Investigating Earth Systems Correlation to the Washington Science Standards, Grades 9-12

Physical Science

EALR 1: Systems (SYS)
Core Content: *Inputs, Outputs, Boundaries and Flows*

Content Standards/Performance Expecations	Location/Page where Standard is found
6-8 SYSA Any *system* may be thought of as containing *subsystems* and as being a *subsystem* of a larger *system*.	
Given a *system*, identify *subsystems* and a larger encompassing *system* (e.g., the heart is a *system* made up of tissues and cells, and is part of the larger circulatory *system*).	CW48-59, CW60-68, CW69-78, W21-31, A39-40, A5-14, A15-25, A65-67, RL1-6, RL35-44
6-8 SYSB The boundaries of a *system* can be drawn differently depending on the features of the *system* being *investigated*, the size of the *system*, and the purpose of the investigation.	
Explain how the boundaries of a *system* can be drawn to fit the purpose of the study (e.g., to study how insect *populations* change a *system* might be a forest, a meadow in the forest, or a single tree).	W 15-20, W21-31, W42-47, W48-56, W57-62, CW1-13, CW20-36, CW48-59, A1-4
6-8 SYSC The *output* of one *system* can become the *input* of another *system*.	
Give an example of how *output* of *matter* or energy from a *system* can become *input* for another *system* (e.g., household waste goes to a landfill).*a	W15-20, W21-31, W48-56, W57-62
6-8 SYSD In an *open system*, *matter* flows into and out of the *system*. In a *closed system*, energy may flow into or out of the *system*, but *matter* stays within the *system*.	
Given a description of a *system*, analyze and defend whether it is open or closed.	W25-20, W21-31, W42-47, W48-56, W57-62, CW1-13, CW20-36, CW48-59, A1-4

6-8 SYSE If the *input* of *matter* or energy is the same as the *output*, then the amount of *matter* or energy in the *system* won't change; but if the *input* is more or less than the *output*, then the amount of *matter* or energy in the *system* will change.	
Measure the flow of *matter* into and out of an *open system* and *predict* how the *system* is likely to change (e.g., a bottle of water with a hole in the bottom, an *ecosystem*, an *electric circuit*).*b	A1-4, W25-20, W21-31, W42-47, W48-56, W57-62, CW1-13, CW20-36, CW48-59
6-8 SYSF The natural and *designed world* is complex; it is too large and complicated to *investigate* and comprehend all at once. Scientists and students learn to define small portions for the convenience of investigation. The units of investigation can be referred to as —systems. ‖	
Given a complex societal issue with strong *science* and *technology* components (e.g., overfishing, global warming), *describe* the issue from a *systems* point of view, highlighting how changes in one part of the *system* are likely to influence other parts of the *system*.	RL45-51, RL52-57, RL58-63, DP41-50, DP61-69, W1-8, W42-47, W48-56, W57-62

EALR 2: Inquiry (INQ)
Core Content: *Questioning and Investigating*

Content Standards/Performance Expecations	Location/Page where Standard is found
6-8 INQA Question Scientific *inquiry* involves asking and answering *questions* and comparing the answer with what scientists already know about the world.	
Generate a *question* that can be answered through scientific investigation. This may involve refining or refocusing a broad and ill-defined *question*.	A73-76, RL1-6, RL7-14, RL15-28, RL34-44, RL45-51, RL52-57, DP1-7, DP8-21, DP2-29, DP30-40, F1-7, A1-4, A15-25, W21-31
6-8 INQB Investigate Different kinds of *questions* suggest different kinds of scientific investigations.	
Plan and conduct a scientific investigation (e.g., *field study*, systematic *observation*, *controlled experiment*, *model*, or simulation) that is appropriate for the *question* being asked.	RL15-28, RL34-44, RL45-51, DP8-21, DP22-29, A15-25, W21-31
Propose a *hypothesis* and give a reason for the *hypothesis* and *explain how* the planned investigation will test the *hypothesis*.	RL15-28, DP1-7, A1-4
Work collaboratively with other students to carry out the investigations.	RL15-28, RL34-44, RL45-51, DP8-21, DP22-29, DP30-40, A15-25, W21-31
6-8 INQC Investigate Collecting, analyzing, and displaying data are essential aspects of all investigations.	

