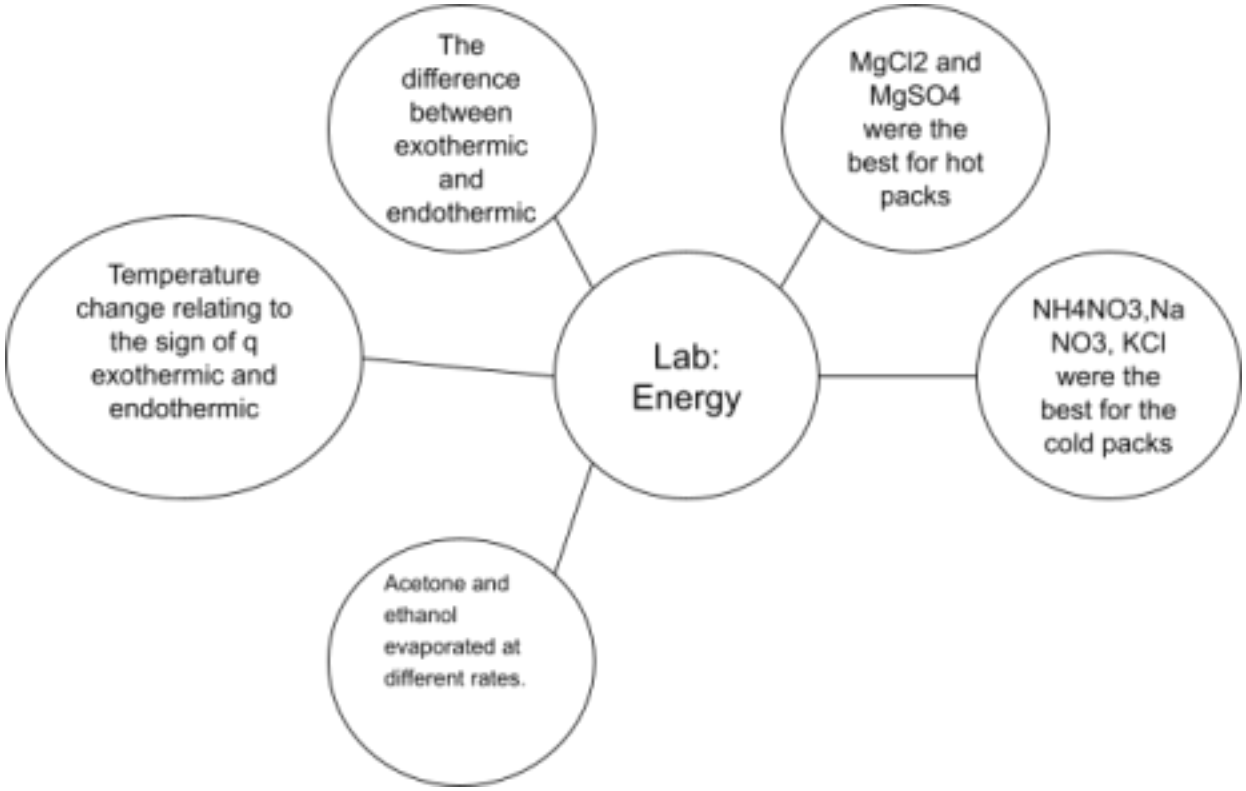
Student Name:_____
Course:_____CHM 151_____

Before you begin, Go to File → **Make a Copy** and Save in your personal Google Drive

Brainstorm what you experienced in the lab to select a Main Claim:

