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Alignment to 2016 Massachusetts Science and Technology/Engineering Curriculum Framework

Grades 6-8
Earth and Space Sciences

State Standard	FOSS Program
ESS1. Earth's Place in the Universe	
6.MSESS1-1a. Develop and use a model of the Earth-Sun-Moon system to explain the causes of lunar phases and eclipses of the Sun and Moon. Clarification Statement: • Examples of models can be physical, graphical, or conceptual and should emphasize relative positions and distances.	**FOSS Next Generation Planetary Science** **TE:** Investigation 1; Part 3 Investigation 3; Part 2 Investigation 4; Parts 1–3 **SE:** *US Naval Moon Phase Calendar, Earth's Moon,* **DR:** *Moon Orientation, Phases of the Moon, Lunar Calendar,*
8.MS-ESS1-1b. Develop and use a model of the Earth-Sun system to explain the cyclical pattern of seasons, which includes Earth's tilt and differential intensity of sunlight on different areas of Earth across the year. Clarification Statement: • Examples of models can be physical or graphical.	**FOSS Next Generation Planetary Science** **TE:** Investigation 2; Parts 2 - 3 **SE:** *Solar Angle, Seasons on Earth, Eratosthenes: First to Measure Earth* **DR:** *Seasons*
8.MS-ESS1-2. Explain the role of gravity in ocean tides, the orbital motions of planets, their moons, and asteroids in the solar system. State Assessment Boundary: • Kepler's laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth are not expected.	**FOSS Next Generation Gravity and Kinetic Energy** **TE:** Investigation 2; Part 2 **SE:** *Gravity in Space, Acceleration of Gravity on Different Celestial Objects* **FOSS Next Generation Planetary Science** **TE:** Investigation 6; Parts 1 - 2 **SE:** *The Cosmos in a Nutshell, How Earth Got and Held onto its Moon* **DR:** *Space Units, Cosmos Card Sort, Solar System Origin of the Moon, Tides*
6. MS-ESS 1-4. Analyze and interpret rock layers and index fossils to determine the relative ages of rock formations. Explain that these sources of evidence, along with radiometric dating, are used to construct the geologic time scale of Earth's history. Clarification Statements: • Analysis includes lows of superposition and crosscutting relationships limited to minor displacement faults that offset layers. Processes that occur over long periods of time include changes in rock types through weathering, erosion, heat, and pressure. State Assessment Boundary: • Strata sequences that have been reordered or overturned, names of specific periods or epochs and events within them, or the identification and naming of minerals or rock types are not expected.	**FOSS Next Generation Earth History** **TE:** Investigation 1; Part 3 Investigation 3; Part 3 Investigation 4; Parts 1-3 Investigation 9; Part 2 **SE:** *Powells' Grand Canyon Expedition, Water on Mars, Rocks, A Fossil Primer, Rocks, Fossils, and Time, Floating on a Prehistoric Sea* **DR:** *Grand Canyon Rocks Correlations, Rock Column Movie Maker, Rock Database, Sedimentary Rocks Tour, Sandstone Formation, Shale Formation, Limestone Formation, Index-Fossil Correlation, Dating Rock Layers*
6. MS-ESS1-5(MA). Use graphical displays to illustrate that Earth and its solar system are one of many in the Milky Way galaxy, which is one of billions of galaxies in the universe. Clarification Statement: • Graphical displays can include maps, charts, graphs, and data tables.	**FOSS Next Generation Planetary Science** **TE:** Investigation 9; Part 2 **SE:** *Exoplanet Transit Graphs, Finding Exoplanets* **DR:** *Venus Transit, Orrery Video 1, Orrery Video 2, Exoplanet Transit Hunt*
ESS2. Earth's Systems	
8. MS-ESS2-1. Use a model to illustrate that energy from Earth's interior drives convection that cycles Earth's crust,	**FOSS Next Generation Earth History** **TE:** Investigation 7; Parts 1 – 2

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leading to melting, crystallization, weathering, and deformation of large rock formations, including generation of ocean sea floor at ridges, submergence of ocean sea floor at trenches, mountain building, and active volcanic chains. Clarification Statement: • The emphasis is on large-scale cycling resulting from plate tectonics.	Investigation 9; Part 2 **SE:** *Earth's Dynamic Systems, Rock Transformations, How One Rock Becomes Another Rock* **DR:** *Convergent Boundary, Divergent Boundary, Transform Boundary, Folding, Volcanoes around the World, Mountain Types, Appalachian Mountain Tour, How Metamorphic Rocks Form, Slate*
7MS-ESS2-2. Construct an explanation based on evidence for how Earth's surface has changed over scales that range from microscopic to global in size and operate at times ranging from fractions of a second to billions of years. Clarification Statements: • Examples of processes occurring over large, global spatial scales include plate motion, formations of mountains and ocean basins, and ice ages. Examples of changes occurring over small, local spatial scales include earthquakes and seasonal weathering and erosion.	**FOSS Next Generation Planetary Science** **TE:** Investigation 5; Part 2 Investigation 7; Part 4 **SE:** *The Disappearance of the Dinosaurs, Gene Shoemaker: Planetary Geologists* **DR:** *2012 Meteor News, Could We Stop and Asteroid? Asteroid Deflection, Earth's Changing Systems, Earth Images Comparison* **FOSS Next Generation Earth History** **TE:** Investigation 1; Parts 2 – 3 Investigation 2; Parts 1 – 3 Investigation 3; Part 3 Investigation 5; Parts 1 and 3 Investigation 6; Parts1–3 Investigation 7; Parts 1-2 **SE:** *Powell's Grand Canyon Expedition, Grand Canyon Flood, Weathering and Erosion, Soil Stories, Water on Mars? Volcanoes, The History of the Theory of Plate Tectonics, Historical Debates about a Dynamic Earth, Earth's Dynamic Systems, Rock Transformations, How One Rock Becomes Another Rock* **DR:** *Grand Canyon Rocks Correlation, Stream Table, Glen Canyon Dam High Flow Experiment, Debris Flow, Frost Wedging, Rock Fall, Volcanoes around the World, Earthquakes around the World, NOAA Plate Tectonics, Mountain Types,*
6MS-ESS2-3. Analyze and interpret maps showing the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence that Earth's plates have moved great distances, collided, and spread apart. Clarification Statement: • Maps map show similarities of rock and rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches), similar to Wegener's visuals. State Assessment Boundary: • Mechanisms for plate motion or paleomagnetic anomalies in oceanic and continental crust are not expected.	**FOSS Next Generation Earth History** **TE:** Investigation 6; Parts 1-3 Investigation 7; Part 1 Investigation 9; Part 2 **SE:** *The History of the Theory of Plate Tectonics, Historical Debates about a Dynamic Earth, Rock Transformations,* **DR:** *Plate Boundaries Map, NOAA Plate Tectonics, Appalachian Mountain Tour,*
7. MS-ESS2-4. Develop a model to explain how the energy of the Sun and Earth's gravity drive the cycling of water, including changes of state, as it moves through multiple pathways in Earth's hydrosphere Clarification Statement: • Examples of models can be conceptual or physical.	**FOSS Next Generation Weather and Water** **TE:** Investigation 7; Parts 1–3 Investigation 8; Part 1-3 **SE:** *Weather Balloons and the Radiosonde, Animal Rains, Earth: The Water Planet, Ocean Currents and Gyres, El Niño, US Map with Western Cities, Alaska Climate over 30 Years, Southern California Climate over 30 Years, Northern*

