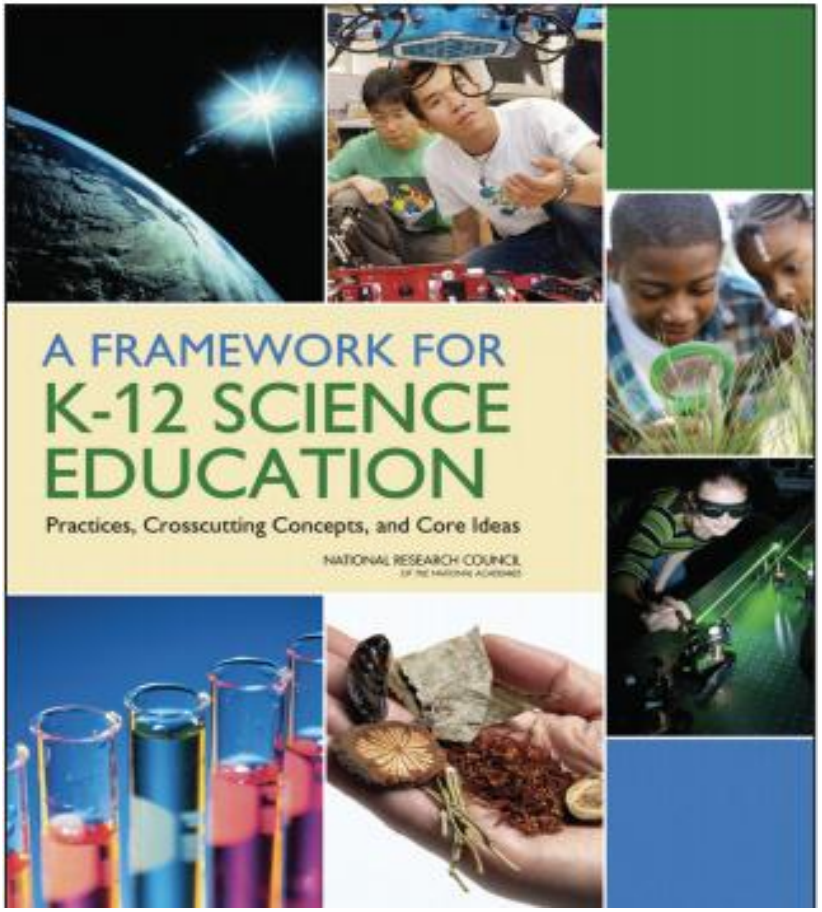
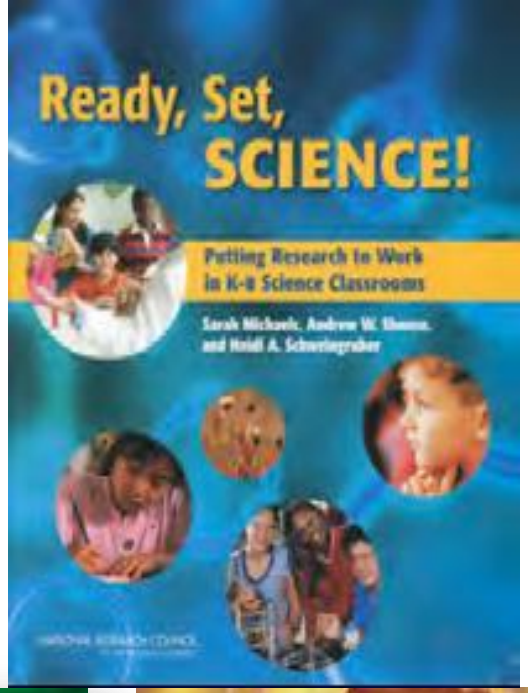
Framework Vision for Science Education and Implications for Next Generation Science Standards

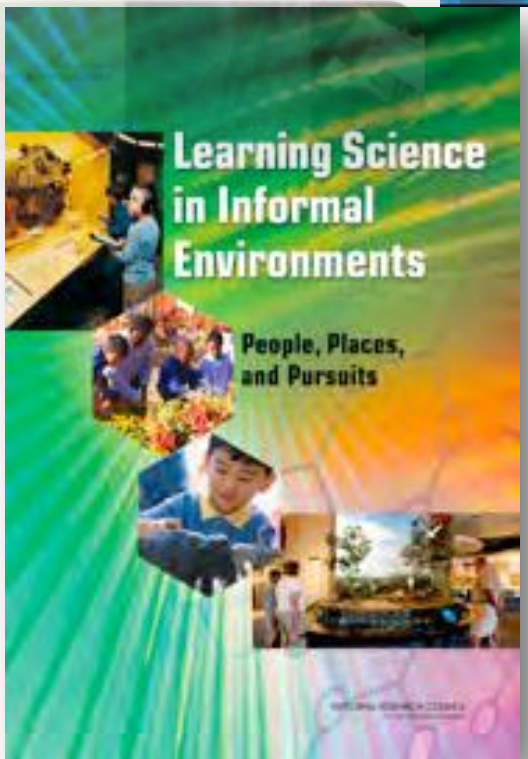
Presentation
by
Brett D. Moulding
Partnership for Effective Science Teaching and Learning

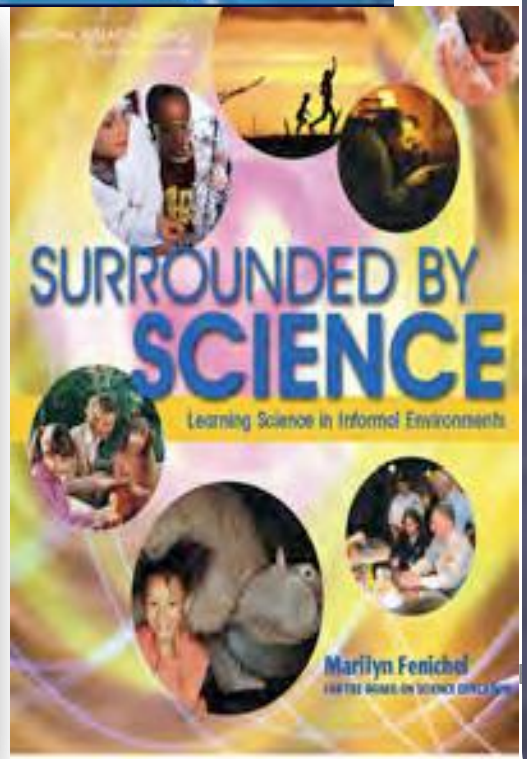
Vision for Science Teaching and Learning

