EarthComm Correlation to the Washington Science Standards, Grades 9-12

EALR 1: Systems (SYS)
Core Content: *Predictability and Feedback*

Content Standards/Performance Expecations	Location/Page where Standard is found
9-12 SYSA *Feedback* is a process in which the *output* of a *system* provides information used to regulate the operation of the *system*. *Positive feedback* increases the disturbance to a *system*. *Negative feedback* reduces the disturbance to a *system*.	
Give examples of a positive *feedback system* and *explain* its regulatory mechanism (e.g., global warming causes Earth's ice caps to melt, reflecting less energy to space, increasing temperatures).*a	**E47-57, E105-116, E117-124, E125-135, E136-143, E156-164, F4-12, F23-36, G85-94, U131-137**
Give examples of a negative *feedback system* and *explain* its regulatory mechanism (e.g., when a human body overheats, it produces sweat that cools the body by evaporation).*a	**E47-57, E105-116, E117-124, E125-135, E136-143, E156-164, F4-12, F23-36, G85-94, U131-137**
9-12 SYSB Systems thinking can be especially useful in analyzing complex situations. To be useful, a *system* needs to be specified as clearly as possible.	
Determine if a *systems* approach will be helpful in answering a *question* or solving a problem.*b	**R146-155, R1560168, R169-176, R177-183, R184-195, R196-202, U124-130, U100-112**
Represent the *system* with a diagram specifying components, boundaries, flows, and *feedbacks*.*a	**R25-34, R156-161, E148-155, E156-164, E165-172, F56-61, R43-61, R72-83, R4-15, R146-155, E117-124, E125-135, F4-12, F13-22, F23-26, F48-55**

Describe relevant *subsystems* and the larger *system* that contains the *system* being analyzed.*a	**R146-155, R1560168, R169-176, R177-183, R184-195, R196-202, U124-130, U100-112**
Determine how the *system functions* with respect to other *systems*.	**R25-34, R156-161, E148-155, E156-164, E165-172, F56-61, R43-61, R72-83, R4-15, R146-155, E117-124, E125-135, F4-12, F13-22, F23-26, F48-55**
9-12 SYSC In complex *systems*, entirely new and unpredictable *properties* may emerge. Consequently, modeling a complex *system* in sufficient detail to make *reliable* predictions may not be possible.	
Create a simplified *model* of a complex *system*. Trace the possible consequences of a change in one part of the *system* and *explain how* the simplified *model* may not be adequate to reliably *predict* consequences.	**E84-95, E105-116, E117-124, E125-135, E136-143, R25-34, R156-161, E148-155, E156-164, E165-172, F56-61, R43-61, R72-83, R4-15, R146-155, E117-124, E125-135, F4-12, F13-22, F23-26, F48-55**
9-12 SYSD Systems can be changing or in equilibrium.	
Analyze whether or not a *system* (e.g., population) is changing or in *equilibrium*. *c	**E84-95, E105-116, E117-124, E125-135, E136-143**
Determine whether a *state* of equilibrium is *static* or *dynamic* (i.e., inflows equal outflows). *c	**R25-34, R156-161, E148-155, E156-164, E165-172, F56-61, R43-61, R72-83, R4-15, R146-155, E117-124, E125-135, F4-12, F13-22, F23-26, F48-55**

EALR 2: Inquiry (INQ)
Core Content: *Conducting Analyses and Thinking Logically*

Content Standards/Performance Expecations	Location/Page where Standard is found
9-12 INQA Question: Scientists *generate* and *evaluate questions* to *investigate* the *natural world*.	

