CHAPTER 1
Thermal Energy Worksheets

CHAPTER OUTLINE

1.1 Temperature and Heat
1.2 Transfer of Thermal Energy
1.3 Using Thermal Energy
Lesson 18.1: True or False

Determine if the following statements are true or false.

_____ 1. Only warm or hot objects have thermal energy.
_____ 2. If particles of an object start to move more quickly, the object’s temperature rises.
_____ 3. Temperature is the same thing as thermal energy.
_____ 4. An object with a higher temperature always has greater thermal energy than an object with a lower temperature.
_____ 5. On the Celsius scale, the boiling point of water is 32 °C.
_____ 6. Most types of matter expand to some degree when they get warmer.
_____ 7. Temperature is a physical property of matter.
_____ 8. Thermal energy always moves from an object with a higher temperature to an object with a lower temperature.
_____ 9. Specific heat is a property that is specific to a given type of matter.
_____ 10. Most metals have a very high specific heat.

Lesson 18.1: Critical Reading

Read this passage from the text and answer the questions that follow.

Heat

Heat is the transfer of thermal energy between objects that have different temperatures. Thermal energy always moves from an object with a higher temperature to an object with a lower temperature. When thermal energy is transferred in this way, the warm object becomes cooler and the cool object becomes warmer. Sooner or later, both objects will have the same temperature. Only then does the transfer of thermal energy end.

Assume that a cool spoon is placed in a cup of steaming hot coffee. Once in the coffee, the spoon quickly heats up. The fast-moving particles of the coffee transfer some of their energy to the slower-moving particles of the spoon. The spoon particles start moving faster and become warmer, causing the temperature of the spoon to rise. Because the coffee particles lose some of their kinetic energy to the spoon particles, the coffee particles start to move more slowly. This causes the temperature of the coffee to fall. Before long, the coffee and spoon have the same temperature.

Questions

1. How is heat defined in physical science?
2. Describe how thermal energy is transferred.
3. When does the transfer of thermal energy end?

Lesson 18.1: Multiple Choice

Circle the letter of the correct choice.

1. If two objects have the same mass, the object with the higher temperature always
   a. has greater thermal energy.
   b. has higher specific heat.
   c. feels warmer.
   d. two of the above

2. Which of the following statements about temperature is true?
   a. Temperature measures heat.
   b. Temperature measures kinetic energy.
   c. Temperature is the same thing as heat.
   d. Temperature is the same thing as thermal energy.

3. If a bucket full of water and a cup full of water have the same temperature, then the water in the
   a. bucket and cup have the same thermal energy.
   b. bucket has greater thermal energy.
   c. cup has lower average kinetic energy.
   d. cup has lower specific heat.

4. The thermal energy of an object depends on its
   a. mass.
   b. temperature.
   c. specific heat.
   d. two of the above

5. If you put a cool spoon into a cup of hot coffee, the temperature of the spoon rises because
   a. thermal energy is transferred from the coffee to the spoon.
   b. specific heat is transferred from the coffee to the spoon.
   c. particles of the spoon gain kinetic energy.
   d. two of the above

6. Which of the following materials has the greatest specific heat?
   a. iron
   b. sand
   c. wood
   d. water

7. A material with greater specific heat
   a. warms up more quickly.
   b. requires less energy to get hot.
   c. always has a higher temperature.
   d. none of the above
Lesson 18.1: Matching

Name___________________ Class______________ Date_______

Match each definition with the correct term.

Definitions
1. device for measuring temperature
2. total kinetic energy of particles of matter
3. amount of energy needed to raise the temperature of 1 gram of a substance by 1 °C
4. average kinetic energy of particles of matter
5. scale for measuring temperature
6. transfer of thermal energy between objects with different temperatures
7. measure that affects the thermal energy of matter but not its temperature

Terms
a. thermal energy
b. heat
c. temperature
d. thermometer
e. mass
f. Celsius
g. specific heat

Lesson 18.1: Fill in the Blank

Name___________________ Class______________ Date_______

Fill in the blank with the appropriate term.

1. The freezing point of water on the Celsius scale is __________.
2. All substances have thermal energy because their particles are always __________.
3. The specific heat of a substance is measured in the SI unit called the __________.
4. A(n) __________ shows how hot or cold something is relative to two reference temperatures.
5. Substances in the __________ state of matter usually expand the most when heated.
6. Water takes up __________ space as a liquid than it does as a solid.
7. Thermal energy is transferred between objects only when they have different __________.

