

Lesson 1: What Is Energy? (2 Days)

☐ Getting Started

Energy is the ability to do work. In order for work to be done, there must be a force (a push or pull) that causes something to move. Energy can cause things to change. There are many types of energy, and you will learn about several in this lesson. We use and observe energy every day without even realizing it.

Stuff You Need

- *Let's Explore Energy* by Moving Beyond the Page
- bags or cans of food
- calculator
- colored pencils or markers
- marbles (kit)
- masking tape
- meter stick or tape measure
- ruler with a groove in the middle (kit)
- scissors
- string (kit)
- thick book

Ideas to Think About

- How does energy affect our daily lives?
- What is the relationship between work, distance, and force?

Things to Know

- **Energy** is the ability to do work.
- A **newton** is a unit used to measure force.
- A **joule** is a unit used to measure work.
- **Potential energy** is stored energy that is waiting to be used.
- **Kinetic energy** is the energy of a moving object.
- **Work = force × distance**

☐ Reading and Questions

Read pages 2-8 in *Let's Explore Energy* and then answer these questions.

1. What is a chemical bond?

2. What two things are required in order for work to have been performed?
(Hint: Consider the formula for work.)
-
-

3. Which has more energy, a hot object or a cool object? What form of energy does that object have more of?
-
-

Activities

☐ Activity 1: Forms of Energy

There are many different forms of energy, as described in the reading. Talk to a parent about which option you should complete.

Option 1: Illustrating Energy.

Create your own graphic or illustration for each form of energy. Your images should be different from those found in the booklet.

Option 2: Energy Demonstration

Think of a way to demonstrate each form of energy so that a person can better understand and remember it. Make notes about your ideas on the "Demonstrating Energy" activity pages. Then make a list of items you would need for your demonstration.

For example, to demonstrate nuclear energy, you could use small balls to represent protons and neutrons in the nucleus of an atom. For nuclear fission, split the nucleus into two parts. For nuclear fusion, start with two nuclei and combine them into a single nucleus. On the activity page, you might write the following:

"Balls represent protons and neutrons. Make two nuclei and push them together to show nuclear fusion. Make one nucleus and split it apart to show nuclear fission. Materials: 4-6 balls."

Use this example to help you design demonstrations for the remaining six forms of energy.

☐ Activity 2: Energy and Work

For this activity you will measure work. In the first two problems, you will use the $w = f \times d$ equation. For the third problem, you will use a variation of the same equation. Because you know the amount of work and the force, but not the distance, the formula will be rearranged to look like this: $d = w \div f$.

Ask your parent which option to complete.

☐ Activity 3: Doing Work

Do something that requires a little work (such as putting away your shoes or setting the table), and then do something that requires a lot of work (like raking leaves or washing the floor). Was the force required different? Was the distance you moved the objects different? Whenever the distance or amount of force changes, the amount of work changes.

Find out how much work it takes to move different objects by completing the "Doing Work" activity page.

Day 2

☐ Activity 4: Kinetic and Potential Energy

Objects have two kinds of energy: kinetic and potential. Potential energy is the energy an object has because of its position. **Potential energy** is stored energy that is waiting to be used. **Kinetic energy** is the energy of a moving object. Watch the following video to learn more.



What is Kinetic and Potential Energy?

www.beyondthepage.com/link/11386/

Next, put a ruler on top of a book, and hold a marble at the top of the ruler. The marble has potential energy at the top of the ruler. The higher you hold the marble on the ruler, the more potential energy the marble has. Now let the marble go. When the marble starts moving, the potential energy becomes kinetic

energy. Kinetic energy is the energy of motion. Any moving object has kinetic energy. Discuss the following questions with a parent:

- Which has more potential energy: a skier at the top of the mountain or one that is half-way down? Explain.
- Does a rollercoaster going down a hill have kinetic or potential energy? Explain.

Find a parent or sibling and demonstrate your understanding of kinetic and potential energy. Use the marbles to demonstrate kinetic energy. Be sure to explain what kinetic energy is and how your demonstration is an example of it. Then think of a way to demonstrate potential energy using a book. Again, be sure to explain what potential energy is and how you are demonstrating it.

