WA State Next Generation Science Standards (NGSS)
Transition Plan for Secondary Science

The tables in the following pages provide draft plans for the transition to the Next Generation Science Standards (NGSS). Districts can determine their own plans for implementing the NGSS; however, the following proposed plans are for those districts that want guidance on how to transition from the 2009 WA State K-12 Science Standards to the NGSS. These documents were developed through the collaborative efforts of the Washington State NGSS Leadership Team with feedback from teachers and critical stakeholders across the state. They provide an overview to assist districts in determining elements of a transition plan that best suits their particular schools, and that outline what OPSI and statewide partners are committed to providing in terms of support for Washington’s schools as we transition to the NGSS. Additionally, the NGSS Appendices provide further guidance. Schools and districts should carefully consider course sequencing and pathways until teachers have had time to analyze and become thoroughly familiar with the NGSS.

The transition plan spans four years beginning in October, 2013 after the NGSS were adopted as Washington State Science Content Learning Standards. Phase 1 focuses on an awareness period in which districts, schools and teachers begin with the Framework for K12 Science Education as the grounding document for the NGSS. The Framework explicated the three dimensions of the NGSS: the science and engineering practices, the crosscutting concepts and the disciplinary core ideas. Understanding how these dimensions complement each other will lead to a greater understanding of the NGSS and its integrative nature. Chapter 10 of the Framework addresses instruction, curriculum and teacher professional development and will be helpful for district leaders charged with implementation of science standards. Chapter 11 of the Framework and Appendix D of the NGSS highlight equity research and strategies in science and engineering education, ensuring that all students have opportunities to engage in high-quality learning experiences. The NGSS call for the standards to be accessible to all students. Phase 1 is continuous through the entire transition period.

Phase 2 infuses crosscutting concepts and science and engineering practices with WA 2009 Science Learning Standards and appropriate NGSS performance expectations while focusing on and identifying the equity opportunities afforded by the NGSS.

“The eight practices are not separate; they intentionally overlap and interconnect. As explained by Bell, et al. (2012), the eight practices do not operate in isolation. Rather, they tend to unfold sequentially, and even overlap.” --APPENDIX F – Science and Engineering Practices in the NGSS

Phase 3 follows the same format as Phase 2 with the continued infusion of crosscutting concepts and science and engineering practices. This advantages teachers by giving them more time to research and plan lessons around less familiar disciplinary core ideas, crosscutting concepts and science and engineering practices. Supporting the phase-in period will be learning resources developed nationally and vetted using Achieve’s EquiP NGSS Rubric. Districts are encouraged to use their existing learning materials and resources until teachers have time to fully understand the NGSS and can make informed selections.

Middle and high school transition plans are similar to elementary beginning with the infusion and integration of science and engineering practices and crosscutting concepts. Model course mapping and pathways will be considered as national plans become available. Achieve is in the process of developing an accelerated pathway for students wishing to take Advanced Placement courses and should be available by late summer 2014. OSPI Teaching and Learning with coordinate with Career and Technical Education on dual crediting of appropriately developed courses. This document consolidates the performance expectations of the NGSS and their connections with the Common Core State Standards in English Language Arts and Mathematics. The transition documents are flexible and will continually be revisited and updated as resources become available. OSPI will work with formal and informal professional development and higher education partners to develop workshops and materials needed to support statewide science education.
Grade 6 – 8
Physical Science

Students in middle school continue to develop understanding of four core ideas in the physical sciences. The middle school performance expectations in the Physical Sciences build on the K – 5 ideas and capabilities to allow learners to explain phenomena central to the physical sciences but also to the life sciences and earth and space science. The performance expectations in physical science blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge to explain real world phenomena in the physical, biological, and earth and space sciences. In the physical sciences, performance expectations at the middle school level focus on students developing understanding of several scientific practices. These include developing and using models, planning and conducting investigations, analyzing and interpreting data, using mathematical and computational thinking, and constructing explanations; and to use these practices to demonstrate understanding of the core ideas. Students are also expected to demonstrate understanding of several of engineering practices including design and evaluation.

The performance expectations in PS1: Matter and its Interactions help students to formulate an answer to the question, “How do atomic and molecular interactions explain the properties of matter that we see and feel?” by building understanding of what occurs at the atomic and molecular scale. In middle school, the PS1 Disciplinary Core Idea from the NRC Framework is broken down into two sub-ideas: the structure and properties of matter, and chemical reactions. By the end of middle school, students will be able to apply understanding that pure substances have characteristic physical and chemical properties and are made from a single type of atom or molecule. They will be able to provide molecular level accounts to explain states of matters and changes between states that chemical reactions involve regrouping of atoms to form new substances, and that atoms rearrange during chemical reactions. Students are also able to apply an understanding of the design and the process of optimization in engineering to chemical reaction systems. The crosscutting concepts of patterns; cause and effect; scale, proportion and quantity; energy and matter; structure and function; interdependence of science, engineering, and technology; and influence of science, engineering and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the PS1 performance expectations, students are expected to demonstrate proficiency in developing and using models, analyzing and interpreting data, designing solutions, and obtaining, evaluating, and communicating information. Students use these scientific and engineering practices to demonstrate understanding of the disciplinary core ideas.

