Performance Expectation *and Louisiana Connectors*
7-MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. ***LC-7-MS-PS2-1a Using data, identify changes that occur after a chemical reaction has taken place (e.g., change in color occurs, gas is created, heat or light is given off or taken in).***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Analyzing and interpreting data: Analyzing data in 6-8 builds on K-5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings. ***Use data to determine similarities in findings.*** ***Use data to determine differences in findings.***	**STRUCTURE AND PROPERTIES OF MATTER** Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) under normal conditions that can be used to identify it. (MS.PS1A.b) ***Pure substances are made from a single type of atom or molecule.*** ***Elements and compounds are pure substances.*** ***Pure substances have characteristics (physical and chemical properties) that are used to identify them.*** **CHEMICAL REACTIONS** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS.PS1B.a) ***Substances react in characteristic ways.*** ***When a chemical reaction occurs, the parts that make up the original substance are regrouped in a new way that makes a new substance with new properties.*** ***If atoms are rearranged, the ending result is a different substance.*** ***Many substances react chemically with other substances to form new substances with different properties.***	**PATTERNS** Macroscopic patterns are related to the nature of microscopic and atomic-level structure. ***Patterns can be related to microscopic and atomic-level structures.*** ***For example, chemical molecules contain particular ratios of different atoms.*** ***Macroscopic patterns are determined by microscopic and atomic level structures.***

Clarification Statement
Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, or mixing zinc with hydrogen chloride. Examples of chemical and physical properties to analyze include density, melting point, boiling point, solubility, flammability, or odor.

Clarification Statement
Performance Expectation *and Louisiana Connectors*
7-MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and the state of a pure substance when thermal energy is added or removed. ***LC-7-MS-PS1-4a Use drawings and diagrams to Identify that adding or removing thermal energy increases or decreases particle motion until a change of state occurs.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Developing and using models: Modeling in 6-8 builds on K-5 experiences and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or use a model to predict and/or describe phenomena. ***Models, such as drawings and diagrams, can be used to describe phenomena.*** ***Models can be used to predict phenomena.***	**STRUCTURE AND PROPERTIES OF MATTER** Gases and liquids are made of molecules or inert atoms (the noble gases) that are moving about relative to each other. (MS.PS1A.c) ***Gases and liquids are made of molecules, which are always moving.*** ***In the liquid state, particles are loosely packed and move past each other.*** ***In a gaseous state, particles freely move past one another.*** ***As the temperature in a system increases, solid, liquid, and gas molecules increase in speed.*** ***As the temperature in a system decreases, solid, liquid, and gas molecules decrease in speed.*** In a liquid, the molecules are constantly in motion and in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS.PS1A.d) ***The molecules in a liquid are always in motion and in contact with other molecules.*** ***The molecules in a gas are widely spaced.*** ***The molecules in a solid are closely spaced. A solid's molecules may vibrate, but they do not change position.*** ***Particles in all three states are in constant motion.*** The changes of state that occur with variations in temperature or pressure can be described and predicted using temperature and pressure models of matter. (MS.PS1A.f) ***Heating and cooling of materials may produce changes in the state of solids, liquids, and***	**CAUSE AND EFFECT** Cause and effect relationships may be used to predict phenomena in natural or designed systems. ***Cause and effect relationships may be used to predict phenomena.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
	gases. ***The state of matter is determined by the temperature and pressure of a substance.*** ***The state of matter can be predicted using temperature and pressure models.*** ***A phase change may occur when a material absorbs or releases heat energy.*** ***Changes in phase do not change the particles but do change how they are arranged.*** The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (MS.PS.3A.c) ***Temperature is a measure of how fast particles are moving inside of a substance (i.e., the energy a substance contains).*** ***Matter at any temperature above absolute zero contains thermal energy. Thermal energy is the random motion of particles.*** ***The amount of matter in a system will affect the amount of energy needed to change the temperature of the matter.*** The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (MS.PS3A.e) ***The term heat, in science, refers to the transfer of thermal energy.***	

Clarification Statement
Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings or diagrams. Examples of particles could include molecules or inert atoms such as the noble gases. Examples of pure substances could include water, carbon dioxide, or helium.

