New York Science

MS. Energy

MS. Energy

A Performance Expectations MS.PS3.E

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. MS.PS3.1

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. MS.PS3.2

3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. MS.PS3.3

4 Plan and conduct an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the temperature of the sample of matter. MS.PS3.4

5 Construct, use, and present an argument to support the claim that when work is done on or by a system, the energy of the system changes as energy is transferred to or from the system. MS.PS3.5

6 Make observations to provide evidence that energy can be transferred by electric currents. MS.PS3.6

B Science and Engineering Practices MS.E.SEP

1 Developing and Using Models MS.E.SEP.1

- a Develop a model to describe unobservable mechanisms. (MSPS3-2) MS.E.SEP.1A

2 Planning and Carrying Out Investigations MS.E.SEP.2

- a Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4) MS.E.SEP.2A
- b Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.(MS-PS3-6) MS.E.SEP.2B

3 Analyzing and Interpreting Data MS.E.SEP.3

- a Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1) MS.E.SEP.3A

4 Constructing Explanations and Designing Solutions MS.E.SEP.4

- a Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MSPS3-3) MS.E.SEP.4A

5 Engaging in Argument from Evidence MS.E.SEP.5

- a Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3-5) MS.E.SEP.5A

6 Scientific Knowledge is Based on Empirical Evidence MS.E.SEP.6

- a Science knowledge is based upon logical and conceptual connections between evidence and explanations (MS-PS3- 4),(MS-PS3-5) MS.E.SEP.6A

C Disciplinary Core Ideas MS.E.DCI

1. PS3.A: Definitions of Energy MS.E.DCI.PS3.A
   - a. Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1) MS.E.DCI.PS3.A.1
   - b. A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) MS.E.DCI.PS3.A.2
   - c. (NYSED) Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, phases (states), and amounts of matter present. (MS-PS3-3),(MS-PS3-4) MS.E.DCI.PS3.A.3
2. PS3.B: Conservation of Energy and Energy Transfer MS.E.DCI.PS3.B
   - a. When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) MS.E.DCI.PS3.B.1
   - b. (NYSED) The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the mass of the sample, and the environment. (MS-PS3-4) MS.E.DCI.PS3.B.2
   - c. Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) MS.E.DCI.PS3.B.3
   - d. (NYSED) An electric circuit is a closed path in which an electric current can exist. (MS-PS3-6) MS.E.DCI.PS3.B.4
3. PS3.C: Relationship Between Energy and Forces MS.E.DCI.PS3.C
   - a. When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2) MS.E.DCI.PS3.C.1
4. ETS1.A: Defining and Delimiting an Engineering Problem MS.E.DCI.ETS1.A
   - a. The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary to MS-PS3-3) MS.E.DCI.ETS1.A.1
5. ETS1.B: Developing Possible Solutions MS.E.DCI.ETS1.B
   - a. A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary to MS-PS3-3) MS.E.DCI.ETS1.B.1

D Crosscutting Concepts MS.E.CC

1. Scale, Proportion, and Quantity MS.E.CC.1
   a. Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-1),(MS-PS3-4) MS.E.CC.1A
2. Systems and System Models MS.E.CC.2
   a. 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) MS.E.CC.2A
3. Energy and Matter MS.E.CC.3
   a. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3 5) MS.E.CC.3A
   b. The transfer of energy can be tracked as energy flows through a designed or natural system. (MSPS3-3),(MS-PS3-6) MS.E.CC.3B