Washington State Science Learning Standards Transition Project

A Comparison of the Next Generation Science Standards to the 2009 WA Science Learning Standards

June 28, 2013

RELEVANT STRATEGIES

Relevant Strategies partnered with the Washington Office of the Superintendent of Public Instruction to conduct a cross-analysis of the Next Generation Science Standards and the 2009 Washington State Science Learning Standards.

SUPERINTENDENT OF PUBLIC INSTRUCTION WASHINGTON

(This page intentionally blank)

Table of Contents

(This page intentionally blank)

1 Executive Summary

Relevant Strategies assisted the Washington Office of the Superintendent of Public Instruction (OSPI) to conduct a comparative analysis of the Next Generation Science Standards (NGSS) and the 2009 Washington State Science Learning Standards. Thirty-one participants with significant experience with both sets of standards gathered to identify how the NGSS compared to the existing state standards. The participants also provided transition advice, which is included in this report, and which will be considered when OSPI develops a formal transition plan.

Under current Washington State law (RCW 28A.655.070), OSPI has the responsibility to develop and maintain Washington's academic learning standards consistent with the goals outlined in the Basic Education Act, RCW 28A.150.210. This includes periodic review and possible revision of the standards. Prior to adopting state learning standards in any subject area, OSPI's process involves several key components that include reviewing and vetting the draft standards with key statewide stakeholder groups, conducting comparisons of previous state learning standards with the revised standards, and conducting a bias and sensitivity process to gather recommendations for implementing the standards in a culturally sensitive and bias-free manner. These steps are conducted prior to adoption to allow OSPI and other statewide partners involved with developing transition and implementation plans and resources to gather specific recommendations on critical issues related to implementing the new standards.

In 2010, the National Research Council, the National Science Teachers Association, the American Association for the Advancement of Science, and Achieve, Inc. began a three year process to develop Next Generation Science Standards (NGSS). The process consisted of two steps beginning with the crafting of *A Framework for K-12 Science Education* which sets forth a contemporary vision of science education reflective of current research on science, engineering, and science learning thus identifying the science that all K-12 students should experience.

The second step was managed by Achieve, Inc. and included a competitive process to select a coalition of states prepared to draft a comprehensive set of K-12 standards based on the *Framework* principles. In 2011, Washington was selected to serve as one of the lead states in the national coalition to develop the NGSS.

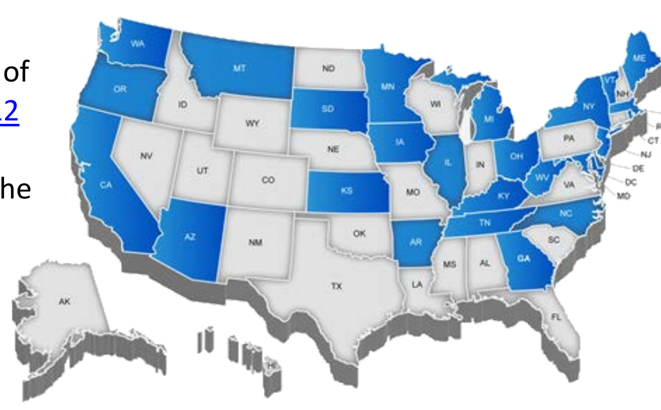

Figure 1. Map showing the NGSS lead states (in blue).

Since Washington had just engaged in an extensive review of the Common Core State Standards (CCSS) for English Language Arts and Mathematics, the state legislature agreed that it made sense for OSPI to also become involved with the development of NGSS in order to inform our state's next adoption of new student learning standards for science (per RCW 28A.150.210 and 28A.665.068).

Between fall 2011 and winter 2013, OSPI and state science partners including the nine regional Educational Service Districts (ESDs) and LASER (Leadership and Assistance for Science Education Reform), with grant support from Battelle/Pacific Northwest National Laboratories and Boeing, convened groups of educators to provide input on the two public drafts of the NGSS. In addition to two public drafts, lead state only releases of the NGSS were reviewed by multiple advisory committees which included leaders in science, science education, higher education, informal education, business and industry.

Once the NGSS were finalized in April 2013, OSPI began the review process necessary to inform the state's adoption of the standards. The process includes the following steps:

1. Completing a thorough review and comparison of the NGSS with Washington's 2009 Science Learning Standards.
2. Completing a bias and sensitivity process to inform implementation of the NGSS in a culturally sensitive and bias-free manner.
3. Developing a plan to guide initial transition to the standards once they are adopted.

Through a competitive bid process, OSPI selected Relevant Strategies to assist with the overall coordination and facilitation of both the standards comparison and bias and sensitivity processes. This report describes the comparative analysis of the NGSS and the 2009 Washington Science Learning Standards.

This review was conducted in May 2013. OSPI convened a group of thirty-one Washington educators and scientists all of whom had a deep understanding of the Washington standards. Many of the comparative analysis workgroup participants had previous experience reviewing the NGSS drafts or were involved in state-led standards and assessment leadership efforts.

The focus of this comparative analysis was to provide specific and detailed information about the similarities and differences between the two sets of standards. The intent of this document is to provide clear comparisons between the two sets of standards for school districts and educators as they transition to the NGSS in future years.

The target audience for this report included includes science educators, curriculum specialists, educational leadership, policy makers, legislators and anyone else who wished wish to understand the similarities and differences between the two sets of standards.

Perhaps the most important findings from this work are that:

- Many overlaps are identified between the 2009 Washington science standards and the NGSS. Both the Washington Science Learning Standards and the NGSS integrated application, systems thinking, and inquiry into disciplinary core ideas, although the NGSS extends the integration of scientific process and scientific content in a much deeper way.
- The NGSS re-sequences some science learning to more closely mirror the related skills addressed in the Common Core State Standards in Mathematics and English Language Arts (CCSS-M and CCSS-ELA).

- Should the Superintendent adopt the NGSS, there will be challenges in terms of the system of science education in our state that must be addressed. Participants provided a wealth of advice regarding both the larger issues and detailed three-year draft plans for transitioning from one set of standards to another.

2 Process Overview

The purpose of comparing the 2009 Washington Science Learning Standards with the Next Generation Science Standards is to determine where similarities and differences exist, identify new content or processes, and form the basis for developing a transition plan should the Superintendent adopt the NGSS.

The task was challenging in that the structures of the two sets of standards are very different; particularly in the integration of scientific inquiry, application, and systems with disciplinary content. The Washington model used four core Essential Academic Learning Requirements (EALRs) – Systems, Inquiry, Application and the Domains of science (life, physics, and earth/space) which are written as separate strands.

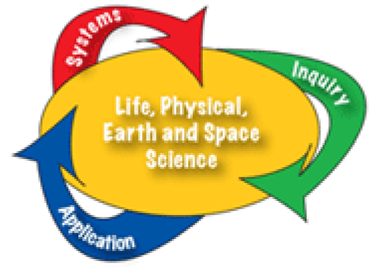

Figure 2. Washington Science Learning Standards model.

In contrast, every NGSS Performance Expectation has three interwoven dimensions – disciplinary core ideas (content), scientific and engineering practices, and cross-cutting concepts. In a sense, the NGSS integrates the Washington EALRs by combining the content, the habits of mind and the practice of science.

Figure 3 depicts the architecture of a Next Generation Science Standard. This graphic represents the entirety of a standard. An NGSS standard includes multiple performance expectations each integrating a practice, core idea, and cross cutting concept that form its structure.

Performance Expectations		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Connections to • Other science disciplines at this grade level • Other DCIs for older and younger students • Common Core State Standards in Mathematics and English Language Arts		

Figure 3. Architecture of a Next Generation Science Standard.

The NGSS has explicit connections to the Common Core State Standards in Mathematics and English Language Arts (CCSS-M and CCSS-ELA) which are found in the connections box. In creating the NGSS, the development team worked closely with the CCSS-M writing team to ensure that the NGSS do not outpace or otherwise misalign to the grade-by-grade standards in the CCSS-M. In addition, the

NGSS development team paired with the CCSS-ELA writing team to identify key literacy connections in science and technical subjects.

> *As the CCSS affirms, reading in science requires an appreciation of the norms and conventions of the discipline of science, including understanding the nature of evidence used, an attention to precision and detail, and the capacity to make and assess intricate arguments, synthesize complex information, and follow detailed procedures and accounts of events and concepts.*[1]

2.1 Standards Comparison

The first step in comparing the two sets of standards was to create a structure by which the two sets of standards could be compared. Broadly speaking, the architectures of the two sets of standards align in the following manner:

Table 1. Architecture comparison between Washington Science Learning Standards and the NGSS.

2009 Washington Science Learning Standards	Next Generation Science Standards
EALR 1: Systems	Cross-Cutting Concepts 1) Patterns 2) Cause and Effect 3) Scale, proportion and quantity 4) Systems and systems models 5) Energy and matter 6) Structure and function 7) Stability and change
EALR 2: Inquiry	NGSS Science and Engineering Practices 1) Asking questions and defining problems 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 and designing solutions 7) Engaging in argument from evidence 8) Obtaining, evaluating and communicating information 9) Nature of science
EALR 3: Application of Science	Engineering, Technology and Applications

[1] Next Generation Science Standards, Appendix M – Connections to the Common Core State Standards for Literacy in Science and Technical Subjects, retrieved from http://www.nextgenscience.org.

