SC.4.P.11.1 Recognize that heat flows from a hot object to a cold object and that heat flow may cause materials to change temperature.

ESSENTIAL **QUESTION**

What Is Heat?

Engage Your Brain

Find the answer to the following question in this lesson and record it here.

Most photographs show people and objects as we see them. What do you think this photograph shows?

_____

_____

_____

ACTIVE **READING**

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

_____

_____

_____

_____

Signal Words: Contrast

Signal words show connections between ideas. Words that signal contrasts include *unlike, different from, but,* and on *the other hand.* Active readers remember what they read because they are alert to signal words that identify contrasts.

The Energy of Heat

It takes heat to shape glass or to make tea. But what is heat, exactly? Think about it for a moment. How would you define *heat*?

ACTIVE READING As you read these two pages, find and underline the definition of *heat*.

Temperature measures how hot or cold something is. Energy moves between objects that have different temperatures. You've already learned about many kinds of energy. **Heat** is the energy that moves between objects of different temperatures. The difference in temperature makes the energy move.

You sense heat as a warming feeling. More precisely, you feel the change in temperature as you gain energy. Heat moves naturally from an object with a high temperature to one with a lower temperature. In other words, heat moves from a warmer object to a cooler object.

Super Hot

You can see and feel heat moving from the flame to the glass. This melted glass is about 1,500 °C/2,732 °F!

Incredibly Cold

This is dry ice—frozen carbon dioxide. It is really cold—about –80 °C/–112 °F.

DO THE MATH

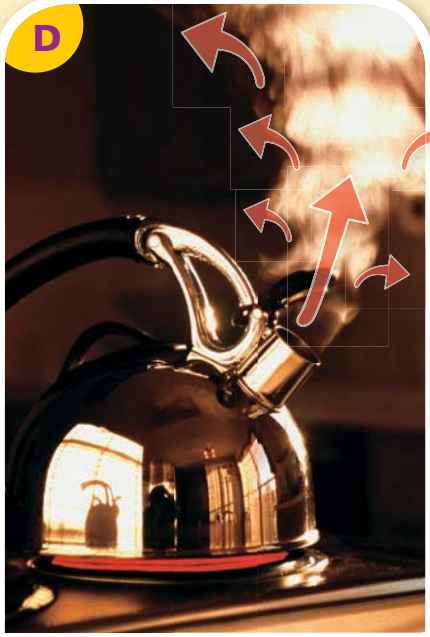
Use Temperature Scales

Temperature is measured in different scales. The two scales on this thermometer are Celsius and Fahrenheit. Write the letter of each picture at the appropriate place on the thermometer.

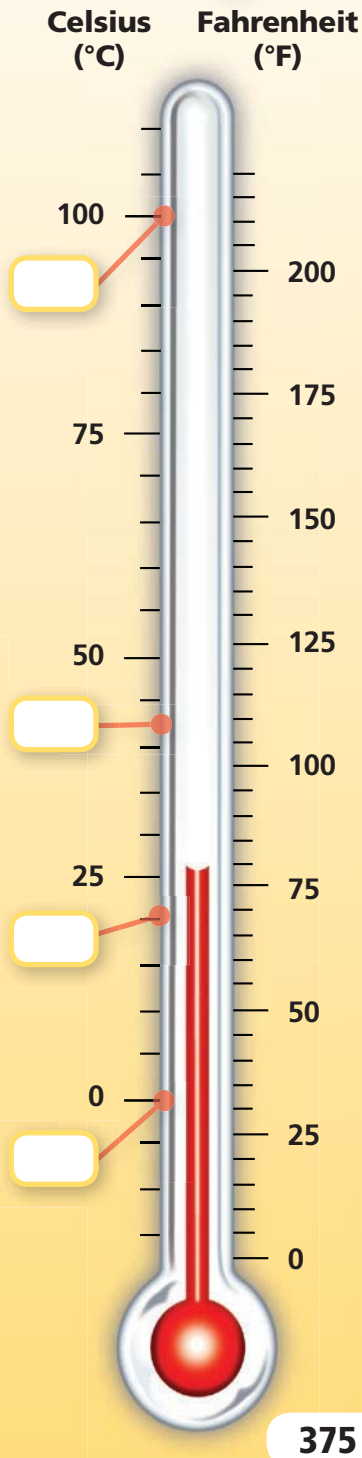
This girl's clothes trap heat near her body. Her jacket slows down energy transfer to the cold air. This girl stays warm while playing in the snow in temperatures as low as 0 °C/32 °F.

