Implementing the NM STEM Ready! Science Standards

Planning Instruction: Bundling Standards

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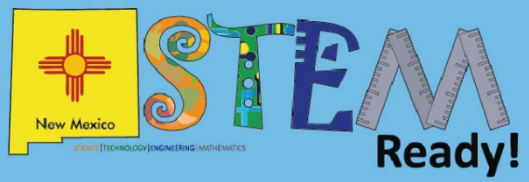
Goals

- Identify effective strategies for planning instruction for the NM STEM Ready! science classroom

- Understand how bundling standards support students in sense making

NM STEM Ready! Science Standards

NGSS
+
New Mexico 6
Specific Standards
=


science standards

Together, the NGSS in their entirety, plus the New Mexico 6 specific standards comprise the NM STEM Ready! science standards.

Christopher N. Ruszkowski
Secretary of Education

What is a NM STEM Ready! science standard?

Students who demonstrate understanding can:

3-PS2-1. **Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.** [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [*Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.*]

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

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Science investigations use a variety of methods, tools, and techniques.

Disciplinary Core Ideas

PS2.A: Forces and Motion

- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)

PS2.B: Types of Interactions

- Objects in contact exert forces on each other.

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified.

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels:

K.PS2.A ; **K.PS2.B** ; **K.PS3.C** ; **5.PS2.B** ; **MS.PS2.A** ; **MS.ESS1.B** ; **MS.ESS2.C**

Common Core State Standards Connections:

ELA/Literacy -

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-PS2-1)*

W.3.7 Conduct short research projects that build knowledge about a topic. (3-PS2-1)

W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-PS2-1)

Mathematics -

MP.2 Reason abstractly and quantitatively. *(3-PS2-1)*

MP.5 Use appropriate tools strategically. *(3-PS2-1)*

3.MD.A.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. *(3-PS2-1)*

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Reading a Standard

MS-PS1-3 **Gather and make sense of information to describe that synthetic materials comes from natural resources and impact society.** [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] *[Assessment Boundary: Assessment is limited to qualitative information.]*

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Science and Engineering Practice
Disciplinary Core Idea

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Science and Engineering Practice
Crosscutting Concept

3-Dimensional Learning

Student Performance Expectation (PE)

Science & Engineering Practices (doing science)

Disciplinary Core Ideas (facts)

Crosscutting Concepts (connecting science)

Adapted from NSTA

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Performance Expectations

ARE

- Guidance for what students should be able to do and understand.
- Specifications for assessments.

ARE NOT

- Learning goals for students
- Instructional strategies for students
- Tests for students

Adapted from Bybee (2013) and Krajcik (2014)

Shifting from "Learning About" to "Figuring Out"

Three key ideas:

1. **Core ideas**: Shift away from breadth of content to *in-depth development of core ideas.*
2. **Practices**: Developing explanations through investigation to make sense of phenomena.
3. **Coherence**: Learning is a *logical progression* in which learners build ideas over time and between science disciplines.

Adapted from Reiser, 2013

Shifting from "Learning About" to "Figuring Out" (*continued*)

- Students using the science and engineering practices are "figuring out" an explanation or solving a problem
  - Application of science knowledge
- Practices mean students should know *why* they are doing an activity

Adapted from Reiser (2013; 2014a,b)

Strategies for Planning Instruction

- Phenomena
- Backwards Design
- Curriculum Adaptation
- Bundling Standards
- Storylines

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- Phenomena
- Backwards Design
- Curriculum Adaptation
- **Bundling Standards**
- **Storylines**

“Bundling” Standards

What does this mean to you?

“Bundling” Standards

- Pruitt (2014) describes bundling as a “set of PEs that provide students with coherent connections among concepts within and across disciplines” (p. 151).
- These ten steps “guide teachers in developing a sequence of lessons to build student proficiency in a bundle of PEs” (Krajcik et al., 2014, p. 163).

"Bundling" Standards

Overview

1. Select standards that work together—a bundle
   (Bybee, 2013; Krajcik, 2014; Pruitt 2014).
2. Inspect the performance expectations, their clarification statements, and assessment boundaries.
3. Examine DCI(s), SEP(s), and CCC(s) and identify implications for instruction.
4. Explore closely the DCI(s) and PE(s).

Adapted from Krajcik (2014)

"Bundling" Standards
Overview (continued)

5. Identify the SEP(s) that support instruction.
6. Develop lesson-level, target PEs.
7. Determine acceptable evidence of learning.
8. Connect to related Common Core State Standards for Math and English Language Arts.

Adapted from Krajcik (2014)

"Bundling" Standards
Overview (continued)

9. Construct a storyline.
   - "Shows how the DCIs, SEPs, and CCCs develop over time. It should also show how students build sophisticated ideas from prior learning, using evidence that build to the understanding described in the standards as student engage in the practice to explain phenomena" (Krajcik, 2014, 170).