Communicate results using pictures, tables, charts, diagrams, graphic displays, and text that are clear, accurate, and informative. *a	RL7-14, RL15-28, DP8-21, DP22-29, DP30-40, A1-4, A15-25, A26-32, A33-45, W21-31
Recognize and interpret *patterns* – as well as *variations* from previously learned or observed *patterns* – in data, diagrams, symbols, and words.*a	RL7-14, RL15-28, RL34-44, DP8-21, DP22-29, DP30-40, F1-7, A1-4, A15-25, A46-54, W21-31
Use statistical procedures (e.g., median, mean, or mode) to analyze data and make *inferences* about *relationships*.*b	RL15-28, DP8-21, DP22-29, DP30-40, F1-7, A1-4, A15-25, A26-32, A33-45, A46-54, W21-31
6-8 INQD Investigate : For an *experiment* to be valid, all (*controlled*) *variables* must be kept the same whenever possible, except for the *manipulated* (*independent*) *variable* being tested, and the *responding (dependent) variable* being measured and recorded. If a *variable* cannot be *controlled*, it must be reported and accounted for.	
Plan and conduct a *controlled experiment* to test a *hypothesis* about a *relationship* between two *variables*. *c Determine which *variables* should be kept the same (*controlled*), which (*independent*) *variable* should be systematically *manipulated*, and which *responding (dependent) variable* is to be measured and recorded. Report any *variables* not *controlled* and *explain how* they might affect results.	RL15-28, RL34-44, RL45-51, DP8-21, DP22-29, DP30-40, A15-25, W21-31
6-8 INQE Model: *Models* are used to represent objects, events, *systems*, and processes. *Models* can be used to test *hypotheses* and better understand *phenomena*, but they have limitations.	
Create a *model* or *simulation* to represent the behavior of objects, events, *systems*, or processes. Use the *model* to explore the *relationship* between two *variables* and point out how the *model* or simulation is similar to or different from the actual phenomenon.	DP41-50, DP61-69, W1-8, W42-47, W48-56, W57-62
6-8 INQF Explain: It is important to distinguish between the results of a particular investigation and general conclusions drawn from these results.	
Generate a scientific conclusion from an investigation, using inferential logic, and clearly distinguish between results (i.e., *evidence*) and conclusions (e.g., explanation). *Describe* the differences between an objective summary of the findings and an *inference* made from the findings.	RL1-6, RL15-28, RL45-51, DP8-21, DP22-29, DP30-40, DP61-69, F1-7, A15-25, W21-31
6-8 INQG Communicate Clearly: Scientific reports should enable another investigator to repeat the study to check the results.	
Prepare a written report of an investigation by clearly describing the *question* being *investigated*, what was done, and an objective summary of results. The report should provide *evidence* to accept or reject the *hypothesis*, *explain* the *relationship* between two or more *variables*, and identify limitations of the investigation.	RL15-28, DP8-21, DP22-29, DP30-40, F1-7, A1-4, A15-25, A26-32, A33-45, A46-54, W21-31
6-8 INQH Intellectual Honestly: *Science* advances through openness to new *ideas*, honesty, and legitimate *Skepticism*. Asking thoughtful *questions*, querying other scientists' explanations, and evaluating one's own thinking in response to the *ideas* of others are abilities of scientific *inquiry*.	
Recognize flaws in scientific *claims*, such as uncontrolled *variables*, overgeneralizations from limited data, and experimenter bias.	RL15-28, DP61-69
Listen actively and respectfully to research reports by other students. Critique their presentations respectfully, using *logical argument* and *evidence*.	RL15-28, RL29-33, DP8-21, DP61-69, A1-4, A15-25, W21-31

