Noam et al., 2003; Gibson & Chase, 2002)
Make Deep Community Connections

“A major goal for science education should be to provide all students with the background to systematically investigate issues related to their personal and community priorities.”

— NRC, 2012, p. 278
Focus is on ways of knowing, doing, and being that are specific to science and other subjects. It presumes that students bring to the learning environment important knowledge, interests, and experiences from their daily lives that teachers must elicit and use to inform instruction.
“All science learning can be understood as a cultural accomplishment....What counts as learning and what types of knowledge are seen as important are closely tied to a community’s values and what is useful in that community context.”

— NRC, 2012, p. 284
What does “culture” mean?

“Everyday experience provides a rich base of knowledge and experience to support **conceptual changes in science.**”

“Everyday contexts and situations that are important in children’s lives not only influence their **repertoires of practice** but also are likely to support their development of complex cognitive skills.”

– NRC Framework, 2012, p. 284
What does “culture” mean in science education?

• Cultural specifics related to science may involve:
  – How students experience, observe, and narrate phenomena
  – The knowledge they develop about the natural world
  – To what extent they find scientific topics salient or interesting
  – How familiar they are with design and working through failure
  – How they communicate and how they view elders
  – Specifically, how they pose questions or engage in argumentative and explanatory talk and writing
Educational Implications of Culture

“A culturally responsive approach to science instruction involves the recognition of community practices and knowledge as being central to the scientific endeavor.”


Homework: Think of a community you are deeply familiar with and a science topic that matters to them. How do the community’s interests, knowledge, and sense-making practices relate to the topic?
How to avoid possible pitfalls associated with culturally responsive instruction

http://STEMteachingtools.org/brief/53
Interest
Identity

Next Gen Science Standards

Building on Learners’ Prior Interest & Identity is Key

We actually need 5D Learning!

For Meaningful Experiences

Orient teaching and learning toward equity and justice goals
How to launch STEM investigations that build on student and community interests and expertise

http://STEMteachingtools.org/brief/31
“Instruction that builds on prior interest and identity is likely to be as important as instruction that builds on knowledge alone. All students can profit from this approach, but the benefits are particularly salient for those who would feel disenfranchised or disconnected from science should instruction neglect their personal inclinations.”

— NRC Framework, p. 287
Overview of the Micros & Me Curriculum: The Microbiology of Human Health

• Part 1: Set up focus on microbiology and community-based health practices
• Part 2: Lessons from original *Microworlds* kit
• Part 3: Student-led investigations into microbiology and health
• Part 4: Research project and development of Public Service Announcement (PSA)
What are the things you and your family do to stay healthy and keep from getting sick?

As you take your pictures, please fill out the following chart. We have given you three examples.

<table>
<thead>
<tr>
<th>What is this picture?</th>
<th>Where did you take this picture?</th>
<th>What activity does this picture explain?</th>
<th>How does this activity help you stay healthy and/or keep you from getting sick?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. This is a picture of a bottle of vitamins.</td>
<td>This was in my bathroom.</td>
<td>I take a vitamin every morning.</td>
<td>I take vitamins so that my body has everything it needs to do its job, even if I don’t eat all of the types of foods I should.</td>
</tr>
<tr>
<td>2. This is a picture of a shot.</td>
<td>This is a picture of a magazine ad.</td>
<td>I get a flu shot every year.</td>
<td>I get a flu shot every year so that I hopefully don’t get the flu.</td>
</tr>
<tr>
<td>3. This is a picture of me making tea.</td>
<td>My brother took this picture of me in the kitchen of our house.</td>
<td>My family drinks this tea that we get from a store in our neighborhood.</td>
<td>My grandmother says that this tea helps people not catch the flu.</td>
</tr>
<tr>
<td>4.</td>
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<tr>
<td>5.</td>
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</table>
Surfacing cultural health practices through self-documentation

- Use community health practices to guide instruction
- Self-documentation technique used to bridge community activities with school inquiry and sense-making
How can science instruction leverage and develop student interests?
Short answer: In so many different ways!

http://STEMteachingtools.org/brief/58
Sample Self-Doc Prompts

Goal: Culturally Responsive Instruction
What are the things you and your family do to stay healthy? Where do you see Newton’s second law in your life? How do you make big decisions in your community?

Goal: Identifying Community Sources of Knowledge
Which groups or individuals in our community have knowledge of how the environment is changing / has changed? How do they know what they know?

Goal: Relating Science to a Community Project
What science-related justice projects do you see in your setting / community? What challenges are faced by your community?

Goal: Establishing a New Interest
Take pictures of things, events, or people you see that you want to learn more about.

