Active Physical Science Correlation to the Washington Science Standards, Grades 9-12

Physical Science

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	105-110, 111-116, 117-121, 634-643, 696-701, 567-575, 779-784, 809-815, 816-825
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	816-825, 612-619, 634-643, 595-604, 809-815, 111-116, 129-134
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	567-575, 429-432, 792-801, 612-619, 634-643, 111-116, 129-134
Represent the *system* with a diagram specifying components, boundaries, flows, and *feedbacks*.*a	612-619, 634-643, 792-801, 816-825
Describe relevant *subsystems* and the larger *system* that contains the *system* being analyzed.*a	567-575, 429-432, 792-801
Determine how the *system functions* with respect to other *systems*.	567-575, 634-643, 802-808, 429-432
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.	117-121, 129-134, 429-432, 634-643, 816-825, 792-801, 802-808
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	792-801, 816-825, 634-643, 433-440, 805-807
Determine whether a *state* of equilibrium is *static* or *dynamic* (i.e., inflows equal outflows). *c	634-643, 433-440, 805-807, 792-801, 816-825, 634-643

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	Throughout 142-146, 147-150, 239-255, 537-541, 81-85, 208-213, 309-319, 324-325
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.	81-85, 208-213, 309-319, 324-325
Collect, analyze, and display data using calculators, computers, or other technical devices when available.*b	512-525, 86-91, 99-104, 105-11, 111-116, 117-121, 122-128, 129-134, 396-399, 400-404, 405-410, 411-415, 416-420, 421-424, 425-428, 429-432, 433-440, 486-497, 498-502, 503-506, 533-538, 539-541, 309-320
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	18-25, 15-17, 176-183, 142-146, 340-345, 158-160, 214-217, 86-93, 147-150, 151-155, 239-255
Analyze alternative explanations and decide which best fits the data.*d	171-175, 142-146, 147-150, 156-160, 214-217, 340-345
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*.	620-621, 340-345, 86-93, 214-217, 142-146, 147-150, 156-160, 105-121, 129-134, 151-155, 94-98, 576-586, 600-605
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*.	81-85, 208-213, 309-319, 324-325
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	660-665, 167-170, 80-85, 141-146, 18-25, 15-17, 176-183, 142-146, 340-345, 158-160, 214-217, 86-93, 147-150, 151-155, 239-255
Describe the development of a scientific *theory* that illustrates logical reasoning, creativity, testing, revision, and replacement of prior *ideas* in light of new *evidence*.	584, 595-604, 567-575, 706-709, 713-720, 721-730, 731-739, 740-747
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.	142-146, 147-150, 156-160, 214-217, 340-345
Respond to *questions* and criticisms, and if appropriate, revise explanations based on these discussions.	18-25, 15-17, 176-183, 142-146, 340-345, 158-160, 214-217, 86-93, 147-150, 151-155, 239-255, 171-175,

	721-725, 726-730, 755-766
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.	80-85, 86-93, 147-150, 171-175
Explain the consequences for failure to provide appropriate citations.	117-121, 572-574

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.	75, 135, 203, 321, 391, 441, 507, 542, 620
List *questions* that scientists *investigate* that are stimulated by the needs of society (e.g., medical research, *global climate* change).	117-121, 572-574
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*.	99-104, 105-11, 111-116, 117-121, 122-128, 129-134, 396-399, 400-404, 405-410, 411-415, 416-420, 421-424, 425-428, 429-432, 433-440, 486-497, 498-502, 503-506, 533-538, 539-541, 309-320
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	94-98, 123-134, 147-150, 142-146, 533-537, 633-677, 683-688, 94-98, 396-399, 400-404, 405-410, 411-416,

	463-471, 576-578, 612-619, 111-116, 117-121, 122-128, 129-136, 309-321, 539-541
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	18-25, 15-17, 176-183, 142-146, 340-345, 158-160, 214-217, 86-93, 147-150, 151-155, 239-255
Use computers, probes, and software when available to collect, display, and analyze data.	129-134, 147-150, 86-93, 141-150, 151-155, 239-255, 721-725, 726-730
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).	86-91, 214-217,340-345, 584, 595-604, 567-575, 706-709, 713-720, 721-730, 731-739, 740-747,
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	171-175, 142-146, 147-150, 156-160, 214-217, 340-345