2009 Washington Science Learning Standards	Next Generation Science Standards
	of Science 1) Engineering Design 2) Interdependence of Science, Engineering and Technology 3) Influence of Engineering, Technology and Science on Society and the Natural World
EALR 4: Domains of Science	Disciplinary Core Ideas

In the NGSS, each performance expectation is based on Science and Engineering Practices, Disciplinary Core Ideas, and Cross-Cutting Concepts.

The format for the NGSS Performance Expectations code is shown in Figure 4 and includes grade level – DCI classification – specific performance expectation.

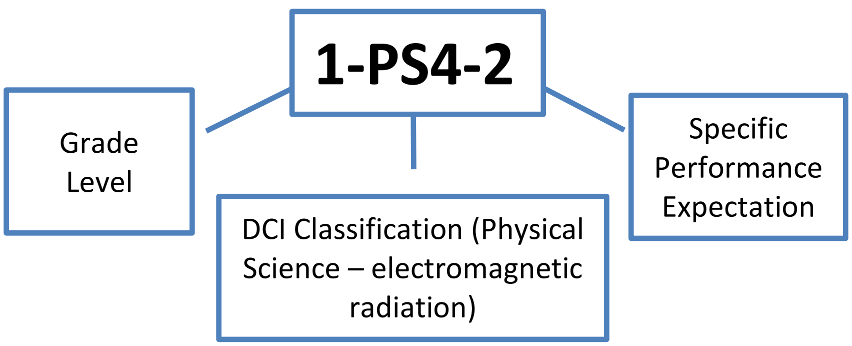

Figure 4. NGSS code format description.

The second step was to create a matrix as shown in *Figure 5*. OSPI provided preliminary worksheets with draft comparisons between the performance expectations and the EALRs. Prior to the standards comparison workshop, OSPI shared early drafts of the standards comparison forms with key stakeholder groups around the state and incorporated feedback from those groups into an updated version that was shared with the workshop participants. Participants worked in grade and subject-level teams to confirm or edit the preliminary worksheets and provide justification for changes. The feedback from the participants shaped the final version of the tables as shown in Section *3.2 Standards Comparison.*

Grade 1	EALR 1 Systems	EALR 2 Inquiry									EALR 3 Application of Science
		NGSS Science and Engineering Practices									
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investi-gations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	NGSS Engineering, Technology, and Applications of Science
1-PS4-1				X						X	
1-PS4-2							X				
1-PS4-3				X							
1-PS4-4							X				X

Figure 5. Sample template for comparing the NGSS to the Washington Science Learning Standards.

The participants spent time discussing potential issues involved in transitioning K-12 science classes across the state to a new set of standards. The advice from participants will be used to develop a subsequent multi-year transition plan.

2.2 Cross-Analysis Workgroup Orientation

The participants selected to take part in the standards comparison work were experienced with both the 2009 Washington Science Learning Standards and the NGSS. Most participants were experienced science educators, while several were practicing scientists committed to quality science education.

Before attending the full-day work session, participants were asked to review the draft comparison tables and both sets of standards. The workshop facilitators provided an orientation to the comparison forms and modeled the expected work. Participants were assigned to grade and subject-level teams of 3-4 people to focus on a particular subset of the NGSS standards to complete the comparison analysis:

- Elem K-2
- Elem 3-5
- MS Life
- MS Physical
- MS Earth/Space
- HS Life
- HS Physical
- HS Earth/Space
- Engineering

Early in the process, workshop facilitators checked with the participants to ensure all teams understood the work asked of them and were consistently applying the comparisons. Later in the day, participant teams merged into larger groups to discuss and justify their comparisons (Note that the sample forms in this section are included for visualization purposes only. The markups and the data are examples and not indicative of the responses provided by the participants).

Kindergarten NGSS and WA State EALRs 1-3 Comparison											
	EALR 1 Systems	EALR 2 Inquiry									EALR 3 Application of Science
		NGSS Science and Engineering Practices									
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	NGSS Engineering, Technology, and Applications of Science
K-PS2-1				X						X	
K-PS2-2	X				X						X
K-PS3-1				~~X~~ (1)						X	
K-PS3-2							X				
K-LS1-1	X				X		X (2)			X	
K-ESS2-1					X						
K-ESS2-2	X							X		X	
K-ESS3-1			X					X			
K-ESS2-2.	X	X							X	X	X
K-ESS3-3	X								X		X
K-2-ETS1-1		X									X
K-2-ETS1-2	X		X								X
K-2-ETS1-3					X						X

Figure 6. Sample worksheet comparing Washington EALRs 1-3 to the NGSS.

Grade 1				
NGSS Standard	Title	Comparison to EALR 4	Agree	Disagree
1-PS4	Waves and their Application in Technology for information transfer	New	✓	
1-LS1	From Molecules to Organisms: Structures and Processes	Subsumes parts of WA K – 1 LS1 (Plant and Animal Parts)	✓	
1-LS3	Heredity: Inheritance and Variation of Traits	Mostly new; Subsumes parts of WA K – 1 LS3 (Classifying Plants and Animals) (4)		✓
1-ESS1	Earth's Place in the Universe	Subsumes WA K-1 ES1 Earth in Space (Observing the Sun and the Moon)	✓	

Figure 7. Sample worksheet comparing EALR 4 to the Disciplnary Core Ideas of the NGSS.

Participants performed two core tasks. The first was to review the draft comparison tables and confirm, correct and/or comment on the draft comparisons. The second task was to provide advice on transition planning specific to their assigned grade/subject areas. In a process similar to the comparative analysis, they were given a draft high level transition plan and were asked to confirm, correct and/or comment on the plan.

Kindergarten		
Year 0	Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concepts	
Year 1	Phase in K-PS2 Forces and Interactions; Phase in K-PS3;	Stop teaching WA K-1 PS1 Forces and Motion (Push-Pull and Position)
Year 2	Phase in K-ESS2 Earth's Systems (Introduces Weather) and K-ESS3 Earth and Human Activity	Continue teaching WA Life Science Standards
Year 3	Phase in K-LS1 Structures and Processes	Stop teaching WA Standards
Comments: Properties and Change (WA – PS 2) does not appear in the NGSS K PEs. Observing the sun/moon system is not called out in the NGSS in Kindergarten. We need to identify the kits that will not be taught at K any longer and phase them out. The idea is to lighten the load for the Grade K Teacher. What are the PD needs? Which kits would best fit this series of standards?		

Figure 8. Sample transition advice form.

2.3 Transition Planning Advice

It is not within the scope of this report to describe a transition plan from the 2009 Washington Science Learning Standards to the NGSS. However, participants were asked to provide both high-level advice and detailed transition planning advice specific to their assigned grade levels/subject areas.

See Section *3.3 Transition Plan* for more details.

3 Findings

3.1 General Observations

For the most part, participants agreed with the draft standards comparisons documents. In the few instances where there was a difference from the draft documents, participants explained their rationale. The OSPI Science Director reviewed all feedback from participants and incorporated it into a final version of the standards comparisons tables, as shown in *Section 3.2*.

Because the two sets of standards are structurally different, it is not possible to do a direct quantitative alignment. Therefore, OSPI elected to do a qualitative alignment. Qualitatively speaking, workshop participants concluded that the vast majority of Washington science standards were fundamentally incorporated into the NGSS. There is some movement of disciplinary core ideas between grades at the elementary level, but this realignment is consistent with the goal of coordinating with the CCSS-M and CCSS-ELA standards.

In particular, the Systems, Inquiry, and Application Essential Academic Learning Requirements from Washington's current standards are well addressed in the NGSS, as shown in the EALR 1-3 comparison tables in *Section 3.2*. Modest differences exist between the disciplinary core ideas in the NGSS and the Domain standards in Washington's EALR 4. Most of the difference involves re-sequencing and an emphasis on current scientific applications, but there is also a fundamental shift to a deeper focus on fewer topics, similar to the CCSS.

The EALR 4 comparison tables in *Section 3.2* highlight the basic differences between the content for NGSS and the 2009 Washington Science Learning Standards. For example, in middle school physical science, DCI PS4 (waves and their applications in technologies for information transfer) does not have a corresponding standard in the current Washington set. The EALR 4 comparison table for middle school physical science identifies this DCI as new, because there is no corresponding content in the Washington standards.

Table 2. Sample comparison analysis for Washington's EALR 4.

NGSS Standard	Topic	Comparison to EALR 4
MS-PS4	Waves and Their Applications in Technologies for Information Transfer	New

In reality, the *practices* of science are as important as the *content* (DCIs in the NGSS or Domains in the WA standards). Students who learn to ask questions and define problems, develop models, plan and carry out investigations, analyze and interpret data, or use evidence when stating a hypothesis are very well served by their science education, and can apply that discipline of thought to any existing or new content area. Thus, the fact that both sets of standards place substantial emphasis on disciplined practices of science is the most significant similarity, and the modest changes in content areas simply provide consistency among science classrooms and labs within the states adopting the NGSS.

3.2 Standards Comparison

What follows is the grade level cross analysis data between the Washington State Standards and the NGSS. Each table represents a different grade from K to 5, and then for middle school (grades 6-8) and high school (grades 9-12). Furthermore, for each grade level or grade band there are two tables – one comparing NGSS with EALRs 1-3 and the second comparing NGSS with EALR 4.

