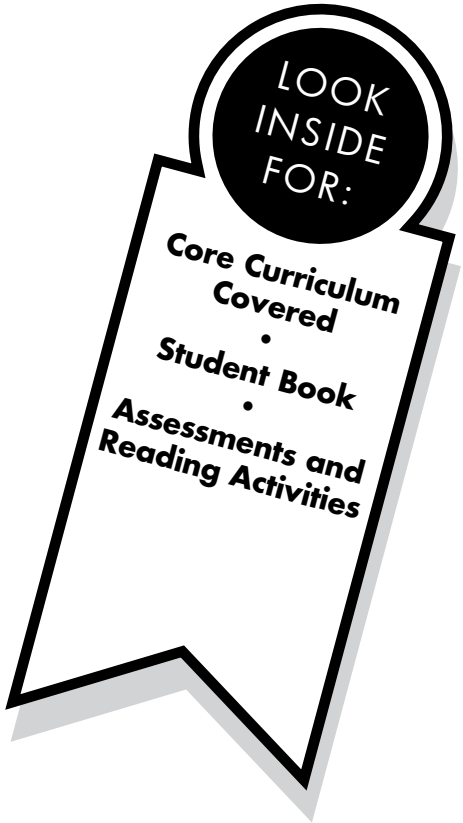
Physical Science

Matter and Energy

Basic Level

Heat Is Energy



FOCUScurriculum

866-315-7880 • www.focuscurriculum.com

Heat Is Energy

What are some ways that energy can be changed from one form to another?

CORE CURRICULUM STATEMENTS

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

Energy exists in various forms: heat, electric, sound, chemical, mechanical, light.

Energy can be transferred from one place to another.

Some materials transfer energy better than others (heat and electricity).

Energy and matter interact: water is evaporated by the Sun's heat; a bulb is lighted by means of electrical current; a musical instrument is played to produce sound; dark colors may absorb light, light colors may reflect light.

Heat can be released in many ways, for example, by burning, rubbing (friction), or combining one substance with another.

Physical Science

Matter and Energy

Basic Level

Student Book

Heat Is Energy

BL

Heat Is Energy

What are some ways that energy can be changed from one form to another?

CORE CURRICULUM STATEMENTS

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

Energy exists in various forms: heat, electric, sound, chemical, mechanical, light.

Energy can be transferred from one place to another.

Some materials transfer energy better than others (heat and electricity).

Energy and matter interact: water is evaporated by the Sun's heat; a bulb is lighted by means of electrical current; a musical instrument is played to produce sound; dark colors may absorb light, light colors may reflect light.

Heat can be released in many ways, for example, by burning, rubbing (friction), or combining one substance with another.

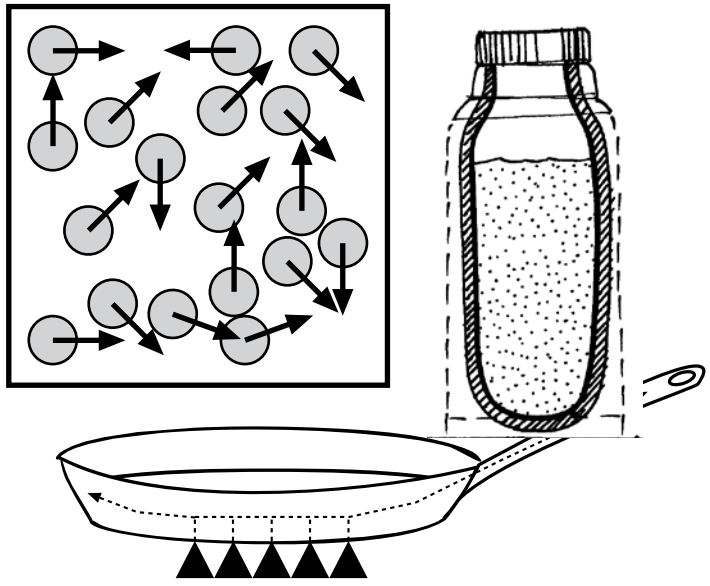
FOCUS ON SCIENCE

Physical Science

Matter and Energy

Heat Is Energy

by Caitlin Scott



FOCUS ON SCIENCE

Physical Science

Matter and Energy

Heat Is Energy

by Caitlin Scott

FOCUScurriculum

Curriculum materials for **your** content standards

Table of Contents

– Predict –
What do you think you will learn from reading this book?