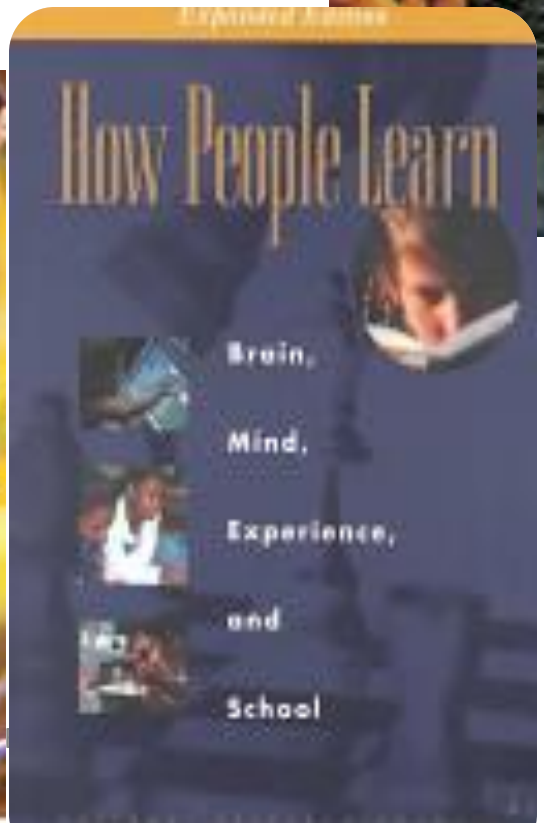




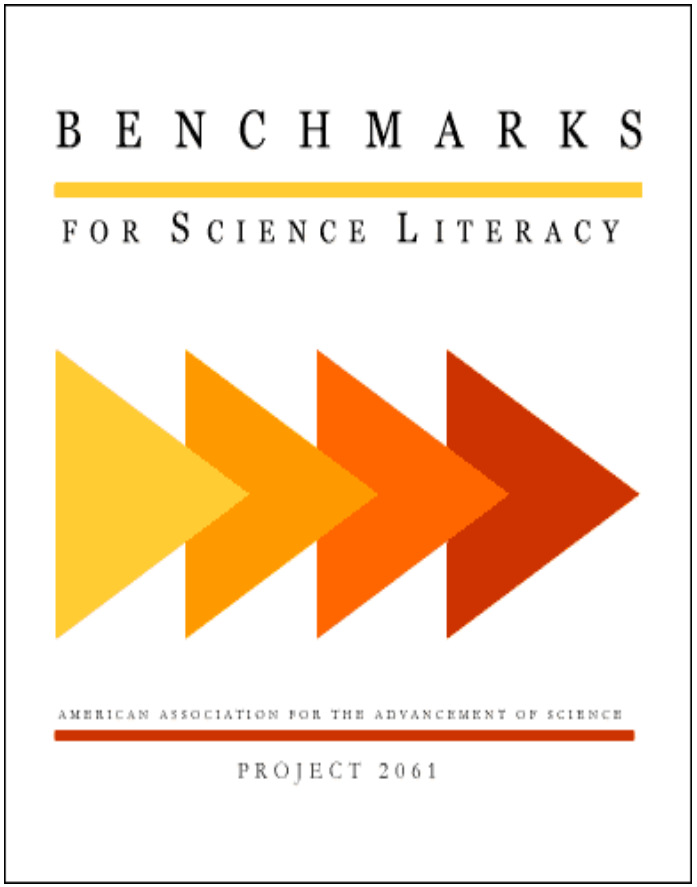
Builds on the Research on Learning the Ideas of Science

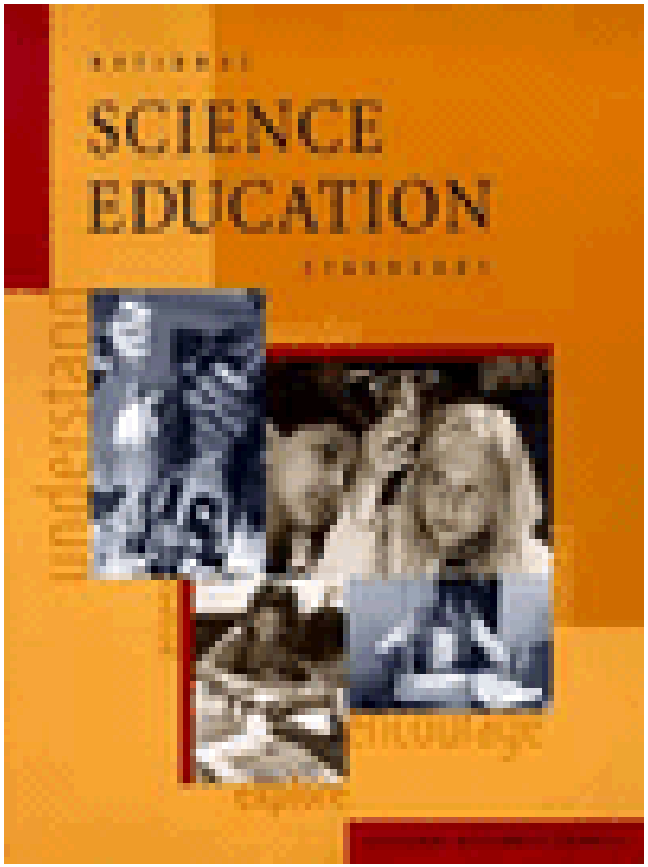






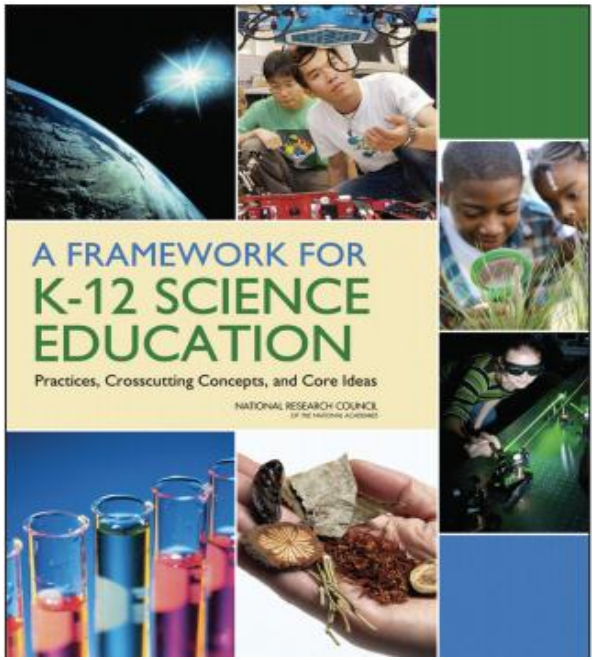
Reports that Shape Where We Find Ourselves Today

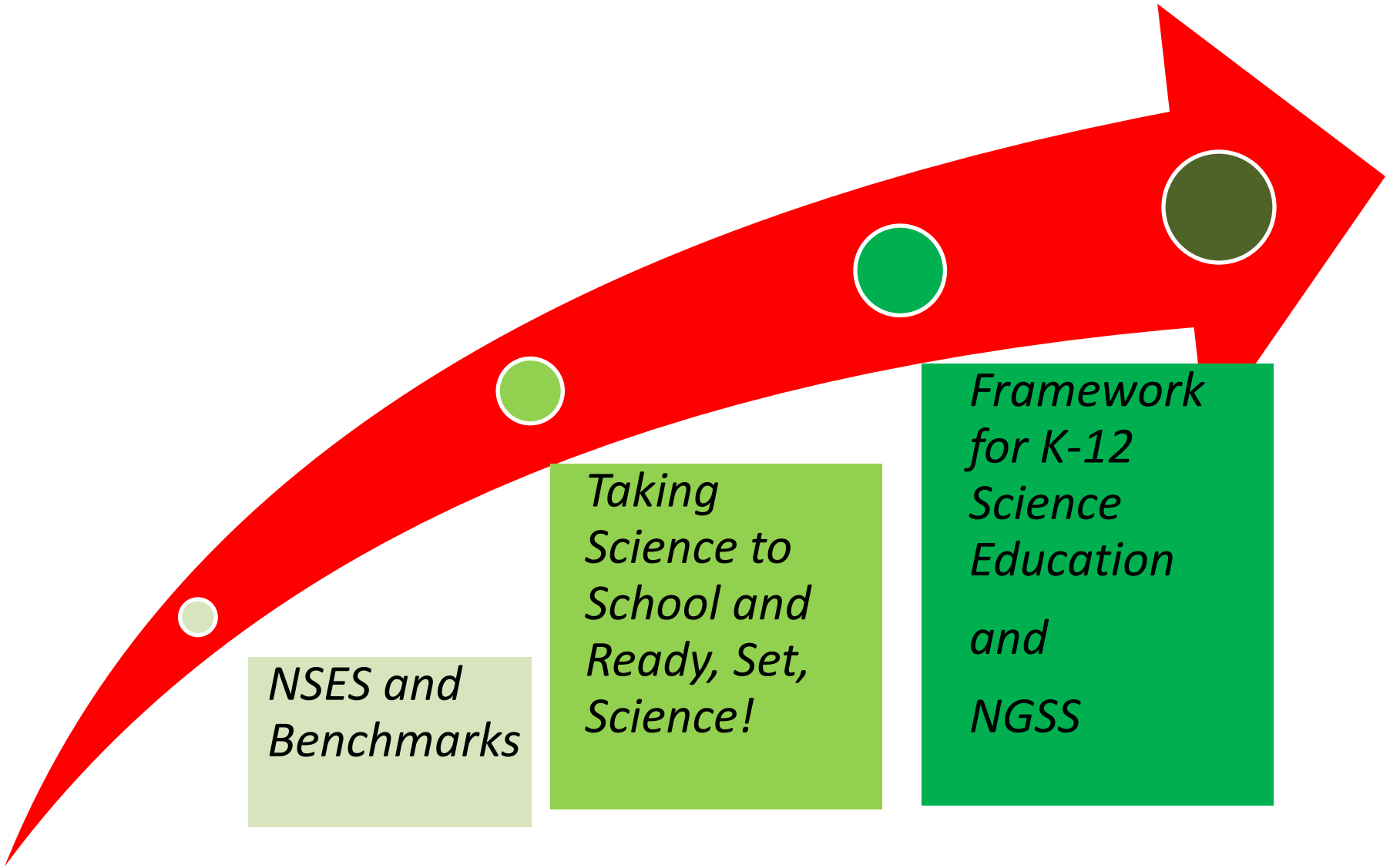




The Framework

- Vision of the Framework
- Goals of the Framework
- Three Dimensions




NSES and Benchmarks
Taking Science to School and Ready, Set, Science!
Framework for K-12 Science Education
and
NGSS

Goals for Science Education

The Framework's vision takes into account two major goals for K-12 science education:

(1) Educating all students in science and engineering.

(2) Providing the foundational knowledge for those who will become the scientists, engineers, technologists, and technicians of the future.

The Framework principally concerns itself with the first task—what all students should know in preparation for their individual lives and for their roles as citizens in this technology-rich and scientifically complex world.

Framework Page 10

The Framework is Designed to Help Realize a Specific Vision for Science Education

- A vision of science education in which all students' experiences over multiple years foster progressively deeper understanding of science.
- Students actively engage in scientific and engineering practices in order to deepen their understanding of crosscutting concepts and disciplinary core ideas.
- In order to achieve the vision embodied in the Framework and to best support students' learning, all three dimensions need to be integrated into the system of standards, curriculum, instruction, and assessment.
- Implications…

Framework Page 217

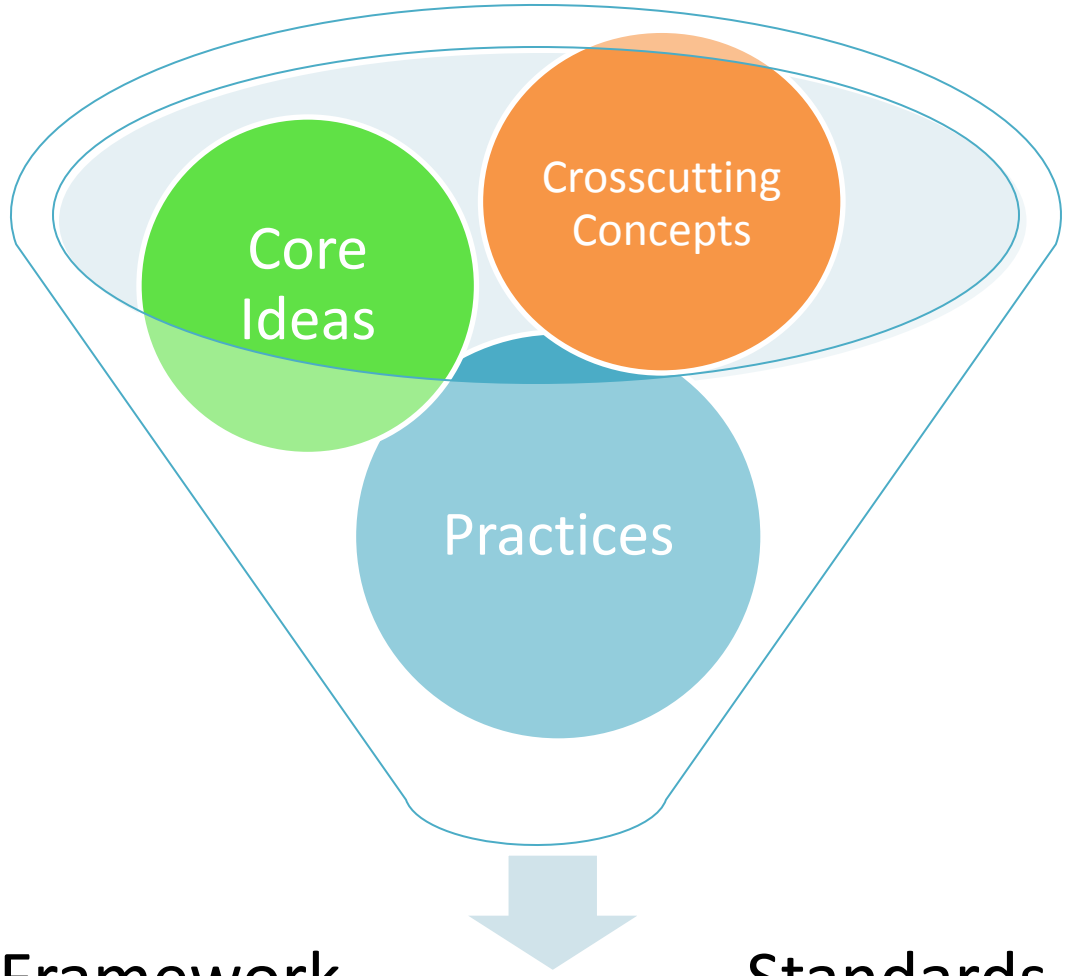
Structure/Dimensions of Framework

- Science and Engineering **Practices**
- Disciplinary Core **Ideas**
- Crosscutting **Concepts**

"The three dimensions of the Framework, which constitute the major conclusions of this report, are presented in separate chapters. However, in order to facilitate students' learning, the dimensions must be woven together in standards, curricula, instruction, and assessments.

When they explore particular disciplinary ideas from Dimension 3, students will do so by engaging in practices articulated in Dimension 1 and should be helped to make connections to the crosscutting concepts in Dimension 2."

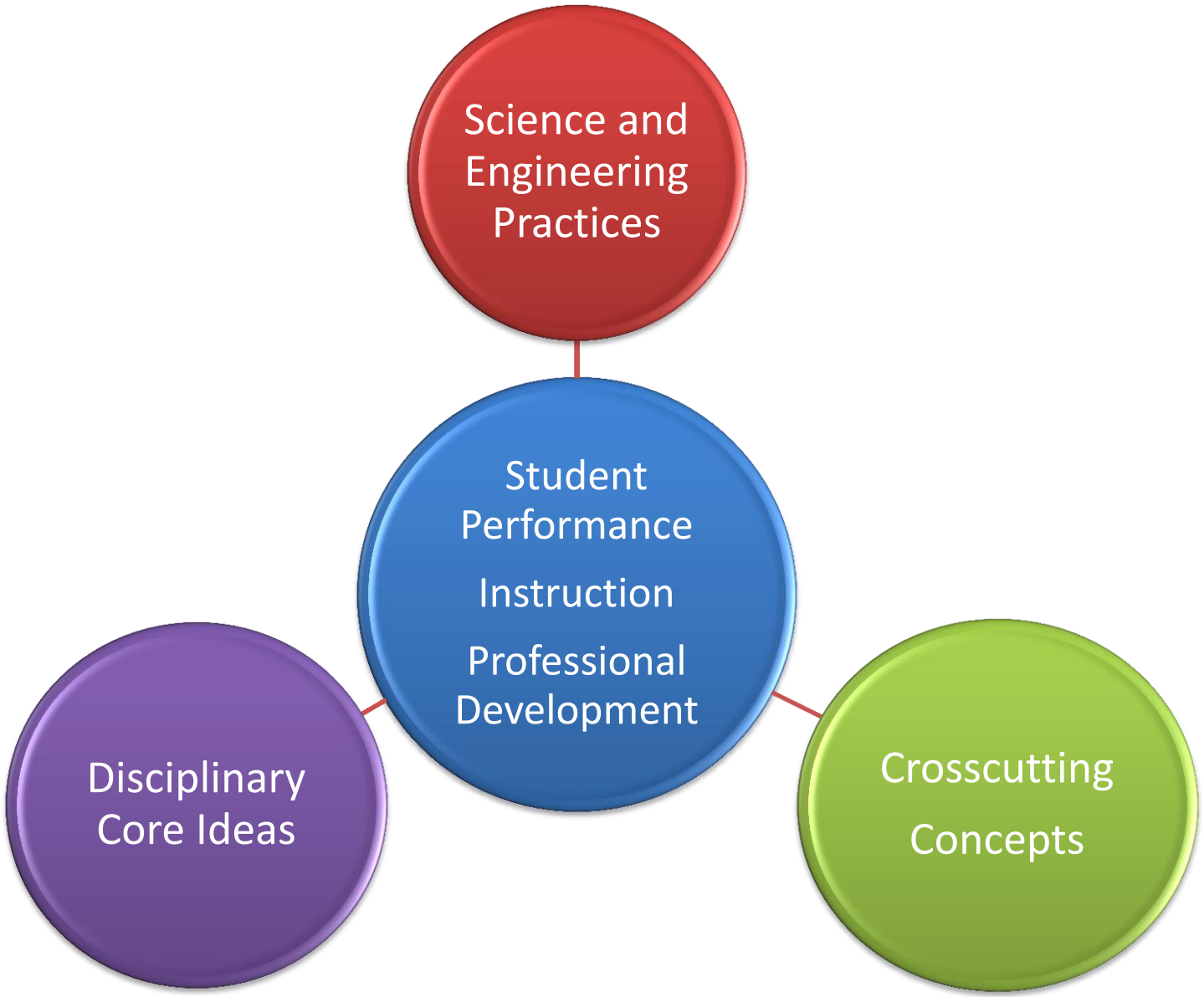
Framework Pages 29 - 30



Framework → Standards

Student Performance Expectations

3-D Model = Science at the Intersection



Science and Engineering Practices

Explanations Using Evidence

Group Activity

Explore how water moves from one cup to another through a paper towel.

1. Explore – place water in one cup, place an empty cup next to it. Connect them with a small piece of paper towel.
2. Formulate questions and investigate **explanations** for how the water moves from one cup to the other cup.
3. Develop **evidence** to support your **explanations.**

Individual Activity

4. Write in your journal or on note paper your **explanation** that may be used to explain this phenomena to others. Include the **evidence** to support the **explanation.**

Reflection

5. Write a short reflection on the nature of science instruction that leads students to develop **explanations** based upon **evidence.**

Science and Engineering Practices

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

Framework Pages 41-82

Connecting the Practices

- ***Asking questions*** to focus ***investigations***, using ***investigations*** and ***analyzing and interpreting data*** using ***mathematics*** to provide evidence to ***construct explanations.***
- ***Using models*** to 1) ***communicate information and explanations***, 2) gather evidence, 3) make predictions.
- ***Engaging in argumentation*** to 1) support ***explanations, 2) Make sense of ideas, and*** *3)* ***communicate*** *explanations*

