

Heat

Grade 9 Science

Mr. Richard Moore

Name _____ Class _____ Date _____

Section 6-1 What is heat?

Directions: Write the definition for the following tech term(s).

1. heat:

Directions: Read section 6-1. Complete the following sentences or questions.

2. At one time, people thought that heat was a _____ substance.
3. Matter is made up of tiny _____.
4. These particles are always in _____.
5. Heat energy makes the particles of matter move _____ and _____ apart.
6. When you boil water, you add _____ energy to the water.
7. The added heat energy makes the particles of water move _____. The water particles move so fast that they _____ from the container.
8. Energy can do _____.
9. For work to be done, something must be _____.
10. If you hold a pinwheel over a hot light bulb, you will see the pinwheel move. This proves that heat can do _____.
11. Moving _____ turns a pinwheel held over a hot light bulb.
12. Suppose you hit a piece of metal several times with a hammer. When you touch the piece of metal, it feels hot. Explain why the metal gets hot after being hit with the hammer.

Directions: Write the three chapter summary sentences below for Lesson 6-1 found on pg 93.

13.

14.

15.

6-1 What is heat?

Lesson Review

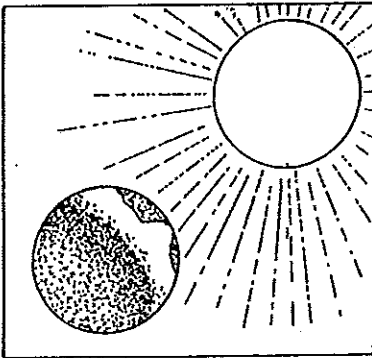
Write true if the statement is true. If the statement is false, change the underlined word to make the statement true. Write your answers in the spaces provided.

- _____ 1. Particles that make up matter are always in motion.
- _____ 2. Benjamin Thompson concluded that heat did flow.
- _____ 3. For work to be done, something must be moved.
- _____ 4. Heat makes particles of matter move slower.
- _____ 5. The particles in solid ice move slower than the particles in liquid water.
- _____ 6. Heat cannot do work.
- _____ 7. Heat can be changed into other forms of energy.
- _____ 8. Heat is an example of a physical substance.

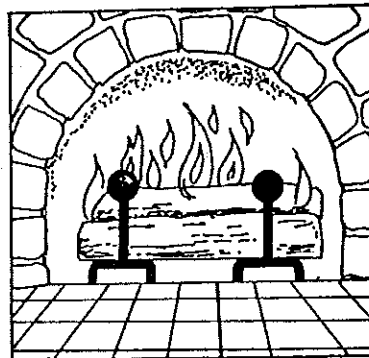
Skill Challenge

Skills: inferring, analyzing

What sources of heat are shown in the following diagrams?



A. _____



B. _____

Section 6-2

How is heat measured?

Directions: Write the definition for the following tech term(s).

1. Calorie:

2. calorie:

Directions: Read section 6-2. Complete the following sentences or questions.

3. When heat is added, the temperature of a substance _____.
4. The change in temperature depends on how much heat is _____ or _____.
5. One g of water is added and raises the temperature 1 degree Celsius the amount is one _____.
6. What is calorie?
7. Food calorie is _____ times larger than calorie, unit of heat.
8. One Calorie or 1 kilocalorie is equal to _____ calories.
9. The study of substances at very low temperatures is called _____.
10. _____ is important in 3 areas: 1)
2) 3)

Directions: Write the three chapter summary sentences below for Lesson 6-2 found on pg 95.

11.

12.

13.

6-2 How is heat measured?

Lesson Review

Complete the following.

1. What is a calorie? _____

2. What is a Calorie? _____
3. What is a kilocalorie? _____
4. How can you change the temperature of a substance? _____

5. What unit is used to measure the energy in food? _____

Skill Challenge

Skills: calculating, organizing, observing

Complete the table.

Table 1 Calories in Food

Food	Food Calories (kilocalories)	calories
1. Apple		70,000
2. Banana	20	
3. Candy bar		150,000
4. Skim milk		90,000
5. French fries	15	
6. Medium egg	80	

Choose 10 food items that you have in your kitchen cupboard. Examine each package or container. Locate the number of Calories per serving that is listed on each package or container. List each food item and the number of Calories per serving. Then convert the number of Calories into calories.

