

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Designing Hot and Cold Packs

### Part 1: Researching Substances

#### Safety Note: Using Chemicals

Do not taste or touch the substances in the investigation. Mix substances only when you are told to do so by your teacher. The substances present skin irritation risks. Wash exposed areas when finished. If a substance gets on your skin or clothes, tell your teacher and rinse the substance off with water. If you get a substance in your eyes, tell your teacher and rinse your eyes with water for 15 minutes. If a substance is inhaled, move to fresh air and seek medical help for any breathing difficulties.

#### Criteria:

- Reach the highest or lowest temperature possible.
- Use as little of the substances as possible.

#### Procedure:

1. Test what happens when you mix different combinations of substances in a plastic bag. Use these tests to explore substances that you might use in a hot or cold pack design.
2. In each test, mix no more than two solids with water. Clearly label your bag with the names of the substances and record them in the table below.
3. For solids, measure  $\frac{1}{4}$  teaspoon (leveled), and add it to the plastic bag. For water, measure 45 mL. Add the water last.
4. Quickly and carefully press the air out of the bag and seal it. Mix the substances through the bag with your fingers.
5. Observe what happens and record the results.

#### Substances:

- baking soda ( $\text{NaCHO}_3$ )
- calcium chloride ( $\text{CaCl}$ )
- citric acid ( $\text{C}_6\text{H}_8\text{O}_7$ )
- water ( $\text{H}_2\text{O}$ )

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### Designing Hot and Cold Packs (continued)

| Substances | Observations |
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## Designing Hot and Cold Packs (continued)

1. Which type of pack will you design?

a hot pack

a cold pack

2. Which substances will you use in your design? (Check all that apply.)

baking soda ( $\text{NaCHO}_3$ )

calcium chloride ( $\text{CaCl}$ )

citric acid ( $\text{C}_6\text{H}_8\text{O}_7$ )

water ( $\text{H}_2\text{O}$ )

3. Why did you choose these substances?

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


## Designing Hot and Cold Packs (continued)

### Part 2: Finding an Optimal Design



#### Constraints:


- In any design, do not use more than 1 teaspoon of calcium chloride, baking soda, or citric acid.
- If using water, always use 45 mL.


| <p> <b>PLAN</b></p> <p>VERSION _____</p> <p>_____</p> <p>_____</p>  | <p> <b>BUILD</b></p> <table border="1"><thead><tr><th>Substance</th><th>Amount</th></tr></thead><tbody><tr><td><input type="text"/></td><td><input type="text"/></td></tr><tr><td><input type="text"/></td><td><input type="text"/></td></tr><tr><td><input type="text"/></td><td><input type="text"/></td></tr></tbody></table> | Substance | Amount | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
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| <p><b>ANALYZE</b></p><br><br><br>  |   |           |        |                      |                      |                      |                      |                      |                      |


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
## Designing Hot and Cold Packs (continued)


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
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
## Designing Hot and Cold Packs (continued)


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## Designing Hot and Cold Packs (continued)

### Part 3: Writing a Proposal

1. Explain how your hot or cold pack works.

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2. Explain why your design is the optimal design. Be sure to address each criterion and provide evidence that shows how your design meets each criterion.

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