Bubble Map

***Double click* on the map below and fill in experiences/observations from the lab**

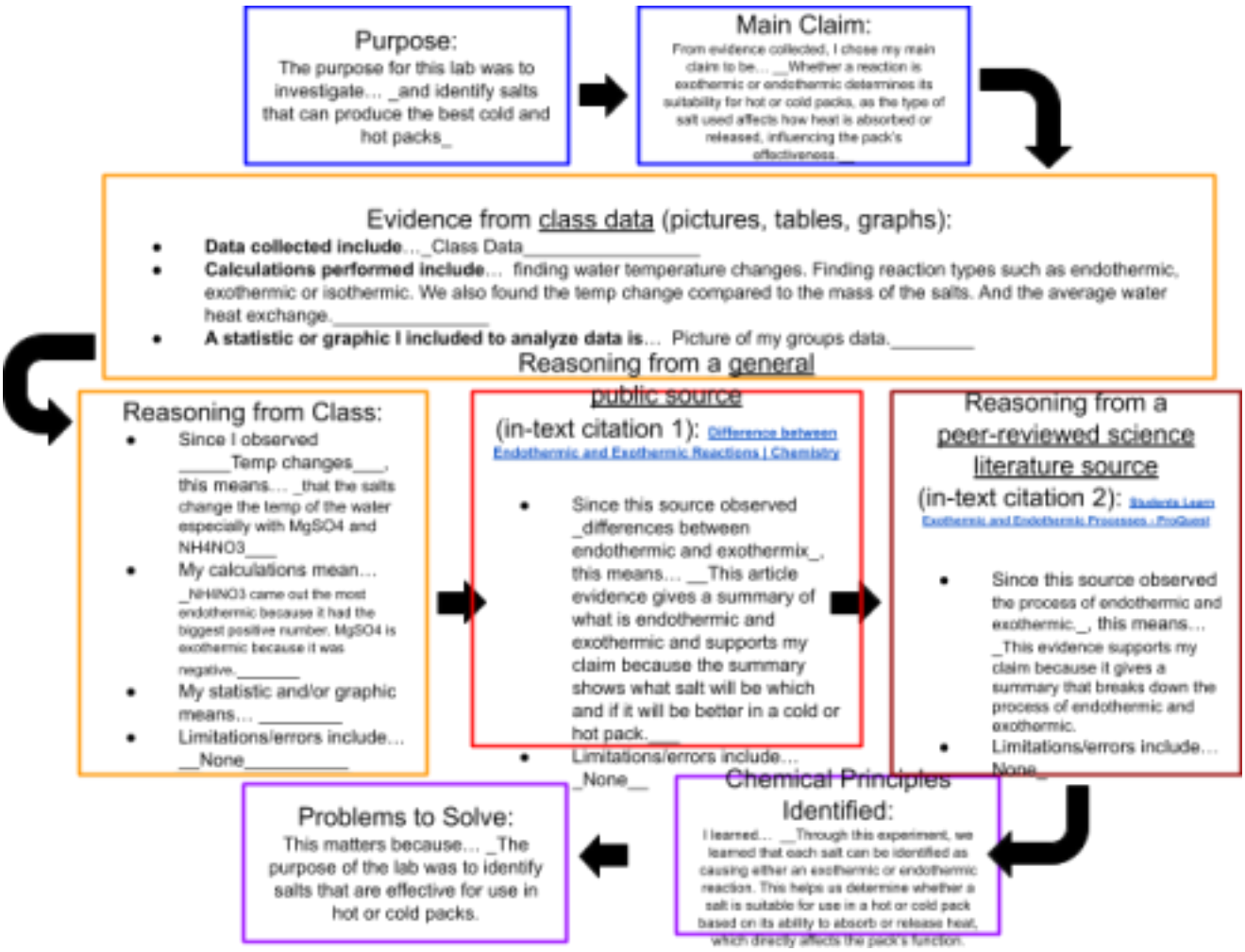


Pick one bubble to focus on for this lab write-up

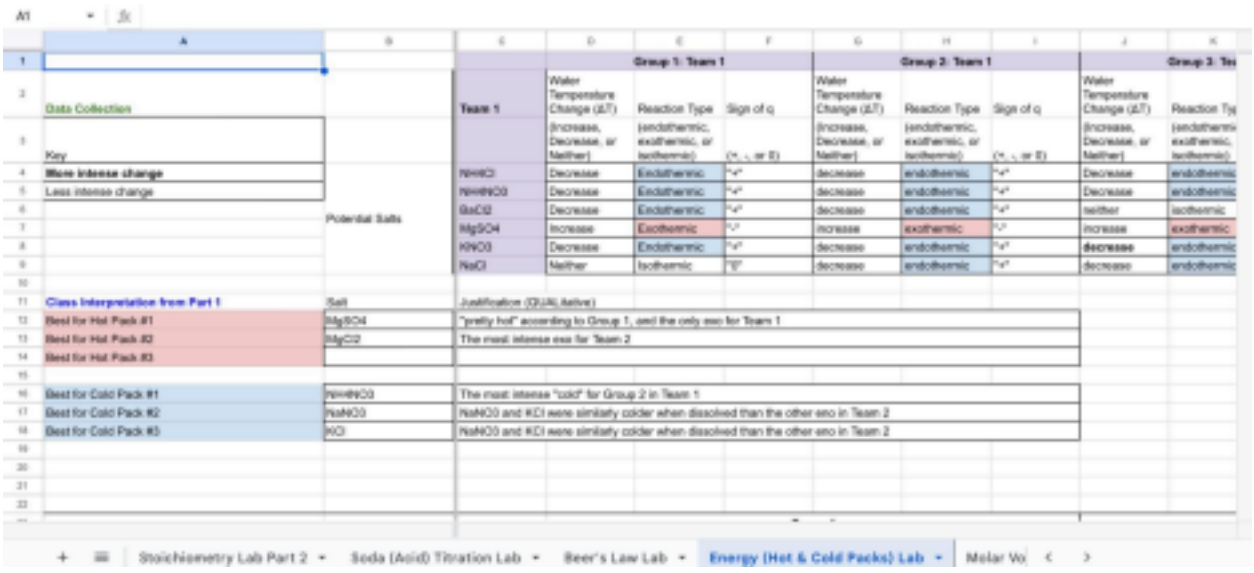
Main Claim: _A reaction is exothermic or endothermic determines its suitability for hot or cold packs, as the type of salt used affects how heat is absorbed or released, influencing the pack's effectiveness._____
Develop an outline for your Lab Write-up:

Flow Map Outline

***Double click* on the map below and fill in *briefly* based on your lab experience**



Class data (Group 1)