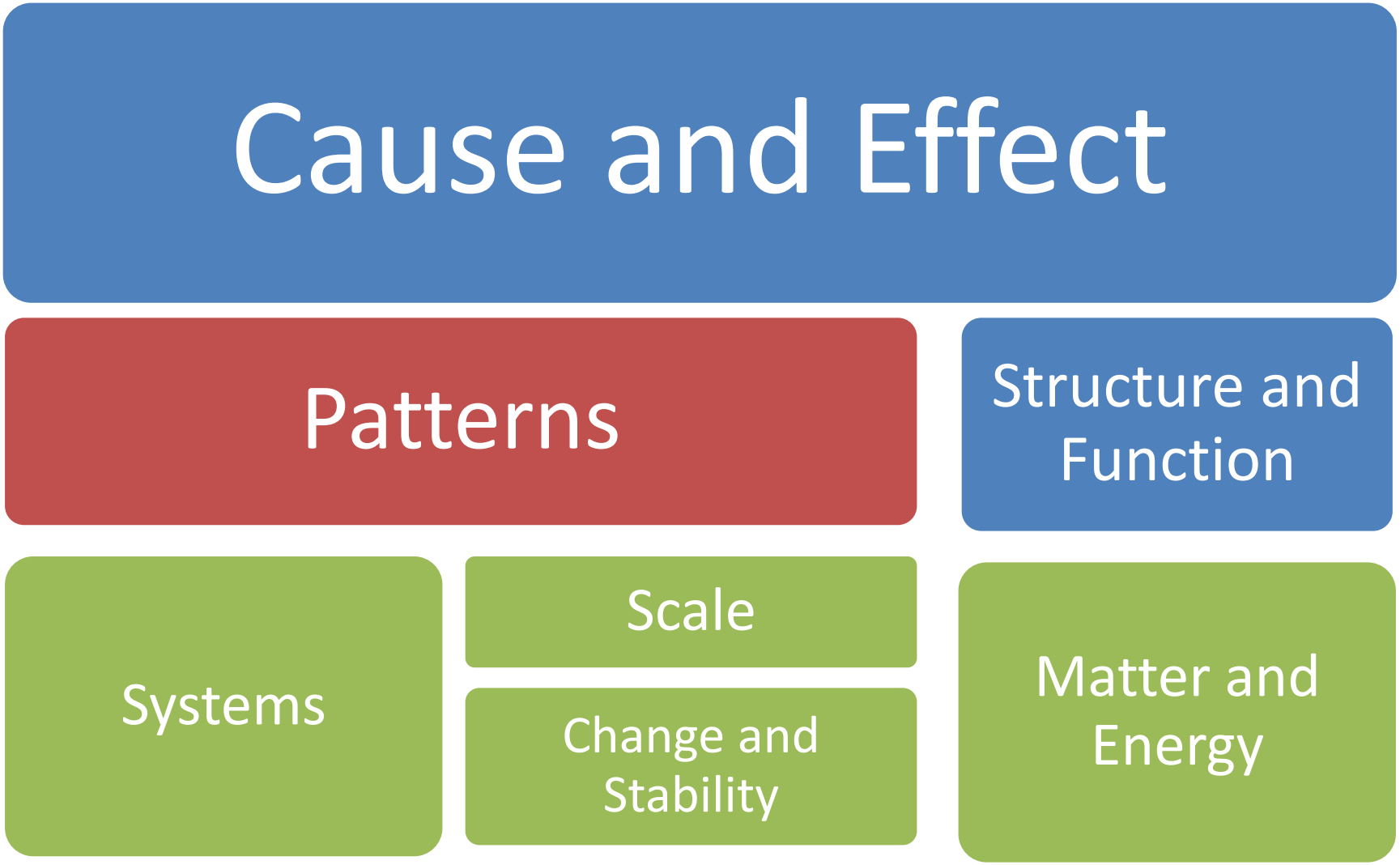
Engineering Practices

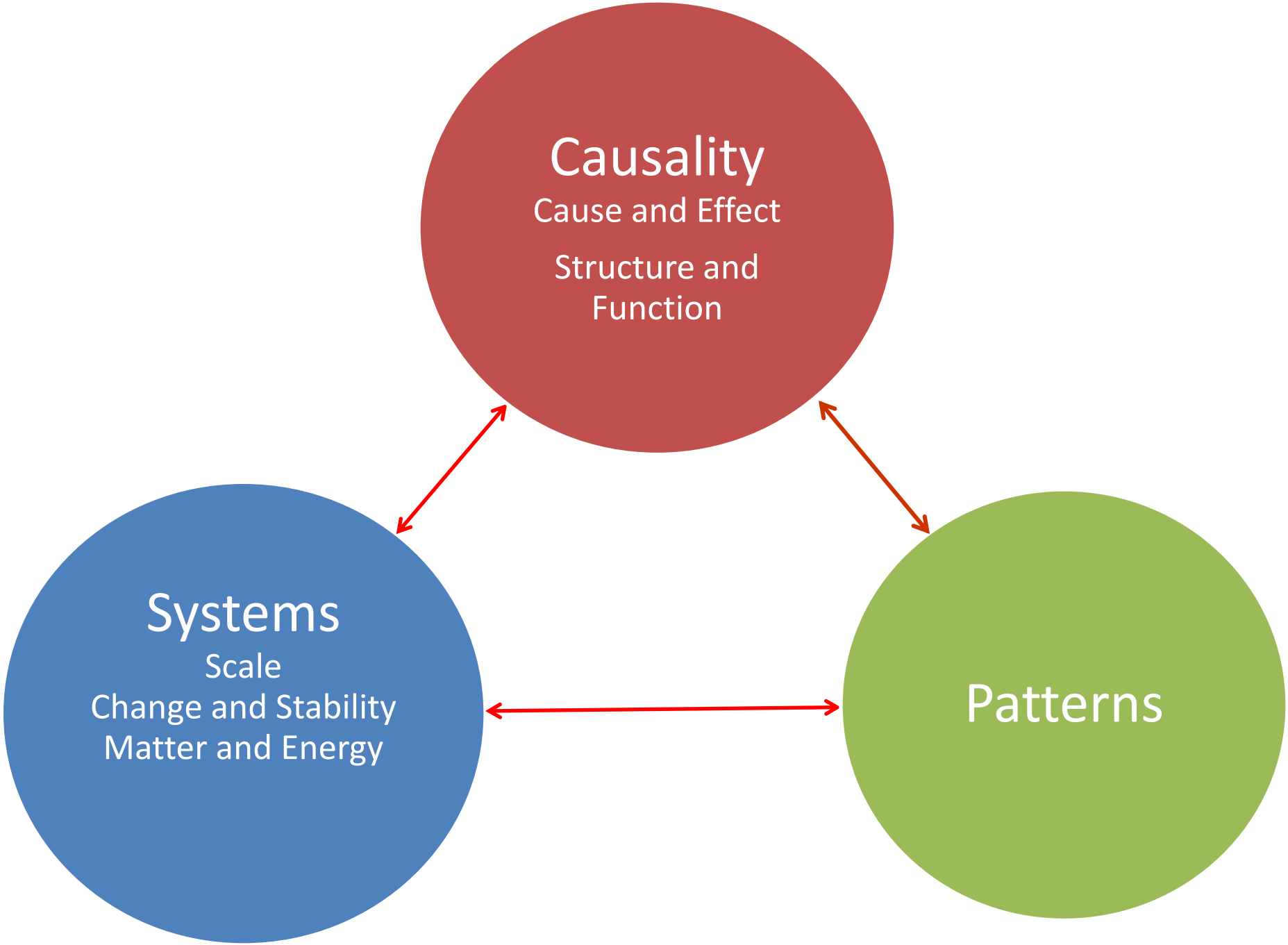
- Engineering practices are a natural extension of science practices.
- Science instruction often includes opportunities for engineering practices.
- Engineering is not a new component of science standards. Some states currently have elements of engineering in their science standards.
- The Framework provides meaningful connections of science and engineering in the Practices.

Crosscutting Concepts

Crosscutting Concepts

The Framework has identified seven key Crosscutting Concepts




Causality
Cause and Effect
Structure and Function
Systems
Scale
Change and Stability
Matter and Energy
Patterns

Crosscutting Concepts

- These concepts should become common and **familiar touchstones** across the disciplines and grade levels.

