South Metro-Salem STEM Hub Summer PD

Next Generation Science Standards

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Science TOSA Newberg Schools
What are Next Generation Science Standards?

http://vimeo.com/64246763
Learning Targets

- I can describe the foundation of NGSS.
- I can read and explain the deconstructed standards for my grade level(s).
- I can begin planning lessons/units incorporating CCSS and NGSS.
Why NGSS?

http://vimeo.com/41706647#

Statewide implementation of NGSS in Oregon classrooms by 2016-17.

Statewide operational implementation of NGSS assessment in Oregon by 2018-19.

Begin to implement units 2014-15 school year at Salem-Keizer

Role in full implementation see print out.
Provide state and district level communication, transition, implementation, and professional development plans, models, and funding.

Develop NGSS formative and interim assessments including grade level work sample scoring rubrics.
<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Work</th>
</tr>
</thead>
</table>
| 2014   | January     | • ODE and Science Panel develop NGSS adoption, transition, professional development (PD), and implementation planning recommendations  
          • State Board conducts first read of the NGSS and considers recommendations                                                   |
| 2014   | February    | • ODE and Science Panel continue work on NGSS adoption, transition, PD, and implementation planning recommendations                                                                                |
| 2014   | March/April | • State Board conducts NGSS second and third read and adoption vote  
          • ODE and Science Panel continue work on NGSS transition, PD, and implementation planning                                       |
| 2014   | May/June    | • ODE and Science Panel develop NGSS transition, implementation, and PD plans  
          • Develop budget and secure funding for PD  
          • Develop systematic communication plan to raise awareness in educational and local communities  
          • Include NGSS in existing summer PD and statewide conferences                                                   |
| 2014   | Summer      | • PD on NGSS awareness and integration with Common Core State Standards  
          • ODE and Science Panel develop PD, lessons, units, and formative assessments                                         |
| 2014   | Fall-Winter | • Provide regional PD to Professional Learning Teams (Administrators, Lead Teachers, Early Adopters)  
          • ODE and Science Panel develop PD, lessons, units, and formative assessments                                         |
| 2015   | Spring-Summer | • Follow up regional Professional Learning Teams PD  
               • ODE and Science Panel develop PD, lessons, units, and formative assessments  
               • ODE conducts NGSS Field Test                                               |
| 2015   | Fall-Winter | • PD for all teachers and administrators  
               • Pilot lessons, units, and formative assessments                             |
| 2016   | Spring-Summer | • Follow up PD for all teachers and administrators  
               • Refine lessons, units, and formative assessments  
               • ODE conducts NGSS Field Test                                               |
| 2016   | Fall-Winter | • NGSS lessons, units, and work sample scoring rubric used statewide  
               • ODE conducts NGSS Pilot Test  
               • ODE and Science Panel provide ongoing NGSS transition and implementation support                                      |
| 2017   | Spring-Summer | • ODE conducts NGSS Field Test  
               • ODE and Science Panel provide ongoing NGSS transition and implementation support                                      |
| 2017   | Fall-Winter | • ODE and Science Panel provide ongoing NGSS transition and implementation support                                                                                                           |
| 2018   | Spring-Summer | • ODE staff lead development of NGSS Performance Level Descriptors, Standard Setting (Cut-Scores Determination), and Rubric Validation  |
| 2018   | Fall-Winter | • SBE Adoption Process for NGSS Performance Level Descriptors and Cut Scores (Standard Setting)  
               • ODE conducts NGSS Operational Test  
               • ODE and Science Panel provide ongoing NGSS implementation support                                                            |
| 2019   | Winter-Spring | • NGSS Adopted Performance Level Descriptors and Cut Scores are in effect in Oregon schools                                                   |
### Alignment of NGSS with Oregon 2009 Science Standards

Alignment Codes: **S** = Strong; **P** = Partial; **D** = Different Grade; **N** = New

