FOSS and SEEd Standard Alignment
Sixth Grade

Strand 6.1: STRUCTURE AND MOTION WITHIN THE SOLAR SYSTEM

The solar system consists of the Sun, planets, and other objects within the Sun's gravitational influence. Gravity is the force of attraction between masses. The Sun-Earth-Moon system provides an opportunity to study interactions between objects in the solar system that influence phenomena observed from Earth. Scientists use data from many sources to determine the scale and properties of objects in our solar system.

FOSS	STANDARDS
Planetary Science **Investigation 1: Earth as a System** **Part 1:** School to Space **SEP: Asking questions, Analyzing and interpreting data, Using mathematics and computational thinking** CCC: System and system models, scale proportion and quantity, Patterns **Standard Content:** Location or position can be described in terms of a frame of reference (relationship to other objects). Point of view is a potion from which an observation is made. **Part 2:** Earth's System **SEP: Using mathematics and computational thinking, Engaging in argument from evidence, Obtaining, evaluating and communicating information.** CCC: System and system models, scale proportion and quantity **Standard Content:** Earth is a system composed of subsystems.	**6.1.1 Develop and use a model** of the Sun-Earth-Moon system to describe the cyclic patterns of lunar phases, eclipses of the Sun and Moon, and seasons. Examples of models could be physical, graphical, or conceptual. (ESS1.A, ESS1.B)

Part 3: Moon Watch **SEP: Developing and using models, Planning and carrying out investigations** CCC: System and system models, scale proportion and quantity **Standard Content:** The Moon can be observed both day and night.	
Planetary Science **Investigation 2: Earth/ Sun Relationship** **Part 1:** Day and Night **SEP: Developing and using models, Planning and carrying out investigations, Constructing explanations, Engaging in argument from evidence, Obtaining, evaluating, and communicating information** CCC: Scale, proportion and quantity, Patterns, System and system models, Cause and effect **Standard Content:** At times, half of Earth is illuminated and half is dark. Daytime and nighttime are the result of Earth's rotation on its axis. Earth's axis tilts at an angle of 23.5 degrees and points toward the North Star. **Part 2:** Summer Heat **SEP: Developing and using models, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations, Engaging in argument from evidence** CCC: Scale, proportion and quantity, Patterns, Structure and function, Energy and matter,, Cause and effect **Standard Content:** Earth's axis tilts at an angle of 23.5 degrees and points toward the North Star. The intensity of solar radiation on Earth's surface depends on the solar angle - that angle at which sunlight strikes the surface. The tilt of the Earth's axis and Earth's revolution around the Sun results in seasons. **Part 3:** Day Length **SEP: Asking questions, Developing and using models, Planning and**	**6.1.1 Develop and use a model** of the Sun-Earth-Moon system to describe the cyclic patterns of lunar phases, eclipses of the Sun and Moon, and seasons. Examples of models could be physical, graphical, or conceptual. (ESS1.A, ESS1.B)

carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating, and communicating information CCC: Patterns, Cause and effect, Scale and proportion and quantity **Standard Content:** Earth's axis tilts at an angle of 23.5 degrees and points toward the North Star. The intensity of solar radiation on Earth's surface depends on the solar angle- that angle at which sunlight strikes the surface. The tilt of Earth's axis and Earth's revolution around the Sun results in season.	
Planetary Science **Investigation 3: Moon Study** **Part 1:** A Close Look at the Moon **SEP: Asking questions, Obtaining, evaluating, and communicating information** CCC: Patterns **Standard Content:** The Moon's surface features that can be identified in telescope images: craters, maria, and mountains. The moon, Earth's satellite, is about one-fourth Earth's diameter, and orbits at a distance of about 384,000 km. **Part 2:** How Big/ How Far **SEP: Developing and using models, Planning and carrying out investigations, Using mathematics and computational thinking** CCC: Scale, proportion and quantity, System and system models, Patterns **Standard Content:** Scale is the size relationship between a representation of an object and the object. Scale can be expressed as a ratio when an object and its representation are measured in related units.	**6.1.1 Develop and use a model** of the Sun-Earth-Moon system to describe the cyclic patterns of lunar phases, eclipses of the Sun and Moon, and seasons. Examples of models could be physical, graphical, or conceptual. (ESS1.A, ESS1.B)

Planetary Science **Investigation 4 At a Glance** **Part 1:** Observed Patterns **SEP: Asking questions, Developing and using models, Planning and carrying out investigations, Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Patterns, System and system models, Cause and effect **Standard Content:** The Moon goes through phases: "new" to "full" and back to "new" in a 4-week cycle. The Moon shines as a result of reflected light from the Sun. Half of the Moon is always illuminated (except during a lunar eclipse. The Moon revolves around Earth once in 4 weeks, resulting in the Moon's rising about 50 minutes later each day. The revolution of the Moon around Earth and the rotation of Earth on its axis account for the phases of the Moon and the time of day (or night) when the Moon is visible. **Part 2:** Moon- Phase Models **SEP: Asking questions, Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Patterns, System and system models. Cause and effect **Standard Content:** The Moon shines as a result of reflected light from the Sun. Half of the Moon is always illuminated (except during a lunar eclipse). Moon phase depends on how much of the Moon's illuminated surface is visible from Earth, which is determined by the relative position of Earth and the Moon with respect to the Sun. The revolution of the Moon around Earth and the rotation of Earth on its axis account for the phases of the Moon and the time of day (or night) when the Moon is visible.	**6.1.3 Use computational thinking to analyze data** and determine the scale and properties of objects in the solar system. Examples of scale could include size and distance. Examples of properties could include layers, temperature, surface features, and orbital radius. Data sources could include Earth and space-based instruments such as telescopes and satellites. Types of data could include graphs, data tables, drawings, photographs, and models. (ESS1.A, ESS1.B)