The water coming from this shower head is hotter than the air around it. The average temperature of shower water is 42 °C/108 °F.

Ice cubes melt as heat transfers to them from the warm air. The puddle of water is about 20 °C/68 °F.



Heat moves from the burner to the kettle, from the kettle to the water, and then from the water vapor to the air. Water boils at 100 °C/212 °F.



Heat on the Move!

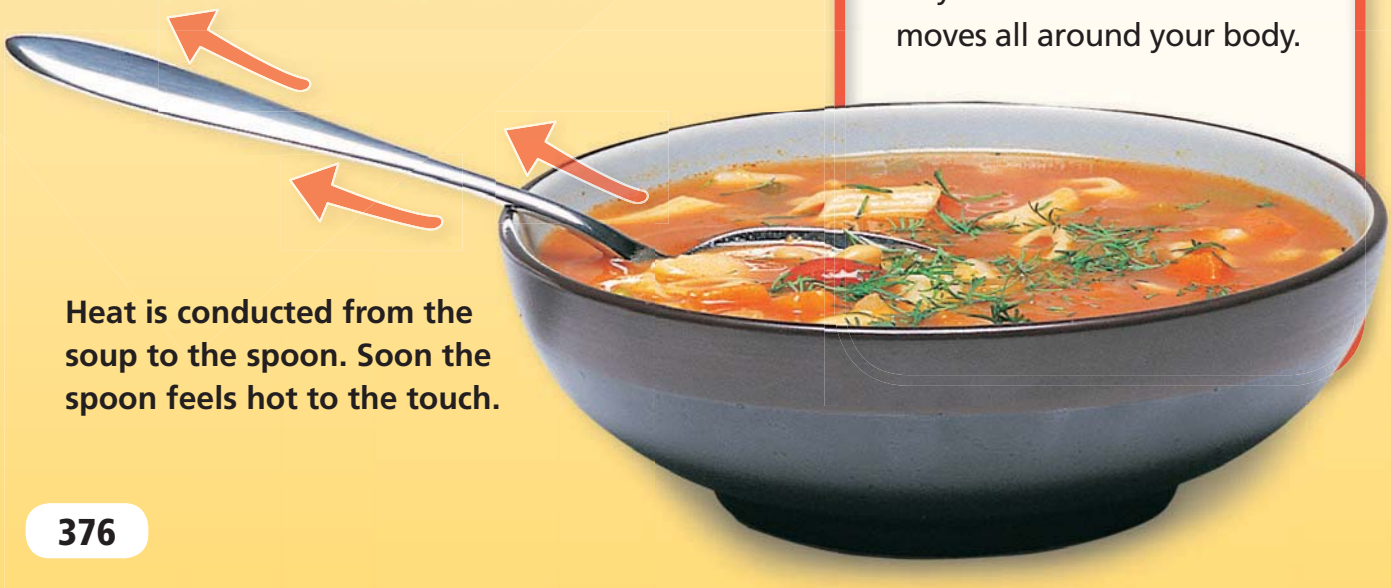
Heat can move in different ways.

ACTIVE **READING** As you read these two pages, draw a box around each main idea.

Heat is conducted from your hand into the snow. The snow melts. Your hand feels cold.

Conduction

Conduction is the transfer, or movement, of heat between two objects that are touching. It can also occur *within* an object. Heat moves from inside your body to warm your skin. Your feet and hands stay warm because heat moves all around your body.



Heat is conducted from the soup to the spoon. Soon the spoon feels hot to the touch.

1. Heat is conducted from the burner to the pot to the water.
2. Heated water travels up, warming the cooler water above.
3. Cooler water sinks to the bottom, where it gets heated. The cycle repeats. This movement is called a *convection current.*

Convection

Convection is the transfer of heat within a liquid or a gas. Particles in liquids and gases move easily, and they take heat with them. Heat from a campfire warms the air around it by convection. Warmer air is always buoyed upward. In this case, the fire is the source of heat for convection.

Hot air rises above cooler air. That's what keeps a hot-air balloon in flight.

