

A Good Cold Pack

Cold packs are used to treat sprained ankles and similar injuries. A cold pack is typically made of a thin plastic inner bag containing water. That bag, in turn, is surrounded by a heavier plastic bag containing a solid substance. When the pack is twisted, the inner bag breaks and releases the water. As the solid substance dissolves in the water, energy is absorbed and the resulting mixture gets colder.

In this experiment, you will first determine temperature changes as several different solid substances dissolve in water. You will then develop and test a plan for making the best cold pack using 3.0 scoops of one of the substances and the best amount of water.

OBJECTIVES

In this experiment, you will

- Use a Temperature Probe to measure temperature.
- Determine temperature changes as solid substances dissolve in water.
- Design and test a plan for making the best cold pack.
- Report your results.

MATERIALS

computer
Logger Lite software
Temperature Probe
50 mL beaker
250 mL beaker

10 mL graduated cylinder
water
ammonium chloride, NH_4Cl
citric acid, $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$
potassium chloride, KCl
sodium bicarbonate, NaHCO_3
sodium carbonate, Na_2CO_3

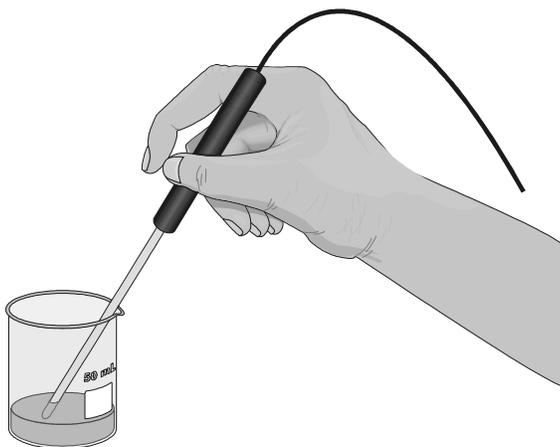


Figure 1

A Good Cold Pack

PROCEDURE

Part I Finding Temperature Changes

1. Obtain and wear goggles.
2. Connect the Temperature Probe. Start the Logger Lite data-collection program.
3. Measure out 3.0 scoops of each of the test substances. Place them on clean, labelled paper towel.
4. Use a 10 mL graduated cylinder to measure out 10 mL of room-temperature water into a clean 50 mL beaker.
5. Collect temperature data.
 - a. Place the Temperature Probe into the 50 mL beaker containing the 10 mL of water.
 - b. Gently move the probe and note the temperature displayed in the meter.
 - c. When the temperature stops changing, click  to begin data collection.
 - d. Monitor the temperature for 5 seconds to establish the initial temperature of the water.
 - e. Carefully add the solid ammonium chloride to the water. Stir gently with the Temperature Probe.
 - f. When the temperature stops changing, click  to end data collection.
 - g. Click the Statistics button,  to display a Statistics box. Record the minimum and maximum temperatures.

(see data chart below)

Close the Statistics box.

6. Repeat Steps 4-5 for each of the remaining substances. Clean the probe after each run and place it into a 250 mL beaker containing room-temperature water to bring the probe back to room temperature.

Part II Finding the Best Cold-Pack Mixture

7. Make a plan for making the coldest temperature using 3.0 scoops of one of the solid substances and the best amount of water. Describe your plan and test it. What were your results?

DATA

Substance	Maximum temperature (°C)	Minimum temperature (°C)	Temperature change (°C)
Ammonium chloride (NH ₄ Cl)			
Citric acid (H ₃ C ₆ H ₅ O ₇)			
Potassium chloride (KCl)			
Sodium bicarbonate (NaHCO ₃)			
Sodium carbonate (Na ₂ CO ₃)			

PROCESSING THE DATA

1. In the space provided in the data table above, subtract to calculate the temperature changes.
2. Which substance caused the greatest temperature decrease?
3. Which substance caused the smallest temperature decrease?
4. Which substance is the most unsuitable for a cold pack? Explain.
5. Which factors other than cooling ability might be considered when choosing a substance for use in a cold pack?

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