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State Assessment Boundary: • A quantitative understanding of the latent heats of vaporization and fusion is not expected.	*California Climate over 30 Years* **DR:** *Cloud in a Bottle, Water Cycle*
8. MS-ESS2-5. Interpret basic weather data to identify patterns in air mass interactions and the relationship of those patterns to local weather. Clarification Statements: • Data includes temperature, pressure, humidity, precipitation, and wind. Patterns can include air masses flow from regions of high pressure to low pressure, and how sudden changes in weather can result when different air masses collide. Data can be provided to student (such as in weather maps, data tables, diagrams, or visualizations) or obtained through field observations or laboratory experiments.	**FOSS Next Generation Weather and Water** **TE:** Investigation 1, Parts 1 – 3 Investigation 2, Parts 1 – 2 Investigation 6, Parts 1 - 3 **SE:** *Severe Weather, What's in the Air? A Thin Blue Veil, What is Air Pressure?, Heating the Atmosphere, Wind on Earth* **DR:** *Hurricanes and Tornadoes, Gas in a Syringe, Elevator to Space, Gas in a Syringe, Weather Balloon Simulation, Elevator to Space, Local Wind, NOAA Ridge, Red Spot Movie*
8. MS-ESS2-6. Describe how interactions involving the ocean affect weather and climate on a regional scale, including the influence of the ocean temperature as mediated by energy input from the Sun and energy loss due to evaporation or redistribution via ocean currents. Clarification Statement: • A regional scale includes a state or multi-state perspective. State Assessment Boundary: • Koppen Climate Classification names are not expected.	**FOSS Next Generation Weather and Water** **TE:** Investigation 3; Parts 1 – 3 Investigation 6; Parts 1 – 3 Investigation 8; Parts 1 – 3 Investigation 10; Parts 1 -2 **SE:** *Density, Density with Dey, Convection, Heating the Atmosphere, Winds on Earth, Earth: The Water Planet, Ocean Currents and Gyres, El Nino, Severe Weather* **DR:** *Particles in Solids, Liquids, and Gases, Energy Transfer: Conduction, Radiation, Convection, Local Wind, NOAA Ridge, Red Spot Movie, Water Cycle, Perpetual Ocean, Weather Maps*
ESS3. Earth and Human Activity	
8. MS-ESS3-1. Analyze and interpret data to explain that the Earth's mineral and fossil fuel resources are unevenly distributed as a result of geologic processes. Clarification Statement: • Examples of uneven distributions of resources can include where petroleum is generally found (locations of the burial or organic marine sediments and subsequent geologic traps), and where metal ores are generally found (locations of past volcanic and hydrothermal activity).	**FOSS Next Generation Earth History** **TE:** Investigation 8; Parts 1-3 **SE:** *Geoscenario Introduction: Glaciers, Geoscenario Introduction: Coal, Geoscenario Introduction: Yellowstone Hotspot, Geoscenario Introduction: Oil* **DR:** *Geoscenarios, Timeliner, Rock Column Movie Maker*
7. MS-ESS3-2. Obtain and communicate information on how data from past geologic events are analyzed for patterns and used to forecast the location and likelihood of future catastrophic events. Clarification Statements: • Geologic events include earthquakes, volcanic eruptions, floods, and landslides. Examples of data typically analyzed can include the locations, magnitudes, and frequencies of the natural hazards. State Assessment Boundary: • Active analysis of data or forecasting in is not expected	**FOSS Next Generation Weather and Water** **TE:** Investigation 9; Parts 1-3 **SE:** *Climates: Past, Present, and Future* **DR:** *CO2 in the Ice Core Record, Earth's Climate over Time, Greenhouse-Gas Simulator, Human-Caused Sources of Carbon Dioxide, Climate Blog, Water Cycle, Climate Change Basics* **FOSS Next Generation Earth History** **TE:** Investigation 6; Parts 1-3 **SE:** *Volcanoes, The History of the Theory of Plate Tectonics, Historical Debates about a Dynamic Earth,* **DR:** *Mount St. Helens: The Eruption Impact, Shake Alert, Volcanoes around the World, Earthquakes around the World, Wegner, Convection Tank, NOAA Plate Tectonics, Carbon Cycle*

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7. MS-ESS3-4. Construct an argument supported by evidence that human activities and technologies can mitigate the impact of increases in human population and per capita consumption of natural resources on the environment. Clarification Statements: • Arguments should be based on examining historical data such as population graphs, natural resource distribution maps, and water quality studies over time. Examples of negative impacts can include changes to the amount and quality of natural resources such as water, mineral, and energy supplies.	**FOSS Next Generation Populations and Ecosystems** **TE:** Investigation 8; Parts 1–3 Investigation 9; Parts 1–3 **SE:** *Biodiversity, Invasive Species, Mono Lake in the Spotlight, Ecoscenario Introductions* **DR:** *Hawaii: Strangers in Paradise, The Mono Lake Story, Ecoscenario Research Center* **FOSS Next Generation Planetary Science** **TE:** Investigation 7; Part 4 **SE:** *Earth's Changing Systems* **DR:** *Earth Images Comparison, World Population* **FOSS Next Generation Earth History** **TE:** Investigation 8; Parts 1-4 **SE:** *Geoscenarios: Glaciers, Coal, Yellowstone Hotspot, Oil* **DR:** *Geoscenarios, Timeliner*
8. MS-ESS3-5. Examine and interpret data to describe the role that human activities have played in causing the rise in global temperatures over the past century. Clarification Statements: • Examples of human activities include fossil fuel combustion, deforestation, and agricultural activity. Examples of evidence can include tables, graphs, and maps of global and regional temperature; atmospheric levels of gases such as carbon dioxide and methane; and the rates of human activities.	**FOSS Next Generation Earth History** **TE:** Investigation 8; Parts 1 - 3 **SE:** *Geoscenarios: Glaciers, Coal, Yellowstone Hotspot, Oil* **DR:** *Geoscenarios, Timeliner* **FOSS Next Generation Weather and Water** **TE:** Investigation 9; Parts 1 - 3 **SE:** *Climates: Past, Present, and Future* **DR:** *CO2 in the Ice Core Record, Earth's Climate Record, Greenhouse-Gas Simulator, Human-Caused Sources of Carbon Dioxide, Carbon Cycle, Water Cycle, Climate Change Basics*