▶ **Write the kind of heat transfer that takes place in the following situations.**

An eruption of lava on the ocean floor

_____

Winds blowing in from a warmer part of the country

_____

Feet touching a cold floor

_____

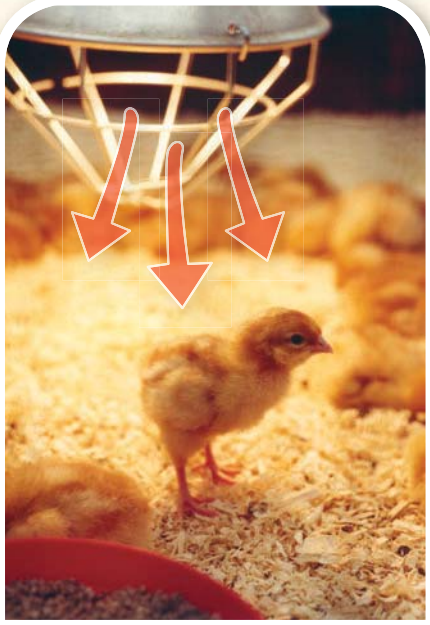
Feeling Radiant!

Heat moves by conduction between solids that are touching. Heat moves by convection through gases and liquids. But can heat travel without moving through matter? Find out.

ACTIVE READING As you read the next page, draw boxes around the clue words or phrases that signal one thing is being contrasted with another.

The third way heat can move is radiation. **Radiation** is the transfer of heat without matter to carry it. Heat simply leaves one object and goes directly to another. Suppose you're standing near a campfire. You can feel the heat from the fire because it warms the air. But you can also feel the heat because it warms you directly through radiation.

In some ways, radiation may be the most important way heat can move. Life on Earth needs heat from the sun. But space is a vacuum. How does heat travel through the emptiness of space? By radiation.



The room is cool and air-conditioned. On the other hand, heat radiating from this light keeps the young chickens warm.

Heat from the sun radiates through space and through the atmosphere before it warms this girl's face.

▶ **Circle the objects that are radiating heat.**

Sum It Up »

Fill in the missing words to complete the conversation.

Rebecca: Ow! How did my cell phone get so hot?

Abdullah: Well, there are (1) _____ ways that heat could have moved into your phone.

Rebecca: I know. If it had been sitting in sunlight, I'd know it was heated through (2) _____ . But it was in the shade.

Abdullah: Well, there's also convection.

Rebecca: Yeah, but that only happens within (3) _____ and (4) _____ . My phone's a solid.

Abdullah: Then it must have been the third way: (5) _____ .

Rebecca: But that only happens when two things are (6) _____ each other. My phone was sitting by itself.

Abdullah: Where?

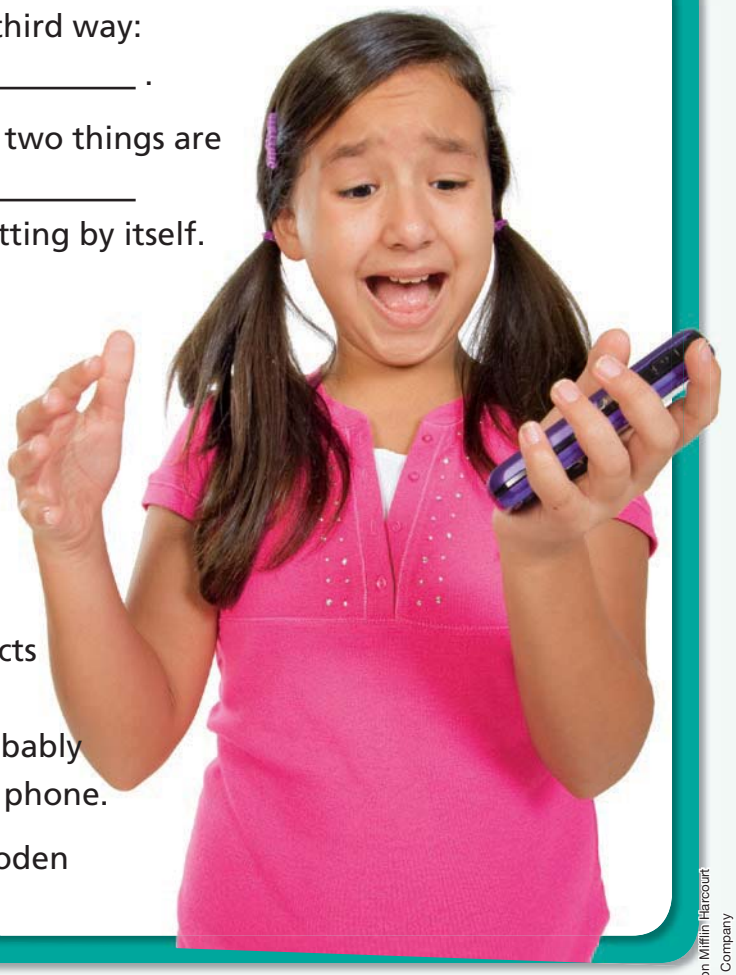
Rebecca: On top of my laptop.

