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## Determining the Specific Heat of a Metal

### THE EXPERIMENT

#### PURPOSE

To determine the specific heat of a metal.

#### BACKGROUND

The specific heat (or specific heat capacity) of a metal is the quantity of heat energy needed to raise a given mass of a metal  $1^{\circ}\text{C}$ . This is equivalent to the quantity of heat energy released when the same mass of metal drops  $1^{\circ}\text{C}$ . The SI unit for specific heat is  $\text{J/kg}\cdot\text{K}$  (although  $\text{kcal/g}\cdot^{\circ}\text{C}$  or  $\text{cal/g}\cdot^{\circ}\text{C}$  are also acceptable).

In this experiment you will be given a sample of metal and will use the process of calorimetry to determine its specific heat.

The procedure involves placing the metal in a beaker of boiling water to bring the metal to an initial temperature equal to the temperature of the boiling water. The hot metal will then be placed in a calorimeter containing a known volume of water at room temperature. (Your team will decide what volume of water to use in the calorimeter and what container to use as the calorimeter). The heat from the metal will be released into the cooler water until the metal and the water reach the same temperature.

#### MATERIALS

Safety equipment: goggles, apron and gloves	100-mL graduated cylinder
Sample of a known metal	Thermometer
Calorimeter	Heat source
400-mL beaker	Tongs

#### PROCEDURE

NOTE: Consult safety information before beginning the experiment.

Remember that the team will decide what volume of water to use in the calorimeter and what container to use as a calorimeter.

1. Begin heating a sample of water in the 400-mL beaker. Use enough water to completely submerge the metal sample.
2. Determine the mass of the sample of metal. Record the mass and identity of the metal.
3. Using tongs, gently lower the metal into the beaker of water being heated. Continue heating the metal and water until the water begins to boil.
4. Pour the predetermined volume of tap water into the calorimeter. Record the volume and temperature of the tap water.
5. When the water in the beaker begins to boil, record the temperature of the boiling water.
6. Turn off the hot plate or Bunsen burner. Hold the calorimeter in one hand near the beaker of hot water. Using tongs, carefully remove the metal from the boiling water and immediately place it in the calorimeter.
7. Monitor the temperature of the water in the calorimeter. Record the maximum temperature of the water.
8. Repeat procedure if necessary.

### SAFETY INFORMATION

1. Be careful when placing the metal in and removing the metal from the hot water.
2. Follow all safety procedures for use of a hot plate or Bunsen burner.
3. After reviewing your procedure, the instructor will discuss any safety precautions that are specific to your experiment.

### TABLE OF ACCEPTED VALUES

Compare the value that you calculated for specific heat with the following table of accepted values.

METAL	SPECIFIC HEAT (cal/g · °C)	SPECIFIC HEAT (J/g · °C)
Aluminum	$2.15 \times 10^1$	$8.99 \times 10^{-1}$
Copper	$9.2 \times 10^{-2}$	$3.8 \times 10^{-1}$
Lead	$3.8 \times 10^{-2}$	$1.6 \times 10^{-1}$
Nickel	$1.06 \times 10^{-1}$	$4.43 \times 10^{-1}$
Tin	$5.1 \times 10^{-2}$	$2.1 \times 10^{-1}$
Zinc	$9.28 \times 10^{-2}$	$3.88 \times 10^{-1}$
Cadmium	$6.0 \times 10^{-2}$	$2.5 \times 10^{-1}$
Brass	$9.0 \times 10^{-2}$	$3.8 \times 10^{-1}$
Iron or steel	$1.1 \times 10^{-1}$	0.46