

Unit 7 - Using Engineering with Force and Motion Systems

Content Area: **Science**
Course(s): **Science 4**
Time Period: **April**
Length: **Marking Period 4**
Status: **Published**

Unit Summary

In this unit of study, students use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students develop an understanding that energy can be transferred from place to place by sound, light, heat, and electrical currents or from objects through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. The crosscutting concepts of Energy and Matter and the Influence of Engineering, Technology, and Science on Society and the Natural World are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems, planning and carrying out investigations, constructing explanations, and designing solutions. Students are also expected to use these practices to demonstrate their understanding of the core ideas.

Standards

MA.4.OA.A.3	Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
LA.RI.4.1	Refer to details and examples in a text and make relevant connections when explaining what the text says explicitly and when drawing inferences from the text.
LA.RI.4.7	Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
LA.RI.4.9	Integrate and reflect on (e.g., practical knowledge, historical/cultural context, and background knowledge) information from two texts on the same topic in order to write or speak about the subject knowledgeably.
LA.W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic.
LA.W.4.8	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
SCI.4.4-PS3-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
SCI.3-5.3-5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
SCI.3-5.3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
SCI.3-5.3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
TECH.8.2.5.C.1	Collaborate with peers to illustrate components of a designed system.

TECH.8.2.5.C.2	Explain how specifications and limitations can be used to direct a product's development.
TECH.8.2.5.C.3	Research how design modifications have lead to new products.
TECH.8.2.5.C.4	Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models.
TECH.8.2.5.C.5	Explain the functions of a system and subsystems.
TECH.8.2.5.C.CS2	The application of engineering design.
TECH.8.2.5.C.CS3	The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.
TECH.8.2.5.D.CS2	Use and maintain technological products and systems.

Student Learning Objectives

SLO 1: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (4-PS3-4)

SLO 2: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

SLO 3: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. (3-5-ETS1-2)

SLO 4: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. (3-5-ETS1-3)

Essential Questions

How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?

Enduring Understandings

Students will understand that:

- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-4)
- When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3)
- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)
- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)
- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Application

Students will be able to independently use their learning to:

- describe the various ways that energy can be transferred between objects.
- apply scientific ideas to solve design problems.
- apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound or passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.)
- define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
- Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Skills

Students will be skilled at: