Lab: Determining Effective Chemicals for Use as Cold Packs

Certain chemicals when dissolved in water give off heat, while others become cold. These chemicals can be used in cold or hot packs. Cold packs can be used to reduce swelling from a bruise or injury.

A company is trying to develop a new cold pack. The cold pack will contain one chemical mixed with 50 mL of water. The company would like your help in determining which of the following chemicals is best for use in a cold pack and how much should be used.

Ammonium chloride (NH_4Cl)
Calcium chloride ($CaCl_2$)
Sodium chloride (NaCl)

Your Task-

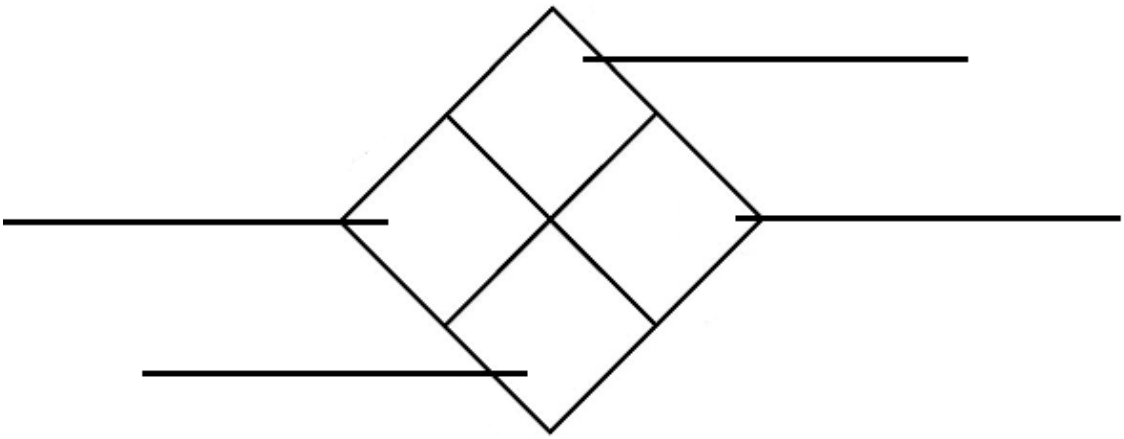
Part 1- You and your partner will design and conduct an experiment to determine which of the three chemicals is best for use in a cold pack.

Part 2- You and your partner will design and conduct an experiment to determine if the amount of the chemical from Part 1 affects its use in the cold pack.

Pre-Lab

Safety

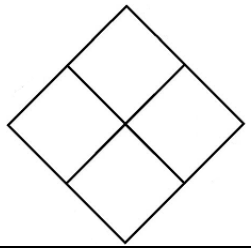
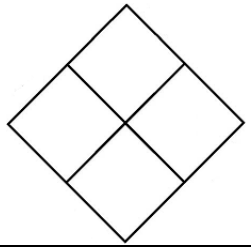
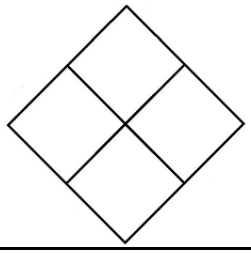
You need to be aware and use appropriately each of the above chemicals. The most common system[a] is simple, readily recognizable, and easily understood for the specific hazards and severity of the chemical. It addresses four hazards. On the diamond below, color each of the small diamonds, write the color, and identify each of these general hazards:



[a] National Fire Protection Association (NFPA)

What is the range of numbers? _____ Lowest:_____ Highest:_____

Look up the material safety data sheet (MSDS) on the web, and specific the specific hazard(s) for each of the above chemicals. Fill in the diamond for each compound and write the specific type of hazard of most concern. (The general concern is given to you.)

Substance	NFPA Placard	Specific Hazard/Treatment
Ammonium chloride (NH_4Cl)	Health: Skin Contact: 	
Calcium chloride ($CaCl_2$)	Health: Skin Contact: 	
Sodium chloride (NaCl)	Health: Skin Contact: 	

Overview –
During this activity you will work with a partner. However, you must keep your own individual lab notes because after you finish you will work independently to write a report about your investigation.

You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided. You may use additional materials and equipment if they are available.

Note- You have been given a total of 10 grams of each chemical. Use some of this amount of each chemical for Part 1 and some for Part 2. It is not necessary to use the entire amount of each chemical.

