LAB-AIDS CORRELATIONS FOR

OKLAHOMA ACADEMIC STANDARDS FOR SCIENCE (OAS-S)

MIDDLE SCHOOL LEVEL – GRADES 6-8

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This document shows how the SEPUP 3rd edition materials align with the *Oklahoma Academic Standards for Science*[1].

ABOUT OUR PROGRAMS

Lab-Aids has maintained its home offices and operations in Ronkonkoma, NY, since 1963. We publish over 200 kits and core curriculum programs to support science teaching and learning, grades 6-12. All core curricula support an inquiry-driven pedagogy, with support for literacy skill development and with robust support for assessment. All programs have extensive support for technology and feature comprehensive teacher support. For more information please visit www.lab-aids.com and navigate to the program of interest.

SEPUP

Materials from the Science Education for Public Understanding Program (SEPUP) are developed at the Lawrence Hall of Science, at the University of California, Berkeley, and distributed nationally by LAB- AIDS, Inc. Since 1987, development of SEPUP materials has been supported by grants from the National Science Foundation and other public and private sources. SEPUP programs include student books, equipment kits, teacher materials, and online digital content, and are available as full year courses, or separately, as units, each taking 3-8 weeks to complete, as listed below.

Middle Level, Grades 6-8

Grade 6	Grade 7	Grade 8
Land, Water, and Human Interactions	Earth's Resources	Force and Motion
Weather and Climate	Chemistry of Materials	Fields and Interactions
Geological Processes	Chemical Reactions	Waves
Energy	Ecology	Reproduction
Cells to Organisms	Body Systems	Evolution
		Solar System and Beyond

[1] https://sde.ok.gov/sites/default/files/Oklahoma%20Academic%20Standards%20for%20Science.pdf

ABOUT THE LAB-AIDS CITATIONS

The following tables are presented in a Disciplinary Core Idea arrangement – Earth Space Science (ESS), Life Science (LS), Physical Science (PS) and Engineering, Technology and Applications of Science (ETS)

Citations included in the correlation document are as follows:

* indicates where the Oklahoma Academic Standard for Science is assessed
Unit title, Activity Number
The Chemistry of Materials, 14

NGSS Performance Expectations	6.PS1.4
Science and Engineering Practices	Planning and Carrying Out Investigations
Crosscutting Concepts	Structure and Function
Disciplinary Core Ideas	PS1.A

SIXTH GRADE

Oklahoma Science Standard	Location in SEPUP	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
6.PS1.4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.	*Chemistry of Materials:* 8, 9, 10*	**Developing and Using Models**: • Develop a model to predict and/or describe phenomena.	• Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. In a liquid, the molecules are constantly 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. • The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of 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. • 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	**Cause and Effect**: • Cause and effect relationships are routinely identified, tested, and used to explain change.

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			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.	
6.PS3.3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*	*Energy:* 1, 7, 8, 10, 11, 12, 13*	**Designing Solutions**: • Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process, or system.	• Temperature is a measure of the average kinetic energy of particles of matter. • The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. • Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. • A solution needs to be tested, 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 criteria and	**Energy and Matter**: • The transfer of energy can be tracked as energy flows through a designed or natural system.

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			constraints of a problem.	
6.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.	*Energy:* 1, 4, 6, 7, 8*	**Planning and Carrying Out Investigations:** • 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.	• Temperature is a measure of the average kinetic energy of particles of matter. • The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. • 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 size of the sample, and the environment.	**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.
6.PS4.2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	*Waves:* 3, 4, 8, 9, 10, 11, 12, 13*	**Developing and Using Models:** • Develop and use a model to describe phenomena.	• A sound wave needs a medium through which it is transmitted. • When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. • The path that light can travel can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.	**Structure and Function:** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can

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			• A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. However, because light can travel through space, it cannot be a matter wave, like sound or water waves.	
6.LS1.1 Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.	*From Cells to Organisms:* 1, 2, 3, 4, 9*	**Planning and Carrying Out Investigations:** • Conduct an investigation to produce data to serve as the basis for evidence that meets the goals of an investigation.	• All living things are made up of cells, which is the smallest unit that can be said to be alive. • An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).	**Scale, Proportion, and Quantity:** • Phenomena that can be observed at one scale may not be observable
6.LS1.2 Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.	*From Cells to Organisms:* 6, 7, 8*	**Developing and Using Models:** • Develop and use a model to describe phenomena.	• Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.	**Structure and Function:** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts.
6.LS1.3 Use an argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.	*From Cells to Organisms*: 10, 14, 15 *Body Systems:* 1, 2, 3, 4, 9, 10, 11, 12*	**Engaging in Argument from Evidence:** • Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.	• 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.	**Systems and System Models:** • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.