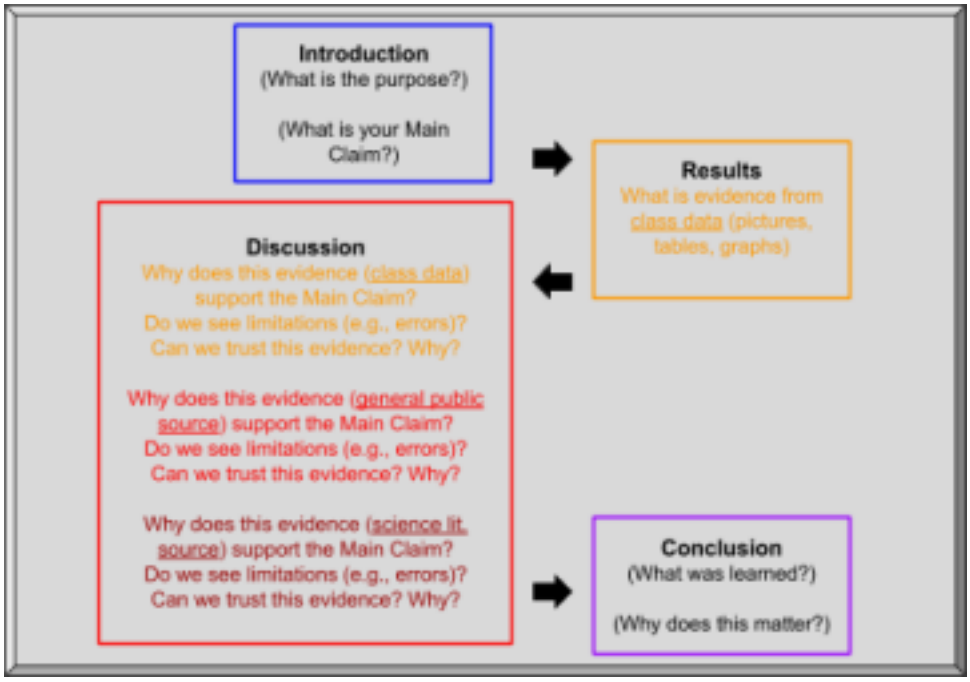


Data Collection		Group 1: Team 1			Group 2: Team 1			Group 3: Team 1	
Team 1		Water Temperature Change (ΔT)	Reaction Type	Sign of q	Water Temperature Change (ΔT)	Reaction Type	Sign of q	Water Temperature Change (ΔT)	Reaction Type
Key		(Increase, Decrease, or Neither)	(endothermic, exothermic, or isothermic)	(+, -, or 0)	(Increase, Decrease, or Neither)	(endothermic, exothermic, or isothermic)	(+, -, or 0)	(Increase, Decrease, or Neither)	(endothermic, exothermic, or isothermic)
More intense change	NH4Cl	Decrease	Endothermic	"+"	decrease	endothermic	"+"	Decrease	endothermic
Less intense change	NH4NO3	Decrease	Endothermic	"+"	decrease	endothermic	"+"	Decrease	endothermic
	CaCl2	Decrease	Endothermic	"+"	decrease	endothermic	"+"	neither	isothermic
	MgSO4	Increase	Exothermic	"-"	increase	exothermic	"-"	increase	exothermic
	KNO3	Decrease	Endothermic	"+"	decrease	endothermic	"+"	decrease	endothermic
	NaCl	Neither	Isothermic	"0"	decrease	endothermic	"+"	decrease	endothermic

Class Interpretation from Part 1	Salt	Justification (Qualitative)
Best for Hot Pack #1	MgSO4	"pretty hot" according to Group 1, and the only exo for Team 1
Best for Hot Pack #2	MgCl2	The most intense exo for Team 2
Best for Hot Pack #3		
Best for Cold Pack #1	NH4NO3	The most intense "cold" for Group 2 in Team 1
Best for Cold Pack #2	NaNO3	NaNO3 and KCl were similarly colder when dissolved than the other exo in Team 2
Best for Cold Pack #3	KCl	NaNO3 and KCl were similarly colder when dissolved than the other exo in Team 2

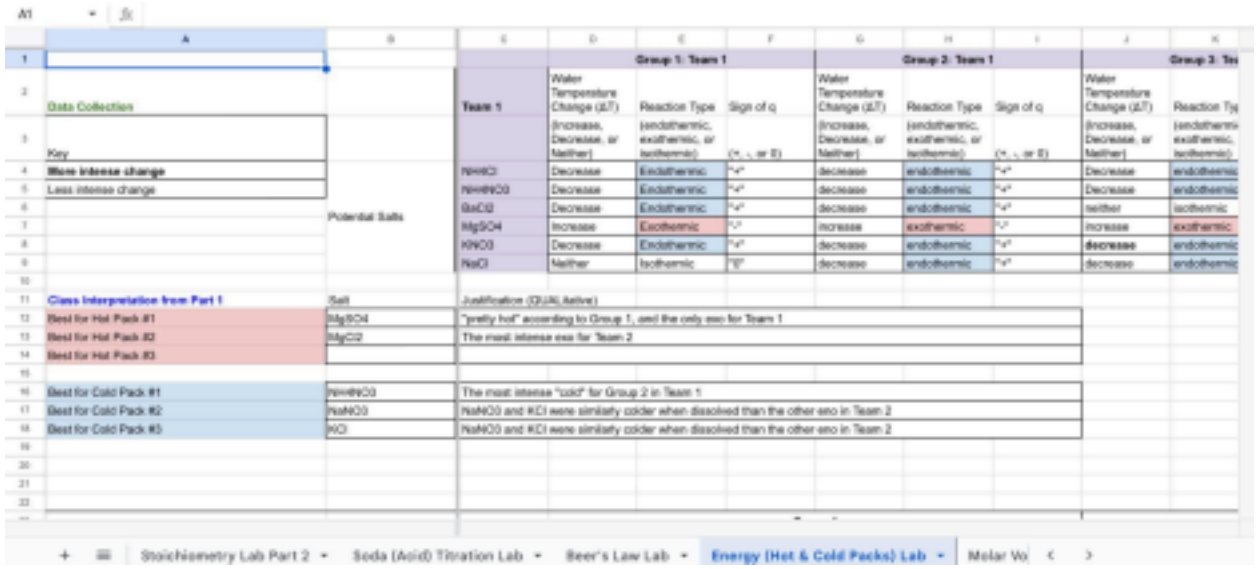
Stoichiometry Lab Part 2 | Soda (Acid) Titration Lab | Beer's Law Lab | Energy (Hot & Cold Packs) Lab | Molar Vo