Part 3: Moon: Phase Simulation **SEP: Developing and using models, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Patterns, System and system models. Cause and effect **Standard Content:** Moon phase depends on how much of the Moon's illuminated surface is visible from Earth, which is determined by the relative position of Earth and the Moon with respect to the Sun. The revolution of the Moon around Earth and the rotation of Earth on its axis account for the phases of the Moon and the time of day (or night) when the Moon is visible.	
Planetary Science **Investigation 5: Craters** **Part 1:** Moon Craters **SEP: Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations, Engaging in argument from evidence, Obtaining, evaluating, and communicating information** CCC: Cause and effect, Stability and change, Scale, proportion, and quantity, Patterns **Standard Content:** Craters of various sizes and types result when meteoroids of various sizes impact the surface of planets and satellites. Craters can be categorized by size and physical characteristic, simple, complex, terraced and flooded. **Part 2:** Target Earth **SEP: Asking questions and defining problems, Planning and carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Obtaining, evaluating, and communicating information** CCC: Cause and effect, Scale, proportion and quantity, Stability and change	**LOOSELY 6.1.1 Develop and use a model** of the Sun-Earth-Moon system to describe the cyclic patterns of lunar phases, eclipses of the Sun and Moon, and seasons. Examples of models could be physical, graphical, or conceptual. (ESS1.A, ESS1.B)

Standard Content: Earth and the Moon have been and continue to be, subjected to the same rate of bombardement by meteoroids. Earth's record of impacts have been erased by the actions of wind, water, and tectonic activity.	
Planetary Science **Investigation 7 The Solar System** **Part 1:** Where are the Planets? **SEP: Developing and using models, Using mathematics and computational thinking, Obtaining, evaluating and communicating information** CCC: Scale, proportion, and quantity, System and system models, and Patterns **Standard Content:** The distance between solar system objects is enormous. **Part 2:** Comparing Temperatures and Atmospheres **SEP: Developing and using models, Analyzing and interpreting data, Constructing explanations, Engaging in argument from evidence, Obtaining, evaluating and communicating information** CCC: Patterns, Cause and effect **Standard Content:** Liquid water is essential for life as we know it. The temperature on a planet depends on two major variables: distance from the Sun, and then nature of the planet's atmosphere. **LOOSELY: Part 3:** Where Is the Water? **SEP: Analyzing and interpreting data, Constructing explanations, Engaging in argument from evidence, Obtaining, evaluating and communicating information** CCC: Patterns, Scale, proportion and quantity **Standard Content:** Images can convey information about the presence and history of liquid water on planetary surfaces.	**6.1.3 Use computational thinking to analyze data** and determine the scale and properties of objects in the solar system. Examples of scale could include size and distance. Examples of properties could include layers, temperature, surface features, and orbital radius. Data sources could include Earth and space-based instruments such as telescopes and satellites. Types of data could include graphs, data tables, drawings, photographs, and models. (ESS1.A, ESS1.B) **6.1.2 Develop and use a model** to describe the role of gravity and inertia in orbital motions of objects in our solar system. (ESS1.B)

LOOSELY Part 4: Changing Systems **SEP: Asking questions, Developing and using models, Analyzing and interpreting data, Constructing explanations, Engaging in argument from evidence, Obtaining, evaluating and communicating information** CCC: Stability and change, System and system models, Cause and effect, Patterns **Standard Content**: Humans modify Earth's systems, creating observable effects.	
Planetary Science **Investigation 8: Space Exploration** **Part 1:** Light Spectra **SEP: Asking questions, Developing and using models, Analyzing and interpreting data, Obtaining, evaluating and communicating information** CCC: Energy and matter, Scale proportion and quantity, Energy and matter, Patterns **Standard Content:** A spectroscope analyzing the wavelengths of light (spectrum) coming from a light source. **Part 2:** Exploration of the Solar System **SEP: Asking questions and defining problems, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Scale, proportion, and quantity, Patterns, Energy and matter **Standard Content:** Scientific missions provide data about the composition and environmental conditions on the planets, moons, and other bodies in the solar system.	**6.1.3 Use computational thinking to analyze data** and determine the scale and properties of objects in the solar system. Examples of scale could include size and distance. Examples of properties could include layers, temperature, surface features, and orbital radius. Data sources could include Earth and space-based instruments such as telescopes and satellites. Types of data could include graphs, data tables, drawings, photographs, and models. (ESS1.A, ESS1.B)

Strand 6.2: ENERGY AFFECTS MATTER

Matter and energy are fundamental components of the universe. Matter is anything that has mass and takes up space. Transfer of energy creates change in matter. Changes between general states of matter can occur through the transfer of energy. Density describes how closely matter is packed together. Substances with a higher density have more matter in a given space than substances with a lower density. Changes in heat energy can alter the density of a material. Insulators resist the transfer of heat energy, while conductors easily transfer heat energy. These differences in energy flow can be used to design products to meet the needs of society.