Engage in reflection and self-evaluation.	RL7-14, RL15-28, RL34-44, RL45-51, DP8-21, DP22-29, DP30-40, A15-25, W21-31

EALR 3: Application (APP)
Core Content: *Science, Technology, and Solving Problems*

Content Standards/Performance Expecations	Location/Page where Standard is found
6-8 APPA People have always used *technology* to solve problems. Advances in human civilization are linked to advances in *technology*.	
Describe how a *technology* has changed over time in response to societal challenges (e.g., population increase created a need for mass communication).	RL15-28, DP8-21, DP22-29, DP30-40, F1-7, A1-4, A15-25, A26-32, A33-45, A46-54, W21-31
6-8 APPB *Scientists* and technological designers (including *engineers*) have different goals. Scientists answer *questions* about the *natural world*; technological designers solve problems that help people reach their goals.	
Investigate several professions in which an understanding of *science* and *technology* is required. *Explain* why that understanding is necessary for success in each profession.	DP51-60, DP61-69, A1-4, A55-72, A73-77, CW37-47, W48-56, CW79-87
6-8 APPC *Science* and *technology* are interdependent. *Science* drives *technology* by demanding better instruments and suggesting *ideas* for new designs. *Technology* drives *science* by providing instruments and research methods.	
Give examples to illustrate how scientists have helped solve technological problems (e.g., how the *science* of biology has helped sustain fisheries) and how engineers have aided *science* (e.g., designing telescopes to discover distant planets).	A55-72, A73-77, W48-56, CW79-87
6-8 APPD The process of *technological design* begins by defining a problem, identifying *criteria* for a successful solution, followed by research to better understand the problem, and brainstorming potential *solutions*.	
Formulate a problem that can be solved by the *technological design process*, and identify *criteria* for success.	DP61-69, A55-72, A73-77, W1-8, W42-47, W48-56, W57-62
Research how others have solved similar problems.	DP61-69, A55-72, W57-62
Brainstorm different *solutions*.	DP61-69, A55-72, A73-77, W1-8, W42-47, W48-56, W57-62
6-8 APPE Scientists and engineers often work together to *generate* creative *solutions* to problems and decide which ones are most promising.	
Collaborate with other students to *generate* creative *solutions* to a problem, and *apply* methods for making trade-offs to choose the best *solution*.*a	DP61-69, A55-72, W57-62, CW37-47

6-8 APPF *Solutions* must be tested to determine whether or not they will solve the problem. Results are used to modify the *design*, and the best solution must be communicated persuasively.	
Test the best *solution* by building a model or other representation, and using it with the intended audience. Redesign if necessary.	DP61-69, A55-72, W57-62
Present the recommended *design* using models or drawings and an engaging presentation.*b	RL15-28, DP8-21, DP22-29, DP30-40, F1-7, A1-4, A15-25, A26-32, A33-45, A46-54, W21-31
6-8 APPG The benefits of science and technology are not available to all the people in the world.	
Contrast the benefits of science and technology enjoyed by people in industrialized and developing nations.	DP51-60, DP61-69, A1-4, A55-72, A73-77, CW37-47, W48-56, CW79-87
6-8 APPH People in all *cultures* have made and continue to make contributions to society through *science* and *technology*.	
Describe scientific or technological contributions to society by people in various *cultures*.	DP51-60, DP61-69, A1-4, A55-72, A73-77, W48-56, CW79-87

EALR 4: Earth and Space Science

Content Standards/Performance Expecations	Location/Page where Standard is found
Big Idea: Earth and Space (ES1) Core Content: *The Solar System*	
6-8 ES1A — The Moon's monthly cycle of phases can be explained by its changing relative position as it *orbits* Earth. An *eclipse* of the Moon occurs when the Moon enters Earth's shadow. An *eclipse* of the Sun occurs when the *Moon* is between the Earth and Sun, and the Moon's shadow falls on the Earth.	
Use a physical *model* or diagram to *explain how* the Moon's changing position in its *orbit* results in the changing phases of the *Moon* as observed from Earth.	A5-9, A33-45

