LAKEWOOD CITY SCHOOL DISTRICT STANDARDS-BASED SCIENCE CURRICULUM
FIFTH GRADE

GRADE BAND THEME
INTERCONNECTIONS WITHIN SYSTEMS – This theme focuses on helping students recognize the components of various systems and then investigate dynamic and sustainable relationships within systems using scientific inquiry.

Units: 1. Ecosystems 2. Earth, Moon, and Sun 3. Light and Sound 4. Forces in Motion
NOTE: Your Research Report Writing Unit may impact unit pacing.

Unit length: 9 weeks each if taught alongside SS. To ensure units are taught before the test, try 8 week units and utilize post-test science time for project work

FIFTH GRADE
SCIENCE INQUIRY AND APPLICATION (SIA) – These scientific process skills should be integrated into the following grade level content units.

Bolded and starred statements come directly from the standards. Bulleted statements are clarifications for teachers from the ODE Model Curriculum.

Science Inquiry and Application	Resources from 2017-18 Update	Resources linked from LKWD 2012 Course of Study
Science Inquiry and Application During the years of 5-8, all students must use the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content areas: ✶ Identify questions that can be answered through scientific investigations; ✶ Design and conduct a scientific investigation; ✶ Use appropriate mathematics, tools and techniques to gather data and information; ✶ Analyze and interpret data; ✶ Develop descriptions, models, explanations and predictions; ✶ Think critically and logically to connect evidence and explanations; ✶ Recognize and analyze alternative explanations and predictions; and ✶ Communicate scientific procedures and explanations.	Current guidance is to teach Science Inquiry and Application through the units described below, rather than as a stand-alone unit.	

Copyright: Summit County ESC, Revised February 2017

FIFTH GRADE
INTERCONNECTIONS WITHIN ECOSYSTEMS
Life Science Strand (LS)

Content Statements	Content Elaboration and Clarification	Resources from 2017-18 Update	Resources linked from LKWD 2012 Course of Study
Life Science ✶ **Organisms perform a variety of roles in an ecosystem. (5)** ● Populations of organisms can be categorized by how they acquire energy. ● Food webs can be used to identify the relationships among producers, consumers and decomposers in an ecosystem.	**Introduction** ✶ **The content statements for fifth-grade life science are each partial components of a larger concept. The parts have been isolated to call attention to the depth of knowledge required to build one of biology's foundational theories: dynamic relationships within ecosystems.** ✶ **It is recommended that the content statements be combined and taught as a whole. For example, it is important that the ecological role of organisms is interwoven with a clear understanding that all living things require energy. Virtual simulations and investigations can help demonstrate energy flow through the trophic levels.** **Roles in Ecosystems** ● Ecosystems include all of the biotic (i.e., living) and abiotic (i.e., nonliving) things in an environment, including their interactions with each other (e.g., plants and animals live in soil, plants and animals need water to survive, plants absorb minerals dissolved in water from the soil to support their growth, animals eat plants for energy, animals use plants for shelter, etc.). The world has different ecosystems and distinct ecosystems support the lives of different types of organisms. ● Animals and plants alike generally need to take in air and water, animals must take in food, and plants need light and minerals; anaerobic life, such as bacteria in the gut, functions without air. Food provides animals with the materials they need to maintain warmth and motion. Plants acquire their materials for growth chiefly from air and water and process matter they have formed to maintain their internal conditions (e.g., at night). (F) ✶ **Plants and some microorganisms are producers. They are the foundation of the food web. Producers transform energy from the sun and make food through a process called photosynthesis.** ● Producers are organisms that are able to produce their own food from inorganic sources (e.g., the sun,	Common Summative Assessments **RESOURCES:** Ohio Science Fusion, Grade 5, Teacher and Student Editions + digital resources through Think Central Directions for accessing Think Central/Fusion Resources 	McGraw-Hill Science: *Ecosystems Around the World* pgs. 482-540 Ecosystem in a Jar Collaborative Ecosystem Exploration Ecosystem Study Jams Predator/Prey Symbiotic Relationships KidsGeo

Copyright: Summit County ESC, Revised February 2017

	minerals, carbon dioxide, water, etc.). ● Plants are producers; they produce their own food from the sun, minerals, carbon dioxide and water. The roots of plants absorb water and minerals, stems transport the water and minerals to the leaves, stomata in the leaves obtain carbon dioxide from the air and leaves produce food for the plants. ● Producers and some microorganisms transform, change one form of energy to another form of energy, through the process of photosynthesis. They transform energy from the sun and make food, which is illustrated by the following simple formula: CO_2 (carbon dioxide) + H_2O (water) + sunlight = glucose (food) + O_2 (oxygen). (Oxygen is the byproduct or waste product of photosynthesis.) ● Examples of some microorganisms that produce their own food include plankton, phytoplankton and photosynthetic bacteria (e.g., cyanobacteria, etc.). ● Chlorophyll is typically the substance within the cells of plants and microorganisms that allows them to absorb energy from light. ✶ **Animals get their energy by eating plants and other animals that eat plants. Animals are consumers and many form predator-prey relationships.** ● The food of any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Either way, they are "consumers." Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plant parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil for plants to use. (F) ● Consumers are organisms which feed on producers or other consumers in order to survive. They include: ° Carnivores - organisms that eat animals (e.g., cheetahs, eagles, foxes, leopards, sharks, lions, etc.) ° Decomposers - organisms that eat decaying or dead organisms or get their nutrients from waste materials or other organic materials around them (e.g., dung beetles, worms, bacteria, fungi such as mushrooms, etc.). ° Herbivores - animals that eat plants (e.g., armadillos, caribou, chipmunks, cows, deer, elephants, giraffes, horses, kangaroos, koalas, llamas, mice, moose, rabbits, sheep, squirrels, pandas, buffalos, zebras, beavers, chinchillas, rhinos, aphids, bees, butterflies, caterpillars, grasshoppers, leafcutter ants, termites, etc.) ° Omnivores - organisms that eat both plants and animals (e.g., opossums, pigs, people, bears, chickens, chimpanzees, badgers, hedgehogs, etc.) ● There are different types of consumers including: ° First-order or Primary Consumers - get their energy from producers (i.e., herbivores and omnivores) ° Second-order or Secondary Consumers - get their energy from plants or other animals depending on what they eat (i.e., carnivores and omnivores)		

Copyright: Summit County ESC, Revised February 2017

	○ Third-order or Tertiary Consumers - get their energy from other animals (i.e., carnivores) ● Omnivores eat both plants and animals, so omnivores can be different types of consumers depending on what they eat. For example, if a turtle eats a plant, then it would be a first-order consumer. However, if a turtle eats an insect, then it would be a second-order consumer. ● Provide examples of predator-prey relationships (e.g., great horned owls and snakes, robins and worms, snakes and mice, etc.). ● Explain how almost all kinds of food for animals can be traced back to plants. ● Explain why there are fewer third-order consumers than first- and second- order consumers. ✶ **Decomposers (primarily bacteria and fungi) are consumers that use waste materials and dead organisms for food. Decomposers also return nutrients to the ecosystem.** ● Decomposers get their energy from feeding on decaying or dead organisms, waste materials or other organic materials around them. They break down decaying matter and then return the materials of living things to ecosystems as the nutrients carbon and nitrogen. Decomposition is the process by which decomposers produce carbon and nitrogen. ● Matter cycles between the air and soil and among plants, animals and microbes as these organisms live and die. Organisms obtain gases, waste and minerals from the environment and release waste matter (gas, liquid or solid) back into the environment. (F) ● Describe pathways, including the organisms involved, through which the carbon and nitrogen cycles take place. ● Recognize the relationship between where organisms get the nutrients or gases they need in the carbon and nitrogen cycles and how they make them available to other organisms (i.e., physical or biological factors that affect the cycles). ● Explain why the cycling of resources is “an accounting of things as they change form” in the natural world, similar to the conservation of matter and energy in physical systems. ● Explain the roles and relationships of, and identify examples of, producers, consumers, decomposers, predators, prey and scavengers in ecosystems (e.g. owls as predators, worms as decomposers, plants as producers, etc.). ● Compare the roles of producers, consumers and decomposers and explain how they work together within an ecosystem. (V) ✶ **One way ecosystem populations interact is centered on relationships for obtaining energy.** ● Food chains illustrate the path that nutrients and energy follow in an ecosystem. Food chains show one source of energy for each consumer, such as: ○ Land food chain = plants (grass) ➔ deer ➔ wolf ○ Water food chain = algae ➔ prawn ➔ stickle fish ➔ heron		

