Environmental Education and the Next Generation Science Standards

Mid-Atlantic Environmental Literacy Summit

Annapolis, MD

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Science and Technology Specialist
Rhode Island Department of Education
CLIMATE SUMMIT

What if it's a big hoax and we create a better world for nothing?

- Energy independence
- Preserve rainforests
- Sustainability
- Green jobs
- Livable cities
- Renewables
- Clean water, air
- Healthy children
- Etc. etc.
Next Generation Science Standards: Building on the Past; Preparing for the Future

1990s

1990s-2009

1/2010 - 7/2011

Step I

Step II

For States, By States

7/2011 – April, 2013
A State–Led Process: NGSS Lead State Partners

Since May 23rd 8 States have adopted NGSS (CA, DE, KS, KY, MD, RI, VT, WA)
NGSS Writers Distribution
“The Framework is designed to help realize a vision for education in the sciences and engineering in which (all) students, over multiple years of school, actively engage in science and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields.”

A Framework for K-12 Science Education, pp. 8 - 9
A Framework for K-12 Science Education

Three-Dimensions:

- Scientific and Engineering Practices
- Crosscutting Concepts
- Disciplinary Core Ideas

Download FREE PDF of Framework at http://www.nap.edu/catalog.php?record_id=13165
Goals for Teaching & Learning

- Coherent investigations of core ideas across multiple years of schooling
- More seamless blending of practices with core ideas
- Performance expectations that require reasoning with core disciplinary ideas
  - explain, justify, predict, model, describe, prove, solve, illustrate, argue, etc.
# Comparison: NGSS Practices and Excellence In Environmental Education Guidelines for Learning

<table>
<thead>
<tr>
<th>NGSS Practices</th>
<th>Excellence In Environmental Education Guidelines for Learning</th>
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</thead>
<tbody>
<tr>
<td>1. Asking questions (for science) and defining problems (for engineering)</td>
<td><strong>Strand 1 - Questioning, Analysis and Interpretation Skills</strong></td>
</tr>
<tr>
<td>2. Developing and using models</td>
<td>▪ Questioning</td>
</tr>
<tr>
<td>3. Planning and carrying out investigations</td>
<td>▪ Designing Investigations</td>
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<tr>
<td>4. Analyzing and interpreting data</td>
<td>▪ Collecting information</td>
</tr>
<tr>
<td>5. Using mathematics and computational thinking</td>
<td>▪ Evaluating accuracy and reliability</td>
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<tr>
<td>6. Constructing explanations (for science) and designing solutions (for engineering)</td>
<td>▪ Organizing information</td>
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<tr>
<td>7. Engaging in argument from evidence</td>
<td>▪ Working with models and simulations</td>
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<tr>
<td>8. Obtaining, evaluating, and communicating information</td>
<td>▪ Drawing conclusions and developing explanations</td>
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<tr>
<td></td>
<td><strong>Strand 3 - Skills for Understanding and Addressing Environmental Issues</strong></td>
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<tr>
<td></td>
<td>▪ Skills for analyzing and investigating environmental issues</td>
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<td></td>
<td>▪ Decision-making and citizenship skills</td>
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</table>
Commonalities Among the Practices in Science, Mathematics, and English Language Arts

Based on work by Tina Chueck ell.stanford.edu

**ELA**

- **E1**: Demonstrate independence in reading complex texts, and writing and speaking about them
- **E2**: Build a strong base of knowledge through content-rich texts
- **E3**: Obtain, synthesize, and report findings clearly and effectively in response to task and purpose
- **E4**: Construct viable arguments and critique reasoning of others
- **E5**: Read, write, and speak grounded in evidence
- **E6**: Use technology & digital media strategically & capably
- **E7**: Come to understand other perspectives and cultures through reading, listening, and collaborations

**Math**

- **M1**: Make sense of problems and persevere in solving them
- **M2**: Reason abstractly & quantitatively
- **M3 & M4**: Construct viable arguments and critique reasoning of others
- **M5**: Use appropriate tools strategically
- **M6**: Attend to precision
- **M7**: Look for & make use of structure
- **M8**: Look for & make use of regularity in repeated reasoning

**Science**

- **S1**: Ask questions and define problems
- **S2**: Develop & use models
- **S3**: Plan & carry out investigations
- **S4**: Analyze & interpret data
- **S5**: Use mathematics & computational thinking
- **S6**: Construct explanations & design solutions
- **S7**: Engage in argument from evidence
- **S8**: Obtain, evaluate, & communicate information
Crosscutting Concepts