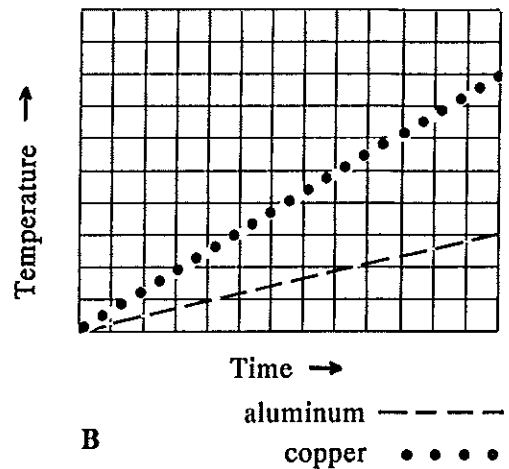
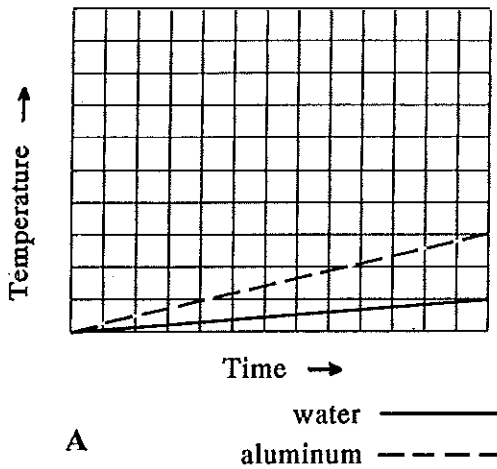
Enrichment Worksheet 23

Use with Lesson 6-2

Specific Heat

Skills: interpreting graphs, applying concepts

One calorie is the amount of energy needed to raise 1 gram of water 1 degree Celsius. Not all substances, however, react to an increase in energy the way water does. Other substances may experience a greater temperature change or a smaller temperature change for every calorie of energy that is added. The graphs below show the temperature change in different substances as heat is added at a steady rate.



1. In graph A, which substance is experiencing a greater increase in temperature? _____
2. Does this substance experience a greater temperature increase or a smaller temperature increase than water for every calorie of energy that is added? _____
3. Look at graph B. Which substance is experiencing the greater temperature increase? _____
4. Does this substance experience a greater temperature increase or a smaller temperature increase than aluminum for each calorie of energy added? _____

The amount of energy needed to raise the temperature of 1 gram of a substance 1°C is called its specific heat. The greater the temperature rise that results from the addition of 1 calorie of energy, the lower the specific heat of that substance. The smaller the temperature rise that results from the addition of 1 calorie of energy, the higher the specific heat of that substance.

5. Which has the higher specific heat, water or aluminum? _____
6. Which has the higher specific heat, aluminum or copper? _____
7. Rank the three substances—aluminum, copper, and water—in order of increasing specific heat.

Section 6-3

What is temperature?

Directions: Write the definition for the following tech term(s).

1. temperature:
2. absolute zero:

Directions: Read section 6-3. Complete the following sentences or questions.

3. Heat is the energy of _____ particles of matter.
4. Energy of motion is called _____ energy.
5. Moving particles of matter have kinetic _____.
6. The average kinetic energy of the particles of a substance is called _____.
7. When you add heat to a substance, you raise its _____.
8. When you remove _____ from a substance, you lower its temperature.
9. The lower the temperature, the _____ the particles of the substance are moving.
10. _____ is the lowest possible temperature.
11. Absolute zero is equal to _____ °C.
12. Heat moves from a place with a high temperature to a place with a _____ temperature.
13. Heat moves from a hot object to a _____ object.

Directions: Fill in each blank with the word that fits best. Choose from the words below.

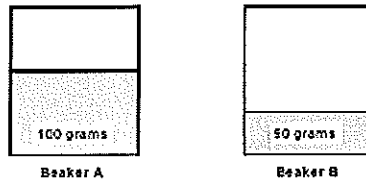
degrees Celsius calorie kilocalorie total
temperature gram heat average

A thermometer measures _____. Scientists use the unit _____

to measure temperature. Temperature is the _____ kinetic energy of all of the particles in a substance.