Strand 6.3: EARTH'S WEATHER PATTERNS AND CLIMATE

All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. Heat energy from the Sun, transmitted by radiation, is the primary source of energy that affects Earth's weather and drives the water cycle. Uneven heating across Earth's surface causes changes in density, which result in convection currents in water and air, creating patterns of atmospheric and oceanic circulation that determine regional and global climates.

FOSS	STANDARDS
Weather and Water **Investigation 1: What is Weather** **Part 1:** Intro to Weather **SEP: Asking questions, Obtaining, evaluating and communicating information** CCC: Cause and effect, Patterns, Stability and change **Standard Content:** Weather is the condition of Earth's atmosphere at a given time in a given place. Severe weather has the potential to cause death	**6.2.1 Develop models** to show that molecules are made of different kinds, proportions and quantities of atoms. Emphasize understanding that there are differences between atoms and molecules, and that certain combinations of atoms form specific molecules. Examples of simple molecules could include water (H_2O), atmospheric oxygen (O_2), and carbon dioxide (CO_2). (PS1.A)

and destruction in the environment. Meteorology is the science of weather, and meteorologists are people who study Earth's weather. Weather and climate are different. **Part 2:** The Air around Us **SEP: Asking questions, Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Constructing explanations, Engaging in argument from evidence** CCC: Cause and effect, System and system models **Standard Content:** Air is matter, it occupies space, has mass and can be compressed. **Part 3:** Earth's Atmosphere **SEP: Developing and using models, Using mathematics and computational thinking, Obtaining, evaluating and communicating information** CCC: Patterns, Cause and effect, Stability and change **Standard Content:** The atmosphere is the layers of gases surrounding Earth. Weather happens in the atmosphere, the layer of the atmosphere closest to earth's surface. The troposphere is a mixture of nitrogen (78%), oxygen (21%), and other gases (1%) including argon, carbon dioxide, and water vapor.	6.2.1 - molecules are introduced in this investigation. This investigation provides the background to the rest of the investigations.
Weather and Water **Investigation 2: Air Pressure and Wind** **Part 1:** Air-Pressure Inquiry **SEP: Asking questions, Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Construing explanations, Obtaining, evaluating and communicating information** CCC: Scale, proportion and quantity, Cause and effect **Standard Content:** Pressure exerted on a gas reduces its volume and	**6.2.1 Develop models** to show that molecules are made of different kinds, proportions and quantities of atoms. Emphasize understanding that there are differences between atoms and molecules, and that certain combinations of atoms form specific molecules. Examples of simple molecules could include water (H_2O), atmospheric oxygen (O_2), and carbon dioxide (CO_2). (PS1.A)

increases its density **Part 2:** Pressure Maps **SEP: Developing and using models, Analyzing and interpreting data, Using mathematics and computational thinking** CCC: Patterns, Cause and effect, Scale, proportion and quantity, Patterns, Cause and effect **Standard Content:** Wind is a large-scale movement of air. Air tends to move from regions of high pressure to regions of low pressure. Air pressure is represented on a map by contour lines called isobars.	
Weather and Water **Investigation 3: Convection** **Part 1:** Density of Fluids **SEP: Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations** CCC: Patterns **Standard Content:** Density is the ratio of a mass to its volume. If two fluids have equal volumes but differ in mass, the one with the greater mass is denser. **Part 2:** Convection in Water **SEP: Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Patterns, Cause and effect, Energy and matter **Standard Content:** As matter heats up, it expands, causing the matter to become less dense. Convection is the circulation of fluid (liquid or gas) that results from energy transfer; relatively warm masses rise and relatively cool masses sink.	**6.2.2 Develop a model** to predict the effect of heat energy on states of matter and density. Emphasize the arrangement of particles in states of matter (solid, liquid, or gas) and during phase changes (melting, freezing, condensing, and evaporating).(PS1.A, PS3.A) **6.3.2 Investigate** the interactions between air masses that cause changes in weather conditions. Collect and analyze weather data to provide evidence for how air masses flow from regions of high pressure to low pressure causing a change in weather. Examples of data collection could include field observations, laboratory experiments, weather maps, or diagrams. (ESS2.C, ESS2.D)

Part 3: Convection in Air **SEP: Developing and using models, Analyzing and interpreting data, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Cause and effect, Scale, proportion, and quantity, System and system models **Standard Content:** Convection is the circulation of fluid (liquid or gas) that results from energy transfer; relatively warm masses rise and relatively cool masses sink.	
Weather and Water **Investigation 4: Radiation** **Part 1:** Latitude **SEP: Asking questions, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations** CCC: Patterns **Standard Content:** Latitude is a factor that affects local weather and climate. **Part 2:** Solar Angle **SEP: Developing and using models, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Scale, proportion and quantity, System and system models, Cause and effect **Standard Content:** The angle at which light from the Sun strikes the surface of Earth is the solar angle. The lower the solar angle is, the less intense the light is on Earth's surface. The Sun is the major source of energy that heats the atmosphere, and solar energy (light and thermal energy) is transferred by radiation. **Part 3:** Heating Earth **SEP: Developing and using models, Planning and carrying out**	**6.2.2 Develop a model** to predict the effect of heat energy on states of matter and density. Emphasize the arrangement of particles in states of matter (solid, liquid, or gas) and during phase changes (melting, freezing, condensing, and evaporating).(PS1.A, PS3.A) **6.2.3 Plan and carry out an investigation** to determine the relationship between temperature, the amount of heat transferred, and the change of average particle motion in various types or amounts of matter. Emphasize recording and evaluating data, and communicating the results of the investigation. (PS3.A) **6.3.3 Develop and use a model** to show how unequal heating of the Earth's systems causes patterns of atmospheric and oceanic circulation that determine regional climates. Emphasize how warm water and air move from the equator toward the poles. Examples of models could include Utah regional weather patterns such as lake-effect snow and wintertime temperature inversions. (ESS2.C, ESS2.D)

investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating and communicating information CCC: Patterns, Cause and effect, energy and matter, Stability and change, Scale, proportion and quantity **Standard Content:** The Sun is the major source of energy that heats the atmosphere, and solar energy (light and thermal energy) is transferred by radiation. Heating transfers energy from one material to another. Heating effects the particles; the more kinetic energy particles possess, the more they move and the hotter that material is. Temperature is the measure of the average kinetic energy of the particles in a substance.	
Weather and Water **Investigation 5: Conduction** **Part 1:** Fluid Conduction **SEP: Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Constructing explanations and designing solutions** CCC: System and system models. Energy and matter **Standard Content:** Energy can transfer through materials by particle collision (conduction). **Part 2:** Insulation **SEP: Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Constructing explanations and designing solutions** CCC: Cause and effect, Energy and matter, System and system models **Standard Content:** Insulating materials reduce energy transfer via conduction. Materials with widely spaced particles serve as insulators. Engineers try to solve problems that satisfy a set of criteria and that conform to constraints placed on a solution to the problem.	**6.2.3 Plan and carry out an investigation** to determine the relationship between temperature, the amount of heat transferred, and the change of average particle motion in various types or amounts of matter. Emphasize recording and evaluating data, and communicating the results of the investigation. (PS3.A) **6.2.4 Design** an object, tool, or process that minimizes or maximizes heat energy transfer. Identify criteria and constraints, develop a prototype for iterative testing, analyze data from testing, and propose modifications for optimizing the **design solution.** Emphasize demonstrating how the structure of differing materials allows them to function as either conductors or insulators. (PS3.A, PS3.B, ETS1.A, ETS1.B, ETS1.C) **6.3.3 Develop and use a model** to show how unequal heating of the Earth's systems causes patterns of atmospheric and oceanic circulation that determine regional climates. Emphasize how warm water and air move from the equator toward the poles. Examples of models could include Utah regional weather patterns such as

Part 3: Home Design **SEP: Asking questions and defining problems, Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Constructing explanations and designing solutions, Obtaining, evaluating, and communicating information** CCC: System and system models, Energy and matter, Structure and function, Cause and effect **Standard Content:** Insulating materials reduce energy transfer via conduction. Materials with widely spaced particles serve as insulators. Engineers try to solve problems that satisfy a set of criteria and that conform to constraints placed on a solution to the problem.	lake-effect snow and wintertime temperature inversions. (ESS2.C, ESS2.D)
Weather and Water **Investigation 6: Air Flow** **Part 1:** Atmospheric Heating **SEP: Developing and using models, Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Cause and effect **Standard Content:** Temperature is a measure of the average kinetic energy of particles of a substance. Energy transfers between particles when they collide. Energy transfer by contact is conduction. Energy always transfers from particles with more kinetic energy to particles with less kinetic energy. **Part 2:** Local Winds **SEP: Developing and using models, Constructing explanations** CCC: Patterns, Cause and effect, Energy and matter **Standard Content:** Differential heating of Earth's surface by the Sun can create high and low pressure areas. Local winds blow in predictable patterns determined by local differential heating. **Part 3:** Global Winds **SEP: Developing and using models, Analyzing and interpreting data,**	**6.2.2 Develop a model** to predict the effect of heat energy on states of matter and density. Emphasize the arrangement of particles in states of matter (solid, liquid, or gas) and during phase changes (melting, freezing, condensing, and evaporating).(PS1.A, PS3.A) **6.2.3 Plan and carry out an investigation** to determine the relationship between temperature, the amount of heat transferred, and the change of average particle motion in various types or amounts of matter. Emphasize recording and evaluating data, and communicating the results of the investigation. (PS3.A) **6.3.2 Investigate** the interactions between air masses that cause changes in weather conditions. Collect and analyze weather data to provide evidence for how air masses flow from regions of high pressure to low pressure causing a change in weather. Examples of data collection could include field observations, laboratory experiments, weather maps, or diagrams. (ESS2.C, ESS2.D)

Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating and communicating information CCC: Cause and effect, Energy and matter, Patterns, System and system models **Standard Content:** Convection is the circulation of fluid (liquid or gas) that results from energy transfer; relatively warm masses rise and relatively cool masses sink. Convection cells and Earth's rotation determine prevailing winds on Earth.	**6.3.3 Develop and use a model** to show how unequal heating of the Earth's systems causes patterns of atmospheric and oceanic circulation that determine regional climates. Emphasize how warm water and air move from the equator toward the poles. Examples of models could include Utah regional weather patterns such as lake-effect snow and wintertime temperature inversions. (ESS2.C, ESS2.D)
Weather and Water **Investigation 7: Water in the Air** **Part 1:** Is Water Really There? **SEP: Planning and carrying out investigations, Analyzing and interpreting data, Constructing explanations, Engaging in argument from evidence, Obtaining, evaluating and communicating information** CCC: Cause and effect, System and system models **Standard Content:** Water changes from gas to a liquid by condensation. **Part 2:** Phase change and Energy Transfer **SEP: Developing and using models, Analyzing and interpreting data, Constructing explanations,Obtaining, evaluating and communicating information** CCC: Cause and effect, Energy and matter **Standard Content:** Water changes from liquid to gas (vapor) by evaporation. Temperature change, which is evidence of energy transfer, accompanies evaporation. Dew point is the temperature at which air is saturated with water vapor and vapor condenses into liquid. **Part 3:** Clouds and Precipitation **SEP: Asking questions, Developing and using models, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating and communicating information**	**6.2.3 Plan and carry out an investigation** to determine the relationship between temperature, the amount of heat transferred, and the change of average particle motion in various types or amounts of matter. Emphasize recording and evaluating data, and communicating the results of the investigation. (PS3.A) **6.3.1 Develop a model** to describe how the cycling of water through Earth's systems is driven by energy from the Sun, gravitational forces, and density. (ESS2.C)

CCC: Scale, proportion and quantity, Cause and effect, System and system models, Energy and matter **Standard Content:** Water changes from a gas to liquid by condensation. Dew point is the temperature at which air is saturated with water vapor and vapor condenses into liquid. Increasing the pressure of a given volume of air increases the temperature of air.	
Weather and Water **Investigation 8: The Water Planet** **Part 1:** Water Cycle Simulation **SEP: Developing and using models, Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Scale, proportion and quantity, System and system models, Energy and matter, Stability and change **Standard Content:** Most of Earth's water is salt water in the ocean, and Earth's freshwater is found in many locations. Water particles might follow many different paths as it travels through the water cycle. **Part 2:** Ocean Currents **SEP: Analyzing and interpreting data, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Patterns, Cause and effect, Energy matter **Standard Content:** Ocean currents are caused primarily by winds, convection of ocean water, and the Coriolis effect. **Part 3:** Ocean Climate **SEP: Developing and using models, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Patterns, Cause and effect, System and system models, Energy and	**6.3.2 Investigate** the interactions between air masses that cause changes in weather conditions. Collect and analyze weather data to provide evidence for how air masses flow from regions of high pressure to low pressure causing a change in weather. Examples of data collection could include field observations, laboratory experiments, weather maps, or diagrams. (ESS2.C, ESS2.D) **6.3.3 Develop and use a model** to show how unequal heating of the Earth's systems causes patterns of atmospheric and oceanic circulation that determine regional climates. Emphasize how warm water and air move from the equator toward the poles. Examples of models could include Utah regional weather patterns such as lake-effect snow and wintertime temperature inversions. (ESS2.C, ESS2.D)

matter **Standard Content:** A location's proximity to a large body of water generally results in less temperature variation and more precipitation.	
Weather and Water **Investigation 9: Climate over Time** **Part 1:** Climate Change **SEP: Planning and carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Engaging in argument from evidence, Obtaining, evaluating and communicating information** CCC: Patterns, Scale, proportion and quantity **Standard Content:** Weather is the condition of the atmosphere at a specific time and location; climate is the average weather in a region over a long period of time. **Part 2:** The Role of Carbon Dioxide **SEP: Developing and using models, Analyzing and interpreting data, Using mathematics and computational thinning, Constructing explanations, Engaging in argument from evidence, Obtaining, evaluating and communicating information** CCC: System and system models, Energy and matter, Cause and effect, Stability and change **Standard Content:** When greenhouse- gas concentrations in the the atmosphere increases, the global temperature rises. Human activity can affect Earth's weather and climate. **Part 3:** Climate in the News **SEP: Asking questions, Developing and using models, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations and designing solutions, Engaging in argument from evidence, Obtaining, evaluating td communicating information**	**6.3.1 Develop a model** to describe how the cycling of water through Earth's systems is driven by energy from the Sun, gravitational forces, and density. (ESS2.C) **6.3.3 Develop and use a model** to show how unequal heating of the Earth's systems causes patterns of atmospheric and oceanic circulation that determine regional climates. Emphasize how warm water and air move from the equator toward the poles. Examples of models could include Utah regional weather patterns such as lake-effect snow and wintertime temperature inversions. (ESS2.C, ESS2.D)