Heat Is Essential for Life

Have you been outside on a cold day? You didn't get cold right away. Instead, you slowly felt colder. That's because your body **generates** its own heat.

You know you should dress in warm clothes when it is cold. Warm clothes **insulate** you. They keep your body heat from moving out into the cold air.

generate: to make
insulate: to keep heat from moving

What would happen if you were lost outside in winter? Slowly, the sun would set. Without the sun's energy, the air would get colder. Your body heat would be lost into the air more quickly. You would get colder.

What could you do? First, you might jump up and down to generate more heat. However, this would not be enough. You would need to find another source of heat, or you might die. Heat is a basic need of life.

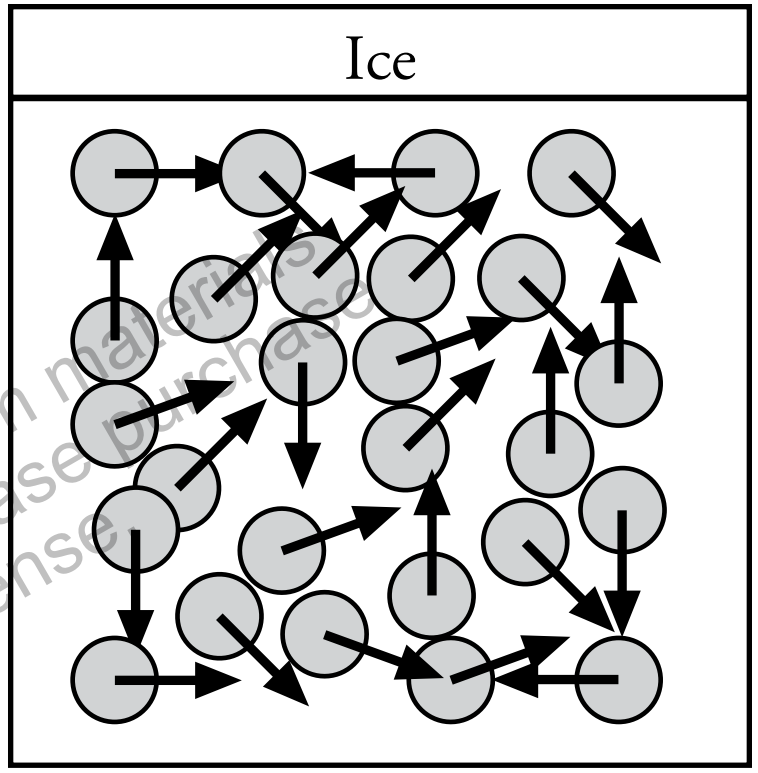
CHAPTER 1

Heat Versus Temperature

Temperature is a measurement of how hot or cold something is. It can be measured using a thermometer. Heat is a form of energy caused by the movement of tiny particles in matter.

