Assessment from a 3D Perspective

NSTA Professional Development Institute

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Key Ideas from NRC Report (2014)  
*Developing Assessments for the Next Generation Science Standards*

Bill Penuel  
*University of Colorado Boulder*
The committee will make recommendations for strategies for developing assessments that validly measure student proficiency in science as laid out in the new K-12 science education framework. The committee will review recent and current, ongoing work in science assessment to determine which aspects of the necessary assessment system for the framework’s vision can be assessed with available techniques and what additional research and development is required to create an overall assessment system for science education in K-12. (Cont’d).
Assessment Challenge

• How can we assess “three-dimensional learning”?
• How is it different from how we assess science learning now?
• How can we design tasks that elicit core ideas, practices, and crosscutting concepts?
Assessment Challenge

- Small or no evidentiary base for most hypothetical learning progressions (Duncan & Rivet, 2013).
- Examples of completely aligned tasks do not exist (Pellegrino, 2013).
- Performance expectations (still) underspecify the nature of evidence needed to draw inferences about student learning (Pellegrino, 2013).
• A range of assessments are needed that answer different questions (tied to needs of different stakeholders) and that provide complementary results:
  – Assessments designed to support classroom instruction;
  – Assessments designed to monitor science learning; and
  – A series of indicators to monitor that the students are provided with adequate opportunity to learn science in the ways laid out in the framework and NGSS.
Assessments for Monitoring

• It is not feasible to cover the full breadth and depth of the NGSS performance expectations for a given grade level with a single external (large-scale) assessment.

• The types of assessment tasks that are needed take time to administer, and several will be required in order to adequately sample the set of performance expectations for a given grade level.

• Some practices, such as demonstrating proficiency in carrying out an investigation, will be difficult to assess using conventional formats of on-demand external assessments.
Opportunity to Learn Indicators

• Essential for documenting practices
• Potential data sources
  – Inspections of school science programs
  – Surveys of students and teachers
  – Monitoring of teacher professional development programs
  – Documentation of curriculum assignments and student work
• Key means for monitoring *equity*
Multi-Component Tasks

- To adequately cover the three dimensions, assessment tasks will need to contain multiple components (e.g., a set of interrelated questions).
- Specific components may focus on individual practices, core ideas, or crosscutting concepts, but, together, the components need to support inferences about students’ three-dimensional science learning as described in a given performance expectation.
Example 5: Movement of Water

• Example of a multi-component task developed to support formative use of assessment evidence to inform instruction.
• Can take place in 1 or 2 class sessions, depending on the results of the assessment
• Co-developed with Denver Public Schools teachers to fit within *Investigating Earth Systems* curriculum
The green areas marked above show the place where a river flows into an ocean. Why does this river look like a triangle (or fan) where it flows into the ocean? Be prepared to explain your response.

A. Sediment is settling there as the land becomes flatter.
B. The water can flow all over the place just before it meets the ocean.
C. The river is transporting sediment to the ocean.
D. Finer sediments suspended in the water are being deposited there.
• Pose question
• Students discuss in pairs and small groups
• Teacher asks why each response might be reasonable
  – Teacher’s orchestration of discussion is supported by a set of talk moves: e.g., “Say more,” “Why do you think that?”
• Students re-answer the question

Modeled after Peer Instruction
Response a: Students may recall that sediment settles where the land is flatter. In addition, water flows more slowly as it meets the ocean, and they may conclude that when water flows slowly, there is more deposition of sediment that is transported in the river (the process of erosion).

Response b: Students may point to evidence in the picture that lots of different river channels (called “distributary channels”) have formed in the alluvial fan. This does not mean, however, that water can flow anywhere; the number and shape of channels has to do in part with the rate of flow of the water in the river and larger body of water.

Response c: Students may recall that rivers do transport sediment all the way to the ocean. Though not clearly visible on this image, sediment is evident in the image presented as part of the starter question for this investigation. If all the material were deposited into the ocean, however, a fan like this one would not have formed.

Response d: Students may know that even fine-grained sediments are deposited at the bottom of rivers and oceans; however, in this case, if sediments are suspended in the water, they may be carried out to the ocean, rather than being deposited into the fan.
Contingent Activity: Developing and Using Models

Here’s a picture showing where a river enters a larger body of water.

![River entering a larger body of water](image)

Draw on the picture to show where you would expect to find gravel, sand, and clay.

Write a final explanation why you would expect to find gravel, sand, and clay at the locations you have marked in your diagram.

Student groups write their explanations and submit it to the teacher at the end of the lesson.
Analyzing the Task

• Multiple components
  – Clicker question
  – Pedagogical pattern
  – Contingent activity

• Integrates the three dimensions across tasks
  – Disciplinary core idea: Clicker question
  – Practices of argumentation, modeling: Class discussion, contingent activity
  – Crosscutting concept: Models and System Models in contingent activity
Three Dimensional Science Learning: Assessment Task Analysis

Bill Penuel and Katie Van Horne

University of Colorado Boulder
Looking Closely at Tasks

MS-LS-4-4:

• Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals’ probability of surviving and reproducing in a specific environment.
Instructions for Pairs

• Review the sample assessment tasks provided, all of which aim to assess **MS-LS-4-4**.
• Rank order them in terms of how well you think they assess the three dimensions integrated in the performance expectation.
• Discuss your rankings.
• Record your rankings in this Google Form:  
  [http://tinyurl.com/n8raye3](http://tinyurl.com/n8raye3)
Looking Closely at Tasks

HS-LS2-1:

- Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
Instructions for Pairs

• Review the sample assessment tasks provided, all of which aim to assess HS-LS2-1.
• Rank order them in terms of how well you think they assess the three dimensions integrated in the performance expectation.
• Discuss your rankings.
• Record your rankings in this Google Form: http://tinyurl.com/l7ug4qe
• Aim: Identify some general criteria for what constitutes a “three-dimensional” task
  – What are some commonalties in our rankings? Why do you think we agree?
  – Where are some differences? What might that reveal about how we are understanding the dimensions differently?
All handouts and the presentation are available at:

NSTA LINK?

Email: william.penuel@colorado.edu
katie.vanhorne@colorado.edu

Twitter: @bpenuel, @LearnDBIR
Break

We’ll reconvene in 10 minutes...