EALR 4: Physical Science

Content Standards/Performance Expecations	**Location/Page where Standard is found**
Big Idea: Force and Motion (PS1): Core Content: *Newton's Laws*	
9-11 PS1A *Average velocity* is defined as a change in position with respect to time. Velocity includes both *speed* and direction.	
Calculate the *average velocity* of a moving object, given the object's change in position and time. ($v = x_2-x_1/ t_2-t_1$) *a	86-93, 142-146, 147-150, 156-159, 184-193
Explain how two objects moving at the same *speed* can have different velocities.	208-217, 86-93, 142-146, 156-159, 171-175, 31-44, 45-49, 50-55, 151-155, 160-166, 176-183, 184-193
9-11 PS1B *Average acceleration* is defined as a change in velocity with respect to time. *Acceleration* indicates a change in *speed* and/or a change in direction.	
Calculate the *average acceleration* of an object, given the object's change in velocity with respect to time. ($a = v_2-v_1/ t_2-t_1$) *a	117-121, 160-166, 184-193, 208-217
Explain how an object moving at constant *speed* can be accelerating.*b	184-193, 86-93, 142-146, 156-159, 171-175, 31-44, 45-49, 50-55, 151-155, 160-166, 176-183
9-11 PS1C An object at rest will remain at rest unless acted on by an unbalanced *force*. An object in *motion* at constant velocity will continue at the same velocity unless acted on by an unbalanced *force*. (Newton's 1st *Law* of *Motion*, the =*Law* of Inertia)	
Given specific scenarios, *compare* the *motion* of an object acted on by balanced *forces* with the *motion* of an object acted on by unbalanced *forces*.	4-14, 15-25, 26-30, 18-25, 117-121, 122-128, 255-263, 266-285, 548-549
9-11 PS1D A net *force* will cause an object to accelerate or change direction. A less massive object will *speed* up more quickly than a more massive object subjected to the same *force*. (Newton's 2nd *Law* of *Motion*, F=ma)	
Predict how objects of different *masses* will accelerate when subject to the same *force*. Calculate the *acceleration* of an object, given the object's *mass* and the net *force* on the object, using Newton's 2nd *law* of *Motion* (F=ma).*c	18-25, 117-121, 122-128, 255-263, 266-285, 548-549
9-11 PS1E Whenever one object exerts a *force* on another object, a *force* of equal magnitude is exerted on the first object in the opposite direction. (Newton's 3rd *Law* of *Motion*)	
Illustrate with everyday examples that for every action there is an equal and opposite reaction (e.g., a person exerts the same *force* on the Earth as the Earth exerts on the person).	45-49, 63-66, 15-25, 297-308, 163-165, 178-180, 188-193,

	291, 266-285
9-11 PS1F *Gravitation* is a universal attractive *force* by which objects with *mass* attract one another. The gravitational *force* between two objects is proportional to their *masses* and inversely proportional to the square of the distance between the objects. (Newton's *Law* of Universal Gravitation)	
Predict how the gravitational *force* between two bodies would differ for bodies of different *masses* or different distances apart.*d	15-25, 178-183, 184-193, 259-265, 266-285, 297-308, 553-555, 19-20, 239-252, 253-265, 286-296
Explain how the *weight* of an object can change while its *mass* remains constant	656-665, 239-252, 253-265
9-11 PS1G Electrical *force* is a *force* of nature, independent of *gravity* that exists between charged objects. Opposite charges attract while like charges repel.	
Predict whether two charged objects will attract or repel each other, and *explain* why.	450-454, 548-554, 713-720, 755-766
9-11 PS1H Electricity and magnetism are two aspects of a single *electromagnetic force*. Moving electric charges produce magnetic *forces*, and moving magnets produce electric *forces*.	
Demonstrate and *explain that* an electric current flowing in a wire will create a magnetic field around the wire (i.e., *electromagnetic effect*).	512-516, 517-520, 450-454, 455-462, 521-525, 526-532, 533-538, 539-540
Demonstrate and *explain that* moving a magnet near a wire will cause an electric current to flow in the wire (i.e., the generator *effect*).	512-516, 517-520, 450-454, 455-462, 521-525, 526-532, 533-538, 539-540
Big Idea: Matter: Properties and Change (PS2): Core Content: *Chemical Reactions*	
9-11 PS2A *Atoms* are composed of *protons*, *neutrons*, and *electrons*. The *nucleus* of an *atom* takes up very little of the *atom*'s volume but makes up almost all of the *mass*. The *nucleus* contains *protons* and *neutrons*, which are much more massive than the *electrons* surrounding the *nucleus*. *Protons* have a positive charge, *electrons* are negative in charge, and *neutrons* have no net charge	
Describe the relative charges, *masses*, and locations of the *protons*, *neutrons*, and *electrons* in an *atom* of an element.	713-720, 721-730, 755-766
9-11 PS2B *Atoms* of the same element have the same number of *protons*. The number and arrangement of *electrons* determines how the *atom* interacts with other *atoms* to form molecules and ionic *compounds*.	
Given the number and arrangement of *electrons* in the outermost shell of an *atom*, *predict* the *chemical properties* of the element.	731-739, 740-747
9-11 PS2C When *elements* are listed in order according to the number of *protons*, repeating *patterns* of physical and *chemical properties* identify families of *elements* with similar *properties*. This Periodic Table is a consequence of the repeating *pattern* of outermost *electrons*.	