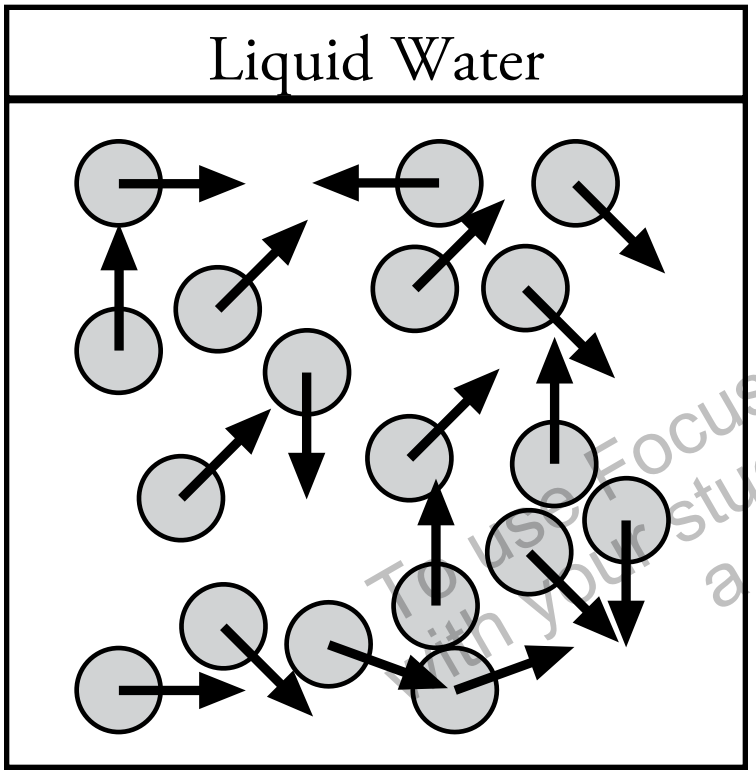
Think about water. It can be in the form of a solid, liquid, or gas.

When water is solid, as in ice, the tiny particles in water are close together. They move slowly. Not much heat can be made. Ice is cold.



In ice, tiny particles are close together. They don't move much, so they don't generate much heat.

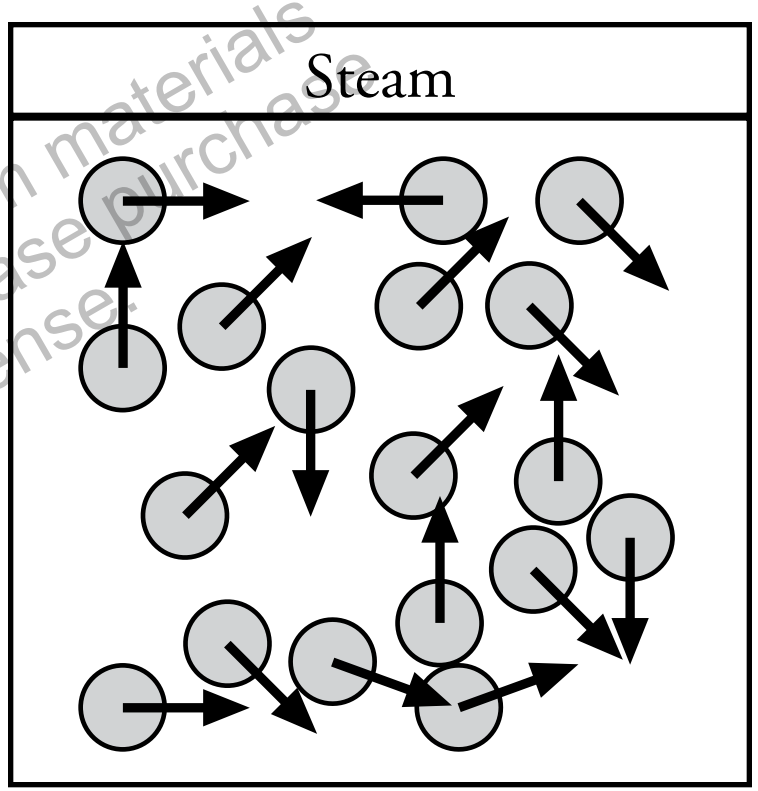
In liquid form, water's particles are farther apart. They can move around more. The movement can create some heat.



In liquid form, particles in water move a bit faster and generate a bit more heat.

– Compare –
Explain why ice is colder than liquid water.

As a gas, the particles of water are farther apart than a liquid. They can move more quickly and generate more heat.



In steam, the particles are farthest apart, so they move most rapidly and generate the most heat.