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6.LS1.8 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.	*Body Systems:* 6, 7, 8*	**Obtaining, Evaluating, and Communicating Information:** • Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas.	• 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.	**Cause and Effect:** • Cause and effect relationships may be used to predict phenomena in natural systems.
6.ESS1.4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's geologic history.	*Earth's Resources:* 9, 10, 11, 12*	**Constructing Explanations:** • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.	• The geologic time scale interpreted from rock strata provides a way to organize Earth's history. • Major historical events include the formation of mountain chains and ocean basins, the adaptation and extinction of particular living organisms, volcanic eruptions, periods of massive glaciation, and development of watersheds and rivers through glaciation and water erosion. • Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.	**Scale, Proportion, and Quantity:** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
6.ESS2.1 Develop a model to describe the cycling of Earth's materials and the	*Geological Processes:* 2, 5, 8, 9, 10, 11, 13, 14,	**Developing and Using Models:**	• All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived	**Stability and Change:** • Explanations of stability and change in natural or designed systems can be

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flow of energy that drives these processes within and among Earth's systems.	15*	• Develop and use a model to describe phenomena.	from the sun and Earth's hot interior. The energy that flows and matter that cycles produces chemical and physical changes in Earth's materials.	constructed by examining the changes over time and forces at different scales, including the atomic scale.
6.ESS2.2 Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	*Geological Processes:* 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13* *Land, Water, and Human Interactions: 3,* 4, 6, 7, 8, 10, 11, 12, 13, 14*	Constructing Explanations: • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.	• The planet's systems interact over scales that range from microscopic to global in size; these interactions have shaped Earth's history and will determine its future. • Water's movements, both on the land and underground, cause weathering and erosion, which change the land's surface features and create underground formations.	**Scale, Proportion, and Quantity:** • Time, space, and energy phenomena can be observed at various scales, using models to study systems that are too large or too small.
6.ESS2.3 Analyze and interpret data on the patterns of distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.	*Geological Processes:* 10, 11, 12, 13, 14*	**Analyze and Interpret Data:** • Analyze and interpret data to determine similarities and differences in findings.	• Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. • Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.	**Patterns** • Patterns in rate of change and other numerical relationships can provide information about natural and human-designed systems.

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6.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.	*Land, Water, and Human Interactions:* 2, 5, 7, 8, 9*	**Developing and Using Models:** • Develop a model to describe unobservable mechanisms.	• Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation, and crystallization, and precipitation, as well as downhill flows on land. • Global movements of water and its changes in form are propelled by sunlight and gravity.	**Energy and Matter:** • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.
6.ESS2.5 Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.	*Weather and Climate:* 2, 3, 7, 9, 10, 11, 12, 13*	**Planning and Carrying Out Investigations:** • Collect data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.	• 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 be predicted only probabilistically.	**Cause and Effect:** • Cause and effect relationships may be used to predict phenomena in natural or designed systems.
6.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.	*Weather and Climate:* 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14*	**Developing and Using Models:** • Develop and use a model to describe phenomena.	• Variations in density due to variations in temperature and salinity drive a global pattern on interconnected ocean currents. • 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. • The ocean exerts a major influence on weather and climate by absorbing energy	**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 the systems.

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			from the sun, and globally redistributing it through ocean currents.	
6.ESS3.2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.	*Geological Processes:* 1, 3, 4, 6, 7, 8, 11, 18*	**Analyzing and Interpreting Data:** • Analyze and interpret data to provide evidence for phenomena.	• Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces, can help forecast the locations and likelihoods of future events.	**Patterns:** • Graphs, charts, and images can be used to identify patterns in data.

SEVENTH GRADE

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7.PS1.1 Develop models to describe the atomic composition of simple molecules and extended structures.	*Chemistry of Materials:* 2, 6, 7, 12*	**Developing and Using Models:** • Use a model to predict the relationships between systems or between components of a system.	• Substances are made from different types of atoms, which combine with one another in various ways. • Atoms form molecules that range in size from two to thousands of atoms. • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).	**Scale, Proportion, and Quantity:** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
7.PS1.2 Analyze and interpret patterns of data related to the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	*Chemical Reactions:* 1, 2, 3, 4, 5* *Chemistry of Materials:* 4	**Analyzing and Interpreting Data:** • Analyze and interpret data to determine similarities and differences in findings.	• Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. • 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.	**Patterns**: • Macroscopic patterns are related to the nature of microscopic and atomic-level structure.
7.PS1.3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.*	*Chemistry of Materials:* 1, 2, 3, 4, 5, 11, 12, 13*	**Obtaining, Evaluating, and Communicating Information:** • Gather, read, and synthesize information from multiple appropriate sources, and assess the credibility, accuracy, and	• Each pure substance has characteristics, physical and chemical properties (for any bulk quantity under given conditions), that can be used to identify it. • Substances react chemically in characteristic ways. • In a chemical process, the atoms that make up the original substances regroup into different molecules, and these new	**Structure and Function**: • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