<table>
<thead>
<tr>
<th>NGSS PE</th>
<th>ORSS</th>
<th>Content</th>
<th>Practice</th>
<th>CCC</th>
<th>Notes on Alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-PS2</td>
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<tr>
<td>K-PS2-1</td>
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<tr>
<td>Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.</td>
<td>K.2P.1</td>
<td>P</td>
<td>D</td>
<td>P</td>
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<td>K.3S.2</td>
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<td>2.4D.2</td>
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<td>K-PS2-2</td>
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<tr>
<td>Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.</td>
<td>K.3S.1</td>
<td>P</td>
<td>D</td>
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<td>1.3S.1</td>
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<td>1.2P.1</td>
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<td>K-PS3</td>
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<td>K-PS3-1</td>
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<tr>
<td>Make observations to determine the effect of sunlight on Earth’s surface.</td>
<td>K.1E.1</td>
<td>S</td>
<td>S</td>
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<td>K.3S.2</td>
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<td>K-PS3-2</td>
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<tr>
<td>Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.</td>
<td>K.1E.1</td>
<td>S</td>
<td>S</td>
<td>S</td>
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<td>K.4D.1</td>
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<td>K-LS1</td>
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<td>K-LS1-1</td>
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<td>Use observations to describe patterns of what plants and animals (including humans) need to survive.</td>
<td>K.1L.1</td>
<td>S</td>
<td>D</td>
<td>P</td>
<td>P</td>
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<td>1.2L.1</td>
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<td>K.3S.1</td>
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<td>K-ESS2-1</td>
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<tr>
<td>Use and share observations of local weather conditions to describe patterns over time.</td>
<td>K.2E.1</td>
<td>P</td>
<td>P</td>
<td>D</td>
<td>D(2)</td>
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<td>K.3S.2</td>
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<td>2.3S.2</td>
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</table>
### NGSS FOR CALIFORNIA PUBLIC SCHOOLS

#### LEARNING PROGRESSIONS FOR MIDDLE SCHOOLS, GRADES 6-8

<table>
<thead>
<tr>
<th>Grade</th>
<th>Cross Cutting Themes</th>
<th>Earth and Space Sciences</th>
<th>Life Sciences</th>
<th>Physical Sciences</th>
<th>Engineering, Technology, and Applications of Science</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>7</strong></td>
<td>Stability and Change, Scale, Proportion, and Quantity</td>
<td>Space Systems, History of Earth, Human Impacts</td>
<td>Natural Selection and Adaptations, Growth Development, and Reproduction of Organisms</td>
<td>Forces and Interactions, Waves and Electromagnetic Radiation, Energy</td>
<td>Engineering, Technology, and Applications of Science</td>
</tr>
</tbody>
</table>

Example Table Entries:
- **MS-ESS1-1**
- **MS-ESS2-2**
- **MS-LS1-3**
- **MS-PS2-1**
- **MS-ETS1-1**
NGSS Conceptual Shifts

1. Interconnected Nature of Science as it is Practiced and Experienced in the Real World
2. Student Performance Expectations – NOT Curriculum.
3. Science Concepts Build Coherently from K–12
4. Focus on Deeper Understanding of Content as well as Application of Content
5. Science and Engineering are Integrated in the NGSS
6. Prepare students for College, Career, and Citizenship
7. The NGSS and CCSS are Aligned
NGSS Alignment with CCSS is Critical

- nstahosted.org/pdfs/ngss/PracticesVennDiagram.pdf

Focus on Equity

- NGSS Appendix D and Case Studies

STEM Education

- STEM is Interconnected
- Incorporates Standards
- Prepares Students for College, Careers, and Citizenship
Connections

Math

M1: Make sense of problems and persevere in solving them
M2: Reason abstractly & quantitatively
M3: Use appropriate tools strategically
M4: Models with mathematics
M5: Use mathematics & computational thinking
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

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

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

Based on work by Tina Chuek ell.stanford.edu
K-12 Science Education
Goal for All Students

- appreciation of the beauty and wonder of science;
- possess sufficient knowledge of science and engineering to engage in public discussions on related issues;
- careful consumers of scientific and technological information related to their everyday lives;
- able to continue to learn about science outside school;
- have the skills to enter careers of their choice

*A Framework for K-12 Science Education* p. ES 2

Released in July 2011; free PDF online

www7.nationalacademies.org/bose/Standards_Framework_Homepage.html
NGSS Vision

- Learning as a developmental progression
- Engaging students in scientific investigations and argumentation to achieve deeper understanding of core science ideas
- Integrating the knowledge of scientific explanations and the practices needed to engage in scientific inquiry and engineering design

KNOWLEDGE AND PRACTICE MUST BE INTERTWINED IN LEARNING EXPERIENCES
Interconnected Dimensions

- Scientific and Engineering Practices
- Crosscutting Concepts
- Core Ideas in Science
Scientific and Engineering Practices

- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Developing explanations and designing solutions
- Engaging in argument
- Obtaining, evaluating, and communicating information
Crosscutting Concepts

- Patterns
- Cause and effect
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter
- Structure and function
- Stability and change
The NGSS are written as Performance Expectations.

