NEXT GENERATION SCIENCE STANDARDS AND LEARNING ENVIRONMENTS!

Ellen Ebert, PhD
Director, Teaching and Learning Science
Washington State Office of Superintendent of Public Instruction

March 21, 2014
“We live in an increasingly complex world and we will need solutions to some big problems...like conserving water and finding new sources of energy.

A high-quality science education that starts in the early grades is the key to ensuring we solve those problems and creating a future full of possibilities.”

-Superintendent Dorn at the October 4, 2013 Adoption Ceremony
6 GREAT PRINCIPLES FROM A FRAMEWORK FOR K-12 SCIENCE EDUCATION

1. Children are born investigators
2. Focus on core ideas and practices
3. Understanding builds over time
4. Science and engineering require both knowledge and practice
5. Connecting to students’ interests and experiences
6. Promoting equity

Photo: Forterra
THE STANDARDS – THREE DIMENSIONS

- **Crosscutting Concepts**
  - Patterns
  - Cause and effect
  - Scale, proportion and quantity
  - Systems and system models
  - Energy and matter
  - Structure and function
  - Stability and change

- **Science & Engineering Practices**
  - Ask questions (for science) and define problems (for engineering)
  - Develop and use models
  - Plan and carry out investigations
  - Analyze and interpret data
  - Use mathematics and computational thinking
  - Construct explanations (for science) and design solutions (for engineering)
  - Engage in argument from evidence
  - Obtain, evaluate, and communicate information

- **Disciplinary Core Ideas**
  - Physical Sciences
  - Life Sciences
  - Earth and Space Sciences
  - Engineering, Technology and Applications of Science
### Layers of an Earth and Space Sciences Performance Expectation

**HS-ESS3-4 Earth and Human Activity**

Students who demonstrate understanding can:

- **HS-ESS3-4.** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

<table>
<thead>
<tr>
<th>Constructing Explanations and Designing Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories.</td>
</tr>
<tr>
<td>• Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ESS3.C: Human Impacts on Earth Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.</td>
</tr>
</tbody>
</table>

**ETS1.B: Developing Possible Solutions**

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary)

---

### Connections to Engineering, Technology, and Applications of Science

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

- Engineers continuously modify these

---

### Articulation of DCIs across grade-bands:

- H.S.LS2.C; H.S.LS4.D

**Common Core State Standards Connections:**

- **ELA/Literacy -**
  - RST.11-12.1: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-ESS3-4)
  - RST.11-12.8: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ESS3-4)

- **Mathematics -**
  - **MP.2:** Reason abstractly and quantitatively. (HS-ESS3-4)
  - **HSN.Q.A.1:** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS3-4)
  - **HSN.Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS3-4)
  - **HSN.Q.A.3:** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS3-4)
WHAT’S DIFFERENT WITH NGSS?

- Emphasis on being scientists and engineers
  - practices vs. collection of facts
- Focus on equity
- Integration of engineering
- Informal and community partners
- Contemporary science
WASHINGTON STATE’S APPROACH

Take it slow

Focus on practices

Professional Learning vs. Professional Development

Engage informal and community educators

Design new courses and pathways

Revise (upgrade) existing curriculum
EQUITY IS CENTRAL TO THE NGSS
ALL STANDARDS, ALL STUDENTS (APPENDIX D)

- Strategies for diverse groups
  - NCLB student groups
    - Economically disadvantaged
    - Racial and ethnic groups
    - Disabilities
    - Limited English proficiency
  - Additional groups
    - Girls
    - alternative education
    - Gifted and talented

- Why is equity central?
Search for “scientist or engineer” images

Do these photos resonate with students?

Am I there?

Do they look like me?

Where is science taking place and what does the learning space look like?

Outdated images of science.
EFFECTIVE HOME & COMMUNITY CONNECTIONS

- Identify resources and strengths in the family and home environments of non-dominant student groups
- Involve parents and extended family
- Define problems and design solutions for community projects in local neighborhoods
- Focus on science learning in informal environments
- Create and use appropriate learning spaces
EFFECTIVE CLASSROOM STRATEGIES

- Connect science education to students’ sense of place
- Apply their funds of knowledge and cultural practices
- Project-based learning
- Culturally relevant pedagogy
- Community involvement and social activism
- Role models
- Accommodations and modifications for students with disabilities
- Home language support and home culture connections
- Language support strategies
The 21st-century classroom should be a place where students get to start exploring their world, discovering their passion, applying what they know and beginning to experience the impact they can have. I’m optimistic that in the hands of talented science educators, conceptual shifts like those in the science standards will make these aspirations a reality for many more of our nation’s students.
FIELD STUDY OPPORTUNITIES