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		possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.	substances have different properties from those of the reactants. • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. • The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.	
7.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.	*Chemical Reactions:* 1, 2, 3, 4, 5, 6, 7*	**Developing and Using Models:** • Develop a model to describe unobservable mechanics.	• 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. • The total number of each type of atom is conserved and thus, the mass does not change. Laws are regularities or mathematical descriptions of natural phenomena.	**Energy and Matter:** • Matter is conserved because atoms are conserved in physical and chemical processes.
7.PS1.6 Construct, test, and modify a device that releases or absorbs thermal energy by chemical	*Chemical Reactions:* 2, 3, 5, 8, 9, 10, 11*	**Designing Solutions**: • Undertake a design project engaging in the design cycle, to	• Some chemical reactions release energy, others store energy. • A solution needs to be tested, and then modified on the basis of the	**Energy and Matter**: • The transfer of energy can be tracked as energy

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processes to solve a problem.*		construct and/or implement a solution that meets specific design criteria and constraints.	test results, in order to improve it. • The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.	flows through a designed or natural system.
7.PS3.1 Construct and interpret graphical displays of data to describe the proportional relationships of kinetic energy to the mass of an object and to the speed of an object.	*Force and Motion: 1, 2, 3, 4, 5**	**Analyze and Interpret Data:** • Construct and interpret graphical displays of data to identify linear and nonlinear relationships.	• Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.	**Scale, Proportion and Quantity:** • Proportional relationships (e.g., speed as a ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and process.
7.PS3.2 Develop a model to describe that when objects interacting at a distance change their arrangement, different amounts of potential energy are stored in the system.	*Fields and Interactions:* 3, 4, 6, 7, 10, 11*	**Developing and Using Models:** • Develop a model to predict and/or describe phenomena.	• A system of objects may also contain stored (potential) energy, depending on their relative positions. • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.	**Systems and System Models:** • Models can be used to represent systems and their interactions (such as inputs, processes, and outputs) and energy and matter flows within systems.
7.PS3.5 Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.	*Energy:* 2, 3, 4, 5, 6*	**Engaging in Argument from Evidence:** • Construct, use, and present oral and written arguments supported by empirical	• When the motion energy of an object changes, there is inevitably some other change in energy at the same time.	**Energy and Matter** • The transfer of energy can be tracked as energy flows through a designed or natural system.

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		evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon.		
7.LS1.6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.	*From Cells to Organisms*: 12, 13*	**Constructing Explanations** • 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.	• Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or 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.	**Energy and Matter:** • Within a natural system, the transfer of energy drives the motion and/or cycling of matter.
7.LS1.7 Develop a model to describe how food molecules in plants and animals are broken down and rearranged through chemical reactions to form new molecules that support growth and/or release energy as matter moves through an organism.	*From Cells to Organisms*: 5, 11* *Body Systems:* 5	**Developing and Using Models:** • Develop a model to predict and/or describe phenomena.	• Within an individual organism, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or release energy. • Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy. In these processes, complex	**Energy and Matter:** • Matter is conserved because atoms are conserved in physical and chemical processes.

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			molecules containing carbon react with oxygen to produce carbon dioxide and other materials.	
7.LS2.1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.	*Ecology:* 5, 6, 9*	**Analyzing and Interpreting Data:** • Analyze and interpret data to provide evidence for phenomena.	• Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. • In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. • Growth of organisms and population increases are limited by access to resources.	**Cause and Effect**: • Cause and effect relationships may be used to predict phenomena in natural or designed systems.
7.LS2.2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	*Ecology:* 2, 8, 10*	**Constructing Explanations:** • Construct an explanation that includes qualitative or quantitative relationships between variables that predict and/or describe phenomena.	• Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. • Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.	**Patterns**: • Patterns can be used to identify cause and effect relationships.
7.LS2.3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving	*Ecology:* 7, 8, 11, 12*	**Developing and Using Models**: • Develop a model to describe phenomena.	• Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as	**Energy and Matter**: • The transfer of energy can be tracked as energy

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parts of an ecosystem.			the three groups interact within an ecosystem. • Transfers of matter into and out of the physical environment occur at every level. • Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. • The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.	flows through a natural system.
7.LS2.4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	*Ecology:* 1, 2, 3, 4, 5, 6, 13, 14*	**Engaging in Argument from Evidence**: • Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or model for a phenomenon.	• 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.	**Stability and Change**: • Small changes in one part of a system might cause large changes in another part.
7.LS2.5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*	*Ecology:* 2, 4, 15*	**Engaging in Argument from Evidence:** • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	• Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. • The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. • Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that	**Stability and Change:** • Small changes in one part of a system might cause large changes in another part.

