Physical Science (#2003310)

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Course Standards

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SC.912.E.7.1:	Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon. **Clarifications:** Describe that the Earth system contains fixed amounts of each stable chemical element and that each element moves among reservoirs in the solid earth, oceans, atmosphere and living organisms as part of biogeochemical cycles (i.e., nitrogen, water, carbon, oxygen and phosphorus), which are driven by energy from within the Earth and from the Sun.
SC.912.L.18.7:	Identify the reactants, products, and basic functions of photosynthesis.
SC.912.L.18.8:	Identify the reactants, products, and basic functions of aerobic and anaerobic cellular respiration.
SC.912.L.18.12:	Discuss the special properties of water that contribute to Earth's suitability as an environment for life: cohesive behavior, ability to moderate temperature, expansion upon freezing, and versatility as a solvent. **Clarifications:** Annually assessed on Biology EOC.
SC.912.N.1.1:	Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following: 1. **Pose questions about the natural world,** (Articulate the purpose of the investigation and identify the relevant scientific concepts). 2. **Conduct systematic observations,** (Write procedures that are clear and replicable. Identify observables and examine relationships between test (independent) variable and outcome (dependent) variable. Employ appropriate methods for accurate and consistent observations; conduct and record measurements at appropriate levels of precision. Follow safety guidelines). 3. **Examine books and other sources of information to see what is already known,** 4. **Review what is known in light of empirical evidence,** (Examine whether available empirical evidence can be interpreted in terms of existing knowledge and models, and if not, modify or develop new models). 5. **Plan investigations,** (Design and evaluate a scientific investigation). 6. **Use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs),** (Collect data or evidence in an organized way. Properly use instruments, equipment, and materials (e.g., scales, probeware, meter sticks, microscopes, computers) including set-up, calibration, technique, maintenance, and storage). 7. **Pose answers, explanations, or descriptions of events,**

	8. **Generate explanations that explicate or describe natural phenomena (inferences),** 9. **Use appropriate evidence and reasoning to justify these explanations to others,** 10. **Communicate results of scientific investigations, and** 11. **Evaluate the merits of the explanations produced by others.**
SC.912.N.1.2:	Describe and explain what characterizes science and its methods. **Clarifications:** Science is characterized by empirical observations, testable questions, formation of hypotheses, and experimentation that results in stable and replicable results, logical reasoning, and coherent theoretical constructs. Florida Standards Connections: MAFS.K12.MP.3: Construct viable arguments and critique the reasoning of others.
SC.912.N.1.3:	Recognize that the strength or usefulness of a scientific claim is evaluated through scientific argumentation, which depends on critical and logical thinking, and the active consideration of alternative scientific explanations to explain the data presented. **Clarifications:** Assess the reliability of data and identify reasons for inconsistent results, such as sources of error or uncontrolled conditions. Florida Standards Connections: MAFS.K12.MP.2: Reason abstractly and quantitatively; MAFS.K12.MP.3: Construct viable arguments and critique the reasoning of others
SC.912.N.1.4:	Identify sources of information and assess their reliability according to the strict standards of scientific investigation. **Clarifications:** Read, interpret, and examine the credibility and validity of scientific claims in different sources of information, such as scientific articles, advertisements, or media stories. Strict standards of science include controlled variables, sufficient sample size, replication of results, empirical and measurable evidence, and the concept of falsification. Florida Standards Connections: LAFS.910.RST.1.1 / LAFS.1112.RST.1.1.
SC.912.N.1.5:	Describe and provide examples of how similar investigations conducted in many parts of the world result in the same outcome. **Clarifications:** Recognize that contributions to science can be made and have been made by people from all over the world.
SC.912.N.1.6:	Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied. **Clarifications:** Collect data/evidence and use tables/graphs to draw conclusions and make inferences based on patterns or trends in the data. Florida Standards Connections: MAFS.K12.MP.1: Make sense of problems and persevere in solving them.
SC.912.N.1.7:	Recognize the role of creativity in constructing scientific questions, methods and explanations. **Clarifications:** Work through difficult problems using creativity, and critical and analytical thinking in problem solving (e.g. convergent versus