- Green Ribbon Schools
- NAAEE Affiliates
- Geo Literacy
- Green technology and jobs
- Common Core ELA and Math
- Business partners
- Climate change and ocean acidification
- STEM field studies
Multi-topic opportunities aka Interdisciplinary Instruction
Sense-making

Investigative

Collecting Evidence

Asking questions

Designing

Begins in Kindergarten
Technology Driven; Collaborative; Lots of Light; Space
Sustainable Engineering and Design

Presenters:
Laura Childs | Morgan Miller | Rachel Blaire
Mike Wierusz | Stacy Smedley
**Activity**

- Let’s take a few minutes to look at some different examples of bundling of NGSS and think about the design of the learning space.
NGSS Promotes Multi-Topic Instruction: Bundling Example: High School Human Sustainability as the Theme:

- **HS-ESS3-1.** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.


- **HS-ESS3-4.** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* HS.LS2.C - Ecosystem Dynamics: Function and Resilience; HS.LS4.D Biodiversity and Humans

- **HS-ESS3-6.** Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.* HS.LS2.B – Cycles of Matter and Energy in Ecosystems ; HS.LS2.C - Ecosystem Dynamics: Function and Resilience; HS.LS4.D Biodiversity and Humans; HS.ESS2.A Earth Materials and Systems
<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration, Awareness, and Statewide Capacity Building</td>
<td>Classroom Transitions, Equity, and Practices</td>
<td>Leveraging Resources, Materials, and Expertise</td>
<td>Statewide Implementation, Assessment, and Coordination</td>
</tr>
</tbody>
</table>

### Ongoing Statewide Coordination and Collaboration to Support

#### Communication (OSPI, State Science Leadership Team, LASER)
- Develop messages
- General outreach on shifts
- Ongoing messaging

#### Statewide Capacity/Network Building (OSPI Programs; State Science Leadership Team)
- Identify existing expertise and gaps
- Develop NGSS support networks
- Ongoing support of leadership network

#### Professional Learning (OSPI Programs, State Science Leadership Team, ESD Regional Science Coordinators, STEM teachers, Administrators, Informal/Community Educators)
- Identify Professional Learning needs (teachers, administrators, and community educators)
- Professional Learning designed for all stakeholders
- Professional Learning implemented for teachers and administrators
- Professional Learning implemented for informal/community educators and ongoing adaptation of Professional Learning

#### Instructional Practices/Shifts (OSPI Programs, State Science Leadership Team, ESD Regional Science Coordinators, STEM teachers)
- Focus on equity and integrating Science and Engineering Practices
- Continued focus on equity and integrating SEPs and Cross Cutting Concepts
- Integration of three dimensions (SEPs, CCCs, and DCIs)
- Instructional shifts in place

#### Instructional Materials and Curriculum (OSPI Programs, State Science Leadership Team, ESD Regional Science Coordinators, LASER)
- Evaluate existing materials
- Adapt existing materials and explore (e) innovations
- Evaluate placement of instructional materials and leverage materials and curriculum
- Develop/evaluate new materials

#### Assessment System (OSPI)
- Review Board on Testing and Assessment Report (NRC)
- Study assessment system opportunities with NGSS adopted states
- Develop new assessments and resources
- Field test new assessments

#### Data Collection (OSPI)
- Determine metrics to be tracked (e.g., course taking, student achievement, STEM, etc.)
- Develop data collection plan
- Track and report science related data

#### Policy Shifts (OSPI, SBE, PESB, Legislature)
- Identify policy changes necessary to implement NGSS (e.g. PESB teacher competencies, secondary pathways, assessment)

---

*Elements of NGSS Transition Plan, OSPI March 2014*
Science Teaching & Learning:
- Ellen Ebert, Ph.D., ellen.ebert@k12.wa.us
- Amber Farthing, amber.farthing@k12.wa.us

Environmental and Sustainability Education:
- Gilda Wheeler, gilda.wheeler@k12.wa.us

Science Support Staff:
- Sultana Shah, sultana.shah@k12.wa.us

NGSS OSPI Website:
http://www.k12.wa.us/Science/NGSS.aspx

Report from Symposium on Science Assessment:
http://www.k12center.org/rsc/pdf/bybee.pdf