Unit 7.1: Energy and Energy Transformations

NGSS Connections

Primary Performance Expectations:
• **MS-PS2-3: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.** [Clarification Statement: Examples of devices that use electric 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.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]
• **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.** [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [*Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.*]
• **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.** [Clarification Statement: 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.]
• **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.** [Clarification Statement: 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.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]

- **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.** [Clarification Statement: 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 objects.] [Assessment Boundary: Assessment does not include calculations of energy.]

Semester Unifying Crosscutting Concept:	Energy and Matter

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems ● Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3) **Analyzing and Interpreting Data** ● Construct, analyze, and/or interpret graphical displays of data and/or	**PS2.B: Types of Interactions** ● Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3) ● Forces that act at a distance (~~electric~~, magnetic~~, and gravitational~~) can be explained by fields that extend through space and	**Cause and Effect** ● Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3, MS-PS2-5) **Systems and System Models** ● Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2)

large data sets to identify linear and nonlinear relationships. (MS-PS3-1) **Developing and Using Models** ● Develop a model to describe unobservable mechanisms. (MS-PS3-2) **Engaging in Argument from Evidence** ● Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute ~~an explanation or a model for a phenomenon or~~ a proposed solution to a problem. (MS-PS3-5)	can be mapped by their effect on a test object ~~(a charged object, or a ball, respectively)~~. (MS-PS2-5) **PS3.A: Definitions of Energy** ● Motion energy is properly called kinetic energy; it is proportional to the mass and speed of the moving object ~~and grows with the square of its speed~~. (MS-PS3-1) ● A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) **PS3.B: Conservation of Energy and Energy Transfer** ● When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) **PS3.C: Relationship Between Energy and Forces** ● When two objects interact, each one exerts a force on the other that	**Energy and Matter** ● Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3-5)

	can cause energy to be transferred to or from the object. (MS-PS3-2)	