Unit 2: Transfer of Energy

Content Area:	**Science**
Course(s):	
Time Period:	**Generic Time Period**
Length:	**3 weeks**
Status:	**Published**

Disciplinary Core Idea

Definitions of Energy

- The faster a given object is moving, the more energy it possesses.
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.

Conservation of Energy and Energy Transfer

- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
- Light also transfers energy from place to place.
- 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.

LA.4.W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic.
LA.4.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.
LA.4.W.4.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
SCI.4-PS3-1	Use evidence to construct an explanation relating the speed of an object to the energy of that object.
SCI.4-PS3-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
LA.4.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.
MA.4.4.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.4.W.4.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

SCI.4-PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
LA.4.RI.4.3	Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
LA.4.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.
SCI.4-PS3-3	Ask questions and predict outcomes about the changes in energy that occur when objects collide.

Essential Questions

Specific NGSS: 4-PS3-2

Essential Unit Question:

- Where do we get the energy we need for modern life?

Guiding Questions:

- How does energy move?
- From what natural resources are energy and fuels derived?
- In what ways does the human use of natural resources affect the environment?

Objectives:

- SWBAT make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- SWBAT obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

Concepts that will be taught...

1. Energy can be transferred in various ways and between objects.
2. Energy can be moved from place to place through sound, light, or electric currents.
3. Energy is present whenever there are moving objects, sound, light, or heat.
4. Light also transfers energy from place to place.
5. Energy can also be transferred from place to place by electric currents; the currents may have been

produced to begin with by transforming the energy of motion into electrical energy.

6. Cause-and-effect relationships are routinely identified and used to explain change.
7. Knowledge of relevant scientific concepts and research findings is important in engineering.
8. Over time, people's needs and wants change, as do their demands for new and improved technologies.
9. Energy and fuels that humans use are derived from natural sources.
10. The use of energy and fuels from natural sources affects the environment in multiple ways.
11. Some resources are renewable over time, and others are not.

Lesson Plan Guideline

Force and Motion Unit

Day 1:

Introduce students to new topic. Ask them to turn and talk about what they already know about energy. Create a list of 100 questions they still have about energy together in groups. Share out a few questions from each. Keep the list to see if their questions are answered by the end of the unit.

Show students a picture of two different roller coasters. One is half the size as the other. Have students make predictions as to what roller coaster they believe will be faster for the riders of the roller coaster. How did you make your predictions? Why do you believe that?

Explain that tomorrow we will be putting their theories to the test in an experiment!

Day 2:

Have students use interactive notebook sheet to fill in their findings as the experiment unwinds.

As a class, construct a ramp that is about 5 cm tall. Construct a second ramp that is about 10 cm tall.

Have students recall their predictions and review why they believed their theories to be true.

Go over the procedure and materials, then identify the variables. Independent, dependent, and controlled.

Use a stopwatch and meter stick or measuring tape to conduct three trials to determine which ramp allows the car to move the fastest. Begin using the phrase “more energy” when referring to the a faster speed. Record data and draw a conclusion.

In the conclusion, be sure to use the terminology “speed” and “energy”.

Have students share their findings and discuss how energy affects the speed of an object.

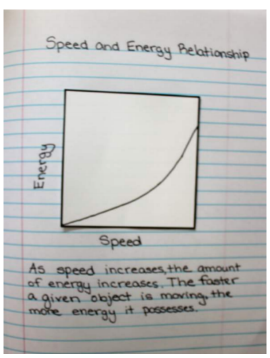
Day 3:

Rollercoaster Experiment Follow up: Ask groups of students to think of another example of fast objects versus slow objects that they can display with objects in the room. Have the groups show their examples to the class and explain which situation has an object with more energy.

Ask: From what you know now, why do you think the first hill of a roller coaster is the tallest?

Day 4:

In this activity, students graph the relative relationship between energy and speed. Students do not need to understand the quantitative relationship between speed and kinetic energy, however they do need to know that the faster an object is moving, the more energy it has. Cut out a white box (one per student) and have them glue it in their notebooks towards the top. Students can draw the box in their notebooks if you prefer. Discuss what you observed in the previous activity and the follow up. (The faster an object moves, the more energy it has. The slower an object moves, the less energy it has.) Label the sides of the graph and think about what it may look like. Then, decide together and draw the line as shown in the example below.



