THINKING DIFFERENTLY ABOUT HOW WE TEACH SCIENCE: WHY NIH SHOULD CARE

SCIENCE EDUCATION CONVERSATIONS

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WHY ENGAGE IN CONVERSATIONS ABOUT STEM EDUCATION?

A 21ST CENTURY PERSPECTIVE

• 21st Century Challenges
• Contemporary Initiatives in STEM Education
• Implications for Leadership: A Vision and Plans
• Moving from National Issues to STEM Classrooms
SOCIAL CHALLENGES FOR THE 21st CENTURY

1. Environmental quality and the need for responses to global climate change
2. Energy efficiency and adequate responses for a carbon-constrained world
3. Resource use and the need to address conflicts over limited natural resources
4. Natural hazards and the need for mitigation of severe weather, earthquakes, fires, droughts
5. Health maintenance and the need to reduce preventable diseases
EDUCATIONAL CHALLENGES FOR THE 21ST CENTURY

• Achieving Higher Levels of STEM Literacy
• Developing a Deep Technical Workforce
• Sustaining an Advanced R&D Workforce with Increased Numbers and Diversity of Students in STEM Professions
CONTEMPORARY INITIATIVES IN STEM EDUCATION

• Next Generation of Science Standards

• 21st Century Workforce Skills
THE NEXT GENERATION OF SCIENCE STANDARDS

SCIENTIFIC AND ENGINEERING PRACTICES

1. Asking questions [for science] and defining problems [for engineering]
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations [for science] and designing solutions [for engineering]
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
THE NEXT GENERATION OF SCIENCE STANDARDS

DISCIPLINARY CORE IDEAS

Physical Sciences
PS 1: Matter and its interactions
PS 2: Motion and stability: Forces and interactions
PS 3: Energy
PS 4: Waves and their applications in technologies for information transfer

Life Sciences
LS 1: From molecules to organisms: Structures and processes
LS 2: Ecosystems: Interactions, energy, and dynamics
LS 3: Heredity: Inheritance and variation of traits
LS 4: Biological Evolution: Unity and diversity

Earth and Space Sciences
ESS 1: Earth’s place in the universe
ESS 2: Earth’s systems
ESS 3: Earth and human activity

Engineering, Technology, and the Applications of Science
ETS 1: Engineering design
ETS 2: Links among engineering, technology, science, and society
THE NEXT GENERATION OF SCIENCE STANDARDS

CROSSCUTTING CONCEPTS

Patterns

Cause and Effect: Mechanism and Explanation

Scale, Proportion, and Quantity

Systems and System Models

Energy and Matter: Focus, Cycles, and Conservation

Structure and Function

Stability and Change
21st Century Workforce Skills

- Adaptability
- Complex Communications/Social Skills
- Nonroutine Problem Solving
- Self-management/Self-development
- Systems Thinking
THREE WAYS TO IMPROVE STUDENT LEARNING AT SCALE

Increase Students’ Active Learning of STEM Content
(Curriculum-Instruction-Assessment)

Increase the Level and Emphasis on STEM Content
(Common Core Standards)

Increase the Skills and Knowledge that Teachers Bring to Teaching STEM Content
(Professional Development)

## From National Issues to STEM Classrooms

<table>
<thead>
<tr>
<th>National Issue</th>
<th>Health</th>
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<tbody>
<tr>
<td><strong>Education Theme</strong></td>
<td>Maintenance of personal health – prevention of disease</td>
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<tr>
<td><strong>Advancing STEM Education Goal</strong></td>
<td>Develop students’ understanding and abilities in 4 areas of personal health</td>
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<tr>
<td></td>
<td>- Predictive</td>
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<td>- Preventive</td>
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<td>- Participatory</td>
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<td><strong>Implementation Strategy for Instructional Core</strong></td>
<td>Include health as a context for STEM programs</td>
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<td>Provide engaging health-related tasks for students</td>
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<td>Use replacement units as the basis for developing teachers’ knowledge and skills</td>
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## Examples of Contexts for Instructional Units

<table>
<thead>
<tr>
<th>CONTEXT</th>
<th>PERSONAL (Elementary School)</th>
<th>SOCIAL (Middle School)</th>
<th>GLOBAL (High School)</th>
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</thead>
<tbody>
<tr>
<td>HEALTH</td>
<td>Maintenance of health, accidents, nutrition, diet</td>
<td>Social transmission of disease, food choices, community health</td>
<td>Epidemics, spread of infectious disease</td>
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<td></td>
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<td>Genetic basis of disease</td>
<td>Biochemical specifics of ailments</td>
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<td>STEM cells and treatment of diseases such as Parkinson’s, liver failure, and diabetes</td>
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DESIGN FOR EXEMPLARY INSTRUCTIONAL UNITS

**SCIENCE**
- National Standards
- NAEP 2009 Framework
- Common Core Science Standards

**TECHNOLOGY**
- ITEA Standards
- NAEP 2012 Framework for Technological Literacy
- Common Core Science Standards

**CONTEXTS**
Life and work situations that involve STEM
(e.g., Environment, Resources, Health, Hazards, Frontiers)

**MATHEMATICS**
- Common Core Standards
- NCTM Standards

**ENGINEERING**
- Common Core Science Standards
- NAE Reports
TOPICS FOR THE CONVERSATION

• Understanding “Superbugs” (e.g., Antibiotic Resistance)
• Understanding Individual, Community, and Global Health
• Integrated (i.e., STEM) Approaches to Health
• Health Decisions and Quantitative Literacy
IDEAS FOR THE CONVERSATION

• Systems Thinking
• Chronic Low-intensity Influences
• Ethics and Health-related Decisions
• Nature of Science in Health Contexts
WHAT IS DIFFERENT ABOUT THE WAY WE TEACH SCIENCE?

CONCLUSION