Course Name:	7/8 Science Course A		
Credits:	n/a		
Prerequisites:	n/a		
Description:	Course covering aspects within Physical, Earth and Life Sciences.		
Academic Standards:	Next-Generation Science Standards		
Units:	**Unit Length:**	**Unit Standards:**	**Unit Outcomes:**
Chemical Interactions	approximately 63 days	MS-PS1-1, MS-PS1-2, MS-PS1-3, MS-PS1-4, MS-PS1-5, MS-PS1-6, MS-PS3-3, MS-PS3-4, MS-PS3-5, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4	Students observe a mystery-mixture reaction and begin to consider the definition of substance and chemical reaction. They identify the two substances in the mystery mixture by observing the characteristics of the reactions that occur when they mix pairs of known substances. Students learn about the periodic table of the elements. They use an online resource to consider properties and categories of elements, and to research individual elements. Students read consumer-product labels to think about the presence of elements in familiar substances. Students recreate the mystery-mixture reaction, using a setup that allows them to capture and study the resulting gas. They learn that the gas is carbon dioxide, which leads them to a study of air. They use syringes to discover that air can be compressed and expanded. Students start to develop a particulate model for matter. Students observe expansion and contraction of solids, liquids, and gases, and explain the phenomena in terms of kinetic theory—the constant motion of particles. Students learn one way that energy moves and how to conceptualize energy transfer as changes of the kinetic energy of particles resulting from particle collisions. Students mix equal volumes of hot and cold water and predict the final temperature. They use the result to determine an algorithm for calculating final temperature. Students are introduced to the calorie as a unit of energy transfer. Students use their understanding of energy transfer to face an engineering problem: how to build a container that keeps hot liquids hot and cold liquids cold. They test materials for their insulating properties in preparation for the design challenge. They determine criteria and constraints in the engineering design process and test their designs. Students explore the difference between melting and dissolving. They go on to study dissolving by comparing aqueous mixtures, one with a soluble solid and one with an insoluble solid. They compare the two mixtures and then attempt to separate them with filters and evaporation. Students experience three common phases (states) of matter—solid, liquid, and gas— and investigate the conditions that induce substances to change from one phase to another. Students engage in an engineering challenge to design a classroom “freezer” that will freeze water. Students blow bubbles into limewater, observe the precipitate, and move atom tiles (representations) to simulate the rearrangement of atoms to form new substances (particles). Students study another reaction involving hydrochloric acid and baking soda and learn to use models to balance chemical equations. Students conduct more chemical reactions, learning about limiting factors and reactants in excess.

Human Systems Interactions	approximately 28 days	MS-LS1-1, MS-LS1-3, MS-LS1-7, MS-LS1-8	Students solve a disease mystery. On the path to diagnosis, students discover the structural levels in human bodies: that cells form tissues, tissues form organs, organs form organ systems, and systems form a complex multicellular organism, the human. They look for evidence of how the organ systems interact, each dependent on all the others for its needs. Students fatigue their muscles and think about how their cells obtain the food and oxygen they need from the digestive, respiratory, and circulatory systems. They learn how aerobic cellular respiration works in cells. They find out that the cells eliminate wastes produced during aerobic cellular respiration via circulatory, respiratory, and excretory systems. Students explore the different senses to understand how humans acquire information from the environment. They engage in a “neuron relay” to model how sensory information travels to the brain for processing and how information returns to the body for action. Students turn their attention to their own learning and memory formation.
Heredity and Adaptations	approximately 31 days	MS-LS3-1, MS-LS3-2, MS-LS4-1, MS-LS4-2, MS-LS4-3, MS-LS4-4, MS-LS4-5, MS-LS4-6, MS-ESS1-4	Students are introduced to the big question that drives the course: How can we explain the diversity of life that exists on Earth? They take a tour of the fossil record, looking for evidence of the existence, diversity, and transitions in life-forms throughout Earth’s history. Students start this investigation with an exploration of evolutionary relationships. They examine a family tree and build a cladogram. Students build a model for how traits are inherited, starting with themselves and moving to a population of imaginary animals, larkeys. They learn about the basis of heredity, chromosomes and genes, and how genetic variation arises in populations. Students use Punnett squares to predict the probability of trait inheritance when the genotypes of the parents are known. Students consider how mutations lead to variation in a population. They see how positive mutations lead to adaptations and how natural selection works, leading to changes in populations over time. They consider the evidence for the theory of evolution. Finally, they research genetic technologies that humans use to influence inheritance and disease.

Planetary Science	approximately 52 days	MS-ESS1-1, MS-ESS1-2, MS-ESS1-3, MS-ESS1-4, MS-ESS2-2, MS-ESS2-4, MS-ESS3-1, MS-ESS3-2, MS-ESS3-3, MS-ESS3-4, MS-PS2-4, MS-PS4-2, MS-ETS1-1	Students develop a sense of planet Earth as a tiny base from which to launch an inquiry into the vast reaches of the solar system and beyond. They observe the Moon and start a log of its changes. Students become familiar with the celestial relationship of the Sun and Earth. They think not only about what they know (Earth is round) but how they know it. They simulate the basic geometry of Earth and the Sun to explain day, night, and year. Students apply what they know about Earth's tilt and the revolution of Earth around the Sun to explain daylight length and seasons. Students learn the factors resulting in seasons, including latitude, tilt of Earth's axis, revolution, and rotation. Students study the surface features of the Moon and the size and distance of our closest celestial neighbor. They read myths to experience how other cultures explain the features and behavior of the Moon. Students analyze Moon log data to identify the pattern of Moon phases, then develop a physical model that can explain Moon phases. They explain how the motions of Earth and the Moon in relation to the Sun result in the phases of the Moon we observe on Earth. Students conduct simple experiments to determine if the craters on the Moon's surface could be caused by impact events of various magnitudes. They use Moon data to determine the number and frequency of major impacts. Students learn the major classifications in which cosmic objects are distributed: solar system, galaxy, universe. They sequence the events that led to the formation of the solar system. Students explore four theories of Moon origin. Students explore the scale of the solar system by making physical and graphical models. They explore the relationship of atmosphere, planet temperature, and liquid water. They search images of planets and satellites for evidence of water. Students are introduced to a tool used to study distant objects in planetary systems, the spectroscope. They use a simple spectroscope to become aware of the spectral signature of elements. Students use telescope images of the moons of Jupiter to determine their orbital patterns and distances from the planet. They study techniques used to search for planets and planetary systems around other stars in the Milky Way galaxy.