Copyright: Summit County ESC, Revised February 2017

	● Food webs illustrate how a series of organisms are related by predator-prey and consumer-resource interactions (either producer or consumer). Food webs are characterized by: ° Overlapping food chains ° More than one energy source for the consumers ° Interactions between members of the web ● Interpret diagrams to recognize that arrows are drawn from organisms that are eaten to the organisms that eat them in illustrations of food chains and food webs (e.g., plants ➔ mouse ➔ snake ➔ owl, etc.). ● Explain the difference between a food chain and a food web. ✶ **Food webs are defined in many ways, including as a scheme of feeding relationships, which resemble a web. This web serves as a model for feeding relationships of member species within a biological community. Members of a species may occupy different positions during their lives. Food chains and webs are schematic representations of real-world interactions. For this grade level, it is enough to recognize that food webs represent an intertwining of food chains within the same biological community. See the content statement for details on grade-appropriate food webs.** ● Biological communities are all of the living organisms interacting in a particular ecosystem at the same time. ● Species are groups of the same kind of organisms that are potentially capable of reproducing offspring. ● Populations are the members of a species of organisms living in a given area at the same time. ✶ **Organisms have symbiotic relationships in which individuals of one species are dependent upon individuals of another species for survival. Symbiotic relationships can be categorized as mutualism where both species benefit, commensalism where one species benefits and the other is unaffected, and parasitism where one species benefits and the other is harmed.** ● Symbiotic relationships are close ecological relationships between the individuals of two or more different species. Sometimes a symbiotic relationship benefits both species, sometimes one species benefits at the expense of the other, and in other cases, neither species benefits. There are different types of symbiotic relationships including: ° Commensalism - one species benefits and the other species is unaffected (e.g., a spider crab buries itself in algae for camouflage and protection but the algae remain unaffected, etc.) ° Mutualism - both species benefit (e.g., bees help pollinate flowers by transferring the pollen made by the flowers of one plant to the flowers of another plant and bees use the pollen as food, a clownfish seeks shelter in an anemone because it is a bad swimmer and would be easy prey without its protection and the clownfish protects the anemone from being attacked by butterfly fish, etc.). ° Parasitism - one species, the parasite, benefits and the other species, the host, is harmed, but not killed (e.g., fleas suck the blood out of many kinds of animals, etc.) ● Given a list of organisms and a description of their interactions within an environment, classify them as		

Copyright: Summit County ESC, Revised February 2017

	producers, consumers, decomposers or by type of symbiotic relationships (i.e., mutualism, commensalism and parasitism). (V) ✶ **Investigations of locally threatened or endangered species must be conducted and include considerations of the effects of remediation programs, species loss and the introduction of new species on the local environment.** ● Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (F) ● Threatened species are species whose survival in their environments is not in immediate jeopardy, but to which a threat exists. Continued or increased stress would most likely result in the species becoming endangered. ● Endangered species are native species faced with possible extinction (i.e., extirpation) from their environments. The danger may result from one or more causes, such as habitat loss, pollution, disease, competition in which individuals of different species compete for the same resource in an ecosystem (i.e., interspecific competition) or predation. ● The Division of Wildlife, a branch of the Ohio Department of Natural Resources, monitors the locally threatened or endangered species in Ohio. ● An invasive species is a species that is not native to an area that interacts and sometimes interferes with existing ecosystems. Examples may include, but are not limited to: ° Asian carp, which have been introduced into the Great Lakes, are large, adaptable fish that threaten the food chains of all other existing organisms. ° The tamarisk is an ornamental shrub from southern Europe that came over to the United States in the 1800's via travelers. Wherever planted, the shrubs cause issues for organisms because they alter the alkalinity of the soil. Altering the alkalinity causes the soil to be saltier, which makes it less than optimal for plant growth and a poor habitat for other organisms (e.g., worms, insects, etc.). ° Zebra mussels have invaded the Great Lakes and the Mississippi River. They are transferred on boats from European waterways and are problematic to the native ecosystems. They alter the clarity of the water, which is attributed to the fact that they clog local water treatment plants. They also consume the food sources of some of the smaller fish, which in turn impacts food chains. They even affect North American mussels by attaching directly to them. ● Design and build a self-sustaining ecosystem (e.g., terrarium, bottle biology, etc.). Considerations for the ecosystem include the size of the container, the location to create the proper temperature, light and humidity, and organisms that will support one another. (V) ● Investigate change in an established model of an ecosystem over time (e.g., terrarium, aquarium, etc.).		

Copyright: Summit County ESC, Revised February 2017

	Answer: What would happen with removal or introduction of one kind of living thing (e.g., one species of producers not all producers, etc.)? Design experiments to observe what actually happens when one species is changed. (V) ● Investigate change in an established model of an ecosystem over time (e.g., terrarium, aquarium, etc.). *Answer: What would happen if one factor of the environment changes* (e.g., temperature increased or decreased, higher intensity of sunlight, etc.)? Design experiments to observe what actually happens when one environmental factor is changed. (V) ● Describe how changing one component of a biological system affects others (e.g., food, water, shelter, space, etc.). ● Investigate environmental changes and/or conditions, both natural and manmade, that may result in the adaptation, endangerment or extinction of living things (e.g., pollution, spraying to control mosquitoes, industrial development, farming, insecticidal or pesticidal runoff, deforestation, commercial or residential land development, storms, forest fires, floods, seasonal change, introduction of new species, etc.). ● Support and provide evidence of how an organism's patterns of behavior are related to the nature of the organism's ecosystem, including the kinds and numbers of other organisms present, the availability of food and resources, and the changing physical characteristics of the ecosystem. ● Summarize why organisms can only survive in ecosystems in which their needs can be met (e.g., food, water, shelter, air, carrying capacity, waste disposal, etc.). ✶ **Note: At this grade, species can be defined by using Ernst Mayer's definition "groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups." Assessments will not include the definition of species.**		
Life Science ✶ **All of the processes that take place within organisms require energy. (5)** ● For ecosystems, the major source of energy is sunlight. ● Energy entering ecosystems as sunlight is transferred and transformed by	**Energy in Ecosystems** ✶ **Energy flows through an ecosystem in one direction, from photosynthetic organisms to consumers (herbivores, omnivores to carnivores) and decomposers.** ● Energy from the sun must first transfer to photosynthetic organisms before energy can begin to flow through an ecosystem. ● Describe the role of producers in the transfer of energy entering ecosystems as sunlight to chemical energy through the process of photosynthesis. ✶ **The exchange of energy that occurs in an ecosystem can be represented as a food web. The exchange of energy in an ecosystem is essential because all processes of life for all organisms require a continual supply of energy.** ● Energy is transferred in an ecosystem; it is passed from one source, one type of organism, to another. ● Given a list of common organisms and a description of their environmental interactions, draw a food web		Food Chains/Food Webs Study Jams