CHAPTER 2

Heat Transfer

Heat moves, or **transfers**, from a warmer object to cooler one. On a cold day, your body heat is transferred to the cold air.

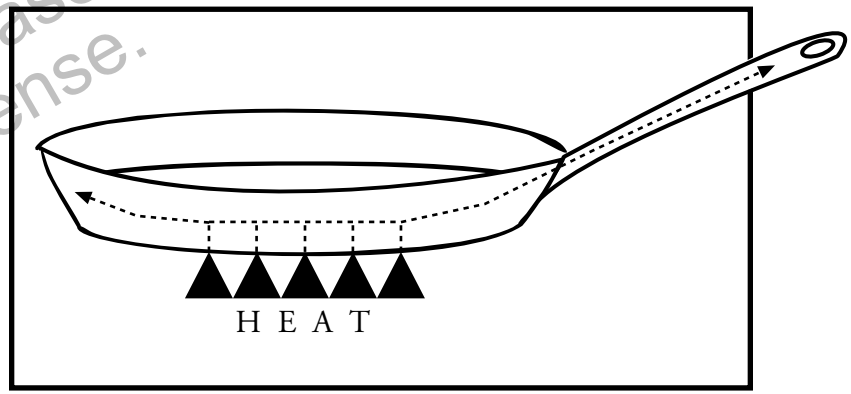
There are three ways heat transfers—conduction, convection, and radiation.

Conduction

Conduction is the movement of heat through **solids**. Think about a frying pan with a metal handle. You put the pan on the stove. Next, you turn on the heat. What happens to the metal handle? The stove heats the bottom of the pan. Over time, heat moves up the sides of the pan and into the handle.

transfer—to move from one place to another
solid: a state of matter that has a definite size and shape

Why does heat move like this? As the pan heats, the particles in the bottom of the pan move faster. They bump into each other creating heat. These moving particles start bumping into particles in the sides of the pan and then the handle. The handle then becomes hot.



– Explain –
How does conduction cause heat to transfer from a stove to the handle of a frying pan?

Convection

Convection is the movement of heat through liquids and gases. Once again, heat moves from hotter areas to colder areas.

Think about pouring cream into a cup of coffee. The coffee is hot. The cream is cool. The cream mixes with the coffee. Heat moves from the coffee to the cream. Soon, they are the same temperature. Will it be warmer or cooler than the original temperature of the coffee?

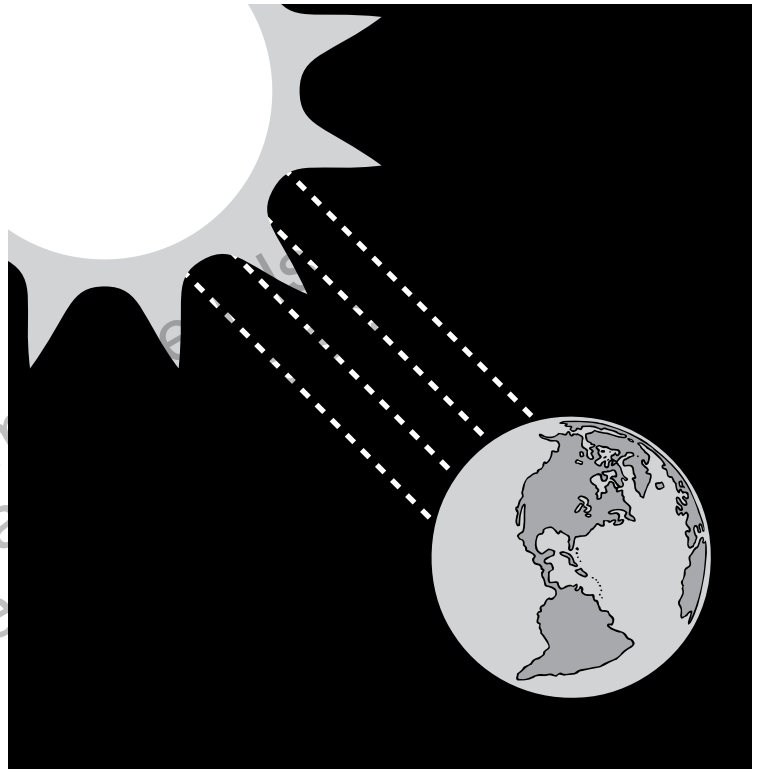
The same happens for gases. Think about a furnace in a house.