Unit Name: **Chemical Interactions**	**Length:** approximately 63 days
Standards: MS-PS1-1, MS-PS1-2, MS-PS1-3, MS-PS1-4, MS-PS1-5, MS-PS1-6, MS-PS3-3, MS-PS3-4, MS-PS3-5, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4	**Outcomes:** Students observe a mystery-mixture reaction and begin to consider the definition of substance and chemical reaction. They identify the two substances in the mystery mixture by observing the characteristics of the reactions that occur when they mix pairs of known substances. Students learn about the periodic table of the elements. They use an online resource to consider properties and categories of elements, and to research individual elements. Students read consumer-product labels to think about the presence of elements in familiar substances. Students recreate the mystery-mixture reaction, using a setup that allows them to capture and study the resulting gas. They learn that the gas is carbon dioxide, which leads them to a study of air. They use syringes to discover that air can be compressed and expanded. Students start to develop a particulate model for matter. Students observe expansion and contraction of solids, liquids, and gases, and explain the phenomena in terms of kinetic theory—the constant motion of particles. Students learn one way that energy moves and how to conceptualize energy transfer as changes of the kinetic energy of particles resulting from particle collisions. Students mix equal volumes of hot and cold water and predict the final temperature. They use the result to determine an algorithm for calculating final temperature. Students are introduced to the calorie as a unit of energy transfer. Students use their understanding of energy transfer to face an engineering problem: how to build a container that keeps hot liquids hot and cold liquids cold. They test materials for their insulating properties in preparation for the design challenge. They determine criteria and constraints in the engineering design process and test their designs. Students explore the difference between melting and dissolving. They go on to study dissolving by comparing aqueous mixtures, one with a soluble solid and one with an insoluble solid. They compare the two mixtures and then attempt to separate them with filters and evaporation. Students experience three common phases (states) of matter—solid, liquid, and gas— and investigate the conditions that induce substances to change from one phase to another. Students engage in an engineering challenge to design a classroom “freezer” that will freeze water. Students blow bubbles into limewater, observe the precipitate, and move atom tiles (representations) to simulate the rearrangement of atoms to form new substances (particles). Students study another reaction involving hydrochloric acid and baking soda and learn to use models to balance chemical equations. Students conduct more chemical reactions, learning about limiting factors and reactants in excess.

Essential Questions:	**Learning Targets:**
How can we find out what two substances are in the mystery mixture? What is the periodic table of elements? What makes up all the substances of Earth? How can the gas produced in a chemical reaction be studied? Is air matter? Does air have mass and take up space? What is the relationship between particles in matter? What happens to particles in a sample of air when the air is heated and cooled? What happens to particles in a sample of liquid when the liquid is heated and cooled? What happens to particles in a sample of solid when the solid is heated and cooled? If two equal volumes of hot and cold water are mixed, what will the final temperature be? How does energy transfer from one substance to another? How is heat measured? How can you reduce energy transfer to or from a sample of water? What is the best thermos design? What is the difference between dissolving and melting? Do all substances form solutions in water? What happens at the particle level when a substance melts? What is the relationship between melting and freezing? How can you freeze water in the classroom? What are all the ways that a substance can change state? How do atoms combine to make new substances? What happens at the particle level during a chemical reaction? What is the chemical reaction between hydrochloric acid and sodium bicarbonate? What is a limiting factor in a chemical reaction? What have I learned about chemical interactions?	Students will learn that: •a substance is a form of matter with a unique composition and distinct physical and chemical properties that can be used to identify it •substances can be represented with common names, chemical names, and chemical formulas •a chemical reaction occurs when substances interact to form new substances (products) •an element is a basic substance that cannot be broken into simpler substances during chemical interactions •there are 90 naturally occurring elements on Earth •elements combine to make all the substances on Earth •the relative abundance of elements varies with location in the universe •matter is made of particles; every substance is defined by a unique particle •gas is matter -- it has mass and occupies space; in a gas, particles are widely spaced and in constant motion •gas compresses when force is applied; gas expands when force is withdrawn •during compression and expansion, the number and character of particles in a sample of gas do not change; the space between the particles does change •solids, liquids, and gases vary in how their particles are arranged in relationship to one another, but the particles are always in motion, kinetic energy is energy of motion •the particles in substances gain kinetic energy as they warm, and los kinetic energy as they cool •matter expands when the kinetic energy of its particles increases; matter contracts when the kinetic energy of its particles decreases •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. •energy is conserved. The amount of energy in a system does not change- no energy is ever created or destroyed. •temperature is a measure of the average kinetic energy of the particles of a substance. •insulating materials reduce energy transfer via conduction. •materials with more widely spaced particles serve as better insulators. •engineers try to solve problems that satisfy a set of criteria and that conform to constraints placed on a solution to the problem. •dissolving occurs when one substance (solute) is reduced to particles and is distributed uniformly throughout the particles of the second substance (solvent). •dissolving involves both kinetic interactions (collisions) and attractive forces (bonds). •not all substances are soluble in water. •solutions can be separated into their original components, which are not chemically changed during dissolution. •matter exists on Earth in three common states -- solid, liquid, and gas. •change of state is the result of change of energy and motion of the particles in a sample of matter. •during phase change, particles do not change; relationships between particles do change. •the temperatures at which phase changes occur are different for different substances. •the processes of phase change are evaporation, condensation, melting, freezing, sublimation, and deposition. •all substances are made from some 90 different types of atoms (elements), which combine in various ways. •a compound is a substance composed of two or more different kinds of atoms. •atoms combine to make particles of substances: molecules and ionic compounds held together by attractive forces called bonds. •a chemical reaction is a process in which the atoms of substances rearrange to form new

Topic 1: **Substances**	**Length:** 6 sessions
Standard(s): MS-PS1-2	**Academic Vocabulary:** chemical formula, chemical name, chemical reaction, matter, substance
Lesson Frame: Mystery Mixture	We will:
	I will:
Lesson Frame: Mixing Substances	We will:
	I will:
Essential Questions: How can we find out what two substances are in the mystery mixture?	**Outcomes:** Students observe a mystery-mixture reaction and begin to consider the definition of substance and chemical reaction. They identify the two substances in the mystery mixture by observing the characteristics of the reactions that occur when they mix pairs of known substances.
Performance Tasks: •Mix substances with water in an effort to determine the identity of an unknown mixture of substances •Analyze and interpret data on the properties of substances before and after a chemical reaction •Explain that as a result of a reaction initial substances change into new, different substances. •Explain how to identify the two substances in a mystery mixture	**Learning Targets:** Students will learn that: •a substance is a form of matter with a unique composition and distinct physical and chemical properties that can be used to identify it •substances can be represented with common names, chemical names, and chemical formulas •a chemical reaction occurs when substances interact to form new substances (products)
Topic 2: **Elements**	**Length:** 5 sessions
Standard(s): MS-PS1-1, MS-PS1-3	**Academic Vocabulary:** element, periodic table of elements, symbol
Lesson Frame: Periodic Table	We will:
	I will:
Lesson Frame: Elements in the World	We will:
	I will:
Essential Questions: •What is the periodic table of elements? •What makes up all the substances of Earth?	**Outcomes:** Students learn about the periodic table of the elements. They use an online resource to consider properties and categories of elements, and to research individual elements. Students read consumer-product labels to think about the presence of elements in familiar substances.