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			humans rely on—for example, water purification and recycling. • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	
7.ESS3.1 Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.	*Geological Processes:* 2, 16*, 17* *Earth's Resources:* 1, 2, 3, 5, 7, 8, 14*	**Constructing Explanations:** • Apply scientific ideas, principles, and evidence (including students' own investigations, models, theories, simulations, peer review) to provide an explanation of phenomena.	• Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. • Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. • These resources are distributed unevenly around the planet as a result of past geologic processes.	**Cause and Effect:** • Cause and effect relationships may be used to predict phenomena in natural or designed systems.
7.ESS3.3 Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.*	*Land, Water, and Human Interactions:* 1, 3, 4, 5, 6, 9, 13, 14, 15, 16*	**Constructing Explanations:** • Apply scientific principles to design an object, tool, process, or system.	• Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. • Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	**Cause and Effect:** • Cause and effect relationships may be used to predict phenomena in natural or designed systems.

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7.ESS3.4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.	*Earth's Resources:* 2, 4, 6, 13* *Evolution:* 14	**Engaging in Argument from Evidence:** • Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or model for a phenomenon.	• Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	**Cause and Effect**: • Cause and effect relationships may be used to predict phenomena in natural or designed systems.
7.ESS3.5 Obtain, evaluate, and communicate evidence of the factors that have caused changes in global temperatures over the past century.	*Weather and Climate:* 1, 10, 14, 15, 16*	**Communicating, Obtaining, and Evaluating Evidence:** • Gather, read, 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.	• Understanding atmospheric changes 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.	**Stability and Change**: • Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

EIGHTH GRADE

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8.PS2.1 Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects in a system.*	*Force and Motion:* 1, 10, 11, 12*	**Constructing Explanations:** • Apply scientific principles to design an object, tool, process, or system.	• For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).	**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 the systems.
8.PS2.2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.	*Force and Motion:* 1, 6, 7, 8, 9, 13*	**Planning and Carrying Out Investigations:** • Plan an investigation individually and collaboratively; 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.	• The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero its motion will change. • The greater the mass of the object, the greater the force needed to achieve the same change in motion. • For any given object, a larger force causes a larger change in motion.	**Stability and Change:** • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.
8.PS2.3 Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.	*Fields and Interactions:* 7, 8, 9, 12, 13*, 14	**Asking Questions:** • Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources	• Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.	**Cause and Effect:** • Cause and effect relationships may be used to predict phenomena in natural or designed systems.

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		and, when appropriate, frame a hypothesis based on observations and scientific principles.		
8.PS2.4 Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.	*Fields and Interactions:* 3, 4, 7*	**Constructing Explanations:** • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.	• Gravitational forces are always attractive. • There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass (e.g., Earth and the sun).	**Systems and System Models:** • Models can be used to represent systems and their interactions(such as inputs, processes and outputs) and energy and matter flows within systems.
8.PS2.5 Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	*Fields and Interactions:* 5, 7, 9, 10, 12*	**Planning and Carrying Out Investigations:** • Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence	• Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).	Cause and Effect: • Cause and effect relationships may be used to predict phenomena in natural or designed systems.

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		that can meet the goals of the investigation.		
8.PS4.1 Use mathematical representations to describe patterns in a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	*Waves:* 1, 2, 3, 7*	**Using Mathematical and Computational Thinking:** • Use mathematical representation to describe and/or support scientific conclusions and design solutions.	• A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.	**Patterns**: • Graphs and charts can be used to identify patterns in data.
8.PS4.3 Integrate qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.*	*Waves:* 5, 6	**Obtaining, Evaluating, and Communicating Information** Communication of Evidence: • Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings.	• Many modern communications devices use digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	**Structure and Function**: • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
8.LS1.4 Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful	*Reproduction:* 10*, 11*	**Engaging in Argument from Evidence:** • Use an oral and written argument supported by empirical evidence and scientific reasoning to	• Animals engage in characteristic behaviors that increase the odds of reproduction. • Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.	**Cause and Effect:** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

