QuickLab

Hot or Cold?

10 min



Procedure

1. You will need **three buckets:** one with **warm water,** one with **cold water,** and one with **hot water.** **CAUTION:** Test a drop of the hot water to make sure that it is not too hot to put your hands into.
2. Put both of your hands into the bucket of warm water, and note how the water feels.
3. Now, put one hand into the bucket of cold water and the other into the bucket of hot water.
4. After a minute, take your hands out of the hot and cold water, and put them back in the warm water.

Analysis

1. Can you rely on your hands to determine temperature? Explain your observations.

Thermal energy depends on particle speed and number of particles.

The temperature of a substance is not determined by how much of the substance you have. For example, a teapot holds more tea than a mug does. But the temperature, or average kinetic energy, of the particles in the tea is the same in both containers. However, the total kinetic energy of the particles in each container is different. The total kinetic energy of the particles that make up a substance is **thermal energy.**

Because particles of matter move faster at higher temperatures than they do at lower temperatures, the faster the particles in a substance move, the more kinetic energy they have. However, the *total* kinetic energy (thermal energy) of a substance depends on the number of particles in that substance. Look back at **Figure 5.** Although the individual particles in the steam have the most kinetic energy, the ocean has the greatest thermal energy because it contains so many more particles.

energy (EN uhr jee) the capacity to do work

temperature (TEM puhr uh chuhr) a measure of how hot (or cold) something is; specifically, a measure of the average kinetic energy of the particles in an object

thermal energy (THUHR muhl EN uhr jee) the total kinetic energy of a substance's atoms

Section 1 Review

KEY IDEAS

1. **List** three main points of the kinetic theory of matter.
2. **State** two examples for each of the four states of matter.
3. **Compare** the shape and volume of solids, liquids, and gases.
4. **Describe** the relationship between temperature and kinetic energy.

CRITICAL THINKING

5. **Compare and Contrast** Compare the temperature and thermal energy of hot soup in a small mug and that of hot soup in a large bowl.
6. **Applying Concepts** Which particles have the strongest attraction between them: the particles of a gas, the particles of a liquid, or the particles of a solid?
7. **Making Inferences** Use the kinetic theory to explain how a dog could find you by your scent.

Answers to Section Review

1. Atoms and molecules are always in motion. Particles move faster at higher temperatures. At any temperature, heavier particles move slower than lighter particles do.
2. Sample answers: solid—marble and brass; liquid—water and mercury; gas—oxygen and nitrogen; plasma—fire and lightning
3. Solids have definite volume and shape; liquids have definite volume but no definite shape; gases have neither definite volume nor definite shape.
4. Temperature is a direct measure of average kinetic energy.
5. Both have the same temperature, but the large bowl of soup has more thermal energy than the small mug of soup does because there is more matter present in the bowl.
6. Sample answer: The particles of a solid have a stronger attraction to one another than the particles of a liquid or a gas has.
7. Gas particles can move freely in all directions. The traces of chemicals that a person leaves when he or she touches something absorb energy, vaporize, and spread outward, so that a dog can detect them.

Close

Reteaching Key Ideas

Adding Energy Place a handful of small rubber balls in a shallow box so that they form a single layer on the bottom of the box. Have students shake the box back and forth gently and observe the motion of the balls. Then, have students shake the box vigorously, adding more energy to the balls. Discuss how this model illustrates a change of state as energy is added to a substance. (The balls represent atoms or molecules. As energy is added, the balls move faster and may eventually escape the box, moving far apart. This represents the change of state from liquid to gas.)

LS Visual/Kinesthetic

Formative Assessment

Which of the following statements describes a solid, liquid, and a gas?

A. They have definite volume, but variable shape. (Incorrect. Only solids and liquids have definite volume. Gases expand to fill the container they are in.)

B. They have variable volume and shape, but the distance between particles remains constant. (Incorrect. Gases have particles that are very far apart while solids have particles that are very close together.)

C. They can be classified based on their shape and volume. (Correct. Solids have definite shape and volume. Liquids have variable shape and definite volume. Gases have variable shape and variable volume.)

D. They change state only when energy is added to the material. (Incorrect. The addition of energy causes a change in state, but these changes also occur when energy is removed.