Rate Your Familiarity With The NM STEM Ready! Science Standards

1. I need to learn about the 3-dimensions
2. I have an understanding of the 3-dimensions
3. I am ready to support implementation of the 3-dimensions
4. I am already supporting implementation of the 3-dimensions

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Exploring the 3-Dimensionality of the NM STEM Ready! Science Standards

March 21st , 2018

Patricia Carden, Math Specialist
Shafiq Chaudhary, Math & Science Specialist

Goals

- To be able to describe the 3-dimensions of the NM STEM Ready! science standards to stakeholders

- To become aware of resources and how to support teachers in implementing 3-dimensional learning

NM STEM Ready! Science Standards

NGSS
+
New Mexico 6
Specific Standards

=

New Mexico STEM Ready!
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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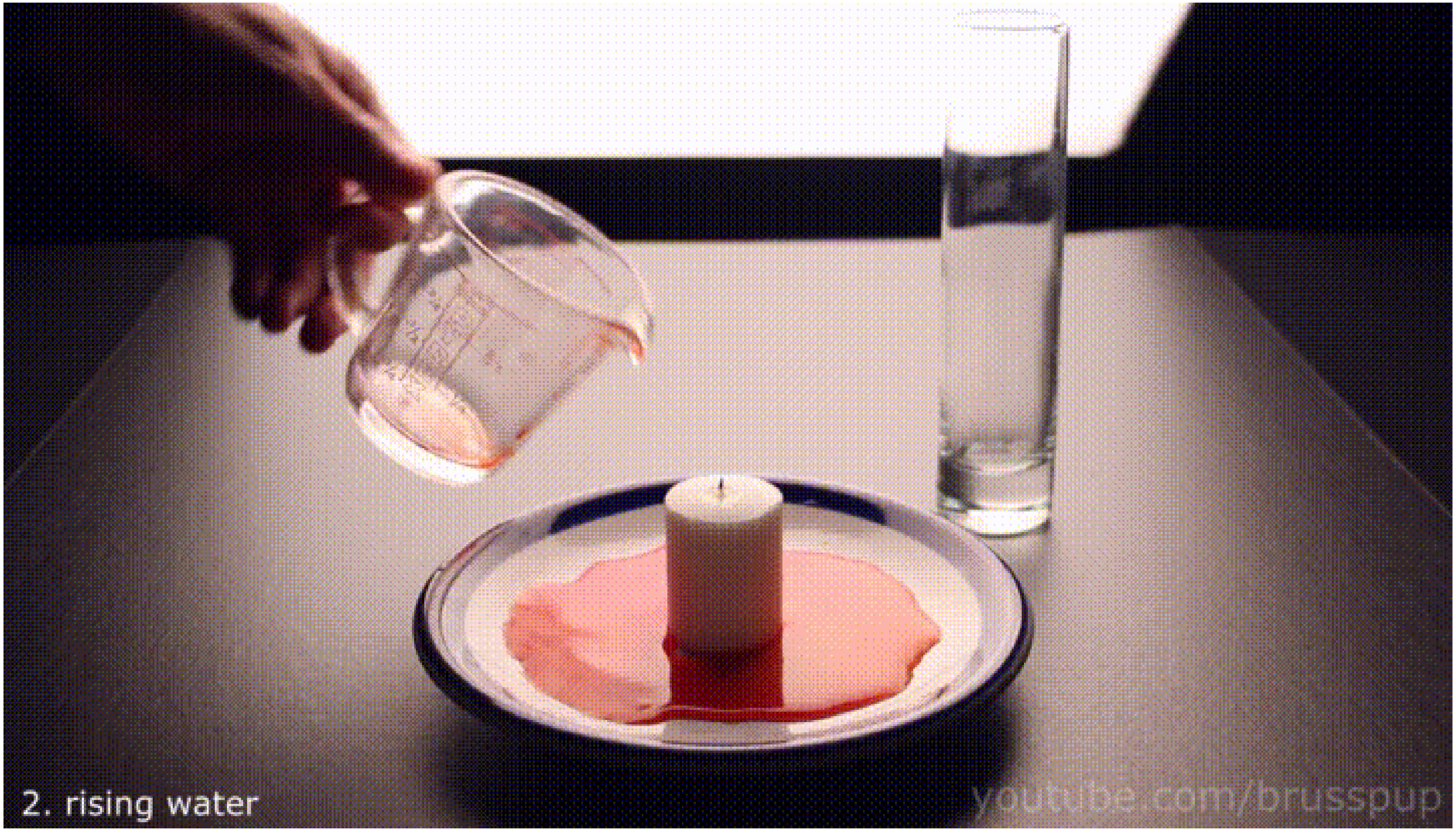
Phenomena



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Review How to Read the Standards

MS-PS1-4 Matter and its Interactions

Students who demonstrate understanding can:

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]

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	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to predict and/or describe phenomena.	**PS1.A: Structure and Properties of Matter** • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. • In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. • The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. **PS3.A: Definitions of Energy** • The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. *(secondary)* • The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. *(secondary)*	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems.

