Assessing the Three Dimensions of the Next Generation Science Standards

MIDDLE SCHOOL SCIENCE
Career & College Readiness Conferences
Summer 2014

To what extent have you interacted with this document?

A. I've read it thoroughly.
B. I've skimmed it for general information.
C. It's on my bookshelf.
D. Huh?

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How about this one?

A. I've read it thoroughly.
B. I've skimmed it for general information.
C. It's on my bookshelf.
D. No clue
Or this one?

A. I’ve read it thoroughly.
B. I’ve skimmed it for general information.
C. It’s on my bookshelf.
D. It’s the first time I’ve seen it.

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Outcomes

- Review the process of developing NGSS
- Discuss the implications of teaching and assessing in the three Dimensions of NGSS
- Explore teaching and assessing through Science and Engineering Practices
- Identify opportunities for formative assessment during instruction
- Examine student activities for assessment tasks
- Discuss the potential structure of an assessment system for science

Developing Assessments for the Next Generation Science Standards

Committee on the Assessment of K-12 Science Proficiency

Board on Testing and Assessment and Board on Science Education
National Academy of Sciences
Topics Addressed in the Report

- The challenges of assessing three-dimensional science learning
- Principles for developing assessment tasks
- Developing classroom assessments
- Developing monitoring assessments
- Developing assessment systems
- Implementing the system

Three-Dimensional Science Learning

- New types of assessment are needed
- NGSS assessment should start with the needs of classroom teaching and learning
- State monitoring assessments must move beyond traditional forms
- States must create coherent systems of assessment that can support both classroom learning and policy monitoring functions

NGSS Assessment Messages
To develop the skills and dispositions to use scientific and engineering practices needed to further their learning and to solve problems, students need to experience instruction in which they
- use multiple practices in developing a particular core idea and
- apply each practice in the context of multiple core ideas.
The NGSS describe specific goals for science learning in the form of performance expectations, statements about what students should know and be able to do at each grade level.

- Each performance expectation incorporates all three dimensions, and the NGSS emphasize the importance of the connections among scientific concepts.

The Assessment Challenge

It will not be feasible to assess all of the performance expectations for a given grade band during a single assessment occasion.

Multiple assessments

Students will need multiple—and varied—assessment opportunities to demonstrate their competence on the performance expectations for a given grade level.
To adequately cover the three dimensions, specific components may focus on individual practices, core ideas, or crosscutting concepts. Assessment tasks will need to contain multiple components, i.e., a set of interrelated questions.

### 3-D Tasks
- Individual and/or group investigation
- Observations in tables and/or graphs
- Constructed responses
- Selected responses
- Electronic drag and drop, ordering, etc.

### Utilize the Practices
- Student activities that reflect such learning include the Practices of:
  - Developing and refining models
  - Generating, discussing and analyzing data
  - Engaging in both spoken and written explanations and argumentation

### Challenges and Opportunities
- Instruction that is aligned with the Framework will naturally provide many opportunities for teachers to observe and record evidence of student learning.
- Incorporate teacher and student reflection into the process.
Use a set or cluster of interrelated questions to generate evidence of NGSS knowledge.
Specific questions may focus on Practices, Disciplinary Core Ideas and/or Crosscutting Concepts.
The parts need to support students’ three-dimensional science learning as described in a specific Performance Expectation.

**Opportunity**

**Drinking Straws & Air Pressure**

Develop a model to explain what happens to the air molecules inside and outside a drinking straw.
- Students use a straw to investigate and explain air pressure.
- Discuss ideas about what is happening to the air.
- Make a claim ...
- Engage in argument from evidence.

**Three Dimensional Assessment**

<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>Matter and Its Interactions</th>
</tr>
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<tbody>
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<td>MS-PS1.1</td>
<td>Develop models to describe the atomic composition of simple molecules and extended structures.</td>
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<tr>
<td>MS-PS1.2</td>
<td>Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.</td>
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<tr>
<td>MS-PS1.3</td>
<td>Give and make sense of information to describe that synthetic materials come from natural resources and impact society.</td>
</tr>
<tr>
<td>MS-PS1.4</td>
<td>Develop a model that explains how the position, motion, and state of a pure substance (temperature, volume, and pressure) change in a phase change.</td>
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<tr>
<td>MS-PS1.5</td>
<td>Devise a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.</td>
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Performance Expectation

Students who demonstrate understanding can:

MS-PS1-1
Develop models to describe the atomic composition of simple molecules and extended structures.
[Clarification statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include... Assessment Boundary: Assessment does not include valence electrons and bonding energy...]

Students who demonstrate understanding can:

- Engage
- Explore
- Explain
- Elaborate
- Evaluate

ID the Assessment Opportunities in the 5E Learning Cycle

- Engage
- Explore
- Explain
- Elaborate
- Evaluate

Explore!

- Materials: drinking straw, clear cup, water, straight pin
- Follow the procedure on the Drinking Straws and Air Pressure Exploration.
- Explain predictions & results to a partner
- Draw models to explain the behavior of the water in the straw during each part
Assessment Opportunities?

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<th>DCIs</th>
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Assessment System

- Performance assessment tasks developed within the classroom
- Portfolio of classroom work samples with tasks specified by district and/or state
- Units (curriculum materials and assessments) developed outside of the classroom (district and/or state)
- Item banks of NGSS-aligned tasks, developed outside of the classroom, from which schools and teachers select

Assessment System Challenges

- A single, external large-scale assessment cannot cover the full breadth and depth of NGSS
- Performance Expectations with suitable assessment tasks take time to administer and several will be required to adequately sample NGSS PE’s
- Some practices are difficult to assess, e.g., carry out an investigation, using conventional formats of external, on-demand assessments
New types of assessment are needed
State monitoring assessments must move beyond traditional forms
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Developing Assessments for the Next Generation Science Standards
http://www.nap.edu/download.php?record_id=18419

NSTA
http://ngss.nsta.org/access-standards/

NAEP Released Items

TIMSS Released Items
http://nces.ed.gov/timss/educators.asp

PISA Released Items
http://nces.ed.gov/surveys/pisa/educators.asp
Exit Slip

- Write two statements that describe the implications for assessing student understanding in YOUR classroom.
  1) Ah-ha! statement
  2) Action(s) statement

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