Life Science

State Standard	FOSS Program
LS1. From Molecules to Organisms: Structures and Processes	
6.MS-LS1-1. Provide evidence that all organisms (unicellular and multicellular) are made of cells. Clarification Statement: • Evidence can be drawn from multiple types of organisms, such as plants, animals, and bacteria.	**FOSS Next Generation Diversity of Life** **TE:** Investigation 3; Parts 1-4 Investigation 4; Part 1-4 Investigation 5; Part 3 Investigation 9; Part 2 **SE:** *Characteristics of Life on Earth, Cells, How Big Are Cells? The Amazing Paramecium, Bacteria All Around Us, Harmful and Helpful Bacteria, Viruses: Living or Non living?* **DR:** *Database: Brine Shrimp Eating, Database: Human Cheek Cells, Levels of Complexity, The Three Domains of Life*
6.MS-LS1-2. Develop and use a model to describe how parts of cells contribute to the cellular functions of obtaining food, water, and other nutrients from its environment, disposing of wastes, and providing energy for cellular processes. Clarification Statement: • Parts of plant and animal cells include (a) the nucleus, which contains a cell's genetic materials and regulates its activities; (b) chloroplasts, which produce necessary	**FOSS Next Generation Diversity of Life** **TE:** Investigation 2; Part 3 Investigation 3; Parts 1-4 Investigation 5; Parts 2–3 **SE:** *Water, Light and Energy,* **DR:** *Levels of Complexity*

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food (sugar) and oxygen through photosynthesis (in plants); (c) mitochondria, which release energy from food through cellular respiration; (d) vacuoles, which store materials, including water, nutrients, and waste; (e) the cell membrane, which is a selective barrier that enables nutrients to enter the cell and wastes to be expelled; and (f) the cell wall, which provides structural support (in plants). State Assessment Boundary: • Specific biochemical steps or chemical processes, the role of ATP, active transport processes involving the cell membrane, or identifying or comparing different types of cells are not expected in state assessment.	
6MS-LS1-3. Construct an argument supported by evidence that the body systems interact to carry out essential functions of life. Clarification Statements: • Emphasis is on the functions and interactions of body systems, not specific body parts or organs. An argument should convey that different types of cells can join together to form specialized tissues, which is turn may form organs that work together as body systems. Body systems to be included are the circulatory, digestive, respiratory, excretory, muscular/skeletal, and nervous systems. State Assessment Boundaries: • The mechanism of one body system independent of others or the biochemical processes involved in body systems are not expected. Describing the function or comparing different types of cells, tissues, or organs are not expected.	**FOSS Next Generation Human Systems Interactions** **TE:** Investigation 1, Parts1-2 Investigation 2, Parts 1–2 Investigation 3, Parts 1-4 **SE:** *Human Organ Systems, Human Cardiovascular System, Aerobic Cellular Respiration, Sensory Receptor Touch, Hearing, Brain Messages, Neurotransmission, Smell and Taste, Sight, Memory and You Brain.* **DR:** *Structural Levels Cards, Human Systems Structural Levels, Digestive and Excretory Systems, Circulatory and Respiratory Systems, Digestive and Excretory Systems, Touch Menu: Touch Receptors, Touch Menu: 3D Finger, Brain: Synapse Function, Brain: Neuron Growth, Smell Menu, Vision Menu, Reaction Timer, Memory and Your Brain.*
7. MS-LS1-4. Construct an explanation based on evidence for how characteristic animal behaviors and specialized plant structures increase the probability of successful reproduction of animals and plants. Clarification Statements: • Examples of animal behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalizations and colorful plumage to attract mates for breeding. Animal behaviors that affect the probability of plant reproduction could include (a) transferring pollen or seeds, and (b) creating conditions for seed germination and growth. Examples of plant structures that affect the probability of plant reproduction could include bright flowers that attract insects that transfer pollen, and hard shells on nuts that squirrels bury. State Assessment Boundary: • Natural section is not expected.	**FOSS Next Generation Diversity of Life** **TE:** Investigation 6; Part 4 **DR:** *Database: Pollinator Collection, Pollinators Game,*
8.MS-LS1-5. Construct an argument based on evidence for how environmental and genetic factors influence the growth of organisms.	**FOSS Next Generation Diversity of Life** **TE:** Investigation 6; Parts 2 - 4 **SE:** *Breeding Salt-Tolerant Wheat, The Making of a New*

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Clarification Statements: • Environmental conditions could include availability of food, light, space, and water. Genetic factors could include the genes responsible for size differences in different breeds of dogs. Environmental factors could include drought decreasing plant growth, fertilizer increasing plant growth, and fish growing larger in large ponds. Examples of both genetic and environmental factors could include different varieties of plants growing at different rates in different conditions. State Assessment Boundary: • Methods of reproduction, genetic mechanisms, gene regulation, biochemical processes, or natural selection are not expected.	*Plant, Seeds on the Move* **DR:** *Database: Flower and Seed Collections, Nonflowering Plants, Pollinator Collection, Pollinators Game*
8. MS-LS1-7. Use informational text to describe that food molecules, including carbohydrates, proteins, and fats, are broken down and rearranged through chemical reactions forming new molecules that support cell growth and/or release of energy. State Assessment Boundary: • Specific details of the chemical reaction for cellular respiration, biochemical steps of breaking down food, or the resulting molecules are not expected.	**FOSS Next Generation Human Systems Interactions** **TE:** Investigation 2, Parts 1 - 2 **SE:** *Aerobic Cellular Respiration* **DR:** *Digestive and Excretory Systems, Circulatory and Respiratory Systems,*
LS2. Ecosystems: Interactions, Energy, and Dynamics	
7. MS-LS2-1. Analyze and interpret data to provide evidence for the effects of periods of abundant and scarce resources on the growth of organisms and the size of populations in an ecosystem.	**FOSS Next Generation Populations and Ecosystems** **TE:** Investigation 6; Parts 1–4 Investigation 7; Parts 1–3 Investigation 8; Parts 1-3 **SE:** *Rachel Carson and the Silent Spring, Trophic Levels, Decomposers, Milkweed Bugs, Limiting Factors, Mono Lake throughout the Year, Biodiversity, Invasive Species, Mono Lake in the Spotlight* **DR:** *Milkweed Bugs Unlimited/Limited, Hawaii: Strangers in Paradise, The Mono Lake Story*
7. MS-LS2-2. Describe how relationships among and between organisms in an ecosystem can be competitive, predatory, parasitic, and mutually beneficial and that these interactions are found across multiple ecosystems. Clarification Statement: • Emphasis is on describing consistent patterns of interactions in different ecosystems in terms of relationships among and between organisms	**FOSS Next Generation Populations and Ecosystems** **TE:** Investigation 3; Parts 1–3 Investigation 4; Part 3 Investigation 6; Parts 1–4 Investigation 7; Part 4 Investigation 8; Parts 1-3 **SE:** *An Introduction to Mono Lake, Mono Lake Food Web, Ecoscenarios, Biosphere 2: An Experiment in Isolation, Trophic Levels, Decomposers, Mono Lake throughout the Year, Biodiversity, Invasive Species, Mono Lake in the Spotlight* **DR:** *The Mono Lake Story, Organism Database*
7. MS-LS2-3. Develop a model to describe that matter and energy are transferred among living and nonliving parts of an ecosystem and that both matter and energy are conserved through these processes. Clarification Statements: • Cycling of matter should include the role of photosynthesis, cellular respiration, and	**FOSS Next Generation Populations and Ecosystems** **TE:** Investigation 3; Parts 1–3 Investigation 5; Parts 1–4 Investigation 6; Parts 1-4 **SE:** *An Introduction to Mono Lake, Ecoscenarios, Energy and Life, What Does Water Do? Wangari Maathai: Being a Hummingbird, Trophic Levels, Decomposers* **DR:** *Mono Lake Food Web, Biomes*