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Exploring the 3-Dimensions

- Disciplinary Core Idea (DCI)

  What content would students need to know?

- Crosscutting Concepts (CCC)

  What patterns could be addressed? How would students make sense of the phenomena?

- Science and Engineering Practices (SEP)

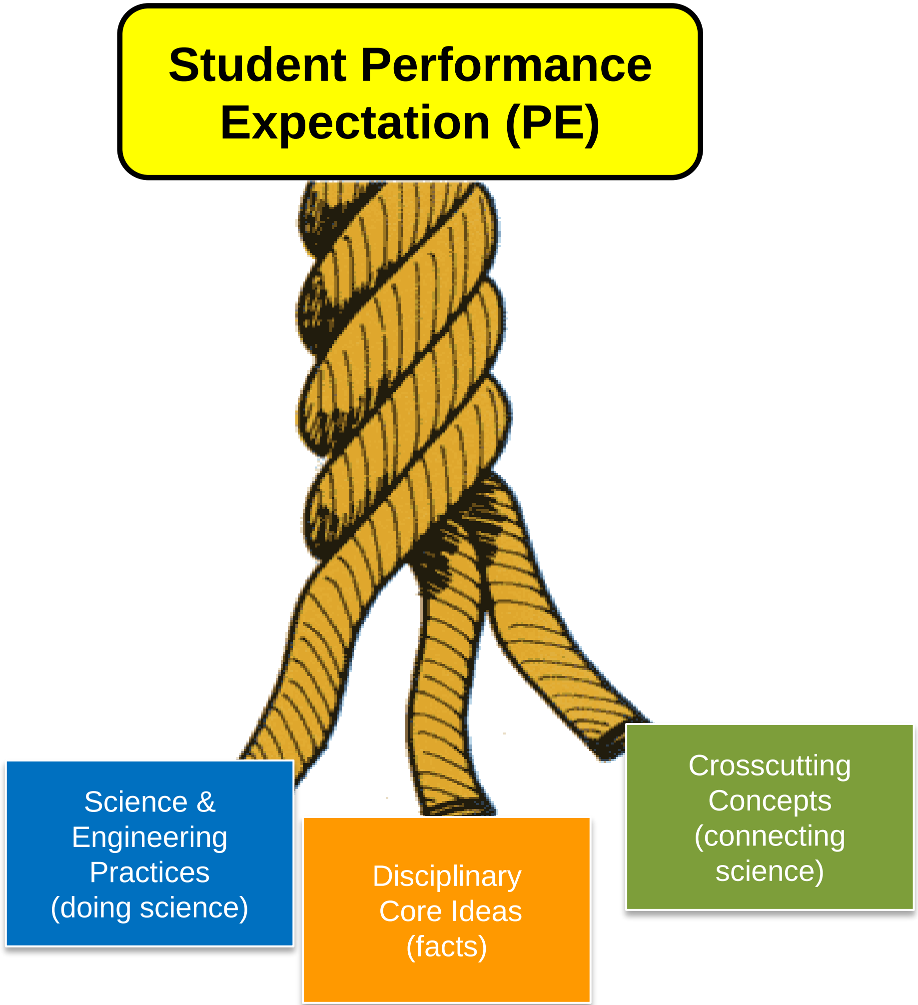
  What practice(s) would students engage in as they made sense of this phenomena?