Performance Expectation *and Louisiana Connectors*
7-MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. ***LC-7-MS-PS1-5a Use a model to identify a chemical reaction in which the mass of the reactants is shown to be equal to the mass of the products.*** ***LC-7-MS-PS1-5b Use a model to show how the total number of atoms does not change in a chemical reaction and thus mass is conserved.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Developing and using models: Modeling in 6-8 builds on K-5 experiences and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to describe unobservable mechanisms. ***A model, such as a drawing or illustration, can be used to describe a mechanism which cannot be seen.***	**CHEMICAL REACTIONS** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS.PS1B.a) ***Substances react in characteristic ways.*** ***Chemical reactions result in new substances with properties that are different from those of the component parts.*** ***When a chemical reaction occurs, the parts that make up the original substance are regrouped in a new way that makes a new substance with new properties.*** ***If atoms are rearranged, the ending result is a different substance.*** ***Many substances react chemically with other substances to form new substances with different properties.*** The total number of each type of atom is conserved, and thus the mass does not change. (MS.PS1B.b) ***Matter cannot be created or destroyed.*** ***During a chemical reaction and rearrangement, all the atoms are accounted for and none are lost.*** ***The atoms are just in a new configuration and the total number of atoms present before the reaction is equal to the number of atoms after the reaction.*** ***The total mass of the mixture is equal to the sum of the masses of the components.*** ***Total mass is conserved when different substances are mixed.***	**ENERGY AND MATTER** Matter is conserved because atoms are conserved in physical and chemical processes. ***Matter is conserved because the original number of atoms before a reaction occurs (product) is the same as the number of atoms after the reaction occurs (reactant).***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
	When materials interact within a closed system, the total mass of the system remains the same.	

Clarification Statement
Emphasis is on the law of conservation of matter and on physical models or drawings, including digital forms that represent atoms. The use of atomic masses, balancing symbolic equations, or intermolecular forces is not the focus of this performance expectation.

Performance Expectation *and Louisiana Connectors*
7-MS-PS3-4 Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. ***LC-7-MS-PS3-4a Using examples and data measurements, describe the relationship between different masses of the same substance and the change in average kinetic energy when thermal energy is added to or removed from the system.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Planning and carrying out investigations: Planning and carrying out investigations to answer questions or test solutions to problems in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. ***Scientific investigations may be undertaken to support a claim.*** ***Scientific investigations should be planned.*** ***Scientific investigations can be developed with others.*** ***The design plan must include what***	**DEFINITIONS OF ENERGY** Temperature is a measure of the average kinetic energy; the relationship between the temperature and the total energy of the system depends on the types, states, and amounts of matter present. (MS.PS3A.d) ***Temperature is a measurement used to determine how fast the particles are moving inside of a substance or how much energy the substance contains.*** ***The temperature of matter is a measurement of the matter's average kinetic energy.*** ***The state, amount of substance, and the type of substance will all affect the total amount of energy it has.*** **CONSERVATION OF ENERGY AND ENERGY TRANSFER** The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the mass of the sample, and the environment. (MS.PS3B.b) ***The amount of matter in a system will affect the amount of energy needed to change the temperature of the matter.*** ***The type of matter in a system will affect the amount of energy needed to change the temperature of the matter.*** ***The environment of a system will affect the amount of energy needed to change the temperature of the matter.*** Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS.PS3B.c)	**SCALE, PROPORTION, AND QUANTITY** Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. ***Ratio and proportionality are used in science.*** ***Ratio and proportionality provide information about the magnitude of properties.*** ***Ratio and proportionality provide information about the***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
tools are needed. ***The design plan must include how measurements will be recorded.*** ***The design plan must include what kind of data must be gathered.*** ***The design plan must include experimental variables including independent, dependent, and controls.***	***Energy is transferred out of hotter regions into colder ones.*** ***Energy is transferred out of hotter objects into colder ones.*** ***Heat energy transfers from warmer substances to cooler substances until they reach the same temperature.***	***magnitude of processes.***

Clarification Statement
Emphasis is on observing change in temperature as opposed to calculating total thermal energy transferred. Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.