Performance Tasks: •Use graphical displays of information in the periodic the to analyze substances in terms of their elemental composition •Explain that all common matter is made of elements •Consider the composition of natural resources and synthetic materials	**Learning Targets:** Students will learn that: •an element is a basic substance that cannot be broken into simpler substances during chemical interactions •there are 90 naturally occurring elements on Earth •elements combine to make all the substances on Earth •the relative abundance of elements varies with location in the universe •the periodic table of the elements displays all naturally occurring and synthesized elements
Topic 3: **Particles**	**Length:** 8 sessions
Standard(s): MS-PS1-2, MS-PS1-4	**Academic Vocabulary:** compress, compression, expand, expansion, gas, liquid, particle, solid
Lesson Frame: Capture the Gas	We will:
	I will:
Lesson Frame: Air is Matter	We will:
	I will:
Lesson Frame: Air as Particles	We will:
	I will:
Essential Questions: •How can the gas produced in a chemical reaction be studied? •Is air matter? Does air have mass and take up space? •What is the relationship between particles in matter?	**Outcomes:** Students recreate the mystery-mixture reaction, using a setup that allows them to capture and study the resulting gas. They learn that the gas is carbon dioxide, which leads them to a study of air. They use syringes to discover that air can be compressed and expanded. Students start to develop a particulate model for matter.
Performance Tasks: •Carry out an investigation to determine the volume of gas produced in a chemical reaction •Plan experimentation to observe the effects of pressure on gases •Develop a model of gas as individual particles in constant motion •Apply the gas model to explain compression and expansion	**Learning Targets:** Students will Learn that: •matter is made of particles; every substance is defined by a unique particle •gas is matter -- it has mass and occupies space; in a gas, particles are widely spaced and in constant motion •gas compresses when force is applied; gas expands when force is withdrawn •during compression and expansion, the number and character of particles in a sample of gas do not change; the space between the particles does change
Topic 4: **Kinetic Energy**	**Length:** 7 sessions
Standard(s): MS-PS1-4	**Academic Vocabulary:** contract, contraction, kinetic energy, temperature, thermometer
Lesson Frame: Gas Expansion/ Contraction	We will:
	I will:
Lesson Frame: Liquid Expansion/Contraction	We will:
	I will:

Lesson Frame: Solid Expansion/Contraction	We will:
	I will:
Essential Questions: •What happens to particles in a sample of air when the air is heated and cooled? •What happens to particles in a sample of liquid when the liquid is heated and cooled? •What happens to particles in a sample of solid when the solid is heated and cooled?	**Outcomes:** Students observe expansion and contraction of solids, liquids, and gases, and explain the phenomena in terms of kinetic theory—the constant motion of particles.
Performance Tasks: •Carry out an investigation heating and cooling gas, liquid, and solid matter to observe expansion and contraction •Develop a model of kinetic energy at the particle level •Construct an explanation of how a thermometer works	**Learning Targets:** Students will learn that: •solids, liquids, and gases vary in how their particles are arranged in relationship to one another, but the particles are always in motion •kinetic energy is energy of motion •the particles in substances gain kinetic energy as they warm, and los kinetic energy as they cool •matter expands when the kinetic energy of its particles increases; matter contracts when the kinetic energy of its particles decreases
Topic 5: **Energy Transfer**	**Length:** 8 sessions
Standard(s): MS-PS1-4, MS-PS3-3, MS-PS3-4, MS-PS3-5	**Academic Vocabulary:** calorie, conduction, conservation of energy, cooling, energy transfer, equilibrium, heating
Lesson Frame: Mixing Hot and Cold	We will:
	I will:
Lesson Frame: Particle Collision	We will:
	I will:
Lesson Frame: Heat	We will:
	I will:
Essential Questions: •If two equal volumes of hot and cold water are mixed, what will the final temperature be? •How does energy transfer from one substance to another? •How is heat measured?	**Outcomes:** Students learn one way that energy moves and how to conceptualize energy transfer as changes of the kinetic energy of particles resulting from particle collisions. Students mix equal volumes of hot and cold water and predict the final temperature. They use the result to determine an algorithm for calculating final temperature. Students are introduced to the calorie as a unit of energy transfer.
Performance Tasks: •Plan an investigation to mix hot and cold water to observe energy transfer •Explain energy transfer in terms of the change of particle kinetic energy resulting from conduction •Calculate and discuss energy transfer in calories. •Analyze data to develop ideas about conservation of energy.	**Learning Targets:** Students will Learn that: •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. •energy is conserved. The amount of energy in a system does not change- no energy is ever created or destroyed. •temperature is a measure of the average kinetic energy of the particles of a substance.

Topic 6: **Thermos Engineering**	**Length:** 5 sessions
Standard(s): MS-PS3-3, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4	**Academic Vocabulary:** constraint, criterion, engineering problem, insulation
Lesson Frame: Insulation	We will:
	I will:
Lesson Frame: Thermos Design	We will:
	I will:
Essential Questions: •How can you reduce energy transfer to or from a sample of water? •What is the best thermos design?	**Outcomes:** Students use their understanding of energy transfer to face an engineering problem: how to build a container that keeps hot liquids hot and cold liquids cold. They test materials for their insulating properties in preparation for the design challenge. They determine criteria and constraints in the engineering design process and test their designs.
Performance Tasks: •Apply principles of energy transfer and conduction to design, construct, and test a device that minimizes thermal-energy transfer •Collect energy-transfer data over multiple trials and multiple design iterations •Analyze data from tests of design solutions to identify characteristics that can be combined to satisfy the criteria for success	**Learning Targets:** Students will learn that: •insulating materials reduce energy transfer via conduction. •materials with more widely spaced particles serve as better insulators. •engineers try to solve problems that satisfy a set of criteria and that conform to constraints placed on a solution to the problem.
Topic 7: **Solutions**	**Length:** 3 sessions
Standard(s): MS-PS1-1, MS-PS1-2, MS-PS1-4	**Academic Vocabulary:** dissolve, melt, mixture, solubility, solute, solution, solvent
Lesson Frame: Dissolve and Melt	We will:
	I will:
Lesson Frame: Solubility	We will:
	I will:
Essential Questions: •What is the difference between dissolving and melting? •Do all substances form solutions in water?	**Outcomes:** Students explore the difference between melting and dissolving. They go on to study dissolving by comparing aqueous mixtures, one with a soluble solid and one with an insoluble solid. They compare the two mixtures and then attempt to separate them with filters and evaporation.

