

Read and Learn

Essential Question

How does heat flow? 2g

Vocabulary

heat, p. 314

conduction, p. 316

convection, p. 316

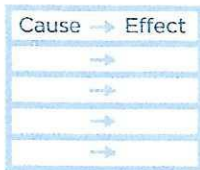
radiation, p. 317

insulators, p. 318

conductor, p. 318

Reading Skill

Cause and Effect



Technology

e-Glossary and e-Review online
at www.macmillanmh.com

What is heat?

Energy is needed for animals to stay warm. Whether it's from the Sun or your body, thermal energy keeps you warm. *Thermal energy* is the energy of the moving particles of matter. The faster the movement of particles, the greater the amount of thermal energy.

Heat is the movement of thermal energy from one object to another. Heat always moves from warmer objects to cooler objects.

Sources of Heat

Some sources of heat include burning wood and fossil fuels. The Sun is Earth's main source of heat. Inside Earth, it is very hot. This source of heat is called geothermal energy.

Try rubbing your hands together. When you rub your hands together you produce *friction*. Friction is another way to produce heat.



Friction between the match head and the surface creates heat.

Changing Temperature

Heating can change an object's temperature (TEM•puh•ruh•chur). *Temperature* is related to the thermal energy of the particles in a substance.

We measure temperature with a *thermometer* (thur•MAH•muh•tur). Inside most thermometers is a liquid such as alcohol. As the thermometer warms, the particles of the liquid move faster and farther apart. This movement makes the liquid expand and rise inside the thermometer.

Have you ever had a fever? You probably measured your temperature in degrees Fahrenheit (F). Scientists often use the Celsius (C) scale to measure temperature.

The thermometer on this page shows the Fahrenheit and Celsius scales. Water freezes at 32°F . This is in the same place on the thermometer as 0°C . Water boils at 212°F . As you can see, that is the same as 100°C .

Quick Check

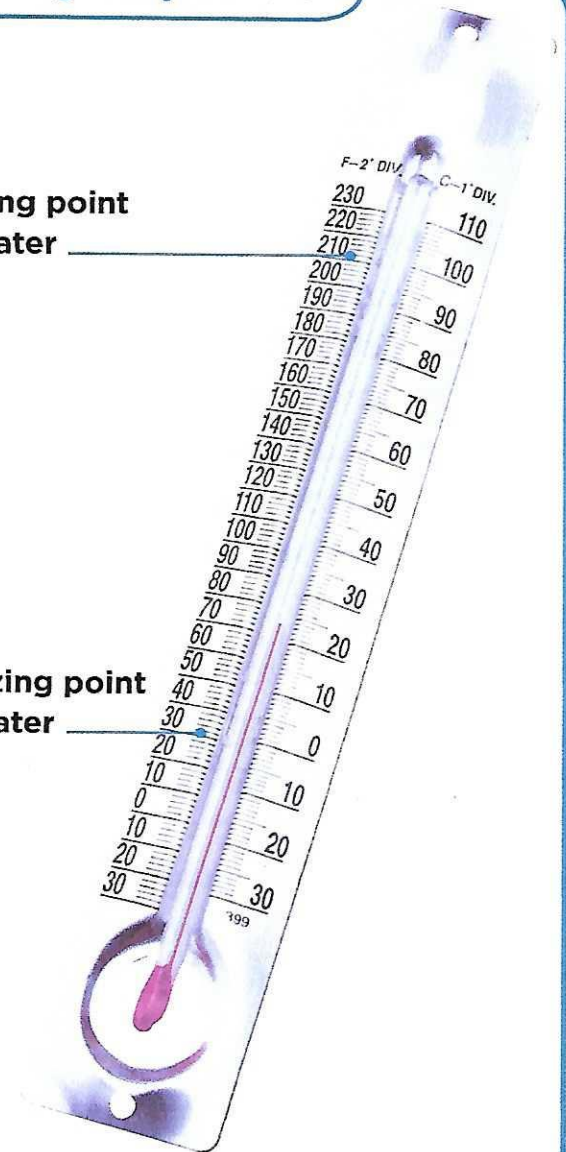
Cause and Effect What happens to the particles of an ice cube when placed in a glass of juice?