Performance Expectation *and Louisiana Connectors*
7-MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. ***LC-7-MS-ESS2-4a Using a model(s), identify components in a model of water cycling among land, ocean, and atmosphere, and recognize how it is propelled by sunlight and gravity.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Developing and using models: Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to describe unobservable mechanisms. ***A model can be used to describe a mechanism which cannot be seen.***	**THE ROLES OF WATER IN EARTH'S SURFACE PROCESSES** Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS.ESS2C.a) ***Through the water cycle, water is cycled and recycled through both the living and non-living components of Earth's ecosystems.*** ***Water cycles through transpiration, evaporation, condensation, crystallization, and precipitation, as well as downhill flows on land through run-off and groundwater.*** ***Water within a watershed travels over and through the land at various speeds based on the rate of change in elevation and the permeability and porosity of the soil.*** Global movements of water and its changes in form are propelled by sunlight and gravity. (MS.ESS2C.c) ***Energy from the sun and the force of gravity drive the continual cycling of water.*** ***Sunlight causes evaporation and propels oceanic and atmospheric circulation.*** ***Gravity causes precipitation to fall from clouds and water to flow downward on the land.*** **LOUISIANA'S NATURAL RESOURCES** Replenishable resources such as groundwater and oxygen are purified by the movement through Earth's cycles. (MS.EVS1A.c) ***As water moves Earth's cycles, it is purified (e.g., groundwater).*** ***As oxygen moves through Earth's cycles, it is purified.***	**ENERGY AND MATTER** Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. ***Energy can be transferred.*** ***Energy transfer drives the motion of matter through systems (natural and designed).*** ***Energy transfer drives the cycling of matter through systems (natural and designed).***

Clarification Statement
Emphasis is on the ways water changes its state and location as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.

Performance Expectation *and Louisiana Connectors*
7-MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. ***LC-7-MS-ESS2-5a Using data, identify how water influences weather and weather patterns through atmospheric, land, and oceanic circulation.*** ***LC-7-MS-ESS2-5b Using data, identify examples of how the sun drives all weather patterns on Earth (e.g., flow of energy that moves through Earth's land, air, and water).***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Planning and carrying out investigations: Planning and carrying out investigations to answer questions (science) or test solutions (engineering) to problems in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. ***Use data to answer scientific questions.*** ***Use data to test design solutions.*** ***Collect data across a range of conditions.***	**THE ROLES OF WATER IN EARTH'S SURFACE PROCESSES** The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS.ESS2C.b) ***Local weather at any point in time varies at different locations around the world.*** ***Weather can change in a short amount of time.*** ***Factors such as air pressure, temperature, humidity, precipitation, and wind can cause weather changes and weather patterns.*** ***Some weather events, such as snowstorms, hurricanes, thunderstorms or tornadoes are more likely to occur at different times of the year.*** **WEATHER AND CLIMATE** Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. Because these patterns are so complex, weather can only be predicted probabilistically. (MS.ESS2D.a) ***The sun drives all weather patterns on Earth.*** ***Sunlight heats Earth's surface, which in turn heats the atmosphere.*** ***The sun's energy heats Earth's surface, and the surface heats the air above it.*** ***The sun's energy heats Earth's surface unevenly.*** ***The ocean exerts a major influence on weather and climate.*** ***The ocean moderates and stabilizes global climates.***	**CAUSE AND EFFECT** Cause and effect relationships may be used to predict phenomena in natural or designed systems. ***Cause and effect relationships may be used to predict phenomena.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
	Differences in latitude, altitude, and local and regional geography can cause different types of weather. ***The climate at a location on Earth is the result of several interacting variables such as latitude, altitude, regional geography, and/or proximity to water.*** ***Weather can be predicted, but weather forecasting has not been perfected.*** ***Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosp here, ice, landforms, and living things.***	

Clarification Statement
Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as condensation).

