Inquiry Lab

50 min

Conduction of Heat by Metals

Metals are typically very good conductors of energy. In this lab, you will test wires of different thicknesses to see whether the thickness of a metal wire affects the wire's ability to conduct energy as heat.

What You'll Do

- **Develop** a plan to measure how quickly energy is transferred as heat through a metal wire.
- **Compare** the speed of energy conduction in metal wires of different thicknesses.

What You'll Need

caliper or metric ruler

candle

clothespin

lighter or matches

newspaper or other covering to catch hot wax

stopwatch

wires, metal, of various thicknesses, each about 30 cm long (3)

Safety

Asking a Question

How does the thickness of a metal wire affect the wire's ability to conduct energy as heat?

Investigating Conduction in Wires

1. Obtain three wires of different thicknesses. Clip a clothespin on one end of one of the wires. Lay the wire and attached clothespin on the lab table. Spread some newspaper or other covering below the wire to catch any extra hot wax.
2. Light the candle. **CAUTION:** Tie back long hair, and confine loose clothing. Never reach across an open flame. To avoid burning yourself, always use the clothespin to hold the wire as you heat and move the wire. Remember that the wires will be hot for some time after they are removed from the flame.
3. Hold the lighted candle above the middle of the wire, and tilt the candle slightly so that some of the melted wax drips onto the middle of the wire.
4. Wait a couple of minutes for the wire and dripped wax to cool completely. The dripped wax will harden and form a small ball. Using the clothespin to hold the wire, place the other end of the wire in the candle's flame. When the ball of wax melts, remove the wire from the flame and place it on the lab table.

Forming and Testing a Hypothesis

5. Think about what caused the wax on the wire to melt. Form a hypothesis about whether a thick wire will conduct energy more quickly or more slowly than a thin wire.

Designing Your Experiment

6. With your lab partner(s), decide how you will use the materials available in this lab activity to compare the speed of conduction in three wires of different thicknesses.
7. In your lab report, list each step that you will perform in your experiment.
8. Have your teacher approve your plan before you carry out your experiment.

Performing Your Experiment

9. After your teacher approves your plan, you can carry out your experiment.
10. Prepare a data table that is similar to the sample data table.
11. Record in your table how many seconds the ball of wax on each wire takes to melt. Perform three trials for each wire. Allow the wires to cool to room temperature between trials.

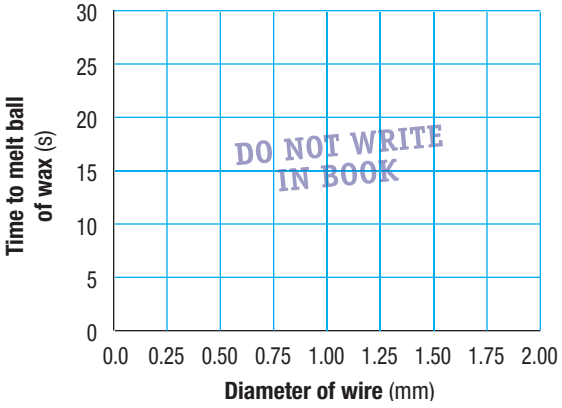
Sample Data Table: Conductivity

	Wire diameter (mm)	Time to melt wax (s)		
		Trial 1	Trial 2	Trial 3
Wire 1				
Wire 2				
Wire 3				

Analysis

1. **Analyzing Data** Measure the diameter of each wire that you tested. If the diameter is listed in inches, convert it to millimeters by multiplying by 25.4. If the diameter is listed in mils, convert it to millimeters by multiplying by 0.0254. In your data table, record the diameter of each wire in millimeters.
2. **Analyzing Data** Calculate the average time required to melt the ball of wax for each wire. Record your answers in your data table.
3. **Graphing Data** Plot the data in your lab report in the form of a graph like the one shown. On your graph, draw the line or smooth curve that best fits the points.

Time to Melt Wax Versus Diameter of Wire



Communicating Your Results

4. **Drawing Conclusions** Based on your graph, which conducts energy more quickly: a thick wire or a thin wire?
5. **Justifying Conclusions** Suppose that someone tells you that your conclusion is valid only for the particular metal that you tested. Without doing further experiments, how can you argue that your conclusion is valid for other metals, too?

Extension

When roasting a large cut of meat, some cooks insert a metal skewer into the meat to make the inside cook more quickly. What difference would the thickness of the skewer make in this case? Explain.