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decomposition, as well as transfer among producers, consumers (primary, secondary, and tertiary), and decomposers. Models may include food webs and food chains.	
7. MS-LS2-4. Analyze data to provide evidence that disruptions (natural or human-made) to any physical or biological component of an ecosystem can lead to shifts in all its populations. Clarification Statement: • Focus should be on ecosystem characteristics varying over time, including disruptions such as hurricanes, floods, wildfires, oil spills, and construction.	**FOSS Next Generation Populations and Ecosystems** **TE:** Investigation 7; Parts 2–3 Investigation 8; Parts 1–3 Investigation 9; Parts 1-3 **SE:** *Limiting Factors, Mono Lake throughout the Year, Biodiversity, Invasive Species, Mono Lake in the Spotlight, Ecoscenario Introductions,* **DR:** *Hawaii: Strangers in Paradise, The Mono Lake Story, Ecoscenario Research Center*
7. MS-LS2-5. Evaluate competing design solutions for protecting an ecosystem. Discuss benefits and limitations of each design. Clarification Statements: • Examples of design solutions could include water, land, and species protection and the prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.	**FOSS Next Generation Populations and Ecosystems** **TE:** Investigation 8, Parts 1 – 3 Investigation 9, Parts 1 - 3 **SE:** *Biodiversity, Invasive Species, Mono Lake in the Spotlight, Ecoscenario Introductions* **DR:** *Hawaii: Strangers in Paradise, The Mono Lake Story, Ecoscenario Research Center*
7. MS-LS2-6(MA). Explain how changes to the biodiversity of an ecosystem—the variety of species found in the ecosystem—may limit the availability of resources humans use. Clarification Statement: • Examples of resources can include food, energy, medicine, and clean water.	**FOSS Next Generation Populations and Ecosystems** **TE:** Investigation 8; Parts 1 **SE:** *Biodiversity*
LS3. Heredity: Inheritance and Variation of Traits	
8. MS-LS3-1. Develop and use a model to describe that structural changes to genes (mutations) may or may not result in changes to proteins, and if there are changes to proteins there may be harmful, beneficial, or neutral changes to traits. Clarification Statements: • An example of a beneficial change to the organism may be a strain of bacteria becoming resistant to an antibiotic. A harmful change could be the development of cancer; a neutral change may the hair color of an organism with direct consequence. State Assessment Boundary: • Specific changes at the molecular level (e.g., amino acid sequence change), mechanisms for protein synthesis, or specific types of mutations are not expected.	**FOSS Next Generation Heredity and Adaptation** **TE:** Investigation 3; Part 1 **SE:** *Adaptation* **DR:** *Walking Sticks: Eat Insects*
8. MS-LS3-2. Construct an argument based on evidence for how asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. Compare and contrast advantages and disadvantages of asexual and sexual reproduction. Clarification Statements: • Examples of an advantage of sexual reproduction can include genetic variation when the environment	**FOSS Next Generation Heredity and Adaptation** **TE:** Investigation 2; Parts 2 - 4 **SE:** *Understanding Heredity, A Larkey Yammer, Mendel and Punnett Squares, Mapping the Human Genome* **DR:** *Heredity, A Model for Predicting Genetic Variation, Larkey Impossible Traits* **FOSS Next Generation Diversity of Life** **TE:** Investigation 7; Parts 1 - 2 **SE:** *Mendel and Punnett Squares*

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changes or a disease is introduced, which examples of an advantage of asexual reproduction can include not using energy to find a mate and fast reproduction rates. Examples of a disadvantage of sexual reproduction can include using resources to find a mate, while a disadvantage in asexual reproduction can be the lack of genetic variation when the environment changes or a disease is introduced.	**DR:** *Genes and Heredity*
8. MS-LS3-3(MA). Communicate through writing and in diagrams that chromosomes contain many distinct genes and that each gene holds the instructions for the production of specific proteins, which in turn affects the traits of an individual. State Assessment Boundary: • Specific changes at the molecular level or mechanisms for protein synthesis are not expected.	**FOSS Next Generation Heredity and Adaptation** **TE:** Investigation 2; Part 2 **SE:** *Understanding Heredity, A Larkey Yammer* **DR:** *Heredity Slide Show*
8. MS-LS3-4(MA). Develop and use a model to show that sexually reproducing organisms have two of each chromosome in their cell nuclei, and hence two variants (alleles) of each gene that can be the same or different from each other, with one random assortment of each chromosome passed down to offspring from both parents. Clarification Statement: • Examples of models can include Punnett squares, diagrams (e.g., simple pedigrees), and simulations. State Assessment Boundary: • State assessment will limit inheritance patterns to dominant-recessive alleles only.	**FOSS Next Generation Heredity and Adaptation** **TE:** Investigation 2; Parts 2-4 **SE:** *Understanding Heredity, A Larkey Yammer, Mendel and Punnett Squares, Mapping the Human Genome* **DR:** *Heredity Slide Show, A Model for Predicting Genetic Variation, Larkey Impossible Traits, Larkey Punnett Squares* **FOSS Next Generation Diversity of Life** **TE:** Investigation 7; Parts 1 - 2 **SE:** *Mendel and Punnett Squares* **DR:** *Genes and Heredity*
LS4. Biological Evolution: Unity and Diversity	
6.MS-LS4-1. Analyze and interpret evidence from the fossil record to describe organisms and their environment, extinctions, and changes to life forms throughout the history of Earth. Clarification Statement: • Examples of evidence include sets of fossils that indicate a specific type of environment, anatomical structures that indicate the function of an organism in the environment, and fossilized tracks that indicate behavior of organisms. State Assessment Boundary: • Names of individual species, geological eras in the fossil record, or mechanisms for extinction or speciation are not expected.	**FOSS Next Generation Heredity and Adaptation** **TE:** Investigation 1; Parts 1–2 **SE:** *Fossil Dating, Mass Extinctions, An Interview with Jennifer Clack, Transitions,* **DR:** *Biodiversity, Fossils, Fish with Fingers, Great Transitions: The Origin of Tetrapods,*
6.MS-LS4-2: Construct an argument using anatomical structures to support evolutionary relationships among and between fossil organisms and modern organisms. Clarification Statement: • Evolutionary relationships include (a) some organisms have similar traits with similar functions because they were inherited from a common ancestor, (b) some organisms have similar traits that serve similar functions because they live in similar environments, and (c) some organism have traits inherited from common ancestors that no longer serve their original	**FOSS Next Generation Heredity and Adaptation** **TE:** Investigation 1; Parts 1–2 **SE:** *Fossil Dating, Mass Extinctions, An Interview with Jennifer Clack, Transitions,* **DR:** *Biodiversity, Fossils, Fish with Fingers, Great Transitions: The Origin of Tetrapods,*

