**Physical Science**

**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

**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

**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

**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

**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