Critical Thinking How are heat and temperature related?

Measuring Temperature

boiling point
of water

freezing point
of water



Read a Photo

What is the temperature in Fahrenheit? In Celsius?

Clue: Find the marks near the top of the red line.

How does heat travel?

You have learned that heat is the movement of thermal energy. Heat can travel in three basic ways.

Conduction

Solids are heated mainly by conduction (kun•DUK•shun).

Conduction occurs between two objects that are touching. Conduction can also occur within an object, such as a metal pot.

What happens when you heat a pan on a stove? The fast moving particles of the burner or flame hit the cooler particles of the pan. The collision gives the cooler particles more thermal energy. The particles of the pan start to move faster. Soon, the entire pan gets hot.

Convection

If you want to boil water, you can heat it in a pot. First the pot heats by conduction. Then the water heats by convection (kun•VEK•shun). **Convection** transfers thermal energy through liquids or gases.

As the pot heats, it transfers energy to the water. The water particles at the bottom of the pot heat first. They move faster and farther apart. The hot water particles become less *dense*, or packed together. The denser, cooler water at the top sinks. It replaces the hot water. Convection transfers heat as these hotter and cooler particles change places and mix.



Heat Transfer

Heat is transferred through the water by convection.

Heat is transferred from the flame to the pot by conduction.

Read a Diagram

Describe how heat is flowing in this pot of water.

Clue: The red circles are hot particles. The blue circles are cooler particles.

Radiation

Radiation (ray•dee•AY•shun) is the third way heat is transferred. Radiation is the transfer of heat by wave energy, such as light waves. Radiation can travel through space. Conduction and convection require matter to transfer heat.

Without radiation, energy from the Sun would not reach Earth. When the Sun's energy reaches Earth, it heats land and water surfaces. The surfaces then warm the air.

Quick Check

Cause and Effect The end of a metal spoon in hot water gets hot. Why?

Critical Thinking How is radiation different from conduction and convection?