3.2.1 Grades K-2

Grade K	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
		NGSS Science and Engineering Practices									
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	Asking Question s and Defining Problems	Developing and Using Models	Planning and carrying out investigation s	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	NGSS Engineering, Technology, and Applications of Science
K-PS2-1				X						X	
K-PS2-2					X						X
K-PS3-1				X						X	
K-PS3-2							X				X
K-LS1-1	X				X					X	
K-ESS2-1					X					X	
K-ESS2-2	X							X			
K-ESS3-1	X		X								
K-ESS2-2		X							X		
K-ESS3-3	X								X		X
K-2-ETS1-1		X			X				X		X
K-2-ETS1-2	X		X				X				X
K-2-ETS1-3					X		X				X

Kindergarten NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Topic**	**Comparison to EALR 4**
K-PS2	Forces and Interactions	Subsumes WA K-1 PS1 Forces and Motion (Push-Pull and Position)
K-PS3	Energy	New; subsumes parts of WA PS3 (Energy Transfer)
K-LS1	Structures and Processes	This standard subsumes WA K-1 LS3 (Classifying Plants and Animals) and replaces LS3, but WA K-1 LS2 and LS3 will be useful for unpacking K-LS1-1 because this is a very rich standard.
K-ESS2	Earth's Systems (Introduces Weather)	Subsumes WA K-1 ES2A (Properties and Change) and WA K-1 ES1A (Observing the Sun and the Moon). K-ESS2-1 replaces WA K-1 ES1; K-ESS2-2 subsumes WA K-1-LS2.
K-ESS3	Earth and Human Activity	Subsumes WA K-1 ES2A (Properties and Change). K-ESS3 replaces WA K-1 ES2.

Grade 1	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investi-gations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
1-PS4-1				X						X	
1-PS4-2							X				
1-PS4-3				X							
1-PS4-4							X				X
1-LS1-1							X				X
1-LS1-2									X	X	

Grade 1	EALR 1 Systems	EALR 2 Inquiry									EALR 3 Application of Science
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investi-gations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
1-LS3-1							X				
1-ESS1-1					X					X	
1-ESS1-2				X							

Grade 1 NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Title**	**Comparison to EALR 4**
1-PS4	Waves and their Application in Technology for Information Transfer	New
1-LS1	From Molecules to Organisms: Structures and Processes	Subsumes parts of WA K-1 LS1 (Plant and Animal Parts) for 1st grade.
1-LS3	Heredity: Inheritance and Variation of Traits	1-LS3 is mostly new for 1st grade and replaces WA K-1 LS3. It subsumes WA 2-3 LS3B.
1-ESS1	Earth's Place in the Universe	Subsumes WA K-1 ES1 Earth in Space (Observing the Sun and the Moon)

Grade 2	EALR 1 Systems	EALR 2 Inquiry									EALR 3 Application of Science
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
2-PS1-1				X							
2-PS1-2					X						X
2-PS1-3	X						X				
2-PS1-4								X		X	
2-LS2-1				X							
2-LS2-2	X		X								X
2-LS4-1				X						X	
2-ESS1-1							X				
2-ESS2-1							X			X	X
2-ESS2-2			X								
2-ESS2-3									X		

Grade 2 NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Title**	**Comparison to EALR 4**
2-PS1	Matter and its Interaction	Subsumes WA PS2 (Matter: Properties and Change)
2-LS2	Ecosystems: Interactions, Energy and Dynamics	Subsumes WA 2-3 LS1 (Life Cycles)
2-LS4	Biological Evolution: Unity and Diversity	Mostly new; Subsumes parts of WA 2-3 LS3 (Variation of Inherited Characteristics)
2-ESS1	Earth’s Place in the Universe	Replaces WA K-1 ES1 Earth in Space (Observing the Sun and the Moon)

Grade 2 NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Title**	**Comparison to EALR 4**
2-ESS2	Earth’s Systems	Replaces WA 2-3 ES2 and subsumes WA 4-5 ES2B, C, F

3.2.2 Grades 3-5

Grade 3	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
3-PS2-1				X							
3-PS2-2				X						X	
3-PS2-3											
3-PS2-4.											X
3-LS1-1			x							X	
3-LS2-1								X			
3-LS3-1					X						
3-LS3-2							X				
3-LS4-1					X						
3-LS4-2							X				
3-LS4-3							X				
3-LS4-4								X			x
3-ESS2-1					X						
3-ESS2-2									X		
3-ESS3-1											X

Grade 3 NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Title**	**Comparison to EALR 4**
3-PS2	Motion and Stability: Forces and Interactions	Subsumes WA PS1 (Forces and Motion)
3-LS1	From Molecules to Organisms: Structures and Processes	Subsumes parts of WA 2-3 LS1 (Lifecycles) and LS2 (Ecosystems)
3-LS2	Ecosystems: Interactions, Energy, and Dynamics	Mostly new; Subsumes parts of WA 2-3 LS1 (Structures and Functions of Living Organisms)
3-LS3	Heredity: Inheritance and Variation of Traits	Subsumes WA 2-3 LS3.
3-LS4	Biological Evolution: Unity and Diversity	Subsumes WA 2-3 LS3D and LS3E, 4-5 ESS3.
3-ESS2	Earth's Systems	Subsumes parts of WA 2-3 Earth Systems, Structures and Properties; introduces climates.
3-ESS3	Earth and Human Activity	Subsumes WA 2-3 Earth Systems, Structures and Properties

Grade 4	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
4-PS3-1				x			x				
4-PS3-2											
4-PS3-3		x									
4-PS3-4										X	X
4-PS4-1	x		x							X	
4-PS4-2			x								
4-PS4-3											X

Grade 4	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
4-LS1-1	X						X				
4-ESS1-1							x				
4-ESS2-1	x			x							
4-ESS2-2					x						
4-ESS3-1	x								x		X
4-ESS3-2											X
4-LS1-2	x		x					x			

Grade 4 NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Topic**	**Comparison to EALR 4**
4-PS3	Energy	Subsumes parts of WA 4-5 PS1 (Forces and Motion) and PS3 (Energy: Transfer, Transformation and Conservation)
4-PS4	Waves and their Applications in Technologies for Information Transfer	New
4-LS1	From Molecules to Organisms: Structures and Processes	Subsumes WA 4-5 LS1 (Structures and Functions of Living Organisms: Structures and Behaviors)
4-ESS1	Earth’s Place in the Universe	Subsumes parts of WA 4-5 ES2 (Earth Systems, Structures, and Processes: Formation of Earth Materials); ES3 (Earth History: Focus on Fossils)
4-ESS2	Earth’s Systems	Subsumes parts of WA 4-5 ES2 (Earth Systems, Structures, and Processes: Formation of Earth Materials)
4-ESS3	Earth and Human Activity	New

Grade 5	EALR 1 Systems	EALR 2 Inquiry									EALR 3 Application of Science
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
5-PS1-1			X								
5-PS1-2						X					
5-PS1-3				X							
5-PS1-4				X							
5-PS2-1								X			
5-PS3-1			X								
5-LS1-1								X			
5-LS2-1	X		X					x			
5-ESS1-1								X			
5-ESS1-2					X						
5-ESS2-1	x		X								
5-ESS2-2						X					
5-ESS3-1	X								X	X	
3-5-ETS1-1		X									X
3-5-ETS1-2							X				X
3-5-ETS1-3				X							

Grade 5 NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Topic**	**Comparison to EALR 4**
5-PS1	Matter and Its Interactions	Subsumes WA 4-5 PS2 (Matter: Properties and Changes) and parts of WA 4-5 LS2B
5-PS2	Motion and Stability: Forces and	Subsumes parts of WA 4-5 PS1 (Forces and Motion)

Grade 5 NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Topic**	**Comparison to EALR 4**
	Interactions	
5-PS3	Energy	New (Inferred in WA 4-5 LS2B; subsumes parts of WA 4-5 LS2B)
5-LS1	From Molecules to Organisms: Structures and Processes	Subsumes parts of WA 4-5 LS2 (Ecosystems)
5-LS2	Ecosystems: Interactions, Energy, and Dynamics	Subsumes parts of WA 4-5 LS2 (Ecosystems)
5-ESS1	Earth's Place in the Universe	Subsumes parts of WA 4-5 ES1 (Earth in Space)
5-ESS2	Earth's Systems	Subsumes parts of WA 4-5 ES2 (Earth Systems, Structures, and Processes: Formation of Earth Materials)
5-ESS3	Earth and Human Activity	New. Subsumes parts of WA 4-5 LS2F and WA 4-5 LS2E

3.2.3 Middle School Physical Science

MS Physical Science	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
MS-PS1-1			X								
MS-PS1-2	X				X					X	
MS-PS1-3											X
MS-PS1-4			X								
MS-PS1-5			X							X	
MS-PS1-6											X
MS-PS2-1	X										X
MS-PS2-2				X						X	
MS-PS2-3		X									

MS Physical Science	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
MS-PS2-4	X							X		X	
MS-PS2-5				X							
MS-PS3-1					X						
MS-PS3-2	X		X								
MS-PS3-3											X
MS-PS3-4				X						X	
MS-PS3-5								X		X	
MS-PS4-1			X								
MS-PS4-2			X								
MS-PS4-3									X	X	X

