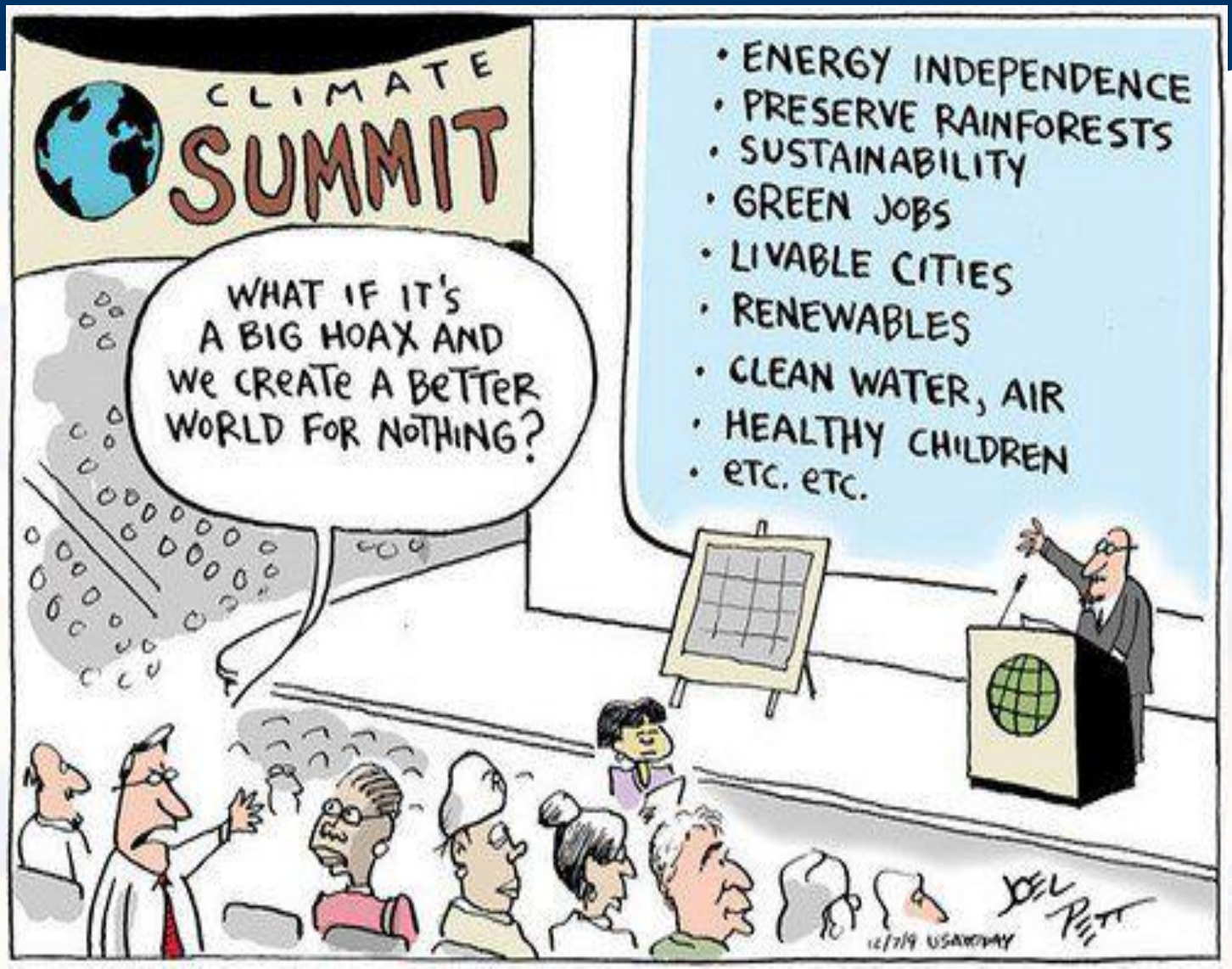
Environmental Education and the Next Generation Science Standards

