A Framework for K-12 Science Education: Practices, Crosscutting Concepts and Core Ideas

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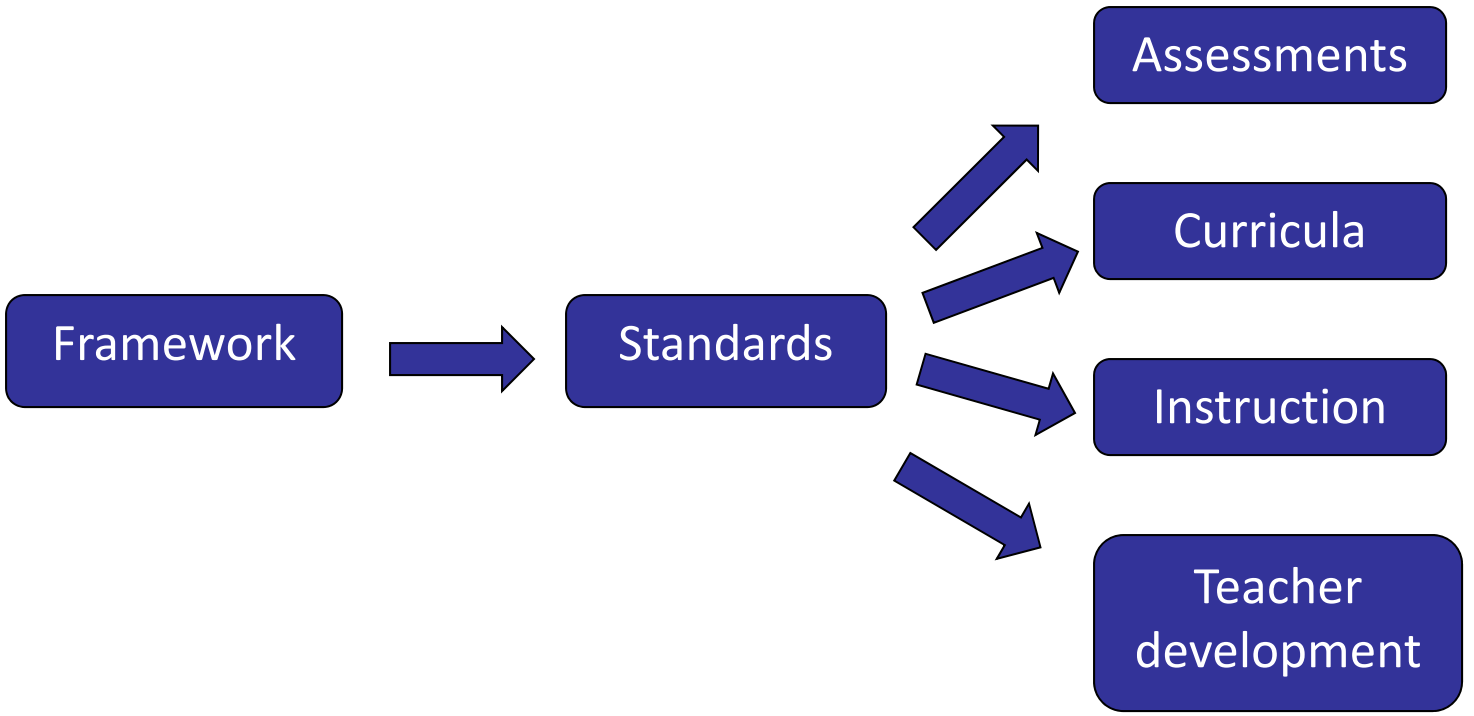
Science for All Students

- Science, engineering and technology are cultural achievements and a shared good of humankind
- Science, engineering and technology permeate modern life
- Understanding of science and engineering is critical to participation in public policy and good decision-making
- More and more careers require knowledge of science


Framework
Standards
Assessments
Curricula
Instruction
Teacher development

Development Team

- 18 member expert committee
  - 9 scientists and engineers
  - 9 experts in learning and teaching science