Abdullah: In that case, heat traveled into your phone through (7) _____ .

Rebecca: Really? How does it do that?

Abdullah: Heat moves from warm objects to (8) _____ objects. Your laptop was probably much warmer than your cell phone.

Rebecca: Maybe I'll leave it on my wooden desk from now on!



Brain Check

Name _____

Vocabulary Review

1 Unscramble each word and write it in the boxes.

How heat moves from one end of a solid to the other

C C N O T N O I U D

The topic of this lesson

T H E A

What heat does during convection or conduction

S R T F N R A E S

How heat moves through a liquid

T N E V C O I N C O

Heat moves from this source by convection and radiation

F I R M P A C E

How heat travels through empty space

D O T A I R N I A

Unscramble the letters in the circles to form a word that is related to this lesson.

_____

Apply Concepts

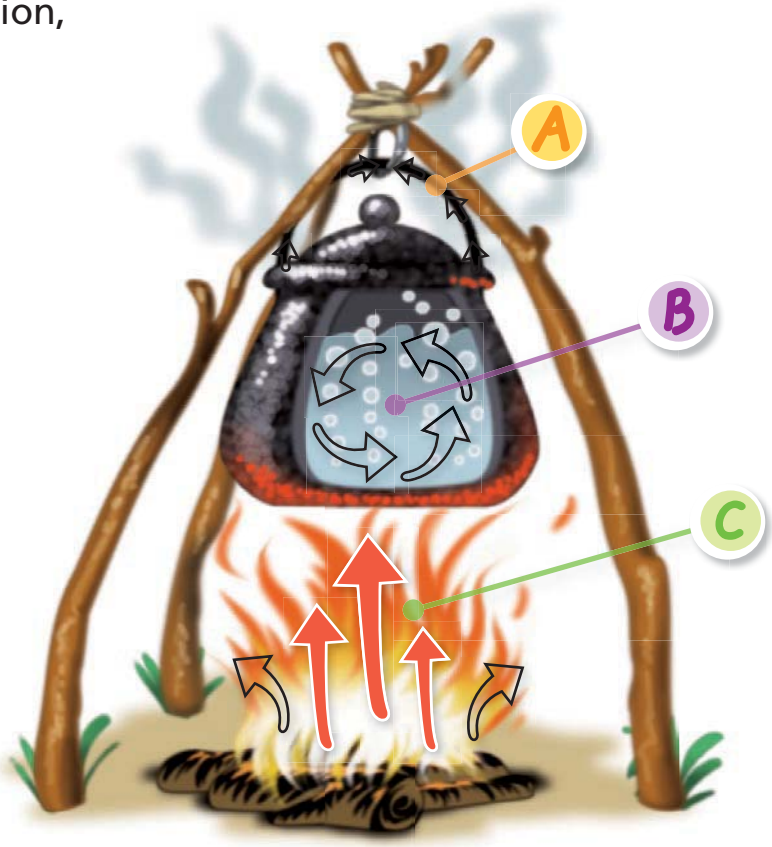
2 A transfer of heat happens between objects of different temperatures. Draw an arrow between each pair of objects to show the direction heat would travel between them.