CCC: Patterns, Cause and effect, System and system models, Patterns, Stability and change **Standard Content:** Human activity can affect Earth's weather and climate. Climate can change over time because of natural Earth- cycles and human-induced changes.	
Weather and Water **Investigation 10: Meteorology** **Part 1:** Weather Maps **SEP: Asking questions, Developing and using models, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations, Engaging in argument from evidence, Obtaining, evaluations and communicating information** CCC: Cause and effect, Patterns, System and system models, **Standard Content:** Weather maps combine many kinds of atmospheric and surface data, including pressure, temperature, wind direction, wind speed, and precipitation. Fronts are areas where large air masses collide. **Part 2:** Identify Key Ideas **SEP: Constructing explanations, Engaging in argument from evidence, Obtaining, evaluations and communicating information** CCC: Cause and effect, Patterns, Stability and change **Standard Content:** Weather is the condition of the atmosphere at a specific time and location; climate is the average weather in a region over a long period of time. Climate can change over time because natural Earth cycles and human-induced changes.	**6.2.3 Plan and carry out an investigation** to determine the relationship between temperature, the amount of heat transferred, and the change of average particle motion in various types or amounts of matter. Emphasize recording and evaluating data, and communicating the results of the investigation. (PS3.A) **6.3.1 Develop a model** to describe how the cycling of water through Earth's systems is driven by energy from the Sun, gravitational forces, and density. (ESS2.C) **6.3.2 Investigate** the interactions between air masses that cause changes in weather conditions. Collect and analyze weather data to provide evidence for how air masses flow from regions of high pressure to low pressure causing a change in weather. Examples of data collection could include field observations, laboratory experiments, weather maps, or diagrams. (ESS2.C, ESS2.D) **6.3.3 Develop and use a model** to show how unequal heating of the Earth's systems causes patterns of atmospheric and oceanic circulation that determine regional climates. Emphasize how warm water and air move from the equator toward the poles. Examples of models could include Utah regional weather patterns such as lake-effect snow and wintertime temperature inversions. (ESS2.C, ESS2.D)

	6.3.4 Construct an explanation supported by evidence for the role of the natural greenhouse effect in Earth's energy balance, and how it enables life to exist on Earth. Examples could include comparisons between Earth and other planets such as Venus and Mars. (ESS2.D)

Strand 6.4: STABILITY AND CHANGE IN ECOSYSTEMS

The study of ecosystems includes the interaction of organisms with each other and with the physical environment. Consistent interactions occur within and between species in various ecosystems as organisms obtain resources, change the environment, and are affected by the environment. This influences the flow of energy through an ecosystem, resulting in system variations. Additionally, ecosystems benefit humans through processes and resources, such as the production of food, water and air purification,

and recreation opportunities. Scientists and engineers investigate interactions among organisms and evaluate design solutions to preserve biodiversity and ecosystem resources.

FOSS	STANDARDS
Populations and Ecosystems **Investigation 1: Milkweed Bugs** **Part 1:** Introducing Milkweed Bugs **SEP: Asking questions, Planning and carrying out investigations, Obtaining, evaluating and communicating information** CCC: Patterns **Standard Content:** An organism is any living thing, and a population is a group of organisms of the same kind living in an area at the specified time. **Part 2:** Milkweed Bug Habitat **SEP: Developing and using models, Obtaining, evaluating and communicating information** CCC: System and system models **Standard Content:** A habitat is where an organism lives, and it supplies all the resources an organism needs to survive and grow. **Part 2:** Observing Milkweed Bug Habitats **SEP: Asking questions, Planning and carrying out investigations, Analyzing and interpreting data, Obtaining, evaluating and communicating information** CCC: Scale, proportion and quantity, Stability and change, Patterns **Standard Content:** A habitat is where an organism lives, and supplies all the resources an organism needs to survive and grow. Organisms depend on environmental interactions with both other living things and nonliving factors.	

Populations and Ecosystems **Investigation 2: Sorting Out Life** **Part 1:** Ecosystem Card Sort **SEP: Analyzing and interpreting data, Constructing explanations, Engaging in argument from evidence, Obtaining, evaluating and communicating information** CCC: System and system models **Standard Content:** A community is all the interacting populations in one area. An ecosystem is a system of interacting organisms and nonliving factors in a specified area. Biotic factors are living factors in an ecosystem: abiotic factors are nonliving factors. **Part 2:** Video Population Study **SEP: Developing and using models, Analyzing and interpreting data, Obtaining, evaluating, and communicating information** CCC: Cause and effect, System and system models **Standard Content:** A community is all the interacting populations in one area. An ecosystem is a system of interacting organisms and nonliving factors in a specified area. **Part 3:** Ecoscenaroios **SEP: Planning and carrying out investigations, Obtaining, evaluating and communicating information** CCC: Scale, proportion and quantity, System and system models **Standard Content:** A community is all interacting populations in one area. An ecosystem is a system of interacting organisms and nonliving factors in a specified area. Biotic factors are living factors in an ecosystem: abiotic factors are nonliving factors. Ecosystems are defined by their biotic and abiotic factors. Biomes are large systems on Earth with similar biotic factors. Humans depend on ecosystem services.	**6.4.1 Analyze data** to provide evidence for the effects of resource availability on organisms and populations in an ecosystem. **Ask questions** to predict how changes in resource availability affects organisms in those ecosystems. Examples could include water, food, and living space in Utah environments. (LS2.A) **6.4.2 Construct an explanation** that predicts patterns of interactions among organisms across multiple ecosystems. Emphasize consistent interactions in different environments, such as competition, predation, and mutualism. (LS2.A)

