Developing Optimal Learning Environments that Align with NGSS

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STEM Smart

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What is really different about the Framework and NGSS?

1. Focus on explaining phenomena or designing solutions to problems
2. 3-Dimensional Learning
   1. Organized around disciplinary core explanatory ideas
   2. Central role of scientific and engineering practices
   3. Use of crosscutting concepts
3. Instruction builds towards performance expectations
4. Coherence: building and applying ideas across time
Core ideas, Practices and Crosscutting Concepts

Work together to Build Understanding

- Scientific ideas are best learned when students engage in practices
- Practices are learned best when students use them to engage with learning specific scientific ideas
- Core ideas, crosscutting concepts and practices co-develop – 3-dimensional learning
3-Dimensional Learning

- Three-dimensional learning shifts the focus of the science classroom to environments where students use core ideas, crosscutting concepts with scientific practices to **explore, examine, and use science ideas** to explain how and why phenomena occur.

- Integrating the three dimensions (core ideas, crosscutting concepts and scientific and engineering practices) to focus instruction and assessment
How NGSS is Different

Standards expressed as performance expectations:

• Combine practices, core ideas, and crosscutting concepts into a single statement of *what is to be assessed*

• Requires students to demonstrate *knowledge-in-use*

• PEs are not instructional strategies or objectives for a lesson – *they describe achievement, not instruction*

• Intended to describe the end-goals of instruction – *the student performance at the conclusion of instruction*
How do I support students in reaching a PE? Always building towards a PE or set of PEs?
MS-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

1. Develop a model to describe that matter is made of particles too small to be seen.

**Clarification Statement:** Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.

**Assessment Boundary:** Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.

**Science and Engineering Practices**

<table>
<thead>
<tr>
<th>Developing and Using Models</th>
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<tbody>
<tr>
<td>Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</td>
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**Disciplinary Core Ideas**

<table>
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<td>The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.</td>
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**Crosscutting Concepts**

<table>
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<th>Scale, Proportion, and Quantity</th>
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<tbody>
<tr>
<td>• Natural objects exist from the very small to the immensely large.</td>
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**HS-PS1-3.**

Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
Instruction can use those same elements

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<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
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<tr>
<td><strong>Obtaining, Evaluating, and Communicating Information</strong></td>
<td><strong>PS1.A: Structure and Properties of Matter</strong></td>
<td><strong>Structure and Function</strong></td>
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</tbody>
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| Obtaining, evaluating, and communicating information builds on experiences and progresses to evaluating the merit and accuracy of ideas and methods.  
  • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts. | The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. | • Different materials have different substructures, which can sometimes be observed. |

But should also mix and match elements
What is different about 3-dimensional learning

• Focus on making sense of phenomena or designing solutions to problems

• Students don’t explore the science idea; rather, they use the science ideas, science and engineering practices and CCs to make sense of the phenomena or solve problems
Why build towards a performance expectation(s)?

Establish Coherence

- Lessons fit together coherently
- Science ideas build upon each other so that they become more sophisticated over time
- Lessons link together
- Where appropriate, disciplinary core ideas from different disciplines are used together to explain phenomena.
- Where appropriate, crosscutting concepts are used in the explanation of phenomena from a variety of disciplines.
Learning Grows Over Time

Learning difficult ideas

- Takes time
- Develops as students work on a task that forces them to synthesize ideas
- Occurs when new and existing knowledge is linked to previous ideas
- Depends on instruction
Storyline: Question and phenomena motivate each step in building 3-dimensional learning

**Goal:** Making sense of phenomena or designing solutions

**Phenorn-driven questions**

- **Phenomena + Question**
- **Phenomena + Question**
- **Phenomena + Question**
- **Revisit Driving question**

**Investigate and build knowledge through practices**

- Analyze data, explain [PE₁]
- Explain, argue, model [PE₂]
- Explain argue, model [PE₃]
- Culminating PE

**Incrementally Build** Explanations, Models, or Designs

- Initial explanation, model or design
- Add to/revise
- Add to/revise
- Final consensus explanation, model or design

**Anchoring phenomena**

Thanks to Brian Reiser
Bringing a 3-Dimensional Perspective to Classroom Instruction
Questions??????

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