What does learning currently look like in science classrooms?

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Looking at the 5 Innovations in a Science Classroom

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Goals

- To identify the possibilities of the 5 innovations for classroom instruction

- To consider what learning looks like in a NM STEM Ready! science classroom

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.

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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)*

What is a NM STEM Ready! science standard?

who demonstrate understanding can:

2-1. **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.*]

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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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.	**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.	**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 -
.2 Reason abstractly and quantitatively. *(3-PS2-1)*
Use appropriate tools strategically. *(3-PS2-1)*
Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multi
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
measurement scale) to represent the problem. *(3-PS2-1)*

What makes the NM STEM Ready! science standards new and different?

Years of NGSS implementation across the country have refined our collective understanding of what is unique about the NGSS. These differences represent the **5 innovations** in science teaching and learning.

Five Innovations

Build on the shifts described in the NGSS Appendix A: Conceptual Shifts, using lessons learned by educators and researchers

Five Innovations in Classroom Instruction

1. Explaining phenomena and designing solutions to problems
2. Three-dimensional learning
3. Building K-12 learning progressions
4. Connecting the NGSS to ELA/language arts and mathematics
5. All standards, all students **(Equity)**

Innovation 1:

Explaining phenomena and designing solutions to problems

More of	Less of
Students learning aspects of how to design solutions while engaged in the design process.	Students are following step-by-step instructions to a “designed solution”.
Using student sense-making and solution-designing as a context for student learning.	Leading students to the “right answer”.

Innovation 2:
Three-dimensional learning

More of	Less of
Students actively engaged in scientific practices to develop an understanding of each of the three dimensions.	A separate lesson or unit on science process/methods followed later by a lesson or unit focused on science knowledge.
Facts and terminology are learned as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning.	Rote memorization of facts and terminology; providing discrete facts and concepts in science disciplines with limited application of practice. Science vocabulary and definitions are introduced before students develop conceptual understanding.

Reflection

- How will these shifts strengthen student learning in your classroom?

Innovation 3:

Building K-12 learning progressions

More of	Less of
Identifying students' prior knowledge, connecting that knowledge to new knowledge, and building on student's multiple entry points.	Providing repetitive, discrete knowledge that students memorize at each grade level that is disconnected from prior learning.

Innovation 4:

Connection to Common Core ELA and Mathematics

More of	Less of
Engaging all students' science learning experiences with explicit and intentional connections to mathematics and language arts that is meaningful, grade-appropriate and will build deep conceptual understanding in all three subject areas.	Science learning in isolation from related learning in English language arts and mathematics.

Innovation 5:

All standards, all students

More of	Less of
The NM STEM Ready! science standards highlight important learning for all students in all grades K-12.	Science, especially advanced topics, is only for those interested in STEM careers. Science opportunities are inconsistent for all K-12 students.

Reflection

How will these shifts positively impact your instructional planning?

What does a NM STEM Ready! science classroom look like?

- https://www.nextgenscience.org/resources/video-first-steps-towards-transitioning-ngss

Resources

- Math and Science Bureau webpage
- Bozeman Science (YouTube videos)
- STEM Teaching Tools
- Teacher Channel Videos
- NGSS videos

Upcoming Professional Learning

- STEM Symposium (June 1, 2018)
- Making Sense of Science (June 11-22, 2018)

Contact Information

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Final Reflection

What are the possibilities for learning in a NM STEM Ready! science classroom?

References

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