FOCUS ON SCIENCE

Forms of Energy

Advanced Level

Physical Science
Simple and Complex Machines

FOCUScurriculum

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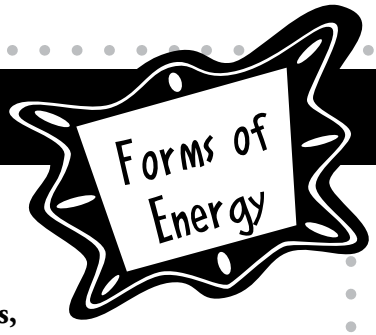


Scientific Inquiry

Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.

Develop, present, and defend formal research proposals for testing their own explanations of common phenomena, including ways of obtaining needed observations and ways of conducting simple controlled experiments.

Design scientific investigations (e.g., observing, describing, and comparing; collecting samples; seeking more information, conducting a controlled experiment; discovering new objects or phenomena; making models)

Carry out their research proposals, recording observations and measurements (e.g., lab notes, audiotape, computer disk, videotape) to help assess the explanation.

Conduct a scientific investigation.

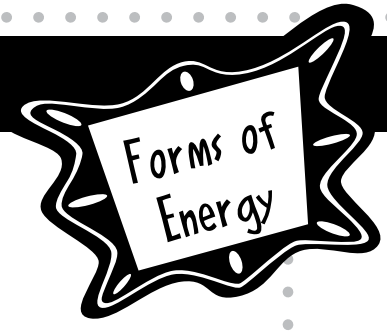
Collect quantitative and qualitative data.

Physical Science

Energy exists in many forms, and when these forms change energy is conserved.

Different forms of energy include heat, light, electrical, mechanical. sound, nuclear, and chemical. Energy is transformed in many ways.

Energy can be considered to be kinetic energy, which is the energy of motion, or potential energy, which depends on relative position.



English Language Arts

The following is a selective listing of the competencies and indicators addressed in this book.

Word Recognition

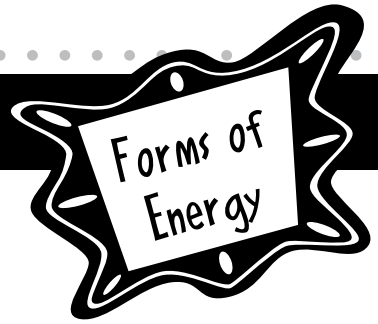
- Use word recognition skills and strategies quickly,accurately, and automatically when decodingunfamiliar words

Background Knowledge and Vocabulary Development

- Use self-monitoring strategies to identify specific vocabulary difficulties that disrupt comprehension,and employ an efficient course of action, such asusing a known word base or a resource such as aglossary to resolve the difficulty

Comprehension Strategies

- Use a variety of strategies (e.g., summarizing,forming questions, visualizing, and making connections) to support understanding of texts read



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How to Help Your Students Make the Best Use of This Book

Encourage students to develop nonfiction literacy skills by completing the Active Reader activities. Also encourage them to . . .

- Underline main ideas in paragraphs.
- Circle details that support the main ideas.
- Write down questions as they read.
- Circle key words as well as unfamiliar words.

Printing Instructions

Student Book: print pages 5–30

Assessments: print pages 31–34

Answer Key: print pages 35–38

FOCUS ON SCIENCE

Forms of Energy

How does energy play a role in our lives?

Do you know what energy is? Do you know where it comes from? Have you ever thought about what we do with energy? Everything we do requires energy. Every change or action in our environment requires energy, too.

There are two kinds of energy: kinetic energy and potential energy. Energy can be stored in the form of potential energy, or it can be directly used for an action as kinetic energy.

Conversions of recognizable forms of energy, such as mechanical and electrical energy, explain everyday occurrences in our lives, like lights turning on or bike wheels turning. Energy helps us with everything we do.

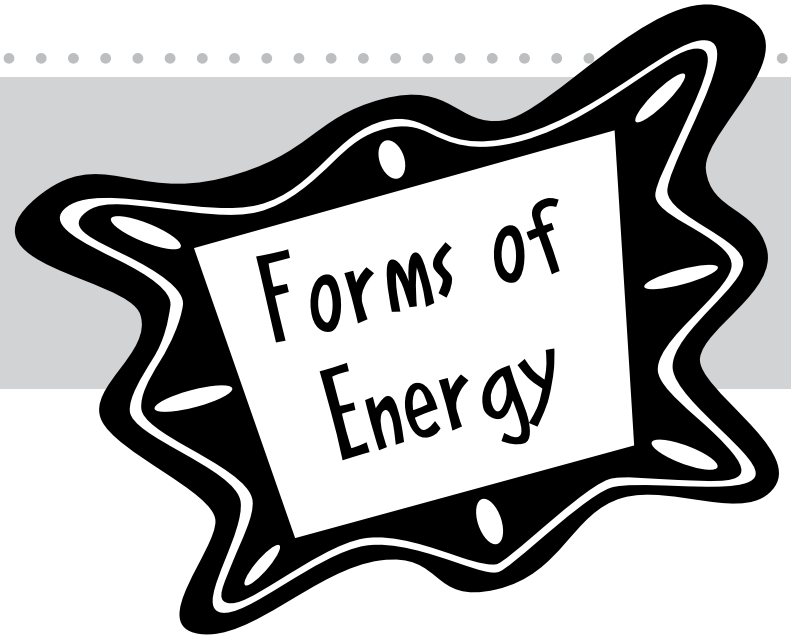


Table of Contents

Starting Points

Build Background

Define

Your friend's little sister wants to know what the word energy means. How would you describe it in a way she would understand?

_____

_____

Brainstorm

Mind mapping is a way of putting your thoughts into pictures and symbols. Think about anything that has to do with energy. A lit match is an example. It provides heat and light energy. Think of other symbols or pictures to add to this mind map. Write a label under each one. Remember, there are no wrong answers. Any connection your brain makes to energy is worth mapping out!

Light and heat energy

Starting Points

Key Vocabulary

Rate Your Knowledge

The words listed below have to do with types of energy. Each word is important, but some of them may be new to you. Rate your knowledge of each one by checking the appropriate column. Give the definition if you know the word. After completing this book, come back to this page and write the definitions of words you did not know.

	I don't know it.	I've seen it, but I'm not sure what it means.	I know it well, it means...
potential			
kinetic			
particle			
atom			
mechanical			
thermal			
radiant			
nuclear			
chemical			
acoustic			

Starting Points

Key Vocabulary

Context Clues

Below are several sentences that use some of the words you read on page 9. Read each sentence. Each sentence contains clues about what the underlined word means from its context. From the context clues in the sentence, write a definition on the lines below. Then go back to the chart on page 9 and add something to the "I've seen it" or "I know it" columns.

1. I prefer to use a <u>mechanical</u> pencil rather than a regular one, because the mechanical pencil doesn't need sharpening.

_____

_____

2. He wasn't crying, he just had a <u>particle</u> of dust in his eye.

_____

_____

3. Joseph could see frost on his window, so he put on his <u>thermal</u> underwear under his school clothes.

_____

_____

4. Because Sarah wasn't trying very hard in school, her parents told her she "wasn't living up to her <u>potential</u>."

_____

_____

Starting Points

Key Concepts

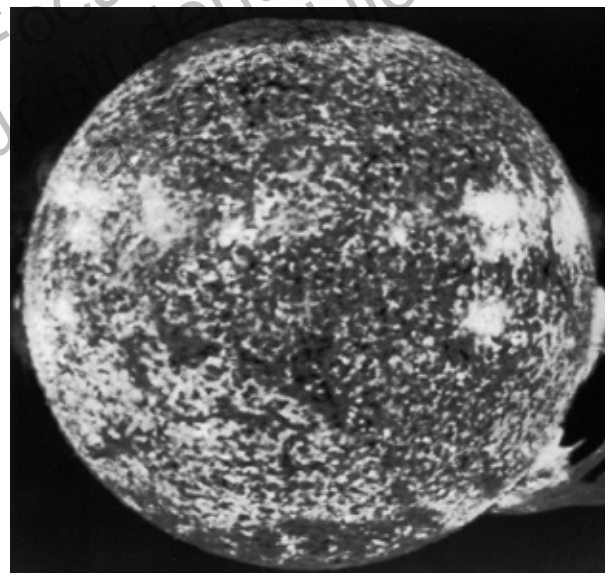
What Is Energy?

What do you mean when you say you have a lot of energy? You probably mean you feel like you can do a lot of active things. Lots of energy might allow you to sprint extra hard in a soccer game, or it might allow you to dance for hours and hours. Too much energy might make it hard for you to sit still until the end of class.

Energy is what allows you to do some kind of activity or work. That's what *energy* means, the strength needed for you to do physical or mental activities. Some energy is energy is used for action while other kinds of energy are stored for later.

Energy comes in many forms and it has many functions. For example, energy from the sun is light energy. It warms us here on Earth and helps plants grow. Energy can come in the form of heat. We use heat to cook things, and our body makes its own heat to keep us warm. Energy can also make things like car engines run or computers process information.

But people and their machines aren't the only things that use energy. Plants use energy to bring water from their roots up to their leaves, and to break down green **pigments** from their leaves in the fall. Animals use energy to chase after and catch prey, or find and eat plants. In fact, animals use energy to digest anything they eat. Gravity does work on anything falling to the ground: a baseball, raindrops, the book you drop on the floor. Work is defined as a transfer of energy



The sun is the source of all energy on Earth.

ACTIVE READER

1 Relate *When do you feel most energetic? Why do you think this is?*

Chapter 1 Kinetic and Potential Energy

FOCUS

In this section, you will be reading about two types of energy, kinetic energy and potential energy. The underlined sentences show how kinetic energy is different from potential energy.

Two Types of Energy

Kinetic Energy

The root of the word kinetic comes from the Greek word kinetos which means "moving." **Kinetic energy** is the energy of motion: if something is moving, it has kinetic energy. For something to have kinetic energy, it has to have mass and it has to be moving.

Since kinetic energy is dependent on mass and speed, the bigger and faster something is, the more kinetic energy it has. That should make sense; if a train were barreling towards you on a track at 30 miles per hour, you'd jump off the track because that train has a lot of energy and it would harm you. In contrast, something light and slow, like a butterfly, doesn't have the energy to harm you. In fact, you'd barely feel it flit against you!

Potential Energy

In contrast to an object with kinetic energy, an object with **potential energy** doesn't have to be moving. Potential energy is stored energy and it can't do work directly: it's ready to do work, but it has to be changed to another kind of energy to actually do work.

A bowling ball traveling down the lane has kinetic energy because it is moving.

ACTIVE READER

1 Extend *If you are interested in a career in sports, you may choose to study the field of kinesiology. Using what you know about the word kinetic, what might you study in the field of kinesiology?*

A match is a good example of potential energy stored in a chemical form. The chemicals in the match head contain potential energy, but they can't burn without being struck first against the side of a matchbox.

A second way to think about potential energy is that the energy has to be actively stored somehow. Potential energy can be stored in the position of an object. For example, you might be sitting at a desk right now. Look at something near the edge of your desk such as a pencil or pen. Even though that pencil or pen isn't moving, it has potential energy because you've kept it off the floor by placing it on your desk. If you give that pencil or pen a little nudge, the potential energy will be converted to another kind of energy as it falls to the floor. When it is falling, it has kinetic energy. Any object that has been lifted away from the ground has gravitational potential energy, because gravity can do work on it. The higher it is, the more gravitational potential energy it has.

Another example of potential energy is a stretched bowstring. Even if the bowstring is not moving, it has potential energy because energy has been stored by stretching it. If you release it, the arrow connected to the bowstring will fly through the air.

The archer has stored energy in the position of the bowstring by drawing it back. Until the archer releases the bowstring, the arrow won't move.

This match has converted potential energy stored in the match head to kinetic energy in the flame.

ACTIVE READER

1 Recall *What can kinetic energy do that potential energy cannot?*

FOCUS QUESTIONS

1. **Two identical cars are driving on the highway. One is driving at 50 mph and one is driving at 65 mph.**

   Identify which car has more kinetic energy. Explain how you know.

   Identify: _____

   Explain: _____

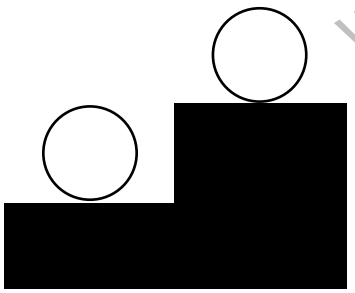
   _____

2. **Identify two ways that potential energy differs from kinetic energy.**

   Identify: _____

   Identify: _____

3. **In this diagram, identify which ball has more potential energy. Explain why.**



Identify: _____

Explain: _____

_____

_____

_____

_____

ACTIVE READER

1 Predict *Which do you think stores more energy, an ice cream cone or a banana?*

_____

_____

2 Explain *Explain your choice from above, using your knowledge of food and energy.*

_____

_____

_____

_____

_____

Good to Know

The oil we use in our cars stores energy. When oil is made into gasoline, our cars are able to use the stored energy in the oil. The potential energy in the oil is converted into kinetic energy when the gasoline is burned. Then the car can move.

Identify Kinetic and Potential Energy

For each of the following objects, fill in whether you think the object has potential energy, kinetic energy, or both. Then provide a brief explanation for your choice.

Object	Kinetic energy, potential energy, or both?	How do you know?
A ball rolling along the ground		
A muffin		
A plane flying through the air		
A car driving on the road		
A compressed spring		
The gasoline tank in a moving car		

Hands On Science

Measure the Effect of Height on Energy

The position of an object can store energy. In this experiment, you will test how the height of a ball affects its energy as it makes an impact on the flour below.

Background

Potential energy can be stored in an object's position. Any object that can be acted on by gravity has gravitational potential energy. We should expect that the position of the object (how far away it is from the floor) should have an effect on its energy. Kinetic energy is the energy of motion. It depends on an object's mass and speed. The energy can be measured by how much flour is displaced by the falling ball. This shows how much work the ball is doing on the flour.

Objective

To determine the effect of the ball's height on its energy as it hits the flour.

Materials

- ball (golf ball works well)
- pan of flour, at least 2–3 inches deep
- meter stick

Hypothesis

Write out what you think will happen and why.

Procedure

1. Using the meter stick, measure 10 cm above the surface of the flour.
2. Drop the ball from this first height.
3. Measure the diameter of the crater formed in the flour. Record this in your data table on page 17.
4. Smooth the flour.
5. Repeat steps 2–4 twice more, recording your data in the data table each time.
6. Complete your trials for the other heights (50 cm, 100 cm).
7. Clean up your lab station.

Hands On Science

Measure the Effect of Height on Energy (continued)

Height of ball drop (cm)	Diameter of crater formed (cm)			Average diameter (cm)
	Trial 1	Trial 2	Trial 3	
10 cm				
50 cm				
100 cm				

Analysis

1. **Identify the variables you are testing in this experiment:**

   a. **Independent variable (what changes):** _____

   b. **Dependent variable (what is affected by change):** _____

2. **When you were holding the ball above the flour, what kind of energy did it have? Explain.**

_____

_____

_____

Hands On Science

Measure the Effect of Height on Energy (continued)

3. In the moment before the ball hit the flour to create the crater, what kind of energy did it have? Explain.

4. Using your data as evidence, write a statement summarizing the effect of height on the energy of a falling object.

5. Why did you perform each trial three times?

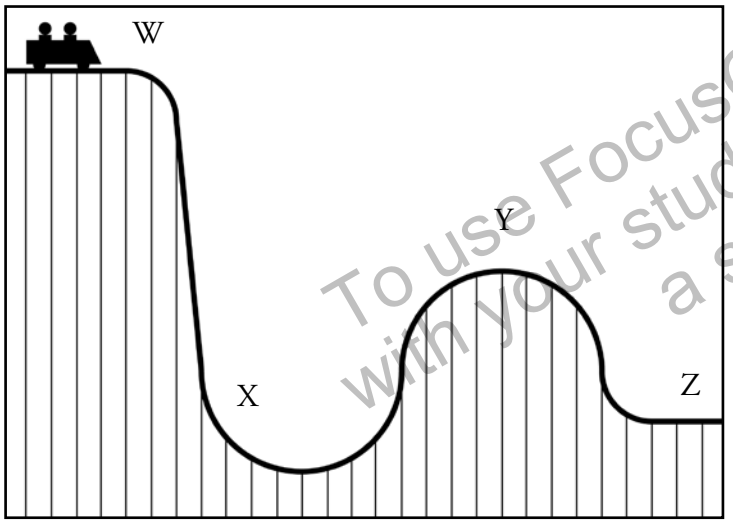
Stop and Think

This page will help you summarize what you have read so far.

1. At the moment a plane touches the ground of the runway, it travels at about 300 mph. As it travels along the runway at this speed, what kind of energy does the plane have?

(1) kinetic energy
(2) radiant energy
(3) potential energy
(4) potential and kinetic energy

Base your answer to question 2 on the diagram below and on your knowledge of science.



2. Which sentence describes the roller coaster car at point X?

(1) The car has only potential energy.
(2) The car has some potential and some kinetic energy.
(3) The car has more potential energy than kinetic energy.
(4) The car has more kinetic energy than potential energy.

Dear Ms. Understanding,

So, I get that potential energy is stored energy, and kinetic energy is the energy of motion. But here's a less clear situation. I just ate a big lunch and I'm running the mile in PE. Aside from having a giant side-stitch, what kind of energy do I have?

Worried in Wyoming County

Dear Worried,

You have both! The fuel your body is using is potential energy. Your body also stores lots of energy in the form of fat that you can use. But when you are running, you also have kinetic energy because your body is moving.

Ms. Understanding

Chapter 2 Energy Types

FOCUS

In this section you will be reading about different types of energy. As you read, think about which are potential energy, which are kinetic energy, and which are both.

Sources of Energy

In the previous section, you read that energy exists as kinetic, or moving energy, and potential, or stored energy. However, you've probably heard of more than just potential and kinetic energy. You may have heard people debating the safety of nuclear energy. Or maybe you've learned that electromagnetic (light) energy from the sun helps plants grow, and can power solar panels to make electricity.

Energy comes from a variety of sources. Some of these are kinetic, and some are potential. Some are both kinetic and potential.

Electrical Energy

Anything that plugs into a wall socket or uses a battery relies on electrical energy, which comes from the movement of electrons. Think of your favorite device. It might be an MP3 player, or a computer, or maybe a cell phone. All those devices rely on electrical energy. When your device is plugged in, it gets electrical energy (electricity) straight from the wall, but when you want to use your device later, you have to "charge" it.

When you charge your cell phone or MP3 player, you are storing electrical energy in a battery for later use. **Charge** is energy stored in a battery. Like a magnet, a battery has a positive and a negative end, for positive and negative charge.

When the positive and negative ends of a battery are connected through a circuit, charge moves through a wire and can do work.

ACTIVE READER

1 Extend *Electrical energy use is on the rise. Name three or more of the objects you use on a daily basis that require electricity.*

_____

_____

_____

_____

2 Weigh In *Do you think our increased use of electrical devices such as computers, MP3 players, and cell phones has improved life or made it more distracting? Why?*

_____

_____

_____

_____

_____

_____

Electrical energy is stored by separating these positive and negative charges in different areas of the battery. Since opposite charges attract, charge will move through a wire when a circuit is connected. This is called an electrical current. So, by turning on a device, the charge moves, flowing through a wire to do the work of playing music, creating a screen display, or showing a text.

Mechanical Energy

Mechanical energy is the form of energy in which one thing moves another thing. For example, wind creates mechanical energy in the moving of wind turbine blades. The working of a car engine creates mechanical energy in the turning of the car's wheels. Mechanical energy always involves motion.

Wind turbines are a promising source of renewable energy. They capture mechanical energy from the wind and covert it to electrical energy.

Chemical Energy

In Chapter 1, we learned a little about the chemical energy stored as potential energy in a match head. Chemical energy is also what we rely on when we eat food to power our daily activities. When we think about "fuel," whether it's food for our bodies, gasoline for our cars, or coal for a coal plant, we're usually talking about chemical energy.

Chemical energy is stored in the connections between the **particles** of a substance. All matter is made of tiny building blocks called **atoms**, and these atoms are held together with **chemical bonds**. Energy stored in the bonds has to be converted to another form of energy to be used; an energy bar can't run the mile in PE for you, but your muscles can convert that chemical energy into the mechanical energy of your legs moving and your heart beating. Gasoline by itself can't power a car, but a car's engine can burn the gasoline, converting it to the mechanical energy of the car's turning wheels.

ACTIVE READER

1 Interview *Interview a parent or friend about his or her energy use. Ask where he or she believes most of our energy should come from and why. Possible energy sources are nuclear energy, coal or gas (chemical), wind or water (mechanical).*

Thermal Energy

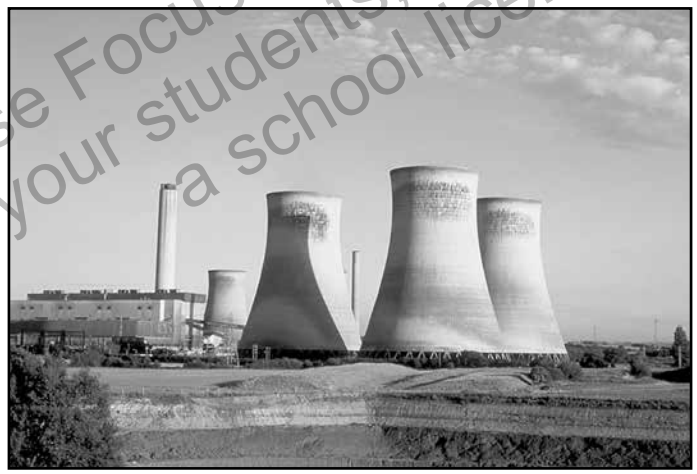
Thermal energy is the energy of heat. Think about what you are changing when you adjust the thermostat in your house. You change the amount of heat in the room. Heat, or temperature, is a measurement of thermal energy. Thermal energy measures the movement of atoms, the tiny particles that make up matter. Though they are way too small to see, atoms are constantly moving. They don't all move the same way, however; the atoms in a solid move much less than the atoms in a gas. The more the atoms move, the more thermal energy the object has.

Nuclear Energy

Nuclear energy is a form of energy stored in the center of an atom. Similar to chemical energy, nuclear energy is stored in bonds, this time within the atom instead of between different atoms. The bonds within the center, or nucleus, of an atom are incredibly strong; breaking these bonds by splitting apart the nucleus releases lots of energy. In nuclear power plants, the released energy is converted to electricity that is used to heat houses and keep the lights on.

Acoustic Energy

Acoustic energy is the energy of sound. It travels in waves. These waves cause things to vibrate. If you think of someone strumming a guitar, the strings vibrate. The acoustic energy travels as a wave that makes air particles vibrate, and the waves travel to your ear, where your eardrum vibrates and you hear the sound of the guitar!



At the Perry Nuclear Power Plant, nuclear energy is converted to thermal energy, which is then converted to electrical energy.

Electromagnetic Energy

Electromagnetic energy is the energy of light. It is sometimes called radiant energy. The major source of light energy on Earth is the sun. Without this energy traveling to us from the sun, our planet would be an icy, lifeless place.

ACTIVE READER

1 Weigh in *Nuclear energy can be a clean, renewable source of power for people to use. However, it can also be dangerous to produce. Based on what you know, do you think more nuclear power plants should be built? Why or why not?*

2 Connect *Acoustic energy travels in waves, moving anything it travels through. Would this be more of a kinetic or a potential form of energy?*

Like acoustic energy, electromagnetic energy travels in waves, some of which we can see, such as the colors of the rainbow, and some of which we can't see, such as UV radiation that can give you a sunburn.

Plants are among the only living things that can convert radiant energy directly into chemical energy, which is why all food chains begin with plants. Radio waves and microwaves are also forms of electromagnetic energy.

Since plants are the main form of life convert the sun's electromagnetic energy to chemical energy, they make life possible for the rest of us!

Good to Know

You probably also know that nuclear energy can be used to create dangerous weapons. Uranium is the atom most often split to create nuclear energy, which is why international groups often track different countries' use of uranium.

FOCUS QUESTIONS

1. **Is electrical energy a form of kinetic energy, potential energy, or both? Explain.**

2. **Is mechanical energy a form of kinetic energy, potential energy, or both? Explain.**

3. **Is chemical energy a form of kinetic energy, potential energy, or both? Explain.**

Web Quest

Where does the energy in your house come from? Look up the power provider in your area. The provider's Web site should give you an idea whether coal, nuclear, renewable sources (wind and water) or some combination create electricity for local homes. Are there "greener," more renewable sources of power for your home that you can use? What are they?

Stop and Think

This page will help you summarize what you have read so far.

Tip:
Consider all of the answer choices before you choose the best one. Think about how each answer choice differs from the others.

1. Hydroelectric power is a clean sorce of renewable energy. The energy created as a river flows through a dam is converted to electricity. Hydroelectric power is an example of

(1) kinetic energy
(2) potential energy
(3) chemical energy
(4) electrical energy

2. The flight of an airplane, from takeoff to landing, involves many different forms of energy. An example of chemical energy is

(1) the energy of the plane's forward motion
(2) the storage and use of the energy in the fuel
(3) the heat energy generated by the plane's motors
(4) the energy stored in the plane's position in the sky

3. Plants take in energy from the sun and turn it into food. Which statement best describes this energy transformation?

(1) acoustic energy into kinetic energy
(2) electrical energy into radiant energy
(3) potential energy into thermal energy
(4) electromagnetic energy into chemical energy

Dear Ms. Understanding,

Wait—so kinetic energy is the energy of motion. But then mechanical energy is about movement as well. What IS the real difference?

Concerned in Canandaigua

Dear Concerned,

You've brought up a great question. You can think of mechanical energy as due to either the movement of an object (kinetic) or its position (potential). So, a bowling ball in a bowler's hands has potential energy and then kinetic energy as it rolls down the lane toward the pins. When it strikes the pins, its mechanical energy is transferred to the pins, and they go flying.

Ms. Understanding

Chapter 3 Energy Conversions

FOCUS

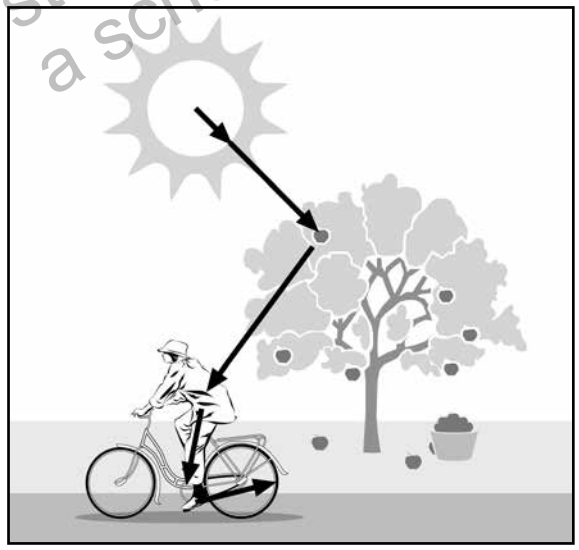
In this section you will read about how energy can be converted to different forms. Use this as a way to review the forms of energy you learned in the last section. If you see a type of energy that you can't quite remember, go back and look it up.

Energy Changes

Any form of energy can be changed to another form. As we know, potential energy is stored, and needs to be converted to kinetic energy to do work. But all the different forms of energy can be converted to other forms, as well.

For example, the chemical energy from the food you eat powers your legs to pedal a bike. In this way, chemical energy is converted into mechanical energy. The potential energy stored in your muscles is converted into the kinetic energy of the moving bike. If you pedal up a hill and slowly come to a stop, the kinetic energy of the bike is converted back into potential energy.

You can think of energy conversions like a long chain. One type of energy is converted to another, and another, and another. Like a food chain, most energy chains can be traced back to the sun. That is where chemical reactions in the core produce radiant energy.



You can think of energy conversions as a kind of chain. Follow the energy chain in this diagram.

ACTIVE READER

1 Connect *Create a chain of at least four energy conversions that begin with the chemical energy of your breakfast. Draw your chain below.*

Many other conversions are also possible. However, no energy is ever lost during these conversions. All of the energy involved in a change appears in some form after the change is completed.

The Law of Conservation of Energy states that energy cannot be created or destroyed. It can only change its form. In fact, the total amount of matter and energy available in the universe doesn't change. There will never be any more or any less.

FOCUS QUESTIONS

1. **What kind of energy can radiant energy be converted to?**

_____

_____

2. **The sound of a siren travels through the air; when it strikes your eardrum, your eardrum vibrates and you hear sound. What two forms of energy are involved in this conversion?**

_____

_____

_____

ACTIVE READER

1 Recall *Look back at the illustration on page 25.*

Identify the relationship and type of energy conversion that occurs at each step in the chain.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Discover Energy Conversions Energy is being converted around you (and by you) all the time! In this activity, you will be identifying some of these transformations. For example, when you hit your pencil against a desk, it makes a noise—mechanical energy is converted to acoustic energy.

Observe

1. Rub your hands together vigorously for 30 seconds. Describe what you observe happening and what you feel.

Explain

2. What simple energy conversion is taking place that explains what you feel?

Extend

3. When it's cold, your hands need help getting warm. Some people use hand-warmers that contain chemicals, which when mixed generate heat that warms your hands. What kind of energy conversion is happening?

Connect

4. Describe three energy conversions that you can observe at school or at home. Make sure you describe what kind of energy is being transformed into each new form.

Stop and Think

This page will help you summarize what you have read so far.

Tip:
Look back through the chapter to find key words in the answer choices. Reread the sentences that contain those words.

1. When the sun's light rays are focused through a magnifying glass onto something dry, like leaves, the leaves will start to burn. What kind of energy conversion is this?

(1) electromagnetic to thermal
(2) chemical to electromagnetic
(3) nuclear to thermal
(4) electromagnetic to mechanical

Base your answers to questions 2 and 3 on the information below and on your knowledge of science.

In some nuclear submarines, a reactor splits atoms to generate heat used to create steam. This steam heat drives an electrical generator to create electricity, which is used to turn the driveshaft and propellers.

2. Draw an energy chain with arrows to show which kinds of energy are being converted at each step. Hint: there are four different types of energy involved.

3. Write a sentence explaining the energy conversion involved in the final step.

Dear Ms. Understanding,

So, I get that almost all of our energy here on Earth can eventually be traced back to the sun's radiant energy. But I learned that all energy comes from somewhere, so where does the sun's energy come from?

Careful in Carmel

Dear Careful,

What a great question! The radiant energy that reaches Earth comes from nuclear reactions between atoms in the sun's hot core. But that nuclear energy has to come from somewhere, right? Scientists believe an event called the Big Bang created all the energy and matter in our universe, in a fraction of a second, and it's this energy that is constantly converted. Exactly how the Big Bang worked, and what came before that, are not yet known. Perhaps you'll someday help to answer some of these questions!

Ms. Understanding

Glossary

atom – a very tiny particle of matter

charge – energy stored chemically in a battery for conversion into electricity

chemical bond – a connection holding different atoms together

chemical composition – the chemicals that make up an object

energy – the ability to do work

kinetic energy – the energy of motion; something must have mass and be moving

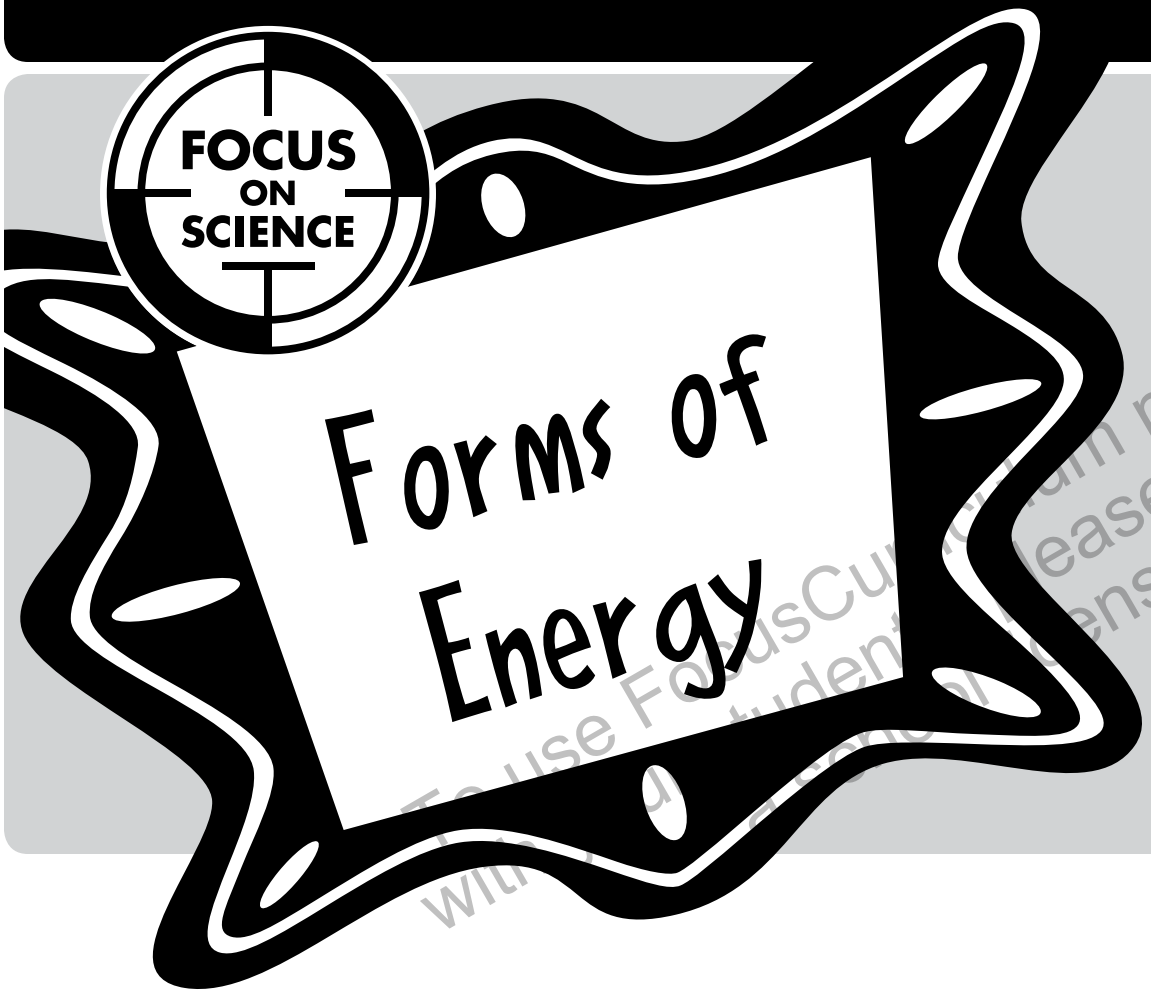
nucleus – the center of an atom

particle – a tiny part of a whole

pigment – the natural coloring matter of an animal or plant

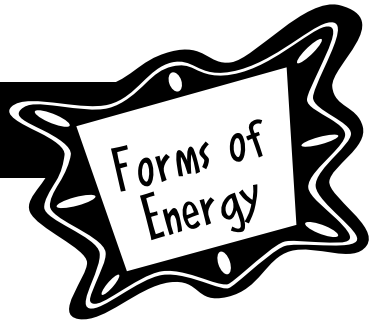
position – a place where something is located

potential energy – energy that is stored in an object's position or its chemical composition



Assessments

Check Understanding



In the Answer Document on this page, mark your answer in the row of circles for each question by filling in the circle that has the same number as the answer you have chosen.

1. Which of the following sentences about potential energy is not true?

   (1) Potential energy can do work directly on an object.

   (2) Potential energy can be stored in the position of an object.

   (3) Potential energy can be converted to other forms of energy.

   (4) Potential energy can be stored in the chemical composition of an object.

2. Your car converts gasoline into the motion of the turning wheels so your car moves. What kind of energy conversion is this?

   (1) nuclear to mechanical

   (2) chemical to mechanical

   (3) mechanical to chemical

   (4) electromagnetic to mechanical

Answer Document

1. ① ② ③ ④
2. ① ② ③ ④

Record your answers in the space provided below each question.

Base your answers to questions 3 and 4 on the information below and on your knowledge of science.

A stove has a coil with electric current running through it. As the current passes through the coil, the coil both glows red and heats up.

3. Identify the first form of energy being used.

_____

_____

_____

4. Explain all the energy conversions that are occurring in this situation.

_____

_____

_____

_____

_____

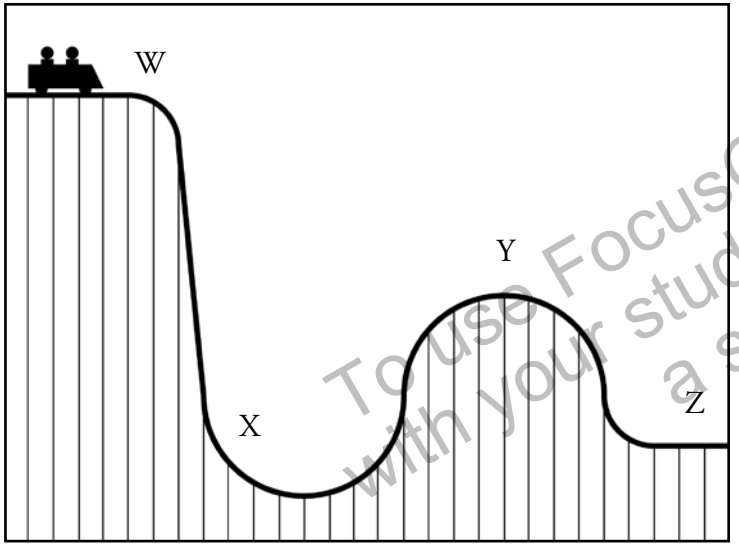
_____

_____

Check Understanding

In the Answer Document on this page, mark your answer in the row of circles for each question by filling in the circle that has the same number as the answer you have chosen.

Base your answers to questions 5 and 6 on the diagram below and on your knowledge of science.



5. At which point does the car have the most potential energy?

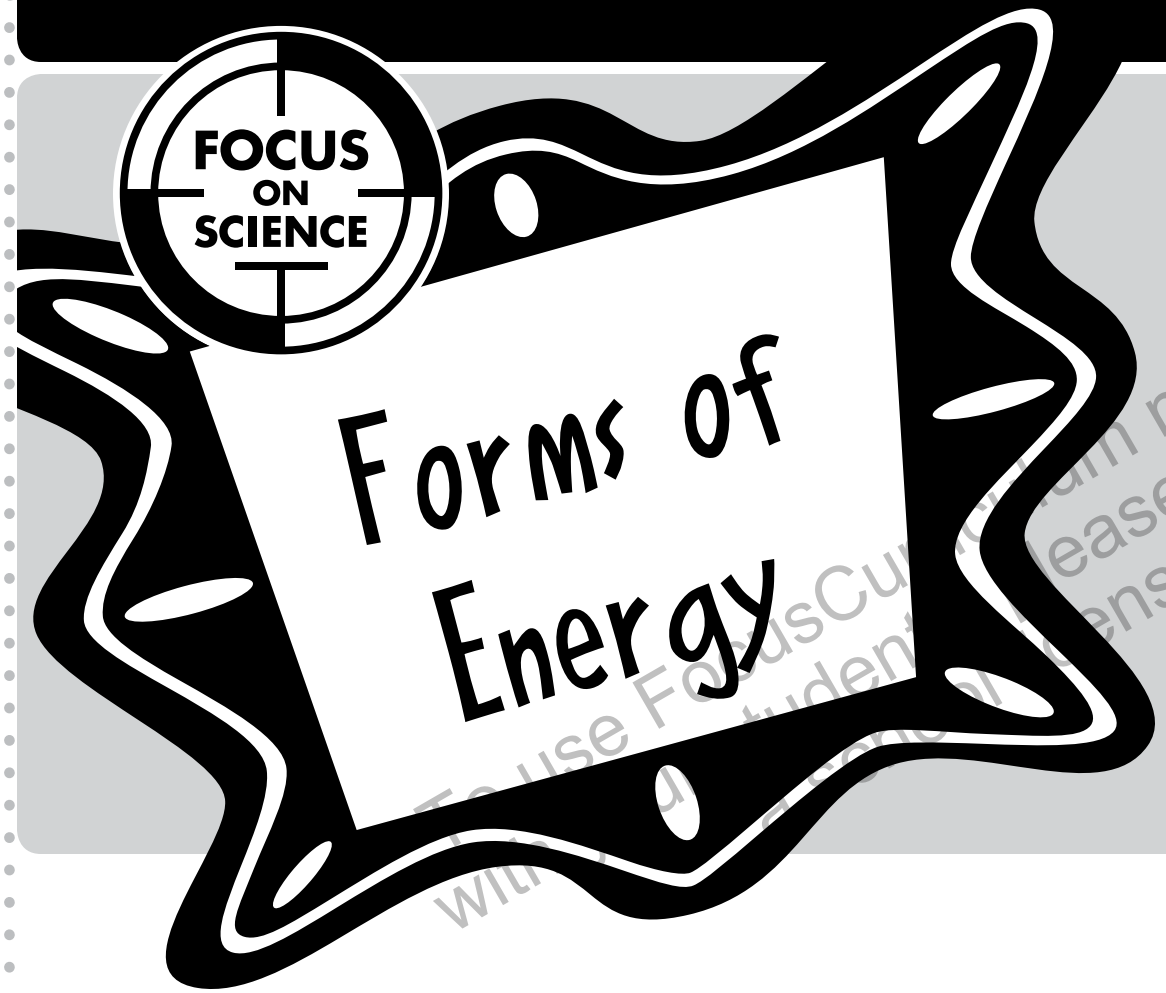
   (1) point W
   (2) point X
   (3) point Y
   (4) point Z

6. Assume that the car is moving at points X, Y and Z. The BEST way to describe the energy of the car as it passes point Y is that the car has what kind of energy?

   (1) kinetic energy
   (2) potential energy
   (3) mechanical energy
   (4) potential and kinetic energy

Answer Document

1. ① ② ③ ④
2. ① ② ③ ④



Answer Key

Answer Key

Pages 8: Starting Points:
Build Background
Define: Answers will vary, depending on students' prior knowledge.
Brainstorm: Answers will vary.

Pages 9 and 10: Starting Points:
Key Vocabulary: Answers will vary.

Page 11: Starting Points: Key Concepts
Active Reader: Answers will vary, but students should identify when they feel most active.

Page 12: Chapter One
Active Reader: Answers will vary, but students should connect their understanding of the term kinetic. Kinesiology is the study of human motion.

Page 13: Chapter One
Active Reader: Kinetic energy can do work directly, potential energy cannot.

Page 14: Chapter One
Active Reader: 1. an ice cream cone, 2. Ice cream cone has more energy because it stores more calories.
Focus Questions: 1. The car driving 65 mph has more kinetic energy; since the masses are the same, the faster car has more kinetic energy., 2. Potential energy differs from kinetic energy in that potential energy cannot do work on objects directly; it has to be put in or stored somehow. Potential energy is stored in position and chemical composition., 3. Ball B has more potential energy because it is higher and so has more gravitational potential energy.

Page 15: Hands on Science: Identify Kinetic and Potential Energy:

Object	Kinetic, Potential, or Both?
A ball rolling along the ground	kinetic
A muffin	potential
A plane flying through the air	both
A car driving on the road	kinetic
A compressed spring	potential
The gasoline tank in a moving car	both

Pages 16-18: Hands on Science: Measure the Effect of Height on Energy
Hypothesis: answers will vary
Analysis: 1. a. independent variable: height of drop. b. dependent variable: energy of impact, measured by diameter of crater, 2. Potential energy (gravitational), because the ball is held up and not moving., 3. Kinetic energy, because the ball is moving and is (almost) at a height of zero., 4. Will vary according to data; most students should find that the height of the drop increases the energy of the ball as measured by the diameter of the crater., 5. Each trial was performed three times so that students could determine an average diameter.

Page 19: Stop and Think
1. (1), 2. (2)

Page 20: Chapter Two
Active Reader: 1. Answers will vary, but students should name three or more objects that use electricity., 2. Answers will vary, but students should offer an opinion as to whether electrical devices have improved life or not.

Page 21: Chapter Two
Active Reader: 1. Answers will vary.

Page 22: Chapter Two
Active Reader: 1. Answers will vary depending on what students know about nuclear power production., 2. Kinetic, since the waves of acoustic energy move whatever they travel through.

Answer Key

Page 23: Chapter Two
Focus Questions: 1. Both: Electrical energy is stored as potential energy in the charge separation, but used as kinetic energy in the flow of charge as current., 2. Kinetic: Mechanical energy is defined as movement-based., 3. Potential: Chemical energy is energy stored in bonds. It has the potential to do work when the bonds are broken, but the storage itself doesn't do work.

Page 24: Stop and Think
1. (1), 2. (2), 3. (4)

Page 25: Chapter Three
Active Reader: Food chains will vary, but should begin with breakfast and have four energy conversions.

Page 26: Chapter Three
Active Reader: 1. Students should identify at least four types of energy conversions that occur in their energy chain.
Focus Questions: 1. any kind, 2. acoustic to mechanical/kinetic

Page 27: Hands On Science: Discover Energy Conversions
1. Hands should warm up., 2. Mechanical (or kinetic) energy of hand rubbing is being converted to thermal energy (heat).,
3. chemical energy to thermal energy.,
4. Answers will vary.

Page 28: Stop and Think:
1. (1); 2. Energy chain: nuclear energy to thermal energy (steam) to electrical energy to mechanical energy.; 3. Electrical energy from the generator is converted to mechanical energy as the propellers move. In this way potential energy is converted to kinetic energy.

Page 33: Assessments
Check Understanding: 1. (1), 2. (2),
3. Electrical energy is used as a current is passed through the coil., 4. Electrical energy is converted to thermal energy and radiant, or electrocagnetic energy.

Page 34: Assessments
Check Understanding: 5. (1), 6. (4)