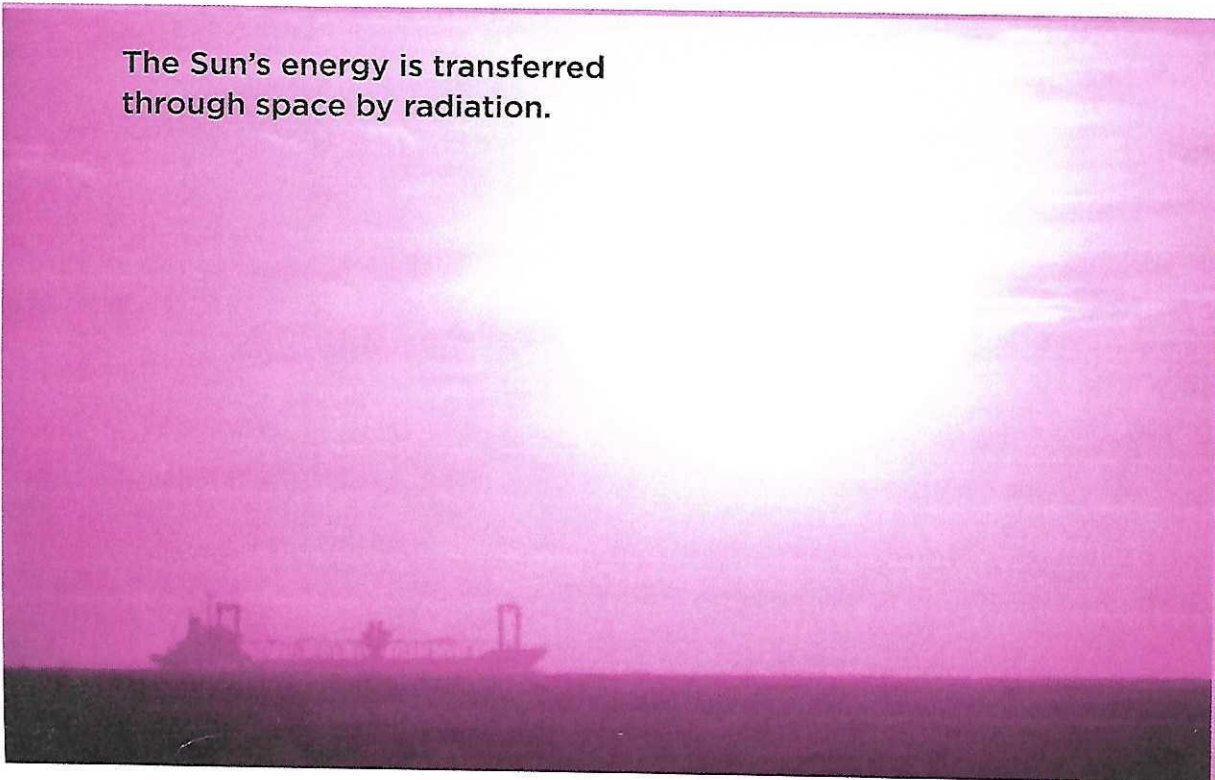
Quick Lab

Temperature and Air

- 1 Predict** Place a deflated balloon over the mouth of an empty plastic bottle. What will happen if you put the bottle in hot water? In cold water?
- 2 Observe** Place the bottle in a bucket of warm water. Wait five minutes. What happens to the balloon?
- 3** Now place the bottle in a bucket of ice water. What happens?
- 4** What do you think caused the balloon to inflate and deflate?



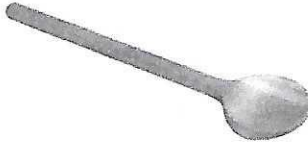



The Sun's energy is transferred through space by radiation.



What materials are insulators and conductors?

In winter, you might wear a fleece jacket to stay warm. Fleece is an insulator (IN•suh•lay•tur). **Insulators** do not transfer heat easily. Fat is an insulator that many animals have in their bodies. It helps keep their body heat from escaping into the cold air.

The opposite of an insulator is a conductor (kun•DUK•tur). A **conductor** transfers heat easily. Metal is a good conductor. That is why many pots and pans are made of metal. A metal spoon feels cool to the touch because it conducts heat away from your body.

Insulators and Conductors		
<p>Wood and plastic are good insulators of heat transferred by conduction. One end of a wooden spoon will not be too hot to touch when left in boiling water.</p>		<p>Trapped air is a good insulator. Warm coats and hats trap air against our bodies and keep us warm.</p> 
Insulators ▲		
<p>Metals are good conductors. The thermal energy from a stove is quickly conducted to the food inside a metal cooking pot.</p>		<p>On sunny days, the asphalt will conduct heat. The asphalt will be hot to the touch.</p> 
Conductors ▲		

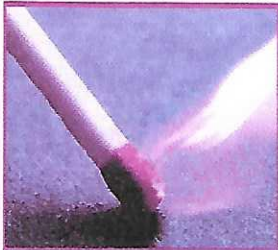
✓ Quick Check

Cause and Effect A metal object feels cooler than a wood object at room temperature. Why?

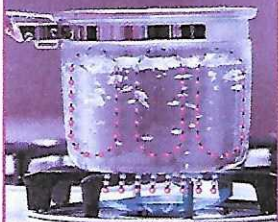
Critical Thinking How does a beach umbrella help keep you cool on a sunny day at the beach?

Lesson Review

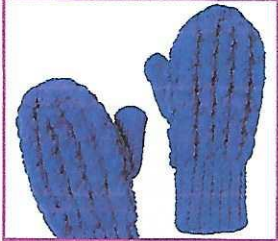
Visual Summary



Heat is the flow of thermal energy from a warmer object to a cooler object.



Heat is transferred through conduction, convection, and radiation.



Insulators are materials that do not transfer heat well. **Conductors** are materials that transfer heat well.

Make a **FOLDABLES** Study Guide

Make a three-tab book. Use it to summarize what you learned about heat.



Writing Link

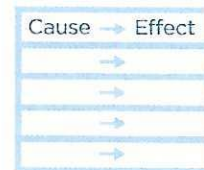
Compare and Contrast

Write a paragraph comparing a metal cup and a foam cup. Which would you choose for a hot drink? A cold drink? Explain your choices.