Goal: Surfacing Student Identities & Expertise
Take pictures of objects that represent who you are. Take pictures of your developing areas of expertise or interest.
With your neighbors, discuss:

1. One or two interest-driven lesson connections or investigations students could engage in

2. How do you think the self-doc instructional technique might support equity in your classroom?
ACESSE Resource C

Overview: Participants learn how to design formative assessments that build on learners’ interest and experience, promoting equity and social justice in the process.

stemteachingtools.org/pd/SessionC
3D Cognitive Assessment Focused on Surfacing the Range of Student Thinking
Cognitive Formative Assessment

Different approaches:
• Learning Progressions
• Facets of Reasoning

Attend to the social nature of learning and provide resources to assess students’ concepts and practices as they participate in increasingly sophisticated practices common to disciplinary experts.
What We Call Misconceptions May Be Necessary Stepping-Stones Toward Making Sense of the World

Todd Campbell, Christina Schwarz, and Mark Windschitl

Free Download: http://www.nsta.org/
The “Facets of Thinking” Perspective on Student Learning (Minstrell)

- Students bring a **diverse range of science-related ideas** to the classroom — more / less productive

- Not all of students’ incorrect thinking should be considered a “misconception” or error—**some ideas are stepping stones** to deeper understanding

- **Facets** are “pieces of knowledge” or “conceptual models” around a key idea or event related to the natural world

- You find them using a stance of **generous interpretation**
Facet Cluster: a grouping of productive and unproductive facets of student ideas that show up regularly for a key idea, event, or topic. Includes the explicit learning goals in addition to various reasoning, conceptual, and procedural difficulties.

*340 Fall time depends upon gravitational field strength and inversely upon fluid medium resistance.
*341 With no resistance by fluid medium, vertical fall near the earth's surface is at nearly constant acceleration of 10 m/s².
342 Gravitational pull and mass compensate with no accounting for air resistance.
343 Greater drag effects compensate for greater gravitational pull explaining equal accelerations.
344 Medium effects will exist even when there is no motion relative to fluid medium.
345 All things fall equally fast regardless of medium effects.
346 Vertical fall is at a constant velocity of 10 m/sec.
348 Heavier will hold back more (fall slower).
348-1 Larger fall substantially slower.
349 Heavier falls faster.
349-1 Larger falls faster.
Investigate Students’ Conceptual Change about Light

- Nature of Light
- Behavior of Light
- Optical Instruments
- Vision
- Light Propagation
“What we want to remember about this evidence is that eventually, light dies out. The farther it goes, the less that is there. The light spreads out and so it fades away. It is brighter at the beginning because there is so much light intensity but then it fades away.”
Evidence: Galaxies in the Young Universe

“This evidence supports LDO because telescopes look at light farther out—before it got to us. It died out before it got to us.”
Developed Facet Clusters

Telescope facet cluster:
– focus or magnify the light reaching them
– can be used to see things far away
– make the light bigger
– take you closer; bring stars closer
– look at light closer to source, before it dies out
Beyond “misconceptions”: How to recognize and build on Facets of student thinking

http://STEMteachingtools.org/brief/37
1. Adopt a stance of *generous interpretation* as you closely read student responses: “Why might an intelligent person in this class give this response?” “What do they seem to be thinking?”

2. Try to get to the “*essence*” of their thinking (e.g., the conceptual model “behind” their response). (You are mining intellectual treasures.)

3. Think about how you would instructionally respond to refine student thinking...
   - What do students experientially or cognitively need?
   - Do they need to combine ideas?
How Can You Explain This? A Fogged Mirror

**How Can You Explain This? A Fogged Mirror**

1. Imagine you can see the particles when vapor hits the cold surface of the mirror. Draw a model including:
   - temperature change
   - particle motion
   - interactions
   - arrows / indicators of motion
   - scientific vocabulary

   **Mirror During Shower**
   - Water vapor hitting the mirror
   - Particles change temperature

   **Mirror After Shower**
   - Cold mirror
   - Particles collide together
   - Move slower

2. Using your model as evidence, explain how water vapor fogs up a mirror.

   **Water vapor from the shower hits the cold mirror**
   - Making the particles move slower.
   - After the shower, the particles move slowly, rolling off of each other closely together, making the particles change from a gas to a liquid.

   **Part of the model**
   - Before hair dryer
   - After heat is added
   - Gold vaporization to gas
   - Liquid not gas
   - Gas not liquid

3. Using your model as evidence, explain how fog clears from the mirror.

   - A fog is cleared from the mirror. The liquid moves slowly, rolling off of each other.
   - When the hair dryer is used, the liquid particles evaporate into gas faster.

