Maine Learning Results: Science and Engineering 6-8 (2019)

Vertical Alignment

I = Introductor *D = Developing* *P = Proficient* *F = Fluent*

*** denotes an essential standard/indicator**

Earth and Space Sciences

MS-ESS1 Earth's Place in the Universe

	6th Sci	7th Sci	8th Sci
MS-ESS1-1 Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. Further explanation: Examples of models can be physical, graphical, or conceptual. Examples could incorporate latitude and season connections, why Lubec is the first town in the continental U.S. to see the sunrise, and tides (king, neap, spring). Developing and using models; the universe and its stars; earth and the solar system; patterns		***P**	
MS-ESS1-2 Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. Further explanation: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state). Developing and using models; the universe and its stars; earth and the solar system; systems and system models		D	
MS-ESS1-3 Analyze and interpret data to determine scale properties of objects in the solar system. Further explanation: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models. Analyzing and interpreting data; earth and the solar system; scale, proportion, and quantity		P	
MS-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. Further explanation: Emphasis is on how analysis of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions. Constructing explanations and designing solutions; the history of planet earth; scale, proportion, and quantity	D		

MS-ESS2 Earth's Systems

	6th Sci	7th Sci	8th Sci
MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. Further explanation: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials. Potential Maine connections include Deer Isle granite, Rockland limestone, Maine tourmaline, Acadia National Park pink granite, along with Maine mining history at Bald Mountain or Katahdin Iron Works. Developing and using models, earth's materials and systems, stability and change	D		
MS-ESS2-2 Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. Further explanation: Emphasis is on how			

processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate. Potential Maine connections include the Desert of Maine, glacial erratics, alluvial fans, Appalachian Trail and Baxter State Park, and the fjord on Mount Desert Island. Constructing explanations and designing solutions, earth's materials and systems, the roles of water in earth's surface processes, scale proportion and quantity	D		
MS-ESS2-3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. Further explanation: Examples of data include similarities of 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). Potential Maine connections can be found in the Gulf of Maine, Georges Bank and the inner continental shelf. Analyzing and interpreting data, the history of planet earth, plate tectonics and large-scale system interactions, patterns	6th Sci *P	7th Sci	8th Sci
MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. Further explanation: Emphasis is on the ways in which water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical. Developing and using models, the roles of water in earth's surface processes, energy and matter	6th Sci P	7th Sci	8th Sci
MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions. Further explanation: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation). Potential Maine connections include "Bombogenesis" snow storms, coastal fog, Nor'easters, sea smoke and valley fog. Planning and carrying out investigations, the roles of water in earth's surface processes, weather and climate, cause and effect	6th Sci D	7th Sci	8th Sci
MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. Further explanation: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations. Developing and using models, the roles of water in earth's surface processes, weather and climate, systems and system models	6th Sci D	7th Sci (D)	8th Sci
MS-ESS3 Earth and Human Activity			
MS-ESS3-1 Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. Further explanation: Emphasis is on how these resources are limited and typically non-renewable and on how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock). Constructing explanations and designing solutions, natural resources, cause and effect	6th Sci D	7th Sci	8th Sci

	6th Sci	7th Sci	8th Sci
MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. Further explanation: Emphasis is on how some natural hazards, such as volcanic eruptions, and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts). Analyzing and interpreting data, natural hazards, patterns	D		
MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. Further explanation: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land). Constructing explanations and designing solutions, human impacts on earth systems, cause and effect		(I)	
MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. Further explanation: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes. Engaging in argument from evidence, human impacts on earth systems, cause and effect		(I)	
MS-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. Further explanation: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures. Asking questions and defining problems, global climate change, stability and change		(I)	
Life Sciences			
MS-LS1 From Molecules to Organisms: Structures and Processes			
MS-LS1-1 Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. Further explanation: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells. Planning and carrying out investigations; structure and function; scale, proportion, and quantity		P	
MS-LS1-2 Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function. Further explanation: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall. Developing and using models; structure and function; structure and function		***P**	

