NEXT GENERATION SCIENCE STANDARDS

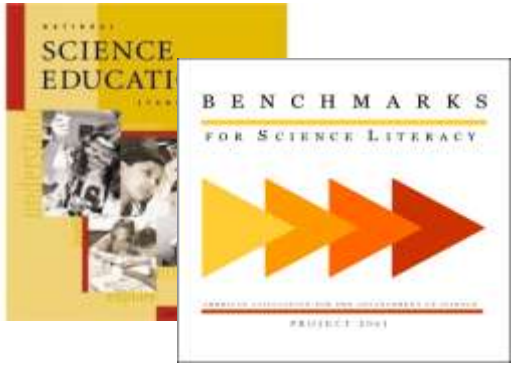
For States, By States

Next Generation Science Standards and Life Sciences

John Olson

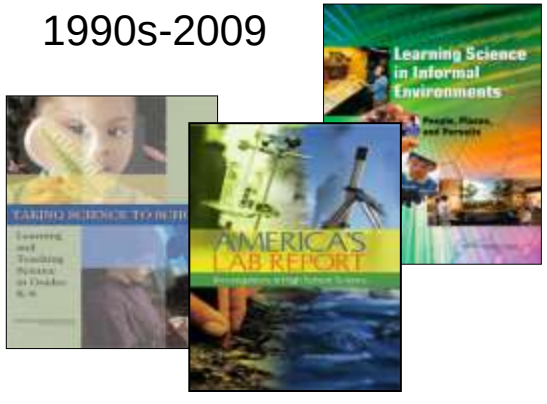
Minnesota Dept. of Education

Building on the Past; Preparing for the Future

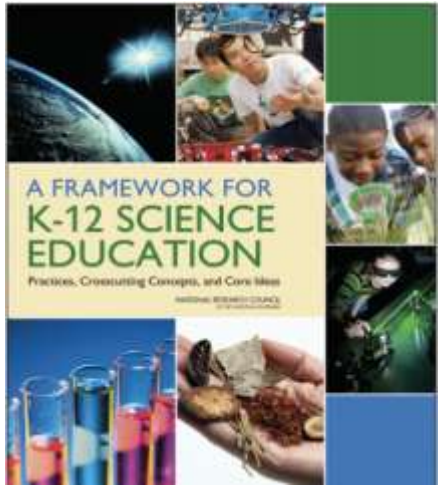


1990s

1990s-2009



Phase I



1/2010 - 7/2011

Phase II

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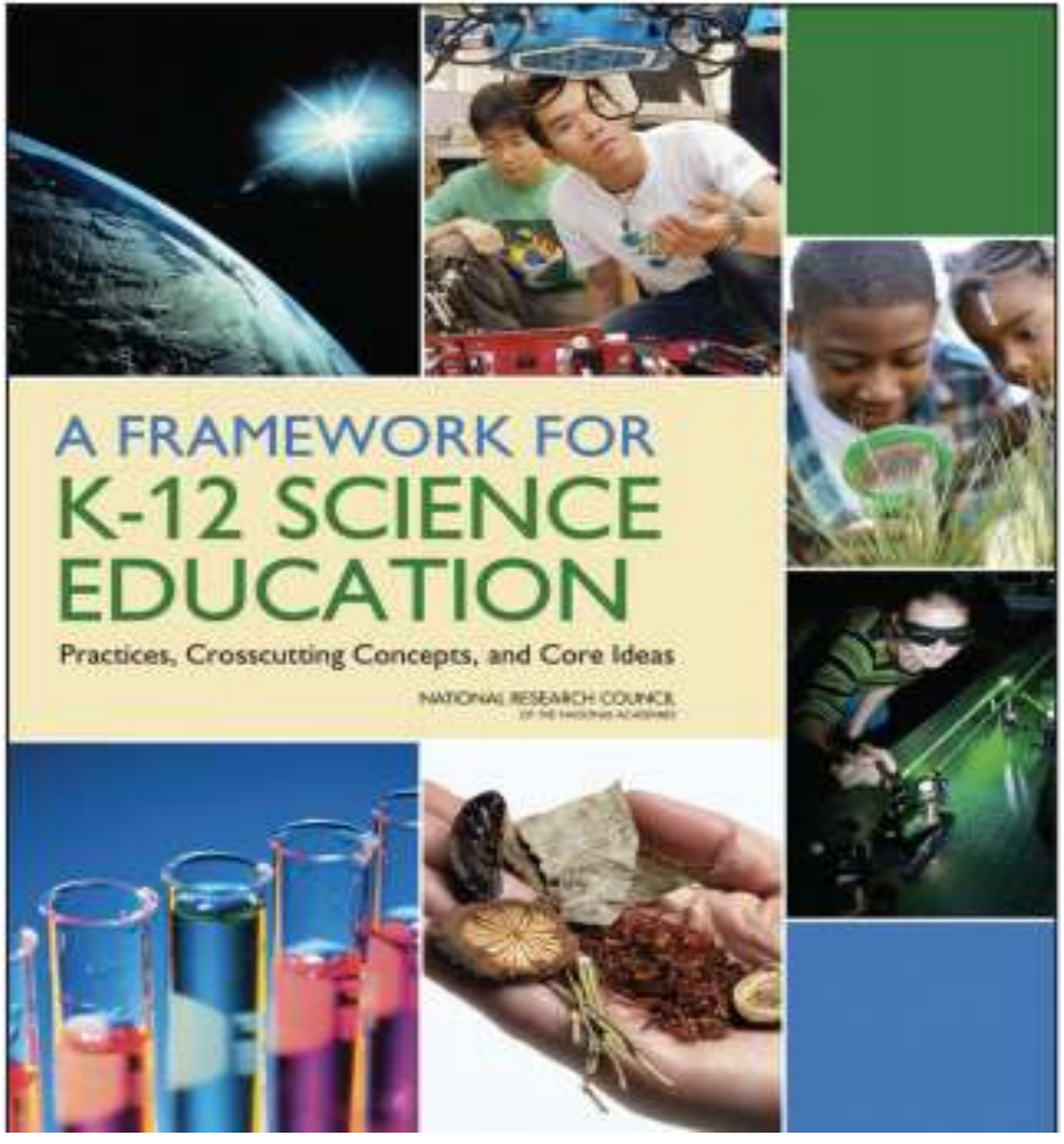
7/2011 – March 2013

State Standards

MN: 2017-18

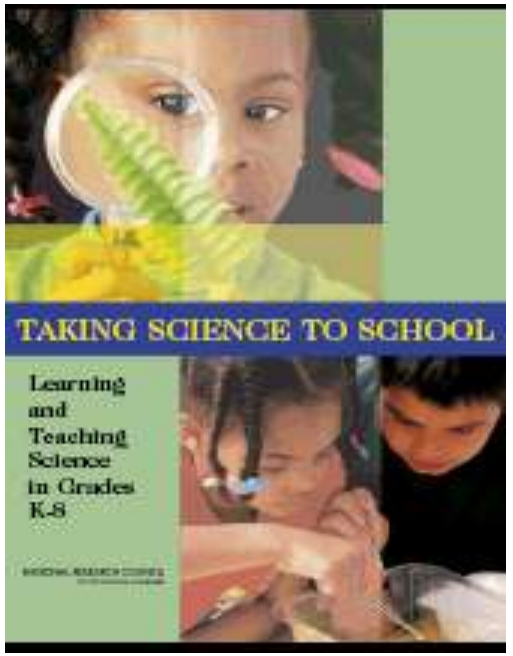


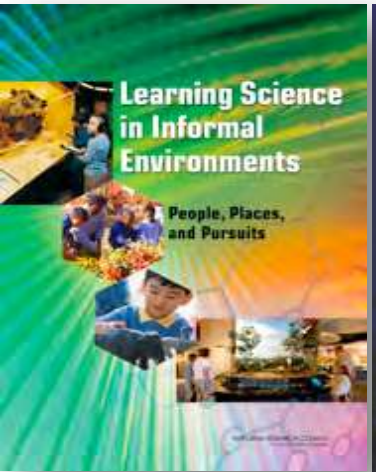
A new Vision of Science Leaning that leads to a new Vision of Teaching.