Generate and *evaluate* a *question* that can be answered through a scientific investigation. Critique *questions generated* by others and *explain* whether or not the *questions* are scientific.*a	**G116-117, E128-129, E136-143, E170-171, E185-186**
9-12 INQB Investigate: Scientific progress requires the use of various methods appropriate for answering different kinds of research *questions*, a thoughtful plan for gathering data needed to answer the *question*, and care in collecting, analyzing, and displaying the data.	
Plan and conduct a scientific investigation, choosing a method appropriate to the *question* being asked.	**G37, G39-40, G84, F136, R5-8, R89-90, R97-99, R147-150, R176, R202, E46, E90-91, E127-128, E137-138, E183**
Collect, analyze, and display data using calculators, computers, or other technical devices when available.*b	**G24, G39, G74, G86, G88, G96, G123-124, G132, G165, 168, U5, U70-72, U82, U92-94, U114, U132-133, U137, U147-148, U156, F5, F14-16, F67, F79, F116, F129-130, F136, F152, F159, F168-169, F175, F181, R5-7, R26, R34, R63, R89, R97-99, R121, R128, R137-138, R147, R157-160, R170, R176, R185-186, R197-198, R202, E15, E29, E46, E57, E59, E70, E91, E98**
9-12 INQC Explain: Conclusions must be logical, based on *evidence*, and consistent with prior *established* knowledge.	
Draw conclusions supported by *evidence* from the investigation and consistent with established scientific knowledge.*c	**E28-36, E37-40, E41-46, G105-114**
Analyze alternative explanations and decide which best fits the data.*d	**G105-109, G110-117, R184-188, R189-195, F88-94, G131-137, G155-163, F113-123, E4-13, G164-171**
9-12 INQD Communicate Clearly: The methods and procedures that scientists use to obtain *evidence* must be clearly reported to enhance opportunities for further investigation.	
Write a detailed laboratory report that includes: the *question* that motivated the study, a justification for the kind of investigation chosen, *hypotheses* (if any), a description of what was done, a summary of data in tables and graphs, and a conclusion, based on the *evidence*, that responds to the *question*.	**G24, G39, G74, G86, G88, G96, G123-124, G132, G165, 168, U5, U70-72, U82, U92-94, U114, U132-133,**

	U137, U147-148, U156, F5, F14-16, F67, F79, F116, F129-130, F136, F152, F159, F168-169, F175, F181, R5-7, R26, R34, R63, R89, R97-99, R121, R128, R137-138, R147, R157-160, R170, R176, R185-186, R197-198, R202, E15, E29, E46, E57, E59, E70, E91, E98
9-12 INQE Model: The essence of scientific investigation involves the development of a *theory* or conceptual *model* that can *generate* testable predictions.	
Formulate one or more *hypotheses* based on a *model* or *theory* of a causal *relationship*. Demonstrate creativity and critical thinking to formulate and *evaluate* the *hypotheses*.	**G38-42, G62-77, R184-188, R189-195, E125-129, G131-137**
9-12 INQF Communicate: *Science* is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new *evidence* comes to light.	
Evaluate an investigation to determine if it was a *valid* means of answering the *question*, and whether or not the results were *reliable*. *e	**E28-36, E37-40, E41-46, G105-114**
Describe the development of a scientific *theory* that illustrates logical reasoning, creativity, testing, revision, and replacement of prior *ideas* in light of new *evidence*.	**G116-117, E128-129, E136-143, E170-171, E185-186, G105-116, E173-181, F13-22, G155-163, G62-77, G122-130**
9-12 INQG Intellectual Honesty: Public *communication* among scientists is an essential aspect of research. Scientists *evaluate* the *validity* of one another's investigations, check the *reliability* of results, and *explain* inconsistencies in findings.	
Participate in a scientific discussion about their own investigations and those performed by others.	**R127-135, E37-44, E74-77**
Respond to *questions* and criticisms, and if appropriate, revise explanations based on these discussions.	**U124-126, U131-134, R169-171, R172-176, R184-188, R189-195**
9-12 INQH Intellectual Honesty: Scientists carefully *evaluate* sources of information for *reliability* before using that information. When referring to the *ideas* or findings of others, they cite their sources of information.	
Provide appropriate citations for all *ideas*, findings, and information used in any and all written reports.	**G44, G86, G165, U70-72, 113-114, U132, U156, F67, F79, F136, F152, R5, R89, R97-99, R121, R160, R176,**

	R185-188, R197-198, E91, E183
Explain the consequences for failure to provide appropriate citations.	**G105-117, G4-13, G14-22, G62-73, G147-154, E117-124**