   **Part of the model**
   - After fog clears
   - Not gas
   - Gas not liquid
Assessment of Student Thinking
Assessment of Student Thinking
<table>
<thead>
<tr>
<th>Bike/Bus Light Student Examples</th>
<th>Facets of Student Thinking</th>
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<tbody>
<tr>
<td></td>
<td>lack of labeled diagram/model (no path of light)</td>
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<tr>
<td></td>
<td>understanding of line of sight</td>
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<tr>
<td></td>
<td>obstructed line of sight</td>
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<tr>
<td></td>
<td>show that you need a light source &amp; line of sight</td>
</tr>
<tr>
<td></td>
<td>modeling understanding (labels/arrows)</td>
</tr>
</tbody>
</table>

**Concern**

<table>
<thead>
<tr>
<th>Appreciation</th>
<th>Instructional Move</th>
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</thead>
<tbody>
<tr>
<td>C: No understanding of how light travels</td>
<td></td>
</tr>
<tr>
<td>C: Lack of modeling conventions</td>
<td></td>
</tr>
<tr>
<td>A: Use of arrows in diagram</td>
<td></td>
</tr>
<tr>
<td>C: Concept of how you see is still weak</td>
<td></td>
</tr>
</tbody>
</table>

**A**: conceptual understanding & modeling application

**B**: ready for next step

**C**: reteach

**D**: ready for next step
### Formative Assessment Facet Rubrics

**Concept & Practice (Facet Cluster):** Students reasoning with evidence about water reservoirs.

**Link to FA - Where is most of the fresh water?**

<table>
<thead>
<tr>
<th>Sample Student Responses</th>
<th>Frequency</th>
<th>Facet of Student Knowledge / Practices</th>
<th>Concern or Appreciation</th>
<th>Instructional Move Options</th>
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</thead>
<tbody>
<tr>
<td>Pearl because the ocean is deep and wide with lots of water in it. Pearl because there are lots of oceans, seas and bays around the world.</td>
<td>15</td>
<td>Partial Understanding - volume and/or abundance but salt not fresh</td>
<td>Salt versus fresh water reservoirs</td>
<td>Drinking water...where do we get from and why? Ocean water? Comparison and contrast of fresh and salt water. Dead sea floating versus sinking in lakes.</td>
</tr>
<tr>
<td>Stephanie because glaciers are really big. Mary because Lake Washington is really big.</td>
<td>6</td>
<td>Partial understanding - volume &amp; abundance</td>
<td>Relative volumes of global water features based on experience.</td>
<td>Overlay a glacier in arctic with lake washington.</td>
</tr>
<tr>
<td>Mary because rivers move so there is more water over time in that location.</td>
<td>1</td>
<td>Alternative understanding - Movement &amp; volume</td>
<td>Understanding of volume relationships to flow rates but need to focus on snapshots of reservoir at one moment in time.</td>
<td>Reservoir system in a given moment in time. Peer-peer conferencing around this.</td>
</tr>
<tr>
<td>Stephanie</td>
<td>2</td>
<td>Partial understanding - scientifically vague content with no reasoning or evidence.</td>
<td>No reasoning around answer.</td>
<td>Say more about why you chose this answer.</td>
</tr>
<tr>
<td>Stephanie because there is the most is defined by mass. Stephanie because there is the most mass of water in glaciers, ice and underground compared to other locations.</td>
<td>6</td>
<td>Partial understanding - Scientifically accurate content and reasoning but no evidence.</td>
<td>Mass is related to abundance of matter not volume.</td>
<td>Lesson on pushing for evidence - What evidence could you draw on to support your claim?</td>
</tr>
<tr>
<td>“Oceans are big and deep”</td>
<td></td>
<td>Language Use Considerations</td>
<td>volume</td>
<td>Paraphrase students’ everyday language with science language</td>
</tr>
<tr>
<td>Lake Washington is big</td>
<td></td>
<td>Connections to Everyday Considerations</td>
<td>Relative volume</td>
<td>Put Lake Washington in the context of other water features globally &amp; acknowledge that in this region Lake Washington is big. Connect to scale.</td>
</tr>
</tbody>
</table>
Facets Surface Student’s Cultural Lives
How Can You Explain This? A Fogged Mirror

1. Imagine you can see the particles when fog clears from the mirror. Draw a model including:
   - temperature change
   - particle motion
   - kinetic energy
   - arrows / indicators of motion
   - scientific vocabulary

   Clearly label all model components.