3 Label each part of the drawing as an example of conduction, convection, or radiation.

A. _____

B. _____

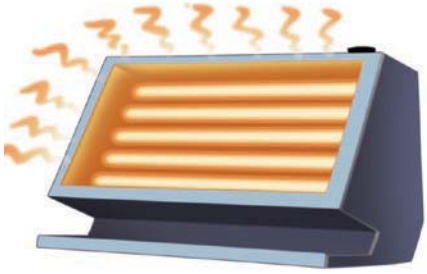
C. _____



4 Label each of the following as examples of conduction, convection, or radiation.

hot water added to bath

_____



space heater

_____

iron-on decal

_____

clothes dryer

_____

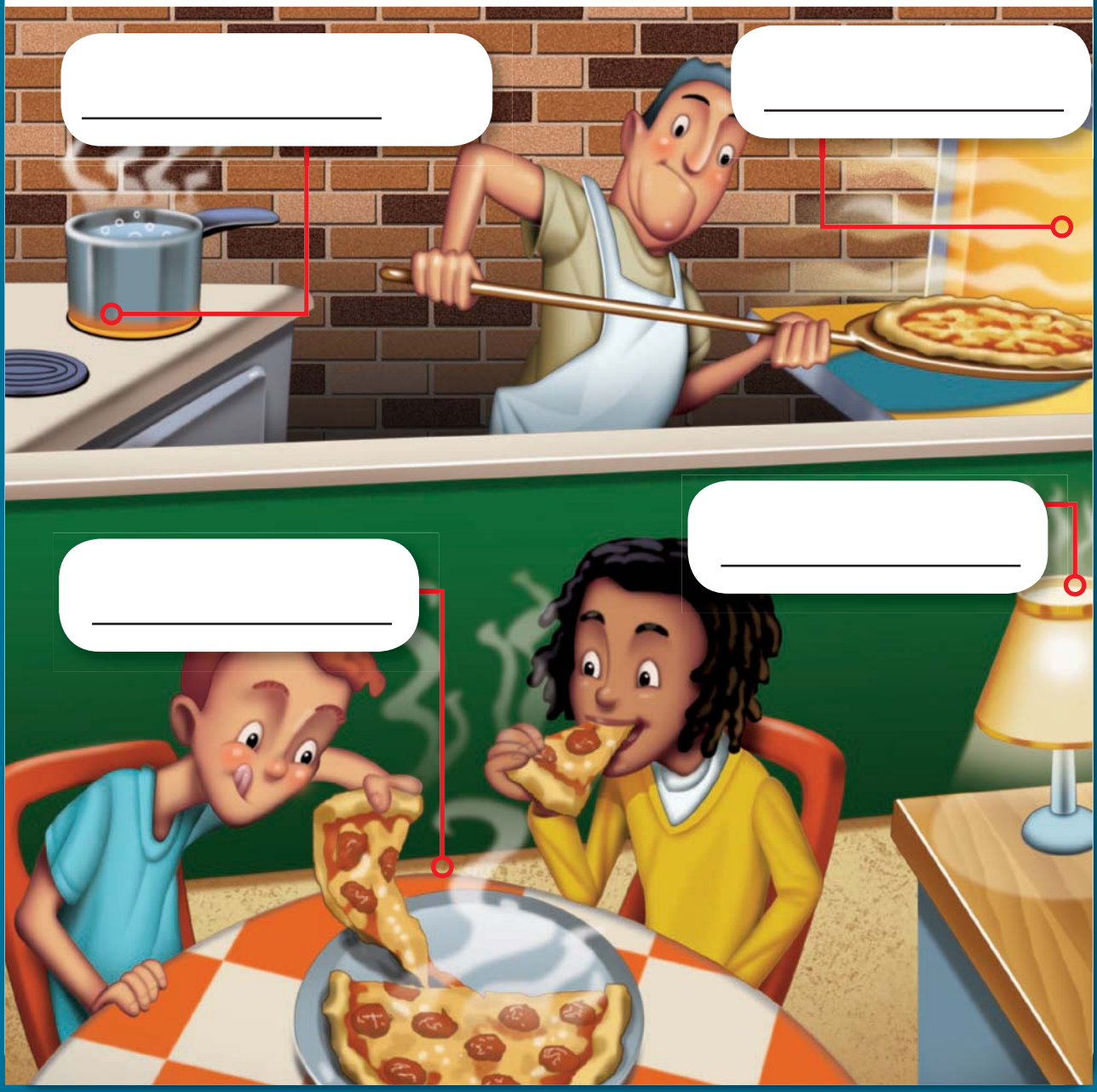
sunlight through a window

_____

sandwich press

_____

5 In this pizza restaurant, heat is traveling in different ways. Label the examples of conduction, convection, and radiation in the spaces provided.



Take It Home!

See ***ScienceSaurus***® for more information about energy.