Mid-Atlantic Environmental Literacy Summit

Annapolis, MD

December 2, 2013

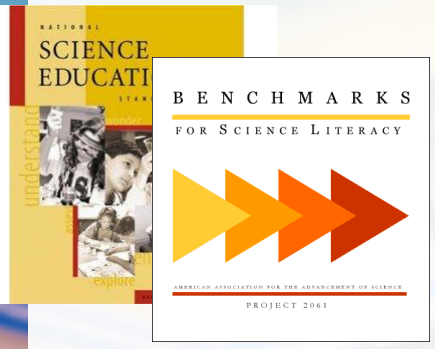
Peter J. McLaren
Science and Technology Specialist
Rhode Island Department of Education


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.
JOEL PETT

Developing the Standards – A Partnership

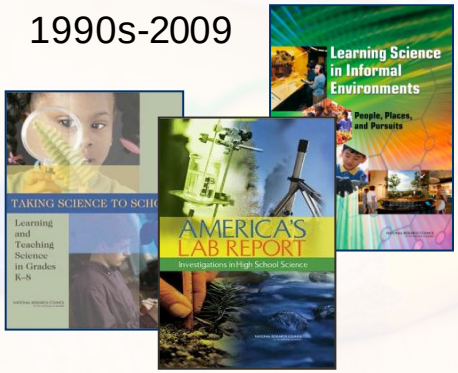
Next Generation Science Standards:

Building on the Past; Preparing for the Future

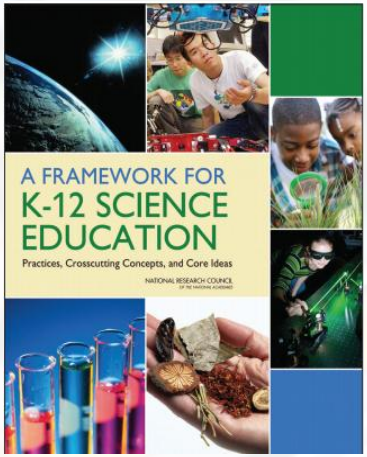


1990s

1990s-2009



Step I



1/2010 - 7/2011

Step II

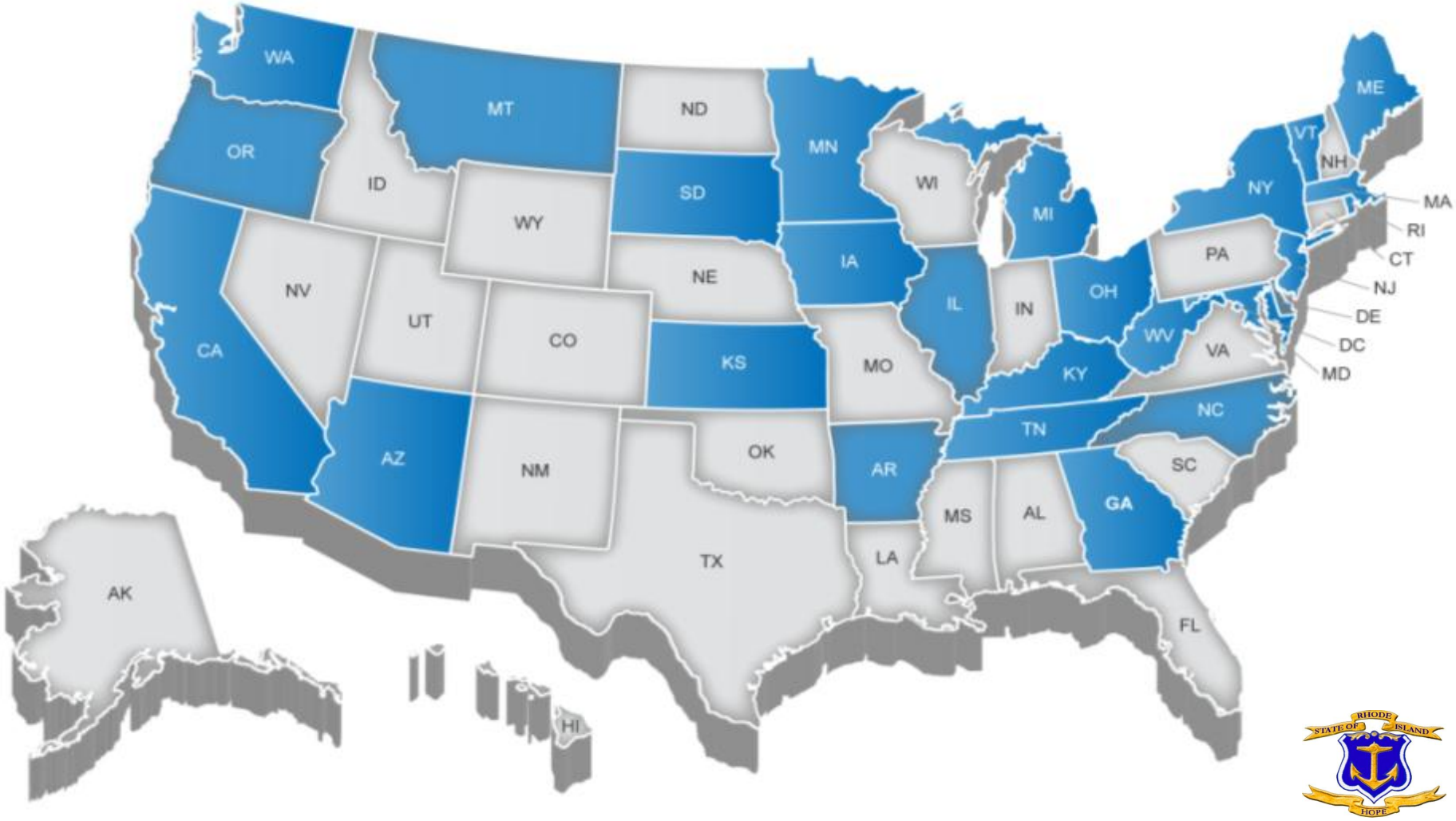
NEXT GENERATION SCIENCE STANDARDS

For States, By States

7/2011 – April, 2013

RHODE ISLAND
STATE OF
HOPE

A State–Led Process: NGSS Lead State Partners



Since May 23rd 8 States have adopted NGSS (CA, DE, KS, KY, MD, RI, VT, WA)

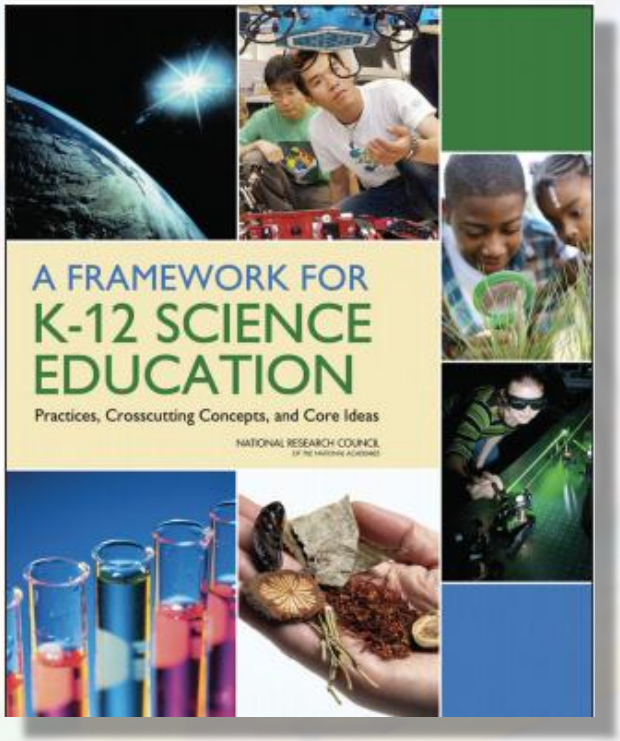
NGSS Writers Distribution

Vision For Science Education

"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

NGSS 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

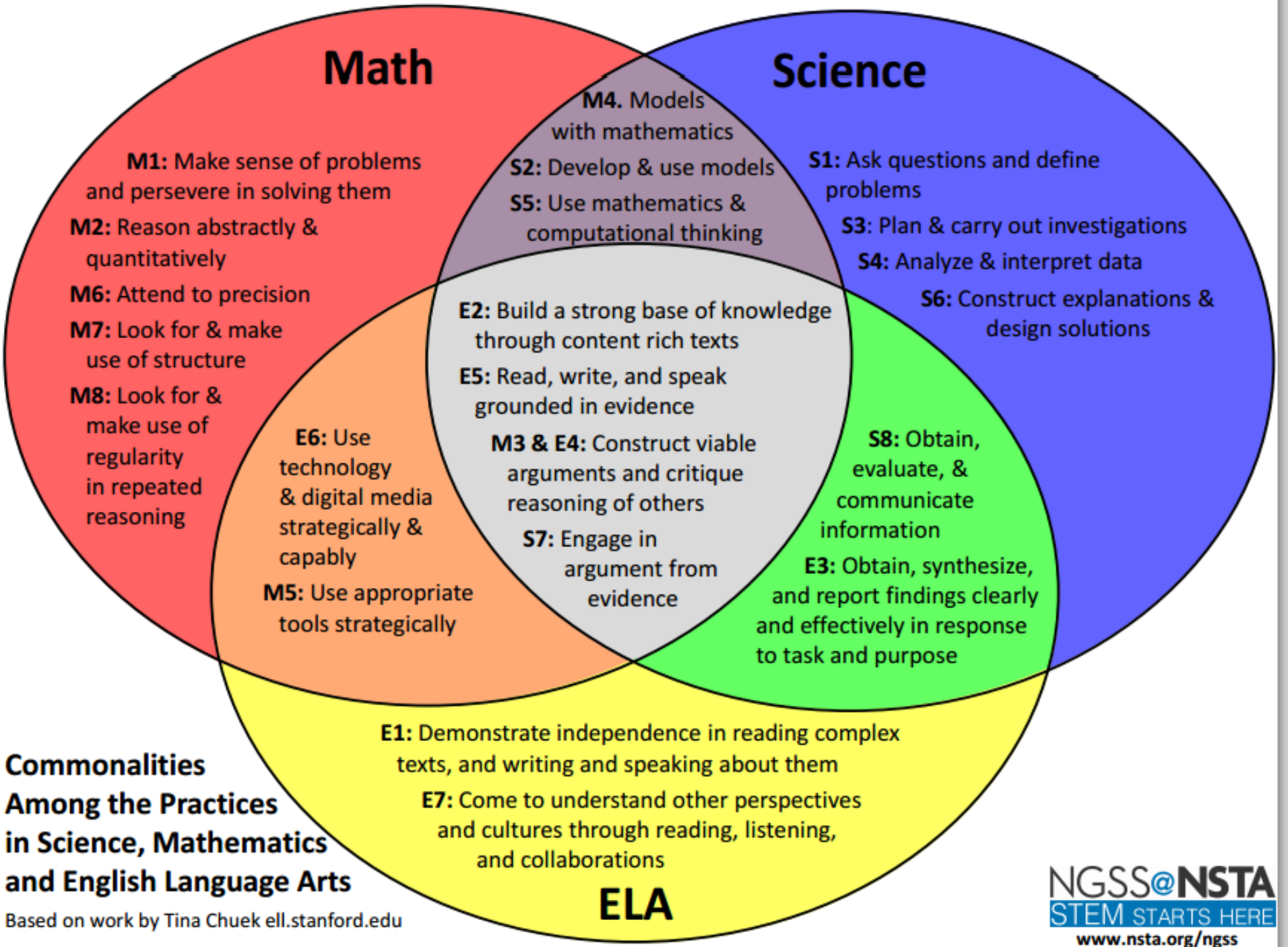
Excellence In Environmental Education Guidelines for Learning

Strand 1 - Questioning, Analysis and Interpretation Skills

- Questioning
- Designing Investigations
- Collecting information
- Evaluating accuracy and reliability
- Organizing information
- Working with models and simulations
- Drawing conclusions and developing explanations

Strand 3 - Skills for Understanding and Addressing Environmental Issues

- Skills for analyzing and investigating environmental issues
- Decision-making and citizenship skills



Commonalities Among the Practices in Science, Mathematics and English Language Arts