Day 5:

Inflate a balloon & pinch the neck closed. Let go & show your students what happens. Then ask them to explain where the energy that made the balloon move came from.

Here's a possible answer: You use your lungs (powered by energy from food you ate) to push air into the balloon. That energy stretches the rubber of the balloon, storing the energy. When you let go, that stored energy makes the air rush out, and the balloon goes flying.

Make balloon powered cars: http://www-tc.pbskids.org/designsquad/pdf/parentseducators/2wheelcar-english.pdf

Day 6:

Have students work with a partner and test out their cars many different times. Encourage students to write down their findings when they focused on the energy and speed of the car. Have students test to see what happens when little energy (air) is put into the car as opposed to the maximum energy (filling the whole balloon with air).

Discuss the balloon powered car trials. Ask students: How was the relative speed of the car affected by the energy you put into it.

Day 7:

Discuss what we now understand about energy. (Stored energy is changed, or transferred, into motion energy.)

Have students work in partners and have them roll marbles into the wall and attempt to roll them so that they collide. Have students work in groups to discuss and write about what they learned about motion, speed, or changed in energy.

In the meantime, pull partners over to the marble run experiment to take more notes.

For this, use pieces of Styrofoam, pool noodles, ramps, or tubing. At the exit of the marble run, build a structure that will make the marble come to a stop (a cup). In their notebooks, have students draw a sketch of the marble run and identify what happened to the marble's energy. Have them explain what happened to the energy when the marble collided with the cup at the end of the run.

Have students write a follow-up question about how this activity might be extended.

Day 8:

Have students share their findings in groups of 2 sets of partners. After 10 minutes, have groups share out what they found to the class.

Explain to students that when a moving object collides with a stationary object, some of the motion engery of one is transferred to the other. In addition, some of the motion energy is changed, or transferred, to the surrounding air and as a result, the air gets heated and sound is produced. Ask: Did you hear a sound when the moving marble collided with the cup? What did the cup do when this happened?

Learning Activities

- Students conduct investigations to observe that energy can be transferred from place to place by sound, light, heat, and electrical currents. They describe that energy and fuels are derived from natural resources and that their uses affect the environment. Throughout this unit, students obtain, evaluate, and communicate information as they examine cause-and-effect relationships between energy and matter.

- To begin the unit of study's progression of learning, students need opportunities to observe the transfer of heat energy. They can conduct simple investigations, using thermometers to measure changes in temperature as heat energy is transferred from a warmer object to a colder one. For example, hot water can be poured into a large Styrofoam cup, and then a smaller plastic cup of cold water can be placed inside the larger cup of water. A thermometer can be placed in each cup, and students can observe and record changes in the temperature of the water in each cup every minute over the course of about 10–15 minutes, or until the temperatures are the same. Students can use their data as evidence to explain that some of the heat energy from the hot water transferred to the cold water. This transfer of heat caused the cold water to become gradually warmer and the hot water to cool. This process continued until the cups of water reached the same temperature.

- Students can also place a thermometer in the palm of their hands, close their hands around it, and measure the temperature. They can then place a piece or two of ice into their palms and close their fists around the ice until it melts. When they again measure the temperature of their palms, they will observe a change. Students can use these data to describe how some of the heat from their hands transferred to the ice, causing it to melt, while the ice also decreased the temperature of their hand. It is important that students understand that heat is transferred from warmer to colder objects. When an object cools, it loses heat energy. When an object gets warmer, it gains heat energy.

- To continue learning about energy transfer, students can build simple electric circuits. As students work in small groups to build circuits, they should add a bulb and/or a buzzer to the circuit in order to observe and describe the ways in which energy is transferred in the circuit. (The word "transfer" can refer to a change in the type of energy or a change in the location of energy.) For example, stored energy in a battery is transferred into electrical energy, which is then transferred into light energy if a bulb is added to the circuit. The energy transfers from the battery to the wire and then to the bulb. The same holds true if a buzzer is added to the circuit. The stored energy in the battery is transferred into electrical energy, which is then transferred into sound energy. (Keep in mind that energy is not actually produced. When we say that energy is "produced," this typically refers to the conversion of stored energy into a desired form for practical use. Students should be encouraged to use the term "transferred" rather than "produced").