Middle School Physical Science NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Topic**	**Comparison to EALR 4**
MS-PS1	Matter and Its Interactions	Subsumes WA 6-8 PS2(Matter: Properties and Changes)
MS-PS2	Motion and Stability: Forces and Interactions	Subsumes WA 6-8 PS1 (Forces and Motion)
MS-PS3	Energy	Subsumes WA 6-8 PS3 (Energy: Transfer, Transformation and Conservation)
MS-PS4	Waves and Their Applications in Technologies for Information Transfer	New

3.2.4 Middle School Life Science

MS Life Science	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
MS-LS1-1		X		X							X
MS-LS1-2	X	X	X								
MS-LS1-3	X	X						X		X	
MS-LS1-4		X						X			
MS-LS1-5		X					X				
MS-LS1-6		X					X			X	
MS-LS1-7		X	X								
MS-LS1-8		X							X		
MS-LS2-1	X	X			X						
MS-LS2-2	X	X					X				
MS-LS2-3	X	X	X							X	
MS-LS2-4	X	X						X		X	
MS-LS2-5	X	X						X		X	X
MS-LS3-1		X	X								
MS-LS3-2	X	X	X								
MS-LS4-1		X			X					X	
MS-LS4-2		X					X			X	
MS-LS4-3		X			X						
MS-LS4-4							X				
MS-LS4-5									X	X	X
MS-LS4-6											

Middle School Life Science NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Topic**	**Comparison to EALR 4**
MS-LS1	From Molecules to Organisms: Structures and Processes	Subsumes WA 6-8 LS1 (Structures and Function of Living Organisms: From Cells to Organisms)
MS-LS2	Ecosystems: Interactions, Energy, and Dynamics	Subsumes WA 6-8 LS2 (Ecosystems: Flow of Energy through Ecosystems)
MS-LS3	Heredity: Inheritance and Variation of Traits	Subsumes WA 6-8 LS3 (Biological Evolution: Inheritance, Variance, and Adaptation)
MS-LS4	Biological Evolution: Unity and Diversity	Subsumes WA 6-8 LS3 (Biological Evolution: Inheritance, Variance, and Adaptation)

3.2.5 Middle School Earth and Space Science

MS Earth and Space Science	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
MS-ESS1-1	X		X					X	X	X	
MS-ESS1-2	X		X						X	X	
MS-ESS1-3	X				X	X					X
MS-ESS1-4	X						X				
MS-ESS2-1	X		X							X	
MS-ESS2-2	X						X				
MS-ESS2-3					X					X	
MS-ESS2-4	X		X							X	
MS-ESS2-5	X			X							
MS-ESS2-6	X		X		X					X	

MS Earth and Space Science	EALR 1 Systems	EALR 2 Inquiry									EALR 3 Application of Science
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
MS-ESS3-1							X				X
MS-ESS3-2					X						X
MS-ESS3-3	X						X				X
MS-ESS3-4	X							X		X	X
MS-ESS3-5		X									

Middle School Earth and Space Science NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Topic**	**Comparison to EALR 4**
MS-ESS1	Earth’s Place in the Universe	Subsumes WA 6-8 ES1 (Earth in Space: The Solar System)
MS-ESS2	Earth’s Systems	Subsumes parts of WA 6-8 ES2 and ES3 (Earth’s Systems, Structures and Processes; Earth History: Evidence of Change)
MS-ESS3	Earth and Human Activity	New

3.2.6 High School Physical Science

HS Physical Science	EALR 1 Systems	EALR 2 Inquiry									EALR 3 Application of Science
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
HS-PS1-1	X		X							X	
HS-PS1-2	X					X	X				
HS-PS1-3	X			X							
HS-PS1-4	X		X							X	
HS-PS1-5							X				
HS-PS1-6	X						X				X
HS-PS1-7	X					X					
HS-PS1-8	X		X							X	
HS-PS2-1					X	X			X		
HS-PS2-2	X					X					
HS-PS2-3	X						X				X
HS-PS2-4	X					X					
HS-PS2-5				X							
HS-PS2-6								X	X		X
HS-PS3-1	X		X		X						
HS-PS3-2	X		X							X	
HS-PS3-3	X						X				X
HS-PS3-4	X			X							
HS-PS3-5			X							X	
HS-PS4-1	X					X					
HS-PS4-2	X	X									X
HS-PS4-3	X							X			
HS-PS4-4	X								X		

HS Physical Science	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
HS-PS4-5	X								X		X

High School Physical Science NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Topic**	**Comparison to EALR 4**
HS-PS1	Matter and Its Interactions	Subsumes WA 9-12 PS2 (Matter: Properties and Changes)
HS-PS2	Motion and Stability: Forces and Interactions	Subsumes parts of WA 9-12 PS1 (Forces and Motion)
HS-PS3	Energy	Subsumes parts of WA 9-12 PS3 (Energy: Transfer, Transformation and Conservation)
HS-PS4	Waves and Their Applications in Technologies for Information Transfer	Subsumes parts of WA 9-12 PS3 (Energy: Transfer, Transformation and Conservation); Some new

3.2.7 High School Life Science

HS Life Science	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
HS-LS1-1	X						X				
HS-LS1-2	X		X								

HS Life Science	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
		NGSS Science and Engineering Practices									
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	NGSS Engineering, Technology, and Applications of Science
HS-LS1-3	X			X						X	
HS-LS1-4			X				X				
HS-LS1-5			X				X				
HS-LS1-6	X						X				
HS-LS1-7	X		X				X				
HS-LS2-1	X					X					
HS-LS2-2	X					X	X			X	
HS-LS2-3	X						X			X	
HS-LS2-4	X					X					
HS-LS2-5	X		X								
HS-LS2-6	X							X		X	
HS-LS2-7	X						X				X
HS-LS2-8	X							X		X	
HS-LS3-1		X									
HS-LS3-2								X			
HS-LS3-3					X					X	
HS-LS4-1									X	X	
HS-LS4-2	X						X			X	
HS-LS4-3	X				X						X
HS-LS4-4							X			X	
HS-LS4-5	X							X		X	
HS-LS4-6	X					X					X

High School Life Science NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Topic**	**Comparison to EALR 4**
HS-LS1	From Molecules to Organisms: Structures and Processes	Subsumes parts of WA 9-12 LS1 (Structures and Function of Living Organisms: From Cells to Organisms)
HS-LS2	Ecosystems: Interactions, Energy, and Dynamics	Subsumes WA 9-12 LS2 (Ecosystems: Flow of Energy through Ecosystems)
HS-LS3	Heredity: Inheritance and Variation of Traits	Subsumes parts of WA 9-12 LS1 (Structures and Function of Living Organisms: From Cells to Organisms); WA 9-12 LS3 (Biological Evolution: Inheritance, Variance, and Adaptation)
HS-LS4	Biological Evolution: Unity and Diversity	Subsumes WA 9-12 LS3 (Biological Evolution: Inheritance, Variance, and Adaptation)

3.2.8 High School Earth and Space Science

HS Earth and Space Science	EALR 1 Systems	EALR 2 Inquiry									EALR 3 Application of Science
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
HS-ESS1-1	X		X		X		X			X	
HS-ESS1-2	X				X		X			X	
HS-ESS1-3	X								X		
HS-ESS1-4	X					X				X	X
HS-ESS1-5	X				X			X	X	X	
HS-ESS1-6	X						X			X	
HS-ESS2-1	X		X								
HS-ESS2-2	X				X		X			X	X
HS-ESS2-3	X		X								
HS-ESS2-4	X		X								

HS Earth and Space Science	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
HS-ESS2-5	X			X							
HS-ESS2-6	X		X			X					
HS-ESS2-7	X							X			
HS-ESS3-1	X						X				X
HS-ESS3-2	X							X			X
HS-ESS3-3	X					X					X
HS-ESS3-4	X		X				X				X
HS-ESS3-5	X				X						
HS-ESS3-6	X		X			X	X				

High School Earth and Space Science NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Topic**	**Comparison to EALR 4**
HS-ESS1	Earth’s Place in the Universe	Subsumes WA 9-12 ES1 (Earth in Space: The Solar System)
HS-ESS2	Earth’s Systems	Subsumes parts of WA 9-12 ES2 and ES3 (Earth’s Systems, Structures and Processes; Earth History: Evidence of Change)
HS-ESS3	Earth and Human Activity	Subsumes parts of WA 9-12 ES2 and ES3 (Earth’s Systems, Structures and Processes; Earth History: Evidence of Change); some new

3.2.9 Engineering

K-2 Engineering and Technology	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Application of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
K-2-ETS1-1		X							x		x
K-2-ETS1-2			X								X
K-2-ETS1-3					X						x

3-5 Engineering and Technology	**EALR 1 Systems**	**EALR 2 Inquiry**									**EALR 3 Applicatio n of Science**
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigation s	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
3-5-ETS1-1		X									X
3-5-ETS1-2							X				X
3-5-ETS1-3			x	X	x						x

MS Engineering Design	EALR 1 Systems	EALR 2 Inquiry									EALR 3 Application of Science
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
MS-ETS1-1		X									X
MS-ETS1-2				x	x			X			X
MS-ETS1-3					X						X
MS-ETS1-4			X								X

HS Engineering Design	EALR 1 Systems	EALR 2 Inquiry									EALR 3 Application of Science
NGSS Performance Expectation	NGSS Cross-Cutting Concepts	NGSS Science and Engineering Practices									NGSS Engineering, Technology, and Applications of Science
		Asking Questions and Defining Problems	Developing and Using Models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information	Nature of Science	
HS-ETS1-1		X									X
HS-ETS1-2	x						X				X
HS-ETS1-3							X				X
HS-ETS1-4	X		x			X					X

Engineering Design NGSS and WA State EALR 4 Comparison		
NGSS Standard	**Topic**	**Comparison to EALR 4**
K-2-ETS1	Engineering Design	New[2]
3-5-ETS1	Engineering Design	New
MS-ETS1	Engineering Design	New
HS-ETS1	Engineering Design	New

[2] The Engineering Design standards are new only in regard to EALR 4, but they are well represented in the Washington EALR 2 (Inquiry) and EALR 3 (Application) standards.

