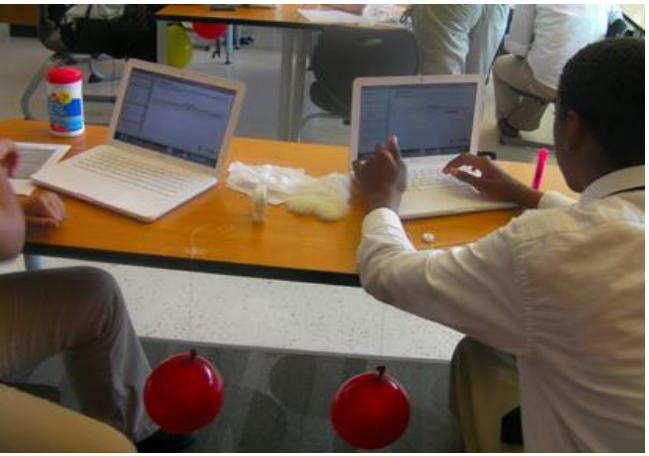
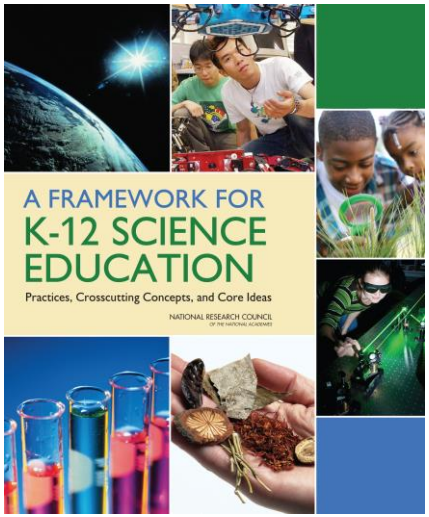
Developing and testing a model to support student understanding of sub-microscopic interactions



CREATE for STEM Institute
The Concord Consortium
UNIVERSITY OF MICHIGAN

The Framework and NGSS Present a New Vision for Teaching and Learning Science



NEXT GENERATION SCIENCE STANDARDS

1. Focus on explaining phenomena or designing solutions to problems
2. 3-Dimensional Learning
    1. Organized around disciplinary core explanatory ideas
    2. Central role of scientific and engineering practices
    3. Use of crosscutting concepts
3. Instructions builds towards performance expectations
4. Coherence: building and applying ideas across time
5. All students, all standards

What's so special about disciplinary core ideas?

- Fewer, clearer, greater depth
- Allow learners to develop understanding that can be used to solve problems and explain phenomena
- Provide anchors to connect related phenomena and related ideas
- Serve as thinking tools

At what temperature does water boil?

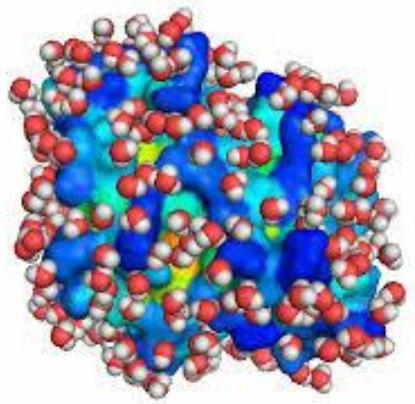
- Why does water boil at 100° C?
- Why does water,H2O, a relatively light molecule boil at 100° C when carbon dioxide, CO2, a much heaver molecule compared to water, boils at a much lower temperature, -57° C?

How are all of these phenomena, events we experience in everyday life, related?









A range of electrical forces with varying strengths tend to dominate the interactions between objects and/or matter.

http://www3.ocn.ne.jp/~herpsgh/yamorikabe.jpg

Why Use Crosscutting Concepts?

Ideas that cut across and are important to all the science disciplines

Provide different lenses to examine phenomena

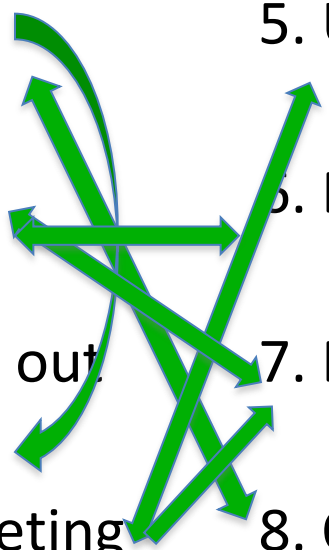
1. Patterns
2. Cause and effect
3. Scale, proportion and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

What are Scientific and Engineering Practices?

The multiple ways of knowing and doing that scientists and engineers use to study the natural world and design world.