Lesson 18.1: Critical Writing

Name___________________ Class______________ Date_______

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.
Explain how kinetic energy, thermal energy, temperature, and heat are related.
Lesson 18.2: True or False

Determine if the following statements are true or false.

_____ 1. Conduction occurs only between particles that collide.
_____ 2. Wood is an example of a good thermal conductor.
_____ 3. Home insulation prevents the transfer of cold into the house.
_____ 4. Warmer air rises because it is less dense than cooler air.
_____ 5. All objects radiate thermal energy.
_____ 6. Convection currents carry thermal energy from the sun to Earth.
_____ 7. Fluid particles with more energy have greater density.
_____ 8. Metals are excellent thermal conductors because they have freely moving electrons.
_____ 9. A land breeze is an example of a convection current.
_____ 10. Thermal energy is transferred from a space heater to a person in front of it by conduction.

Lesson 18.2: Critical Reading

Read this passage from the text and answer the questions that follow.

Convection

Convection is the transfer of thermal energy by particles moving through a fluid. Particles transfer energy by moving from warmer to cooler areas. That’s how energy is transferred through soup in a pot on a hot stove. Particles of soup near the bottom of the pot get hot first. They have more energy so they spread out and become less dense. With lower density, these particles rise to the top of the pot. By the time they reach the top of the pot, they have transferred their thermal energy and cooled. They have less energy to move apart, so they become denser. With greater density, the particles sink to the bottom of the pot, and the cycle repeats. This loop of moving particles is called a convection current. Convection currents move thermal energy through many fluids, including molten rock inside Earth, water in the oceans, and air in the atmosphere.

Questions

1. What is convection?
2. Describe how convection currents transfer thermal energy throughout a pot of soup on a stovetop.
3. Give other examples of fluids in which thermal energy is transferred by convection currents.
Lesson 18.2: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. A pot resting on a hot stovetop heats up because of
   a. convection.
   b. conduction.
   c. radiation.
   d. all of the above

2. Your hand feels cold when you hold an ice cube because
   a. the ice radiates cold to your hand.
   b. the ice conducts cold to your hand.
   c. your hand cools down by convection.
   d. your hand transfers thermal energy to the ice.

3. In which of the following materials does conduction occur most quickly?
   a. iron
   b. wood
   c. plastic
   d. oxygen

4. Examples of thermal insulators include
   a. down feathers.
   b. Styrofoam.
   c. air.
   d. all of the above

5. The transfer of thermal energy by convection occurs only in
   a. gases.
   b. solids.
   c. fluids.
   d. liquids.

6. Thermal energy is transferred throughout the ocean by
   a. radiation.
   b. conduction.
   c. thermal conductors.
   d. convection currents.

7. A sea breeze blows
   a. toward the land.
   b. toward the sea.
   c. only at night.
   d. during both day and night.

Lesson 18.2: Matching

Name___________________ Class______________ Date__________
1.2. Transfer of Thermal Energy

Match each definition with the correct term.

Definitions

1. material that allows little if any conduction of thermal energy
2. transfer of thermal energy by waves that can travel through space
3. flow of particles in a fluid due to differences in temperature and density
4. material that is good at transferring thermal energy by conduction
5. amount of mass in a given volume of matter
6. transfer of thermal energy between particles of matter that are touching
7. transfer of thermal energy by particles moving through a fluid

Terms

a. conduction
b. thermal conductor
c. convection
d. thermal insulator
e. radiation
f. convection current
g. density

Lesson 18.2: Fill in the Blank

Fill in the blank with the appropriate term.

1. When you hold a hot object, thermal energy is transferred from the object to your hands by __________.
2. Cooking pots are made of metals because metals are excellent thermal __________.
3. Cooking pot handles are often made of plastic because plastic is a good thermal __________.
4. Particles of a fluid that have the greatest kinetic energy have the __________ density.
5. Convection currents in Earth’s atmosphere create __________.
6. Thermal energy is transferred from a campfire to nearby people by __________.
7. __________ is the only way of transferring thermal energy that doesn’t require matter.

Lesson 18.2: Critical Writing

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Why does conduction work better in solids whereas convection works only in gases and liquids?
Lesson 18.3: True or False

Determine if the following statements are true or false.

_____ 1. The function of a thermostat is to transfer thermal energy.
_____ 2. The water in a hot-water heating system is heated by a furnace.
_____ 3. In a warm-air heating system, pipes carry thermal energy throughout the house.
_____ 4. Thermal energy from inside a refrigerator changes the refrigerant to a gas.
_____ 5. A combustion engine burns fuel to produce thermal energy.
_____ 6. In any combustion engine, the engine does the work of moving a piston.
_____ 7. In a warm-air heating system, warm-air vents are always placed near the ceiling.
_____ 8. An air conditioner is an example of a cooling system.
_____ 9. Refrigerant changes to a liquid in the condenser of a refrigerator.
_____ 10. Steam ships have internal combustion engines.