Heat is the _____ kinetic energy of all the particles in a substance. The unit of heat is the _____.

One calorie can raise the temperature of one _____ of water one degree Celsius. 1000 calories is equal to one _____.



14. How many calories does it take to raise the temperature of Beaker A from 80 to 82 degree Celsius?

_____ calories (Hint: Look at the definition of calorie in the key terms)

15. How many calories does it take to raise the temperature of Beaker B from 80 to 82 degree Celsius?

_____ calories. (Hint: Look at the definition of calorie in the key terms)

16. In Rumford's experiment, _____ energy was changed into heat energy.

Directions: Write the four chapter summary sentences below for Lesson 6-3 found on pg 97.

17.

18.

19.

20.

Section 6-4

What is freezing point?

Directions: Write the definition for the following tech term(s).

1. freezing point:

2. melting point:

Directions: Read section 6-4. Complete the following sentences or questions.

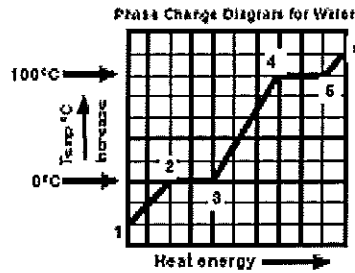
3. What happens when water freezes?

4. At what temperature does water begin to freeze?

5. What is the temperature at which water changes to ice called?

6. What is the freezing point of water?

7. Do all liquids freeze at the same temperature?



8. In what phase(s) is the water between points 1 and 2? _____
9. In what phase(s) is the water between points 2 and 3? _____
10. In what phase(s) is the water between points 3 and 4? _____
11. In what phase(s) is the water between points 4 and 5? _____
12. In what phase(s) is the water between points 5 and 6? _____
13. Between which two points is the boiling plateau? _____
14. Between which two points is the melting plateau? _____
15. What is the difference between the freezing point and the melting point of a substance?
16. What happens to a solid at its melting point?
17. What is the melting point of ice?
18. What is sublimation?

Directions: Write the 4 chapter summary sentences below for Lesson 6-4 found on pg 99.

19.

20.

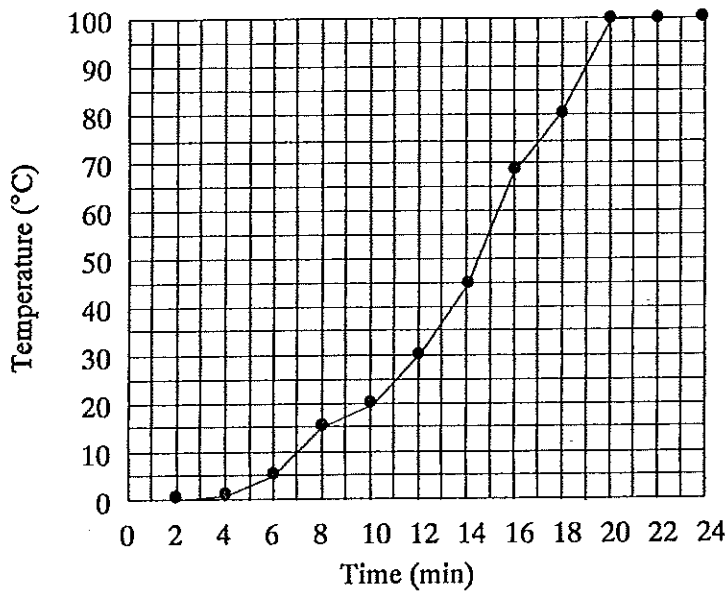
21.

22.

6-4 What is freezing point?

Lesson Review

Use the graph to answer the following questions.



A student heated a beaker of ice over a Bunsen burner. He measured the temperature every 2 minutes. He then graphed his results.

1. What was the initial temperature of the ice? _____
2. How long did it take for the temperature to reach 5°C? _____
3. How long did it take for the temperature to reach 100°C? _____
4. What happened to the temperature between 20 and 24 min? _____
5. What was the temperature at 14 min? _____

Skill Challenge

Skills: experimenting, analyzing

Design an experiment to solve the problem

Problem: What is the freezing point of milk?