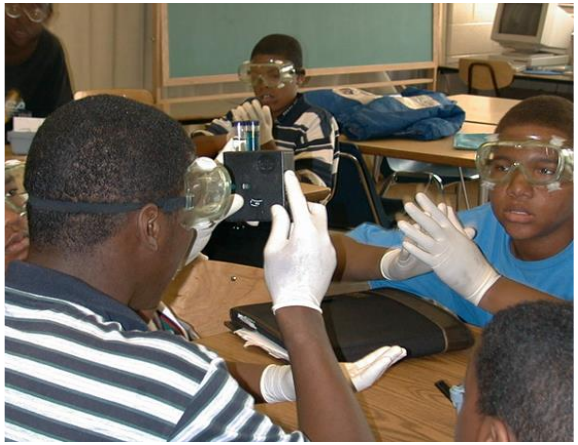
The practices work together – they are not separated!

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



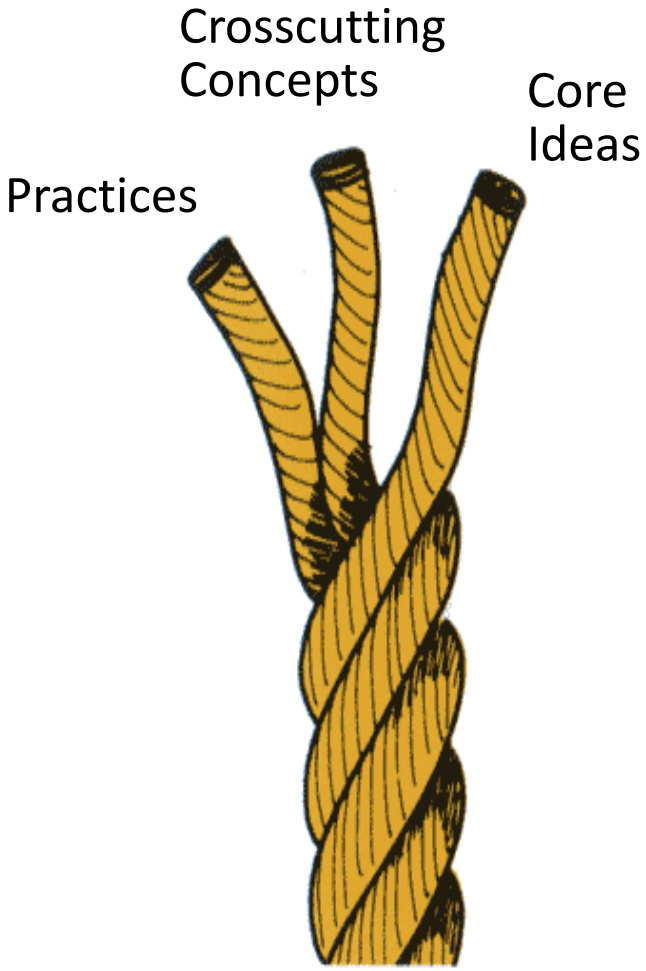
Focus on the Framework and NGSS

Science classroom became environments where students use disciplinary core ideas, crosscutting concepts with scientific practices to **explore, examine,** and **explain** how and why phenomena occur and to **design solutions** to problems - Three dimensional learning



DCI, CCCs and Practice Work together to Build Understanding

- Scientific ideas are best learned when students engage in practices
- Practices are learned best when students use them to engage with learning specific scientific ideas
- Content and practices co-develop – 3-dimensional learning



Background

Teaching interactions governed by electric forces

- Science seeks to explain phenomena
- The *Framework* and *NGSS* clearly specifies the importance of the relationship between electrical interactions, force and energy
- Most students in our nation do not understand the nature of electrical forces and the importance of this force in explain a variety of phenomena
- Current instruction does not help students develop understanding of ideas related to forces and energy needed to explain interactions between atoms and molecules

Design Principles

- Aligned o the Framework and NGSSS
- Performance Driven Learning Goals
- Contextualized in Phenomena
- Science Ideas Build Across Time
- Educative Materials for Teachers
- Use of Multiple Representations
- Integral Use of Technology

Value of the materials

Teachers across a variety of contexts – large urban, rural and small urban – can use the materials

Student responses to open-ended tasks to explain phenomena become progressively more sophisticated from pre- to post-tests

Student models and explanations become progressively more sophisticated during the unit

- **Supported by NSF DRK12 grant, DRL-1232388**

- **Examine materials:**
  http://concord.org/projects/interactions
- **View Videos: http://ngss.nsta.org/ngss-videos.aspx**
- **More information:**

http://create4stem.msu.edu/story/interactions-phenomenal-new-approach

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