☐ **Activity 5: Mechanical Energy**

Kinetic and potential energy are both forms of *mechanical energy*. An object has mechanical energy when it has either potential energy or kinetic energy. Often it has both at the same time! Think of the marble in Activity 4. While the marble was rolling down the ruler, it was also in the air. An object that is moving while in the air has both kinetic and potential energy at the same time. As the marble rolled and got closer to the ground, it gained kinetic energy but lost potential energy.

Read over the following options and choose one to complete.

Option 1: Illustrating Mechanical Energy

On the "Illustrating Mechanical Energy" page, draw a picture to represent potential energy and one to represent kinetic energy. Your examples should not include ideas or pictures from the previous activity's demonstration or video.

Option 2: Demonstrating Mechanical Energy

Think of ways to demonstrate potential and kinetic energy. Record your ideas on the "Demonstrating Mechanical Energy" page. Your examples should not include ideas or pictures from the previous activity's demonstration or video.

Demonstrate both types of energy to family members.

☐ **Activity 6: Energy in Our Lives**

Review the different forms of energy, and brainstorm a list of ways that energy impacts your life. Write your ideas down on a piece of paper. Then decide which

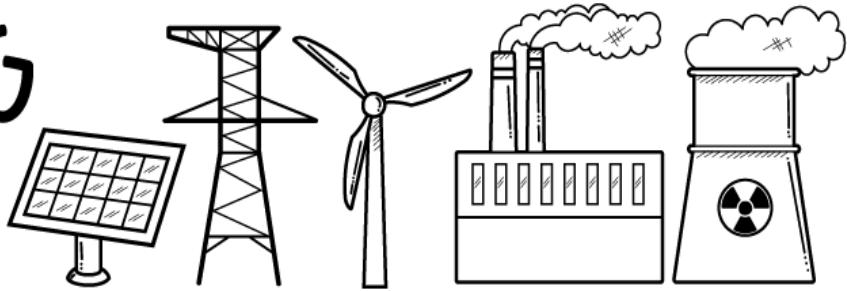
forms of energy each one involves. Use the chart on the "Energy in Our Lives" activity pages to organize your ideas by listing each idea under the category (or categories) that it applies to.

Note that some of your ideas may only involve one form of energy, but many of your ideas will probably include multiple forms of energy. For example, drying clothes with a dryer would involve thermal, mechanical, and electrical energy, while drying clothes on a clothesline would use radiant energy.

Wrapping Up

Review the different forms of energy and the difference between kinetic and potential energy.

ILLUSTRATING ENERGY

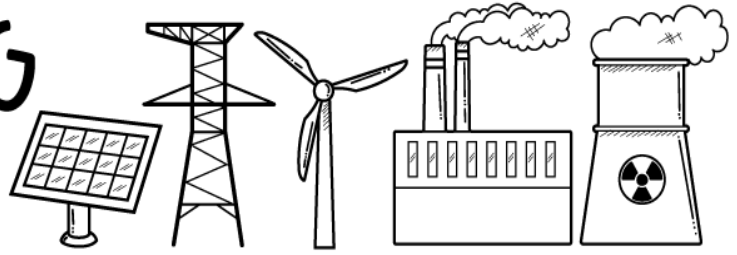


Directions: Draw a graphic or illustration to help someone better understand and remember each form of energy.

radiant	nuclear
electrical	

chemical		thermal	
mechanical		sound	

DEMONSTRATING ENERGY



Directions: Think of a way to demonstrate each form of energy so that a person can better understand and remember it. Make notes about your ideas. Then list the items you would need for your demonstration.

radiant

chemical

sound

thermal

electrical

mechanical

ENERGY & WORK

Directions: Solve the problems involving work. You can use a calculator to help with the calculations.

$$W_{\text{(work)}} = F_{\text{(force)}} \times D_{\text{(distance)}}$$

Problem 1:

You are trying to lift a large rock into your wheelbarrow. How many joules of work are required to lift the rock 0.75 meters to the wheelbarrow if the force required is 44.59N?

$$W = 44.59 \text{ newtons} \times .75 \text{ meters}$$

$$W = \underline{\hspace{2cm}} \text{ joules}$$



Problem 2:

You are asked to push your friend in a wheelchair across the parking lot to his car. This requires a force of 489.3 newtons. His car is 8 meters away. How much work will you do?