Your experiment should include:

1. The materials you would need.
2. A list of safety precautions you should follow.
3. A step-by-step procedure.
4. A description of how you would record your data.

Section 6-5

What is boiling point?

Directions: Write the definition for the following tech term(s).

1. boiling point:
2. evaporation:

Directions: Read section 6-5. Complete the following sentences or questions.

3. When water _____, it changes to steam.
4. Steam is water in the form of a _____.
5. The temperature at which water changes to steam is its _____ - _____.
6. Small bubbles that appear in water that is being heated show that a _____ is being formed.
7. When a liquid reaches its boiling point, it begins to change to a _____.
8. At 100°C, water boils or changes to a gas. How long will the temperature remain 100°C for the boiling water? _____
9. What is steam? _____
10. Every liquid has its own _____ point.
11. What is the boiling point of Benzene using Figure 1 on page 100? _____
12. Which liquid listed in table 1 has the highest boiling point? _____
13. An uncovered liquid changes to a gas at room temperature by the process of _____.
14. Evaporation occurs only at the _____ of a liquid.
15. When a liquid evaporates, _____ of the liquid escapes into the air.

Directions: Write the three chapter summary sentence below for Lesson 6-5 found on pg 101.

16.

17.

18.

6-5 What is boiling point?

Lesson Review

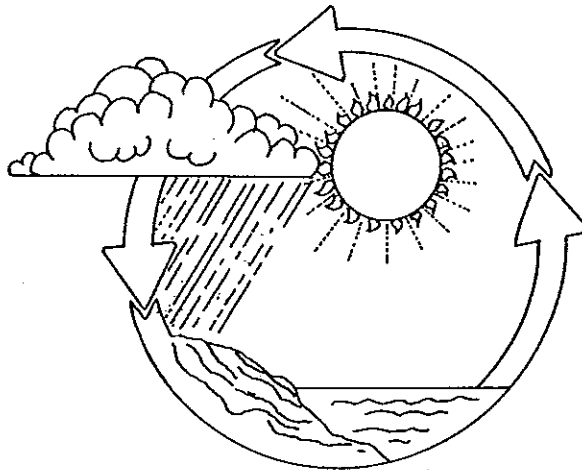
Write true if the statement is true. If the statement is false, change the underlined word to make the statement true. Write your answers in the spaces provided!

- _____ 1. The boiling point of water is the same as the boiling point of benzene.
- _____ 2. Evaporation is a slow process.
- _____ 3. The temperature of a liquid continues to rise once it reaches its boiling point.
- _____ 4. Evaporation of water takes place at the surface.
- _____ 5. Water will evaporate slower at a temperature of 21°C than at 15°C.
- _____ 6. The boiling point of a liquid is the same as its melting point.
- _____ 7. Because of evaporation, you can smell an open bottle of perfume at the back of a room.
- _____ 8. Water will stop boiling once it reaches 100°C.

Skill Challenge

Skills: interpreting a diagram, inferring

Use the diagram of the water cycle to answer the questions.



1. Where does evaporation take place in the water cycle? _____
- _____
2. What would happen if precipitation in the form of rain or snow continued, but evaporation did not take place? _____
- _____

Enrichment Worksheet 24

Use with Lessons 6-4 and 6-5

Freezing Point Depression/Boiling Point Elevation

Skills: interpreting, applying concepts

The following passage describes what happens to the freezing and boiling points of a liquid solvent when a solid or liquid solute is dissolved in it. Read the passage carefully, then answer the questions that follow.

Experiments show that when a solute is dissolved in a liquid solvent, the freezing point of the solvent is lowered. This lowering of the freezing point is called freezing point depression. As a result of freezing point depression, the solution can exist in the liquid phase at a lower temperature than can the pure solvent.

The addition of solute to a pure liquid solvent also raises the boiling point of the solvent. This increase is called boiling point elevation. As a result of boiling point elevation, the solution can exist in the liquid phase at a higher temperature than can the pure liquid solvent.