Lab Write-Up Format
(for reference ONLY)



Lab Write-Up
***Copy* your outline information above and thenat**

Introduction: **The purpose of this lab is to identify salts that can be used in cold or hot packs. A reaction is exothermic or endothermic determines its suitability for hot or cold packs, as the type of salt used affects how heat is absorbed or released, influencing the pack's effectiveness.**
Results:



		Group 1: Team 1			Group 2: Team 1			Group 3: Team 1	
Data Collection	Team 1	Water Temperature Change (ΔT) (Increase, Decrease, or Neither)	Reaction Type (endothermic, exothermic, or isothermic)	Sign of q (+, -, or 0)	Water Temperature Change (ΔT) (Increase, Decrease, or Neither)	Reaction Type (endothermic, exothermic, or isothermic)	Sign of q (+, -, or 0)	Water Temperature Change (ΔT) (Increase, Decrease, or Neither)	Reaction Type (endothermic, exothermic, or isothermic)
Key									
More intense change	NH4Cl	Decrease	Endothermic	"+"	decrease	endothermic	"+"	Decrease	endothermic
Less intense change	NH4NO3	Decrease	Endothermic	"+"	decrease	endothermic	"+"	Decrease	endothermic
Potential Salts	CaCl2	Decrease	Endothermic	"+"	decrease	endothermic	"+"	neither	isothermic
	MgSO4	Increase	Exothermic	"-"	increase	exothermic	"-"	increase	exothermic
	KNO3	Decrease	Endothermic	"+"	decrease	endothermic	"+"	decrease	endothermic
	NaCl	Neither	Isothermic	"0"	decrease	endothermic	"+"	decrease	endothermic

Class Interpretation from Part 1	Salt	Justification (Qualitative)
Best for Hot Pack #1	MgSO4	"pretty hot" according to Group 1, and the only exo for Team 1
Best for Hot Pack #2	MgCl2	The most intense exo for Team 2
Best for Hot Pack #3		
Best for Cold Pack #1	NH4NO3	The most intense "cold" for Group 2 in Team 1
Best for Cold Pack #2	NaNO3	NaNO3 and KCl were similarly colder when dissolved than the other exo in Team 2
Best for Cold Pack #3	KCl	NaNO3 and KCl were similarly colder when dissolved than the other exo in Team 2

Stoichiometry Lab Part 2 | Soda (Acid) Titration Lab | Beer's Law Lab | Energy (Hot & Cold Packs) Lab | Molar Vo

		Group 1						Group 2			
Part 2		Best for Cold Pack #3 KCl			Best for Cold Pack #1 NH4NO3			Best for Hot Pack #1 MgSO4			
Data Collection		Trial 1: 4g	Trial 2: 8g	Trial 3: 8g	Trial 1: 4g	Trial 2: 8g	Trial 3: 8g	Trial 1: 4g	Trial 2: 8g	Trial 3: 8g	Trial 1: 4
Mass of Salt	(g)	4.057	8.054	8.044	4.056	8.05	8.041	4	8.009	8	
Average Mass of Salt	Ave g			6.051666667			8.050			6.003	
Water Temperature Change (ΔT)	(Final - Initial)	-3.1	-4.4	-5.4	-4.1	-6.3	-8.9	6.4	9	11.5	
Average Temperature Change of Water	Ave ΔT			-4.3			-5.766666667			8.97	
Water Temperature Change given Mass of Salt	ΔTg	-0.78	-0.73	-0.67	-1	-1.04	-0.89	1.6	1.5	1.4	
Average Temp Change of Water given Mass of Salt	Ave ΔTg			-0.72			-0.97			1.5	
Calculations											
Average Water Heat exchanged (q) q = m x c x ΔT where mass (m) is in grams heat capacity (c) = 4.184 J/g•C, is that of liquid water. q = ΔH for all practical purposes, at constant pressure.	(J)			-115.27			-151.44			225.295	
Average Water Heat exchanged	(kJ)			-0.11527			-0.15144			0.2253	
Average Moles of Salt	(mol)			0.081			0.070			0.0496	
Water Change in Internal Energy (Enthalpy: ΔH)	(kJ/mol)			-1.42			-1.99			4.524600451	
Salt Change in Internal Energy (Enthalpy: ΔH)	(kJ/mol)			1.42			1.99			-4.524600451	
Average Salt Change in Enthalpy				1.118			0.376			-4.008	
% Difference				27.4			429.9			12.9	
Class Interpretation from Part 2	Salt	Justification (Qualitative)									
Ranked #1 for Hot Pack	MgSO4	12% difference and higher average than MgCl2									
Ranked #2 for Hot Pack											
Ranked #3 for Hot Pack											
Ranked #1 Cold Pack	NH4NO3	Best (highest average) and lowest percent difference									
Ranked #2 Cold Pack											