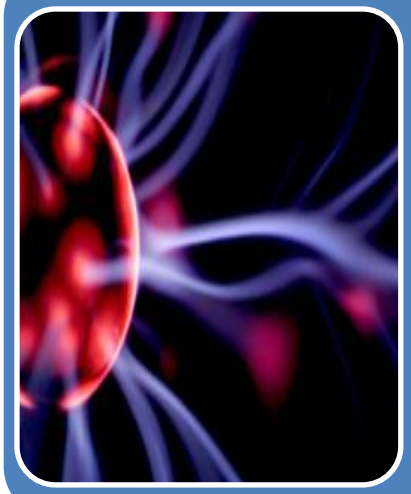
- Explicit reference to the concepts, as well as their emergence in multiple disciplinary contexts, can help students develop a cumulative, coherent, and usable understanding of science and engineering.

Organizing the Crosscutting Concepts

- This set of crosscutting concepts begins with two concepts that are fundamental to the nature of science: that observed **patterns** can be explained and that science investigates **cause and effect** relationships by seeking the mechanisms that underlie them.
- The next concept—**scale, proportion, and quantity**—concerns the sizes of things and the mathematical relationships among disparate elements.
- The next four concepts—**systems and system models, energy and matter flows, structure and function, and stability and change**—are interrelated in that the first is illuminated by the other three. Each concept also stands alone as one that occurs in virtually all areas of science and is an important consideration for engineered systems as well.

Framework Pages 84-85

Disciplinary Core Ideas



Physical Science

- PS1: Matter and Its Interactions
- PS2: Motion and Stability: Forces and Interactions
- PS3: Energy
- PS4: Waves and Their Applications in Technologies for Information Transfer

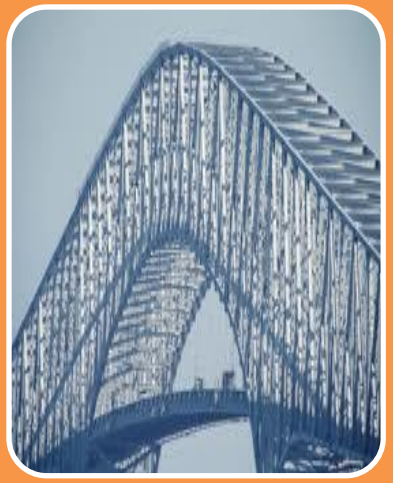
Life Science

- LS1: From Molecules to Organisms: Structure and Processes
- LS2: Ecosystems: Interactions, Energy, and Dynamics
- LS3: Heredity: Inheritance and Variation of Traits
- LS4: Biological Evolution: Unity and Diversity

Disciplinary Core Ideas

Earth and Space Science

- 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

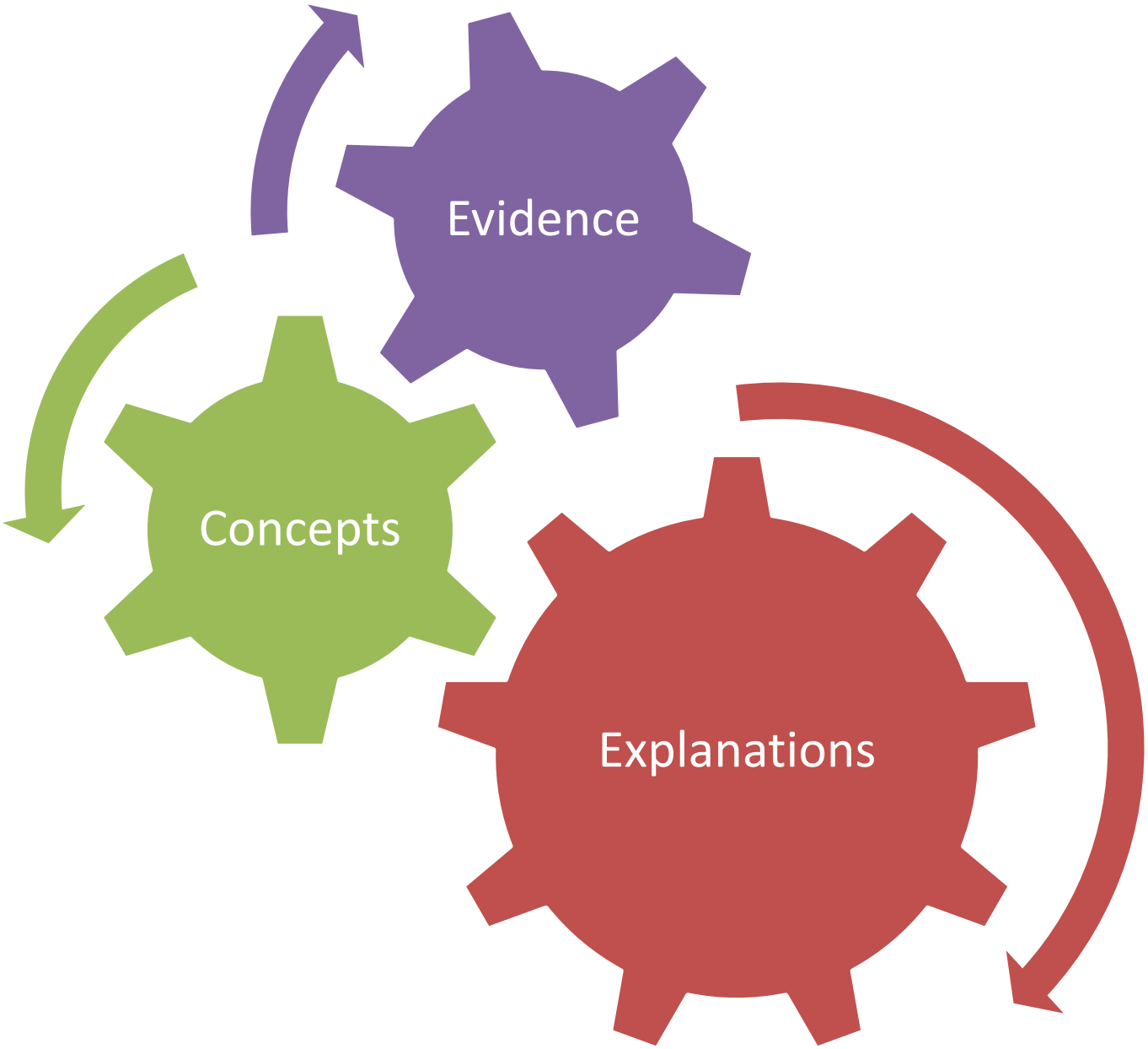
Putting it All Together in a "Performance"