3.3 Transition Planning Advice

It is not within the scope of this report to describe a transition plan from the 2009 Washington Science Learning Standards to the NGSS. However, participants were asked to provide both high-level and detailed transition planning advice specific to their assigned grades/subject areas.

This section contains advice and guidance from the participants. OSPI will produce a separate transition plan and report and will consider advice from the standards comparison participants and other stakeholder groups when developing the transition plan. Not every idea presented in this section may be adopted, but all will be considered.

3.3.1 General Transition Advice

Participants identified several larger issues that they believe would need to be discussed and resolved as part of transitioning to the NGSS.

Assessment and Graduation Requirements

The state should:

- Consider how the end of course biology assessment, which is based upon the Washington Science Learning Standards, may need to change.
- Open a discussion with key stakeholders about a high school graduation requirement for a 3^{rd} credit of science. Include a discussion about college entrance requirements and admissions expectations.
- Consider an integrative science assessment that combines physical science, life science and earth and space science. This approach would help ensure earth and space science was offered in high schools across the state.

Instructional Materials

The state should:

- Consider a plan to assist districts in instructional materials selection and determine resource availability to support districts in updating their science instructional materials.
- Use the *Analysis of Instructional Materials* (AIM) or similar process for evaluating and implementing quality instructional materials that are aligned to standards. The transition plan should include a similar process for vetting instructional materials, with a focus on pedagogical issues.
- Emphasize that kits, instructional materials, labs, etc. should not lead the transition focus; rather, the Science and Engineering practices should lead.

Professional Development

The state should:

- Provide support to districts for professional development around the NGSS.
- Consider developing short (2-3 minute) video vignettes on practices to create professional development modules.

- Ensure that sufficient attention is placed on transitioning the shifts in thinking between Washington's Application EALR and NGSS Engineering Performance Expectations.
- Consider implementing a few practices at a time, and do not immediately change instructional materials.

Communication and Coordination

The state should:

- Develop a communications plan with regard to the adoption of and transition to the NGSS. The communications plan should be designed to address information flow from, and to, a wide variety of stakeholder groups.
- Connect STEM and Common Core State Standards (CCSS) ELA and Math practices to the NGSS.
    - Engage in dialog about the connections between Science Technology Engineering and Mathematics (STEM) courses and Career and Technical Education (CTE).
    - Ensure that the NGSS is integrated within the domains of science and with CCSS-ELA and CCSS-Math.
    - Address the new focus on human activity in NGSS Standard ESS3, Earth and *Human* Activity, which contains references to sometimes controversial topics such as global warming.

Timing

The state should:

- Consider whether three years will be sufficient for transitioning from the existing standards to the NGSS. A clear roadmap needs to be developed that outlines what needs to be done when.
- Convene science educational leadership to review and develop a plan for Washington State that clearly examines the NGSS model course map for middle and high school (Appendix J of the NGSS).

3.3.2 Grade Level/Subject Area Transition Advice

The following tables show detailed transition advice provided by the workshop participants. Each team received a draft high level transition plan for their grade level/subject area. They provided comments and advice on the draft plan. OSPI will develop a detailed transition plan and will consider this advice. Content in bold represents the advice given by the teams about the draft transition plan, which is in a normal font. Not all draft plan elements had comments or advice.

Kindergarten		
Year 0	Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concepts **Lead with pedagogy. Work with the instructional materials behind the scenes to prepare for transition of materials.**	
Year 1	Phase in K-PS2 Forces and Interactions; Phase in K-PS3;	Stop teaching WA K-1 PS1 Forces and Motion (Push-Pull and Position)

Kindergarten		
	Offer a series of professional development opportunities over the course of the transition period on Practices and the integration of CCSS Math and CCSS ELA and NGSS, with new and deeper learning each year.	**Continue teaching WA Earth Science Standards and WA Life Science Standards**
Year 2	Phase in K-ESS2 Earth's Systems (Introduces Weather) and K-ESS3 Earth and Human Activity **See above.**	Continue teaching WA Life Science Standards **Stop teaching WA Earth Science Standards**
Year 3	Phase in K-LS1 Structures and Processes **See above.**	Stop teaching WA Standards ✔
Comments: Properties and Change (WA-PS 2) does not appear in the NGSS K PEs. Observing the sun/moon system is not called out in the NGSS in Kindergarten. We need to identify the kits that will not be taught at K any longer and phase them out. The idea is to lighten the load for the Grade K Teacher. What are the PD needs? Which kits would best fit this series of standards? **Change the overall comments to this:** **Properties and Change (WA – K1-PS 2) does not appear in the NGSS K PEs. Have transitions in instructional materials to best meet K standards. What are the PD needs? Which instructional materials would best fit this series of standards?** **We need to identify gaps in instructional materials and fill those gaps as a state system. Examine possible instructional materials with AIM-like protocols to fill gaps. Teachers will need PD about deeper conceptual knowledge for new Performance Expectations (PE's) such as pushes and pulls and weather. Use a vertical PD model for learning instructional strategies from teachers who were teaching those concepts. Pattern after the Math CCSS model.**		

Grade 1		
Year 0	Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concepts	
Year 1	Phase in 1-ESS1 Earth's Place in the Universe **See kindergarten.**	Continue Teaching WA Life Science **and PS** Standards; stop teaching WA ES ✔
Year 2	Phase in 1-LS1 From Molecules to Organisms: Structures and Processes and 1-LS3 Heredity: Inheritance and Variation of Traits ✔	Stop teaching WA LS. **Continue teaching WA PS standards**

<table>
<tr><th colspan="3">Grade 1</th></tr>
<tr><td>Year 3</td><td>Phase in 1-PS4 Waves and their Application in Technology for information transfer
✔</td><td>Stop teaching WA standards.
✔</td></tr>
<tr><td colspan="3">Comments:

See kindergarten.</td></tr>
</table>

<table>
<tr><th colspan="3">Grade 2</th></tr>
<tr><td>Year 0</td><td colspan="2">Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concepts</td></tr>
<tr><td>Year 1</td><td>Phase in 2-PS1 Matter and its Interactions</td><td>Stop teaching WA PS
Continue teaching the WA LS and ES standards.</td></tr>
<tr><td>Year 2</td><td>Phase in 2-LS2 Ecosystems: Interactions, Energy and Dynamics and 2-LS4 Biological Evolution: Unity and Diversity</td><td>Stop teaching WA LS
Continue teaching WA ES standards.</td></tr>
<tr><td>Year 3</td><td>Phase in 2-ESS1 Earth’s Place in the Universe; and 2-ESS2 Earth’s Systems</td><td>Stop teaching WA standards</td></tr>
<tr><td colspan="3">Comments: There are no standards at second grade for Forces and Motion. ES1 – The Sun’s daily motion is subsumed into Grade 1 ESS1. We need to determine how to best integrate the Engineering Design. What are the PD needs? Which kits would best fit this series of standards?

States of matter as described in WA K1 PS2, WA 2-3 PS2C, WA 2-3 PS2D are not found in the NGSS Performance Expectations but are in the foundation box.</td></tr>
</table>

<table>
<tr><th colspan="3">Grade 3</th></tr>
<tr><td>Year 0</td><td colspan="2">Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concepts
Combine year 0 and year 1. Focus on NGSS, Tools for Amb., Sci Tchg(KW), CIS/OEL (see comments) . Review instructional materials. Develop Course Maps. Explore STEM-CTE connections.</td></tr>
<tr><td>Year 1</td><td>Phase in 3-PS2 Motion and Stability: Forces and Interactions</td><td>Stop teaching WA PS; Continue teaching WA ES and LS</td></tr>
<tr><td>Year 2</td><td>Phase in 3-ESS2 Earth’s Systems and 3-ESS3 Earth and Human Activity
Develop and implement plan to manage assessment shifts.</td><td>Stop teaching WA ES; Continue teaching WA LS</td></tr>
<tr><td>Year 3</td><td>Phase in 3-LS2 Ecosystems: Interactions, Energy, and Dynamics and 3-LS4</td><td>Stop teaching WA LS</td></tr>
</table>

Grade 3		
	Biological Evolution: Unity and Diversity	
Comments: There are no standards at third grade for Matter: Properties and Change, or Energy. ES1 – The Sun's daily motion is subsumed into Grade 1 ESS1. What are the PD needs? Which kits would best fit this series of standards? **Utilize effective instructional supports, such as Tools for Ambitious Science Teaching (http://tools4teachingscience.org), and Observing for Evidence of Learning professional development model from the Center for Inquiry Science (http://www.slideshare.net/hsiaoching/oel-paper).** **In Year 2 shift 1-2 Domains and in Year 3rd shift the other Domains.** **What is the process to help systems to think through the transition from old materials (spiraling) to new materials?**		

Grade 4		
Year 0	Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concepts	
Year 1	Phase in 4-LS1 From Molecules to Organisms: Structures and Processes	Stop teaching WA LS; Continue teaching WA ES and PS
Year 2	Phase in 4-ESS1 Earth's Place in the Universe; 4-ESS2 Earth's Systems and 4-ESS3 Earth and Human Activity	Stop teaching WA ES; Continue teaching WA PS
Year 3	Phase in 4-PS3 Energy and 4-PS4 Waves and their Applications in Technologies for Information Transfer	Stop teaching WA PS
Comments: There are no standards fourth grade for Matter: Properties and Changes (PS2); Earth and Space (ES1); Ecosystems (LS2); or Biological Evolution (LS3). What are the PD needs? Which kits would best fit this series of standards?		