Copyright: Summit County ESC, Revised February 2017

producers into energy that organisms use through the process of photosynthesis. That energy then passes from organism to organism as illustrated in food webs. ● In most ecosystems, energy derived from the sun is transferred and transformed into energy that organisms use by the process of photosynthesis in plants and other photosynthetic organisms.	using arrows to illustrate the flow of energy. Properly identify the producers and consumers. (V) ● There is less available energy "higher up" on a food chain or web. The producer uses 90% of the sun's energy and passes 10% on to the first-order consumer. ● To visualize how less energy is available higher up on a food chain, create an energy pyramid as a visual model. ● Diagram and analyze food chains, food webs and energy pyramids to trace the energy transfer among organisms, beginning with photosynthesis. ● Identify the relative amount of energy that is available (i.e., least or most) from producers to an organism or group of organisms in a food chain, food web or energy pyramid. ● Account for the transfer, transformation and conservation of energy in living systems according to the following principles: ° Organisms gain energy, directly or indirectly, from the sun. ° Energy can be stored in the chemical bonds of food, which is passed on as organisms consume food or each other. ° Animals get energy from oxidizing their food, releasing some of its energy as heat. ° Energy is transferred or transformed in living systems, but the total amount of matter and energy remains constant in an ecosystem. ✶ **Satellite imaging, remote sensing or other digital-research formats can be used to help visualize what happens in an ecosystem when new producers (e.g., Tamarisk plants) are introduced into an ecosystem. The information gained should be used to determine the relationship between the producers and consumers within an ecosystem.** ● Analyze how organisms, including humans, cause changes within their ecosystems and describe how these changes can be beneficial, neutral or detrimental to the environment (e.g., beavers building dams and changing pond habitats, earthworms burrowing in the soil, grasshoppers eating and destroying plants, people cutting down and then replanting trees, humans introducing a new species to an area, etc.). ● Explain ways that humans can improve the health of ecosystems (e.g., recycling wastes, establishing rain gardens, planting native species, etc.). (V)		

Copyright: Summit County ESC, Revised February 2017

FIFTH GRADE
CYCLES AND PATTERNS IN THE SOLAR SYSTEM
Earth and Space Science Strand (ESS)

Content Statements	Content Elaboration and Clarification	Resources from 2017-18 Update	Resources linked from LKWD 2012 Course of Study
Earth and Space Science ✶ **The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics. (5)** ● The distance from the sun, size, composition and movement of each planet are unique. Planets revolve around the sun in elliptical orbits. Some of the planets have moons and/or debris that orbit them. Comets, asteroids and meteoroids orbit the sun. ● Note: The shape of Earth's orbit is nearly circular (also true for other planets). Many graphics that illustrate the orbit overemphasize the elliptical shape, leading to the misconception regarding seasonal change being	**Planets** ✶ **Eight major planets in the solar system orbit the sun.** ● The eight planets in the solar system that orbit the sun include Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. ● The inner (i.e., terrestrial) planets are the planets in the inner part of the solar system that orbit closest to the sun, including Mercury, Venus, Earth and Mars. The inner planets are mostly composed of rock. Generally, inner planets are both smaller and denser than outer planets. They also have only a few or no moons and no rings circling them. ● The outer planets are Jupiter, Saturn, Uranus and Neptune. The outer planets are so much larger than the inner planets that they make up 99% of the mass of the celestial bodies that orbit the sun. The outer planets are also called the Jovian planets or gas giants because they are mainly composed of gas, not solid material. However, they may have what scientists refer to as a rocky core, composed of heavy liquid metals. While the inner planets have only a few or no moons, the outer planets have dozens each. The outer planets often have dozens of satellites and rings composed of particles of ice and rock. ● The inner and outer planets are separated by the asteroid belt. ● Compare and contrast the characteristics of the inner and outer planets. ● Recognize that there are eight major planets in the solar system and they all orbit the sun. (V) ✶ **Some of the planets have a moon or moons that orbit them. Earth is a planet that has a moon that orbits it.** ● Explain that Earth is one of several planets to orbit the sun, and that the moon orbits Earth. (V) ✶ **The planets orbits are because of their gravitational attraction to the sun. Moons orbit around planets because of their gravitational attraction to the planets.** ● Recognize that everything on or anywhere near Earth is pulled toward Earth's center by gravitational force; gravitational force is the dominant force determining motions of celestial objects in the solar system.	Common Summative Assessments **RESOURCES:** Ohio Science Fusion, Grade 5, Teacher and Student Editions + digital resources through Think Central Directions for accessing Think Central/Fusion Resources 	McGraw-Hill Science: *Observing the Sky* pages C44-C67 (Inner planets, Outer planets, asteroids, comets, meteors) http://www.nasa.gov Gravity Telescopes Exploring Solar System Meteors, Comets, etc Engineering Interact Solar System Nine Planets.org

Copyright: Summit County ESC, Revised February 2017

related to how close Earth is to the sun. The discussion of planet characteristics should be at an introductory level for this grade.	● An orbit is the gravitationally curved path of an object around a point in space. Planets orbit around the center of a star system, the solar system. Orbits of planets are typically elliptical in shape. ✶ **Asteroids are metallic, rocky bodies that orbit the sun but are too small to be classified as a planet.** ● Asteroids are essentially chunks of rock that measure in size from a few feet to several miles in diameter. For example, Ceres, the largest asteroid, is about 590 miles (950 kilometers) wide. Like most asteroids, Ceres lies in the asteroid belt between Mars and Jupiter. ● Smaller rock and debris particles, or smaller asteroids, are referred to as meteoroids. ✶ **A meteor appears when a particle or chunk of metallic or stony matter called a meteoroid enters Earth's atmosphere from outer space.** ● Meteor showers sometimes occur when Earth passes through the orbit of a comet. Some meteor showers occur with great regularity (e.g., the Perseid meteor shower occurs every year between August 9th and 13th when Earth passes through the orbit of Comet Swift-Tuttle, Comet Halley is the source of the Orionid shower in October, etc.). ● Meteor showers are commonly called shooting stars or falling stars. ● A meteoroid that survives falling through the Earth's atmosphere and colliding with the Earth's surface is known as a meteorite. ● Describe the effect that asteroids or meteoroids have when moving through space and sometimes entering planetary atmospheres. ✶ **Comets are a mixture of ices (both water and frozen gases) that are not part of a planet.** ● Comets are sometimes called "dirty snowballs" or "icy mud balls." They are a mixture of ices, frozen from water and gases, and dust that for some reason did not get incorporated into the planets when the solar system was formed. ● Since comets are brightest when they orbit near the sun, they are usually visible only at sunrise or sunset. Most comets have highly unusual orbits which take them far beyond the orbit of Pluto; they are seen once and then disappear for millennia. Only the short- and intermediate-period comets, such as Comet Halley, stay within the orbit of Pluto for a significant fraction of their orbits. ● When comets are active and orbiting near the sun, they have three distinct parts: ° Coma - dense cloud of water, composed of carbon dioxide and other gases ° Nucleus - relatively solid and stable, composed of mostly ice and gas with a small amount of dust and other solids ° Tail - millions of kilometers long, composed of smoke-sized dust particles and other materials, the most prominent part of a comet seen by the unaided eye ● Compare the orbits and compositions of asteroids, meteors and comets with that of Earth.		