Lesson 18.3: Critical Reading

Read this passage from the text and answer the questions that follow.

Cooling Systems

Cooling systems, such as air conditioners and refrigerators, transfer thermal energy in order to keep homes and cars cool or to keep food cold. In a refrigerator, for example, thermal energy is transferred from the cool air inside the refrigerator to the warmer air in the kitchen. Thermal energy naturally moves from a warmer area to a cooler area, so how can it move from the cooler refrigerator to the warmer room? The answer is work. The refrigerator does work to transfer thermal energy in this way. Doing this work takes energy, which is usually provided by electricity.

The key to how a refrigerator (or other cooling system) works is the refrigerant. A refrigerant is a substance, such as Freon\(^{TM}\), that has a low boiling point and changes back and forth between liquid and gaseous states as it cycles through the refrigerator. As a liquid, the refrigerant absorbs thermal energy from the cool air inside the refrigerator. The thermal energy causes the refrigerant to change to a gas. As a gas, the refrigerant releases thermal energy to the warm air outside the refrigerator. This causes the refrigerant to change back to a liquid, and the cycle repeats.

Questions

1. What is a cooling system?
2. What work must a cooling system do?
3. What is the role of the refrigerant in a cooling system?

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**Lesson 18.3: Multiple Choice**

Name___________________ Class________________ Date__________

Circle the letter of the correct choice.

1. Types of home heating systems include
   a. warm-air heating systems.
   b. hot-water heating systems.
   c. solar heating systems.
   d. all of the above

2. How is thermal energy transferred in a refrigerator?
   a. from the warm kitchen to the cool refrigerator
   b. from the cool refrigerator to the warm kitchen
   c. from the cool refrigerator to the cold outdoors
   d. two of the above

3. Why must a cooling system do work to keep things cool?
   a. It transfers thermal energy from a cooler to a warmer place.
   b. It takes energy to reverse the normal direction of heat flow.
   c. It takes energy to maintain the normal direction of heat flow.
   d. two of the above

4. What happens to the refrigerant as it passes through a cooling system?
   a. It freezes and lowers the temperature of the system.
   b. It changes between liquid and gaseous states.
   c. It releases thermal energy into the refrigerator.
   d. It keeps evaporating and has to be replaced.

5. In an external combustion engine, thermal energy is used directly to
   a. move the piston back and forth.
   b. move the piston up and down.
   c. turn water into steam.
   d. all of the above

6. What happens first in an internal combustion engine?
   a. Exhaust gases exit the cylinder.
   b. The piston moves up or down.
   c. A fuel-air mixture enters the cylinder.
   d. The piston rod turns the crankshaft.

7. Thermal energy from a radiator travels throughout the air in a room by
   a. conduction.
   b. convection.
   c. radiation.
   d. all of the above
Lesson 18.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. substance that absorbs and releases thermal energy in a cooling system
_____ 2. device in a heating system that controls the furnace or boiler
_____ 3. complex machine that produces thermal energy outside the machine and uses the thermal energy to do work
_____ 4. heating system that includes a boiler, pipes, and radiators
_____ 5. complex machine that produces thermal energy inside the machine and uses the thermal energy to do work
_____ 6. refrigerator or air conditioner
_____ 7. heating system that includes a furnace, ducts, and vents

Terms
a. internal combustion engine
b. cooling system
c. refrigerant
d. warm-air heating system
e. external combustion engine
f. hot-water heating system
g. thermostat

Lesson 18.3: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. As hot water flows through the pipes and radiators of a hot-water heating system, the water becomes ______-_____.
2. Vents are placed near the floor in a warm-air heating system because warm air is low in density and ______-_____.
3. A cooling system transfers thermal energy from a cooler area to a warmer area by doing _______.
4. The key to how a cooling system works is a substance with a low boiling point called a(n) _______.
5. Any complex machine that burns fuel to produce thermal energy and then uses the energy to do work is a(n) _______.
6. The type of engine that is found in most motor vehicles is a(n) _______ combustion engine.
7. A steam engine is a type of engine called a(n) _______ combustion engine.
Lesson 18.3: Critical Writing

Name___________________ Class________________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how an external combustion engine produces thermal energy and uses it to do work.