The furnace heats air and blows it into a cool room. The heat from the hot air mixes with cool air. The heat in the warm air is transferred to the cooler air through convection.

Radiation

Radiation is the movement of heat through a vacuum. A vacuum is an empty space. There are no solid, liquid, or gas particles in it. For example, outer space is a vacuum.

Radiation allows heat to move in a vacuum. That is how we get heat from the sun. Light and heat travel from the sun through the vacuum of space. When it reaches Earth, it provides us with light and heat.



Heat from the sun radiates through the vacuum of space.

– Compare –
Explain the difference between conduction, convection, and radiation.

– Apply –
Think about all the things you touched today that felt hot. Where did the heat come from? Discuss this with a classmate.

CHAPTER 3

Transfer Materials

You just learned that heat moves in three ways—conduction, convection, and radiation. But, some things make heat move more quickly. Others slow down the transfer of heat.

Conductors

Conductors are things that speed up the movement of heat. Solids are better conductors than liquids. Liquids are better than gases.

The particles in solids are close together. Heat moves quickly from one particle to the next. In liquids, particles are further apart. Heat moves a little more slowly. In a gas, heat moves even more slowly.

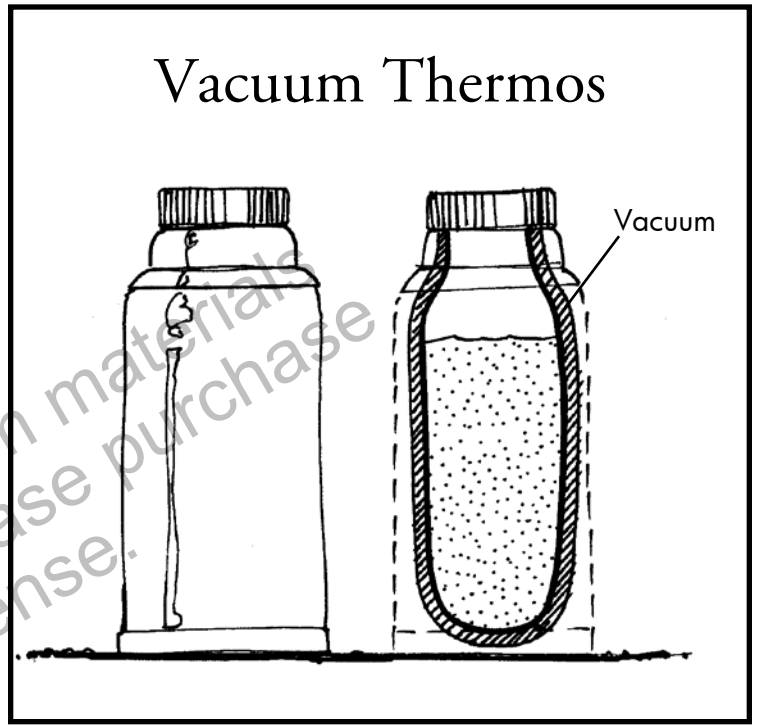
What do we do when we want heat to move quickly? We use good conductors. Think about cooking. People want heat to transfer quickly from the stove to their food. What are pots and pans made of?

Most pots and pans are made of solid metal. Most metals are good conductors. Glass is also a good conductor. Some baking dishes are made of glass.

Insulators

Sometimes we want things to stay warm. So, we use insulators. An insulator slows the movement of heat. Coats, hats, and gloves insulate you in the cold winter.