- After conducting these types of investigations, the class can create a list of events in which energy is transferred. For example, when a ball is thrown against a wall, some of the motion energy is transferred to sound energy; when water boils on the stove top, heat energy from the stove is transferred to the pot and to the water in the pot; and when a doorbell is rung, electrical energy is transferred into sound energy.

- Next, students learn about fuels and energy, and conduct research using books and other reliable media to determine which natural resources are sources of energy. Light, heat, sound, and electricity are all forms of energy. Energy is not matter. Fuels, however, are matter. For example, fossil fuels, such as coal, oil, and natural gas, are matter. When fossil fuels are burned, energy stored in the fuel can be transferred from stored energy to heat, light, electrical, and/or motion energy. Therefore, fuels are considered to be a source of energy.

- Energy can also be obtained from other sources, such as wind, water, and sunlight. Air and water are both matter, but when they are moving, they have motion energy. Energy from wind (moving air) and from moving water can be transferred into electrical energy. Light energy from the sun can also be transferred to heat energy or electrical energy. In addition, energy can be released through nuclear fission using materials known as fissile materials.

- As students learn about fuels and other sources of energy, they should determine which sources are renewable and which are nonrenewable. Generally, a fuel or source of energy is considered nonrenewable if that source is limited in supply and cannot be replenished by natural means within a reasonable amount of time. Renewable sources of energy are those that are replenished constantly by natural means. Using this general description, all fossil fuels are considered nonrenewable, because these resources were naturally created over millions of years. Fissile materials are also nonrenewable. On the other hand, wind, moving water, and sunlight are renewable sources of energy.

- As the population continues to grow, so does the demand for energy. Human use of natural resources for energy, however, has multiple effects on the environment. Students should conduct further research to determine how the use of renewable and nonrenewable resources affects the environment. Some examples include:
    - Changes in and loss of natural habitat due to the building of dams and the change in the flow of water;
    - Changes in and loss of natural habitat due to surface mining; and
    - Air pollution caused by the burning of fossil fuels in factories, cars, and homes.
- As students conduct research and gather information from a variety of reliable resources, they can take notes and use the information to describe and explain the impact that human use of natural resources has on the environment.

Mystery Science

Unit: Energizing Everything - Energy & Motion

Mystery 4: Energy & Engineering

***In this Mystery, students construct an explanation of how energy is stored and transferred in chain reactions, such as falling dominoes. In the activity, students are presented with an engineering design challenge to create their own chain reaction machine--a project they will continue in Mystery 5.*

Essential Question - Could you knock down a building using only dominoes?

Materials: Each student will need - scissors, ruler, three stickers or strips of masking tape, cup no more than 4 inches high, rubber band, thick marker at least 1/2-inch in diameter, dixie cup, paper clip, small 1/2-inch or 5/8-inch marble, "Chain-Reaction Starter Kit" handout, "Marble Corral" handout.

Procedure: **Note - it is reccommended to pair this Mystery with Mystery 5. Do not throw away the ramps, as you will reuse them. Prior to the lesson, watch activity instructions and obtain/print out all necessary student materials and teacher answer keys. Access Mystery Science website on the SmartBoard. Utilize iPads for small group/individual use as desired. View Exploration video (30 min). Follow prompts for stopping points for questioning and discussion. Guide students in prepping and carrying out Activity: Build a Chain Reaction (Part I) (30 min). Optional Extras are available to supplement lesson (2 hrs).

Assessment: Informal observation during exploration & activity, Mystery 4 assessment

Mystery 5: Energy & Engineering

***In this Mystery, students design and refine a chain reaction machine, a project they began in Mystery 4.*

Essential Question - Can you build a chain reaction machine?

Materials: Students will work in pairs. Each group will need - scissors, at least four stickers or strips of masking tape, dixie cup, up to four jumbo paper clips, one of the ramps built in Mystery 4, one of the levers from Mystery 4 (or the ruler, marker, and rubber band used to make it), a 3 X 5 card, a few books to stack for height, table or desks to work on, small 1/2-inch or 5/8-inch marble, a marker to write with. Students can also add a variety of materials to extend their chain-reaction machines. Each student will need a copy of the "Pop-Up" Sign handout.