Given the number of *protons*, identify the *element* using a Periodic Table.	731-739, 740-747
Explain the arrangement of the *elements* on the Periodic Table, including the significant *relationships* among *elements* in a given column or row.	731-739, 740-747
9-11 PS2D *Ions* are produced when *atoms* or molecules lose or gain *electrons*, thereby gaining a positive or negative electrical charge. *Ions* of opposite charge are attracted to each other, forming *ionic bonds*. Chemical formulas for *ionic compounds* represent the proportion of *ion* of each *element* in the *ionic array*.	
Explain how ions and *ionic bonds* are formed (e.g., sodium *atoms* lose an *electron* and chlorine *atoms* gain an *electron*, then the charged *ions* are attracted to each other and form bonds).	721-730, 731-739, 748-754
Explain the meaning of a chemical formula for an *ionic array* (e.g., NaCl).	785-791, 748-754
9-11 PS2E *Compounds* are composed of two or more *elements* bonded together in a fixed proportion by sharing *electrons* between *atoms*, forming *covalent bonds*. Such *compounds* consist of well-defined *molecules*. Formulas of *covalent compounds* represent the types and number of *atoms* of each *element* in each molecule.	
Give examples to illustrate that molecules are groups of two or more *atoms* bonded together (e.g., a molecule of water is formed when one oxygen *atom* shares *electrons* with two hydrogen *atoms*).	721-730, 731-739, 748-754
Explain the meaning of a chemical formula for a molecule (e.g., CH_4 or H_2O).*a	785-791, 748-754
9-11 PS2F All forms of life are composed of large molecules that contain carbon. Carbon *atoms* bond to one another and other *elements* by sharing, forming *covalent bonds*. Stable molecules of carbon have four *covalent bonds* per carbon *atom*.	
Demonstrate how carbon *atoms* form four *covalent bonds* to make large molecules. Identify the *functions* of these molecules (e.g., plant and animal tissue, polymers, sources of food and nutrition, *fossil fuels*).	683-688, 673-677
9-11 PS2G *Chemical reactions* change the arrangement of *atoms* in the molecules of substances. *Chemical reactions* release or acquire energy from their surroundings and result in the formation of new substances.	
Describe at least three *chemical reactions* of particular importance to humans (e.g., burning of *fossil fuels*, *photosynthesis*, rusting of metals)	792-801, 779-784, 816-825, 826-829, 669-670
Use a chemical equation to illustrate how the *atoms* in molecules are arranged before and after a reaction	792-801, 816-825, 836-829
Give examples of *chemical reactions* that either release or acquire energy and result in the formation of new substances (e.g., burning of fossil fuels releases large amounts of energy in the form of heat).	802-808, 629-632
9-11 PS2H *Solutions* are *mixtures* in which particles of one substance are evenly distributed through another substance. *Liquids* are limited in the amount of dissolved *solid* or *gas* that they can contain. *Aqueous solutions* can be described by relative quantities of the dissolved substances and acidity or alkalinity (pH)	
Give examples of *common solutions*. *Explain* the differences among the processes of dissolving, melting, and reacting.	644-649, 792-801