The best insulator for conduction or convection is a vacuum. You know heat moves when tiny particles bump into one another. You also know that there are no particles in a vacuum. So, heat cannot move.



A vacuum thermos is great for keeping things cold or hot. A thermos has an inner lining and an outer lining. Between these two linings is a vacuum. It slows heat from moving by conduction or convection.

CHAPTER 4

The Mpemba Effect

Scientists in many different countries help us understand heat. One important discovery was made by Erasto B. Mpemba. He was just a 15 year-old high school student in Tanzania, Africa.

For a long time, people thought liquids cooled at a **constant** rate. They thought cool water would freeze faster than warm water. It just made sense. Mpemba proved everyone wrong, though.

constant: not changing; staying the same

Mpemba was making ice cream in high school science. This was supposed to show how liquids changed to solids. But, Mpemba didn't follow all the steps. He didn't cool his cream and sugar mixture. He just put it right in the ice cream maker. A funny thing happened. His ice cream was done before the rest of the class.

Other scientists tried it too. Mpemba was right. Sometimes warm liquids freeze faster than cold liquids.

Scientists are still trying to figure out why. They call Erasto's discovery the Mpemba Effect.

– Hypothesize –
Why do you think warm liquids might freeze faster than cold liquids? Talk about it with a friend.

Glossary

constant—not changing; staying the same

generate—to make

insulate—to keep heat from moving

transfer—to move from one place to another

To Find Out More . . .

Want to learn more about heat?

Try these books

Energy Projects for Young Scientists by Richard Craig Adams and Robert Gardner. Franklin Watts, 2003.

Environmental Experiments About Renewable Energy by Thomas R. Rybolt and Robert C. Mebane. Enslow Publishers, 1994.

Access these Web sites

Energy Kids Page: The Energy Information Administration
http://www.eia.doe.gov/kids/

U.S. Department of Energy for Students and Kids
http://www.energy.gov/forstudentsandkids.htm

Write for More Information

Energy Information Administration
1000 Independence Ave., SW
Washington, DC 20585
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585

Index

Published by FOCUScurriculum

866-315-7880

www.focuscurriculum.com

Order Number: PS-23BL

Created by Kent Publishing Services, Inc.

Designed by Signature Design Group, Inc.

Physical Science

Matter and Energy

Basic Level

Assessments

Heat Is Energy

Print pages 20–22 of this PDF for the assessments.

Heat Is Energy

Check Understanding

Shade the circle next to the correct answer or write your answer on the lines provided.

1. People wear jackets outside when it is winter. How do jackets help people stay warm?

Ⓐ Jackets keep all heat energy from leaving the body.

Ⓑ Jackets keep most heat energy from leaving the body.

Ⓒ Jackets keep all heat energy from entering the body.

Ⓓ Jackets keep most heat energy from entering the body.

2. A pan is put on a stove and the heat is turned on. In a few minutes the handle of the pan becomes hot. What allowed the handle of the pan to become hot?

Ⓐ radiation

Ⓑ convection

Ⓒ conduction

Ⓓ insulation

3. Heat and temperature are two different things. Explain what temperature is.

_____

_____

_____

_____

_____

Explain what heat is.

_____

_____

_____

_____

_____

Check Understanding

Shade the circle next to the correct answer or write your answer on the lines provided.

4. A student puts a pot of cold water on a stove. She turns the stove on. The water becomes warmer. Identify what happened.

_____

_____

_____

Explain why it happened.

_____

_____

_____

_____

_____

_____

5. What form of energy causes an ice cube to melt?

Ⓐ electrical

Ⓑ heat

Ⓒ mechanical

Ⓓ magnetic

6. Which instrument would you use to measure heat?

Ⓐ graduated cylinder

Ⓑ pan balance

Ⓒ thermometer

Ⓓ ruler

7. A student rubs his hands together and they get warm. What forms of energy were transfered?

Ⓐ mechanical to heat

Ⓑ electrical to magnetic

Ⓒ light to heat

Ⓓ mechanical to sound

Heat Is Energy

Assessment Scoring Guidelines

1. Answer B is correct.

2. Answer C is correct.

3. Temperature is a measurement of heat.

Heat is a form of energy caused by the movement of tiny particles in matter.

