Section 16.1 Thermal Energy and Matter

(pages 474–478)

This section defines heat and describes how work, temperature, and thermal energy are related to heat. Thermal expansion and contraction of materials is discussed, and uses of a calorimeter are explained.

Reading Strategy (page 474)

Previewing Before you read, preview the figures in this section and add two more questions in the table. As you read, write answers to your questions. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.

Thermal Energy and Matter	
Questions About Thermal Energy and Matter	**Answers**
Which has more thermal energy, a cup of tea or a pitcher of juice?	A pitcher of juice
Why did Rumford conclude that heat is not a form of matter? (Fig. 1)	The brass was hot enough to make water boil only during drilling, so the heat must be related to the motion of the drill.
How is specific heat related to temperature? (Fig. 3)	The lower a material's specific heat, the more its temperature rises when a given amount of energy is absorbed by a given mass.

Work and Heat (page 474)

1. Heat is the transfer of thermal energy from one object to another as the result of a difference in ___temperature___.
2. Circle the letter of each sentence that is true about heat.
   a. Heat is a fluid that flows between particles of matter.
   (b.) Heat flows spontaneously from hot objects to cold objects.
   (c.) Friction produces heat.
   (d.) The transfer of thermal energy from one object to another is heat.

Temperature (page 475)

3. What is temperature? Temperature is a measure of how hot or cold an object is compared to a reference point.
4. Is the following sentence true or false? On the Celsius scale, the reference points for temperature are the freezing and boiling points of water. ___true___

5. Circle the letter of each sentence that explains what happens when an object heats up.
   a. Its particles move faster, on average.
   b. The average kinetic energy of its particles decreases.
   c. Its mass increases.
   d. Its temperature increases.

Thermal Energy (page 475)

6. What is thermal energy? Thermal energy is the total potential and kinetic energy of all the particles in an object.

7. Thermal energy depends upon the mass, temperature, and phase of an object.

8. Is the following sentence true or false? Two substances can be the same temperature and have different thermal energies. true

Thermal Expansion and Contraction (page 476)

9. Is the following sentence true or false? Thermal contraction occurs when matter is heated, because particles of matter tend to move closer together as temperature increases. false

10. Describe thermal expansion and contraction by completing the table below.

Thermal Expansion and Contraction			
Condition	**Temperature**	**Space Between Particles**	**Volume**
Thermal expansion	Increases	Increases	Increases
Thermal contraction	Decreases	Decreases	Decreases

Specific Heat (pages 476–477)

11. The amount of heat needed to raise the temperature of one gram of material by one degree Celsius is called specific heat.

12. Why are you more likely to burn yourself on a metal toy than on a plastic toy if both have been sitting in the sun? The specific heats of metals tend to be lower than the specific heats of plastics. If equal masses of metal and plastic absorb the same thermal energy, the metal's temperature rises more.

Measuring Heat Changes (page 478)

13. What device is used to measure changes in thermal energy? a calorimeter

14. Is the following sentence true or false? A calorimeter uses the principle that heat flows from a hotter object to a colder object until both reach the same temperature. true