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function because their environments are different than their ancestors' environments.	
8. MS-LS4-4. Use a model to describe the process of natural selection, in which genetic variations of some traits in a population increase some individuals' likelihood of surviving and reproducing in a changing environment. Provide evidence that natural selection occurs over many generations. Clarification Statements: • The model should include simple probability statements and proportional reasoning Examples of evidence can include Darwin's finches, necks of giraffes, and peppered moths. State Assessment Boundary: • Specific conditions that lead to natural selection are not expected.	**FOSS Next Generation Heredity and Adaptation** **TE:** Investigation 3; Parts 1 - 2 **SE:** *Adaptation, Natural Selection, What Makes a Scientific Theory* **DR:** *Walking Sticks: Eat Insects, Walking Sticks: Find* **I***nsects in Three Environments, Larkey Natural Selection, The Making of the Fittest: Natural Selection and Adaptation, The Origin of Species: The Beak of the Finch, Biodiversity Slide Show*
8. MS-LS4-5. Synthesize and communicate information about artificial selection, or the ways in which humans have changed the inheritance of desired traits in organisms. Clarification Statement: • Emphasis is on the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, and gene therapy).	**FOSS Next Generation Heredity and Adaptation** **TE:** Investigation 3; Part 3 **SE:** *Influencing Evolution* **DR:** *Genetic Technology Resources*

Physical Science

State Standard	FOSS Program
PS1. Matter and Its Interactions	
8.MS-PS1-1. Develop a model to describe that (a) atoms combine in a multitude of ways to produce pure substances which make up all of the living and nonliving things that we encounter, (b) atoms form molecules and compounds that range in size from two to thousands of atoms, and (c) mixtures are composed of different proportions of pure substances. Clarification Statement: • Examples of molecular-level models could include drawings, three-dimensional ball and stick structures, and computer representations showing different molecules with different types of atoms. State Assessment Boundary: • Valence electrons and bonding energy, the ionic nature of subunits of complex structures, complete depictions of all individual atoms in complex molecule or extended structure, or calculations of proportions in mixtures are not expected.	**FOSS Next Generation Chemical Interactions** **TE:** Investigation 2; Parts 1 – 2 Investigation 7; Parts 1 – 2 Investigation 9; Part 1 **SE:** *Elements, Substances on Earth, Elements in the Universe, How Things Dissolve, Concentration, Better Living through Chemistry* **DR:** *Periodic Table of the Elements, Explore Dissolving*
8.MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. Clarification Statements: • Examples of reactions could include burning sugar or steel wood, fat reacting with sodium hydroxide, and mixing zinc with HCl. Properties of substances	**FOSS Next Generation Chemical Interactions** **TE:** Investigation 1, Parts 1 – 2 Investigation 9, Parts 1 – 3 Investigation 10, Part 1 **SE:** *White Substances Information, Better Living through Chemistry, How Do Atoms Rearrange? Fireworks, Antoine-Laurent Lavoisier, Organic Compounds* **DR:** *Two-Substance Reactions, Burning Sugar*

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include density, melting point, boiling point, solubility, flammability, and odor.	
8.MS-PS1-4. Develop a model that describes and predicts changes in particle motion, relative spatial arrangement, temperature, and state of a pure substance when thermal energy is added or removed. Clarification Statements: • Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of pure substances could include water, carbon dioxide, and helium.	**FOSS Next Generation Chemical Interactions** **TE:** Investigation 3; Parts 1 – 3 Investigation 4; Parts 1 – 3 Investigation 7; Parts 1 – 2 Investigation 8; Parts 1 - 4 **SE:** *Particles, Three Phases of Matter, Particles in Motion, Expansion and Contraction, How Things Dissolve, Concentration, Rock Solid, Heat of Fusion,* **DR:** *Gas in a Syringe, Particles in Gases, Particles in Solids, Liquids, and Gases, Explore Dissolving* **FOSS Next Generation Weather and Water** **TE:** Investigation 3; Parts 1 – 3 Investigation 6; Parts 1 – 3 Investigation 7; Parts 2 - 3 **SE:** *Density, Density with Dey, Convection, Heating the Atmosphere, Wind on Earth, Weather Balloons and the Radiosonde, Animal Rains* **DR:** *Particles in Solids, Liquids, and Gases, Fluid Convection, Energy Transfer: Conduction, Radiation, Convection, Local Wind, NOAA Ridge, Cloud in a Bottle*
8.MS-PS1-5. Use a model to explain that atoms are rearranged during a chemical reaction to form new substances with new properties. Explain that the atoms present in the reactants are all present in the products and thus the total number of atoms is conserved. Clarification Statement: • Examples of model can include physical models or drawings, including digital forms, that represent atoms. State Assessment Boundary: • Use of atomic masses, molecular weights, balancing symbolic equations, or intermolecular forces is not expected.	**FOSS Next Generation Chemical Interactions** **TE:** Investigation 9; Parts 1 – 3 Investigation 10; Part 1 **SE:** *Better Living through Chemistry, How Do Atoms Rearrange? Fireworks, Antoine-Laurent Lavoisier, Organic Compounds* **DR:** *Burning Sugar*
6.MS-PS1-6. Plan and conduct an experiment involving exothermic and endothermic chemical reactions to measure and describe the release or absorption of thermal energy. Clarification Statements: • Emphasis is on describing transfer of energy to and from the environment. Examples of chemical reactions could include dissolving ammonium chloride or calcium chloride.	**FOSS Next Generation Chemical Interactions** **TE:** Investigation 8; Part 3 **SE:** *Heat of Fusion, Science Practices, Engineering Practices*
6.MS-PS1-7(MA). Use a particulate model of matter to explain that density is the amount of matter (mass) in a given volume. Apply proportional reasoning describe, calculate, and compare relative densities of different materials.	**FOSS Next Generation Chemical Interactions** **TE:** Investigation 4; Parts 1-3 **SE:** *Particles in Motion, Three Phases of Matter, Expansion and Contraction* **DR:** *Particles in Solids, Liquids, and Gases*
6.MS-PS1-8(MA). Conduct an experiment to show that many materials are mixtures of pure substances that can be separated by physical means into their component pure substances. Clarification Statement:	**FOSS Next Generation Chemical Interactions** **TE:** Investigation 7; Part 2 **SE:** *How Things Dissolve, Concentration* **DR:** *Explore Dissolving*