	divergent thinking and creativity in problem solving). Florida Standards Connections: MAFS.K12.MP.1: Make sense of problems and persevere in solving them; and MAFS.K12.MP.2: Reason abstractly and quantitatively.
SC.912.N.2.1:	Identify what is science, what clearly is not science, and what superficially resembles science (but fails to meet the criteria for science). **Clarifications:** Science is the systematic and organized inquiry that is derived from observations and experimentation that can be verified or tested by further investigation to explain natural phenomena (e.g. Science is testable, pseudo-science is not; science seeks falsifications, pseudo-science seeks confirmations.)
SC.912.N.2.2:	Identify which questions can be answered through science and which questions are outside the boundaries of scientific investigation, such as questions addressed by other ways of knowing, such as art, philosophy, and religion. **Clarifications:** Identify scientific questions that can be disproved by experimentation/testing. Recognize that pseudoscience is a claim, belief, or practice which is presented as scientific, but does not adhere to strict standards of science (e.g. controlled variables, sample size, replicability, empirical and measurable evidence, and the concept of falsification). Florida Standards Connections: MAFS.K12.MP.3: Construct viable arguments and critique the reasoning of others.
SC.912.N.2.3:	Identify examples of pseudoscience (such as astrology, phrenology) in society. **Clarifications:** Determine if the phenomenon (event) can be observed, measured, and tested through scientific experimentation.
SC.912.N.2.4:	Explain that scientific knowledge is both durable and robust and open to change. Scientific knowledge can change because it is often examined and re-examined by new investigations and scientific argumentation. Because of these frequent examinations, scientific knowledge becomes stronger, leading to its durability. **Clarifications:** Recognize that ideas with the most durable explanatory power become established theories, but scientific explanations are continually subjected to change in the face of new evidence. Florida Standards Connections: MAFS.K12.MP.1: Make sense of problems and persevere in solving them; MAFS.K12.MP.3: Construct viable arguments and critique the reasoning of others.
SC.912.N.2.5:	Describe instances in which scientists' varied backgrounds, talents, interests, and goals influence the inferences and thus the explanations that they make about observations of natural phenomena and describe that competing interpretations (explanations) of scientists are a strength of science as they are a source of new, testable ideas that have the potential to add new evidence to support one or another of the explanations. **Clarifications:** Recognize that scientific questions, observations, and conclusions may be influenced by the existing state of scientific

	knowledge, the social and cultural context of the researcher, and the observer's experiences and expectations. Identify possible bias in qualitative and quantitative data analysis.
SC.912.N.3.1:	Explain that a scientific theory is the culmination of many scientific investigations drawing together all the current evidence concerning a substantial range of phenomena; thus, a scientific theory represents the most powerful explanation scientists have to offer. **Clarifications:** Explain that a scientific theory is a well-tested hypothesis supported by a preponderance of empirical evidence. Florida Standards Connections: MAFS.K12.MP.1: Make sense of problems and persevere in solving them; and, MAFS.K12.MP.3: Construct viable arguments and critique the reasoning of others.
SC.912.N.3.2:	Describe the role consensus plays in the historical development of a theory in any one of the disciplines of science. **Clarifications:** Recognize that scientific argument, disagreement, discourse, and discussion create a broader and more accurate understanding of natural processes and events. Florida Standards Connections: MAFS.K12.MP.3: Construct viable arguments and critique the reasoning of others.
SC.912.N.3.3:	Explain that scientific laws are descriptions of specific relationships under given conditions in nature, but do not offer explanations for those relationships. **Clarifications:** Recognize that a scientific theory provides a broad explanation of many observed phenomena while a scientific law describes how something behaves.
SC.912.N.3.4:	Recognize that theories do not become laws, nor do laws become theories; theories are well supported explanations and laws are well supported descriptions. **Clarifications:** Recognize that theories do not become laws, theories explain laws. Recognize that not all scientific laws have accompanying explanatory theories.
SC.912.N.3.5:	Describe the function of models in science, and identify the wide range of models used in science. **Clarifications:** Describe how models are used by scientists to explain observations of nature. Florida Standards Connections: MAFS.K12.MP.4: Model with mathematics.
SC.912.N.4.1:	Explain how scientific knowledge and reasoning provide an empirically-based perspective to inform society's decision making. **Clarifications:** Recognize that no single universal step-by-step scientific method captures the complexity of doing science. A number of shared values and perspectives characterize a scientific approach.

