

Dougherty Valley HS AP Chemistry
Hand warmer challenge
Sample data

Investigation Calculations Table (based on sample data)								
Solid	Cost per 500 g (\$)	Temperature Change, ΔT ($^{\circ}\text{C}$)	Thermal energy change in calorimeter contents, q_{rxn} (J)	Thermal energy change of calorimeter, q_{cal} (J)	Internal energy change, q_{solu} (J)	Molar Mass, (g/mol)	Moles used (mol)	Enthalpy of dissolution, ΔH_{soln} (kJ/mol)
$\text{NaC}_2\text{H}_3\text{O}_2$	3.95	4.8	1000	77	-1080	82.03	0.061	-17.7
CaCl_2	6.55	16.0	3350	256	-3600	111.10	0.0450	-80.1
Na_2CO_3	12.90	5.0	1050	80	-1130	106.00	0.047	-23.9
NaCl	6.15	-1.4	-290	-22	310	58.45	0.086	3.7
LiCl	32.75	18.0	3770	288	-4050	42.39	0.118	-34.4
NH_4NO_3	9.05	-7.5	-1570	-120	1690	80.04	0.062	27.0

Based on the cost information provided, and your experimental work and calculations, select which chemical you believe will make the most cost-efficient hand warmer. The hand warmer you are designing needs to increase in temperature by 20°C . Calculate the amount of the compound you selected that would be required for a hand warmer that meets this requirement.

Argumentation and Documentation

Write a paragraph in which you describe all the factors you considered and you explain your rationale for choosing one chemical and not each of the other chemicals studied in this experiment. Your paragraph should start with a claim sentence that clearly states your choice and the amount of substance to use. The claim should be followed by evidence from your experiment and cost and safety analysis. The paragraph should conclude with reasoning explaining how your evidence supports your claim.

Post Lab Assessment

[1] Are the dissolving processes you carried out endothermic or exothermic or neither? Explain your reasoning

[2] Dissolving ionic compounds involves the separation of the solid ionic compound into cations and anions in water. This process is represented by an equation showing the solid as a reactant and the aqueous ions as products. The heat of the reaction ΔH_{solu} is written after the products, typically in units of kJ/mol

Example: sodium hydroxide dissolves exothermically, releasing 44.2 kilojoules per mole dissolved. This process is represented as

$$\text{NaOH}(s) \rightarrow \text{Na}^+(aq) + \text{OH}^-(aq), \Delta H_{\text{solu}} = -44.2 \text{ kJ/mol}$$

Write an equation to represent the dissolving process for each salt you studied. Include your calculated heat of reaction as in the example.

[3] Changes in matter are generally classified as physical or chemical based on whether new substances are formed through the process. Does dissolving represent a physical change, a chemical change, or an intermediate change? Explain your reasoning, including evidence from the animation you viewed. [\[LINK\]](#)

[4] Find the published value of ΔH_{solu} for each solid and determine the percent error in those values.

[5] What possible sources of error could affect the accuracy of your calculated value of the amount of solid in your hand warmer? List at least two and what effect they would have on the temperature change.