Grade 5		
Year 0	Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concepts	
Year 1	Phase in 5-LS1 From Molecules to Organisms: Structures and Processes and 5-LS2 Ecosystems: Interactions, Energy, and Dynamics	Stop teaching WA LS; Continue teaching WA PS and ES
Year 2	Phase in 5-ESS1 Earth's Place in the Universe; 5-ESS2 Earth's Systems and 5-ESS3 Earth and Human Activity	Stop teaching WA ES; Continue teaching WA PS
Year 3	Phase in 5-PS1 Matter and its Interactions; 5-PS2 Motion and Stability:	Stop teaching WA PS

Grade 5		
	Forces and Interactions and 5-PS3 Energy	
Comments: What are the PD needs? Which kits would best fit this series of standards?		

MS Life Science		
Year 0	Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concept	
Year 1	Phase in MS-LS1 From Molecules to Organisms: Structures and Processes **Consider transitioning this DCI last because it encompasses the content that is hardest to transition to the practices.**	Stop teaching WA LS1
Year 2	Phase in MS-LS2 Ecosystems: Interactions, Energy, and Dynamics	Stop teaching WA LS2
Year 3	Phase in MS-LS3 Heredity: Inheritance and Variation of Traits and MS-LS4 Biological Evolution: Unity and Diversity	Stop teaching WA LS3
Comments: What are the material demands for this series of standards? What are the PD needs? **We think more time needs to be spent thinking about the MS transition. Districts vary greatly in how they sequence MS classes. A district with 6th grade Life Science, 7th grade Physical Science, 8th grade Earth Science might use the plan above. A district with mixed sciences at each grade might transition all of NGSS in year 1, Physical Science in year 2, Earth Science in year 3. This variable plan keeps the burden spread through the grade levels. Alternatively-adopt all of one or a few practices a year.**		

MS Physical Science		
Year 0	Awareness Work; Introduce Cross Cutting Concepts **Study the K-12 Framework Science and Engineering Practices. This part should continue throughout the years in the context of content.** **Preparation and Planning: collect video examples of instruction that embodies NGSS and design PD around the video library.**	
Year 1	Phase in MS-PS1 Matter and its Interactions, **and the practices and cross-cutting concepts that go with them.**	Stop teaching WA PS2

MS Physical Science		
Year 2	Phase in MS-PS 2 Motion and Stability: Forces and Interactions and MS-PS3 Energy	Stop teaching WA PS1 and PS3
Year 3	Phase in MS-PS4 Waves and Their Applications in Technologies for Information Transfer	Stop teaching WA standards

Comments: What are the material demands for this series of standards? What are the PD needs?

Preparation and Planning

1. **Consider developing formative assessments for the practices in content for the purposes of PD for teachers. This will help develop assessment expertise and will provide a foundation for widespread or larger scale assessments.**
2. **State(s) can develop rubrics for science curriculum evaluations/**
3. **Perhaps focus on transitioning the Science and Engineering Practices first before the DCI to address science instruction/**

We have a general concern about the standards comparisons. They may lead the reader to only consider content, rather than consider the implications of the NGSS structure which blends disciplinary core ideas, science and engineering practices, and cross-cutting concepts.

MS Earth and Space Science		
Year 0	Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concepts	
Year 1	Phase in MS-ESS1 Earth's Place in the Universe	Stop teaching WA ES1
Year 2	Phase in MS-ESS2 Earth's Systems	Stop teaching WA ES2 and WA ES3
Year 3	Phase in MS-ESS3 Earth and Human Activity	Stop teaching WA standards

Comments: What are the material demands for this series of standards? What are the PD needs?

- **I like this plan.**
- **Teachers will need PD on the document and the teaching practices**

MS Earth and Space Science
Another respondent offered a dissenting opinion: • **I see year 1 and 2 as co-dependent. Year 2 influences Year 1's pedagogy. I don't see this one being handled well in isolation. WA EALR's-all of the iterations to WA Science Learning Standards were well done and this state has dragged its feet long enough! I would prefer to see a three-year transition where year 1 is the zero year, year one is 1+2, and year 2 is for year 3 as presented above. I see the big jump is for Science Education to implement the NGSS with full integrity and support the classroom teacher with difficult topics.** • **I can be ok with the NGSS if they are adopted up front in their entirety and the PD is present and prescriptive.**

High School Life Science		
Year 0	Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concepts	
Year 1	Phase in HS-LS1 From Molecules to Organisms: Structures and Processes **Consider organizing the transition by practice instead of content area. This would highlight the importance of the practices. This would allow teachers in different content areas to collaborate, which is especially important in small districts with non-job-alike teachers.**	Stop teaching WA 9-12 LS1; continue teaching WA LS2 and LS3 **Continued from box to the left-for example transition to all the argumentation Performance Expectations one year, modeling the next year, etc.**
Year 2	Phase in HS-LS2 Ecosystems: Interactions, Energy, and Dynamics	Stop teaching WA 9-12 LS2; continue teaching WA LS3
Year 3	Phase in HS-LS3 Heredity: Inheritance and Variation of Traits and HS-LS4 Biological Evolution: Unity and Diversity	Stop teaching WA 9-12 LS3 **We can't stop teaching current standards when the current standards are the one that are assessed. Instruction needs to match assessment and vice versa.**

High School Life Science

Comments: Sequencing is important as we minimize the impact on the Biology End-of-course test.

Year 0

- **NGSS need to be seen as powerful and doable.**
- **All teachers need to be involved in some way.**
- **Provide classroom observations and/or video so teachers can "see" what the NGSS looks like.**
- **Teachers may need some extra PD in Earth Science, integration of engineering and even the integration of math.**

Regarding sequencing:
Currently, whether or not students graduate is dependent on passing the Biology EOC, which is based on the 2009 Science Learning Standards. While the Biology EOC remains high stakes for teachers, school districts and students in terms of graduation, teachers are not going to be able to "stop teaching" the 2009 state standards until there is a new assessment based on the NGSS. Eliminating the high stakes nature of the Biology EOC would help alleviate this problem.

High School Physical Science		
Year 0	Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concept	
Year 1	Phase in HS-PS1 Matter and Its Interactions; Phase in HS-PS3 Energy **Delete HS-PS3 Energy and phase in HS PS2 Motion and Stability because of relatively small changes to two courses.**	Phase in HS-PS1 Matter and Its Interactions; Phase in HS-PS3 Energy **Do not phase in HS-PS3 Energy.** **Stop teaching PS-2 Properties and Change.** **Stop teaching PS-1 Force and Motion.**
Year 2	Phase in HS-PS2 Motion and Stability: Forces and Interactions and HS-PS3 Energy **Keep the HS-PS3 Energy, delete HS-PS2. This is a bigger change which affects all courses.**	Phase in HS-PS2 Motion and Stability: Forces and Interactions and HS-PS3 Energy
Year 3	Phase in HS-PS4 Waves and Their Applications in Technologies for Information Transfer **This would be a minor change to one course.**	Phase in HS-PS4 Waves and Their Applications in Technologies for Information Transfer **Delete above.** **Stop Teaching PS3-D waves.**

High School Physical Science
Comments: High school is problematic for this set of standards. Which standards move to chemistry? Which move to physics? Do we recommend integrated science? There are multiple pathways depending on this decision. **1. Implement the transition in two years for these standards. Look at this, not as DCI-oriented, but rather as topics that combine standards.** **2. OSPI needs to identify a pathway for high school: Integrated Approach for grades 9-12 OR Disciplinary Core Ideas approach for grades 9-12.** **3. Do not change instructional materials. Focus PD on how to implement the Practices a few at a time, matched to certain DCI's.**

