Group # _____ Name _____
Period ___ Date ___/___/___

Lab Ch 3 • Hot & Cold Packs

Lab Partners: _____ _____ _____

Read ENTIRE lab.
MAKE NOTES in the margin (Highlight, circle, etc) up to Data Table.

Objective of Lab

Ever used a cold pack or hot pack on an injury? This quick and easy procedure will demonstrate how to make a cold/hot packs with chemicals. The process in making the these packs is NOT a chemical reaction but merely the physical act of dissolving.

Many instant hot and cold packs function by dissolving a salt into water. As the salt dissociates, heat is either released in an exothermic reaction or absorbed in an endothermic reaction. When the salt is dissolved in water, the ionic bonds of the salt separate. This process requires energy, which is obtained from the surroundings. The ions then form bonds with the water, a process that releases energy. If more energy is released than taken in, then the process is exothermic, making the solution feel warmer. If more energy is taken in than released, then the process is endothermic, making the solution feel cooler.

Background – Calorimetry

Calorimetry is the science of measuring heat. Many chemical and physical transformations involve energy transfer in the form of heat. The magnitude and direction of heat may be determined using a calorimeter. In reactions that occur in aqueous solutions, the energy is transferred to or taken away from the water. A calorimeter is an apparatus that is insulated and prevents heat from flowing in or out of the system. Since the experiment is run under constant pressure (atmospheric), the change in water temperature that is measured is due to the enthalpy of reaction (heat of reaction). The heat of reaction may be calculated using the values measured for change in the water temperature.

The heat transfer, or change in enthalpy in a reaction (q_{rxn}), is related to the mass of the solution (m), the specific heat capacity of the solution (c), and the temperature change ($\Delta T = T_{final} - T_{initial}$).

$$q_{rxn} = (m \times c \times \Delta T)$$

The specific heat capacity of a substance is the amount of energy required to raise 1 g of the substance 1° C. The specific heat capacity of water is 4.186 J / (° C × g). In experiments conducted in aqueous solution, the specific heat capacity of water is generally used.

Materials

Chemical	Equipment
Calcium chloride	25mL Graduated Cylinder
Ammonium nitrate	400mL Beaker
Distilled Water	Balance
	(2) Baggies
	Thermometer
	Weigh boat

Group # _____ Name _____
Period ___ Date ___/___/___

Lab Ch 3 • Hot & Cold Packs

Procedure

1. Weigh out 10 grams of ammonium nitrate in a weigh boat using a balance.
2. Transfer the ammonium nitrate into a plastic bag. Use a beaker to place the plastic baggie into support the baggie. Teacher will demonstrate.
3. Using a graduated cylinder, measure out 20 mL of water.
4. Measure the temperature inside the bag (This is time zero). Place the thermometer inside the bag and let it sit next to the side of the baggie.
5. BEFORE YOU ADD THE WATER – READ FIRST. Have someone record the temperatures, someone read the temperature, and (Very important) someone must hold the baggie & keep it air tight as much as possible so the heat doesn't escape/enter.
6. Quickly, but carefully, pour the water into the bag of ammonium nitrate, and seal the bag. (Try to remove the excess air before sealing the bag.)
7. Gently use the thermometer to mix the solid and water (but not too much). Record the temperatures every 15 seconds for 5 minutes.
8. Once you are finished recording times, feel the baggie. Did it get hot or cold? Record observations in Data table.
9. Repeat steps 1-8 in a new baggie and use calcium chloride.

Disposal/Clean Up

- Salt solutions may go down the sink with lots of water.
- Throw away baggies when you are finished.
- Clean ALL equipment with LAB Equipment soap & brushes
- Leave dishes to dry inverted on a paper towel.
- Clean Lab BENCH with small soap bottle and sponge.
- Wash hands with hand soap.
- Let me know when you are ready. **Do not get unprotected until dismissed**.

Data and Observations

Ammonium nitrate		**Calcium chloride**	
Time	Temp (ºC)	Time	Temp (ºC)
0		0	
15s		15s	
30s		30s	
45s		45s	
1 min		1 min	
15s		15s	
30s		30s	
45s		45s	
2 min		2 min	

Group # _____ Name _____
Period ___ Date ___/___/___

Lab Ch 3 • Hot & Cold Packs

15s		15s	
30s		30s	
45s		45s	
3 min		3 min	
15s		15s	
30s		30s	
45s		45s	
4 min		4 min	
15s		15s	
30s		30s	
45s		45s	
5 min		5 min	
Feel the baggie. Is it hot or cold?		Feel the baggie. Is it hot or cold?	

Graph

Graph the change in temperature vs. time for each salt solution. Make sure you have the following on your graph:

- Title and label each axis (name and units)
- Determine how you are going to number each axis so that the graph is BIG (at least ¾'s the page)
- Plot values. Connect your data points in COLOR.
- Make a color key for each line

Calculations

1. For each substance, look at your data table and write down the highest temperature and lowest temperature for each solid solution.

Substances	Highest temperature (ºC)	Lowest temperature(ºC)
Ammonium nitrate		
Calcium chloride		

2. Calculate the heat absorbed or released for each salt solution. The specific heat of water is 4.184 J/° C × g. (Show all work and units).
   (HINT: one of these salt solutions RELEASED heat…. so q will be negative)

$$q = [c \times m \times \Delta T]$$

Group # _____ Name _____
Period ___ Date ___/___/___

Lab Ch 3 • Hot & Cold Packs

Ammonium nitrate:

Calcium chloride:

Post-Lab Questions

1. a) How do you know that a reaction is “exothermic”?

   b) How do you know that a reaction is “endothermic”?

2. a) When mixed with water, which of the salt solutions produced an <u>exothermic</u> reaction? **Explain** your answer

   b) Would this salt solution be best used in a cold pack or hot pack?

3. When mixed with water, which of the salt solutions produced an <u>endothermic</u> reaction? **Explain** your answer

   b) Would this salt solution be best used in a cold pack or hot pack?