Copyright: Summit County ESC, Revised February 2017

	✶ **Pluto is classified as a dwarf planet (definition from http://www.nasa.gov).** ● According to the International Astronomical Union (IAU), which sets definitions for planetary science, a dwarf planet is a celestial body that: ° Has enough mass to assume a nearly round shape ° Has not cleared the neighborhood around its orbit ° Is not a moon ° Orbits the sun ● The main distinction between a planet and a dwarf planet is that "true" planets have a cleared path around the sun. Dwarf planets tend to orbit in zones of similar objects that can cross their paths around the sun, such as the asteroid and Kuiper belts. Dwarf planets also are generally smaller than the planet Mercury. ● There are currently five officially recognized dwarf planets including Ceres, Pluto, Haumea, Makemake and Eris. The IAU estimates there may be dozens or even more than one hundred dwarf planets awaiting discovery. ● The IAU recognized Pluto's special place in our solar system by designating dwarf planets that orbit the sun beyond Neptune as plutoids. Eris, which orbits far beyond Neptune, is a plutoid while Ceres, which orbits in the main asteroid belt between Mars and Jupiter, is just a dwarf planet. ● Recognize that other celestial bodies also orbit the sun. These can include dwarf planets, comets, asteroids, meteoroids and comets. (V) ✶ **General information regarding planetary positions, orbital patterns, planetary composition and recent discoveries and projects (e.g., missions to Mars) are included in this content.** ● Describe the characteristics of Earth and its orbit around the sun (e.g., three-fourths of Earth's surface is covered by a layer of water and some of it is frozen, the entire planet is surrounded by a thin blanket of air, has an elliptical orbit, has a tilted axis, is a spherical planet, etc.). ● Using specific data to determine the actual distances and sizes of objects within the solar system is an important part of understanding Earth's role in the solar system. Create a graphic organizer to describe characteristics of the planets beyond Earth which may include, but are not limited to: ° Mercury - closest to the sun, no atmosphere, -280°F to 800°F, 3030 miles in diameter, length of day equals 59 days, length of year equals 88 days, no moons ° Venus - hottest planet, 900°F, 7500 miles in diameter, length of day equals 243 days, length of year equals 225 days, thick atmosphere consisting of CO_2, no moons ° Mars - most Earth-like, atmosphere of CO_2 plus argon and nitrogen, 68°F to 193°F, length of day about 24 hours, length of year equals 687 days, has largest volcano in the solar system, commonly called the Red Planet ° Jupiter - largest planet, length of day equals 10 hours, length of year equals 12 years, many moons, has		

Copyright: Summit County ESC, Revised February 2017

	the Great Red Spot which is actually a storm that is larger than the size of Earth, 89000 miles in diameter ° Saturn - most notable rings, length of day about 11 hours, length of year equals 29 years, 74900 miles in diameter, gas composition, many moons in addition to rings ° Uranus - unusually tilted on its side, 32000 miles in diameter, length of day equals 17 hours, length of year equals 84 years, many moons, has rings ° Neptune - 30800 miles in diameter, length of day equals16 hours and 7 minutes, length of year equals 165 years, strongest winds of any planet, many moons ● Make a table, chart or graphic that interprets the general characteristics of the major planets in the solar system. Use real data (current) to compare and contrast the findings. (V) ● Choose a major planet. Plan and build a scaled model that can demonstrate the planet size and rotation orbit in relationship to the sun and Earth. Conduct the demonstration (with explanation) to the class. (V) ✶ **Tools and technology are an essential part of understanding the workings within the solar system.** ● Research the history of the exploration of the solar system or a recent space discovery. Make a timeline or write a report to interpret and clarify the major events, the tools and technology used, and the discoveries made. Share findings with the class. (V) ● Tools, technology, professional organizations and major events in the history of space exploration may include, but are not limited to: ° Apollo Missions ° Hubble Space Telescope ° International Astronomical Union (IAU) ° International Space Station ° Mars Pathfinder ° Mars rover ° NASA ° Space probes ° Space Shuttle Program ° Telescopes ° Voyagers 1 and 2 ● Identify a telescope as a tool that can be used to magnify the appearance of objects in the solar system. (V) ● Choose a planet (other than Earth) and research and develop a plan to colonize the planet with humans. Evaluate current conditions and what would be needed to meet the basic requirements for humans to live on Mars. Critique the plan. Ask: *Is the plan feasible? What equipment is required?* Make a final recommendation based on the research. Present recommendations to the class. (V)		

Copyright: Summit County ESC, Revised February 2017

	✶ **Note: Additional information about gravity is found in PS grade 5.**		
Earth and Space Science ✶ **The sun is one of many stars that exist in the universe. (5)** ● The sun appears to be the largest star in the sky because it is the closest star to Earth. Some stars are larger than the sun and some stars are smaller than the sun.	**Stars** ✶ **The sun is the closest star to Earth.** ● Identify that the sun is the brightest star in the universe (when viewed from Earth) and determine that it is located in the center of our solar system. ✶ **Scaled models (3-D or virtual) and graphics can be used to show the vast difference in size between the sun and Earth.** ✶ **The sun is a medium-sized star and is the only star in our solar system. There are many other stars of different sizes in the universe. Stars appear in patterns called constellations, which can be used for navigation. Because they are so far away, they do not appear as large as the sun.** ● Recognize that there are more stars in the sky than anyone can easily count. ● Explain that stars are like the sun, some being smaller and some larger, but so far away that they look like points of light. ● A great deal of light travels through space to Earth from the sun and from distant stars. (F) ● The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their size and distance from Earth. (F) ● Identify the sun as a medium-sized star and the only star in the solar system. (V) ● Examine the life cycle of a star and predict the next likely stage of a star. ● Differentiate between the sun and a red dwarf or blue giant star. Make a table or chart to represent the comparison. (V) ● Recall that there are many other stars in the universe and they are different sizes, but the sun appears larger because it is closer to Earth. (V) ✶ **General facts about the size and composition of the sun are introduced. Details (e.g., age of the sun, specific composition, temperature values) are above grade level. The emphasis should be on general characteristics of stars and beginning to understand the size and distance of the sun in relationship to Earth and other planets.** ● The sun is a medium-sized star, a hot ball of glowing gases at the heart of our solar system. Its influence extends far beyond the orbits of distant Neptune and Pluto. Without the sun's intense energy and heat, there would be no life on Earth. There are billions of stars like the sun scattered across the Milky Way galaxy. General facts about the sun may include, but are not limited to: ° Age - 4.6 billion years old (Enrichment) ° Diameter - 109 times the diameter of Earth (864,400 miles or 1,391,000 kilometers) ° General Composition - approximately 92% hydrogen and 8% helium		McGraw-Hill Science: *Observing the Sky* C70-81 (Stars) The Sun Our Star the Sun