1. What happens to the freezing point of a liquid solvent when a solid or liquid is dissolved in that liquid? _____
2. What happens to the boiling point of a liquid solvent when a solid or liquid is dissolved in that liquid? _____
3. Suppose that sugar is dissolved in water. Would you expect the water to boil at 100 °C? Why or why not? _____

4. Antifreeze consists of ethylene glycol. When antifreeze is added to the water in a car radiator, the water does not freeze, even when the outside temperature is below freezing. Why does antifreeze work? _____

5. Suppose that you place two pots of water on the stove. Both pots are the same size and contain the same amount of water. To one pot of water you add some salt. Which pot of water will boil first? Why? _____

6. Why is salt spread on an icy sidewalk in winter? _____

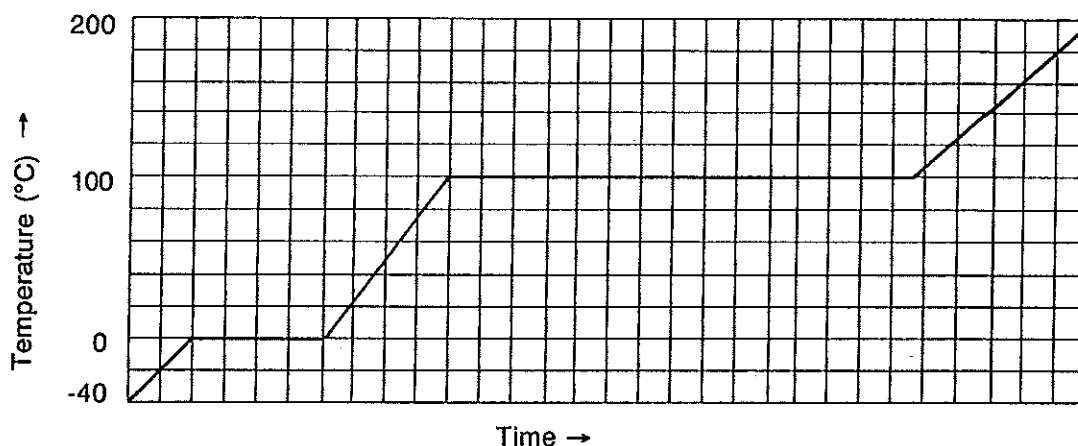
Enrichment Worksheet 25

Use with Lessons 6-3 to 6-5

Phase Change Diagram

Skills: interpreting a graph, applying concepts

In order for the temperature of a substance to increase, energy must be added. Energy must also be added in order for a substance to change from a solid to a liquid (melt), or from a liquid to a gas (boil or evaporate). A graph that shows the change in temperature of a substance as it changes from a solid to a liquid to a gas is called a phase change diagram. The phase change diagram below shows what happens to a sample of Substance X as it is heated. Refer to the diagram as you answer the questions that follow.



1. What is happening to the temperature of Substance X at the beginning of the time period? _____

2. What happens to the temperature of Substance X once it reaches 0 °C? _____

3. What do you think is happening to Substance X during this time? _____

4. Notice when the temperature of Substance X begins to rise again. At what temperature does this increase stop? _____
5. What begins to happen at this temperature? _____
6. Why does the temperature of Substance X not rise during this time? _____
7. Which phase change requires more energy, solid to liquid or liquid to gas? How can you tell?

8. What is Substance X? _____

Section 6-6

What is conduction?

Directions: Write the definition for the following tech term(s).

1. conduction:

2. conductor:

3. insulator:

Directions: Read section 6-6. Complete the following sentences or questions.

4. Heat moves through solids by _____.

5. Heat moves from a place with a high temperature to a place with a _____ temperature.

6. Heat travels by conduction when moving particles of matter bump into each _____.

7. A _____ is a substance that allow heat to move through it easily.

8. Copper and _____ are two of the best conductors of heat.

9. Items made of copper and silver will get _____ faster than items of iron or steel.

10. Substances that do not conduct heat easily are called _____.

11. List four examples of insulators. 1) _____, 2) _____

3) _____, 4) _____

12. Insulators _____ heat from moving place to place.

13. Houses are _____ to keep them warm in the winter and cool in the summer.

Directions: Answer/complete the following from the “Home Insulation” at the bottom of page 103.