Performance Tasks: •Carry out an investigation to determine that some solids dissolve and others don't •Develop a particle model to explain the process of dissolving •Design methods to separate aqueous solutions. •Engage in argumentation from evidence to distinguish between dissolving and melting	**Learning Targets:** Students will learn that: •dissolving occurs when one substance (solute) is reduced to particles and is distributed uniformly throughout the particles of the second substance (solvent). •dissolving involves both kinetic interactions (collisions) and attractive forces (bonds). •not all substances are soluble in water. •solutions can be separated into their original components, which are not chemically changed during dissolution.
Topic 8: **Phase Change**	**Length:** 8 sessions
Standard(s): MS-PS1-4, MS-PS1-6, MS-3-4, MS-ETS1-2, MS-ETS1-3	**Academic Vocabulary:** condensation, deposition, evaporation, freeze, freezing point, melting point, phase change, state of matter, sublimation
Lesson Frame: Melting Temperature	We will:
	I will:
Lesson Frame: Adding Thermal Energy	We will:
	I will:
Lesson Frame: Freezing Water	We will:
	I will:
Lesson Frame: Changing Phase	We will:
	I will:
Essential Questions: •What happens at the particle level when a substance melts? •What is the relationship between melting and freezing? •How can you freeze water in the classroom? •What are all the ways that a substance can change state?	**Outcomes:** Students experience three common phases (states) of matter—solid, liquid, and gas— and investigate the conditions that induce substances to change from one phase to another. Students engage in an engineering challenge to design a classroom “freezer” that will freeze water.
Performance Tasks: •Carry out investigations to transfer heat to and from substances to observe phase change •Develop a model of state in terms of the relationship of particles to one another in a substance •Communicate information about phase change in terms of kinetic energy and energy transfer •Undertake a design project to construct, test, and modify a device that absorbs thermal energy by chemical processes.	**Learning Targets:** Students will learn that: •matter exists on Earth in three common states -- solid, liquid, and gas. •change of state is the result of change of energy and motion of the particles in a sample of matter. •during phase change, particles do not change; relationships between particles do change. •the temperatures at which phase changes occur are different for different substances. •the processes of phase change are evaporation, condensation, melting, freezing, sublimation, and deposition.
Topic 9: **Reaction**	**Length:** 9 sessions
Standard(s): MS-PS1-1, MS-PS1-2, MS-PS1-5	**Academic Vocabulary:** atom, bond, burning, compound, conservation of matter, crystal, ionic compound, molecule, precipitate, product, reactant

Lesson Frame: Substance Models	We will:
	I will:
Lesson Frame: Lime Water Reaction	We will:
	I will:
Lesson Frame: Baking Soda and Acid	We will:
	I will:
Essential Questions: •How do atoms combine to make new substances? •What happens at the particle level during a chemical reaction? •What is the chemical reaction between hydrochloric acid and sodium bicarbonate?	**Outcomes:** Students blow bubbles into limewater, observe the precipitate, and move atom tiles (representations) to simulate the rearrangement of atoms to form new substances (particles). Students study another reaction involving hydrochloric acid and baking soda and learn to use models to balance chemical equations.
Performance Tasks: •Use chemical formulas and atom tiles to show that the total number of atoms does not change in a chemical reaction and thus that mass is conserved •Use limewater to collect evidence that carbon dioxide is produced when hydrochloric acid and sodium bicarbonate react •Develop an explanation of a chemical reaction as a process in which atoms rearrange to form new substances	**Learning Targets:** Students will learn that: •all substances are made from some 90 different types of atoms (elements), which combine in various ways. •a compound is a substance composed of two or more different kinds of atoms. •atoms combine to make particles of substances: molecules and ionic compounds held together by attractive forces called bonds. •a chemical reaction is a process in which the atoms of substances rearrange to form new substances. •atoms are neither created nor destroyed during chemical reactions, only rearranged.
Topic 10: **Limiting Factors**	**Length:** 4 sessions
Standard(s): MS-PS1-1, MS-PS1-2, MS-PS1-5	**Academic Vocabulary:** concentration, limiting factor
Lesson Frame: Citric Acid and Baking Soda	We will:
	I will:
Lesson Frame: Identify Key Ideas	We will:
	I will:
	We will:
	I will:
Essential Questions: •What is a limiting factor in a chemical reaction? •What have I learned about chemical interactions?	**Outcomes:** Students conduct more chemical reactions, learning about limiting factors and reactants in excess.

Performance Tasks:	**Learning Targets:**
•Collect data by measuring the volume of gas produced in a reaction to develop explanations about the concentrations of reactants •Use a model of the concept of limiting factor in chemical reactions •Reflect on and communicate key points from the entire Chemical Interactions Unit	Students will learn that: •the quantities of reactants available at the start of a reaction determine the quantities of products. •the limiting factor is the reactant present in the lowest amount. •reactants that remain in their original form after a reaction has run to completion were present in excess. •atoms are neither created nor destroyed during chemical reactions, only rearranged; matter is conserved.

Unit Name: **Human Systems Interactions**	**Length:** approximately 28 days
Standards: MS-LS1-1, MS-LS1-3, MS-LS1-7, MS-LS1-8	**Outcomes:** Students solve a disease mystery. On the path to diagnosis, students discover the structural levels in human bodies: that cells form tissues, tissues form organs, organs form organ systems, and systems form a complex multicellular organism, the human. They look for evidence of how the organ systems interact, each dependent on all the others for its needs. Students fatigue their muscles and think about how their cells obtain the food and oxygen they need from the digestive, respiratory, and circulatory systems. They learn how aerobic cellular respiration works in cells. They find out that the cells eliminate wastes produced during aerobic cellular respiration via circulatory, respiratory, and excretory systems. Students explore the different senses to understand how humans acquire information from the environment. They engage in a “neuron relay” to model how sensory information travels to the brain for processing and how information returns to the body for action. Students turn their attention to their own learning and memory formation.
Essential Questions: What is a human body made of? How do human organ systems interact? How do cells in the human body get the resources they need? How does the energy in food become energy that cells can use? How does the sense of touch work in humans? How do messages travel to and from the brain? How are the senses alike and how are they different? How do humans learn and form memories?	**Learning Targets:** Students will learn that: •multicellular organisms are complex systems composed of organ systems, which are made of organs, which are made of tissues, which are made of cells. •cells are made of cell structures, which are made of molecules, which are made of atoms. •the human body is a system of interacting subsystems (circulatory, digestive, endocrine, excretory, muscular, nervous, respiratory, skeletal, and others). •the human body is a system of interacting subsystems. •the respiratory system supplies oxygen and the digestive system supplies energy (food) to the cells in the body. •the circulatory system transports food and oxygen to the cells in the body and carries waste products to the excretory / respiratory systems for disposal. •aerobic cellular respiration is the process by which energy stored in food molecules is converted into energy for cells. •sensory receptors respond to an array of mechanical, chemical, and electromagnetic stimuli. •sensory information is transmitted electrically to the brain along neural pathways for processing and response. •neural pathways change and grow as information is acquired and stored as memories.
Topic 1: **Systems Connections**	**Length:** 6 sessions
Standard(s): MS-LS1-1, MS-LS1-3	**Academic Vocabulary:** Atom, cell, cell structure, circulatory system, diabetes, diagnosis, digestive system, endocrine system, hormone, molecule, muscular system, nervous system, organ, organ system, respiratory system, skeletal system, symptom, tissue
Lesson Frame: Human Body Structural Levels	We will:
	I will:
Lesson Frame: Systems Research	We will:

	I will:
Essential Questions: • What is a human body made of? •How do human organ systems interact?	**Outcomes:** Students solve a disease mystery. On the path to diagnosis, students discover the structural levels in human bodies: that cells form tissues, tissues form organs, organs form organ systems, and systems form a complex multicellular organism, the human. They look for evidence of how the organ systems interact, each dependent on all the others for its needs.
Performance Tasks: •Obtain, evaluate, and communicate information regarding a single human organ system •Diagnose a disease affecting a patient by evaluating research information and evidence •Engage in argument from evidence to defend conclusions	**Learning Targets:** Students will learn that: •multicellular organisms are complex systems composed of organ systems, which are made of organs, which are made of tissues, which are made of cells. •cells are made of cell structures, which are made of molecules, which are made of atoms. •the human body is a system of interacting subsystems (circulatory, digestive, endocrine, excretory, muscular, nervous, respiratory, skeletal, and others).
Topic 2: **Supporting Cells**	**Length:** 7 sessions
Standard(s): MS-LS1-3, MS-LS1-7	**Academic Vocabulary:** aerobic cellular respiration, alveolus, calorie, capillary, glucose
Lesson Frame: Food and Oxygen	We will:
	I will:
Lesson Frame: Aerobic Cellular Respiration	We will:
	I will:
Essential Questions: •How do cells in the human body get the resources they need? •How does the energy in food become energy that cells can use?	**Outcomes:** Students fatigue their muscles and think about how their cells obtain the food and oxygen they need from the digestive, respiratory, and circulatory systems. They learn how aerobic cellular respiration works in cells. They find out that the cells eliminate wastes produced during aerobic cellular respiration via circulatory, respiratory, and excretory systems.
Performance Tasks: •Develop models to describe how food molecules are rearranged by chemical reactions forming new molecules to provide usable energy for cells •Construct explanations about organ system interactions at different scales	**Learning Targets:** Students will learn that: •the human body is a system of interacting subsystems. •the respiratory system supplies oxygen and the digestive system supplies energy (food) to the cells in the body. •the circulatory system transports food and oxygen to the cells in the body and carries waste products to the excretory/respiratory systems for disposal. •aerobic cellular respiration is the process by which energy stored in food molecules is converted into energy for cells.
Topic 3: **The Nervous System**	**Length:** 15 sessions

Standard(s): MS-LS1-3, MS-LS1-8	**Academic Vocabulary:** cerebral cortex, chemoreceptor, learning, mechanoreceptor, memory, metacognition, nerve, neuron, neurotransmitter, photoreceptor, reaction time, receptive field, response, sensory receptor, smell, stimulus, synapse, touch, vision
Lesson Frame: The Sense of Touch	We will:
	I will:
Lesson Frame: Sending a Message	We will:
	I will:
Lesson Frame: Other Senses	We will:
	I will:
Lesson Frame: Learning and Memory	We will:
	I will:
Essential Questions: •How does the sense of touch work in humans? •How do messages travel to and from the brain? •How are the senses alike and how are they different? •How do humans learn and form memories?	**Outcomes:** Students explore the different senses to understand how humans acquire information from the environment. They engage in a “neuron relay” to model how sensory information travels to the brain for processing and how information returns to the body for action. Students turn their attention to their own learning and memory formation.
Performance Tasks: •Develop a model for the action of a neural pathway •Gather and interpret data on sensory stimuli and responses •Neural pathways change and grow as information is acquired and stored as memories	**Learning Targets:** Students will learn that: •sensory receptors respond to an array of mechanical, chemical, and electromagnetic stimuli. •sensory information is transmitted electrically to the brain along neural pathways for processing and response. •neural pathways change and grow as information is acquired and stored as memories.

Unit Name: **Heredity and Adaptation**	**Length:** approximately 31 days
Standards: MS-LS3-1, MS-LS3-2, MS-LS4-1, MS-LS4-2, MS-LS4-3, MS-LS4-4, MS-LS4-5, MS-LS4-6, MS-ESS1-4	**Outcomes:** Students are introduced to the big question that drives the course: How can we explain the diversity of life that exists on Earth? They take a tour of the fossil record, looking for evidence of the existence, diversity, and transitions in life-forms throughout Earth's history. Students start this investigation with an exploration of evolutionary relationships. They examine a family tree and build a cladogram. Students build a model for how traits are inherited, starting with themselves and moving to a population of imaginary animals, larkeys. They learn about the basis of heredity, chromosomes and genes, and how genetic variation arises in populations. Students use Punnett squares to predict the probability of trait inheritance when the genotypes of the parents are known. Students consider how mutations lead to variation in a population. They see how positive mutations lead to adaptations and how natural selection works, leading to changes in populations over time. They consider the evidence for the theory of evolution. Finally, they research genetic technologies that humans use to influence inheritance and disease.
Essential Questions: What does the fossil record tell us about the history of life on Earth? What does the fossil record tell us about how life has changed over time? How can a model help us understand the relationships among organisms? What leads to variation in population? How can we model how genetic information passes from generation to generation? How can we predict the distribution of traits in a future generation? How do genetic mutation lead to variation in a population? How do populations change over time? How are humans influencing inheritance?	**Learning Targets:** Students will learn that: •the chronological fossil record documents the existence, diversity, extinction, and change of life-forms throughout Earth's history. •the fossil record is incomplete because of the nature of fossilization. •structural similarities between ancient and modern organisms is one kind of evidence from which we can infer relatedness. •a cladogram is a model that demonstrates evolutionary relationships among organisms. •embryo development can be used to identify relationships not evident in adults of different species. •heredity explains why organisms are similar but not identical to their parents. •genes on DNA code for proteins that are responsible for an organism's traits. •variation of traits in a population is established in part as a result of sexual reproduction. •a punnett square is a model used to predict the probability of inheriting genotypes in individuals of a population. •variation in a population can occur due to random genetic mutations, which can have harmful, helpful, or no effects. •an adaptation is an inherited trait that increases an organism's chances of surviving in an environment long enough to pass on its genes. •natural selection is a process by which individuals in a population best adapted to their environment tend to survive and pass their traits to subsequent generations. •change in populations by means of natural selection is the basis for the theory of evolution, which best explains the biodiversity on Earth. •Humans use genetic technologies to influence inheritance.
Topic 1: **The History of Life**	**Length:** 9 sessions