Procedure: Prior to teaching the lesson, watch the activity instructions and obtain/print out all necessary student materials & teacher answer keys. Access Mystery Science website on Smartboard. Utilize iPads for small group/individual use as desired. Before viewing Exploration video (30 min), have students watch the short videos and still images in "Inspiration for Chain Reaction Builders". Follow prompts for stopping points for questioning and discussion. Guide students in prepping and carrying out Activity: Build a Chain Reaction (Part II) (30 min). Optional

Extras are available to supplement lesson (2 hrs).

Assessment: Informal observation during exploration & activity, Mystery 5 assessment

Mystery 6: Electrical Energy

***In this Mystery, students are introduced to electricity as a form of energy that has multiple uses. In the activity, students investigate how electrical energy travels and design flashlights that can turn on and off.*

Essential Question - What if there were no electricity?

Materials: Each student will need - at least one LED, at least one 3V 2032 button battery, one 3 X 5 card, at least four strips of masking tape or stickers, scissors, a "Flashlight Maker" worksheet. Additionally, you'll need a roll of aluminum foil.

Procedure: Prior to teaching lesson, watch activity instructions and obtain/print out all necessary student materials and teacher answer keys. Additionally, tear off a strip of aluminum foil that's about 4 inches wide and as long as the roll is (usually 12 inches), for each student. Access Mystery Science website on SmartBoard. Utilize classroom iPads for small group/individual use as desired. View Exploration video (30 min). Follow prompts for stopping points for questioning and discussion. Guide students in prepping and carrying out Activity: Build a Flashlight (30 min). Optional Extras are available to supplement lesson (2 hrs).

Assessment: Informal observation during exploration & activity, Mystery 6 assessment, summative assessment

Materials & Resources

www.mysteryscience.com

Mystery 4: Each student will need - scissors, ruler, three stickers or strips of masking tape, cup no more than 4 inches high, rubber band, thick marker at least 1/2-inch in diameter, dixie cup, paper clip, small 1/2-inch or 5/8-inch marble, "Chain-Reaction Starter Kit" handout, "Marble Corral" handout.

Mystery 5: Each group (of two students) will need - scissors, at least four stickers or strips of masking tape, dixie cup, up to four jumbo paper clips, one of the ramps built in Mystery 4, one of the levers from Mystery 4 (or the ruler, marker, and rubber band used to make it), a 3 X 5 card, a few books to stack for height, table or desks to work on, small 1/2-inch or 5/8-inch marble, a marker to write with. Students can also add a variety of materials to extend their chain-reaction machines. Each student will need a copy of the "Pop-Up" Sign handout.

Mystery 6: Each student will need - at least one LED, at least one 3V 2032 button battery, one 3 X 5 card, at least four strips of masking tape or stickers, scissors, a "Flashlight Maker" worksheet. Additionally, you'll need a roll of aluminum foil.

Accommodations & Modifications

- Large print textbooks
- Additional time for assignments
- Review of directions
- Have student restate information
- Provision of notes or outlines
- Concrete examples
- Adaptive writing utensils
- Support auditory presentations with visuals
- Weekly home-school communication tools (notebook, daily log, phone calls or email messages)
- Space for movement or breaks
- Extra visual and verbal cues and prompts
- Books on tape

- Graphic organizers
- Quiet corner or room to calm down and relax when anxious
- Preferential seating
- Alteration of the classroom arrangement
- Reduction of distractions
- Answers to be dictated
- Hands-on activities
- Use of Manipulatives
- Follow a routine/schedule
- Alternate quiet and active time
- Teach time management skills
- Rest breaks
- Verbal and visual cues regarding directions and staying on task
- Daily check-in special education teacher
- Visual daily schedule
- Varied reinforcement procedures
- Immediate feedback
- Personalized examples

Assessment

Science Textbook

- Chapter Review
- Chapter Test

Mystery Science

- Individual Mystery Assessments

- Summative Assessment
- Informal Observation during explorations & activities

Teacher-Made Assessments

- Quizzes
- Tests
- Classwork
- Homework
- Projects