
Presented by: Helen Quinn, Tom Keller and Brett Moulding
With NSTA Response from Dr. Francis Eberle

July 26, 2011
Why now?

- Improved knowledge about learning and teaching science
- Opportunities to improve current teaching practice
- Advances in scientific knowledge
Who are we?

National Research Council
Board on Science Education
Committee Members

Helen Quinn, Chair Stanford University (Physics)
Wyatt Anderson, University of Georgia (Biology)
Tanya Atwater, UC Santa Barbara (Earth Science)
Philip Bell, University of Washington (Learning Sciences)
Thomas Corcoran, Center for Policy Research in Education, Columbia Teachers College
Rodolfo Dirzo, Stanford University (Biology)
Phillip Griffiths, Institute for Advanced Study, Princeton (Mathematics)
Dudley Herschbach, Harvard University (Chemistry)
Linda Katehi, UC Davis (Engineering)
John Mather, NASA (Astrophysics)

Brett Moulding, Educator, Utah
Jonathan Osborne, Stanford University (Science Education)
James Pellegrino, University of Illinois at Chicago (Learning Sciences)
Stephen L. Pruitt, GA Department of Education (until June, 2010)
Brian Reiser, Northwestern University (Learning Sciences)
Rebecca Richards-Kortum, Rice University (Engineering)
Walter Secada, University of Miami (Mathematics Education)
Deborah Smith, Pennsylvania State University (Elementary Education)
Design Teams

Earth and Space Science
Michael Wyssession (Lead), Department of Earth and Planetary Sciences, Washington University in Saint Louis
Scott Linneman, Geology Department, Western Washington University
Eric Pyle, Department of Geology & Environmental Science, James Madison University
Dennis Schatz, Pacific Science Center
Don Duggan-Haas, Paleontological Research Institution and its Museum of the Earth

Physical Science
Joseph Krajcik (Lead), School of Education, University of Michigan
Shawn Stevens, School of Education, University of Michigan
Sophia Gershman, Watchung Hills Regional High School
Arthur Eisenkraft, Graduate College of Education, University of Massachusetts
Angelica Stacy, Department of Chemistry, University of California, Berkeley

Life Science
Rodger Bybee (Lead), BSCS
Bruce Fuchs, National Institutes of Health
Kathy Comfort, WestEd
Danine Ezell, San Diego County Office of Education

Engineering, Technology and Applications of Science
Cary Sneider (Lead), Center for Education, Portland State University
Rodney L. Custer, Department of Technology, Illinois State University
Jacob Foster, Mass. Department of Elementary and Secondary Education
Yvonne Spicer, Nat’l Center for Technological Literacy, Museum of Science, Boston
Maurice Frazier, Chesapeake Public School System
Let’s pause for questions from the audience
Vision: 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
- National need
Vision: Coherent learning

- Coherent investigation of core ideas across multiple years of school
- More seamless blending of practices with core ideas and crosscutting concepts
Structure of the Report

- Part I: A Vision for K-12 Science Education
- Part II: Dimensions of the Framework
- Part III: Realizing the Vision
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 information and computer technology
6. Developing explanations and designing solutions
7. Engaging in argument
8. Obtaining, evaluating, and communicating information
Do your students use modeling for understanding?

A. Habitually, in science
B. When prompted, often
C. When prompted, sometimes
D. Rarely
E. Never
Do your students distinguish a claim and supporting evidence?

A. Readily
B. When prompted, often
C. When prompted, sometimes
D. Rarely
E. Never
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
Do your students use the language of systems?

A. Readily
B. When prompted, often
C. When prompted, sometimes
D. Rarely
E. Never
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
Let’s pause for questions from the audience
Integrating the Dimensions
Chapter 9

• 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.
Key Components in the System that Need to be Aligned for Implementation

Chapter 10

- Standards
- Curriculum and instructional materials
- Assessment
- Pre-service preparation of teachers
- Professional development for in-service teachers
Diversity and Equity
Chapter 11

- Equalizing opportunities to learn
- Inclusive science instruction
- Making diversity visible
- Value multiple modes of expression
Guidance for Standards Developers
Chapter 12

• Set rigorous learning goals for all students
• Emphasize all 3 dimensions
• Include performance expectations
• Be organized as progressions that support learning over multiple grades
• Attend to issues of diversity and equity
Key Areas of Research
Chapter 13

• Learning progressions
• Scientific and engineering practices
• Curricular and instructional materials
• Assessment
• Supporting teachers’ learning
• Evaluation of the impact of standards
Let’s pause for questions from the audience
Major changes from July draft

- Re-organized chapters
- Added chapters on implementation, diversity and equity, and guidance for standards developers
- Expanded discussion of integrating the three dimensions
- Replaced “prototype learning progressions” with “grade-band endpoints”
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
Free PDF version of *A Framework for K-12 Science Education* is available at:
http://www.nap.edu/catalog.php?record_id=13165
Response from NSTA
Thank you to the sponsor of tonight's Web Seminar:

GE Foundation

This web seminar contains information about programs, products, and services offered by third parties, as well as links to third-party websites. The presence of a listing or such information does not constitute an endorsement by NSTA of a particular company or organization, or its programs, products, or services.
National Science Teachers Association
Dr. Francis Q. Eberle, Executive Director
Zipporah Miller, Associate Executive Director
Conferences and Programs
Al Byers, Assistant Executive Director e-Learning

NSTA Web Seminars
Paul Tingler, Director
Jeff Layman, Technical Coordinator