Goals

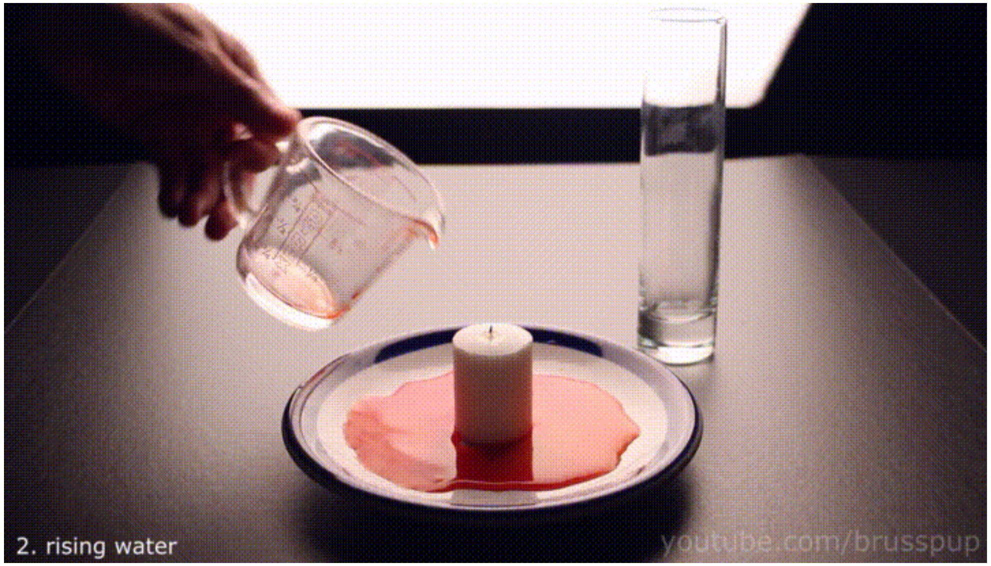
- **To be able to describe the 3-dimensions of the NM STEM Ready! science standards to stakeholders**

- To become aware of resources and how to support teachers in implementing 3-dimensional learning

3-Dimensional Learning



Disciplinary Core Ideas (DCI)



"Research in teaching and learning of science shows that teaching content in isolation from how to use it results in disconnected ideas that learners find difficult to use and apply" **(NRC, 2007)**

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SCIENCE!

Physical Sciences (PS)	Life Sciences (LS)	Earth and Space Sciences (ESS)	Engineering, Technology, and Applications of Science (ETS)

Disciplines

From California Academy of Sciences,

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Disciplinary Core Ideas
Physical Science (PS)

Classroom activities in Middle School will look less like this:	And look more like this:
Physical Sciences	**Physical Sciences**
Students memorize Newton's Law of Gravity.	Students gather and analyze evidence about gravity's effect on objects with different masses.
Students follow scripted chemistry experiments.	Students use chemistry knowledge to design and explain a heat pack.
Students memorize the difference between Fahrenheit and Celsius.	Students construct arguments about the relationship between particle motion and temperature.

https://www.nextgenscience.org/sites/default/files/ParentGuide%20Grades%206to8%20-%20General.pdf

Learning Progressions

for Disciplinary Core Ideas

Example: PS1.A Structure of Matter

Physical Science Progression

INCREASING SOPHISTICATION OF STUDENT THINKING

	K-2	3-5	6-8	9-12
PS1.A Structure of matter (includes PS1.C Nuclear processes)	Matter exists as different substances that have observable different properties. Different properties are suited to different purposes. Objects can be built up from smaller parts.	Matter exists as particles that are too small to see, and so matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials.	The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter.	The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter, including chemical reactions and nuclear processes. Repeating patterns of the periodic table reflect patterns of outer electrons. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy to take the molecule apart.

The link for Appendix E can be found at the MSB webpage.

Appendices

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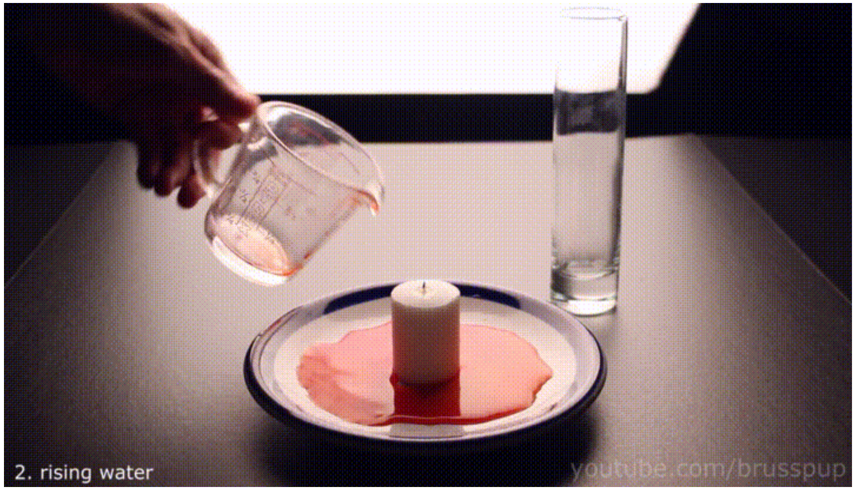
Science and Engineering Practices



Sense making is about actively trying to figure out the way the world works (for scientific questions) and exploring how to create or alter things to achieve design goals (for engineering questions).