High School Earth and Space Science		
Year 0	Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concepts ✔	
Year 1	Phase in HS-ESS1 Earth's Place in the Universe ✔	Stop teaching WA 9-12 ES1 ✔
Year 2	Phase in HS-ESS2 Earth's Systems ✔ **Since it's not widely taught could the move to NGSS happen in year 1?**	Stop teaching WA 9-12 ES2 and parts of ES3 ✔
Year 3	Phase in HS-ESS3 Earth and Human Activity ✔	Stop teaching WA standards ✔
Comments: High school is problematic for this set of standards. Earth Science is not widely taught across the state. Where do we integrate these standards; How do we infuse them or create a new pathway? What materials are needed and what are the PD needs? **Attention to the PE HS-ESS2-2 need to be paid as it links to * 9-11 LS1A, 9-11 LS1B, and 9-11 LS2A which are assessed on the Biology EOC**		

Engineering, Technology and Application of Science	
Year 0	Awareness Work; study K-12 Framework Science and Engineering Practices; Introduce Cross Cutting Concepts • **Design PD that illustrates the correlation between WA Application standards and Engineering practices, DCI's, and Influence of Science, Engineering and Technology in Society cross-cutting concepts.**

Engineering, Technology and Application of Science		
	• **Develop community awareness of NGSS Engineering practice and design.**	
Year 1	**Identify and optimize existing instruction and instructional materials**	**Stop saying/thinking Application; start saying/thinking "Engineering".**
Year 2	**Develop and implement engineering design lessons that connect to real world applications. Integrate these lessons into existing instruction and instructional materials.**	**Support implementation of the newly designed engineering lessons w/ PD and materials support.**
Year 3	**Implement emerging instructional resources from national non-profits.**	
Comments: What are the material demands for this series of standards? What are the PD needs? We need to determine the best integration of Engineering Design at all grade levels. Where is the natural fit for Engineering Design? **None listed.**		

4 Next Steps

There are two major steps remaining for Washington State. The Superintendent must first decide whether to adopt the NGSS and second, if the NGSS are adopted, OSPI must develop a detailed transition plan to assist districts in the process of converting from the current standards to the NGSS.

Many factors are considered when states decide to adopt a new set of standards. The impact on students, educators, administrators and budgets is profound, and this is not a decision to be made lightly. Twenty-six states took part in developing the NGSS, and most or all of those states are expected to adopt the NGSS within the next two years. Washington State science education leaders had a significant role in developing the NGSS over the past two years, and the influence of the existing Washington Science Learning Standards is reflected in the NGSS, particularly with regard to the integration of the performance expectations with the science and engineering practices, disciplinary core ideas and cross-cutting concepts.

While the impact of adopting new standards is profound, the benefits can be far-reaching. When a majority of the states adopt a core set of standards, curriculum developers take note resulting in focused, quality curricular materials. Students, who move from one location to another, are better poised to maintain consistency in their learning when the standards are the same from state to state. Perhaps most importantly, we will have the ability to develop scientific literacy in a more comprehensive systematic way for all students which will have far reaching positive impacts on our society.

The process of making a decision to adopt the standards involves comparing existing standards to the proposed new standards, identifying strategies ensure a bias-free implementation of the standards, and creating a detailed roadmap for transitioning from one set to another.

Two of the three steps are complete. What remains is to create a transition plan for implementing the NGSS (if adopted) across the state. Participants in the standards comparison work identified both broad transition topics and issues that they believe will need to be addressed, and provided detailed advice on transitions within their grade level/subject areas. This initial feedback will help shape the transition plan when the NGSS are adopted.

Appendix A. Progressions Within the Next Generation Science Standards

The following tables show progressions of the Disciplinary Core Ideas (DCI) through the K-12 spectrum. See *Appendix E: Progressions within the NGSS* at http://www.nextgenscience.org for more information. These tables are included as a reference for readers to understand the DCI codes.

<table>
<tr><th colspan="5">Earth and Space Science Progression</th></tr>
<tr><th></th><th>K-2</th><th>3-5</th><th>6-8</th><th>9-12</th></tr>
<tr><td rowspan="2">ESS1.A The universe and its stars</td><td rowspan="3">Patterns of movement of the sun, moon, and stars as seen from Earth can be observed, described, and predicted.</td><td>Stars range greatly in size and distance from Earth and this can explain their relative brightness.</td><td></td><td rowspan="2">Light spectra from stars are used to determine their characteristics, processes, and lifecycles. Solar activity creates the elements through nuclear fusion. The development of technologies has provided the astronomical data that provide the empirical evidence for the Big Bang theory.</td></tr>
<tr><td></td><td>The solar system is part of the Milky Way, which is one of many billions of galaxies.</td></tr>
<tr><td>ESS1.B Earth and the solar system</td><td>The Earth's orbit and rotation, and the orbit of the moon around the Earth cause observable patterns.</td><td>The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.</td><td>Kepler's laws describe common features of the motions of orbiting objects. Observations from astronomy and space probes provide evidence for explanations of solar system formation. Changes in Earth's tilt and orbit cause climate changes such as Ice Ages.</td></tr>
<tr><td>ESS1.C The history of planet Earth</td><td>Some events on Earth occur very quickly; others can occur very slowly.</td><td>Certain features on Earth can be used to order events that have occurred in a landscape.</td><td>Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history.</td><td>The rock record resulting from tectonic and other geoscience processes as well as objects from the solar system can provide evidence of Earth's early history and the relative ages of major geologic formations.</td></tr>
<tr><td>ESS2.A Earth materials and systems</td><td>Wind and water change the shape of the land.</td><td>Four major Earth systems interact. Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around.</td><td>Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.</td><td>Feedback effects exist within and among Earth's systems.</td></tr>
</table>

Earth and Space Science Progression				
	K-2	**3-5**	**6-8**	**9-12**
ESS2.B Plate tectonics and large-scale system interactions	Maps show where things are located. One can map the shapes and kinds of land and water in any area.	Earth's physical features occur in patterns, as do earthquakes and volcanoes. Maps can be used to locate features and determine patterns in those events.	Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history. Maps are used to display evidence of plate movement.	Radioactive decay and residual heat of formation within Earth's interior contribute to thermal convection in the mantle.
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. --- Complex interactions determine local weather patterns and influence climate, including the role of the ocean.	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.		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.
ESS2.E Bio-geology	Plants and animals can change their local environment ------------------ Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans	Living things can affect the physical characteristics of their environment.	[Content found in LS4.A and LS4.D]	The biosphere and Earth's other systems have many interconnections that cause a continual co-evolution of Earth's surface and life on it
ESS3.A Natural resources		Energy and fuels humans use are derived from natural sources and their use affects the environment. Some resources are renewable over time, others are not.	Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes.	Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits.

Earth and Space Science Progression				
	K-2	3-5	6-8	9-12
	use natural resources for everything they do.			
ESS3.B Natural hazards	In a region, some kinds of severe weather are more likely than others. Forecasts allow communities to prepare for severe weather.	A variety of hazards result from natural processes; humans cannot eliminate hazards but can reduce their impacts.	Mapping the history of natural hazards in a region and understanding related geological forces.	Natural hazards and other geological events have shaped the course of human history at local, regional, and global scales.
ESS3.C Human impacts on Earth systems	Things people do can affect the environment but they can make choices to reduce their impacts.	Societal activities have had major effects on the land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments.	Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.	Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies.
ESS3.D Global climate change	N/A	N/A	Human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.	Global climate models used to predict changes continue to be improved, although discoveries about the global climate system are ongoing and continually needed.

Life Science Progression				
	K-2	3-5	6-8	9-12
LS1.A Structure and function	All organisms have external parts that they use to perform daily functions.	Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction.	All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions.	Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.

Life Science Progression				
	K-2	**3-5**	**6-8**	**9-12**
LS1.B Growth and development of organisms	Parents and offspring often engage in behaviors that help the offspring survive.	Reproduction is essential to every kind of organism. Organisms have unique and diverse life cycles.	Animals engage in behaviors that increase the odds of reproduction. An organism's growth is affected by both genetic and environmental factors.	Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types.
LS1.C Organization for matter and energy flow in organisms	Animals obtain food they need from plants or other animals. Plants need water and light.	Food provides animals with the materials and energy they need for body repair, growth, warmth, and motion. Plants acquire material for growth chiefly from air, water, and process matter and obtain energy from sunlight, which is used to maintain conditions necessary for survival.	Plants use the energy from light to make sugars through photosynthesis. Within individual organisms, food is broken down through a series of chemical reactions that rearrange molecules and release energy.	The hydrocarbon backbones of sugars produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy.
LS1.D Information Processing	Animals sense and communicate information and respond to inputs with behaviors that help them grow and survive.	Different sense receptors are specialized for particular kinds of information; Animals use their perceptions and memories to guide their actions.	Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain; The signals are then processed in the brain, resulting in immediate behavior or memories.	N/A
LS2.A Inter-dependent relationships in ecosystems	Plants depend on water and light to grow, and also depend on animals for pollination or to move their seeds around.	The food of almost any animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants, while decomposers restore some materials back to the soil.	Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving factors, any of which can limit their growth. Competitive, predatory, and mutually beneficial interactions vary across ecosystems but the patterns are shared.	Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem.
LS2.B Cycles of matter and energy transfer in ecosystems	[Content found inLS1.C and ESS3.A]	Matter cycles between the air and soil and among organisms as they live and die.	The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Food webs model	Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food

