

## THE MOVEMENT OF HEAT THROUGH MATERIALS

When you put food in a metal pan and place it on a stove burner to cook, you are acting on your knowledge of the conductive property of metal. Conductivity is the movement of heat through a material by means of the action of atoms that make up the material. Atoms in the heated end vibrate other nearby atoms, which in turn, vibrate other cooler atoms. The heat travels in this way from atom to atom. Metals conduct heat better than most nonmetals, but do all metals conduct with the same efficiency?

**Questions & Predictions** Predict and record answers to these questions. Observe and measure for Evidence & Proof below.

1. In what order would aluminum, copper, steel and brass be placed if they were ranked with the highest rate of conductivity as #1 and the lowest as #4?
2. Glass is also used for cooking. Does glass conduct heat more quickly than some materials? Which ones?

### EVIDENCE & PROOF

#### Materials:

small candle; matches; steel, copper, brass, aluminum and glass rods, each about 3/8 in. in diameter and about 6 in. long; 5 small, different-colored buttons; a metal bottle cap or jar lid; laboratory tongs; a steel-can tripod provided by your teacher; burner (or alcohol lamp); stopwatch, watch with second hand or watch or timer that displays seconds; graph paper or computer program with graphing capabilities; safety glasses; container of water

**Process:** Follow these steps. Compare your results with your predicted answers to the questions.



**Caution:** Tie back long hair; wear safety glasses. Keep a container of water nearby. Know the location of the fire extinguisher.

1. Hold the candle with the tongs. Have your partner light it. Allow the wax to drip into the cap or lid. Quickly dip one end of one of the rods into the melted wax and carefully, while the wax is still hot, place a button on the melted wax. (See Fig. 1) When the wax has hardened, make sure the button stays attached to the rod when you hold the rod horizontally. (See Fig. 2) Do this for each of the five rods. Blow out the candle.

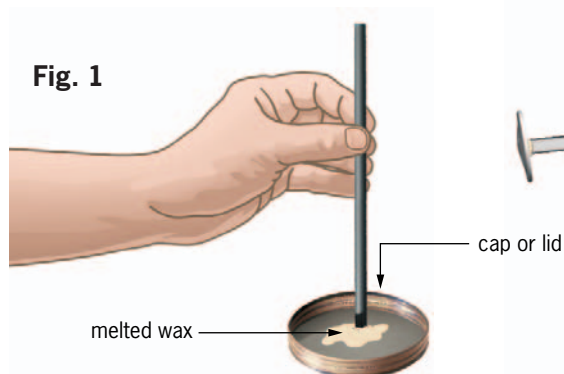


Fig. 2

2. Place the five rods into the steel-can tripod as shown in Fig. 3. Make sure the rods inside the tripod are touching so that all are an equal distance from the flame. Make a chart showing the color of the button and the material of the rod to which that button is attached.
3. While your partner holds the stopwatch or timer, ready to start it, light the alcohol lamp and gently slide it under the tripod. Carefully, but quickly, move the lamp so that the tip of the flame is in the center of the pentagon made by the five rods. (See Fig. 3) When the lamp is centered under the rods, say, "Go!" Your partner should start the watch or timer.
4. Each time a button falls, call out its color. This is your partner's signal to note the time and call out the number of seconds that have passed. On your chart record the elapsed time next to the color of the button that fell.
5. Present your data in the form of a vertical bar graph. Label each bar with the name of the material. Label the y-axis "Time (Seconds)."

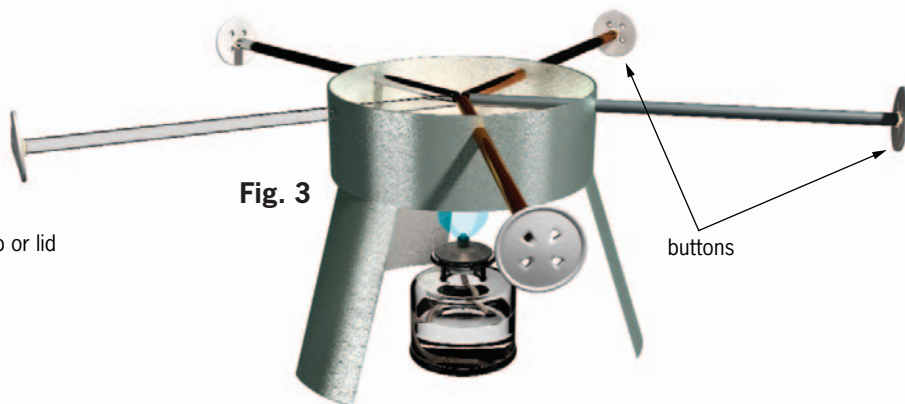


Fig. 3

### CONCLUSIONS & INFERENCE

Suppose that you are designing a variety of household items. For which of the following would you recommend using copper? The outside bottom of the cooking pan; the handle

for the cooking pan; a fireplace poker; kitchen tongs. Explain each of your answers.