14. Good insulation can cut fuel use by as much as _____%

15. In most homes, heat loss occurs through the _____ floor, the ceiling of an unheated basement, and the side _____.

16. A number called an R- _____ is used to grade insulating materials.

17. An insulating material with a high R-value is best in _____ heat loss.

18. Choosing insulation with the best R-value can greatly _____ fuel costs.

19. Which insulator is the best insulator, a piece of plastic with an R-value of 3.5 or a glass window with an R-value of 3?

Directions: Write the five chapter summary sentences below for Lesson 6-6 found on pg 103.
20.

21.

22.

23.

24.

Section 6-7 **What is convection?**

Directions: Write the definition for the following tech term(s).

1. convection:

2. convection current:

Directions: Read section 6-7. Complete the following sentences or questions.

3. Heat travels through gases and liquids by _____.

4. _____ is a gas.

5. When air heats up, the particles of air move farther apart and the air becomes _____.

6. Cold air _____ and warm air _____.

7. _____ are up and down movements of fluids.

6-6 What is conduction?

Lesson Review

Part A *Answer the following.*

1. What is a conductor? _____

2. What is an insulator? _____

Part B *Determine if each substance is a conductor or an insulator. Complete the table by putting a check mark in the correct column.*

Table 1 Conductors and Insulators

Substance	Conductor	Insulator
1. Gold		
2. Plastic		
3. Fiberglass		
4. Silver		
5. Rubber		
6. Copper		
7. Air		
8. Glass		
9. Wax		
10. Paper		

Skill Challenge

Skills: *applying, organizing, classifying*

Think of at least 10 items that you wear or use every day that are insulators. Then think of 10 items that are conductors. Organize your insulators and conductors in a table.

8. Heat transferred by convection is used in some home _____.

Directions: Write the four chapter summary sentences below for Lesson 6-7 found on pg 105.

9.

10.

11.

12.

Section 6-8

What is radiation?

Directions: Write the definition for the following tech term(s).

1. vacuum:

2. radiation:

Directions: Read section 6-8. Complete the following sentences or questions.

3. Heat from the sun travels through 150 million km of vacuum or _____ before it reaches earth.

4. Why can heat from the sun not travel by conduction or convection?

5. Heat reaches the earth by _____.

6. What is radiation?

7. Radiation is used in some _____.

8. Explain how radiant hot water systems work.

9. _____ heating systems use the heat from the sun to warm a house.

10. What are two kinds of heating systems that use radiation?

6-7 What is convection?

Lesson Review

Answer the following.

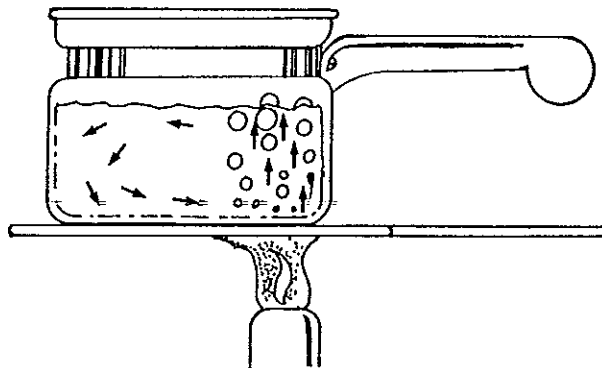
1. What is convection? _____
2. What is a convection current? _____

3. Why does warm air or water rise? _____
4. Why does cool air or water sink? _____

Skill Challenge

Skills: interpreting a diagram, describing

Use the diagram to answer the questions.



1. What is happening to the water in the pot? _____
2. Describe the movement of the water in the pot. _____

3. What is this movement called? _____

Directions: Write the four chapter summary sentences below for Lesson 6-8 found on pg 107.

11.

12.

13.

14.

Section 6-9 **What is thermal expansion?**

Directions: Write the definition for the following tech term(s).

1. thermal expansion:

Directions: Read section 6-9. Complete the following sentences or questions.