Life Science Progression				
	K-2	3-5	6-8	9-12
			how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.	web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem elements are combined in different ways and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle.
LS2.C Ecosystem dynamics, functioning, and resilience	N/A	When the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die.	Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.	If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.
LS2.D Social interactions and group behavior	N/A	Being part of a group helps animals obtain food, defend themselves, and cope with changes.	N/A	Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.
LS3.A Inheritance of traits	Young organisms are very much, but not exactly, like their parents and also resemble other organisms of the same kind.	Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops.	Genes chiefly regulate a specific protein, which affect an individual's traits.	DNA carries instructions for forming species' characteristics. Each cell in an organism has the same genetic content, but genes expressed by cells can differ
LS3.B Variation of traits			In sexual reproduction, each parent contributes half of the genes acquired by the offspring resulting in variation between parent and offspring. Genetic information can be altered because of mutations, which may result in beneficial, negative, or no change to proteins in or traits of an organism.	The variation and distribution of traits in a population depend on genetic and environmental factors. Genetic variation can result from mutations caused by environmental factors or errors in DNA replication, or from chromosomes swapping sections during meiosis.
LS4.A Evidence of common ancestry and	N/A	Some living organisms resemble organisms that once lived on Earth. Fossils provide evidence	The fossil record documents the existence, diversity, extinction, and change of many life forms and their	The ongoing branching that produces multiple lines of descent can be inferred by comparing DNA sequences, amino

Life Science Progression				
	K-2	**3-5**	**6-8**	**9-12**
diversity		about the types of organisms and environments that existed long ago.	environments through Earth's history. The fossil record and comparisons of anatomical similarities between organisms enables the inference of lines of evolutionary descent.	acid sequences, and anatomical and embryological evidence of different organisms.
LS4.B Natural selection	N/A	Differences in characteristics between individuals of the same species provide advantages in surviving and reproducing.	Both natural and artificial selection result from certain traits giving some individuals an advantage in surviving and reproducing, leading to predominance of certain traits in a population.	Natural selection occurs only if there is variation in the genes and traits between organisms in a population. Traits that positively affect survival can become more common in a population.
LS4.C Adaptation	N/A	Particular organisms can only survive in particular environments. --- Populations of organisms live in a variety of habitats. Change in those habitats affects the organisms living there.	Species can change over time in response to changes in environmental conditions through adaptation by natural selection acting over generations. Traits that support successful survival and reproduction in the new environment become more common.	Evolution results primarily from genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. Adaptation means that the distribution of traits in a population, as well as species expansion, emergence or extinction, can change when conditions change.
LS4.D Biodiversity and humans	A range of different organisms lives in different places.		Changes in biodiversity can influence humans' resources and ecosystem services they rely on.	Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth.

Physical Science Progression				
	K-2	**3-5**	**6-8**	**9-12**
PS1.A Structure of matter (includes PS1.C Nuclear processes)	Matter exists as different substances that have observable different properties.	Because matter exists as particles that are too small to see, matter is always conserved even if it seems to disappear. Measurements of a variety of observable	The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter.	The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter, including chemical reactions and nuclear

Physical Science Progression				
	K-2	**3-5**	**6-8**	**9-12**
	Different properties are suited to different purposes. Objects can be built up from smaller parts.	properties can be used to identify particular materials.		processes. Repeating patterns of the periodic table reflect patterns of outer electrons. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy to take the molecule apart.
PS1.B Chemical reactions	Heating and cooling substances cause changes that are sometimes reversible and sometimes not.	Chemical reactions that occur when substances are mixed can be identified by the emergence of substances with different properties; the total mass remains the same.	Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.	Chemical processes are understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved.
PS2.A Forces and motion	Pushes and pulls can have different strengths and directions, and can change the speed or direction of its motion or start or stop it.	The effect of unbalanced forces on an object results in a change of motion. Patterns of motion can be used to predict future motion. Some forces act through contact, some forces act even when the objects are not in contact. The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	The role of the mass of an object must be qualitatively accounted for in any change of motion due to the application of a force.	Newton's 2nd law (F=ma) and the conservation of momentum can be used to predict changes in the motion of macroscopic objects.
PS2.B Types of interactions			Forces that act at a distance involve fields that can be mapped by their relative strength and effect on an object.	Forces at a distance are explained by fields that can transfer energy and can be described in terms of the arrangement and properties of the interacting objects and the distance between them. These forces can be used to describe the relationship between electrical and magnetic fields.
PS2.C Stability & instability in physical systems	N/A	N/A	N/A	N/A
PS3.A Definitions of energy	N/A	Moving objects contain energy. The faster the object moves, the more energy it has. Energy	Kinetic energy can be distinguished from the various forms of potential energy. Energy changes to and from	The total energy within a system is conserved. Energy transfer within and between systems can be

Physical Science Progression				
	K-2	3-5	6-8	9-12
PS3.B Conservation of energy and energy transfer	[Content found in PS3.D]	can be moved from place to place by moving objects, or through sound, light, or electrical currents. Energy can be converted from one form to another form.	each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter.	described and predicted in terms of energy associated with the motion or configuration of particles (objects). --------------------------------------- Systems move toward stable states.
PS3.C Relationship between energy and forces	Bigger pushes and pulls cause bigger changes in an object's motion or shape.	When objects collide, contact forces transfer energy so as to change the objects' motions.	When two objects interact, each one exerts a force on the other, and these forces can transfer energy between them.	Fields contain energy that depends on the arrangement of the objects in the field.
PS3.D Energy in chemical processes and everyday life	Sunlight warms Earth's surface.	Energy can be "produced," "used," or "released" by converting stored energy. Plants capture energy from sunlight, which can later be used as fuel or food.	Sunlight is captured by plants and used in a reaction to produce sugar molecules, which can be reversed by burning those molecules to release energy.	Photosynthesis is the primary biological means of capturing radiation from the sun; energy cannot be destroyed, it can be converted to less useful forms.
PS4.AWave properties	Sound can make matter vibrate, and vibrating matter can make sound.	Waves are regular patterns of motion, which can be made in water by disturbing the surface. Waves of the same type can differ in amplitude and wavelength. Waves can make objects move.	A simple wave model has a repeating pattern with a specific wavelength, frequency, and amplitude, and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena including sound and light. Waves can transmit energy.	The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. Waves can be used to transmit information and energy.
PS4.B Electro-magnetic radiation	Objects can be seen only when light is available to illuminate them.	Object can be seen when light reflected from their surface enters our eyes. -------------------------------------- Patterns can encode, send, receive and decode information.	The construct of a wave is used to model how light interacts with objects.	Both an electromagnetic wave model and a photon model explain features of electromagnetic radiation broadly and describe common applications of electromagnetic radiation.
PS4.C Information	People use devices to send		Waves can be used to transmit digital information. Digitized	Large amounts of information can be stored and shipped

Physical Science Progression				
	K-2	3-5	6-8	9-12
technologies and instrument-tation	and receive information.		information is comprised of a pattern of 1s and 0s.	around as a result of being digitized.

Appendix B. Acknowledgements

We are indebted to the volunteers who thoughtfully assisted in conducting the Science Standards Comparison Analysis. The panel members compared the NGSS and the 2009 Washington Science Learning Standards, with a commitment to providing a quality resource to school districts looking for guidance. They devoted many hours out of their busy schedules to do this work. We are grateful for their efforts.

Name	Organization
Adrienne McKay	Federal Way School District
Adrienne Somera	Education Service District 189
Angie DiLoreto	Bellevue School District
B Lippitt	Institute for Systems Biology
Bob Sotak	Everett Public Schools
Caroline Kiehle	Institute for Systems Biology
Cheryl Lydon	Education Service District 121
Cinda Parton	Office of Superintendent of Public Instruction
Craig Gabler	Education Service District 113
Dan Gallagher	Seattle Public Schools
Dana Riley Black	Institute for Systems Biology
Dawn Cope	Office of Superintendent of Public Instruction
Dennis Milliken	Office of Superintendent of Public Instruction
Edward Geary	Western Washington University
Eric Maggi	Spokane School District
Gloria Ferguson	Education Service District 112
Heather Cassidy	Seattle Public Schools
Jake Duke	Bellevue School District
Jeff Ryan	Education Service District 114
Jennifer Eklund	Institute for Systems Biology
Kara Monroe	Office of Superintendent of Public Instruction
Karen Madsen	Office of Superintendent of Public Instruction
Kim Klinke	Institute for Systems Biology
Maren Johnson	Chimacum School District
Mechelle LaLanne	Education Service District 171
Meg Town	Lake Washington School District
Michael Brown	Education Service District 105
Pat Ehrman	Institute for Systems Biology
Sonia Siegel-Vexler	LASER/Pacific Science Center
Stamatis Vokos	Seattle Pacific University
Wendy Whitmer	Education Service District 101

A special thanks is due to the staff and scientists of the Center for Inquiry Science at the Institute for Systems Biology. The Center hosted the day-long work session and provided important contributions to the standards comparison work.

OSPI Planning Staff

Ellen Ebert, Ph.D., Science Director, Teaching and Learning
Gilda Wheeler, Environmental and Sustainability Program Supervisor, Teaching and Learning
Jessica Vavrus, Assistant Superintendent, Teaching and Learning
Breanne Conley, Executive Assistant, Teaching and Learning
Sultana Shah, Administrative Assistant, Teaching and Learning

Relevant Strategies Staff

Porsche Everson, Lead
Dana Twight
Patricia Chandler