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reproduction of animals and plants respectively.		support or refute an explanation or a model for phenomena.		
8.LS1.5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.	*Reproduction:* 1, 7*	**Constructing Explanations:** • 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.	• Genetic factors, as well as local conditions, affect the growth of the adult plant.	**Cause and Effect:** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
8.LS3.1 Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.	*Reproduction:* 1, 3, 8, 12, 13* *Evolution:* 3, 4, 5*	**Developing and Using Models:** • Develop and use a model to describe phenomena.	• Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. • Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. • In addition to variations that arise from sexual reproduction, genetic	**Structure and Function**: • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore complex natural structures/systems can be analyzed to determine how they function.

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			information can be altered because of mutations. • Though rare, mutations may result in changes to the structure and function of proteins. • Some changes are beneficial, others harmful, and some neutral to the organism.	
8.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.	*Reproduction:* 1, 2, 3, 4, 5, 6, 8, 9*	**Developing and Using Models:** • Develop and use a model to describe phenomena.	• Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. • Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. • In sexually reproducing organisms, each parent contributes half of 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.	**Cause and Effect**: • Cause and effect relationships may be used to predict phenomena in natural systems.
8.LS4.1 Analyze and interpret data to identify patterns within the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth.	*Evolution: 7, 8, 9, 10 11**	**Analyze and Interpret Data:** • Analyze and interpret data to determine similarities and differences in findings.	• The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.	**Patterns**: • Graphs and charts can be used to identify patterns in data.

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			• Because of the conditions necessary for their preservation, not all types of organisms that existed in the past have left fossils that can be retrieved.	
8.LS4.2 Apply scientific ideas to construct an explanation for the patterns of anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer ancestral relationships.	*Evolution:* 7, 8, 9, 10 11, 12*	**Constructing Explanations:** • Construct a scientific explanation based on valid and reliable evidence.	• Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record serve as evidence of ancestral relationships among organisms and changes in populations over time.	**Patterns**: • Graphs and charts can be used to identify patterns in data.
8.LS4.3 Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.	*Evolution:* 12, 13*	**Analyze and Interpret Data:** • Analyze and interpret data to determine similarities and differences in findings.	• Comparison of embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.	**Patterns**: • Graphs and charts can be used to identify patterns in data.
8.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.	*Evolution:* 1, 2, 3, 4*	**Constructing Explanations**: • Construct an explanation that includes qualitative or quantitative relationships between variables that predict and/or describe phenomena.	• Natural selection leads to the predominance of certain traits in a population, and the suppression of others.	**Cause and Effect**: • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

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8.LS4.5 Gather and synthesize information about the practices that have changed the way humans influence the inheritance of desired traits in organisms.*	*Evolution:* 14, 15, 16*	**Obtaining, Evaluating, and Communicating Information:** • Gather, read, synthesize information from multiple appropriate sources; assess the credibility, accuracy, and possible bias of each publication and methods used; and describe how they are supported or not supported by evidence.	• In artificial selections, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits by genes, which are then passed on to offspring. • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems.	**Cause and Effect:** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
8.LS4.6 Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	*Evolution:* 1, 2, 3, 4, 5, 6*	**Using Mathematics and Computational Thinking:** • Use mathematical representation to describe and/or support scientific conclusions and design solutions.	• Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. • Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population change.	**Cause and Effect**: • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
8.ESS1.1 Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and	*Solar System and Beyond:* 2, 3, 4, 5*, 6, 7, 8, 9*	**Developing and Using Models:** • Develop and use a model to describe a phenomenon.	• Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. • The model of the solar system can explain eclipses of the sun and the	**Patterns:** • Patterns can be used to identify cause-and-effect relationships.

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moon, and seasons.			moon. • Earth's spin axis is fixed in direction over the short term, but tilted relative to its orbit around the sun. The seasons are a result of it's tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.	
8.ESS1.2 Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.	*Solar System and Beyond:* 10, 11, 12, 14, 15, 16*	**Developing and Using Models**: • Develop and use a model to describe a phenomenon.	• Earth and its solar system are part of the Milky Way Galaxy, which is one of the many galaxies in the universe. • The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. • The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.	**Systems and System Models:** • Models can be used to represent systems and their interactions.
8.ESS1.3 Analyze and interpret data to determine scale properties of objects in the solar system.*	*Solar System and Beyond:* 1, 10, 11, 12, 13*	**Analyzing and Interpreting Data:** • Analyze and interpret data to determine similarities and differences in findings.	• The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems.	**Scale, Proportion, and Quantity:** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.