Populations and Ecosystems **Investigation 3: Mono Lake** **Part 1:** A Visit to Mono Lake **SEP: Asking questions, Analyzing and interpreting data, Obtaining, evaluating and communicating information** CCC: Cause and effect, Stability and change, Scale proportion and quantity **Standard Content:** The Mono Lake alkaline- lake ecosystem is defined by the interactions among organisms and abiotic factors. **Part 2:** Mono Lake Food Web **SEP: Developing and using models, Analyzing and interpreting data, Obtaining, evaluating, and communicating information** CCC: Patterns, System and system models, Energy and Matter, Cause and effect **Standard Content:** The path that food takes as one organism eats another is a food chain. The feeding relationships in an ecosystem can be represented as a food web. The Mono Lake alkaline- lake ecosystem is defined by the interactions among organisms and abiotic factors. **Part 3:** Ecoscenarios Food Web **SEP: Developing and using models, Analyzing and interpreting data, Obtaining, evaluating and communicating information** CCC: Patterns, System and system models, Energy and matter, Cause and effect **Standard Content:** The path that food takes as one organism eats another is a food chain. The feeding relationship in an ecosystem can be represented as a food web. All ecosystems are defined by the interactions among the organisms and abiotic factors that exist in the region.	**6.4.2 Construct an explanation** that predicts patterns of interactions among organisms across multiple ecosystems. Emphasize consistent interactions in different environments, such as competition, predation, and mutualism. (LS2.A) **6.4.3 Develop a model** to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, and deserts. (LS2.B)

Populations and Ecosystems **Investigation 4: Mini Habitats** **Part 1:** The Physical Environment **SEP: Planning and carrying out investigations, Obtaining, evaluating and communicating information** CCC: System and system models **Standard Content:** An aquatic function in water. A terrestrial ecosystem functions on land. Organisms depend on the abiotic elements in their ecosystem. **Part 2:** Introducing Life **SEP: Developing and using models, planning and carrying out investigations, Analyzing and interpreting data, Obtaining, evaluating and communicating information** CCC: Structure and function, Cause and effect, System and system model **Standard Content:** Organisms depend on the abiotic elements in their ecosystem. **Part 3:** Observing Mini Habitats **SEP: Developing and using models, Planning and carrying out investigations. Analyzing and interpreting data, Obtaining, evaluating and communicating information** CCC: Cause and effect, System and system models, Stability and change **Standard Content:** An aquatic ecosystem functions in water. A terrestrial ecosystem functions on land. Organisms depend on the abiotic elements in their ecosystem.	**6.4.1 Analyze data** to provide evidence for the effects of resource availability on organisms and populations in an ecosystem. **Ask questions** to predict how changes in resource availability affects organisms in those ecosystems. Examples could include water, food, and living space in Utah environments. (LS2.A) **6.4.4 Construct an argument supported by evidence** that the stability of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, and deserts. (LS2.C)

Populations and Ecosystems **Investigation 5: Producers** **Part 1:** Growing Producers **SEP: Planning and carrying out investigations, Analyzing and interpreting data, Constructing explanations** CCC: Cause and effect, Energy and matter, Patterns, System and system models **Standard Content:** Photosynthesis is the process by which energy- rich molecules are made from water, carbon dioxide and light. **Part 2:** Biomass Producers **SEP: Analyzing and interpreting data, using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating dan communicating information** CCC: Patterns, Energy and matter **Standard Content:** Photosynthesis is the process by which energy - rich molecules are made from water carbon dioxide and light. Photosynthesis produces potential energy, and aerobic cellular respiration transfers usable energy to organisms. Producers increase the biomass of an ecosystem through photosynthesis. **Part 3:** Ecoscenario Producers **SEP: Analyzing and interpreting data, Obtaining, evaluating and communicating information** CCC: System and system models **Standard Content:** Photosynthesis produces potential energy, and aerobic cellular respiration transfers usable energy to organisms. Ecosystems are defined by their producers. **Part 4:** Energy and Transfer from Food **SEP: Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations, Obtaining,**	**6.4.2 Construct an explanation** that predicts patterns of interactions among organisms across multiple ecosystems. Emphasize consistent interactions in different environments, such as competition, predation, and mutualism. (LS2.A) **6.4.3 Develop a model** to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, and deserts. (LS2.B)

evaluating and communicating information CCC: Energy and matter, Scale and proportion and quantity, System and system models **Standard Content:** Food is energy-rich organic matter that organisms need to conduct their life processes.	
Populations and Ecosystems **Investigation 6 Following Energy** **Part 1:** Using Energy **SEP: Analyzing and interpreting data, Constructing explanations, Engaging in argument from evidence** CCC: Energy and matter **Standard Content:** Every activity undertaken by living organisms involves expenditure of energy. **Part 2:** Food-Chain Game **SEP: Asking questions, Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating and communicating information** CCC: System and system models, Energy and matter, Cause and effect, Stability and change, Patterns **Standard Content:** Feeding relationships identify trophic roles. Biomass moves through an ecosystem from one trophic level to the next. **Part 3:** Trophic Levels **SEP: Asking questions, Developing and using models, Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Energy and matter, System and system models, Patterns, Scale proportion and quantity, Patterns **Standard Content:** Feeding relationships identify trophic roles. Biomass moves through an ecosystem from one trophic level to the next. Only a	**6.4.1 Analyze data** to provide evidence for the effects of resource availability on organisms and populations in an ecosystem. **Ask questions** to predict how changes in resource availability affects organisms in those ecosystems. Examples could include water, food, and living space in Utah environments. (LS2.A) **6.4.2 Construct an explanation** that predicts patterns of interactions among organisms across multiple ecosystems. Emphasize consistent interactions in different environments, such as competition, predation, and mutualism. (LS2.A) **6.4.3 Develop a model** to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, and deserts. (LS2.B)