Copyright: Summit County ESC, Revised February 2017

	° Mean Distance to Earth - approximately 93 million miles or 150 million kilometers ° Rotation Period at Equator - 26.8 days ° Rotation Period at Poles - 36 days ° Size - 1,300,000 planet Earths can fit inside the sun ° Weight - weighs about 333,000 times as much as Earth ✶ **Current and new discoveries related to stars and the sun must be included.** ● Explain that the universe consists of billions of galaxies that are classified by shape. (Enrichment)		
Earth and Space Science ✶ **Most of the cycles and patterns of motion between Earth and sun are predictable. (5)** ● Earth's revolution around the sun takes approximately 365 days. Earth completes one rotation on its axis in a 24-hour period, producing day and night. This rotation makes the sun, stars and moon appear to change position in the sky. Earth's axis is tilted at an angle of 23.5°. This tilt, along with Earth's revolution around the sun, affects the amount of direct sunlight that Earth receives in a single day and throughout the year. The average daily temperature is related to the amount of direct sunlight received. Changes in average temperature throughout the	**Revolution and Rotation** ✶ **Models, interactive websites and investigations are required to illustrate the predictable patterns and cycles that lead to the understanding of day and night, seasons, years and the amount of direct sunlight Earth receives. Three-dimensional models should be used to demonstrate that the tilt of Earth's axis is related to the amount of direct sunlight received and seasonal temperature changes.** ● The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily and seasonal changes in the length and direction of shadows; phases of the moon; and different position of the sun, moon, and stars at different times of the day, month, and year. (F) ● Some objects in the solar system can be seen with the naked eye. Planets in the night sky change positions and are not always visible from Earth as they orbit the sun. Stars appear in patterns called constellations, which can be used for navigation and appear to move together across the sky because of Earth's rotation. (F) ● Observe constant and changing patterns of objects in the day and night sky and describe how the sun, moon and stars all appear to move slowly across the sky. ● Investigate and record the length and direction of shadows created by objects and/or people at different times during the day. ● Observe patterns that stars make in the night sky, i.e. constellations (e.g., using pictures, STARLAB®, etc.). ● Observe and record how the moon appears a little different every day but looks nearly the same again about every four weeks. ● Using a simple model, investigate the positions of the sun, moon and Earth to detect and test the reasons why the moon and sun appear to change position in the sky and the phases of the moon. Note: The names of the phases are not the emphasis at this grade level. The emphasis is on observational differences. Names of phases are taught in middle school. (V) ● Diagram phases of the moon and describe their relationship to the moon's position near the earth.		McGraw-Hill Science: *Observing the Sky* C18-27 (Earth & Sun) Rotation Revolution

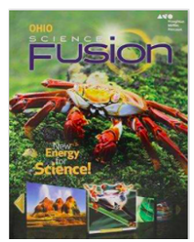
Copyright: Summit County ESC, Revised February 2017

year are identified as seasons. ● Note 1: The amount of direct sunlight that Earth receives is related to the altitude of the sun, which affects the angle of the sun's rays, and the amount of time the sun is above the horizon each day. ● Note 2: Different regions around the world have seasonal changes that are not based solely on average temperature (e.g., rainy season, dry season, monsoon season).	● Describe how night and day are caused by Earth's rotation. ● Recognize that the rotation of Earth on its axis produces day and night, which is why the sun, stars and moon appear to change position in the sky. (V) ● Demonstrate how Earth revolves around the sun and explain how this affects seasonal change. ● Describe the similarities between the revolution of Earth around the sun and the revolution of the moon around Earth. ● Create models of the Earth, sun and moon system and its cycles (e.g., using a globe or sphere and a light source, STARLAB®, etc.). Discuss the limitations of these models. ● Represent the sun, moon and Earth and their orbits graphically and to scale. Use actual data and measurements for the representation. (V) ● Model and diagram arrangements of the earth, sun and/or moon that produce: ° High and/or low tides (Introduced, Taught at Middle School) ° Phases of the moon (crescent to full) ° Seasonal change ° Solar and lunar eclipses (Introduced, Taught at Middle School) ● Explain characteristics, cycles and patterns involving Earth and its place in the solar system. ✶ **Seasonal change should be expanded in grade 5 to include regions of the world that experience specific seasonal weather patterns and natural weather hazards (e.g., hurricane season, monsoon season, rainy season, dry season). This builds upon making observations of the seasons throughout the school year in the earlier grades and prepares students for understanding the difference between weather and climate.** ● Weather is the minute-by-minute to day-by-day variation of the atmosphere's condition on a local scale. Scientists record the patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. Climate describes the ranges of an area's typical weather conditions and the extent to which those conditions vary over years to centuries. (F) ● Infer the relationship between: ° Earth's tilt and seasonal change ° Hemispherical location and seasonal temperatures or cycles (e.g., amount of sunlight, daylight savings time, changing daylight or darkness hours, climate, etc.).		

Copyright: Summit County ESC, Revised February 2017

LAKEWOOD CITY SCHOOL DISTRICT STANDARDS-BASED SCIENCE CURRICULUM
FIFTH GRADE

FIFTH GRADE
LIGHT AND SOUND
Physical Science Strand (PS)

Content Statements	Content Elaboration and Clarification	Resources from 2017-18 Update	Resources linked from LKWD 2012 Course of Study
Physical Science ✶ **Heat, electrical energy, light, sound and magnetic energy are forms of energy. (3-See "Important Note" under Strategies for Teaching and Learning.)** ● There are many different forms of energy. Energy is the ability to cause motion or create change. ● Note: The different forms of energy that are outlined at this grade level should be limited to familiar forms of energy that a student is able to observe. **Important Note:** ● The Physical Science Third Grade Content Statement "Heat, electrical energy, light, sound and magnetic energy are forms of energy" has been integrated with this Fifth	**Forms of Energy (As Related to Light and Sound)** ● According to the American Association for the Advancement of Science (AAAS), at the simplest level, energy can be thought of as "something needed to make things go, run, or happen." ● Energy is present whenever there are moving objects, sound, light or heat. (F) ● The faster a given object is moving, the more energy it possesses. Energy can be moved from place to place by moving objects or through sound, light or electric currents. (Boundary: At this grade level, no attempt is made to give a precise or complete definition of energy.) (F) ● When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (F) ● Light also transfers energy from place to place. For example, energy radiated from the sun is transferred to Earth by light. When this light is absorbed, it warms Earth's land, air and water and facilitates plant growth. (F) ● Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy (e.g., moving water driving a spinning turbine which generates electric currents, etc.). (F) (Taught at Fourth Grade) ● Identify different forms of energy including: ° Acoustic (i.e., sound) ° Chemical (Taught at Middle School) ° Electrical (Taught at Fourth Grade) ° Mechanical ° Nuclear (Taught at Middle School) ° Radiant (e.g., light, solar, etc.) ° Thermal (i.e., often referred to as "heat", but heat is really the transfer of thermal energy) (Taught at	Common Summative Assessments **RESOURCES:** Ohio Science Fusion, Grade 5, Teacher and Student Editions + digital resources through Think Central Directions for accessing Think Central/Fusion Resources 	

Copyright: Summit County ESC, Revised February 2017

Grade energy content.	Fourth Grade) ✶ **Examples of energy causing motion or creating change include a falling rock causing a crater to form on the ground, heating water causing water to change into a gas, light energy from the sun contributing to plant growth, electricity causing the blades of a fan to move, electrically charged objects causing movement in uncharged objects or other electrically charged objects, sound from a drum causing rice sitting on the drum to vibrate, and magnets causing other magnets and some metal objects to move.** ● Explore examples of energy causing motion or creating change that relate only to light and sound. Examples related to heat, electricity and magnetism were taught at fourth grade. ✶ **Investigations (3-D or virtual) must be used to demonstrate the relationship between different forms of energy and motion.** ✶ **Note 1: It is not appropriate at this grade to explore the different types of energy in depth or use wave terminology when discussing energy. These will be developed at later grades.** ✶ **Note 2: There often is confusion between the concepts of force and energy. Force can be thought of as a push or pull between two objects and energy as the property of an object that can cause change. If forces actually push or pull something over a distance, then there is an exchange of energy between the objects. The differences between force and energy will be developed over time and are not appropriate for this grade level.** ✶ **Note 3: The word "heat" is used loosely in everyday language, yet has a very specific scientific meaning. Usually what is called heat is actually "thermal or radiant energy." An object has thermal energy due to the random movement of the particles that make up the object. Radiant energy is that which is given off by objects through space (e.g., warmth from a fire, solar energy from the sun). "Heating" is used to describe the transfer of thermal or radiant energy to another object or place. Differentiating between these concepts is inappropriate at this grade. This document uses the same conventions as noted in the NAEP 2009 Science Framework (see page 29) where "heat" is used in lower grades. However, the word "heat" has been used with care so it refers to a *transfer* of thermal or radiant energy. The concept of thermal energy, as it relates to particle motion, is introduced in grade 6.**		
<u>Physical Science</u> ✶ **Light and sound are forms of energy that behave in predictable ways. (5)** ● Light travels and maintains	**<u>Light and Sound</u>** ✶ **Light can travel through some materials, such as a glass or water. Light also can travel through empty space, like from the sun to Earth.** ● A great deal of light travels through space to Earth from the sun and from distant stars. (F) ● Conduct experiments to demonstrate that as light spreads out from its source, it decreases in intensity.		McGraw-Hill Science: Unit F *Motion and Energy* F48-103