2. Using your model as evidence, explain how water vapor fogs up a mirror.
   
   Water vapor from the shower hits the cold mirror making the particles move slower. After the shower, the particles move slowly, rolling off of each other closer together making the particles change from a gas to a liquid.

   Before hairdryer:
   - Gold
   - Evaporation
   - Heating
   - Gas

   After heat is added:
   - Liquid
   - Volatilization
   - Cooling
   - Not

   The fog is cleared from the mirror, the liquid move slowly, rolling off of each other closer together on the mirror. When the hairdryer is used, the liquid particles evaporate into gas faster because heat is added so the particles move faster.

3. Using your model as evidence, explain how fog clears from the mirror.
3D Performance Expectation Bundle

*Unless otherwise specified, “descriptions” referenced in the evidence statements could include but are not limited to written, oral, pictorial, and kinesthetic descriptions.

<table>
<thead>
<tr>
<th>MS-PS1-4  Matter and its Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students who demonstrate understanding can:</td>
</tr>
<tr>
<td>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.]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MS-PS1-5  Matter and its Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students who demonstrate understanding can:</td>
</tr>
<tr>
<td>MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms. [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MS-PS3-5  Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students who demonstrate understanding can:</td>
</tr>
<tr>
<td>MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object. [Assessment Boundary: Assessment does not include calculations of energy.]</td>
</tr>
</tbody>
</table>
In small groups (4-5), review the range of student responses. Using a “round robin” approach, identify the range of facets (ideas) that students are using (showing). Organize them into themes.
How can you support students to express their understanding using multiple modes of expression on your classroom assessments?
How to design assessments for emerging bilingual students

http://STEMteachingtools.org/brief/33
Overview: Participants will engage in crafting 3D learning performances and develop cognitive formative assessments for them. In the process, they learn deeply about three dimensional learning.
ACESSE Resource F

Overview: Participants analyze the range of student thinking in batches of student assessment responses. In the process, they learn how to identify and analyze student’s conceptual models of science phenomena.

tinyurl.com/ACESSE-Drive
(to be published soon)
Conclusion:

Working on the Short and the Long-Game Towards Equity & Justice
Whose interests are being served?
The Bottom Line: Expand Relationships Among Students, Teachers & Science

“The bottom line is, the more you show genuine intellectual and scientific interest in your students’ sense-making [of phenomena], the more you expand the space of possible relations among you, your students, and science.”

—Bang, Brown, Calabrese Barton, Rosebery & Warren (2017, p. 34)
The Equity Stance of Cultural Formative Assessment

- In terms of **rightful presence**, we should legitimize and center the cultural lives of learners—especially those from non-dominant communities—in instruction.

- In terms of **de-settling**, we want to disrupt the notion that science and science learning is acultural—and that only some people live cultural lives.

- In terms of **extending learning pathways**, by leveraging the interests and identities of learners we can support expansive learning experiences for youth.
The Equity Stance of a Facets Approach

• In terms of **rightful presence**, we want all students’ ideas, experiences, perspectives, and worldviews to be seriously considered during a knowledge refinement process.

• In terms of **de-settling**, we want to move beyond the quick right/wrong judgement frame of a misconceptions view and recognize the range of student ideas as sense-making resources for the community.

• In terms of **extending learning pathways**, by recognizing, exploring, pushing on, and refining students’ ideas learners will be engaged in meaningful conceptual refinement, learn how to learn, and better identify with science.
How can you advance equity and justice through science teaching?

http://STEMteachingtools.org/brief/71
Professional Learning Resources to Support STEM Ed Improvement

- Co-designed by educators & researchers
- Tested & refined over time
- Easily shareable—over social media, email, paper

Using curriculum adaptation as a strategy to help teachers learn about NGSS and developing aligned instructional materials

What Is The Issue
Using curriculum materials aligned to NGSS is a crucial part of implementation, but there is very little aligned curricula to choose from. Districts may not have the resources to purchase it, and teachers typically don’t have time to develop new curriculum from scratch. However, teachers can effectively adapt existing curriculum materials and instruction to better align with NGSS. This can help them learn about important parts of the NGSS vision for learning—and result in instructional materials for use across classrooms.

Why IT MATTERS TO YOU
- Teachers should analyze and adapt tasks to existing curriculum to support student engagement in the science and engineering practices.
- District staff and PD providers should learn about how to support networks of teachers to engage in curriculum adaptation and share the resulting instructional materials.
- School leaders should support efforts to engage teachers in adapting, revising, and refining effective components of curricularly aligned curriculum materials.