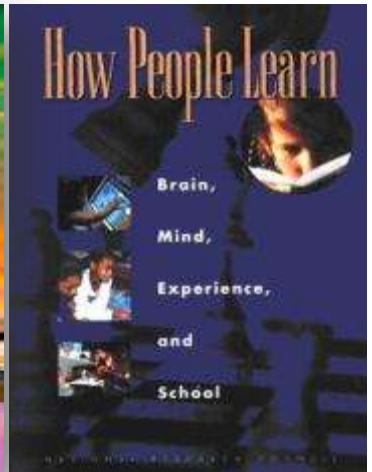
free download at
www.nap.edu

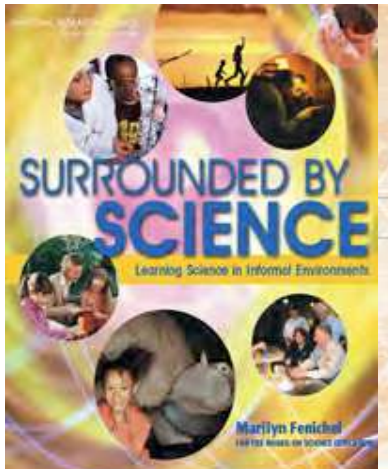
The Guiding Principles of the Framework are Research-Based and Include. . .

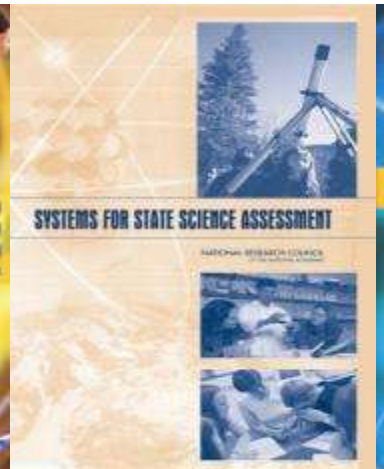
- **Children are born investigators**
- **Understanding builds over time**
- **Science and Engineering require both knowledge and practice**
- **Connecting to students' interests and experiences is essential**
- **Focusing on core ideas and practices**
- **Promoting equity**