	6th Sci	7th Sci	8th Sci
MS-LS1-3 Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. Further explanation: Emphasis is on conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples would include the interaction of subsystems within a system and the normal functioning of those systems. Engaging in argument from evidence; structure and function; system and system models		D	
MS-LS1-4 Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively. Further explanation: Examples of 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 vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury. Potential Maine connections could include herding of white-tail deer and caribou, vocalizations of moose and cardinals, and keystone species such as those on the coast (e.g. harbor seals and sea stars). Engaging in argument from evidence; growth and development of organisms; cause and effect		D	
MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. Further explanation: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting the growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than in small ponds. Examples could include winter and cold temperatures, hibernation (e.g. black bear), and the migration of hummingbirds and Canada geese. Constructing explanations and designing solutions; growth and development of organisms; cause and effect		P	
MS-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. Further explanation: Emphasis is on tracing movement of matter and flow of energy. Constructing explanations and designing solutions; organization for matter and energy flow in organisms; energy in chemical processes and everyday life; energy and matter	D	***P**	
MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. Further explanation: Emphasis is on describing that molecules are broken apart and put back together and that in this process energy is released. Developing and using models; organization for matter and energy flow in organisms; energy in chemical processes and everyday life; energy and matter		D	
MS-LS1-8 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. Obtaining, evaluating, and communicating information; information processing; cause and effect		**I**	
MS-LS2 Ecosystems: Interactions, Energy, and Dynamics			
MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. Further explanation: Emphasis is on cause and effect relationships between resources and the growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources. Analyzing and interpreting data; interdependent relationships in ecosystems; cause and effect	***P**		

	6th Sci	7th Sci	8th Sci
MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. Further explanation: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial. Potential Maine connections include predation: coyotes and house cats with smaller prey or white tail deer and wolves; mutualism in the union of algae and fungus to form lichen; parasitism in deer ticks on dogs; and commensalism when barnacles attach to minke whales or a grey squirrel makes a nest in a red oak tree. Constructing explanations and designing solutions; interdependent relationships in ecosystems; patterns	P		
MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Further explanation: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems and on defining the boundaries of the system. Explore the reason behind burning blueberry fields biennially and the cycling of matter. Developing and using models; cycle of matter and energy transfer in ecosystems; energy and matter	D		
MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. Further explanation: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations and on evaluating empirical evidence supporting arguments about changes to ecosystems. Examples include the introduction of invasive species like the green crab or knotweed and their impact on native species. Explore the impacts of farming, urban sprawl and pollution. Engaging in argument from evidence; ecosystem dynamics, functioning, and resilience; stability and change	*P		
MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services. Further explanation: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations. Consider the balance of conservation with the logging of forests or with the lobster and blueberry industries. Engaging in argument from evidence; ecosystem dynamics, functioning, and resilience; biodiversity and humans; developing possible solutions; stability and change;	*P		
MS-LS3 Heredity: Inheritance and Variation of Traits			
MS-LS3-1 Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of an organism. Further explanation: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins. Developing and using models; inheritance of traits; variation of traits; structure and function		D	
MS-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. Further explanation: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and the resulting genetic variation. Connections can be made to Maine agricultural crops, i.e. strawberries, blueberries, and potatoes. Developing and using models; growth and development of organisms; inheritance of traits; variation of traits; cause and effect		D	
MS-LS4 Biological Evolution: Unity and Diversity			
MS-LS4-1 Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. Further explanation: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in rock layers. Analyzing and interpreting data; evidence of common ancestry and diversity; patterns	P		

	6th Sci	7th Sci	8th Sci
MS-LS4-2 Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. Further explanation: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarities or differences of the gross appearance of anatomical structures. Constructing explanations and designing solutions; evidence of common ancestry and diversity; patterns	D		
MS-LS4-3 Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. Further explanation: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures. Analyzing and interpreting data; evidence of common ancestry and diversity; patterns		I	
MS-LS4-4 Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. Further explanation: Emphasis is on using simple probability statements and proportional reasoning to construct explanations. Constructing explanations and designing solutions; natural selection; cause and effect	D	P	
MS-LS4-5 Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. Further explanation: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, and gene therapy) and on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries. Obtaining, evaluating, and communicating information; natural selection; cause and effect		P	
MS-LS4-6 Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. Further explanation: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time. Using mathematics and computational thinking; adaptation; cause and effect		P	
Physical Science			
MS-PS1 Matter and Its Interactions			
MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures. Further explanation: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, three-dimensional ball and stick structures, or computer representations showing different molecules with different types of atoms. Developing and using models; Obtaining, evaluating, and communicating information; structure and properties of matter; scale, proportion, and quantity			***P**
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. Further explanation: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride. Examine electrical conductivity differences between fresh water and sea water. Obtaining, evaluating, and communicating information; Analyzing and interpreting data; structure and properties of matter; chemical reactions; patterns			***P**
MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. Further explanation: Emphasis is on natural resources that undergo a chemical process to form synthetic material. Examples of new materials could include new medicines, foods, and			D