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STEM Teaching Tools
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Resources co-designed by practitioners & researchers to help educators learn about #SciEd, #NGSS, #STEM & #Equity. Edited by @philipbell. We are NSFfunded.

STEMteachingtools.org
Joined June 2014
1,006 Photos and videos

Your Tweet activity
Your Tweets earned 3,595 impressions over the last week
Signing Up for Our Newsletter
http://stemteachingtools.org/newsletter

Newsletter Section: Field Notes

Field Notes is the email newsletter of STEM Teaching Tools, a regular compilation of new briefs, professional development resources, and other science education tools. Enter your email below to receive these periodic updates. This is a low-volume email list, and we promise not to share your address with others.

Your Email [ ] Send

STEM Teaching Tools August 2017 Newsletter

STEM Teaching Tools June 2017 Newsletter
Thank you! For more info...

Relevant Resources

• STEM Teaching Tools
  STEMteachingtools.org (web site)
  @STEMTeachTools (twitter)
  STEMTeachingTools (Facebook)
  STEMteachingtools.org/newsletter (newsletter sign-up)

• Other ACESSE PD Modules on Formative Assessment
  STEMteachingtools.org/PD

Contact Me

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Back Pocket Slides
Equity & Diversity (NRC Framework Chapter 11)

- Equalizing opportunities to learn
- Inclusive science instruction
  - Science Learning as Cultural Accomplishment
  - Relating Youth Discourses to Scientific Discourses
  - Building on Prior Interest & Identity
  - Leveraging Students’ Cultural Funds of Knowledge
- Making diversity visible
- Value multiple modes of expression
Three principles towards more equitable learning in science

**Principle 1: Notice sense-making repertoires.** Consider students’ diverse sense-making as connecting to science practices.

**Principle 2: Support sense-making.** Support students to use their sense-making repertoires and experiences as critical tools in engaging with science practices.

**Principle 3: Engage diverse sense-making.** Students’ scientific practices and knowledge are always developing and their community histories, values, and practices contribute to scientific understanding and problem solving.

From: Bang, Brown, Calabrese Barton, Rosebery & Warren, Toward more equitable learning in science, In *Helping students make sense of the world using next generation science and engineering practices*, NSTA.
With Framework / NGSS there are different instructional uses for natural phenomena:

- **Anchoring Phenomena** frame curriculum units
- **Investigative Phenomena** focus student investigations & sense-making
- **Everyday Phenomena** make personally and culturally relevant connections

[Links to additional resources]

http://STEMteachingtools.org/brief/42
http://STEMteachingtools.org/brief/28
Cómo iniciar las investigaciones de STEM que se basan en los intereses y la experiencia de los estudiantes y la comunidad

Involucrando a los Estudiantes de Inglés en las Prácticas de Ciencia e Ingeniería
Assessment Task Formats for the Practices

We created a collection of task formats for the science and engineering practices that help with the design of assessment components—can also guide instruction.

[Image of children playing with blocks]

Integrating Science Practices Into Assessment Tasks

[Website link: STEMteachingtools.org/brief/30]
## Task Formats for Developing & Using Models

<table>
<thead>
<tr>
<th>Format</th>
<th>Task Requirements for Students</th>
</tr>
</thead>
</table>
| 1      | Present two models to students, *then*  
|        | Ask them to compare the models to identify both common and unique model components, relationships, and mechanisms. |
| 2      | Present students with an illustration or drawing of a scientific process or system, *then*  
|        | Ask students to label the components, interactions, and mechanisms in the model, *and*  
|        | Write a description of what is shown in the drawing. |
| 3      | Present students with a model of an observable scientific process or system and some evidence about how the system behaves that does not fit the model, *then*  
|        | Ask students to revise the model to better fit available evidence. |
| 4      | Present students with a textual description of an observable scientific phenomenon, *then*  
|        | Ask students to draw and label the model components, interactions among components, and mechanisms in the model, *and*  
|        | Ask students to write an explanation for the phenomenon, using the model as supporting evidence. |
Prompts for Assessing Cross-Cutting Concepts

Prompts for Integrating Crosscutting Concepts Into Assessment and Instruction

STEMteachingtools.org/brief/41
Prompts for Assessing Cross-Cutting Concepts

CAUSE AND EFFECT

When drawing conclusions from a simple investigation, Ask students:

What caused the patterns you observed?

Follow up question: How do you know that ________ caused ________?

Does the fact that the data showed that ________ always happened [after/whenever] ________ occurred mean that ________ causes ________? Why or why not?

Follow up question: How can you test whether ________ caused ________ to happen?

What do you predict would happen if [extrapolate to new, related situation]?