Performance Expectation *and Louisiana Connectors*
7-MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth causes patterns of atmospheric and oceanic circulation that determine regional climates. ***7-MS-ESS2-6a Using a model(s), identify that as the sun's energy warms the air over the land (expands and rises), the air over the ocean (cooler air) rushes in to take its place and is called wind (sea breeze).*** ***7-MS-ESS2-6b Using a model(s), identify that weather and climate vary with latitude, altitude, and regional geography.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Developing and using models: Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. ***Use a model to describe phenomena.*** ***Develop a model to describe phenomena.***	**THE ROLES OF WATER IN EARTH'S SURFACE PROCESSES** Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS.ESS2C.d) ***The movement of water among the geosphere, hydrosphere, and atmosphere affects such things as weather systems, ocean currents, and global climate.*** ***Ocean currents and sea surface temperature are directly related to global climate patterns.*** ***Ocean currents are the result of variations in the ocean's density.*** ***The density of different regions of the ocean is due to temperature and salinity variations.*** **WEATHER AND CLIMATE** Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. Because these patterns are so complex, weather can only be predicted probabilistically. (MS.ESS2D.a) ***The sun drives all weather patterns on Earth.*** ***Sunlight heats Earth's surface, which in turn heats the atmosphere.*** ***The ocean exerts a major influence on weather and climate.*** ***The ocean moderates and stabilizes global climates.*** ***Differences in latitude, altitude, and local and regional geography can cause different types of weather.*** ***The climate at a location on Earth is the result of several interacting variables such as latitude, altitude, regional geography, and/or proximity to water.***	**SYSTEMS AND SYSTEM MODELS** Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. ***Models can represent systems.*** ***In many systems there are cycles of various types.*** ***Energy flows within systems.*** ***Matter flows within systems.*** ***Information flows within systems.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
	Weather can be predicted, but weather forecasting has not been perfected. The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS.ESS2D.b) ***The ocean absorbs and stores large amounts of energy from the sun and releases it very slowly.*** ***The ocean's thermal capacity contributes to moderating temperature variations around the globe.*** ***Energy is redistributed globally through ocean currents.*** ***Ocean currents can redistribute energy from the sun, which can affect regional climates.***	

Clarification Statement
Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation (e.g. el Niño/la Niña) is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.

Performance Expectation *and Louisiana Connectors*
7-MS-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. ***LC-7-MS-ESS3-5a Identify evidence of the effects of human activities on changes in global temperatures over the past century using a variety of resources (e.g., tables, graphs, and maps of global and regional temperatures; atmospheric levels of gases, such as carbon dioxide and methane; and rates of human activities).*** ***LC-7-MS-ESS3-5b Using a variety of resources, ask questions or make observations about how the effects of human activities have changed global temperatures.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking questions and defining problems: Asking questions (science) and defining problems (engineering) in 6-8 builds on K-5 experiences and progresses to specifying relationships between variables, clarifying arguments and making models. • Ask questions to identify and/or clarify evidence and/ or the premise(s) of an argument. ***Ask questions to identify the premise of an argument.*** ***Ask questions to clarify the premise of an argument.*** ***Ask questions to identify evidence.*** ***Ask questions to clarify evidence.***	**GLOBAL CLIMATE CHANGE** Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature. Addressing climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS.ESS3D.a) ***Heat energy stored in the oceans and transferred by currents influence climate.*** ***A disruption of the circulation and temperature of the world's oceans would foster climate change and have environmental and economic consequences.*** ***Global climate change is driven by both natural phenomena and by human activities.*** ***Global climate change could have large consequences for all of Earth's surface systems.*** ***With further scientific research, people can learn more about climate changes and help guide more effective responses.*** ***Using science-based predictive models, humans can anticipate long-term change more effectively and plan accordingly.***	**STABILITY AND CHANGE** Stability might be disturbed either by sudden events or gradual changes that accumulate over time. ***Stability can be disturbed by sudden events.*** ***Stability can be disturbed by an accumulation of gradual changes.***

Clarification Statement
Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures,

Clarification Statement
atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.)