Based on work by Tina Chuek ell.stanford.edu

NGSS@NSTA
STEM STARTS HERE
www.nsta.org/ngss

Crosscutting Concepts

Cause and Effect

Patterns

Structure and Function

Systems and System Models

Scale, Proportion, and Quantity

Stability and Change

Matter and Energy

Dimension 3: Disciplinary Core Ideas

Life Science	Physical Science
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	PS1: Matter and Its Interactions PS2: Motion and Stability: Forces and Interactions PS3: Energy PS4: Waves and Their Applications in Technologies for Information Transfer
Earth & Space Science	**Engineering & Technology**
ESS1: Earth's Place in the Universe ESS2: Earth's Systems ESS3: Earth and Human Activity	ETS1: Engineering Design ETS2: Links Among Engineering, Technology, Science, and Society

Influence of Engineering, Technology, and Science on Society and the Natural World

K-2 Connections Statements	3-5 Connections Statements	6-8 Connections Statements	9-12 Connections Statements
•Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. •Taking natural materials to make things impacts the environment.	•People's needs and wants change over time, as do their demands for new and improved technologies. •Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. •When new technologies become available, they can bring about changes in the way people live and interact with one another.	•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. •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. •Technology use varies over time and from region to region.	•Modern civilization depends on major technological systems, such as agriculture, health, water, energy, transportation, manufacturing, construction, and communications. • Engineers continuously modify these systems to increase benefits while decreasing costs and risks. •New technologies can have deep impacts on society and the environment, including some that were not anticipated. •Analysis of costs and benefits is a critical aspect of decisions about technology

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.]

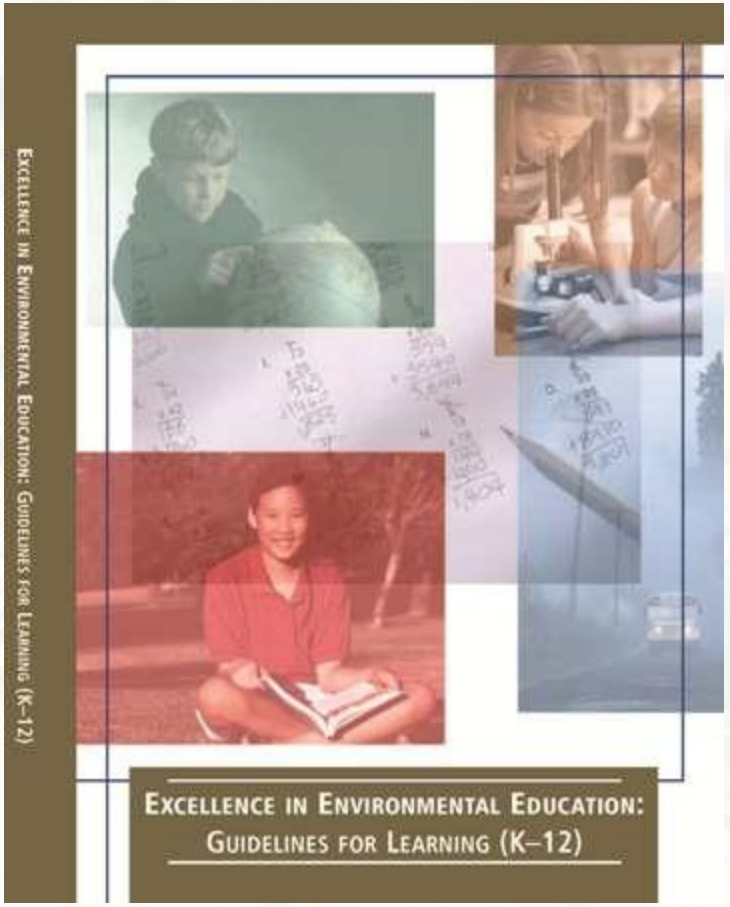
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating 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).]