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• Examples of common mixtures include salt, water, oil and vinegar, milk, and air.	
PS2. Motion and Stability: Forces and Interactions	
8.MS-PS2-1. Develop a model that demonstrates Newton's third law involving the motion of two colliding objects State Assessment Boundary: • Limited to vertical or horizontal interactions in one dimension.	**FOSS Next Generation Gravity and Kinetic Energy** **TE:** Investigation 3; Part 3 **SE:** *Newton's Laws*
8.MS-PS2-2. Provide evidence that the change in an object's speed depends on the sum of the forces on the object (the net force) and the mass of the object. Clarification Statement: • Emphasis is on balanced (Newton's first law) and unbalanced forces in a system, qualitative comparisons of forces, mas, and changes in speed (Newton's second law), in one dimension. State Assessment Boundaries: • Limited to forces and changes in motion in one dimension in an inertial reference frame and to change in one variable at a time. The use of trigonometry is not expected.	**FOSS Next Generation Gravity and Kinetic Energy** **TE:** Investigation 1; Parts 1 – 3 Investigation 2; Parts 1 – 2 Investigation 3 **SE:** *How Fast Do Things Go? Faster and Faster, Gravity: It's the Law, A Weighty Matter, Gravity in Space* **DR:** *Movie Tracker, Falling Ball Analysis Slide Show, Falling Ball, Hammer and Feather in Space, Heavy and Light Balls* **FOSS Next Generation Electromagnetic Force** **TE:** Investigation 1, Parts 1 - 3 **SE:** **T***he Force is with You, The Discovery of Friction, Net Force* **DR:** *Forces*
7.MS-PS2-3. Analyze data to describe the effect of distance and magnitude of electric charge on the strength of electric forces. Clarification Statement: • Includes both attractive and repulsive forces. State Assessment Boundaries: • State assessment will be limited to proportional reasoning. Calculations using Coulomb's law or interactions of sub-atomic particles are not expected.	**FOSS Next Generation Electromagnetic Force** **TE:** Investigation 2, Parts 1 - 3 Investigation 3, Parts 2 - 3 **SE:** *Magnetic Force, Electromagnetism,* **DR:** *Magnetism, Adding Magnetic Force, Virtual Electromagnet*
6.MS-PS2-4. Use evidence to support the claim that gravitational forces between objects are attractive and are only noticeable when one or both of the objects have a very large mass. Clarification Statement. • Examples of objects with very large masses include the Sun, Earth, and other planets. State Assessment Boundary: • Newton's law of gravitation or Kepler's laws are not expected.	**FOSS Next Generation Planetary Science** **TE:** Investigation 6; Part 2, Steps 14-18 **SE:** *How Earth Got and Held onto Its Moon* **DR:** *Solar System Origin Card Sort, Origin of the Moon, Tides* **FOSS Next Generation Gravity and Kinetic Energy** **TE:** Investigation 1; Part 3 Investigation 2, Part 2 **SE:** *Gravity: It's the Law, Gravity in Space* **DR:** *Falling Ball Analysis*
7.MS-PS2-5. Use scientific evidence to argue that fields exist between objects with mass, between magnetic objects, and between electrically charged objects that exert force on each other even though the objects are not in contact. Clarification Statement: • Emphasis is on evidence that demonstrates the existence of fields, limited to gravitational, electric, and magnetic fields. State Assessment Boundary:	**FOSS Next Generation Electromagnetic Force** **TE:** Investigation 2; Parts 1 - 3 Investigation 3; Parts 2 - 3 **SE:** *Magnetic Force, Electromagnetism* **DR:** *Magnetism, Adding Magnetic Force, Virtual Electromagnet* **FOSS Next Generation Gravity and Kinetic Energy** **TE:** Investigation 2, Part 2 **SE:** *Gravity in Space*

• Calculations of force are not expected.	
PS3. Energy	
7.MS-PS3-1. Construct and interpret data and graphs to describe the relationships among kinetic energy, mass, and speed of an object. Clarification Statements: • Examples could include riding a bicycle at different speeds and rolling different-sized rocks downhill. Consider relationships between kinetic energy vs. mass and kinetic energy vs. speed separate from each other; emphasis is on the difference between the linear and exponential relationships. State Assessment Boundary: • Calculation or manipulation of the formula for kinetic energy is not expected.	**FOSS Next Generation Gravity and Kinetic Energy** **TE:** Investigation 3; Parts 1 - 3 **SE:** *Potential and Kinetic Energy, Avoiding Collisions, Newton's Laws*
7.MS-PS3-2. Develop a model to describe the relationship between the relative positions of objects interacting at a distance and their relative potential energy in the system. Clarification Statements: • Examples of objects within systems interacting at varying distances could include Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a stream of water. Examples of models could include representations, diagrams, pictures, and written descriptions of systems. State Assessment Boundaries: • State assessment will be limited to electric, magnetic, and gravitational interactions and to interactions of two objects at a time. Calculations of potential energy are not expected.	**FOSS Next Generation Electromagnetic Force** **TE:** Investigation 2; Part 3 **DR:** *Adding Magnet Fields* **FOSS Next Generation Gravity and Kinetic Energy** **TE:** Investigation 3; Parts 1 - 3 **SE:** *Potential and Kinetic Energy, Avoiding Collisions, Newton's Laws*
7.MS-PS3-3. Apply scientific principles of energy and heat transfer to design, construct, and test a device to minimize or maximize thermal energy transfer Clarification Statement: • Examples of devices could include an insulated box, a solar cooker, and a vacuum flask. State Assessment Boundary: • Accounting for specific hear or calculations of the total amount of thermal energy transferred is not expected.	**FOSS Next Generation Weather and Water** **TE:** Investigation 5; Parts 1 - 3 **SE:** *Insulating Materials, Home Insulation* **DR:** *Energy Transfer by Collision, Energy Transfer: Conduction, Radiation, Convection, Particles in Solids, Liquids, and Gases* **FOSS Next Generation Chemical Interactions** **TE:** Investigation 6; Parts 1 - 2 **SE:** *Engineering a Better Design, Science Practices, Engineering Practices* **DR:** *Energy Flow, Particles in Solids, Liquids, and Gases*
7.MS-PS3-4. Conduct an investigation to determine the relationships among the energy transferred, how well the type of matter retains or radiates heat, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. State Assessment Boundary: • Calculations of specific heat or the total amount of thermal energy transferred are not expected.	**FOSS Next Generation Weather and Water** **TE:** Investigation 3; Parts 1 – 3 Investigation 4; Part 3 Investigation 5; Parts 1 - 3 **SE:** *Density, Density with Dey, Convection, Thermometer: A Device to Measure Temperature, Home Insulation* **DR:** *Particles in Solids, Liquids, and Gases, Fluid Convection, Energy Transfer: Conduction, Radiation, and*

