**HS-PS3 Energy**

**HS-PS3-1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.**

Further explanation: Emphasis is on explaining the meaning of mathematical expressions used in the model. Examples could include wind turbines, hydroelectric or tidal power. Further examples could be found in FunTown USA roller coasters or any sport (e.g. why a hockey puck changes motion, a baseball being hit, etc.).

Using Mathematics and Computational Thinking, Definitions of Energy, Conservation of Energy and Energy Transfer, Systems and System Models

**HS-PS3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).**

Further explanation: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.

Developing and Using Models, Definitions of Energy, Energy and Matter

**HS-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.**

Further explanation: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency. Consider the Wind Blade Challenge or use of a solar oven when camping.

Constructing Explanations and Designing Solutions, Definitions of Energy, Defining and Delimiting Engineering Problems, Energy and Matter

**HS-PS3-4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).**

Further explanation: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water. Other examples can be found in heat pumps for radiant heat systems, insulation (to prevent heat transfer) or the use of hot rocks to warm a tent when camping.

Planning and Carrying out an Investigation, Conservation of Energy and Energy Transfer, Energy in Chemical Processes, Systems and System Models

**HS-PS3-5 Develop and use a model of two objects interacting through electrical or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.**

Further explanation: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.

Developing and Using Models, Relationship between Energy and Forces, Cause and Effect