Performance Expectation *and Louisiana Connectors*
7-MS-LS1-3 Use an argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. ***LC-7-MS-LS1-3a Identify that the body is a system of multiple interacting subsystems.*** ***LC-7-MS-LS1-3b Identify evidence which supports a claim about how the body is composed of various levels of organization for structure and function which includes cells, tissues, organs, organ systems, and organisms using models or diagrams.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Engaging in argument from evidence: Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. ***Construct an argument to support or refute an explanation, model, or solution to a problem.*** ***Use an argument to support or refute an explanation, model, or solution to a problem.*** ***Present an argument to support or refute an explanation, model, or solution to a problem.***	**STRUCTURE AND FUNCTION** In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions in order to maintain homeostasis. (MS.LS1A.c) ***In multicellular organisms, groups of cells work together to perform tasks and are called tissues.*** ***Groups of tissues may work together to form organs.*** ***Organs work together as systems to perform particular functions in the body.*** ***The body systems work together to maintain stable conditions (homeostasis) in the body.*** ***The human body has systems that perform functions necessary for life.*** ***Major systems of the human body include the digestive, respiratory, reproductive, and circulatory systems, etc.*** **INFORMATION PROCESSING** Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS.LS1D.a) ***An organism's ability to sense and respond to its environment enhances its chance of surviving and reproducing.*** ***Animals have external and internal sensory receptors that detect different kinds of information.*** ***An animal's sense receptors transfer information to the brain as signals.*** ***The brain processes the signals into usable information.*** ***The brain can guide a response behavior and store memories.***	**SYSTEMS AND SYSTEM MODELS** Systems may interact with other systems; they may have subsystems and be a part of larger complex systems. ***Systems may work with other systems.*** ***Systems can be made of smaller subsystems.*** ***A system can be a part of a larger system.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
	Nerve cells communicate with each other to transmit information from the internal and external environment often resulting in physiological or behavioral responses.	

Clarification Statement
Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems. Systems could include circulatory, excretory, digestive, respiratory, muscular, endocrine, or nervous systems.

Performance Expectation *and Louisiana Connectors*
7-MS-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis and cellular respiration in the cycling of matter and flow of energy into and out of organisms. ***LC-MS-LS1-6 Use a scientific explanation about photosynthesis to identify the movement of matter and flow of energy as plants use the energy from light to make sugars.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Constructing explanations and designing solutions: Constructing explanations (science) and designing solutions (engineering) in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ***Obtain evidence from valid and reliable sources.*** ***Construct a scientific explanation based on evidence.*** ***Construct a scientific explanation***	**ORGANIZATION FOR MATTER AND ENERGY FLOW IN ORGANISMS** Plants, plant-like protists (including algae and phytoplankton), and other microorganisms use the energy from light, to make sugars (food) from carbon dioxide from the atmosphere and water from the environment through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS.LS1C.a) ***Almost all energy that drives the cycling of matter comes from the sun.*** ***Plants, algae, and photosynthetic microorganisms require energy (in the form of sunlight), carbon dioxide, and water to survive.*** ***Plants and other organisms use the sun's energy to make sugars (food).*** ***Plant cells contain organelles called chloroplasts, while animal cells do not.*** ***Chloroplasts allow plants to make the food they need to live through photosynthesis.*** ***During photosynthesis, food is made from carbon dioxide and water, and oxygen is released.*** ***The organism can use the food created immediately or store it for later use.*** The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (MS.PS3D.a) ***The sun provides the energy required for photosynthesis.*** ***Photosynthesis is a chemical reaction.***	**ENERGY AND MATTER** Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. ***Energy can be transferred.*** ***Energy transfer drives the motion of matter through systems (natural and designed).*** ***Energy transfer drives the cycling of matter through systems (natural and designed).***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
based on the assumption that theories and laws that describe the natural world operate today as they did in the past.	***A chemical reaction is a process by which different reactants are converted to a new substance.*** ***During photosynthesis, food molecules are made from carbon dioxide and water.*** ***During photosynthesis, plants release oxygen into the environment.*** ***Plants and animals can take the energy stored in food through a process called cellular respiration.*** ***A chemical reaction also occurs in animals during cellular respiration.*** ***In cellular respiration, the food molecules react with oxygen to release energy and produce carbon dioxide and water.*** **LOUISIANA'S NATURAL RESOURCES** Renewable resources have the ability to self-maintain due to the processes of photosynthesis. (MS.EVS1A.a) ***Matter and energy cycle through both living and non-living parts of ecosystems.*** ***Plants are renewable resources because they reproduce.*** ***Renewable resources can maintain themselves by photosynthesis.***	