	Convection, Convection Chamber in Action **FOSS Next Generation Chemical Interactions** **TE:** Investigation 5; Parts 1 - 3 **SE:** *Energy on the Move* **DR:** *Energy Transfer by Collision, Mixing Hoot and Cold Water, Thermometer, Energy Flow*
7.MS-PS3-5. Present evidence to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. Clarification Statement: • Examples of empirical evidence could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of an object. State Assessment Boundary: • Calculations of energy are not expected.	**FOSS Next Generation Weather and Water** **TE:** Investigation 4; Part 3 **SE:** *Thermometer: A Device to Measure Temperature* **DR:** *Energy Transfer: Conduction, Radiation, Convection* **FOSS Next Generation Chemical Interactions** **TE: I**nvestigation 4; Parts 1 – 3 Investigation 5; Parts 1 - 3 **SE:** *Particles in Motion, Three Phases of Matter, Expansion and Contraction, Energy on the Move* **DR:** *Particles in Solids, Liquids, and Gases, Energy Transfer by Collision, Mixing Hot and Cold Water, Thermometer, Energy Flow* **FOSS Next Generation Gravity and Kinetic Energy** **TE:** Investigation 3; Parts 1 - 3 **SE:** *Potential and Kinetic Energy, Avoiding Collisions, Newton's Laws*
7.MS-PS3-6(MA). Use a model to explain how thermal energy is transferred out of hotter regions or objects and into colder ones by convection, conduction, and radiation	**FOSS Next Generation Weather and Water** **TE:** Investigation 3; Parts 1 – 3 **I**nvestigation 4; Part 3 **SE:** *Density, Convection, Thermometer: A Device to Measure Temperature* **DR:** *Particles in Solids, Liquids, and Gases, Energy Transfer: Conduction, Radiation, Convection*
7.MS-PS3-7(MA). Use informational text to describe the relationship between kinetic and potential energy and illustrate conversions from one form to another. Clarification Statement: • Types of kinetic energy include motion, sound, thermal, and light; types of potential energy include gravitational, elastic, and chemical.	**FOSS Next Generation Gravity and Kinetic Energy** **TE:** Investigation 3; Parts 1 **SE:** *Potential and Kinetic Energy*
PS4. Waves and Their Applications in Technologies for Information Transfer	
6.MS-PS4-1. Use diagrams of a simple wave to explain that (a) a wave has a repeating pattern with a specific amplitude, frequency, and wavelength, and (b) the amplitude of a wave is related to the energy of the wave. State Assessment Boundary: • Electromagnetic waves are not expected. State assessment will be limited to standard repeating waves.	**FOSS Next Generation Waves** **TE:** Investigation 1; Part 2 Investigation 2; Parts 1 and 3 **SE:** *Transverse and Compression Waves, Ocean Waves, Tsunamis!, Sound Waves, Acoustic Engineering,* **DR:** *Metronome, Big Waves, Oscilloscope,*
6.MS-PS4-2. Use diagrams and other models to show that both light rays and mechanical waves are reflected, absorbed, or transmitted through various materials. Clarification Statements. • Materials may include solids, liquids, and gases. Mechanical waves, (including sound) need a material (medium) through which they are transmitted.	**FOSS Next Generation Waves** **TE:** Investigation 2; Part 3 Investigation 3; Parts 1 and 4 **SE:** *Sound Waves, Acoustic Engineering, Reflecting on Light, Seismic Waves* **DR:** *Oscilloscope, Refraction*

TE: Teacher Editions-Investigations Guide, Teacher Resources • **SE:** Student Edition-Science Resources Book • **DR:** Digital Resources

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Examples of models could include drawings, simulations, and written descriptions. State Assessment Boundary: • State assessment will be limited to qualitative applications.	
6.MS-PS4-3. Present qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses representing 0s and 1s) can be used to encode and transmit information. State Assessment Boundary: • Binary counting or the specific mechanism of any given device are not expected.	**FOSS Next Generation Waves** **TE:** Investigation 4; Parts 1-3 **SE:** *Lasers, Amplitude and Frequency Modulation, Digital Communication, Telecommunication: From Telegraph to Smartphone* **DR:** *Fiber Optics, Digitized Images*

Technology/Engineering

State Standard	FOSS Program
ETS.1. Engineering Design	
6.MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution. Include potential impacts on people and natural environment that may limit possible solutions.	**FOSS Next Generation Waves** **TE:** Investigation 2; Part 3 **SE:** *Sound Waves, Acoustic Engineering* **DR:** *Oscilloscope* **FOSS Next Generation Variables and Design** **TE:** Investigation 1; Part 3 Investigation 2; Parts 1 -2 Investigation 3; Parts 1 - 2 **SE:** *Keep Your Variables Under Control, Spotlighting Engineers, Efficiency, The Problem of Traffic, Digital Manufacturing, Robotics* **DR:** *Virtual Aquarium, Engineering Design Cycle, EnableTech, Maker Space, Jumping Robot, Genetic Engineering, 3D Printing Explained*
7.MS-ETS1-2. Evaluate competing solutions to a given design problem using a decision matrix to determine how well each meets the criteria and constraints of the problem Use a model of each solution to evaluate how variations in one or more design features, including size, shape, weight, or cost, may affect the function or effectiveness of the solution*	**FOSS Next Generation Variables and Design** **TE:** Investigation 1; Part 3 Investigation 2; Parts 1 -2 Investigation 3; Parts 1 - 2 **SE:** *Keep Your Variables Under Control, Spotlighting Engineers, Efficiency, The Problem of Traffic, Digital Manufacturing, Robotics* **DR:** *Virtual Aquarium, Engineering Design Cycle EnableTech, Maker Space, Jumping Robot, Genetic Engineering, 3D Printing Explained* **FOSS Next Generation Waves** **TE:** Investigation 2, Part 3 **SE:** *Sound Waves, Acoustic Engineering* **DR:** *Oscilloscope*
7.MS-ETS1-4. Generate and analyze data from iterative testing and modification of a proposed object, tool, or process to optimize the object, tool, or process for its intended purpose.*	**FOSS Next Generation Variables and Design** **TE:** Investigation 2, Parts 1 – 2 Investigation 3, Parts 1 – 2 **SE:** *Lead Detector, Solar Tents* **DR:** *Bridge Design, Engineering Design Cycle, Enable Tech, Maker Space, Jumping Robot*
6.MS-ETS1-5(MA). Create visual representations of solutions to a design problem. Accurately interpret and apply scale and proportion to visual representations.	**FOSS Next Generation Waves** **TE:** Investigation 2, Part 3 **SE:** *Sound Waves, Acoustic Engineering*