Stoichiometry Lab Part 2 | Soda (Acid) Titration Lab | Beer's Law Lab | Energy (Hot & Cold Packs) Lab | Molar Vo

General Public Source 1:

- The endothermic process...This energy is produced as a result of the reaction of reactants into the product. It occurs as a result of the dissociation of the bonds between the molecules. The energy is then released through the formation of new bonds.Heat is taken up from the surroundings in such reactions, so the temperature of the system where the reaction is taking place remains cooler. Also, at the end of the reaction, the enthalpy, which is the change in heat energy during the conversion of reactants to products, increases (Admin, 2022).

- The exothermic reaction…The energy released is caused by the formation of new bonds (products) at a higher level. While the energy required to break up the bonds (reactants) is lower. At the end of the reaction, the enthalpy change decreases as well. During chemical reactions, a great deal of energy is required. This energy was used to maintain the bond that held the molecules together. As a result of the reactions between molecules and compounds, as well as the breaking of bonds, a tremendous amount of energy is released (Admin, 2022). **Scientific**

Literature Source 2:

- Endothermic and exothermic processes are the result of the breaking and forming of bonds between atoms. During many reactions, bonds break, atoms rearrange, and new bonds form. To break bonds, energy is taken into the chemical reaction, known as the system, from the surrounding environment. When bonds form, energy is released into the surrounding environment. Consequently, during a reaction, there is an exchange of energy between the system and the surroundings. When more energy is taken in than released, an endothermic process occurs, causing a decrease in temperature. Evaporating liquid water is one example of an endothermic process. An exothermic process occurs when more energy is released than taken in, causing an increase in temperature. Combustion is an exothermic process (Evelyn Gray, 2018).

Discussion: The class data supports my main claim because it shows which salts produce endothermic or exothermic reactions, helping determine their suitability for hot or cold packs. Temperature changes means that the salts change the temp of the water especially with $MgSO_4$ and NH_4NO_3. My calculations mean NH_4NO_3 came out the most endothermic because it had the biggest positive number. $MgSO_4$ is exothermic because it was negative.This evidence summarizes the heat absorption and release patterns, which directly relate to how effective each salt would be in a thermal pack. I don't currently see any limitations in the data. Since it comes from our own experiment, it's a reliable source for this context. Additionally, other sources we used seem trustworthy as they include an author, publication dates, and appear credible, even though one summary lacked a clear author. Overall, this evidence effectively supports the claim by explaining the relationship between heat transfer and the function of hot and cold packs.

Conclusion: I learned through this experiment, we learned that each salt can be identified as causing either an exothermic or endothermic reaction. This helps us determine whether a salt is suitable for use in a hot or cold pack based on its ability to absorb or release heat, which directly affects the pack's function. This matters because… _The purpose of the lab was to identify salts that are effective for use in hot or cold packs.

References (MUST at least include the 2 outside sources in APA formatting)

CHM 151 Class data

Gray, Evelyn. (2018). *Students learn exothermic and endothermic - ProQuest.* Students Learn Exothermic and Endothermic Processes - ProQuest N.m. (2022). *Difference between Endothermic and Exothermic Reactions | Chemistry.* BYJUS. Difference between Endothermic and Exothermic Reactions | Chemistry