4. Heat was transfered from the stove to the pot and then to the water.

The hot stove created tiny particles in the pot to move around. This generated heat in the pot. Then the moving particles in the pot started bumping into particles in the water.This caused the water to become warmer.

5. Answer B is correct.

6. Answer C is correct.

7. Answer A is correct.

Physical Science

Matter and Energy

Basic Level

English Language Arts Activities

Heat Is Energy

Print pages 24–28 of this PDF for the reading activities.

Make Predictions

You can use facts in informational writing to make predictions. *Thermal Energy* contains many facts about the heat that would help you predict heat transfer.

Read this paragraph from *Thermal Energy*.

Why does heat move like this? Think about the particless in the pan. As the bottom of the pan heats up the particles move faster. The pan doesn't melt like ice, but the particles do start to move faster. They bump into the particles in the sides of the pan, so that they start to move faster, too. Finally this bumping moves all the way into the handle.

What would happen if you put a metal lid on the pan? Can you answer the question?

The lid of the pan is likely to heat up, too.

TRY THE SKILL

Read the paragraph. Then answer the questions.

Maria went ice skating. She put on her favorite fluffy cotton sweater. The fibers in the cotton form tiny pockets of air. These pockets trap air and prevent the transfer of heat away from the body by convection. However, if the fibers absorb moisture, the air pockets break down.

1. Why does Maria wear a sweater?

Ⓐ to conduct heat from her body
Ⓑ to insulate her body
Ⓒ to allow heat to radiate to her body

2. What will happen if Maria gets in a snowball fight and her sweater gets wet and soggy?

Ⓐ Her mother will be mad that she got in a fight, so she should hide the evidence.
Ⓑ She should keep her wet sweater on because it will still be able radiate heat to her body.
Ⓒ She should change her sweater because wet cotton doesn't insulate well.

Summarize

Summarizing means retelling what you have read.
Summaries are shorter than the text you read.
But, they may include more than one main idea.

Read this paragraph from *Heat Is Energy*.
Try summarizing it.

> Have you been outside on a cold day? You probably didn't get cold right away. Instead, you slowly felt colder. That's because your body generates its own heat. But if the air is colder than your body, then your body's heat is slowly lost.

Is this a good summary?

Your body generates it's own heat.

No! This statement is too specific and does not summarize the main ideas. How about the one below? Is this a good summary?

If you go outside on a cold day, you slowly get cold. This is because you lose body heat.

Yes! These are main ideas of the paragraph.

TRY THE SKILL

Read the paragraphs. Shade the circle next to the best summary.

1. You may not have known about body heat. But, you probably knew you should dress in warm clothes like a coat, a hat, and mittens. Warm clothes insulate you.

Ⓐ You probably did not know much about body heat.

Ⓑ You wear warm clothes in winter. These clothes insulate you.

Ⓒ You should always wear a hat. But, you may not know about heat.

2. What would happen if you were outside in winter and got lost? Slowly, the sun would set. Without the sun's energy, the air would get colder. Your body heat would be lost into the air more quickly. You would get uncomfortable. You might be in danger of freezing.

Ⓐ What would happen if you were outside in winter and got lost?

Ⓑ The sun sets very slowly. The sun might make you uncomfortable.