Materials-

10 grams ammonium chloride (NH_4Cl)
10 grams sodium chloride (NaCl)
10 grams calcium chloride ($CaCl_2$)
Access to a watch or clock with a second hand
Access to an electronic balance
Access to distilled or deionized water
Safety goggles and apron
scoopula
4 foam cups
1 graduated cylinder
1 stirrer
1 thermometer
Paper towels for cleanup

Steps to follow-

1. In your own words, clearly state the problems you are going to investigate for both Part 1 and Part 2. Include a clear identification of the independent and dependent variables that will be studied.

2. Design a separate experiment to solve each problem. Use the amount of chemical you have been given for both Part 1 and Part 2. Your experimental design should match the statement of the problem, should control for variables, and should be clearly described so that someone else could easily replicate your experiment. Include a control if appropriate.

3. When your experimental design is completed, show your design to your teacher for approval before starting your experimental work. Your teacher's approval does not necessarily mean your experiments are well designed. It simply means your teacher believes your experiments are not dangerous or are likely to cause a mess.

4. While conducting your experiments, take notes in your notebook. Include the results of your experiments. All data should be organized in tables, charts, and graphs, which should all be properly labeled.

Your notes will not be scored, but they will be helpful to you later as you work independently to write about your experiments and results. You must keep your own notes because you will not work with your partner when you write your lab report.

SAFETY-

CAUTION- Do not mix the chemicals together
Dispose of all used chemicals down the sink with excess water.
Follow standard safety procedures.

Laboratory Report Format

Working on your own, summarize your experiments and results in a typed Laboratory Report. You may use your own notes that you took previously while working with your partner. Use the following report format.

Chemistry Name: _____

Date: _____ Lab Partner: _____

Cold Pack Laboratory

Purpose: Present a clear statement of the problems you investigated. Include a clear identification of the independent and dependent variables, and control(s) that were studied.

Procedure: Describe the experiments that you carried out. Your description should be clear and complete enough so that someone else could easily replicate your experiments.

Results: Provide the results of your experiments. Tables, charts, and/or graphs should be used where appropriate and all should be properly labeled. Charts and/or graphs can be computer generated.

Conclusions: Present the conclusions from your experiments. In your discussion, your conclusions should be fully supported by experimental data. Comment about how valid your conclusions are. How much confidence do you have in your results and conclusions? Discuss any factors that may have led to errors in your experiments and how you might correct these errors. Include ways that your experiments could be improved if you were to do it again.

Grading Rationale

Purpose	25%
Procedure	25%
Results	25%
Conclusions	25%

RUBRIC FOR THE COLD PACK LAB

ELEMENT	ABOVE GOAL 3 points	AT GOAL 2 points	NEAR GOAL 1 points	BELOW GOAL 0 point
Purpose – problem definition	The problem is stated very clearly. The independent and dependent variables are clearly identified.	The problem is stated. The independent and dependent variables are identified.	The problem statement is poorly stated. Independent and dependent variables are misidentified.	The problem statement is missing. The independent and dependent variables are not identified.
Procedure – experimental design	The experimental design is clearly stated. Variables are controlled. The procedure is clear, complete, and replicable. A control and multiple trials are included where appropriate.	Descriptions are relatively clear and complete. Some omissions may effect replicability. Controls and multiple trials may not be included.	The experimental design matches the stated problem to some extent. Descriptions are unclear and/or incomplete such that the experiment is not replicable.	The experimental plan is incomplete and/or unclear.
Results- observing and recording data	Tables, charts, or graphs are clearly labeled with correct units and are in agreement with collected data.	Tables, charts, and graphs are generally complete and match collected data.	Data are poorly organized. Tables, charts, or graphs are incomplete, mislabeled, and/or do not match collected data.	Data and/or results are very poorly organized or missing.
Conclusions & validity	Conclusions are thoroughly discussed and are fully supported by the data. Sources of error are clearly enumerated and explained. Steps to minimize these errors are thoroughly discussed.	Conclusions are presented with minor omissions or errors that do not significantly detract from evidence of understanding. Some data supporting the conclusions are included. Most of the sources of error are enumerated and explained. Steps to minimize these errors are described.	Conclusions are related to the stated problem and supported by data to a limited extent. Major errors in interpretation may be present. Some sources of error are listed. The causes of these errors and steps to minimize them are either missing or poorly described.	Conclusions are missing or major omissions or errors are present. There is no discussion of validity of conclusions.

Above Goal: 10-12 points At Goal: 7-9 points Near Goal: 4-6 points Below Goal: 0-3 points