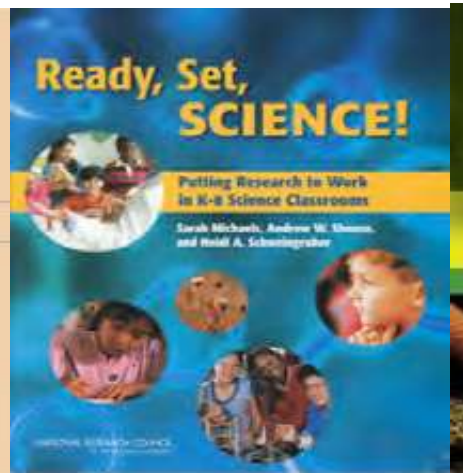


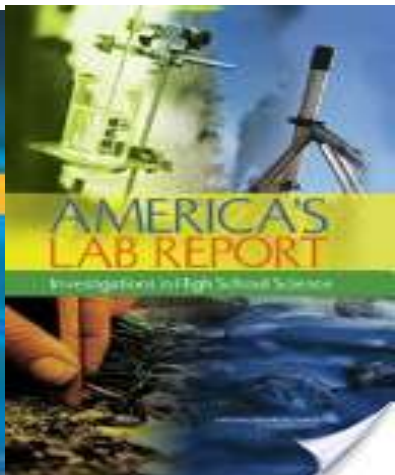






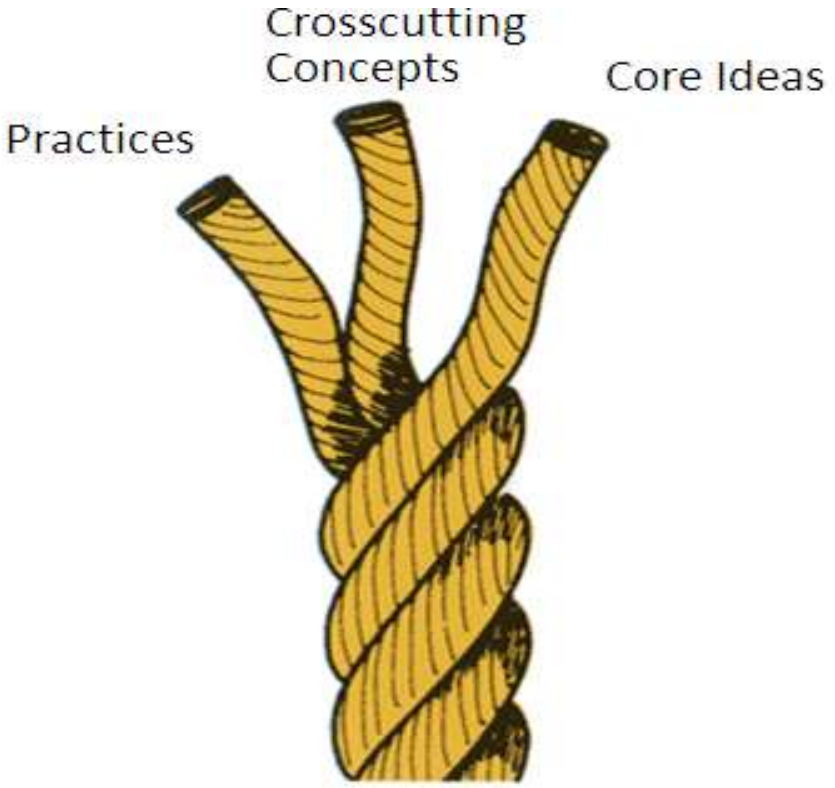






Three Dimensions

- Dimension I – Scientific and Engineering Practices
- Dimension II – Crosscutting Concepts
- Dimension III – Core Ideas



NEXT GENERATION SCIENCE STANDARDS

I. Science and Engineering Practices

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

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II. Cross Cutting Concepts

Cause and Effect

Patterns

Structure and Function

Systems

Scale

Change and Stability

Matter and Energy

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III. Disciplinary Core Ideas

A core idea for K-12 science instruction is a scientific idea that:

- Has broad importance across multiple science or engineering disciplines or is a key organizing concept of a single discipline
- Provides a key tool for understanding or investigating more complex ideas and solving problems
- Relates to the interests and life experiences of students or can be connected to societal or personal concerns that require scientific or technical knowledge
- Is teachable and learnable over multiple grades at increasing levels of depth and sophistication

NEXT GENERATION SCIENCE STANDARDS

Core Ideas

Physical Sciences

- PS1: Matter and its interactions
- PS2: Motion and stability: Forces and interactions
- PS3: Energy
- PS4: Waves and their applications in technologies for information transfer

Life Sciences

- LS1: From molecules to organisms: Structures and processes
- LS2: Ecosystems: Interactions, energy, and dynamics
- LS3: Heredity: Inheritance and variation of traits
- LS4: Biological evolution: Unity and diversity

Earth and Space Sciences

- ESS1: Earth's place in the universe
- ESS2: Earth's systems
- ESS3: Earth and human activity

Engineering, Technology and Applications of Science

- ETS1: Engineering design
- ETS2: Links among engineering, technology, Science, and society

NEXT GENERATION SCIENCE STANDARDS

Life Science Core and Component Ideas

LS1: From molecules to organisms: Structures and processes

- Structure and Function
- Growth and Development of Organisms
- Organization for matter and energy flow in organisms
- Information Processing

LS2: Ecosystems: Interactions, energy, and dynamics

- Independent relationships in ecosystems
- Cycles of matter and energy transfer in ecosystems
- Ecosystem dynamics and resilience
- Social interactions and group behavior

LS3: Heredity: Inheritance and variation of traits

- Inheritance of traits
- Variation of traits

LS4: Biological evolution: Unity and diversity

- Evidence of common ancestry and diversity
- Natural Selection
- Adaptation
- Biodiversity and humans