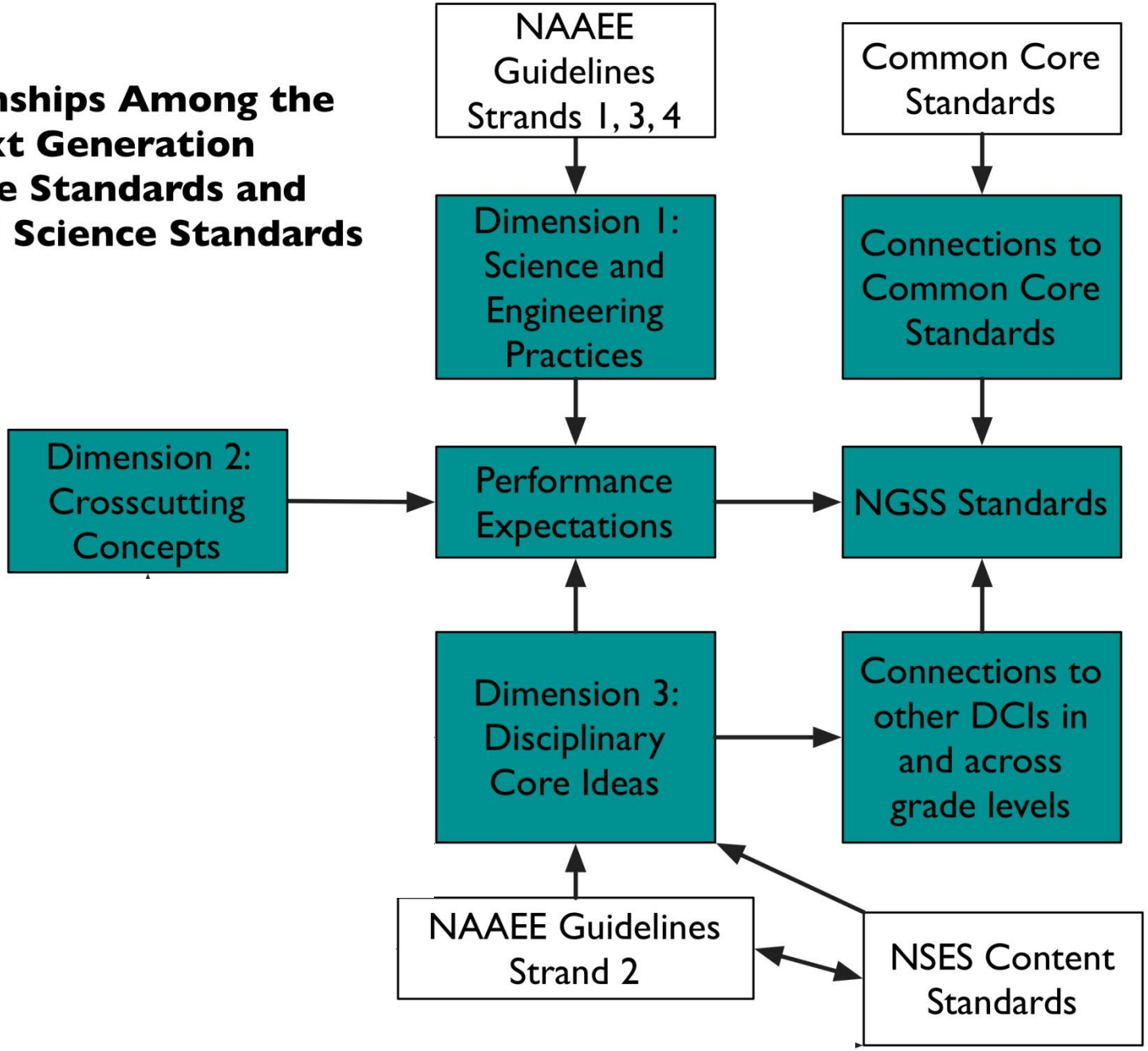
NGSS as a Means of Delivery of Environmental Education

NEXT GENERATION SCIENCE STANDARDS

For States, By States



Relationships Among the Next Generation Science Standards and Other US Science 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

	K-2	3-5	6-8	9-12
ESS2.C The roles of water in Earth's surface processes	Water is found in many types of places and in different forms on Earth.	Most of Earth's water is in the ocean and much of the Earth's fresh water is in glaciers or underground.	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.	The planet's dynamics are greatly influenced by water's unique chemical and physical properties.
ESS2.D Weather and climate	Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region and time. People record weather patterns over time.	Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed.	Complex interactions determine local weather patterns and influence climate, including the role of the ocean.	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…

Thank You!

Peter McLaren
Peter.mclaren@ride.ri.gov
401-222-8454

Twitter
@peterjmclaren

Science and Technology Specialist
Rhode Island Department of Education