Name _____ Date _____ Class _____

**Thermal Energy and Heat** ▪ *Skills Lab*

# Just Add Water



## Problem

Can you build a calorimeter—a device that measures changes in thermal energy—and use it to determine how much thermal energy is transferred from hot water to cold water?

## Skills Focus

observing, calculating, interpreting data

## Materials

hot tap water
scissors
4 plastic foam cups
2 thermometers or temperature probes
beaker of water kept in an ice bath
balance
pencil

## Procedure


**Making a Calorimeter**

**A.** Label a plastic foam cup with the letter *C*, which stands for cold water.

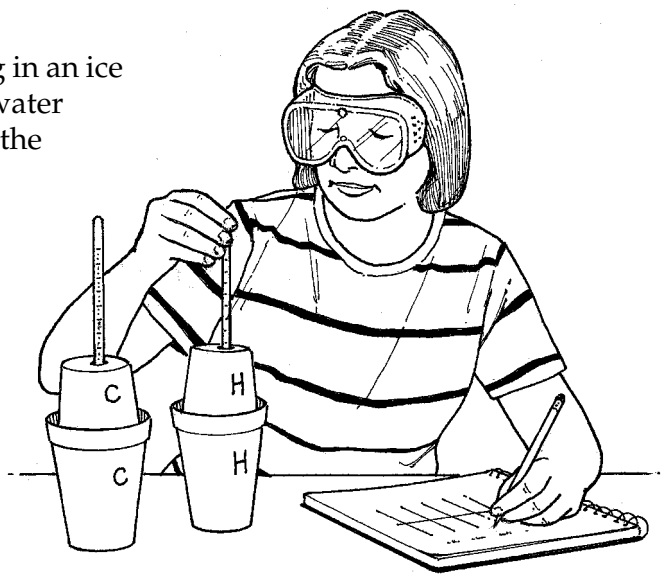
**B.** Cut 2 to 3 cm from the top of a second plastic foam cup. Invert the second cup inside the first. Label the cover with a *C* also. The cup and cover are your cold-water calorimeter.

**C.** Using a pencil, poke a hole in the cover large enough for a thermometer to fit into snugly.

**D.** Repeat Steps A, B, and C with two other plastic foam cups. This time, label both cup and cover with an *H.* This is your hot-water calorimeter.

1. Predict how the amount of thermal energy lost by hot water will be related to the amount of thermal energy gained by cold water.
2. Record all data in the provided data table.
3. Follow the instructions in the box to make two calorimeters. Find the mass of each empty calorimeter (including the cover) on a balance and record each mass in your data table.

## Just Add Water *(continued)*




4. From a beaker of water that has been sitting in an ice bath, add water (no ice cubes) to the cold-water calorimeter. Fill it about one third full. Put the cover on, find the total mass, and record the mass in your data table.
5. Add hot tap water to the hot-water calorimeter. **CAUTION:***Hot tap water can cause burns.* Fill the calorimeter about one third full. Put the cover on, find the total mass, and record the mass in your data table.
6. Calculate the mass of the water in each calorimeter. Record the results in your data table.
7. Put thermometers through the holes in the covers of both calorimeters. Wait a minute or two and then record the temperatures. If you are using temperature probes, see your teacher for instructions.
8. Remove both thermometers and covers. Pour the water from the cold-water calorimeter into the hot-water calorimeter. Put the cover back on the hot-water calorimeter, and insert a thermometer. Record the final temperature as the final temperature for both calorimeters.

### Data Table

| Calorimeter | Mass of Empty Cup (g) | Mass of Cup and Water (g) | Mass of Water (g) | Starting Temp. (°C) | Final Temp. (°C) | Change in Temp. (°C) |
|---|---|---|---|---|---|---|
| **Cold Water** | | | | | | |
| **Hot Water** | | | | | | |

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## Analyze and Conclude

*Write your answers on a separate sheet of paper.*

1. **Observing** What is the temperature change of the cold water? Record your answer in the data table.
2. **Observing** What is the temperature change of the hot water? Record your answer in the data table.
3. **Calculating** Calculate the amount of thermal energy that enters the cold water by using the formula for the transfer of thermal energy. The specific heat of water is 4.18 J/(g·K), so you use the following formula.

   Thermal energy transferred = 4.18J/(g·K) × Mass of cold water × Temperature change of cold water.

   Remember that a change of 1°C is equal to a change of 1 K.
4. **Calculating** Now use the formula to calculate the thermal energy leaving the hot water.
5. **Calculating** What unit should you use for your results for Questions 3 and 4?
6. **Interpreting Data** Was your prediction from Step 1 confirmed? How do you know?
7. **Communicating** What sources of error might have affected your results? Write a paragraph explaining how the lab could be redesigned in order to reduce the errors.

## Design an Experiment

How would your results be affected if you started with much more hot water than cold? If you used more cold water than hot? Make a prediction. Then design a procedure to test your prediction. *Obtain you teacher's permission before carrying out your investigation.*