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

Content Standards/Performance Expecations	**Location/Page where Standard is found**
9-12 APPA *Science* affects society and cultures by influencing the way many people think about themselves, others, and the *environment*. Society also affects *science* by its prevailing views about what is important to study, and by deciding what research will be funded.	
Describe ways that scientific *ideas* have influenced society or the development of differing cultures.	**U131-137, E125-135, U122-130, R19-24, E156-164, E136-143, R77-83**
List *questions* that scientists *investigate* that are stimulated by the needs of society (e.g., medical research, *global climate* change).	**G116-117, E128-129, E136-143, E170-171, E185-186**
9-12 APPB The *technological design process* begins by defining a problem in terms of *criteria* and *constraints*, conducting research, and generating several different solutions.	
Work collaboratively with other students to *generate ideas* for solving a problem. Identify *criteria* and *constraints*, research the problem, and *generate* several possible *solutions*.	**G52-53, E128-129, G105-109, G110-117, R184-195, G105-109, G110-117, R184-188, R189-195, F88-94, G131-137, G155-163, F113-123, E4-13, G164-171**
9-12 APPC Choosing the best *solution* involves comparing alternatives with respect to *criteria* and *constraints*, then building and testing a *mode* or other representation of the final design.	
Choose the best *solution* for a problem, create a model or drawing of the final design, and devise a way to test it. Redesign the *solution*, if necessary, then present it to peers.*b	**G116-117, E128-129, E136-143, E170-171, E185-186**
9-12 APPD The ability to solve problems is greatly enhanced by use of mathematics and information technologies.	
Use proportional reasoning, *functions*, graphing, and estimation to solve problems.*a*b*c	R-127-135, R62-71. R184-188, R189-195,

	E125-129, E47-57, G131-137, F138-148, F149-157, F180-188
Use computers, probes, and software when available to collect, display, and analyze data.	**U124-126, U131-134, R169-171, R172-176, R184-188, R189-195**
9-12 APPE Perfect *solutions* do not exist. All technological *solutions* involve *trade-offs* in which decisions to include more of one quality means less of another. All solutions involve consequences, some intended others not.	
Analyze a societal issue that may be addressed through *science* and/or *technology*. *Compare* alternative *solutions* by *considering trade-offs* and unintended consequences (e.g., removing dams to increase salmon spawning).	**G44, G86, G165, U70-72, 113-114, U132, U156, F67, F79, F136, F152, R5, R89, R97-99, R121, R160, R176, R185-188, R197-198, E91, E183**
9-12 APPF - It is important for all citizens to *apply science* and *technology* to critical issues that influence society.	
Critically analyze scientific information in current events to make personal choices, or to inform public-policy decisions.*d	**G105-117, G4-13, G14-22, G62-73, G147-154, E117-124**

EALR 4: Earth and Space Science

Content Standards/Performance Expecations	**Location/Page where Standard is found**
Big Idea: Energy: Transfer, Transformation, and Conservation (PS3) **Core Content: *Evolution of the Universe***	
9-11 ES1A Stars have —*life cycles*. ‖ During their active periods, stars produce heavier *elements*, starting with the *fusion* of hydrogen to form helium. The heaviest *elements* are formed when massive stars —die ‖ in massive explosions.	
Connect the *life cycles* of stars to the production of *elements* through the process of nuclear *fusion*.	E47-57, E69-79
9-11 ES1B The *Big Bang theory* of the origin of the universe is based on *evidence* (e.g., red shift) that all galaxies are rushing apart from one another. As space expanded, and *matter* began to cool, gravitational attraction pulled clumps of *matter* together, forming the stars and galaxies, clouds of *gas* and dust, and *planetary systems* that we see today. If we were to run time backwards we would find that all of the galaxies were in the same place 14.7 billion years ago.	
Cite *evidence* that supports the —*Big Bang theory* ‖ (e.g., red shift of galaxies).	E4-13, E58-68, E69-79
Big Idea: Earth Systems, Structures, and Processes (ES2) Core Content: *Energy in Earth Systems*	
9-11 ES2A *Global climate* differences result from the uneven heating of Earth's surface by the Sun. Seasonal climate variations are due to the tilt of Earth's axis with respect to the plane of Earth's nearly circular *orbit* around the Sun.	
Explain that Earth is warmer near the equator and cooler near the poles due to the uneven heating of Earth by the Sun.	**G85-94, G95-104, G105-117, E47-57, E105-116, E117-124, E125-135, E136-143, E156-164, F4-12, F23-36, U131-137**
Explain that Earth is warmer near the equator and cooler near the poles due to the uneven heating of Earth by the Sun.	**G85-94, G95-104, G105-117, E47-57, E105-116, E117-124, E125-135, E136-143, E156-164, F4-12, F23-36, U131-137**
9-11 ES2B *Climate* is determined by *energy transfer* from the sun at and near Earth's surface. This *energy transfer* is influenced by dynamic processes such as cloud cover and Earth's rotation, as well as static conditions such as proximity to mountain ranges and the ocean. Human activities, such as burning of *fossil fuels*, also affect the *global climate*.	
Explain how the climate in the Pacific Northwest region is affected by seasonal weather *patterns*, as well as other *factors* such as the addition of greenhouse *gases* to the atmosphere, and proximity to mountain ranges and to the ocean.	**F66-76, F77-87, F113-123, F88-94**
9-11 ES2C Earth is a *system* that contains a fixed amount of each stable chemical *element*, existing in different chemical forms. Each *element* on Earth moves among reservoirs in the solid Earth, oceans, atmosphere, and *organisms* as part of *biogeochemical cycles*, driven by energy from Earth's interior and from the Sun.	