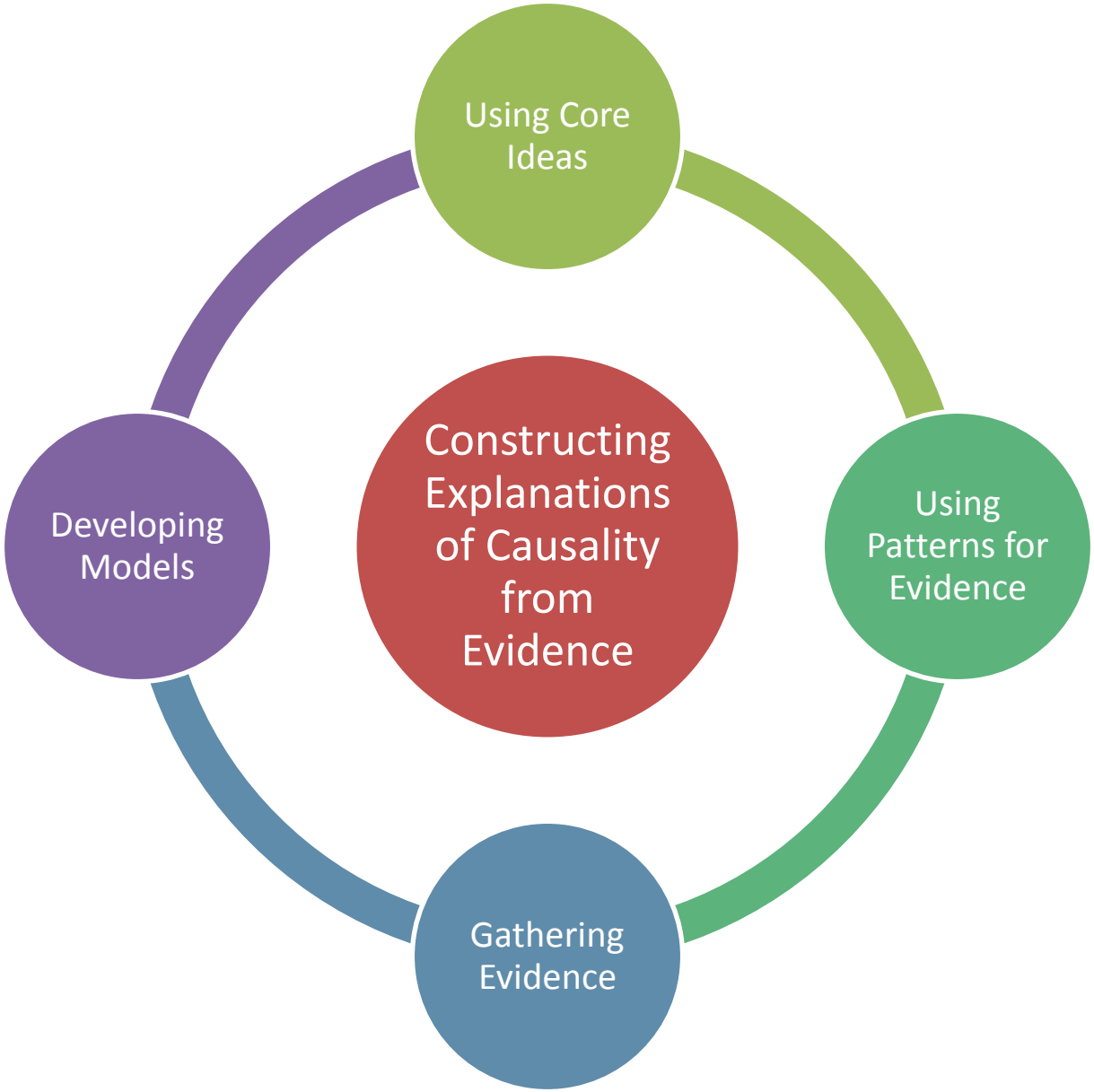
Engaging in Science

Science and Engineering Practices

Crosscutting Concepts

Core Ideas


Evidence
Concepts
Explanations


Using Core Ideas
Using Patterns for Evidence
Gathering Evidence
Developing Models
Constructing Explanations of Causality from Evidence

The Intersection is the Performance!

- The Framework and NGSS provides a clear vision of science performance at the intersection of the three dimensions.
- It is not about unpacking, it is about science instruction that engages students in performances that can be described by the intersection, not the parts of the intersection.

The Three Dimensions Work Together

Students are able to make sense of science phenomena when they develop causal relationships, supported by evidence, of observed phenomena in defined systems.

These explanation rely on Core Ideas (e.g., matter is made of particles, matter cycles, energy flows, smaller objects are attracted to larger objects by gravity).

The crosscutting concepts organize a set of familiar touchstones for students to use in their sense making and evidence gathering. These crosscutting concepts are utilized in the process by which students gather and use evidence in the science and engineering practices.

The practices engage students in obtaining and using information obtained from investigations and other sources, developing and using models, constructing explanations and communicating arguments that support these explanations.

Accessing the Framework, Ready, Set Science, Taking Science to School and NGSS

- *Ready, Set, SCIENCE!*
  http://www.nap.edu/catalog.php?record_id=11882

- Framework for K-12 Science Standards
  http://www.nap.edu/catalog.php?record_id=13165

- Nest Generation Science Standards
  http://nextgenscience.org/

Discussion and Questions

Discussion and Questions

Brett Moulding

- Partnership for Effective Science Teaching and Learning
- mouldingb@ogdensd.org