2. The expansion of solids and other substances when they are heated is _____
_____.

3. Most solids _____ or get larger, when they are heated.

4. Without the _____ in sidewalks they would buckle and break.

5. Most liquids _____ when they are heated.

6. As the liquid cools, the particles _____ closer together.

7. As the volume increases the density _____.

8. Ice is _____ dense than liquid water. That is why ice floats.

9. Gases _____ when they are heated and _____ when they are cooled.

10. Explain how a hot air balloon works.

Directions: Write the four chapter summary sentences below for Lesson 6-9 found on pg 109.

6-8 What is radiation?

Lesson Review

Answer the following.

1. What is a passive solar heating system? _____

2. How does an active solar heating system work? _____

3. Why does radiation allow the earth to receive heat from the sun? _____

Skill Challenge

Skills: *organizing, classifying*

Complete the table by identifying each example listed as representing conduction, convection, or radiation. Place check marks in the correct columns.

Table 1 Heat Transfer

Example	Conduction	Convection	Radiation
1. Solar heating system			
2. Boiling water for tea			
3. Cooking a hot dog over a fire			
4. Getting a sunburn			
5. Cooking a hard-boiled egg			

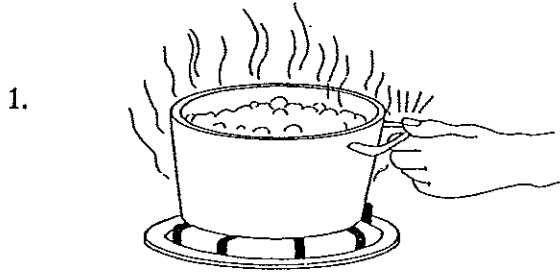
Enrichment Worksheet 21

Use with Lessons 6-6 to 6-8

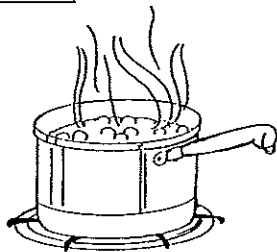
Methods of Heat Transfer

Skills: analyzing, identifying

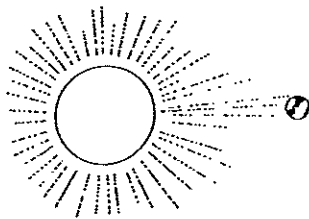
Decide whether each of the following diagrams illustrates conduction, convection, or radiation. Write your answers in the spaces provided. Then explain why you made the choices you did.



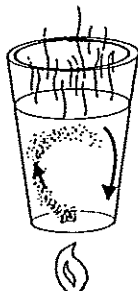
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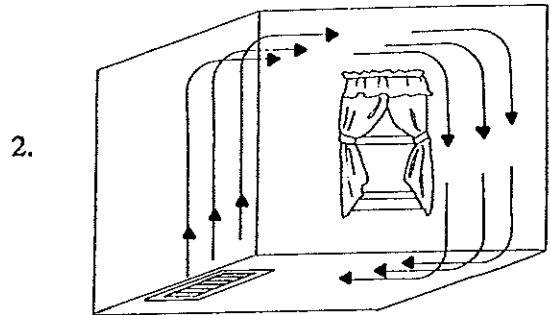


5.



7.



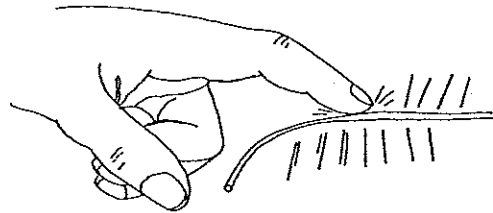


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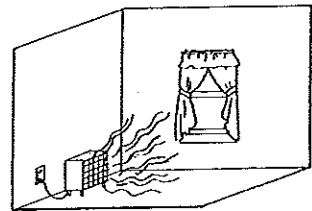
4.



6.



8.



Name _____ Class _____ Date _____

Test Review

Know why heat and temperature is not the same thing.

Know what happens to molecules when they are heated or cooled.

Know about melting, freezing, and boiling points (the graph).

Know and understand the 3 forms of heat transfer.

Know what happens when you dissolve a solute in a solvent.

Understand specific heat.

Understand calorie, Calorie, and kilocalorie:

Know where cooling vents should be in a home and why they should be placed there.

Know why we have wind.

Know how a thermometer works.

Know how a hot air balloon works.

Know the difference between a conductor and an insulator.

Know what sublimation is.