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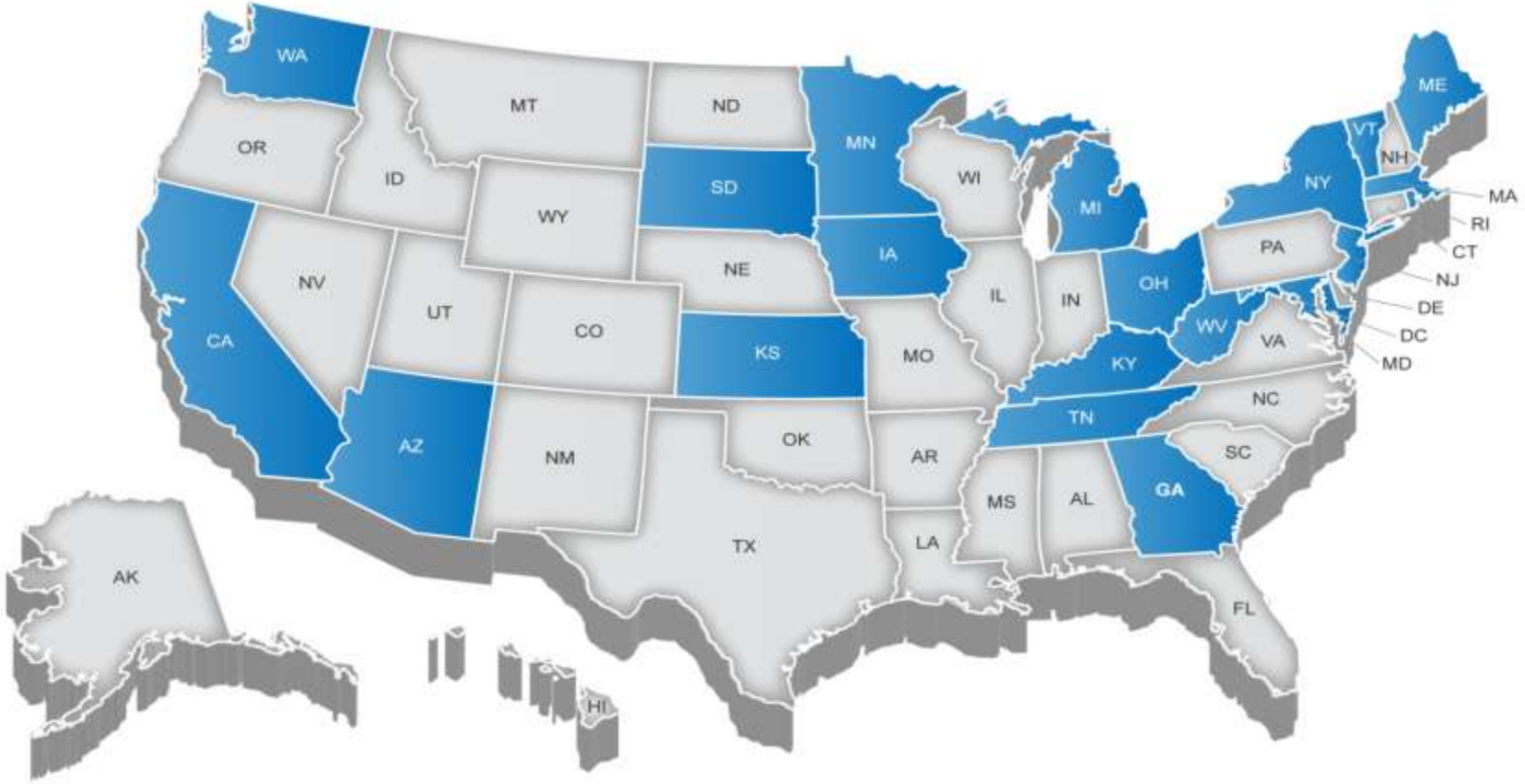
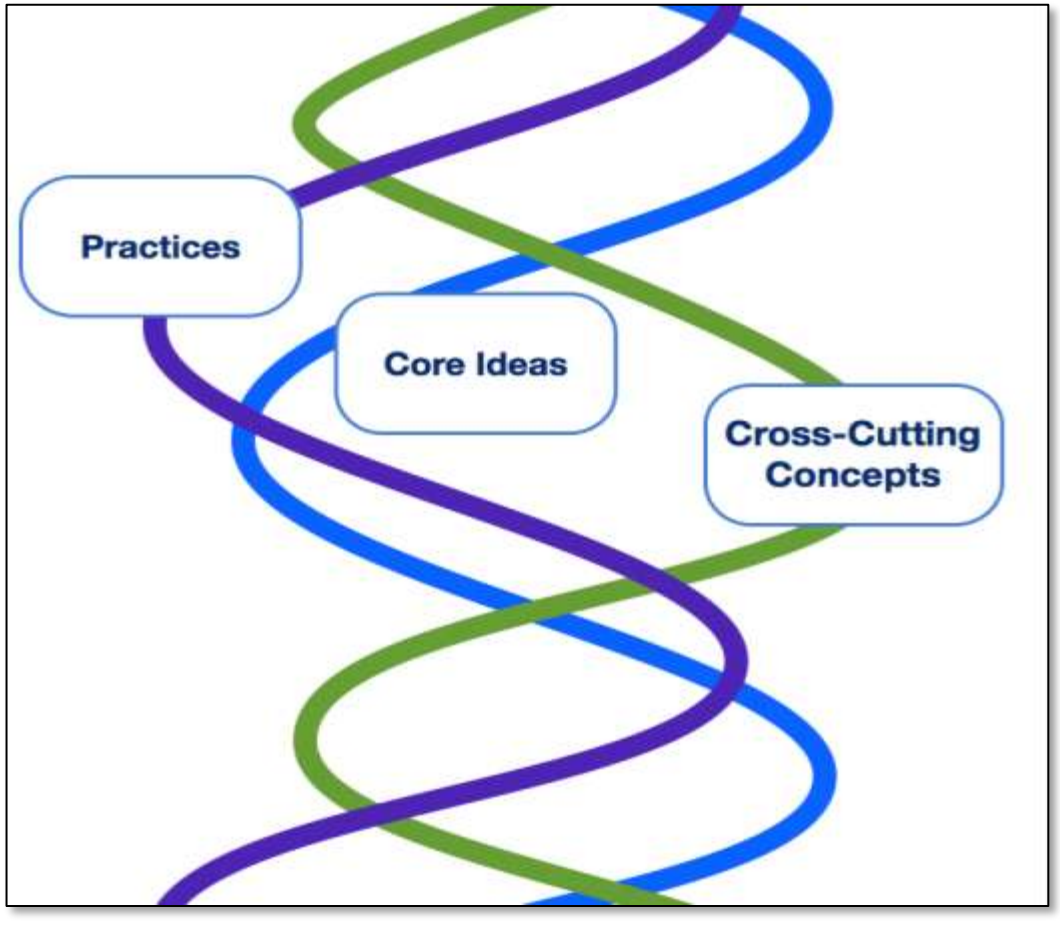
Lead State Partners