Copyright: Summit County ESC, Revised February 2017

its direction until it interacts with an object or moves from one medium to another and then it can be reflected, refracted or absorbed. ● Sound is produced by vibrating objects and requires a medium through which to travel. The rate of vibration is related to the pitch of the sound. ● Note: At this grade level, the discussion of light and sound should be based on observable behavior. Waves are introduced at the middle school level.	✶ **When light travels from one location to another, it goes in a straight line until it interacts with another object or material.** ● Verify, through experimentation, that light travels in a straight line. ✶ **When light strikes objects through which it cannot pass, shadows are formed.** ● Identify examples of transparent, translucent and opaque materials and describe how light travels differently through each type of material: ° Transparent Materials - allow light to pass through them, objects can be clearly seen through transparent materials (e.g., glass, water, windows, etc.) ° Translucent Materials - allow light to pass through them but they scatter it, objects cannot be clearly seen through translucent materials (e.g., waxed paper, glass block windows, frosted windows, ice, etc.) ° Opaque Materials - do not allow light to pass through them, objects cannot be seen through opaque materials (e.g., wood blocks, metal spoons, cardboard, etc.) ● Observe how shadows are formed when a light source is blocked by different objects (e.g., investigate and record the direction of a person's shadow at different times during the day, create "shadow puppet" shows, experiment with pinhole cameras, etc.). ✶ **As light reaches a new material, it can be absorbed, refracted, reflected or can continue to travel through the new material; one of these interactions may occur, or many may occur simultaneously, depending on the material.** ✶ **Light can be absorbed by objects, causing them to warm. How much an object's temperature increases depends on the material of the object, the intensity of and the angle at which the light striking its surface, how long the light shines on the object and how much light is absorbed. Investigating and experimenting with temperature changes caused by light striking different surfaces can be virtual or in a lab setting.** ● Some objects will absorb or "soak up" light waves into the surfaces of the materials from which they are made. ● Demonstrate how light can be absorbed by various materials, causing them to change temperature (e.g., measure water temperature in the form of snow versus "snow water" after exposure to light, water temperature in the form of ice versus "ice water" after exposure to light, temperatures of various soils before and after exposure to light, temperatures from thermometers placed on white versus black objects including clothing before and after exposure to light, temperatures of various surfaces before and after exposure to light, etc.). ✶ **When light passes from one material to another, it is often refracted at the boundary between the two materials and travels in a new direction through the new material (medium). For example, a magnifying lens bends light and focuses it toward a single point. A prism bends white light and**		Sound and Light Energy Study Jams Sound Webquest Light and Sound Wiki Engineering Interact Light and Sound

Copyright: Summit County ESC, Revised February 2017

	separates the different colors of light. Experiment with prisms and magnifying lenses to observe the refraction of light. ● Refraction is the bending of light rays as they pass from one medium into another (e.g., prisms, pencil in a glass of water, eyeglasses, magnifying glasses, etc.). ● Draw a picture of a pencil half-submerged in a cup of water. Trace the path of light as it travels from a submerged part of the pencil to the eye. Use this picture to explain why the pencil appears to be bent or broken when placed in water. (V) ● View objects through convex (i.e., converging) and concave (i.e., diverging) lenses to determine the differences between the images. ● Use convex (i.e., thicker in the middle, bends light to a focal point) and concave (i.e., thicker on the edges, spreads light rays apart) lenses to explore how light is refracted as it passes through different materials. ● Because lenses bend light beams, they can be used, singly or in combination, to provide magnified images of objects too small or too far away to be seen with the naked eye. (F) ● Lenses can be used to make eyeglasses, telescopes or microscopes in order to extend what can be seen. The design of such instruments is based on understanding how the path of light bends at the surface of a lens. (F) ● Explore how white light enters a prism, bends and comes out separated into the different colors of light found on the visible spectrum (i.e., red, orange, yellow, green, blue, indigo and violet). ● Plan and implement a scientific experiment to investigate what happens when light enters a new medium (e.g., passing from air to water, passing from Jell-O® to air, etc.). (V) ● Pictorially represent the path light takes when traveling from one medium to another. (V) ● Recognize that refraction involves bending of light when passing into a new medium. (V) ✶ **Visible light may be emitted from an object (like the sun) or reflected by an object (like a mirror or the moon).** ● Light may be radiated directly from an object (e.g., sun, light bulb, fireworks, glow sticks, etc.) or reflected off of an object. Reflection is the bouncing of a light wave off of a surface. An object can only be seen when light reflected from a surface enters the eyes (e.g., the moon, planets, mirrors, all objects seen daily, etc.). ● Verify, through experimentation, that when light is reflected, its angle of incidence is equal to its angle of reflection. ● Recognize that the angle that light approaches a reflective surface affects the direction in which the light is reflected. (V) ● Plan and implement a scientific investigation to determine the ideal angle to place a reflective surface to bend light through a right angle. (V)		

Copyright: Summit County ESC, Revised February 2017

	● Use convex (i.e., spreads light rays apart), concave (i.e., reflects light to focal point) and plane (i.e., bounces light at the same angle that it hits) mirrors to observe light as it bounces off surfaces and changes direction. ● Design models of mirror systems, such as: ° Design a mirror system to use when building a periscope. Draw a picture of the periscope design and trace the path of light as it travels from the object to the eye. (V) ° Design, construct and test a laser tag game prototype system that uses a system of mirrors and lenses to direct light through a simple maze to strike targets. (V) ✶ **The reflected colors are the only colors visible when looking at an object. For example, a red apple looks red because the red light that hits the apple is reflected while the other colors are absorbed.** ● Determine, through inquiry, that observing an object requires light to travel from a light source to an object and then to travel back from the object to the eye of the observer. ● An object can be seen when light reflected from its surface enters the eyes; the color people see depends on the color of the available light sources as well as the properties of the surface. (Boundary: The phenomenon is observed, but no attempt is made to discuss what confers the color reflection and absorption properties on a surface. The stress is on understanding that light traveling from the object to the eye determines what is seen.) (F) ● When an object is observed, some colors are absorbed and others are reflected. The reflected colors are the colors that are seen in the environment. ● Explore and summarize observations of the transmission, bending (i.e., refraction) and reflection of light. ● Research the structures of the eye and explain how organisms see. (Enrichment) ● Explore optical illusions and explain what causes them. (Enrichment) ✶ **Pitch can be changed by changing how fast an object vibrates. Objects that vibrate slowly produce low pitches; objects that vibrate quickly produce high pitches.** ● Produce a variety of sounds by striking, plucking or blowing a variety of objects. ● Vibration is the back and forth motion of an object. ● Pitch is a measure of how high or low a sound is. ● Produce examples of high-pitched and low-pitched sounds using objects of varying sizes/lengths, thicknesses and/or tensions (e.g., Geoboards® and rubber bands, shoeboxes and rubber bands, model guitars made with fishing line, straws cut to various lengths, water bottles filled with different levels of liquid, drums of different sizes, bells of different sizes, PVC tubing cut to various lengths, blowing across the tops of bottles filled with various amounts of water versus tapping the same bottles, tuning forks of various pitches, etc.). ● Plan and implement a scientific investigation to investigate how the length of PVC tubing affects the pitch		