Clarification Statement
Emphasis is on tracing movement of matter and flow of energy.

Performance Expectation *and Louisiana Connectors*
7-MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. ***LC-7-MS-LS1-7a Use a model to identify the outcome of the process of breaking down food molecules (e.g., sugar) as the release of energy, which can be used to support other processes within the organism.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Developing and using models: Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or use a model to predict and/or describe phenomena. ***Models can be used to describe phenomena.*** ***Models can be used to predict phenomena.***	**ORGANIZATION FOR MATTER AND ENERGY FLOW IN ORGANISMS** Within individual organisms, food (energy) moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy through aerobic and anaerobic respiration. (MS.LS1C.b) ***Organisms need food to provide materials and energy for life.*** ***Organisms breakdown food molecules for energy.*** ***Organisms need energy to form new molecules and to grow.*** ***Energy can be released through aerobic and anaerobic respiration.*** Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (MS.LS1C.c) ***Plants and animals can get the energy stored in food through a process called cellular respiration.*** ***A chemical reaction also occurs in animals during cellular respiration.*** ***In cellular respiration, the food molecules react with oxygen to release energy and produce carbon dioxide and water.*** ***Other materials from food are used for building and repairing cell parts.***	**ENERGY AND MATTER** Matter is conserved because atoms are conserved in physical and chemical processes. ***Matter cannot be created or destroyed.*** ***Matter is conserved because the original number of atoms before a reaction occurs (reactant) is the same as the number of atoms after the reaction occurs (product).***

Clarification Statement
Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.

Performance Expectation *and Louisiana Connectors*
7-MS-LS2-5 Undertake a design project that assists in maintaining diversity and ecosystem services. ***LC-7-MS-LS2-5a Identify a design project that shows the stability of an ecosystem's biodiversity is the foundation of a healthy, functioning ecosystem.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Constructing explanations and designing solutions: Constructing explanations (science) and designing solutions (engineering) in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. ***Design solutions must meet certain criteria and constraints.*** ***In the design cycle, solutions are modified on the basis of specific design criteria and constraints.*** ***A solution must meet specific design criteria and constraints before it can be implemented.***	**ECOSYSTEM DYNAMICS, FUNCTIONING, AND RESILIENCE** Biodiversity describes the variety of species found in Earth's terrestrial and aquatic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS.LS2C.b) ***Biodiversity refers to the variety of life an ecosystem contains (i.e., numbers of different species).*** ***An ecosystem's health is measured by its biodiversity or the variety of life it contains.*** **BIODIVERSITY AND HUMANS** Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services on which humans rely. (MS.LS4D.a) ***A change in an ecosystem's biodiversity can impact humans.*** ***Humans rely on ecosystems for resources (e.g., food, energy, medicine).*** ***Humans and other organisms impact biodiversity.*** **ENGINEERING DESIGN: DEVELOPING POSSIBLE SOLUTIONS** A solution needs to be tested to prove the validity of the design and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. Models of all kinds are important for testing solutions (MS.ETS1B.a) ***Design solutions must be tested.*** ***Tests are often designed to identify failure points or difficulties.***	**STABILITY AND CHANGE** **S**mall changes in one part of a system might cause large changes in another part. ***A small change in one part of a system may have a big effect elsewhere in the system.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
	Testing a solution involves investigating how well it performs under a range of likely conditions. ***Solutions are modified on the basis of the test results.*** ***Different solutions can be combined to create a better solution.*** ***Designing solutions to problems is a systematic process.*** ***There are many types of models.*** ***Models can be used to investigate how a design might work.*** ***Models allow the designer to better understand the features of a design problem.*** ***Engineering design is tested and altered due to criteria and constraints.***	