Standard(s): MS-LS4-1, MS-LS4-2, MS-ESS1-4	**Academic Vocabulary:** biodiversity, extinct, fossil, fossil record, organism, paleontologist, paleontology, principle of superposition, sedimentary rock, sediments, tetrapod, transition
Lesson Frame: The Fossil Record	We will:
	I will:
Lesson Frame: Transitions	We will:
	I will:
	We will:
	I will:
Essential Questions: •What does the fossil record tell us about the history of life on Earth? •What does the fossil record tell us about how life has changed over time?	**Outcomes:** Students are introduced to the big question that drives the course: How can we explain the diversity of life that exists on Earth? They take a tour of the fossil record, looking for evidence of the existence, diversity, and transitions in life-forms throughout Earth's history.
Performance Tasks: •Analyze data and use models to predict the characteristics of organisms missing from the fossil record •Integrate information from a variety of media to develop evidence to explain a phenomenon	**Learning Targets:** Students will learn that: •the chronological fossil record documents the existence, diversity, extinction, and change of life-forms throughout Earth's history. •The fossil record is incomplete because of the nature of fossilization. •Structural similarities between ancient and modern organisms is one kind of evidence from which we can infer relatedness.
Topic 2: **Heredity**	**Length:** 11 sessions
Standard(s): MS-LS3-1, MS-L3-2, MS-LS4-2, MS-LS4-3	**Academic Vocabulary:** allele, characteristic, chromosome, cladogram, common ancestor, descendant, DNA, Dominant, feature, filial, gene, generation, genome, genotype, heredity, heterozygous, homozygous, inheritance, inherited characteristic, limitations, most recent common ancestor, phenotype, population, protein, punnett square, recessive, related, species, trait, variation
Lesson Frame: Lines of Descent	We will:
	I will:
Lesson Frame: Inheriting Traits	We will:
	I will:
Lesson Frame: Modeling Heredity	We will:
	I will:
Lesson Frame: Punnett Squares	We will:
	I will:

Essential Questions: •How can a model help us understand the relationships among organisms? •What leads to variation in population? •How can we model how genetic information passes from generation to generation? •How can we predict the distribution of traits in a future generation?	**Outcomes:** Students start this investigation with an exploration of evolutionary relationships. They examine a family tree and build a cladogram. Students build a model for how traits are inherited, starting with themselves and moving to a population of imaginary animals, larkeys. They learn about the basis of heredity, chromosomes and genes, and how genetic variation arises in populations. Students use Punnett squares to predict the probability of trait inheritance when the genotypes of the parents are known.
Performance Tasks: •Analyze and interpret data to construct explanations, using mathematical models involving probability	**Learning Targets:** Students will learn that: •a cladogram is a model that demonstrates evolutionary relationships among organisms. •embryo development can be used to identify relationships not evident in adults of different species. •heredity explains why organisms are similar but not identical to their parents. •genes on DNA code for proteins that are responsible for an organism's traits. •variation of traits in a population is established in part as a result of sexual reproduction. •a punnett square is a model used to predict the probability of inheriting genotypes in individuals of a population.
Topic 3: **Evolution**	**Length:** 11 sessions
Standard(s): MS-LS3-1, MS-LS4-4, MS-LS4-5, MS-LS4-6	**Academic Vocabulary:** adaptation, artificial selection, gene therapy, genetically modified organism, mutation, natural selection, speciation, theory, theory of evolution, transgenic organism
Lesson Frame: Adaptation	We will:
	I will:
Lesson Frame: Natural Selection	We will:
	I will:
Lesson Frame: Genetic Technology	We will:
	I will:
Essential Questions: •How do genetic mutation lead to variation in a population? •How do populations change over time? •How are humans influencing inheritance?	**Outcomes:** Students consider how mutations lead to variation in a population. They see how positive mutations lead to adaptations and how natural selection works, leading to changes in populations over time. They consider the evidence for the theory of evolution. Finally, they research genetic technologies that humans use to influence inheritance and disease.

Performance Tasks:	**Learning Targets:**
•Analyze and interpret data to construct explanations using mathematical models involving probability	Students will learn that: •variation in a population can occur due to random genetic mutations, which can have harmful, helpful, or no effects. •an adaptation is an inherited trait that increases an organism's chances of surviving in an environment long enough to pass on its genes. •natural selection is a process by which individuals in a population best adapted to their environment tend to survive and pass their traits to subsequent generations. •change in populations by means of natural selection is the basis for the theory of evolution, which best explains the biodiversity on Earth. •Humans use genetic technologies to influence inheritance.

Unit Name: **Planetary Science**	**Length:** approximately 53 sessions
Standards: MS-ESS1-1, MS-ESS1-2, MS-ESS1-3, MS-ESS1-4, MS-ESS2-2, MS-ESS2-4, MS-ESS3-1, MS-ESS3-2, MS-ESS3-3, MS-ESS3-4, MS-PS2-4, MS-PS4-2, MS-ETS1-1	**Outcomes:** Students develop a sense of planet Earth as a tiny base from which to launch an inquiry into the vast reaches of the solar system and beyond. They observe the Moon and start a log of its changes. Students become familiar with the celestial relationship of the Sun and Earth. They think not only about what they know (Earth is round) but how they know it. They simulate the basic geometry of Earth and the Sun to explain day, night, and year. Students apply what they know about Earth's tilt and the revolution of Earth around the Sun to explain daylight length and seasons. Students learn the factors resulting in seasons, including latitude, tilt of Earth's axis, revolution, and rotation. Students study the surface features of the Moon and the size and distance of our closest celestial neighbor. They read myths to experience how other cultures explain the features and behavior of the Moon. Students analyze Moon log data to identify the pattern of Moon phases, then develop a physical model that can explain Moon phases. They explain how the motions of Earth and the Moon in relation to the Sun result in the phases of the Moon we observe on Earth. Students conduct simple experiments to determine if the craters on the Moon's surface could be caused by impact events of various magnitudes. They use Moon data to determine the number and frequency of major impacts. Students learn the major classifications in which cosmic objects are distributed: solar system, galaxy, universe. They sequence the events that led to the formation of the solar system. Students explore four theories of Moon origin. Students explore the scale of the solar system by making physical and graphical models. They explore the relationship of atmosphere, planet temperature, and liquid water. They search images of planets and satellites for evidence of water. Students are introduced to a tool used to study distant objects in planetary systems, the spectroscope. They use a simple spectroscope to become aware of the spectral signature of elements. Students use telescope images of the moons of Jupiter to determine their orbital patterns and distances from the planet. They study techniques used to search for planets and planetary systems around other stars in the Milky Way galaxy.