Copyright: Summit County ESC, Revised February 2017

	of the sound. Summarize the data in a way that is clear and easy to understand. Recognize that longer tubes produce lower pitches and shorter tubes produce higher pitches. (V) ● Demonstrate that fast vibrations cause high-pitched sounds and that slow vibrations cause low-pitched sounds. ● Describe how changing the rate of vibration can vary the pitch of a sound. ● Recall that increasing the rate of vibration can increase the pitch of a sound. (V) ● Design two different musical instruments, one using blowing and one using plucking, that can create the same three notes. Verbally explain how the design of the instrument allows different pitches to be produced. (V) ● Explore the "Doppler Effect" (i.e., when a vibrating object approaches and then moves away, its pitch changes). ● Explore resonance (i.e., when an object causes another object of the same natural frequency to vibrate). (Enrichment) ✶ **Audible sound can only be detected within a certain range of pitches.** ● Infer that the loudness of a sound relates directly to the amount of energy used in producing a sound. Volume is the loudness or softness of a sound. ● Describe sound in quantitative measures (e.g., hertz, decibels, etc.). ● Humans can only hear within a certain range of pitches, 20 Hz to 20 kHz. ● Research the structures of the ear and explain how organisms hear. (Extension) ✶ **Sound must travel through a material (medium) to move from one place to another. This medium may be a solid, liquid or gas. Sound travels at different speeds through different media. Once sound is produced, it travels outward in all directions until it reaches a different medium. When it encounters this new medium, the sound can continue traveling through the new medium, become absorbed by the new medium, bounce back into the original medium (reflected) or engage in some combination of these possibilities.** ● Sounds usually travel the fastest through solids, which are the densest medium they can encounter. Sounds travel the slowest through gases because the particles in gases are spread further apart. ● Reflection is the bouncing of a sound wave off of a surface (e.g., echoes, SONAR, ultrasound, etc.). ● Absorption is the "disappearance" of a sound wave into a surface (e.g., sound absorbed by acoustical tiles, carpet, drapes, sound insulation, sound baffles, etc.). ● Observe and demonstrate the reflection and absorption of sound waves. ● Describe and summarize observations of the transmission, reflection and absorption of sound. ✶ **Light travels faster than sound.** ● In air, light travels 186,000 miles per second (300,000 km) per second versus sound which travels		

Copyright: Summit County ESC, Revised February 2017

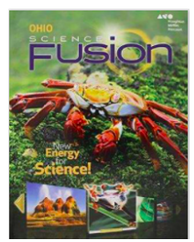
	approximately 361yards (330 meters) per second. ✶ **Technology and virtual simulations and models can help demonstrate movement of light and sound.** ● Digitized information (e.g., the pixels of a picture) can be stored for future recovery or transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information - convert it from digitized form to voice - and vice versa. (F) ✶ **Experimentation, testing and investigation (3-D or virtual) are essential components of learning about light and sound properties.** ✶ **Note: Students are not responsible for knowing the additive rules for color mixing of light other than the fact that white light is a mixture of many colors. The wave nature of sound and light are not introduced at this level nor are parts of the electromagnetic spectrum other than visible light. At this grade, how sound travels through the medium is not appropriate as atoms and molecules are not introduced until grade 6.** ● Identify the general characteristics and properties of waves (e.g., wavelength, amplitude, frequency, wave speed, wave energy, crests, troughs, etc.). (Introduced, Taught at Middle School) ● Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between peaks). Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) Earthquakes cause seismic waves, which are waves of motion in Earth's crust. (F) ● Compare and contrast the behavior electromagnetic waves (such as light waves), which can travel through empty space and through matter, versus mechanical waves (i.e., sound or acoustic waves, seismic waves, water waves), which require a medium to travel through. (Introduced, Taught at Middle School) ● Mechanical waves are classified as transverse or longitudinal (compression) depending on the direction of movement of the medium. (Enrichment, Taught at Middle School) ● Recognize the relationship between wavelength and frequency (i.e., inversely related) and their relationship to wave speed (i.e., wave speed = wavelength x frequency). (Enrichment, Taught at Middle School) ● Interpret the electromagnetic spectrum to determine relationships among frequency, wavelength and different kinds of radiation (i.e., radio, microwave, infrared, visible light, ultraviolet, gamma, x-ray and gamma). (Enrichment, Taught at Middle School)		

Copyright: Summit County ESC, Revised February 2017

LAKEWOOD CITY SCHOOL DISTRICT STANDARDS-BASED SCIENCE CURRICULUM
FIFTH GRADE

Copyright: Summit County ESC, Revised February 2017

FIFTH GRADE
MOTION
Physical Science Strand (PS)

Content Statements	Content Elaboration and Clarification	Resources from 2017-18 Update	Resources linked from LKWD 2012 Course of Study
Physical Science ✶ **The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted. (5)** ● Movement can be measured by speed. The speed of an object is calculated by determining the distance (d) traveled in a period of time (t). ● Earth pulls down on all objects with a gravitational force. Weight is a measure of the gravitational force between an object and Earth. ● Any change in speed or direction of an object requires a force and is affected by the mass* of	**Introduction to Kinetic and Potential Energy (Taught In-Depth at Middle School)** ● Identify different forms of energy including: ° Acoustic (i.e., sound) ° Chemical (Taught at Middle School) ° Electrical (Taught at Fourth Grade) ° Mechanical ° Nuclear (Taught at Middle School) ° Radiant (e.g., light, solar, etc.) ° Thermal (i.e., often referred to as "heat", but heat is really the transfer of thermal energy) (Taught at Fourth Grade) ● There are many forms of energy, but all forms can be put into two categories, kinetic and potential: ° Objects in motion have kinetic energy. The kinetic energy of objects changes when their speed changes. The faster objects move, the more kinetic energy they have. ° Objects can have energy as a result of their positions. Potential energy is the energy of position between two interacting objects (e.g., a stretched rubber band, a roller coaster at the top of a hill, etc.). ● Important Note: Potential energy is often referred to as "stored" energy. However, using the word "stored" to define potential energy is sometimes misleading. The word "stored" implies that the energy is kept by the object and not given away to another object. Therefore, kinetic energy can also be classified as "stored" energy. For example, a rocket moving at constant speed through empty space has kinetic energy and is not transferring any of this energy to another object. ● Gravitational potential energy is associated with the height of an object above a reference position. The gravitational potential energy of an object changes as its height above the reference changes. Recognize that increasing height increases gravitational potential energy. (Introduced, Taught at Middle School) ● Conduct an experiment to demonstrate how energy changes from potential to kinetic and from kinetic to potential. ● Recall that an object can have potential energy due to its position relative to another object and can have	Common Summative Assessments **RESOURCES:** Ohio Science Fusion, Grade 5, Teacher and Student Editions + digital resources through Think Central Directions for accessing Think Central/Fusion Resources 	McGraw-Hill Science: Unit F *Motion and Energy* F2-45 Engineering Interact Forces and Motion Study Jams Force and Motion Physics4Kids