(Schwarz *et al*., 2017)

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Science and Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

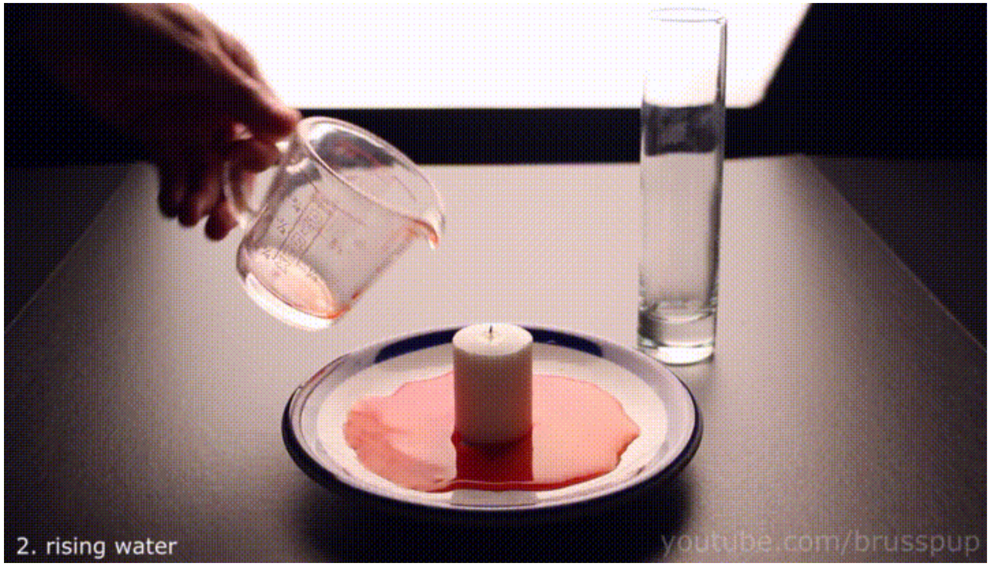
Learning Progression

for Science and Engineering Practices

Example: Constructing Explanations and Designing Solutions

K-2	3-5	6-8	HS
Builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.	Builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.	Builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.	Builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

Crosscutting Concepts



The crosscutting concepts are themes scientists use across disciplines to further understand how phenomena work.

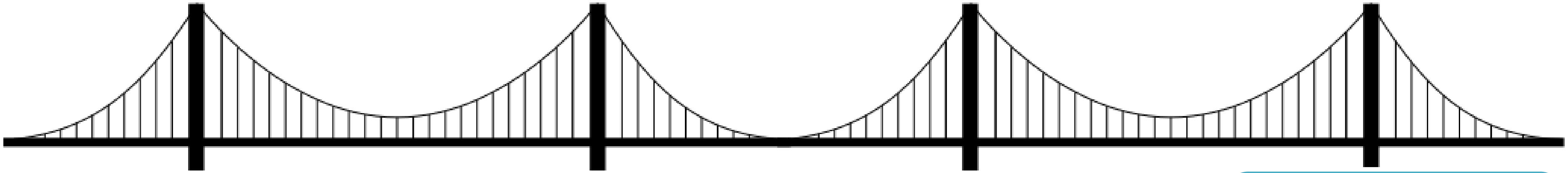
(Fick, 2017)

Crosscutting Concepts

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter in systems
6. Structure and function
7. Stability and change of systems

Crosscutting Concepts

The Framework identifies seven crosscutting concepts that can help students deepen their understanding of the **disciplinary core ideas.**



Physical Sciences

Life Sciences

Earth and Space Sciences

Engineering, Technology, and Applications of Science

Learning Progression
for Crosscutting Concepts

Example: *Systems and System Models*

Progression Across the Grades			
K-2	*3-5*	*6-8*	*9-12*
Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.	Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.	Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales.

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Goals

- To be able to describe the 3-dimensions of the NM STEM Ready! science standards to stakeholders

- **To become aware of resources and how to support teachers in implementing 3-dimensional learning**

NM STEM READY! SCIENCE RESOURCES

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Opportunities for New Mexico Connections to the NGSS

Appendices

NEXT GENERATION SCIENCE STANDARDS For States, By States

NextGenScience

NEXT GENERATION SCIENCE STANDARDS For States, By States

NM STEM READY! SCIENCE RESOURCES

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NGSS@NSTA

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STEM STARTS HERE

STEM Teaching Tools

STEM
teaching tools

Videos & Webinars

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NM STEM READY! SCIENCE RESOURCES

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NGSS Appendices

NGSS Appendices A through M provide background and detail about the standards, along with some implementation models. Other NGSS support documents are available here.