NGSS require contextual application of the three dimensions by students.

Focus is on how and why as well as what.
NGSS Architecture

Performance Expectations
NGSS Architecture

Based on NRC Framework and expanded into Matrices

NRC Framework language from Grade Band Endpoints

Based on NRC Framework and expanded into Matrices
NGSS Architecture

Performance Expectations

Foundation Boxes

Connection Boxes
# 12 Core Ideas NGSS

(Adopted from the *Framework*, which underpinned the development of the NGSS)

<table>
<thead>
<tr>
<th>Physical Science</th>
<th>Life Science</th>
<th>Earth Science</th>
<th>Engineering Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matter and its interactions</td>
<td>From molecules to organisms: Structures and processes</td>
<td>Earth’s place in the universe</td>
<td>Engineering design</td>
</tr>
<tr>
<td>Motion and stability: Forces and interactions</td>
<td>Ecosystems: Interactions, energy, and dynamics</td>
<td>Earth’s systems</td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>Heredity: Inheritance and variation of traits</td>
<td>Earth and human activity</td>
<td></td>
</tr>
<tr>
<td>Waves and their applications in technologies for information transfer</td>
<td>Biological evolution: Unity and diversity</td>
<td></td>
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</tbody>
</table>
## NGSS Standard: From Molecules to Organisms: Structures and Processes

**MS-LS1-7.** Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

### What does this standard require students to...

<table>
<thead>
<tr>
<th>KNOW? (Concepts)</th>
<th>DO? (Skills/Reasoning)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disciplinary Core Ideas - Explanation:</strong></td>
<td><strong>MS-LS1-7.</strong> Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.</td>
</tr>
<tr>
<td>Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)</td>
<td></td>
</tr>
<tr>
<td>Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (Secondary to MS-LS1-7)</td>
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</tr>
<tr>
<td><strong>Clarification Statement:</strong> Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.</td>
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</tbody>
</table>

### Core Vocabulary:
- Chemical Reactions
- Molecules
- Cellular Respiration
- Energy
- Product
- Reactants

### Assessment Boundary:
- Assessment boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.

### Science and Engineering Practices

#### Developing and Using Models
- Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
  - Develop a model to describe unobservable mechanisms. (MS-LS1-7)

#### Crosscutting Concepts
- Energy and Matter
  - Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7)

### Common Core & STEM Connections:

#### ELA/Literacy:
- MLR 12: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-2L/MS-LS1-7)

#### Mathematics (STEM): None Addressed
### Summary of Shifts in Teacher Knowledge and Practice

<table>
<thead>
<tr>
<th>Traditional Science Teaching</th>
<th>Shift to NGSS Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topics are sequentially pursued according to the traditional breakdown of lessons</td>
<td>Lessons should be structured so that the work is driven by questions arising from phenomena</td>
</tr>
<tr>
<td>The goal of investigations is testing hypothesis</td>
<td>The goal of investigations is to guide construction of explanatory models</td>
</tr>
<tr>
<td>Answers to investigations are whether and how two variables are related</td>
<td>Answers to investigations need to help construct an explanatory account of whether and how two variables are related</td>
</tr>
<tr>
<td>Students see what they are learning as the next assigned topic</td>
<td>Students should see what they are working on as answering explanatory questions</td>
</tr>
<tr>
<td>Large part of teachers’ role is the procedural skills in doing experiments</td>
<td>Large part of teachers’ role is to support the knowledge building aspects of practices and not just the procedural skills in doing experiments</td>
</tr>
<tr>
<td>Textbooks and teacher present ideas to students</td>
<td>Extensive class focus needs to be devoted to argumentation and reaching consensus about ideas</td>
</tr>
<tr>
<td>Classroom Culture that:</td>
<td>Classroom Culture that:</td>
</tr>
<tr>
<td>*Students are learning what they are told</td>
<td>*Students are learning what they are motivated to figure out</td>
</tr>
<tr>
<td>*Students wait for answers</td>
<td>*Students accept responsibility for the work of figuring out answers</td>
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<tr>
<td></td>
<td>*Students expect to work together and learn with their peers.</td>
</tr>
</tbody>
</table>
http://www.pd360.com/index.cfm?ContentId=7774

Grade 6– Engineering Design
Alka-Seltzer

ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

http://www.pd360.com/index.cfm?ContentId=7779

Grade 7– Engineering Design
Earthquake Structures

ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
What does it look like?

http://fw.to/e3GCM8d

Grade 8 Balanced & Unbalanced Forces
Analyzing Data in Small Groups

- **PS2-2.** Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.