Grades 6-8

Clarification Statements: Examples of visual representation can include sketches, scaled drawings, and orthographic projections. Examples of scale can include ¼” = 1’0” and 1 cm = 1 m.	**DR:** *Oscilloscope, Soundproof Engineering* **FOSS Next Generation Variables and Design** **TE:** Investigation 2, Parts 1 – 2 Investigation 3, Parts 1 – 2 **SE:** *Lead Detector, Solar Tents* **DR:** *Bridge Design, Engineering Design Cycle, Enable*
6.MS-ETS1-6(MA). Communicate a design solution to an intended user, including design features and limitations of the solution. Clarification Statement: Examples of intended users can include students, parents, teachers, manufacturing personnel, engineers, and customers.	**FOSS Next Generation Waves** **TE:** Investigation 2, Part 3 **SE:** *Sound Waves, Acoustic Engineering* **DR:** *Oscilloscope, Soundproof Engineering* **FOSS Next Generation Variables and Design** **TE:** Investigation 2, Parts 1 – 2 Investigation 3, Parts 1 – 2 **SE:** *Lead Detector, Solar Tents* **DR:** *Bridge Design, Engineering Design Cycle, Enable Tech, Maker Space, Jumping Robot*
7.MS-ETS1-7(MA). Construct a prototype of a solution to a given design problem.*	**FOSS Next Generation Variables and Design** **TE:** Investigation 2; Parts 1 – 2 Investigation 3; Parts 1 – 2 **SE:** *Lead Detector, Solar Tents* **DR:** *Bridge Design, Engineering Design Cycle, Enable Tech, Maker Space, Jumping Robot*
ETS2. Tools and Manufacturing	
6MS-ETS2-1(MA). Analyze and compare properties of metals, plastics, wood, and ceramics, including flexibility, ductility, hardness, thermal conductivity, electrical conductivity, and melting point.	**FOSS Next Generation Chemical Interactions** **TE: I**nvestigation 9 **SE:** *Better Living through Chemistry*
6MS-ETS2-2(MA). Given a design task, select appropriate materials based on specific properties need in the construction of a solution. Clarification Statement: • Examples of materials can include metals, plastics, wood, and ceramics.	**FOSS Next Generation Chemical Interactions** **TE: I**nvestigation 6; Parts 1-2 **SE:** *Engineering a Better Design,* **DR:** *Particles in Solids, Liquids, and Gases* **FOSS Next Generation Waves** **TE:** Investigation 2, Part 3 **SE:** *Sound Waves, Acoustic Engineering* **DR:** *Oscilloscope, Soundproof Engineering*
6MS-ETS2-3(MA). Choose and safely use appropriate measuring tools, hand tools, fasteners, and common hand-held power tools used to construct a prototype.* Clarification Statements: • Examples of measuring tools include a tape measure, a meter stick, and a ruler. Hand tools include a hammer, a screwdriver, a wrench, and pliers. Fasteners include nails, screws, nuts and bolts, staples, flue, and tape. Common power tools include jigsaw, drill, and sander.	**FOSS Next Generation Variables and Design** **TE:** Investigation 1; Part 1 Investigation 2; Part 1 Investigation 3; Part 1 **SE:** *Digital Manufacturing* **DR:** *Maker Space, 3D Printing Explained, 3D-Printed Home*
8. MS-ETS2-4(MA). Use informational text to illustrate that materials maintain their composition under various kinds of physical processing: however, some material properties may change if a process changes the particular structure of the material. Clarification Statements: • Examples of physical processing can include cutting, forming, extruding, and sanding. Changes in material	**FOSS Next Generation Chemical Interactions** **TE: I**nvestigation 9; Parts 1, 3 **SE:** *Better Living through Chemistry, Organic Compounds* **FOSS Next Generation Waves** **TE:** Investigation 2, Part 3, Steps 17-18, 22 **SE:** *Acoustic Engineering*

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properties can include a non-magnetic iron materials becoming magnetic after hammering and a plastic material becoming ridged after heat treatment.	
8. MS-ETS2-5(MA). Present information that illustrates how a product can be created using basic processes in manufacturing systems, including forming, separating, conditioning, assembling, finishing, quality control, and safety. Compare the advantages and disadvantages of human vs. computer control of these processes.	**FOSS Next Generation Variables and Design** **TE:** Investigation 3: Part 2 **SE:** *Digital Manufacturing*
ETS3. Technological Systems	
7MS-ETS3-1(MA). Explain the function of a communication system and the role of its components, including a source, encoder, transmitter, receiver, decoder, and storage.	**FOSS Next Generation Waves** **TE:** Investigation 4, Part 3 **SE:** *Lasers, Digital Communication, Telecommunications: From Telegraph to Smartphone* **DR:** *Digitized Images*
7MS-ETS3-1(MA). Compare the benefits and drawbacks of different communications systems. Clarification Statements: • Examples of communications systems can include radio, television, print, and Internet. Benefits and drawbacks can include speed of communication, distance or range, number of people reached audio only vs. audio and visual, and one-way vs. two-way communication.	**FOSS Next Generation Waves** **TE:** Investigation 4, Parts 1- 3 **SE:** *Lasers, Digital Communication, Telecommunications: From Telegraph to Smartphone* **DR:** *Fiber Optics, Digitized Images*
7MS-ETS3-3(MA). Research and communicate information about how transportation systems are designed to move people and goods using a variety of vehicles and devices. Identify and describe subsystems of a transportation vehicle, include structural, propulsion, guidance, suspension, and control subsystems. Clarification Statements: • Examples of design elements include vehicle shape to maximize cargo or passenger capacity, terminals, travel lanes, and communications/controls. Vehicles can include a car, sailboat, and small airplane.	**FOSS Next Generation Waves** **TE:** Investigation 4, Parts 1- 3 **SE:** *Lasers, Digital Communication, Telecommunications: From Telegraph to Smartphone* **DR:** *Fiber Optics, Digitized Images*
7MS-ETS3-4(MA). Show how the components of a structural system work together to serve a structural function. Provide examples of physical structures and relate their design to intended use. Clarification Statements: • Components of a structural system could include foundation, decking, wall, and roofing. Explanations of function should include identification of live vs. dead loads and forces of tension, torsion, compression, and shear. Uses include carrying loads and forces across a span (such as a bridge) providing livable space (such as a house or office building), and providing specific environmental conditions (such as greenhouse or cold storage). State Assessment Boundary: Calculation of magnitude or direction of load or forces are not expected.	**FOSS Next Generation Weather and Water** **TE:** Investigation 5; Part 3 **SE:** *Home Insulation, Science Practices, Engineering Practices, Engineering Design Process*

Grades 6-8

7MS-ETS3-5(MA). Use the concept of systems engineering to model inputs, processes, output, and feedback among components of a transportation, structural, or communication system.	**FOSS Next Generation Variables and Design** **TE:** Investigation 3: Part 1 **SE:** *The Problem of Traffic*