A Good Cold Pack

Question: What makes a good cold pack?

Kentucky Core Content:

SC-M-1.1.2 The chemical properties of a substance cause it to react in predictable ways with other substances to form compounds with different characteristic properties. In chemical reactions, the total mass is conserved. Substances are often classified into groups if they react in similar ways.

SC-M-1.1.3 Chemical elements do not break down during normal laboratory reactions such as heating, exposure to electric currents, or reaction with acids. Elements combine in many ways to produce compounds.

Objectives: Students will be able to

1. Observe which of the given substances will, when mixed with water, make the best cold pack.
2. Describe which substances produce an endothermic reaction and which produce an exothermic reaction.

Materials:

Per pair of students
Graphing calculator and CBL with temperature probe
100 ml beaker
Medicine cup
Water
Paper towels
Citric acid, calcium chloride, baking soda, table salt, rock salt—approximately 10 ml/5 gm of each

Procedure/Time: This activity should take two class periods.
The procedure is outlined on the worksheet for the students and the teacher. In the first part of the procedure, students will be using the CBL and temperature probe to find the temperature change in different chemical reactions. Students must record this data on their worksheet. The second part of the activity requires the students to have a class discussion on what changes could be made to make the best cold pack using the same amount of a given solute as used in Part 1.

Assessment: Assessment for this activity will be the completed worksheets and an informal in class discussion after the activity.

Teacher Notes: If students are not familiar with CBLs, the teacher may want to demonstrate one solute from part 1 to help them see what to do. Depending on water temperature, etc, it may be necessary to alter the amounts of solute and/or water for best results. It would be in the teacher's best interest to test each solute first before beginning this activity. Teachers can substitute solutes with other chemicals at their own discretion. Make sure students clean out their beakers completely between each chemical reaction and after they finish.

Name _____ Date _____

A Good Cold Pack

Endothermic and Exothermic Reactions

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.

In this experiment you will:

- Measure temperature
- Determine temperature changes in solutions
- Design and test a plan for making the best cold pack
- Report your results

MATERIALS:

Graphing calculator and CBL with temperature probe
1 100 ml beaker
1 medicine cup
water
paper towel
Citric acid, Calcium chloride , Baking soda, Table salt, Rock salt

PROCEDURE:

Part 1—Finding Temperature Changes

1. Plug the temperature probe into channel one of the CBL. Use the link cable to connect the CBL to the calculator. Make sure ends are firmly pressed in.
2. Turn on the calculator. Press the APPS key and choose 2:CBL/CBR. Press enter.
3. Choose 2:Data logger. Press enter.
4. Set up the calculator to take the appropriate data:
    a. Probe: TEMP
    b. # Samples: 36
    c. Intrvl (sec): 5
    d. Units: F
    e. Plot: REALTIME
    f. Directions: ON
    g. Highlight GO and press enter
5. Continue pressing enter until you reach the screen that says "PRESS (ENTER) TO BEGIN".
6. Place 20 ml of water into the beaker.
7. Measure 5mL of citric acid into a medicine cup.
8. Collect temperature data:
    a. Place temp probe into the water. You may need to tilt the beaker to cover the probe.
    b. Press ENTER on the calculator.
    c. Count to 15 and then add the citric acid and stir with your temp probe making sure to keep the probe tip under water.

d. Stir until the calculator stops taking data.
e. Remove probe and dry off.

9. Record the minimum and maximum temperatures onto the data table.
    a. When data collection stops, a graph of temp vs. time will be displayed. Use the ARROW key on the calculator to examine data points along the curve. As you move the cursor right or left, the time and temp value of each data point are displayed below the graph.
    b. Record the min and max temps to the nearest 0.1 F.
    c. Press ENTER to return to the main screen
10. Repeat steps 4-9 for each of the remaining substances. Clean the probe each time. Rinse beaker each time as well.
11. For each substance calculate the temperature change. Place a + or a – to show if the temp increased or decreased.

DATA

Substance	Max Temp (F)	Min Temp (F)	Temp change (F)
Citric Acid			
Calcium Chloride			
Baking Soda			
Table Salt			
Rock Salt			

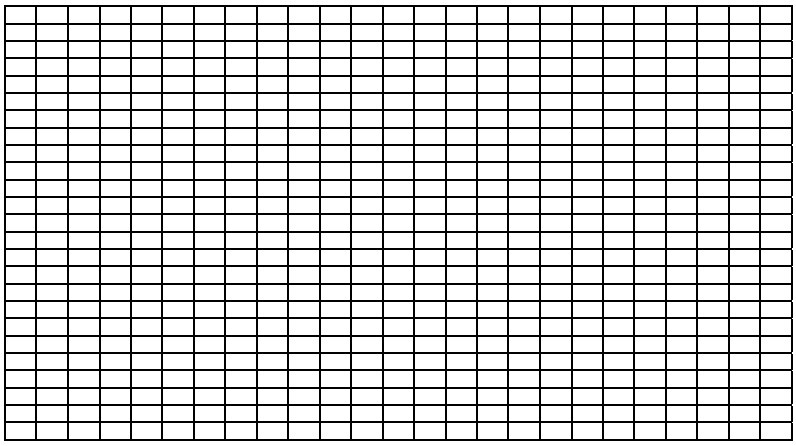
PART 2 Finding the best Cold-Pack Mixture

Using the same amount of a solute from the table, how can the coldest cold pack be made? Use class discussion to help create a classroom plan to test your hypothesis.

Record the classroom results in the table below:

substance	Variable	Max Temp (F)	Min Temp (F)	Temp Change (F)

Use the classroom results to create a graph of the results. Make sure to label all parts.



PROCESSING THE DATA: (Individual and Classroom)

1. Which substance caused the greatest temperature decrease?

2. Which substance is the most unsuitable for a cold pack? Explain.

3. Explain how the variable in PART 2 affected the results.

4. Did a chemical or physical reaction take place in this experiment? How do you know?