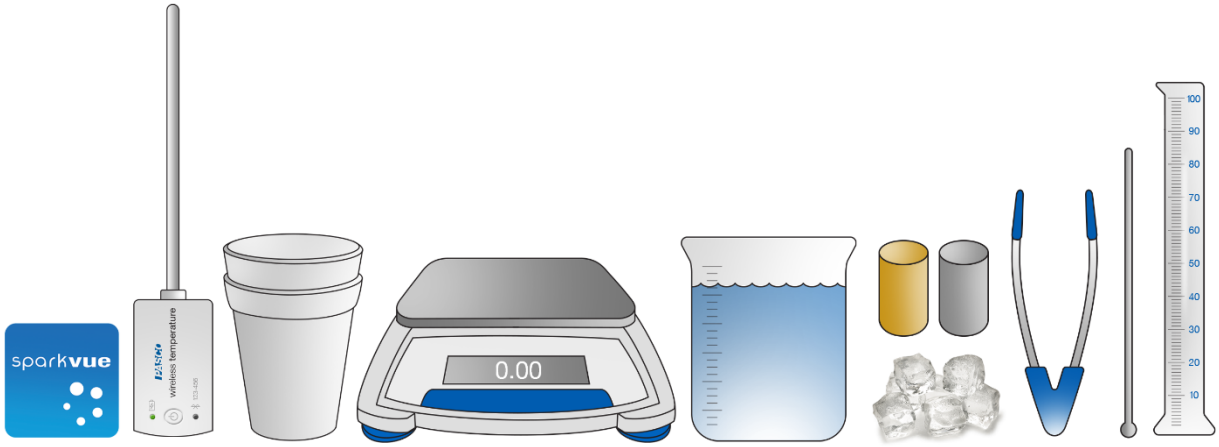
4B – SPECIFIC HEAT

INQUIRY

Combining equal masses of the same substance (water) with different temperatures will produce a mixture with a temperature that is an average of the two samples. Will equal masses of different substances produce the same result?

MATERIALS

- Device with SPARKvue software
- Temperature sensor
- Graduated cylinder, 100-mL
- Balance (readability: 0.01 g)
- Stirring rod or coffee stirrer
- Tongs
- Metal samples (2)
- Foam cups, 8-oz (2)
- Hot water sample
- Ice



BACKGROUND

Specific heat is a property of a given substance, abbreviated as: C_p. Specific heat is the amount of energy necessary to increase the temperature of a specific mass of a substance by a specific amount. The specific heat of water is 4.18 J/g·°C because it takes 4.18 joules of energy to raise 1 gram of water by 1 degree C.

SAFETY

Follow these important safety precautions in addition to your regular classroom procedures:

- Wear safety goggles at all times.
- Use caution with hot water.

PROCEDURE

Part 1 – Different materials

1. What do you predict the temperature will be if you mix equal masses of a cold metal and hot water, for example 100 g of water at 50 °C and 100 g of copper at 0 °C? Record your prediction in the space provided above Table 1 on your answer sheet.

2. Open SPARKvue.

3. Open the 04B Specific Heat lab file in SPARKvue.

4. Use the Bluetooth icon to connect the Temperature sensor.

PROCEDURE

5. Obtain a sample of metal. Measure its mass and record the exact mass in Table 1.
6. Add the metal to a foam cup and cover it with ice and water so it reaches a temperature of 0 °C. Assume the metal will go to 0 °C and record this as the initial temperature for metal in Table 1.
7. Use the graduated cylinder to measure a mass of hot water equal to the mass of metal. The density of water is 1 g/mL.
8. Record the mass in Table 1. Pour the hot water into the empty foam cup.
9. Insert the temperature probe into the hot water.
10. Start collecting data. Record the initial temperature of the hot water in Table 1 just BEFORE mixing.
11. Use the tongs to quickly add the cold metal to the hot water. Be careful not to transfer any ice.
12. Stir for a few moments.
13. Measure and record the mixture temperature in Table 1.
14. Stop collecting data

ANALYSIS

Complete the analysis for Part 1 on your answer sheet.

QUESTIONS

Answer the questions for Part 1 on your answer sheet.

PROCEDURE

Part 2 – Specific heat capacity

1. You will now investigate the ability of a *different* metal to change its temperature under the same conditions as Part 1. Empty both cups and dry the inside and outside of each cup thoroughly.
2. Measure and record the mass of a different metal in Table 2 on your answer sheet.
3. Add the metal to a foam cup and cover it with ice and water so it reaches a temperature of 0 °C. Record the initial temperature of the metal as 0 °C.
4. Measure a mass of hot water equal to the mass of metal. Record the mass in Table 2.
5. Add the hot water to the empty cup. Insert the temperature probe into the hot water. Start collecting data and record the initial water temperature in Table 2.
6. Use the tongs to quickly add the cold metal to the hot water. Be careful not to transfer any ice.
7. Stir for a few moments.
8. Measure and record the final mixture temperature in Table 2. Enter the same temperature for the metal and the water.
9. Stop collecting data.

ANALYSIS

Complete the analysis for Part 2 on your answer sheet.

QUESTIONS

Answer the questions for Part 2 on your answer sheet.