$$W = \underline{\hspace{2cm}} \text{ newtons} \times \underline{\hspace{2cm}} \text{ meters}$$

$$W = \underline{\hspace{2cm}} \text{ joules}$$



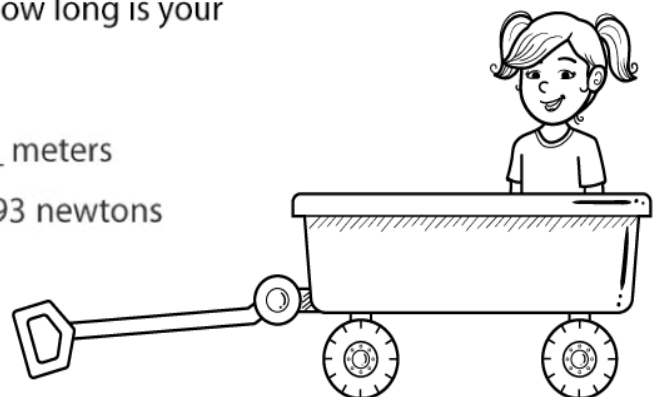
Problem 3:

If a force of 177.93 newtons results in 600 joules of work in order to pull your sister up your driveway, how long is your driveway?

$$600 \text{ joules} = 177.93 \text{ newtons} \times \underline{\hspace{2cm}} \text{ meters}$$

$$\underline{\hspace{2cm}} \text{ meters} = 600 \text{ joules} \div 177.93 \text{ newtons}$$

The driveway is $\underline{\hspace{2cm}}$ meters long.



ENERGY & WORK

Directions: Write the equation for and solve the problems involving work. You can use a calculator to help with the calculations.

$$W_{\text{(work)}} = F_{\text{(force)}} \times D_{\text{(distance)}}$$

Problem 1:

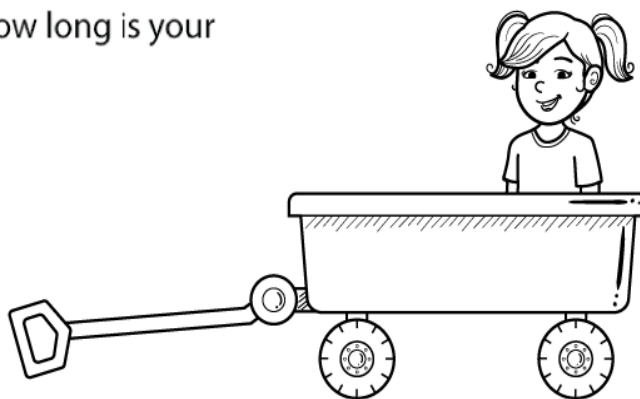
You are trying to lift a large rock into your wheelbarrow. How many joules of work are required to lift the rock 0.75 meters to the wheelbarrow if the force required is 44.59N?

**Problem 2:**

You are asked to push your friend in a wheelchair across the parking lot to his car. This requires a force of 489.3 newtons. His car is 8 meters away. How much work will you do?

**Problem 3:**

If a force of 177.93 newtons results in 600 joules of work in order to pull your sister up your driveway, how long is your driveway?



Doing Work



Materials:

- calculator
- 2 cans or bags of food
- string (kit)
- masking tape
- meter stick or tape measure
- scissors

Procedure:

1. Find two food items from your kitchen. Look for cans or bags with the item's weight shown in ounces. Choose one heavy item and one light item.
2. Record each item and its weight in the table. Convert each weight to newtons to find out how much force is needed to move the object. One newton equals 3.6 ounces, so you will divide ounces by 3.6. An example has been done for you. Round your answers to the nearest tenth.

Item	Weight (ounces)	Newtons (ounces ÷ 3.6)
<i>Example</i>	16 oz	$16 \div 3.6 = 4.4 \text{ N}$

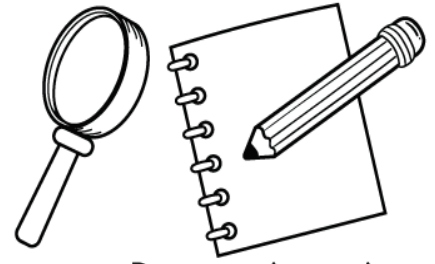
3. Place a piece of masking tape on the floor to mark your starting line. With the tape measure or meter stick, measure a total distance of 3 meters, placing a piece of tape at the 1 meter mark, the 2 meter mark, and the 3 meter mark.
4. Cut the string from your science kit into 2 equal pieces. They should each be about 9-10 feet long. Tie one piece of string around each object. Put both objects at the starting line. Now stand between the 2 and 3 meter marks and pull each object toward you, one at a time, in a straight line until they cross the 2 meter mark. Record the distance you moved each item (2 meters) under "Trial 1" in the table on page 2.
5. Put both items back at the starting line. This time, pull the light item a distance of 3 meters and record it under "Trial 2" in the table. Pull the heavier item a distance of 1 meter and record it in the table.
6. Calculate the amount of work it took to move each object using the formula for work: $W = F \times D$. An example has been done for you.
7. Answer the questions on page 2.