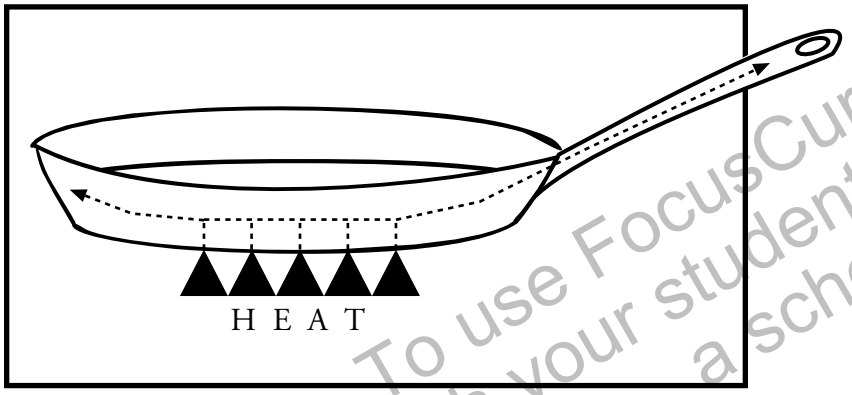
Ⓒ When the sun sets, you get cold faster. You might even freeze.

Interpret Graphics

TRY THE SKILL

Graphics give you a lot of information quickly. Understanding graphics can help you understand what you read.

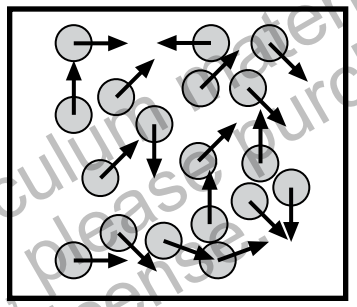
Look at this graphic from *Heat Is Energy*.

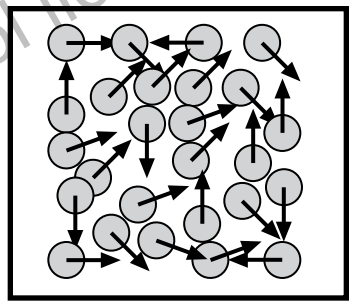


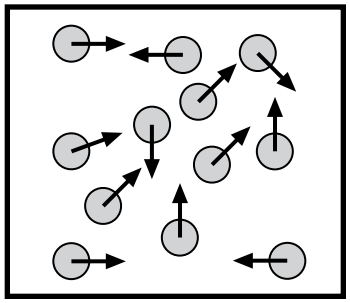
What does this graphic tell you?

Heat from the stove moves into the bottom of the metal pan and then into the handle. This is an example of conduction.

Use what you know about heat energy to write a caption for each illustration.







Steps in a Process

In good directions, each step is clear and complete. You can make your directions clear by using words such as, *first, then, next,* and *finally*. This will help.

Read this passage from *Heat Is Energy*. Restate the steps clearly.

Conduction is the movement of heat through solids. Think about a frying pan with a metal handle. You put the pan on the stove. Next, you turn on the heat. What happens to the metal handle? The stove heats the bottom of the frying pan. Over time, heat moves up the sides of the pan and into the handle.

Step 1	First, you put the pan on the stove.
Step 2	Next, you turn on the heat.
Step 3	Then, the stove heats the bottom of the frying pan.
Step 4	Finally, heat moves up the sides of the pan and into the handle.

TRY THE SKILL

Read this passage. How does convection move heat when you pour cream into coffee? Try to identify the steps in the process. Use the graphic organizer to help.

Convection moves heat through liquids and gases. You pour cream into a cup of coffee. The cream mixes with the coffee. Heat moves from the coffee to the cream. Soon, they are the same temperature.

Step 1	
Step 2	
Step 3	

Answer Key

Make Predictions

1. B

2. C

Summarize

1. B

2. C

Interpret Graphics

Water

Particles in water have more space between them than particles in ice, so they move a bit faster and generate a bit more heat energy.

Ice

Particles in ice are so tightly packed that they can't move, so they don't generate much heat energy.

Steam

Particles in steam are furthest apart, so they move most rapidly and generate the most heat energy.

Steps in a Process

Step 1: First, you pour cream into a cup of coffee.

Step 2: Next, heat moves from the coffee to the cream.

Step 3: Finally, they are the same temperature.