Explain how the cause of an *eclipse* of the Moon is different from the cause of the Moon's A5-9,		
6-8 ES1B	Earth is the third planet from the sun in a *system* that includes the Moon, the Sun, seven other major *planets* and their *moons*, and smaller objects, such as *asteroids*, *plutoids*, and *comets*. These bodies differ in many *characteristics* (e.g., size, composition, relative position).	
Compare the relative sizes and distances of the Sun, Moon, Earth, other major *planets*, *moons*, *asteroids*, *plutoids*, and *comets*. *a		A5-9, A15-25, A26-32, A33-45, A46-54, A55-72, A73-77
6-8 ES1C	Most objects in the *Solar System* are in regular and predictable *motion*. These *motion*s *explain* such *phenomena* as the day, the year, *phases of the moon*, and *eclipses*.	
Use a simple physical *model* of the Earth, Sun, Moon *system* or labeled drawing to *explain* day and night, *phases of the Moon*, and *eclipses* of the Moon and Sun.		A5-9, A33-45
6-8 ES1D	*Gravity* is the *force* that keeps planets in *orbit* around the Sun and governs the rest of the *motion* in the *Solar System*. *Gravity* alone holds us to the Earth's surface.	
Predict what would happen to an *orbiting* object if *gravity* were increased, decreased, or taken away.		A15-25
6-8 ES1E	Our Sun is one of hundreds of billions of stars in the *Milky Way galaxy*. Many of these stars have planets *orbiting* around them. The Milky	

	Way galaxy is one of hundreds of billions of galaxies in the universe.	
Construct a physical *model* or diagram showing Earth's position in the *Solar System*, the *Solar System*'s position in the Milky Way, and the Milky Way among other galaxies.		A5-9, A15-25, A26-32, A33-45, A46-54, A55-72, A73-77
Big Idea: Earth Systems, Structures, and Processes (ES2) Core Content: *Cycles in Earth Systems*		
6-8 ES2A	The atmosphere is a *mixture* of nitrogen, oxygen, and trace *gases* that include *water vapor*. The atmosphere has different *properties* at different elevations.	
Describe the composition and *properties* of the troposphere and stratosphere.		CW1-13, CW31-36, CW37-47, CW48-59
6-8 ES2B	The Sun is the major source of energy for *phenomena* on Earth's surface, such as *winds*, ocean currents, and the water cycle.	
Connect the uneven heating of Earth's surface by the Sun to global *wind* and ocean currents.		CW14-21, CW22-36, CW37-47, W21-31
Describe the role of the Sun in the water cycle.		A33-45, CW60-68
6-8 ES2C	In the *water cycle, w*ater *evaporates* from Earth's surface, rises and cools, forms clouds, then condenses and falls as rain or snow, and collects in bodies of water.	
Describe the water cycle and give local examples of where parts of the water cycle can be seen.		W21-31, W1-8, W9-14, W15-20, W32-41, W42-47, W48-56, W57-62