The performance expectations in PS2: Motion and Stability: Forces and Interactions focuses on helping students understand ideas related to why some objects will keep moving, why objects fall to the ground and why some materials are attracted to each other while others are not. Students answer the question, “How can one describe physical interactions between objects and within systems of objects?” At the middle school level, the PS2 Disciplinary Core Idea from the NRC Framework is broken down into two sub-ideas: Forces and Motion and Types of interactions. By the end of middle school, students will be able to apply Newton’s Third Law of Motion to relate forces to explain the motion of objects. Students also apply ideas about gravitational, electrical, and magnetic forces to explain a variety of phenomena including beginning ideas about why some materials attract each other while others repel. In particular, students will develop understanding that gravitational interactions are always attractive but that electrical and magnetic forces can be both attractive and negative. Students also develop ideas that
objects can exert forces on each other even though the objects are not in contact, through fields. Students are also able to apply an engineering practice and concept to solve a problem caused when objects collide. The crosscutting concepts of cause and effect; system and system models; stability and change; and the influence of science, engineering, and technology on society and the natural world serve as organizing concepts for these disciplinary core ideas. In the PS2 performance expectations, students are expected to demonstrate proficiency in asking questions, planning and carrying out investigations, and designing solutions, and engaging in argument; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **PS3: Energy** help students formulate an answer to the question, “**How can energy be transferred from one object or system to another?**” At the middle school level, the PS3 Disciplinary Core Idea from the NRC Framework is broken down into four sub-core ideas: Definitions of Energy, Conservation of Energy and Energy Transfer, the Relationship between Energy and Forces, and Energy in Chemical Process and Everyday Life. Students develop their understanding of important qualitative ideas about energy including that the interactions of objects can be explained and predicted using the concept of transfer of energy from one object or system of objects to another, and the total change of energy in any system is always equal to the total energy transferred into or out of the system. Students understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions in a field. Students will also come to know the difference between energy and temperature, and begin to develop an understanding of the relationship between force and energy. Students are also able to apply an understanding of design to the process of energy transfer. The crosscutting concepts of scale, proportion, and quantity; systems and system models; and energy are called out as organizing concepts for these disciplinary core ideas. The performance expectations in PS3 expect students to demonstrate proficiency in developing and using models, planning investigations, analyzing and interpreting data, and designing solutions, and engaging in argument from evidence; and to use these practices to demonstrate understanding of the core ideas in PS3.

The performance expectations in **PS4: Waves and Their Applications in Technologies for Information Transfer** help students formulate an answer to the question, “**What are the characteristic properties of waves and how can they be used?**” At the middle school level, the PS4 Disciplinary Core Idea from the NRC Framework is broken down into Wave Properties, Electromagnetic Radiation, and Information Technologies and Instrumentation. Students are able to describe and predict characteristic properties and behaviors of waves when the waves interact with matter. Students can apply an understanding of waves as a means to send digital information. The crosscutting concepts of patterns and structure and function are used as organizing concepts for these disciplinary core ideas. The performance expectations in PS4 focus on students demonstrating proficiency in developing and using models, using mathematical thinking, and obtaining, evaluating and communicating information; and to use these practices to demonstrate understanding of the core ideas (NGSS, pp. 47-8).

Middle School teachers introduce students to Physical Science and engineering design standards. These are integrated with key science and engineering practices and crosscutting concepts. These standards should be bundled with other related standards in Life Science and Earth and Space Science.

**MS-PS Structure and Property of Matter**

**MS-PS1-1.** Develop models to describe the atomic composition of simple molecules and extended structures.

**MS-PS1-3.** Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

MS-PS Chemical Reactions

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*

MS-PS2 Forces and Interactions

MS-PS2-1. Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.*

MS-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.

MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

MS-PS3 Energy

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*

MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

MS-PS3-5. Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.

MS-PS4 Waves and Electromagnetic Radiation

MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.
**MS-ETS1 Engineering Design**

**MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

**MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

**MS-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.

**MS-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.

*Indicates an engineering connection.*

These following standards coordinate with Physical Science and should be bundled with them as appropriate.

**LS. Structure, Function, and Information Processing**

**LS. Matter and Energy in Organisms and Ecosystems**

**LS. Interdependent Relationships in Ecosystems**

**ESS. Earth's Systems**

**ESS. Weather and Climate**

Common Core State Standards Connections:

**ELA/Literacy**

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-PS1-2),(MS-PS1-3)

RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-1),(MS-PS1-2),(MS-PS1-4),(MS-PS1-5)

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS1-6)

WHST.6-8.1 Write arguments focused on discipline-specific content. (MS-PS2-4)

WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-3)

**Mathematics**

MP.2 Reason abstractly and quantitatively. (MS-PS1-1),(MS-PS1-2),(MS-PS1-5)

MP.4 Model with mathematics. (MS-PS1-1),(MS-PS1-5)

6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-1),(MS-PS1-2),(MS-PS1-5)
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<td>6.NS.C.5</td>
<td>Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4)</td>
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<td>8.EE.A.3</td>
<td>Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. (MS-PS1-1)</td>
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<td>6.SP.B.4</td>
<td>Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (MS-PS1-2)</td>
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<tr>
<td>6.SP.B.5</td>
<td>Summarize numerical data sets in relation to their context. (MS-PS1-2)</td>
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**Comments:** ESDs; LASER Alliances; Community Partners will develop statewide professional learning modules to be used statewide.

**Which learning materials/resources best fit this series of standards?**