Clarification Statement
Examples of ecosystem services could include water purification, nutrient recycling, habitat conservation or soil erosion mitigation. Examples of design solution constraints could include scientific, economic, or social considerations.

Performance Expectation *and Louisiana Connectors*
7- MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. ***LC-7-MS-LS2-4a Using evidence, identify the outcome of changes in physical or biological components of an ecosystem to populations of organisms in that ecosystem.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Engaging in argument from evidence: Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. ***Construct an argument to support or refute an explanation, model, or solution to a problem.*** ***Use an argument to support or refute an explanation, model, or solution to a problem.*** ***Present an argument to support or refute an explanation, model, or solution to a problem.***	**ECOSYSTEM DYNAMICS, FUNCTIONING, AND RESILIENCE** Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS.LS2C.a) ***Ecosystems naturally change over time.*** ***Disruptions to an ecosystem can affect all its populations.*** ***Organisms and their environments are interconnected. Changes in one part of the system will affect other parts of the system.*** ***Changes in an organism's environment may cause a shift in populations.***	**STABILITY AND CHANGE** Small changes in one part of a system might cause large changes in another part. ***A small change in one part of a system may have a big effect elsewhere in the system.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Clarification Statement		
Emphasis is on recognizing patterns in data, making inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.		

Performance Expectation *and Louisiana Connectors*
7-MS-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. ***LC-7-MS-LS3-2a Using a model(s), identify that in asexual reproduction identical inherited traits are passed from parents to offspring.*** ***LC-7-MS-LS3-2b Using a model(s), identify that in sexual reproduction a variety of inherited traits are passed from parents to offspring and lead to differences in offspring (e.g., eye color).***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Developing and using models: Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or use a model to predict and/or describe phenomena. ***Models can be used to describe phenomena.*** ***Models can be used to predict phenomena.***	**GROWTH AND DEVELOPMENT OF ORGANISMS** Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (MS.LS1B.a) ***Organisms can reproduce and transfer their genetic information to their offspring.*** ***Sexual reproduction is the production of new living organisms by combining genetic information from two individuals of different types (sexes).*** ***In asexual reproduction, the offspring results in identical genetic information.*** ***Sexual reproduction results in offspring that have greater genetic diversity than those resulting from asexual reproduction.*** Cells divide through the processes of mitosis and meiosis. (LS.MS.1B.b) ***Cells undergo a regular sequence of growth and division.*** ***There are two processes of cell division, mitosis and meiosis.*** ***Cell division occurs via a process called mitosis, when a cell divides in two.*** ***Mitosis produces two cells with identical genetic material.*** ***In sexual reproduction, a specialized type of cell division called meiosis occurs.*** ***Meiosis results in the production of sex cells, which contain only half the chromosomes from the parent cell.*** ***When the sex cells combine, one-half of the offspring's genetic information comes from the "male" parent and one-half comes from the "female" parent.*** **INHERITANCE OF TRAITS**	**CAUSE AND EFFECT** Cause and effect relationships may be used to predict phenomena in natural or designed systems. ***Cause and effect relationships may be used to predict phenomena.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
	Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS.LS3A.d) ***In all organisms, the genetic instructions for forming species' characteristics are carried in the chromosomes.*** ***Variations of inherited traits between the parent and offspring arise from random genetic differences.*** ***Through inheritance, traits are passed from one generation to the next.*** ***Genetic differences help to ensure the survival of offspring in varied environments.*** In sexually reproducing organisms, each parent contributes to the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS.LS3B.a) ***Genetic information is transferred to the offspring through egg and sperm cells.*** ***The offspring have a combination of genetic information from each parent.*** ***In species that reproduce sexually, each cell contains two variants of each chromosome, one inherited from each parent.*** ***These variants are called alleles. An allele is defined as one of a pair of genes that appear at a particular location on a particular chromosome and control the same characteristic.*** ***Each parent contributes half of the gene, or one allele, acquired at random by the offspring.*** ***Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These alleles may be identical or may differ from each other.***	

Clarification Statement
Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.