6-8 ES2D Water is a solvent. As it passes through the water cycle, it dissolves minerals and *gases* and carries them to the oceans.	
Distinguish between bodies of saltwater and fresh water and *explain how* saltwater become salty.	W32-41, W21-331, W42-47, W48-56
6-8 ES2E The solid Earth is composed of a relatively thin *crust*, a dense metallic *core*, and a layer called the *mantle* between the *crust* and *core* that is very hot and partially melted.	
Sketch and label the major layers of Earth, showing the approximate relative thicknesses and consistency of the *crust*, *core*, and *mantle*.*a	DP8-21, DP41-50, DP51-60
6-8 ES2F The *crust* is composed of huge *crustal plates* on the scale of continents and oceans, which move centimeters per year, pushed by *convection* in the upper *mantle*, causing earthquakes, volcanoes, and mountains.	
Draw a labeled diagram showing how *convection* in the upper *mantle* drives movement of crustal plates.	DP8-21, DP22-29, DP30-40, DP41-50, DP51-60, DP61-69
Describe what may happen when plate boundaries meet (e.g., earthquakes, *tsunami*, *faults*, mountain building), with examples from the Pacific Northwest.	DP8-21, DP22-29, DP30-40, DP41-50, DP51-60, DP61-69, CW69-78, CW79-87
6-8 ES2G *Landforms* are created by processes that build up structures and processes that break down and carry away material through *erosion* and *weathering*.	
Explain how a given landform (e.g. mountain) has been shaped by processes that build up structures (e.g., uplift) and by processes that break down and carry away material (e.g.,	RL7-14, RL15-28, RL29-33, RL34-44, RL45-51, RL52-57, RL58-62, DP8-21, DP51-60, DP61-69, W9-14, W15-20,

weathering and *erosion*).	W21-31, DP22-29, DP30-40, DP41-50
6-8 ES2H — The *rock cycle describes* the formation of *igneous rock* from magma or lava, *sedimentary* rock from compaction of eroded particles, and *metamorphic* rock by heating and pressure.	
Identify samples of *igneous*, *sedimentary*, and *metamorphic* rock from their *properties*, and *describe* how their *properties* provide *evidence* of how they were formed. *Explain how* one kind of rock could eventually become a different kind of rock.	RL1-6, RL7-14, DP8-21, DP61-69, F8-18
Big Idea: Earth History (ES3) **Core Content: *Evidence of Change***	
6-8 ES3A — Our understanding of Earth history is based on the assumption that processes we see today are similar to those that occurred in the past.	
Describe Earth processes that we can observe and measure today (e.g., rate of *sedimentation*, movement of crustal plates, and changes in composition of the atmosphere) that provide clues to Earth's past.*a	DP51-60, DP61-69, F1-7, F8-18, CW69-78, CW79-87
6-8 ES3B — Thousands of layers of *sedimentary rock* provide *evidence* that allows us to determine the age of Earth's changing surface and to estimate the age of *fossils* found in the rocks.	
Explain how the age of landforms can be estimated by studying the number and thickness of rock layers, as well as *fossils* found within rock layers.	F1-7, F19-27, F28-40, DP51-60, DP61-69, F1-7, F8-18, CW69-78, CW79-87

6-8 ES3C In most locations *sedimentary* rocks are in horizontal formations with the oldest layers on the bottom. However, in some locations, rock layers are folded, tipped, or even inverted, providing *evidence* of geologic events in the distant past.	
Explain why younger layers of *sedimentary rocks* are usually on top of older layers, and *hypothesize* what geologic events could have caused huge blocks of horizontal *sedimentary* layers to be tipped or older rock layers to be on top of younger rock layers.	RL15-28, RL34-44, RL45-51, RL52-57, RL58-62, DP8-18, DP30-40, DP51-60, F41-48, F57-62
6-8 ES3D Earth has been shaped by many natural catastrophes, including earthquakes, volcanic eruptions, glaciers, floods, storms, *tsunami*, and the impacts of *asteroid*s.	
Interpret current landforms of the Pacific Northwest as *evidence* of past geologic events (e.g., Mount St. Helens and Crater Lake provide *evidence* of volcanism, the Channeled Scablands provides *evidence* of floods that resulted from melting of glaciers).	DP8-18, DP30-40, DP51-60, F41-48, F57-62
6-8 ES3E Living *organisms* have played several critical roles in shaping landforms that we see today.	
List several ways that living *organisms* have shaped landforms (e.g., coral islands, limestone deposits, oil and coal deposits).	F1-7, F8-18, F19-27, F28-40, F41-48, F57-62