Cause and Effect

Patterns

Systems and System Models

Scale, Proportion, and Quantity

Structure and Function

Stability and Change

Matter and Energy
## Dimension 3: Disciplinary Core Ideas

<table>
<thead>
<tr>
<th>Life Science</th>
<th>Physical Science</th>
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</thead>
<tbody>
<tr>
<td>LS1: From Molecules to Organisms: Structures and Processes</td>
<td>PS1: Matter and Its Interactions</td>
</tr>
<tr>
<td>LS2: Ecosystems: Interactions, Energy, and Dynamics</td>
<td>PS2: Motion and Stability: Forces and Interactions</td>
</tr>
<tr>
<td>LS3: Heredity: Inheritance and Variation of Traits</td>
<td>PS3: Energy</td>
</tr>
<tr>
<td>LS4: Biological Evolution: Unity and Diversity</td>
<td>PS4: Waves and Their Applications in Technologies for Information Transfer</td>
</tr>
<tr>
<td><strong>Earth &amp; Space Science</strong></td>
<td><strong>Engineering &amp; Technology</strong></td>
</tr>
<tr>
<td>ESS1: Earth’s Place in the Universe</td>
<td>ETS1: Engineering Design</td>
</tr>
<tr>
<td>ESS2: Earth’s Systems</td>
<td>ETS2: Links Among Engineering, Technology, Science, and Society</td>
</tr>
<tr>
<td>ESS3: Earth and Human Activity</td>
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</tbody>
</table>
### Influence of Engineering, Technology, and Science on Society and the Natural World

<table>
<thead>
<tr>
<th>K-2 Connections Statements</th>
<th>3-5 Connections Statements</th>
<th>6-8 Connections Statements</th>
<th>9-12 Connections Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials.</td>
<td>• People’s needs and wants change over time, as do their demands for new and improved technologies.</td>
<td>• All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.</td>
<td>• Modern civilization depends on major technological systems, such as agriculture, health, water, energy, transportation, manufacturing, construction, and communications.</td>
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<tr>
<td>• Taking natural materials to make things impacts the environment.</td>
<td>• Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.</td>
<td>• The uses of technologies are driven by people’s needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.</td>
<td>• Engineers continuously modify these systems to increase benefits while decreasing costs and risks.</td>
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<tr>
<td></td>
<td>• When new technologies become available, they can bring about changes in the way people live and interact with one another.</td>
<td>• Technology use varies over time and from region to region.</td>
<td>• New technologies can have deep impacts on society and the environment, including some that were not anticipated.</td>
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<td></td>
<td></td>
<td></td>
<td>• Analysis of costs and benefits is a critical aspect of decisions about technology</td>
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NGSS Appendix J
Some examples of engineering integrated into NGSS

**MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.** [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

**MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.** [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

**HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.** [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]
NGSS as a Means of Delivery of Environmental Education
Relationships Among the Next Generation Science Standards and Other US Science Standards

NAAEE Guidelines Strands 1, 3, 4

Common Core Standards

Dimension 1: Science and Engineering Practices

Connections to Common Core Standards

Performance Expectations

NGSS Standards

Dimension 2: Crosscutting Concepts

Connections to other DCIs in and across grade levels

Dimension 3: Disciplinary Core Ideas

NAAEE Guidelines Strand 2

NSES Content Standards
Interdisciplinarity & Transferability

- Learning progressions described in Framework – climate is **embedded from K-12 in all domains of science** – not just specific domains
- S&EP and CC not only cut across all of the Core Disciplinary Ideas they are also **relevant in many other disciplines** – outside the sciences
- The **skills** students gain by having their curriculum address the S&EP and CC are **transferable to many other careers**
• Students develop understanding over time
• Standards are developed cohesively

<table>
<thead>
<tr>
<th>ESS2.C</th>
<th>K-2</th>
<th>3-5</th>
<th>6-8</th>
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</thead>
<tbody>
<tr>
<td>The roles of water in Earth’s surface processes</td>
<td>Water is found in many types of places and in different forms on Earth.</td>
<td>Most of Earth’s water is in the ocean and much of the Earth’s fresh water is in glaciers or underground.</td>
<td>Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features.</td>
</tr>
<tr>
<td>ESS2.D</td>
<td>Weather and climate</td>
<td>Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region and time. People record weather patterns over time.</td>
<td>Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed.</td>
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</tbody>
</table>

The planet’s dynamics are greatly influenced by water’s unique chemical and physical properties.
The role of radiation from the sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. Global climate models are used to predict future changes, including changes influenced by human behavior and natural factors.

NGSS Appendix E
Standards, Curriculum, and Instruction

Standards
- Learning goals
- Adopted by the state

Curriculum
- Plans for meeting standards
- Developed/adopted locally

Instruction
- Strategies teachers use to promote student understanding
- Implemented in the classroom

Assessment
- Emphasis on classroom formative and summative assessment
Systems of Science Education Affected by Implementation of NGSS

- Curriculum
- Instruction
- Assessment
- Materials and Resources
- Professional Development
- Pre-Service Education and Higher Ed Arts and Sciences
- Informal Education
- Inclusion of Business
With the Holidays upon us please, now more than ever, remember the environment...