	MAFS.K12.MP.1: Make sense of problems and persevere in solving them, and MAFS.K12.MP.2: Reason abstractly and quantitatively.
SC.912.N.4.2:	Weigh the merits of alternative strategies for solving a specific societal problem by comparing a number of different costs and benefits, such as human, economic, and environmental. **Clarifications:** Identify examples of technologies, objects, and processes that have been modified to advance society, and explain why and how they were modified. Discuss ethics in scientific research to advance society (e.g. global climate change, historical development of medicine and medical practices). Florida Standards Connections: MAFS.K12.MP.1: Make sense of problems and persevere in solving them, and MAFS.K12.MP.2: Reason abstractly and quantitatively.
SC.912.P.8.1:	Differentiate among the four states of matter. **Clarifications:** Differentiate among the four states of matter (solid, liquid, gas and plasma) in terms of energy, particle motion, and phase transitions. (Note: Currently five states of matter have been identified.)
SC.912.P.8.2:	Differentiate between physical and chemical properties and physical and chemical changes of matter. **Clarifications:** Discuss volume, compressibility, density, conductivity, malleability, reactivity, molecular composition, freezing, melting and boiling points. Describe simple laboratory techniques that can be used to separate homogeneous and heterogeneous mixtures (e.g. filtration, distillation, chromatography, evaporation).
SC.912.P.8.4:	Explore the scientific theory of atoms (also known as atomic theory) by describing the structure of atoms in terms of protons, neutrons and electrons, and differentiate among these particles in terms of their mass, electrical charges and locations within the atom. **Clarifications:** Explain that electrons, protons and neutrons are parts of the atom and that the nuclei of atoms are composed of protons and neutrons, which experience forces of attraction and repulsion consistent with their charges and masses. Florida Standards Connections: MAFS.K12.MP.4: Model with mathematics.
SC.912.P.8.5:	Relate properties of atoms and their position in the periodic table to the arrangement of their electrons. **Clarifications:** Use the periodic table and electron configuration to determine an element's number of valence electrons and its chemical and physical properties. Explain how chemical properties depend almost entirely on the configuration of the outer electron shell.
SC.912.P.8.7:	Interpret formula representations of molecules and compounds in terms of composition and structure.

	Clarifications: Write chemical formulas for simple covalent (HCl, SO2, CO2, and CH4), ionic (Na+ + Cl- +NaCl) and molecular (O2, H2O) compounds. Predict the formulas of ionic compounds based on the number of valence electrons and the charges on the ions.
SC.912.P.8.8:	Characterize types of chemical reactions, for example: redox, acid-base, synthesis, and single and double replacement reactions. **Clarifications:** Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
SC.912.P.8.11:	Relate acidity and basicity to hydronium and hydroxyl ion concentration and pH. **Clarifications:** Use experimental data to illustrate and explain the pH scale to characterize acid and base solutions. Compare and contrast the strengths of various common acids and bases.
SC.912.P.10.1:	Differentiate among the various forms of energy and recognize that they can be transformed from one form to others. **Clarifications:** Differentiate between kinetic and potential energy. Recognize that energy cannot be created or destroyed, only transformed. Identify examples of transformation of energy: Heat to light in incandescent electric light bulbs; Light to heat in laser drills; Electrical to sound in radios; Sound to electrical in microphones; Electrical to chemical in battery rechargers; Chemical to electrical in dry cells; Mechanical to electrical in generators [power plants]; Nuclear to heat in nuclear reactors; Gravitational potential energy of a falling object is converted to kinetic energy then to heat and sound energy when the object hits the ground.
SC.912.P.10.3:	Compare and contrast work and power qualitatively and quantitatively. **Clarifications:** Describe both qualitatively and quantitatively how work can be expressed as a change in mechanical energy, and the concept of power as the rate at which work is done per unit time. Recognize that when a net force, F, acts through a distance on an object of mass, m, work is done on the object.
SC.912.P.10.4:	Describe heat as the energy transferred by convection, conduction, and radiation, and explain the connection of heat to change in temperature or states of matter. **Clarifications:** Explain the mechanisms (convection, conduction and radiation) of heat transfer. Explain how heat is transferred (energy in motion) from a region of higher temperature to a region of lower temperature until equilibrium is established. Solve problems involving heat flow and temperature changes by using known values of specific heat and/or phase change constants (latent heat). Explain the phase transitions and temperature changes demonstrated by a heating or cooling curve.
SC.912.P.10.5:	Relate temperature to the average molecular kinetic energy.