Describe the different forms taken by carbon and nitrogen, and the reservoirs where they are found. *Give examples* of carbon found on Earth (e.g., carbonate rocks such as limestone, in coal and oil, in the atmosphere as carbon dioxide *gas*, and in the tissues of all living *organisms*).	**R4-15, R43-61, R146-155, R184-195, E125-135, U4-13, U14-22, U23-32, U33-38**
9-11 ES2D The earth does not have infinite resources; increasing human consumption places severe stress on the natural processes that renew some resources and it depletes those resources that cannot be renewed.	
Identify renewable and nonrenewable resources in the Pacific Northwest region.	**R16-24, R25-34, R35-42, R43-52, R52-61, R62-71, R72-83**
Explain how human use of natural resources stress natural processes and link that use to a possible long term consequence.	**R16-24, R25-34, R35-42, R43-52, R52-61, R62-71, R72-83, F48-55, F95-102, F113-123, F174-179, U138-145, G23-30, G31-37, G147-154, G155-163, F37-47, F48-55, F56-62, U163-170**
Big Idea: Earth History (ES3) Core Content: *Evolution of the Earth*	
9-11 ES3A *Interactions* among the solid Earth, the oceans, the atmosphere, and *organisms* have resulted in the ongoing *evolution* of the Earth *system*. We can observe changes such as earthquakes and volcanic eruptions on a human time scale, but many processes such as mountain building and plate movements take place over hundreds of millions of years.	
Interpret current rock formations of the Pacific Northwest as *evidence* of past geologic events. *Consider* which Earth processes may have caused these landforms (e.g., *erosion*, deposition, and scraping of terrain by glaciers, floods, volcanic eruptions, *tsunami*), and construct a timeline showing the development of the landform.	**U100-112, F167-173, F174-179, F149-157, F158-166, U113-119, U146-154, U70-80, U81-89, U90-99, U155-162**
9-11 ES3B Geologic time can be estimated by several methods (e.g., counting tree rings, observing rock sequences, using *fossils* to correlate sequences at various locations, and using the known decay rates of radioactive isotopes present in rocks to measure the time since the rock was formed).	
Explain how decay rates of radioactive materials in rock layers are used to establish the timing of geologic events. *a	**E148-155, E173-181**
Given a geologic event, *explain* multiple methods that could be used to establish the timing of that event.	**E148-155, E173-181**
9-11 ES3C *Evidence* for one-celled forms of life—the bacteria—extends back billions of years. The appearance of life on Earth caused dramatic changes in the composition of Earth's atmosphere, which did not originally contain oxygen	
Compare the chemical composition of the Earth's atmosphere before bacteria and plants evolved and after they became widespread.	**F66-76, F77-87, E165-172, E173-181, E182-188**
9-11 ES3D Data gathered from a variety of methods have shown that Earth has gone through a number of periods when Earth was much warmer and much colder than today.	

Describe factors that change climates over long periods of time and cite methods that scientists have found to gather information on ancient climates.	**E165-172, E173-181, E182-188, E96-104, E136-143, E117-124**