small fraction of the biomass consumed at a level is used to produce growth (biomass) at a level; most of it is used for energy, and much is lost to the environment. **Part 4:** Decomposers **SEP: Developing and using models, Analyzing and interpreting data, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Energy and matter, Stability and change, System and system models **Standard Content:** Decomposers recycle food molecules to basic particles for use by organisms in the ecosystem.	
Populations and Ecosystems **Investigation 7: Population Size** **Part 1:** Reproductive Potential **SEP: Asking questions, Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations** CCC: Cause and effect, Scale proportion and quantity, Patterns, Systems and system models, Stability and change **Standard Content:** Reproductive potential is the theoretical unlimited growth of a population over time. A limiting factor is a biotic or abiotic component of the ecosystem that controls the size of the population. **Part 2:** Limiting Factors **SEP: Analyzing and interpreting data, Engaging in argument from evidence, Obtaining, evaluating and communicating information** CCC: Cause and effect, Patterns, Stability and change **Standard Content:** A limiting factor is any biotic or abiotic component of the ecosystem that controls the size of the population. **Part 3:** Population Dynamics **SEP: Analyzing and interpreting data, Constructing explanations,**	**6.4.1 Analyze data** to provide evidence for the effects of resource availability on organisms and populations in an ecosystem. **Ask questions** to predict how changes in resource availability affects organisms in those ecosystems. Examples could include water, food, and living space in Utah environments. (LS2.A) **6.4.2 Construct an explanation** that predicts patterns of interactions among organisms across multiple ecosystems. Emphasize consistent interactions in different environments, such as competition, predation, and mutualism. (LS2.A) **6.4.4 Construct an argument supported by evidence** that the stability of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, and deserts. (LS2.C)

Obtaining, evaluating and communicating information CCC: Cause and effect, Patterns **Standard Content:** A limiting factor is any biotic or abiotic component of the ecosystem that controls the size of the population.	
Populations and Ecosystems **Investigation 8: Human Impact** **Part 1:** Biodiversity **SEP: Planning and carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Scale proportion and quantity, cause and effect, Stability and change, Patterns, System and system models **Standard Content:** Biodiversity is the variety of organisms in an ecosystem. A biodiversity index is one measure of the health of an ecosystem and its ability to recover from stress; in a sustainable ecosystem, the system is resilient to change. **Part 2:** Invasive Species **SEP: Analyzing and interpreting data, Constructing explanations, Engaging in argument from evidence, Obtaining, evaluating and communicating information** CCC: Cause and effect, Stability and change **Standard Content:** Introduced species compete with native species in an ecosystem. If an introduced species has no predictors in the new ecosystem, it can thrive and become invasive. **Part 3:** Mono Lake Revisited **SEP: Analyzing and interpreting data, Constructing explanations, Obtaining, evaluating and communicating information** CCC: Cause and effect, System and system models, Stability and change, Cause and effect	**6.4.4 Construct an argument supported by evidence** that the stability of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, and deserts. (LS2.C)

Standard Content: Humans affect ecosystems in both positive and negative ways.	
Populations and Ecosystems **Investigation 9: Ecoscnearios** **Part 1:** Human Involvement **SEP: Asking questions, and defining problems, Analyzing and interpreting data, Obtaining, evaluating and communicating information** CCC: Cause and effect, System and system models **Standard Content:** Humans rely on ecosystems for ecosystem service (provisioning, regulating, cultural and supporting services). Ecosystems are dynamic systems of complex interactions. Disruptions to abiotic factors in ecosystems can cause shifts in population and changes to ecosystem sustainability. Changes in ecosystems can affect services essential to humans. Solutions can be engineered to mitigate human impact. **Part 2:** Evaluating Solutions **SEP: Planning and carrying out investigations analyzing and interpreting data, Constructing explanations and designing solutions, Engaging in argument from evidence, Obtaining, evaluating and communicating information** CCC: Cause and effect, System and system models, Stability and change **Standard Content:** Humans rely on ecosystems for ecosystem services (provisioning, regulating, cultural and supporting services). Ecosystems are dynamic systems of complex interactions. Disruptions to abiotic factors in ecosystems can cause shifts in population and changes to ecosystem sustainability. Changes in ecosystems can affect services essential to humans. Solutions can be engineered to mitigate human impact.	**6.4.4 Construct an argument supported by evidence** that the stability of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, and deserts. (LS2.C) **6.4.5** Evaluate competing design solutions for preserving ecosystem services that protect resources and biodiversity based on how well the solutions maintain stability within the ecosystem. Emphasize **obtaining, evaluating, and communicating** information of differing design solutions. Examples could include policies affecting ecosystems, responding to invasive species or solutions for the preservation of ecosystem resources specific to Utah, such as air and water quality and prevention of soil erosion. (LS2.C, LS4.D, ETS1.A, ETS1.B, ETS1.C)

Part 3: Presentations **SEP: Asking questions and defining problems, Constructing explanations and designing solutions, Engaging in argument from evidence, Obtaining, evaluating and communicating information** CCC: **Standard Content:** Humans rely on ecosystems for ecosystem services (provisioning, regulating, cultural and supporting services). Ecosystems are dynamic systems of complex interactions. Disruptions to abiotic factors in ecosystems can cause shifts in population and changes to ecosystem sustainability. Changes in ecosystems can affect services essential to humans. Solutions can be engineered to mitigate human impact.	