	Item	Distance (meters)	Work (joules)
Trial 1	Example	2 meters	$4.4\text{ N} \times 2\text{ m} = 8.8\text{ J}$
	Light item		
	Heavy item		
Trial 2	Light item		
	Heavy item		

Questions:

1. When you moved the items the same distance which one took more work? Why?
2. When you moved the heavier item a shorter distance did it take more or less work than in the first trial? Why?
3. When you moved the lighter item a longer distance did it take more or less work than in the first trial? Why?
4. Was the work used for both items closer to equal in the first trial or the second trial? Why?

Illustrating Mechanical Energy

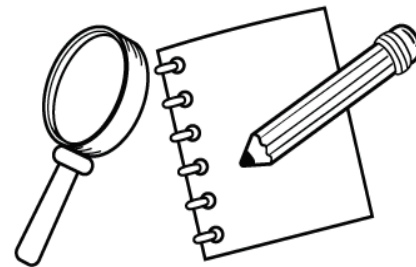


Directions: Draw a picture in the first box that illustrates kinetic energy. Draw a picture in the second box that illustrates potential energy.

kinetic energy

potential energy

Demonstrating Mechanical Energy



Directions: Record your ideas for demonstrating potential and kinetic energy. Demonstrate both types of energy to your family using one of your ideas.

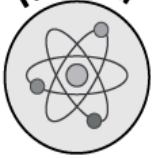
kinetic energy

potential energy

Energy in Our Lives

Directions: On a separate sheet of paper, list ways that energy impacts your life. Then list each idea under the category (or categories) that it applies to.

Nuclear

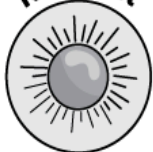


Chemical



Sound



Radiant**Mechanical****Thermal****Electrical**

Lesson 1: What Is Energy? (2 Days)

Getting Started

? Ideas to Think About

- How does energy affect our daily lives?
- What is the relationship between work, distance, and force?



Things to Know

- **Energy** is the ability to do work.
- A **newton** is a unit used to measure force.
- A **joule** is a unit used to measure work.
- **Potential energy** is stored energy that is waiting to be used.
- **Kinetic energy** is the energy of a moving object.
- **Work = force × distance**

⦿ Skills

- Determine the motion of an object by following and measuring its position over time. (S)
- Evaluate how pushing or pulling forces change the position and motion of an object. (S)
- Differentiate among forms of energy including light, heat, electrical, nuclear, chemical, sound, mechanical, magnetic, and solar energy. (S)
- Recognize the difference between potential and kinetic energy. (S)

Introducing the Lesson

Explain to your child that today he will explore forms of energy. Many people think of electricity when they think of energy, but there are many forms of energy at work in the world. We could never keep track of the number of roles that energy has in our daily lives.

Reading and Questions

1. What is a chemical bond?

A chemical bond is an attractive force between atoms that holds them together.

2. What two things are required in order for work to have been performed? (Hint: Consider the formula for work.)

Work requires a force, and there must be some distance involved.

3. Which has more energy, a hot object or a cool object? What form of energy does that object have more of?

A hot object has more thermal energy than a cool object.

Activities

Activity 1: Forms of Energy

Help your child select one of the following options. For Option 1 he will illustrate each form of energy, and for Option 2 he will think of a way to demonstrate each form of energy.

Option 1: Illustrating Energy

For this option, check to see that your child has accurately illustrated each form of energy. Ask him to explain how he came up with his ideas. His images should be different than the ones in the booklet.

Option 2: Energy Demonstration

Review your child's demonstration ideas. If he would like to do any of the demonstrations, find a time during the day for him to do so. Provide feedback on the accuracy of his demonstrations.

Activity 2: Energy and Work

Select one of the options for your child. The first option sets up the equations, while the second option requires the student to set up his own equations. Note that for simplicity these calculations assume friction is not a factor.

Answer Key:

- Problem 1:
 $W = 44.59 \text{ newtons} \times .75 \text{ meters}$
 $W = 33.44 \text{ joules}$
- Problem 2:
 $W = 489.3 \text{ newtons} \times 8 \text{ meters}$
 $W = 3914.4 \text{ joules}$
- Problem 3:
 $600 \text{ joules} = 177.93 \text{ newtons} \times D$
 $D = 600 \text{ joules} \div 177.93 \text{ newtons}$
 $D = 3.37 \text{ meters}$

Activity 3: Doing Work

This activity begins by asking your child to experience the difference between an activity that requires a lot of work and an activity that requires a little bit of work. Activities that require a little bit of work might include dusting, folding laundry, setting the table, or putting shoes away. Activities that require a lot of work might include raking leaves, taking out trash, vacuuming, or washing the floor. Take time to discuss this activity and the activity page.

Your child may need assistance with the calculations as he completes the activity page. He can use a calculator. Answers will vary depending on the weights of the objects and the distance they are moved. Check that he has done the calculations correctly.

NOTE: The calculations on the activity page are simplified to assume that there was no friction and that your child applied the force in the same direction the object moved (as opposed to pulling at an angle).

Answer Key:

1. When you moved the items the same distance which one took more work? Why? (the heavy item took more work because it took more newtons of force to move)
2. When you moved the heavier item a shorter distance did it take more or less work than in the first trial? Why? (less work, because the distance was shorter)
3. When you moved the lighter item a longer distance did it take more or less work than in the first trial? Why? (more work, because the distance was longer)

4. Was the work used for both items closer to equal in the first trial or the second trial? Why? (Answers will vary depending on the difference between the number of newtons it takes to move each item, which your child calculated in Step 2. If there is a bigger difference in the values, then the amount of work will most likely be closer in Trial 2. He should see that this is because the amount of work to move the lighter object increased and the amount of work to move the heavier object decreased. If there is a smaller difference in the number of newtons required to move each object, he may find that the amount of work is actually closer when the two items are moved the same distance.)

Day 2

Activity 4: Kinetic and Potential Energy

Answer Key:

Your child was asked to consider the following questions:

- Which has more potential energy: a skier at the top of the mountain or one that is half-way down? Explain.
- Does a rollercoaster going down a hill have kinetic or potential energy? Explain.

A skier at the top of the mountain has more potential energy. The roller coaster has both kinetic and potential energy. The movement downhill is kinetic energy. The position on the hill (above ground level) is potential energy. As the kinetic energy increases as the roller coaster goes down the hill the potential energy will decrease.

To demonstrate his understanding of kinetic energy, he might shoot one marble at the remaining marbles. Any marble that is moving has kinetic energy. For potential energy, he could simply hold the book or marble in the air. The book has potential energy in that position because if he lets go of it, it will fall and the potential energy will then become kinetic energy.

Activity 5: Mechanical Energy

Your child will select one of the options provided. In Option 1, he will illustrate potential and kinetic energy. In Option 2, he will think of ways to demonstrate both types of energy.

Option 1: Illustrating Mechanical Energy

If your child selects Option 1, encourage him to share his pictures of mechanical and potential energy.

Option 2: Demonstrating Mechanical Energy

If your child selects Option 2, encourage him to demonstrate both types of mechanical energy to you or other family members. His examples should not include ideas or pictures from the previous activity's demonstration or video.

Activity 6: Energy in Our Lives

Review your child's list of ways that energy plays a role in his daily life. Check to see that he sorted each idea into the appropriate category of energy.

Wrapping Up**Questions to Discuss**

- What is the formula for determining an amount of work? ($\text{work} = \text{force} \times \text{distance}$)
- What are the different forms of energy? Can you provide an example of each one? (nuclear, radiant, mechanical, sound, chemical, thermal, and electrical)
- What is the difference between kinetic and potential energy? (kinetic = energy in movement; potential = stored energy)

Things to Review

Review the definitions of energy, potential energy, and kinetic energy. Review the ways energy plays a role in our daily lives.

Special Notes

In the third lesson, your child needs to take a field trip to the local power plant. Begin arranging the field trip now. (Virtual options are also available.)