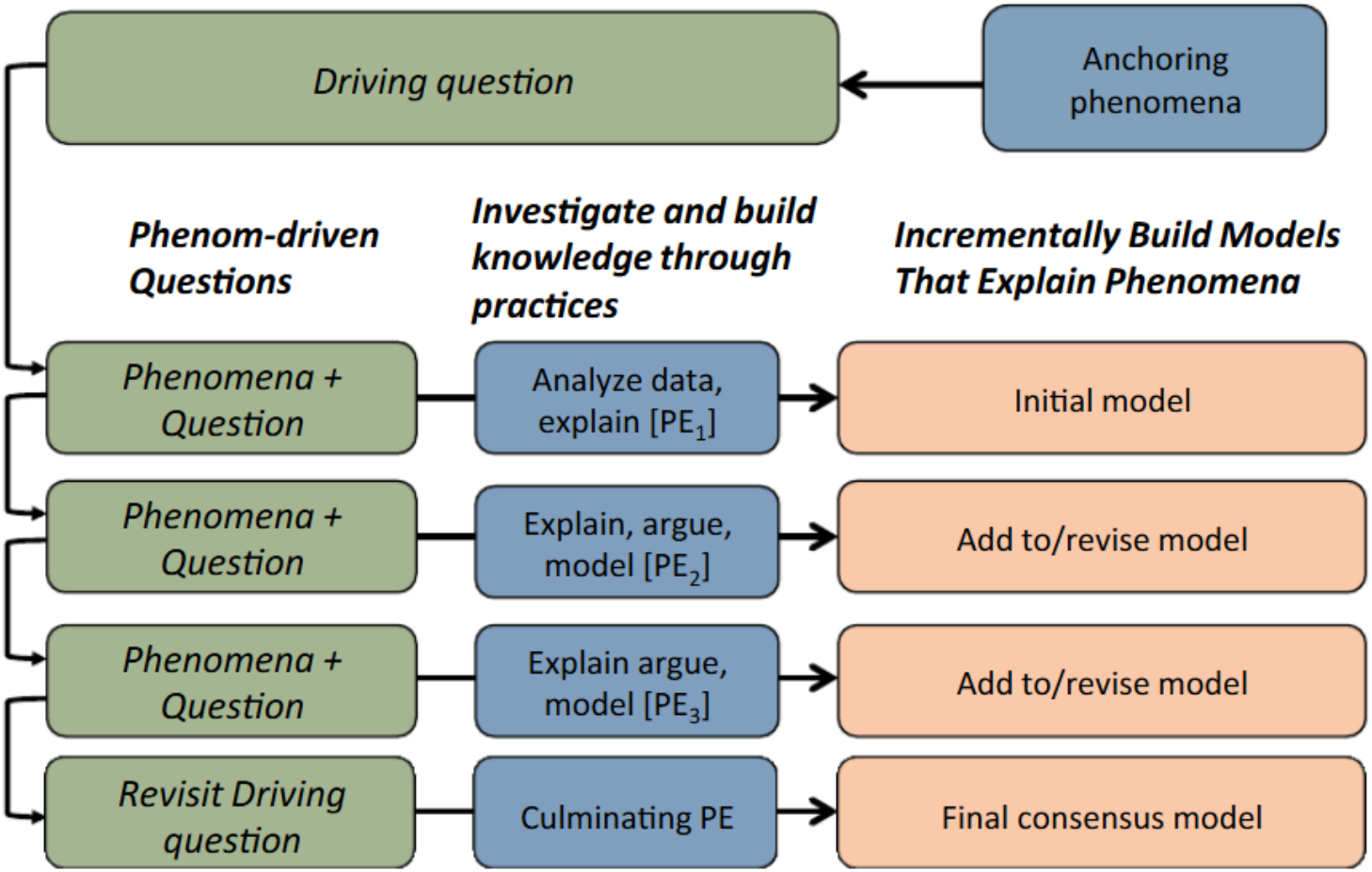
Adapted from Krajcik (2014)

Storylines

- A coherent sequence of lessons that is driven by students' questions with a goal of explaining phenomena or solving a problem.

- A storyline provides a coherent path toward building disciplinary core ideas and crosscutting concepts, piece by piece, anchored in students' own questions.

Storylines (*cont.*)



Adapted from Reiser (2014a, b)

"Bundling" Standards
Overview (continued)

10. Ask yourself, "How do the tasks(s) and lesson(s) help students toward understanding of the targeted standards?"

Adapted from Krajcik (2014)

Resources

- NM STEM Ready! Science Resources page
  - Curriculum Development
    - Phenomena
    - Bundling Standards/Storylines
  - Implementation

- NGSS In Practice–Tools and Processes (Appendices A– E)

Next Steps

Next Webinar:

End of January 2019 - Planning Instruction: Scientific Discourse

Professional Learning:

Please visit the Math and Science Bureau's Professional Learning page; registration for Making Sense of SCIENCE is upcoming.

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