Think, Talk, and Write

1 **Vocabulary** The transfer of heat by objects that are touching is called _____.

2 **Cause and Effect** What happens when heat is transferred to ice? To liquid water? To air in a balloon?



3 **Critical Thinking** Explain why heat does not flow from an ice cube to a hot drink.

4 **Test Prep** Why are many pots and pans made of metal?

- A Metal is a good conductor.
- B Metal is a good insulator.
- C Metal is a good heat source.
- D Metal is a good radiator.

5 **Essential Question** How does heat flow?



Art Link Objective 2g

Heat Transfer Picture

Draw a picture that shows examples of the three ways that heat is transferred. Add labels and captions to your picture.

Heat Energy WS #1

Name _____

1. _____ energy is the energy of the moving particles of matter.
2. Heat - _____

3. The _____ is Earth's main source of heat.
4. Inside Earth, it is very hot and this source of heat called _____.
5. When you rub your hands together you produce _____.
Friction is another way to produce heat.
6. _____ is related to the thermal energy of the particles in a substance.
Heating can change an object's temperature.
7. We measure temperature with a _____.
8. Water freezes at _____ F or _____ C. Water boils at _____ F or _____ C.
9. Heat travels in three basic ways - _____, _____, _____
10. **conduction** - _____

11. **convection** - _____

12. **radiation** - _____

13. **insulators** - _____

14. **conductor** - _____

Heat Energy WS #2

Science

Name _____

Pages 318-319

1. _____ - a material that does not transfer heat easily.
2. _____ - a material that does transfer heat or electricity easily
3. In winter, you might wear a fleece jacket to stay warm. _____ is an insulator.
4. _____ is an insulator that many animals have in their bodies to keep warm.
5. _____ is a good conductor because heat travels through pots and pans easily.
6. Wood and plastic are good _____ because heat does not travel through them easily.
7. Warm coats and hats trap air against our bodies and keep us warm.
Trapped air is a good _____.
8. _____ is the flow of thermal energy.
9. Metal is a good _____. Heat travels well through metals.
10. In order for conduction to occur, two objects must be _____.
11. When you hold a cup of hot chocolate, how does heat travel to your hands?
a. conduction b. convection c. radiation
12. How does a sweatshirt keep you warm on a cold day? Sweatshirts are good _____ of heat.
a. conductors b. insulators

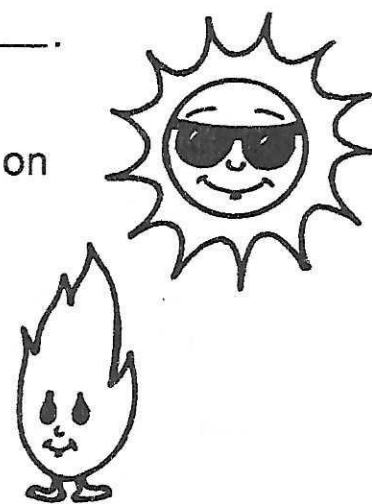
Finding Out About Heat

Use this index to write the correct page numbers on the blanks below.

Index

Celsius, Anders, 53	Natural gas, 25–26
Coal, how it is formed, 20–21	Petroleum, where it is found, 22; petroleum products, 24–26
Fahrenheit, Gabriel, 52–53	Sun, facts about, 8–11; protection from, 43–44
Fire, 12–19	Thermometers, kinds of, 52–53; uses of, 54–55
Fuels, 20–26	Wood, 35–38
Heat, sources of, 8–20; how it travels, 38–40; experiments, 60–61	

- Heat experiments are discussed on pages _____.
- Information on natural gas is on pages _____.
- Pages _____ tell how heat travels.
- Hints about protecting yourself from sunburn are on pages _____.
- Information about Gabriel Fahrenheit is on pages _____.
- The last page on which you will find something about fire is page _____.
- Facts about kinds of thermometers are on pages _____.
- To find out the sun's temperature, look at pages _____.
- You will find out about Anders Celsius on page _____.
- Facts about wood are found on pages _____.



Try This! Design a cover for a book in which this index might be found.