Appendix A: Conceptual Shifts Learn more about the conceptual shifts that make the NGSS new and different.

Appendix B: Responses to Public Drafts Describes the feedback on the draft NGSS during each of the two public review periods, along with the writers' response to it.

Appendix C: College and Career Readiness Learn about why student success in postsecondary education and careers will require a strong K-12 preparation in science.

Appendix D: All Standards, All Students / Case Studies The Appendix and the seven case studies about diverse student groups address what classroom teachers can do to ensure that the NGSS are accessible to all students.

Appendix E: Disciplinary Core Idea Progressions Describes the DCI progressions across K-12, summarizing the main focus of the science disciplinary content at each grade band.

Appendix F: Science and Engineering Practices Describes the progression of the practices across K-12, detailing the specific elements of each practice that are targets for students at each grade band.

Appendix G: Crosscutting Concepts Describes the progression of the Crosscutting Concepts (CCC) across K-12, detailing the specific elements of each CCC that are targets for students at each grade band.

Appendix H: Nature of Science Describes rationale for and research on the nature of science in the context of the NGSS, and discusses how to emphasize the nature of science in school programs.

Appendix I: Engineering Design in the NGSS Describes the framing of Engineering Design concepts and practices throughout the NGSS.

Appendix J: Science, Technology, Society, and the Environment Learn how the interactions between science, technology, society, and the environment are addressed in the NGSS.

Appendix K: Model Course Mapping in Middle and High School Describes examples of ways to arrange the NGSS into middle and high school courses or years.

Appendix L: Connections to CCSS-Mathematics Learn about the connections to Common Core State Standards (CCSS)-Mathematics in the NGSS.

Appendix M: Connections to CCSS-Literacy in Science and Technical Subjects Learn about the connections to Common Core State Standards (CCSS)-Literacy in Science and Technical Subjects in the NGSS.

Resources for the NM STEM Ready! Science Standards

VIDEOS AND WEBINARS

Home / Bureaus / Math and Science Bureau / NM STEM Ready! Science / Videos and Webinars

- **Introduction to the Next Generation Science Standards**
  Presented By Stephen Pruitt
- **How to Read the Next Generation Science Standards**
  By Achieve. This video highlights the structure of the Next Generation Science Standards.
- **NGSS: Crosscutting Concepts**
  Presented by The Learning Channel and Achieve. This video highlights the crosscutting concepts in a teacher professional development setting.
- **NGSS: Science and Engineering Practices**
  Presented by The Learning Channel and Achieve. This video highlights the science and engineering practices in a teacher professional development setting.
- **NGSS: Disciplinary Core Ideas**
  Presented by The Learning Channel and Achieve. This video highlights the crosscutting concepts in a teacher professional development setting.

Resources for the NM STEM Ready! Science Standards

NEXT GENERATION SCIENCE STANDARDS For States, By States

THE STANDARDS INSTRUCTION AND ASSESSMENT PLANNING AND COMMUNICATION

Communicating About the Standards

NextGenScience

NEXT GENERATION SCIENCE STANDARDS For States, By States

NEXT GENERATION SCIENCE STANDARDS For States, By States

AN OVERVIEW FOR PRINCIPALS

The purposes of this document are to introduce principals to the Next Generation Science Standards (NGSS) and provide a general overview of the key instructional and conceptual shifts required by the NGSS. Principals have a critical role to play in the implementation process and this resource can be a guide for administrators working in states that have recently adopted new K-12 science standards, based on the NGSS.

Upcoming
Professional Learning Opportunities

- Webinars
- 2018 NM STEM Symposium
- Making Sense of SCIENCE

Professional Learning:

http://webnew.ped.state.nm.us/bureaus/math-science/professional-learning/

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Rate Your Familiarity Now With The NM STEM Ready! Science Standards

On a scale of 1 to 4,

1. I gained knowledge about the 3-dimensions
2. I grew in my understanding of the 3-dimensions
3. I know next steps to take towards supporting the implementation of the 3-dimensions
4. I strengthen how I can support the implementation of the 3-dimensions

Next Steps

Feedback Survey:

https://www.surveymonkey.com/r/KKKSSYB

Next Webinar:

April 2018. Please visit the Math and Science Bureau's Professional Learning page for updated information.

Resources

Math and Science Bureau NM STEM Ready! science page:

http://webnew.ped.state.nm.us/bureaus/math-science/nm-stem-ready-science/

Webinars:

http://webnew.ped.state.nm.us/bureaus/math-science/nm-stem-ready-science/videos-and-webinars/

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