- Four design teams (5 members on each)

Goals of the Framework

- Coherent investigation of core ideas across multiple years of school

- More seamless blending of practices with core ideas and crosscutting concepts

Three Dimensions

- Scientific and engineering practices
- Crosscutting concepts
- Disciplinary core ideas

Scientific 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
8. Obtaining, evaluating, and communicating information

Crosscutting Concepts

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

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

Disciplinary 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

Disciplinary Core Ideas: 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

Disciplinary Core Ideas: Earth and Space Sciences

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

Disciplinary Core Ideas:
Engineering, Technology and Applications of Science

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

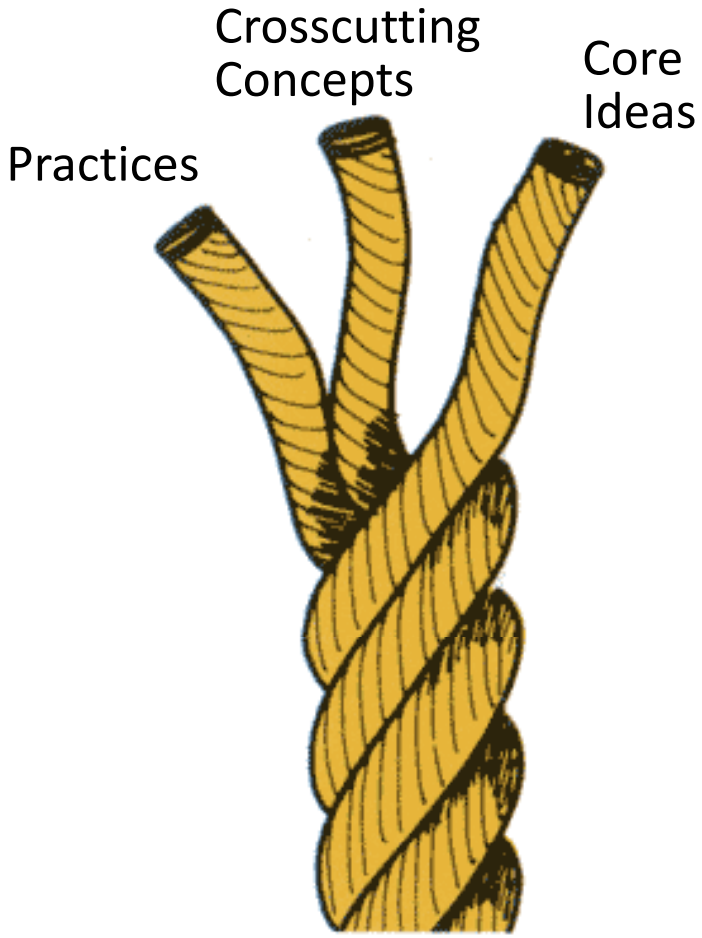
Integrating the Dimensions

- To facilitate students' learning the dimensions must be woven together in standards, assessments, curriculum and instruction.

- Students should explore a core idea by engaging in the practices and making connections to crosscutting concepts.

Implications

- Not separate treatment of "content" and "inquiry" ***(No "Chapter 1")***
- Curriculum and instruction needs to do more than present and assess scientific ideas – they need to involve learners in using scientific practices to develop and apply the scientific ideas.



Implementation: Aligning Components of the System

- Standards
- Curriculum and instructional materials
- Assessment
- Pre-service preparation of teachers
- Professional development for in-service teachers

Diversity and Equity

- Equalizing opportunities to learn
- Inclusive science instruction
- Making diversity visible
- Value multiple modes of expression

Next Steps

- Outreach and dissemination of the framework by the NRC
- State-led development of Next Generation Science Standards, coordinated by Achieve
- Progress on critical steps toward implementation

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Free PDF version of *A Framework for K-12 Science Education* is available at:
http://www.nap.edu/catalog.php?record_id=13165

Updates on Science Standards:
http://nas.edu/BOSE
http://www.nextgenscience.org