Predict the result of adding increased amounts of a substance to an *aqueous solution*, in concentration and pH.*b	792-801
9-11 PS2I The rate of a physical or *chemical change* may be affected by *factors* such as temperature, surface area, and pressure.	
Predict the *effect* of a change in temperature, surface area, pressure, on the rate of a given physical or *chemical change*.*b	809-815, 634-643, 779-784, 792-801, 650-655
9-11 PS2J The number of *neutrons* in the *nucleus* of an *atom* determines the *isotope* of the *element.* Radioactive isotopes are unstable and emit particles and/or *radiation*. Though the timing of a single nuclear decay is unpredictable, a large group of nuclei decay at a predictable rate, making it possible to estimate the age of materials that contain radioactive isotopes.	
Given the *atomic number* and *atomic mass number* of an isotope, students draw and label a *model* of the *isotope's* atomic structure (number of *protons*, *neutrons* and *electrons*)	755-766, 595-604
Given data from a sample, use a decay curve for a radioactive isotope to find the age of the sample. *Explain how* the decay curve is derived. *c	755-766
9-11 PS2K Nuclear reactions convert *matter* into energy, releasing large amounts of energy compared with *chemical reactions*. *Fission* is the splitting of a large *nucleus* into smaller pieces. *Fusion* is the joining of nuclei and is the process that *generates* energy in the Sun and other stars.	
Distinguish between nuclear *fusion* and nuclear *fission* by describing how each process transforms *elements* present before the reaction into *elements* present after the reaction.	755-766, 595-604, 605-611, 612-619
Big Idea: Energy: Transfer, Transformation, and Conservation (PS3) **Core Content: *Transformation and Conservation of Energy***	
9-11 PS3A Although energy can be *transferred* from one object to another and can be *transformed* from one *form* of energy to another form, the total energy in a *closed system* is constant and can neither be created nor destroyed. (*Conservation of Energy*)	
Describe a situation in which energy is *transferred* from one place to another, and *explain how* energy is conserved.*a	433-440, 416-420, 634-643, 31-44, 218-230, 721-730, 194-202
Describe a situation in which energy is *transformed* from one *form* to another and *explain how* energy is conserved.*a	678-682, 683-688, 721-730, 194-202, 411-415, 486-497, 346-353
9-11 PS3B *Kinetic energy* is the energy of *motion*. The kinetic energy of an object is defined by the equation: $E_k = ½ mv^2$	
Calculate the *kinetic energy* of an object, given the object's *mass* and velocity. *b	31-44, 184-193, 194-202, 218-230, 231-236
9-11 PS3C *Gravitational potential energy* is due to the separation of mutually attracting *masses*. *Transformations* can occur between *gravitational potential energy* and *kinetic energy*, but the total amount of energy remains constant.	

Give an example in which *gravitational potential energy* and *kinetic energy* are changed from one to the other (e.g., a child on a swing illustrates the alternating *transformation* of *kinetic* and *gravitational potential energy*).	31-44, 184-193, 194-202, 218-230, 231-236
9-11 PS3D *Waves* (including sound, seismic, light, and water *waves*) *transfer* energy when they interact with *matter*. *Waves* can have different *wavelengths, frequencies, amplitudes,* and travel at different *speeds*.	
Demonstrate how energy can be transmitted by sending *waves* along a spring or rope. Characterize physical *waves* by *frequency*, *wavelength*, *amplitude*, and *speed*. *Apply* these *properties* to the pitch and volume of sound *waves*, and to the *wavelength* and magnitude of water *waves*.*b	326-339, 340-345, 346-353, 354-361
9-11 PS3E *Electromagnetic waves* differ from physical *waves* because they do not require a medium and they all travel at the same *speed* in a vacuum. This is the maximum *speed* that any object or *wave* can travel. Forms of *electromagnetic waves* include X-rays, ultraviolet, visible light, infrared, and radio.	
Illustrate the *electromagnetic spectrum* with a labeled diagram, showing how regions of the spectrum differ regarding *wavelength*, *frequency*, and energy, and how they are used (e.g., infrared in *heat* lamps, microwaves for heating foods, X-rays for medical imaging).	721-730, 418, 576-586