Performance Expectation *and Louisiana Connectors*
7-MS-LS4-4 Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. ***LC-7-MS-LS4-4a Identify a similarity or difference in an external feature (e.g., shape of ears on animals or shape of leaves on plants) between young plants and animals and their parents.*** ***LC-7-MS-LS4-4b Describe the relationship between genetic variation and the success of organisms in a specific environment (e.g., individual organisms that have genetic variations and traits that are disadvantageous in a particular environment will be less likely to survive, and those traits will decrease from generation to generation due to natural selection).***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Constructing explanations and designing solutions: Constructing explanations (science) and designing solutions (engineering) in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. ***Construct an explanation that includes qualitative relationships to predict and describe a phenomena.*** ***Construct an explanation that includes quantitative relationships***	**NATURAL SELECTION** Natural selection leads to the predominance of certain traits in a population and the suppression of others. (MS.LS4B.a) ***The diversity and changing of life forms over many generations is the result of natural selection.*** ***Within every population, there are variations of organisms.*** ***Some of these variations exhibit traits that favor the chance to survive and reproduce, while others will decrease the likelihood to survive and reproduce.*** ***Natural selection leads to more organisms in a population with traits that favor the chance to survive and reproduce.*** ***Therefore, organisms with advantageous traits survive, reproduce, and pass those traits to offspring.***	**CAUSE AND EFFECT** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. ***Phenomena may have more than one cause.*** ***Some cause and effect relationships in systems can only be described using probability.*** ***Some cause and effect relationships are complex and can only be predicted using probabilities.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
to predict and describe a phenomena.		

Clarification Statement
Emphasis is on using simple probability statements and proportional reasoning to construct explanations about why some traits are suppressed and other traits become more prevalent for those individuals better at finding food, shelter, or avoiding predators.

Performance Expectation *and Louisiana Connectors*
7-MS-LS4-5 Gather, read, and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms. ***LC-7-MS-LS4-5a Identify ways in which technologies (e.g., artificial selection for breeding of certain plants and animals) have changed the way humans influence the inheritance of desired traits in plants and animals.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Obtaining, evaluating, and communicating information: Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods. • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. ***Gather information from multiple appropriate sources.*** ***Read information from multiple appropriate sources.*** ***Synthesize information from multiple appropriate sources.*** ***Assess the credibility of each publication.*** ***Assess the accuracy of each publication.***	**NATURAL SELECTION** Genetic engineering techniques can manipulate the DNA within various organisms. Technology has changed the way humans influence the inheritance of desired traits in organisms (e.g., selective breeding, gene modification, gene therapy, or other methods). (MS.LS4B.b) ***Through the use of biotechnology, scientists engineer plants and manipulate growing conditions to meet human needs and wants.*** ***Genetic engineering manipulates the DNA within organisms.*** ***Through technology, humans have found ways to enhance the rate at which some beneficial traits in some organisms occur.*** ***These technologies may include concepts such as genetic modification, animal husbandry, and gene therapy.*** ***Selective breeding is used to cultivate plants and domesticated animals with desirable traits.*** ***In artificial selection, humans can choose desired parental traits determined by genes, which are then passed on to offspring.***	**CAUSE AND EFFECT** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. ***Phenomena may have more than one cause.*** ***Some cause and effect relationships in systems can only be described using probability.*** ***Some cause and effect relationships are complex and can only be predicted using probabilities.***

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Assess the possible bias of each publication. ***Assess the methods used by each publication.*** ***Use evidence to describe how the methods used are supported or not supported.***		

Clarification Statement
Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy) and on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.