	Clarifications: Recognize that the internal energy of an object includes the energy of random motion of the object's atoms and molecules, often referred to as thermal energy.
SC.912.P.10.7:	Distinguish between endothermic and exothermic chemical processes. **Clarifications:** Classify chemical reactions and phase changes as exothermic (release thermal energy) or endothermic (absorb thermal energy).
SC.912.P.10.10:	Compare the magnitude and range of the four fundamental forces (gravitational, electromagnetic, weak nuclear, strong nuclear). **Clarifications:** Recognize and discuss the effect of each force on the structure of matter and the evidence for it.
SC.912.P.10.12:	Differentiate between chemical and nuclear reactions. **Clarifications:** Describe how chemical reactions involve the rearranging of atoms to form new substances, while nuclear reactions involve the change of atomic nuclei into entirely new atoms. Identify real-world examples where chemical and nuclear reactions occur every day.
SC.912.P.10.14:	Differentiate among conductors, semiconductors, and insulators. **Clarifications:** Describe band structure, valence electrons, and how the charges flow or rearrange themselves between conductors and insulators.
SC.912.P.10.15:	Investigate and explain the relationships among current, voltage, resistance, and power. **Clarifications:** Use Ohm's and Kirchhoff's laws to explain the relationships among circuits.
SC.912.P.10.18:	Explore the theory of electromagnetism by comparing and contrasting the different parts of the electromagnetic spectrum in terms of wavelength, frequency, and energy, and relate them to phenomena and applications. **Clarifications:** Describe the electromagnetic spectrum (i.e., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays and gamma rays) in terms of frequency, wavelength and energy. Solve problems involving wavelength, frequency, and energy.
SC.912.P.10.21:	Qualitatively describe the shift in frequency in sound or electromagnetic waves due to the relative motion of a source or a receiver. **Clarifications:** Describe the apparent change in frequency of waves due to the motion of a source or a receiver (the Doppler effect).
SC.912.P.12.2:	Analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time.

	Clarifications: Solve problems involving distance, velocity, speed, and acceleration. Create and interpret graphs of 1-dimensional motion, such as position versus time, distance versus time, speed versus time, velocity versus time, and acceleration versus time where acceleration is constant. Florida Standards Connections: MAFS.912.N-VM.1.3 (+) Solve problems involving velocity and other quantities that can be represented by vectors.
SC.912.P.12.3:	Interpret and apply Newton's three laws of motion. **Clarifications:** Explain that when the net force on an object is zero, no acceleration occurs; thus, a moving object continues to move at a constant speed in the same direction, or, if at rest, it remains at rest (Newton's first law). Explain that when a net force is applied to an object its motion will change, or accelerate (according to Newton's second law, F = ma). Predict and explain how when one object exerts a force on a second object, the second object always exerts a force of equal magnitude but of opposite direction and force back on the first: F1 on 2 = -F1 on 1 (Newton's third law).
SC.912.P.12.4:	Describe how the gravitational force between two objects depends on their masses and the distance between them. **Clarifications:** Describe Newton's law of universal gravitation in terms of the attraction between two objects, their masses, and the inverse square of the distance between them.
SC.912.P.12.7:	Recognize that nothing travels faster than the speed of light in vacuum which is the same for all observers no matter how they or the light source are moving. **Clarifications:** Recognize that regardless of the speed of an observer or source, *in a vacuum* the speed of light is always *c*.
SC.912.P.12.10:	Interpret the behavior of ideal gases in terms of kinetic molecular theory. **Clarifications:** Using the kinetic molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle's law), volume and temperature (Charles's law), pressure and temperature (Gay-Lussac's law), and number of particles in a gas sample (Avogadro's hypothesis).
SC.912.P.12.11:	Describe phase transitions in terms of kinetic molecular theory. **Clarifications:** Explain, at the molecular level, the behavior of matter as it undergoes phase transitions.
SC.912.P.12.12:	Explain how various factors, such as concentration, temperature, and presence of a catalyst affect the rate of a chemical reaction.

	Clarifications: Various factors could include: temperature, pressure, solvent and/or solute concentration, sterics, surface area, and catalysts. The rate of reaction is determined by the activation energy, and the pathway of the reaction can be shorter in the presence of enzymes or catalysts. Examples may include: decomposition of hydrogen peroxide using manganese (IV) oxide; nitration of benzene using concentrated sulfuric acid; hydrogenation of a C=C double bond using nickel.