alternative fuels (alternative plastics derived from potatoes and jet fuel made from trees). Other possible areas of study might include plastics from organics, advanced composites and wood products under development at UMO. Obtaining, evaluating, and communicating information; chemical reactions; structure and properties of matter; structure and function			
MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. Further explanation: 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 particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium. Developing and using models; structure and properties of matter; definitions of energy; cause and effect	6th Sci	7th Sci	8th Sci
			D
MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. Further explanation: Emphasis is on the law of conservation of matter and on physical models or drawings, including digital forms that represent atoms. Developing and using models; chemical reactions; energy and matter	6th Sci	7th Sci	8th Sci
			P
MS-PS1-6 Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. Further explanation: Emphasis is on design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride for road treatments in Maine winters. Constructing explanations and designing solutions; chemical reactions; developing possible solutions; optimizing the design solution; structure and function	6th Sci	7th Sci	8th Sci
			D
MS-PS2 Motion and Stability: Forces and Interactions			
MS-PS2-1 Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. Further explanation: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle. Constructing explanations and designing solutions; forces and motion; system and system models;	6th Sci	7th Sci	8th Sci
			P
MS-PS2-2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. Further explanation: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units. Plan and carry out investigations; forces and motion; stability and change;	6th Sci	7th Sci	8th Sci
			D
MS-PS2-3 Ask questions about data to determine the factors that affect the strength of electrical and magnetic forces. Further explanation: Examples of devices that use electrical and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor. Possible explorations include the effects of living near high tension power lines, the similarities found in hydroelectric generators and wind turbines or the growing electric car market in Maine. Asking questions and defining problems; types of interactions; cause and effect;	6th Sci	7th Sci	8th Sci
			D
MS-PS2-4 Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. Further explanation: Examples of evidence for arguments could include data generated from simulations or digital tools and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system. Examples include the gravitational effects of the moon on Maine tides. Engaging in argument from evidence; types of interactions; system and system models;	6th Sci	7th Sci	8th Sci
			P

	6th Sci	7th Sci	8th Sci
MS-PS2-5 Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. Further explanation: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, electrically-charged pith balls, and maglev trains. Examples of investigations could include first-hand experiences or simulations. Plan and carry out investigations; types of interactions; cause and effect;		I	P
MS-PS3 Energy			
MS-PS3-1 Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. Further explanation: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball. Consider different sized skiers or different vehicles from pulp trucks to personal cars. Analyzing and interpreting data; definitions of energy; scale, proportion, and quantity			***P**
MS-PS3-2 Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. Further explanation: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include the 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 classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems. Developing and using models; definitions of energy; relationship between energy and forces; system and system models			P
MS-PS3-3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. Further explanation: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup. Possible explorations could include insulating outerwear and clothing for winter sports or emergency shelters designed for Maine winters. Constructing explanations and designing solutions; definitions of energy; conservation of energy and energy transfer; defining and delimiting an engineering problem; developing possible solutions; energy and matter			D
MS-PS3-4 Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. Further explanation: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added. Planning and carrying out investigations, Definitions of energy; conservation of energy and energy transfer; scale, proportion, and quantity			P
MS-PS3-5 Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. Further explanation: Examples of empirical evidence used in arguments 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. Engaging in argument from evidence; conservation of energy and energy transfer; energy and matter			P
MS-PS4 Waves and Their Applications in Technologies for Information Transfer			
MS-PS4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. Further explanation: Emphasis is on describing waves with both qualitative and quantitative thinking. Possibilities for exploration might include coastal wave			***P**

erosion, effects of the wind turbines/farms on the air flow patterns and harmonics. Using mathematics and computational thinking; Obtaining, evaluating, and communicating information; wave properties; patterns			
<u>MS-PS4-2</u> Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. Further explanation: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions. Possibilities for explorations might include Maine's geographic location for utilizing solar power, power generation from ocean waves, possibility for extended farming seasons with artificial lighting. Developing and using models; wave properties; electromagnetic radiation; structure and function	**6th Sci**	**7th Sci**	**8th Sci**
			D
<u>MS-PS4-3</u> Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. Further explanation: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in Wi-Fi devices, and conversion of stored binary patterns to make sound or text on a computer screen. Obtaining, evaluating, and communicating information; information technologies and instrumentation; structure and function	**6th Sci**	**7th Sci**	**8th Sci**
			D