Three Dimensions Intertwined



- NGSS will require contextual application of the three dimensions by students.
- The NGSS are written as Performance Expectations

NEXT GENERATION SCIENCE STANDARDS
For States, By States

MS-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

MS-PS1-d. Develop molecular models of reactants and products to support the explanation that atoms, and therefore mass, are conserved in a chemical reaction. [Clarification Statement: Models can include physical models and drawings that represent atoms rather than symbols. The focus is on law of conservation of matter.] [Assessment Boundary: The use of atomic masses is not required. Balancing symbolic equations (e.g. N2 + H2 -> NH3) is not required.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to support explanations, describe, test, and predict more abstract phenomena and design systems.

- Use and/or develop models to predict, describe, support explanation, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. (MS-PS1-a), (MS-PS1-c), (MS-PS1-d)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-d)

Disciplinary Core Ideas

PS1.B: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-d), (MS-PS1-e), (MS-PS1-f)
- The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-d)

Crosscutting Concepts

Energy and Matter

- Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-d)

Note: Performance expectations combine practices, core ideas, and crosscutting concepts into a single statement of ***what is to be assessed.***

They are not instructional strategies or objectives for a lesson.

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Conceptual Shifts in the NGSS

1. K-12 Science Education Should Reflect the Interconnected Nature of Science as it is Practiced and Experienced in the Real World.
2. The Next Generation Science Standards are student performance expectations – NOT curriculum.
3. The science concepts build coherently from K-12.
4. The NGSS Focus on Deeper Understanding of Content as well as Application of Content.
5. Science and Engineering are Integrated in the NGSS from K–12.
6. NGSS content is focused on preparing students for the next generation workforce.
7. The NGSS and Common Core State Standards (English Language Arts and Mathematics) are Aligned.

NEXT GENERATION SCIENCE STANDARDS
For States, By States

Resources

- *Framework for K-12 Science Education*; *Taking Science to School; Ready, Set, Science* www.nap.edu (FREE)
- Next Generation Science Standards www.nextgenscience.org
- National Science Teachers Assn. www.nsta.org/ngss
- John.c.olson@state.mn.us, Science Content Specialist

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