Essential Questions:	**Learning Targets:**
Where are you when you are in science class? Why is Earth described as a system? How does the Moon change day by day? What causes day and night? Why is it hotter in the summer? Why are there more hours of sunlight in the summer? What is visible on the Moon? What does an Earth/Moon scale model? What Moon-phase patterns can be observed? What causes Moon phases? How do models help us understand phases of the Moon? Are Moon craters the result of volcanoes or impacts? Will Earth experience a major impact in the future? What is in the solar system? Where did the solar system come from? Where are the planets in the solar system? Which planet is most like Earth? Where is the water in the solar system? What impact do humans have on Earth's systems? Why is light important in astronomy? What are the big questions that guide space exploration? What can be learned by studying the moons of Jupiter? How are exoplanets found? Where are you when you are in science class?	Students will learn that: •location or position can be described in terms of a frame of reference (relationship to other objects). •point of view is a position from which a visual observation is made. •Earth is a system composed of subsystems. •the moon can be observed both day and night. •line of sight is the straight, unimpeded path taken by light from an object to an eye. •objects appear to sink when they move across the ocean and slip below the horizon on a curved surface. •at all 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. •the Moon has 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. •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 measure in related units. •the moon goes through phases: "new" to "full" and back to "new" in a 4-week cycle. •the moon shines as a results 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 positions of Earth and the Moon in their orbits around the Sun. •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. •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 characteristics: simple, complex, terraced, ringed (or basin), and flooded. •Earth and the Moon have been, and continue to be, subjected to the same rate of bombardment by meteoroids. •Earth's record of impacts has been erased by the actions of wind, water, and tectonic activity. •the solar system includes the Sun; eight planets and their satellites; and a host of smaller objects, including dwarf planets, asteroids, comets, Kuiper Belt objects, and Oort Cloud matter. •the solar system formed during a sequence of events that started with a nebula of dust and gas. •the Moon formed after a massive collision between the forming Earth and a planetesimal about the size of Mars. •the distance between solar system objects is enormous. •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 the nature of the planet's atmosphere. •images can convey information about the presence and history of liquid water on planetary surfaces. •humans modify Earth's systems, creating observable effects. •a spectroscope analyzes the wavelengths of light (spectrum) coming from a light source. •scientists use spectral data from distant moons, planets, and stars to determine their temperature, composition, motion, and more. •scientific missions provide data about the composition and environmental conditions on the planets, moons, and other bodies in the solar system. •planetary-system objects move in measurable and predictable patterns. •a transit occurs when a planet passes between a star and an observer, causing a dip in the intensity of light from the star. •the magnitude and duration of the dip in light intensity during a transit reveals information about the planet. •location can be described in relation to a frame of reference.

Topic 1: **Earth as a System**	**Length: 4** sessions
Standard(s): MS-ESS1-1, MS-ESS3-4	**Academic Vocabulary:** altitude, atmosphere, biosphere, Bird's-eye view, elevation, frame of reference, Geosphere, Hydrosphere, location, point of view, Subsystem, System
Lesson Frame: School to Space	We will:
	I will:
Lesson Frame: Earth's Systems	We will:
	I will:
Lesson Frame: Moon Watch	We will:
	I will:
Essential Questions: •Where are you when you are in science class? •Why is Earth described as a system? •How does the Moon change day by day?	**Outcomes:** Earth as a System introduces students to the anchor phenomenon of Earth as an object in space. Students study images of Earth at different scales, then explore Earth's interacting subsystems. They develop a sense of planet Earth as a base from which to launch an inquiry into the vast reaches of the solar system and beyond.
Performance Tasks: •Use images to describe a location on Earth from ever-changing points of view •Explain interactions between Earth's systems •Observe the Moon and maintain a Moon log to record	**Learning Targets:** Students will learn that: •location or position can be described in terms of a frame of reference (relationship to other objects). •point of view is a position from which a visual observation is made. •Earth is a system composed of subsystems. •the moon can be observed both day and night.
Topic 2: **Earth/Sun Relationship**	**Length:** 8 sessions
Standard(s): MS-ESS1-1	**Academic Vocabulary:** axis, equator, equinox, latitude, longitude, north star, orbit, revolution, rotation, season, solar angle, solstice
Lesson Frame: Day and Night	We will:
	I will:
Lesson Frame: Summer Heat	We will:
	I will:
Lesson Frame: Day Length	We will:
	I will:
Essential Questions: •What causes day and night? •Why is it hotter in the summer? •Why are there more hours of sunlight in the summer?	**Outcomes:** In Earth/Sun Relationship, students explore the investigative phenomena of days and seasons on Earth. They develop a model incorporating the basic geometry of Earth and the Sun to explain day, night, and year.
Performance Tasks: •Use models and simulations to observe ships on round and flat Earth •Determine the direction of Earth's rotation •Use light sources and spheres to model day and night	**Learning Targets:** Students will learn that: •line of sight is the straight, unimpeded path taken by light from an object to an eye. •objects appear to sink when they move across the ocean and slip below the horizon on a curved surface. •at all 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

Topic 3: **Moon Study**	**Length:** 4 sessions
Standard(s): MS-ESS1-1, MS-ESS1-3	**Academic Vocabulary:** crater, highlands, mare, ray, rille, scaling factor
Lesson Frame: A Close Look at the Moon	We will:
	I will:
Lesson Frame: How Big/ How Far?	We will:
	I will:
Essential Questions: •What is visible on the Moon? •What does a scaled Earth/Moon scale model look like?	**Outcomes:** Moon Study introduces students to the phenomenon of surface feature of the Moon. Students explore the scale of the Earth/Moon relationship. Students also read myths to experience how other cultures explain the features and behaviors exhibited by the moon.
Performance Tasks: •Observe images of the Moon to identify and classify some major surface features •Generate a list of questions about the Moon that will guide further study •Construct a scale model of the Earth/Moon system.	**Learning Targets:** Students will learn that: •the Moon has 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. •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 measure in related units.
Topic 4: **Phases of the Moon**	**Length:** 5 sessions
Standard(s): MS-ESS1-1, MS-ESS1-3	**Academic Vocabulary:** crescent, first quarter, full moon, gibbous, lunar eclipse, new moon, phase, solar eclipse, third quarter, waning, waxing
Lesson Frame: Observed Patterns	We will:
	I will:
Lesson Frame: Moon-Phase Models	We will:
	I will:
Lesson Frame: Moon-Phase Simulation	We will:
	I will:
Essential Questions: •What Moon-phase patterns can be observed? •What causes Moon phases?	**Outcomes:** Phases of the Moon helps students explore the phenomenon of Moon phases by gaining a better understanding of the motions of Earth and the Moon in relation to the Sun, which result in these phases.
Performance Tasks: •Observe, record, and analyze the Moon's appearance and position in relation to the Sun over a 4-week period •Use models of the Sun, Moon, and Earth to explain the mechanics of Moon phases and eclipses	**Learning Targets:** Students will learn that: •the moon goes through phases: "new" to "full" and back to "new" in a 4-week cycle. •the moon shines as a results 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 positions of Earth and the Moon in their orbits around the Sun. •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.