Copyright: Summit County ESC, Revised February 2017

the object and the amount of force applied. ● Note 1: Gravity and magnetism are introduced (through observation) in PS grade 2. ● Note 2: While mass* is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.	kinetic energy due to its motion. ● A system can change as it moves in one direction (e.g., a ball rolling down a hill), shifts back and forth (e.g., a swinging pendulum), or goes through cyclical patterns (e.g., day and night). Examining how the forces on and within the system change as it moves can help to explain the system's patterns of change. (F) ● A system can appear to be unchanging when processes within the system are occurring at opposite but equal rates (e.g., water behind a dam is at a constant height because water is flowing in at the same rate that water is flowing out, etc.). Changes can happen very quickly or very slowly and are sometimes hard to see (e.g., plant growth). Conditions and properties of the objects within a system affect how fast or slowly a process occurs (e.g., heat conduction rates, etc.). (F) **Motion** ✶ **The motion of an object can change by speeding up, slowing down or changing direction.** ● An object in motion changes position over time. The change in position of an object is measured by the change in distance between a starting and an ending point. The starting point is the frame of reference (i.e., reference point) to which the ending point is compared. ● Describe how a change in the position of an object (i.e., motion) is always judged and described in comparison to a reference point. ✶ **Forces cause changes in motion.** ● Forces, pushes or pulls on objects, may result in changes in motion of objects. ● Objects in contact exert forces on each other (e.g., friction, elastic pushes and pulls, etc.). Electric, magnetic and gravitational forces between a pair of objects do not require that the objects be in contact - for example, magnets push or pull at a distance. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (F) ● Types of forces include: ° Friction - Friction is a contact force that acts when two surfaces are touching. It is a force that can cause objects to slow down or stop and can keep objects from moving at all. Air resistance is a form of friction that works against the motion of objects that are traveling through the air. Static, sliding and rolling are other forms of friction that work against the motion of objects that are traveling across surfaces. Friction often produces heat (i.e., mechanical energy converted to heat energy, etc.). ° Collision - When objects collide, the contact forces transfer energy so as to change the objects' motions. (F)		

Copyright: Summit County ESC, Revised February 2017

	° Gravity - Everything on or anywhere near Earth is pulled toward Earth's center by gravitational force. Gravity is a noncontact force that can change the motion of objects by pulling them toward Earth's core. ° Magnetism - Magnets can exert forces on other magnets or on magnetizable materials, causing energy transfer between them (e.g., leading to changes in motion) even when the objects are not touching. (F) ● Each force acts on one particular object and has both a strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) The patterns of an object's motion in various situations can be observed and measured; when past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (F) ● Force diagrams, also called free body diagrams, are pictorial representations often used by physicists and engineers to analyze the forces acting on objects. Force diagrams show all the different types of forces acting on objects and their relationship to one another. ● Describe the motion of objects, and predict changes in motion they may experience due to the effects of forces (e.g., gravity, air resistance, magnetism, rolling friction, etc.). ● Important Note: There is often confusion between the concepts of force and energy. Force can be thought of as a push or pull between two objects and energy as the property of an object that can cause change. If forces actually push or pull something over a distance, then there is an exchange of energy between the objects. The differences between force and energy will be developed over time and are not appropriate for this grade level. ✶ **If a force is applied in the same direction of an object's motion, the speed will increase. If a force is applied in the opposite direction of an object's motion, the speed will decrease.** ✶ **Generally, the greater the force acting on an object, the greater the change in motion. Generally, the more mass* an object has, the less influence a given force will have on its motion.** ● Mass is the amount of matter in an object or substance. The more massive something is, the harder it is to move. ● Weight is a measure of the gravitational force between an object and the earth. ● Plan and implement a scientific experiment that determines how the mass* of an object (or amount of force acting on an object) affects how the motion of an object changes. Represent the data graphically. Analyze the data to determine trends. Formulate a conclusion. (V)		

Copyright: Summit County ESC, Revised February 2017

	● Measure forces using a spring scale. ● Recognize that increasing the force acting on an object will result in greater changes in motion. (V) ● Compare and rank the relative change in motion for objects of different masses* that experience the same force. (V) ● Recognize that objects with greater mass* will change their motion less than objects with less mass*. (V) ✶ **If no forces act on an object, the object does not change its motion and moves at constant speed in a given direction. If an object is not moving and no force acts on it, the object will remain at rest.** ● Explain how an object stays at rest when balanced forces act on the object; no movement occurs because the forces cancel each other out (e.g., a child sitting balanced at the top of a slide or at the bottom of swing set, equal forces pulling during a tug-of-war match indicated when the rope is not moving toward one team or the other, etc.). ● Explain how motion occurs when unbalanced forces act on an object (i.e. pushing a child to start down a slide or to swing on a swing set, unequal forces pulling during a tug-o-war match indicated when the rope is moving toward one team, etc.). ● Explain how an unbalanced force acting on an object in motion may change the speed and/or direction of the object. ● Content related to motion is to remain conceptual at this grade. Although knowing the names of and memorizing and reciting Newton's Laws of Motion is not required, the following laws should be applied conceptually to models and real-world examples of motion: ° Newton's First Law - An object at rest stays at rest and an object in motion stays in motion, at the same speed and in the same direction, unless acted on by an unequal force (e.g., friction causes objects in motion to slow down or stop, a bowling ball hits pins that are at rest and then they move, etc.). This law illustrates the concept of inertia. ° Newton's Second Law - The acceleration of an object depends on the mass of the object and the size of the force applied to it. The mathematical relationship for this law will be taught at middle school (i.e., force x mass = acceleration). ° Newton's Third Law - For every action, there is an equal and opposite reaction (e.g., a straw rocket travels forward on a string when air pressure is released from a balloon connected to the rocket, a basketball hits a wall and bounces back, etc.). ● Motion can be demonstrated using a variety of models, real-world settings and technology (e.g., "roller coasters" made from pipe insulation cut down the middle for the track and different-sized marbles as the cars or weights, examples of everyday motion on websites and television, toy cars and tracks, toys that move, equipment borrowed from or used during physical education classes, outdoor games and recess activities, objects that can be thrown or released by people who are standing still or in motion, etc.).		

Copyright: Summit County ESC, Revised February 2017

	✶ **Movement is measured by speed (how fast or slow the movement is). Speed is measured by time and distance traveled (how long it took for the object to go a specific distance). Speed is calculated by dividing distance by time.** ● Describe an object's motion by tracing and measuring its position over time. The distance an object travels is always measured from some reference point. ● Identify what factors must be measured to determine speed. (V) ● Recall the mathematical relationship between distance, time and speed. (V) ● Given the distance and time, calculate the average speed of an object. ● Explain that motion describes a change in the position of an object, characterized by speed and direction, as time changes. ● Predict what will happen to the motion of an object. Provide the speed and direction of motion and a force diagram on the object. Explain the prediction. (V) ● Identify factors that influence the amount of change in motion of an object. (V) ✶ **Speed must be investigated through testing and experimentation. Real-world settings are recommended for the investigations when possible. Virtual investigations and simulations also can be used to demonstrate speed.** ✶ **An object that moves with constant speed travels the same distance in each successive unit of time. In the same amount of time, a faster object moves a greater distance than a slower object. When an object is speeding up, the distance it travels increases with each successive unit of time. When an object is slowing down, the distance it travels decreases with each successive unit of time.** ✶ **Speed must be explored and tested through investigations (3-D or virtual) inside and outside of the classroom. Video technology can be used to stop movement and measure changes at different steps in the investigations.** ● Identify three ways the motion of an object can be changed (i.e., speed up, slow down, change direction). (V) ✶ **Note 1: This content can be taught in conjunction with the following ESS content: Everything on or anywhere near Earth is pulled toward Earth's center by gravitational force. Weight is a measure of this force. The planets are kept in orbit due to their gravitational attraction for the sun.** ✶ **Note 2: While concepts are related to Newton's second law, remain conceptual at this grade. Knowing the name of the law is not required. Memorizing and reciting words to describe Newton's second law is not appropriate.** ✶ **Note 3: Although mathematics is applied to the concept of speed at this grade level, its use should support deeper understanding of the concept of speed and not be taught as the primary definition of speed.**		

Copyright: Summit County ESC, Revised February 2017

LAKEWOOD CITY SCHOOL DISTRICT STANDARDS-BASED SCIENCE CURRICULUM
FIFTH GRADE

Copyright: Summit County ESC, Revised February 2017