Topic 5: **Craters**	**Length:** 6 sessions
Standard(s): MS-ESS1-4, MS-ESS2-2, MS-ESS3-2, MS-ETS1-1	**Academic Vocabulary:** asteroid, comet, complex crater, ejecta, flooded crater, impact, meteoroid, regolith, simple crater
Lesson Frame: Moon Craters	We will:
	I will:
Lesson Frame: Target Earth	We will:
	I will:
Essential Questions: •Are Moon craters the results of volcanoes or impacts? •Will Earth experience a major impact in the future?	**Outcomes:** In Craters, students conduct experiments to determine if the craters on the Moon could be caused by impact events of various magnitudes. Students consider the possibility that Earth was also subjected to intense bombardment during its history and speculate on the destruction that would result from impacts on Earth comparable to those that have occurred on the Moon.
Performance Tasks: •Conduct experiments to determine the effect of meteoroid size and speed on crater characteristics •Use mathematical reasoning to determine the frequency of major impacts on Earth	**Learning Targets:** Students will learn that: •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 characteristics: simple, complex, terraced, ringed (or basin), and flooded. •Earth and the Moon have been, and continue to be, subjected to the same rate of bombardment by meteoroids. •Earth's record of impacts has been erased by the actions of wind, water, and tectonic activity.
Topic 6: **Beyond the Moon**	**Length:** 6 sessions
Standard(s): MS-PS2-4, MS-ESS1-2	**Academic Vocabulary:** accretion, astronomical unit (AU), galaxy, gravity, light-year (ly), nebula, orbit radius, solar system, universe
Lesson Frame: What's Out There?	We will:
	I will:
Lesson Frame: Origins	We will:
	I will:
Essential Questions: •What is in the solar system? •Where did the solar system come from?	**Outcomes:** In Beyond the Moon, students explore the phenomenon of objects in outer space. They learn the major classifications into which cosmos objects are organized: solar system, galaxy, and universe, and create a sequence of events that resulted in the formation of the solar system. Finally, students weigh the evidence supporting four theories of the origin of the Moon.
Performance Tasks: •Carry out an investigation to organize objects in the cosmos into three nested systems: solar system, galaxy, universe •Analyze and interpret data to sequence the events and processes that resulted in the formation of the solar system •Present an argument citing evidence for the Moon's forming as a result of a big impact (or other theory).	**Learning Targets:** Students will learn that: •the solar system includes the Sun; eight planets and their satellites; and a host of smaller objects, including dwarf planets, asteroids, comets, Kuiper Belt objects, and Oort Cloud matter. •the solar system formed during a sequence of events that started with a nebula of dust and gas. •the Moon formed after a massive collision between the forming Earth and a planetesimal about the size of Mars.
Topic 7: **The Solar System**	**Length: 9** sessions
Standard(s): MS-ESS1-2, MS-ESS1-3, MS-ESS2-2, MS-ESS2-4, MS-ESS3-1, MS-ESS3-3, MS-ESS3-4	**Academic Vocabulary:** anthropocene, atmosphere, exoplanet

Lesson Frame: Where are the Planets?	We will:
	I will:
Lesson Frame: Comparing Temperatures and Atmospheres	We will:
	I will:
Lesson Frame: Where is the Water?	We will:
	I will:
Lesson Frame: Changing Systems	We will:
	I will:
Essential Questions: •Where are the planets in the solar system? •Which planet is most like Earth? •Where is there water in the solar system? •What impact do humans have on Earth's systems?	**Outcomes:** In The Solar System, students continue to explore the scale of the solar system by making physical and graphical models. Students explore the compositional and physical differences among the planets, the Moon, and other solar system objects. By focusing on the recent history of solar system exploration, students discover that only Earth possesses the fortuitous combination of factors that support life.
Performance Tasks: •Design and construct scale models of the solar system •Compare the temperatures and atmospheres of the planets •Analyze photographic images to search for evidence of the presence of water on planets and satellites	**Learning Targets:** Students will learn that: •the distance between solar system objects is enormous. •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 the nature of the planet's atmosphere. •images can convey information about the presence and history of liquid water on planetary surfaces. •humans modify Earth's systems, creating observable effects.
Topic 8: **Space Exploration**	**Length: 4** sessions
Standard(s): MS-PS4-2, MS-ETS1-1	**Academic Vocabulary:** absorption line, emission line, light signature, spectroscope, spectrum, visible light
Lesson Frame: Light Spectra	We will:
	I will:
Lesson Frame: Exploration of the Solar System	We will:
	I will:
Essential Questions: •Why is light important in astronomy? •What are the big questions that guide space exploration?	**Outcomes:** In Space Exploration, students are introduced to one of the most important tools astronomers use to study distant objects in planetary systems, the spectroscope. Students use a simple spectroscope to explore the spectral signature of elements of the Sun and other light sources.
Performance Tasks: •Use a spectroscope a to analyze light coming from several light sources •Investigate the big questions scientists are asking in the exploration of the solar system and beyond	**Learning Targets:** Students will learn that: •a spectroscope analyzes the wavelengths of light (spectrum) coming from a light source. •scientists use spectral data from distant moons, planets, and stars to determine their temperature, composition, motion, and more. •scientific missions provide data about the composition and environmental conditions on the planets, moons, and other bodies in the solar system.

Topic 9: **Orbits and New Worlds**	**Length:** 7 sessions
Standard(s): MS-ESS1-1, MS-ESS1-2, MS-ESS1-3, MS-PS2-4	**Academic Vocabulary:** orbit radius, orbital period, transit, orrery
Lesson Frame: The Moons of Jupiter	We will:
	I will:
Lesson Frame: Looking for Planets	We will:
	I will:
Lesson Frame: What is Our Cosmic Address?	We will:
	I will:
Essential Questions: •What can be learned by studying the moons of Jupiter? •How are exoplanets found? •Where are you when you are in science class?	**Outcomes:** Orbits and New Worlds begins by having students use images of the moons of Jupiter to determine their orbital patterns and distances from the planet. They investigate the techniques that scientists use to search for planetary systems around other stars in our galaxy. Students redefine their place in the universe.
Performance Tasks: •Use data and images to determine the orbital period and orbit radii of the four Galilean moons of Jupiter. •Use an orrery and light sensor to model how to locate planetary systems in our galaxy.	**Learning Targets:** Students will learn that: •planetary-system objects move in measurable and predictable patterns. •a transit occurs when a planet passes between a star and an observer, causing a dip in the intensity of light from the star. •the magnitude and duration of the dip in light intensity during a transit reveals information about the planet. •location can be described in relation to a frame of reference.