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Day 22 Apr 14 Intern: Chemical reactions and energy

Fire and Ice

1-1-2016

22.0.B Discussion Chemical Heat

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RECORDER REPORT, Chem 444A "Fire & Ice" (1)

Group Member Name	Role
Charles C.	Spokesperson
Jon T.	Manager
Calé F.	Recorder

Date: April 14, 2015

PART 1

Initial temp of vinegar: 72.8°F
Final temp: 65°F

Observations (vinegar & baking soda): Immediate bubbling & fizzing (very frothy), goes down w/ larger bubbles. Temp. goes down. Small bubbles continue to rise from the surface. → fades after a while → baking soda mostly dissolves. (20 mL)

Expl. Qs

1. This is the first expt. that we've done that explores heat in the context of chemistry.
2. Both substances' molecules have potential energy & when they come together in a chemical reaction, they expend their energy & have less energy after the reaction is finished, resulting in a lower temp of the two substances combined. Energy released from the reaction causes fizzing & bubbles & releases heat into the air. (This is our idea, anyway.) ↳ Taking heat from surroundings in order to complete the process (endothermic process), heat is being used in the reaction

PART 2

10 mL vinegar w/ 1, 2, 3 scoops of baking soda
- ↳ 1 scoop: (initial temp: 75.5°F final temp: 66.9): fizzed more slowly than first expt.
- 2 sc. (IT: 73.2°F, FT: 65.5°): went higher, faster than 1 scoop
- 3 sc. (IT: 72.8°F, FT: 65.1°): didn't go as high, excess baking powder forms a lump in the middle

2 scoops of baking soda w/ 10, 20, 30 mL of vinegar → we doubled it for some reason
- ↳ 10 mL: (IT: 72.7°, FT: 64.5): very quick reaction, no excess baking soda
- 20 mL: (IT: room temp, FT: 65.2): quicker than previous, up to top
- 30 mL: (IT: 75.1°F, FT: 62.1): even quicker than previous & bubbled over the top.

Expl. Qs pt. 2

1. It adds an aspect of "hard" chemistry to our knowledge of heat — a chemical reaction draws heat from the environment in order to occur, & the heat is released because it takes energy to complete the reaction. In this example, it's released in the form of gas, releasing heat.
2. Heat first comes from the substances & surroundings & is released as the reaction releases energy in the form of a gas.

Q:
- (1st group): Did they dissolve into a liquid or did the reaction create a liquid?
- (3rd group): Why did it get so cold? (neg. °C)
- (4th): Is parafilm a bad conductor? Why didn't oxidation occur w/ small amt. of vinegar?
- (5th): How exactly do endothermic processes occur?/How is heat drawn in?
- (6th): For ours, the opposite happened → more baking soda = lower temp. Why?
- (7th): So is using batteries dangerous?

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RECORDER REPORT, Chem 444A "Fire & Ice"

Group Member Name	Role
Eliza	Manager
Marisa	Spokesperson
Mandy	Recorder

Date: 14 April 2015

Initial temp in cup: 23.9°C

Temp after rxn air of cup: 34.4°C

Temp of liquid after rxn: 58.5°C

We were able to see a visible reaction ~~tha~~ in which heat was produced. The reaction was also quick. In the past we have observed transfer of heat through conduction, convection, and radiation, this is quite different.

The immediate reaction was bubbling, fizzing, and production of heat. At the molecular level, the molecules gained speed and the some water changed phases from liquid to gas. The liquid left did not mix with the solid, baking soda and calcium chloride.

When changing the amounts, the size of reaction will change. With more baking soda solution, the reaction may decrease, and when increasing the calcium chloride, the reaction will increase in size.

Experiment 1

Cup 1: (1 scoop)
Initial temp: 23.1°C
Temp after rxn: 60.3°C

Cup 2: (2 scoops)
Initial temp: 26.4°C
temp. after rxn: 55.6°C

Cup 3: (3 scoops)
Initial temp: ~~23~~ 26.0°C
temp after rxn: 69.9°C

The resulting solid turned into chunks (precipitate?). The vinegar bubbled and fogged up the glass, leaving condensation on the sides

→

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Experiment 2 | (2)

Cup 1: (5mL of baking soda sln)
Initial temp of powder: 30.2°C
Initial temp baking soda sln: 22.8°C
Temp after rxn: 64.3°C

Cup 2: (10mL of baking soda sln)
Initial temp of Calcium chloride: 30.7°C
Initial temp of solution: 23.6°C
temp after rxn: 86.2°C

Cup 3: (15 mL of solution)
initial temp of calcium chloride: 32.0°C
initial temp of solution: 22.2°C
temp after rxn: 79.0°C ← error? put solution in in 2 steps

Exothermic process - giving off heat

Reaches peak temp. then drops after reaction.

With more baking soda solution, we saw a greater increase in temperature.

This illustrated exothermic process because it gave off ~~eo~~ heat.

Heat comes from the chemical reaction and leaves to heat up the air and glass.

Question:

- What determines if a reaction is exothermic or endothermic?
- If these were both solids (powder), how were they able to react so greatly?
- What is the difference between adding more solid or liquid, what ~~is~~ are the different results?
- Why did different amounts of reactants not change the results of the reactions (hydrogen peroxide + baking soda experiment)?
- Why does vinegar strip away steel wool's ~~g~~ coating?
- What are the reactants involved causing a production of heat (in steel wool exp.)?
- ~~What~~ How is heat is transfered in the reaction?
- What created the heat in the battery rxn?

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RECORDER REPORT, Chem 444A "Fire & Ice"

(3)

Group Member Name | Role | Date: 4/14/15

Group Member Name	Role
Heather	"manager" → spokesperson
Samantha	reflector → spokesperson
Emily	?

Erlenmeyer flask: initial = 24.8°C (76.6°F) (3:57) 2nd trial started

* the temperature is not changing but there seems to be a pressure change which is pulling the parafilm in a suction slightly inward.

after Ben soaked a large chunk of steel wool, and we didn't remove all of the vinegar, the heat in the flask began to increase

Part ~~One~~ Two

the steel wool is changing colors!

* possibly the color is being changed in the area where the vinegar removed the protective coating from air.

temp: 10 min in: 28.1°C
15 min in: 29.1°C
20 min in: 30.3°C

This heat exploration is different than others we have done because we are exploring a solid in a contained vessel. We are making the steel wool more susceptible to temperature by removing a natural coating it has instead of adding something to make it more susceptible we are taking away its insulative properties and making it a poor insulator. Oxidation is occurring and it is rusting. This is an exothermic reaction because heat is exiting.

* is O_2 being added, how?

Part One

when we initially did this experiment with a small piece of steel wool with less vinegar and the temperature didnt change at all. Since we did part 2 without knowing, we realized we changed the size of wool and amount of vinegar at the same time. In order to isolate the variable, we will do the experiment again to isolate amount of vinegar.

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4:20

starting temp 24.4
5min: 25.4°C
10min: 26.4°C
15min: 27.5°C
20min: 28.2°C

*vinegar allows the O_2 to bend to the iron better, so oxidation occurs when O_2 is trapped.

question bank

* each presentation:
  * barium hydroxide - ~~if it is absorbing heat why is the temperature dropping~~? why was the 2:2 ratio so much more drastic?
  * vinegar, baking soda & heat - what would happen if you trapped the heat?
  * hydrogen peroxide & baking soda - why did the second reaction not work?
  * steel wool - if oxygen is being added, how?
  * water & ammonium chloride - what if the amount of ammonium chloride was kept constant?
  * exothermic process - what practical application does this have?
  * battery - what if a larger sized battery was used instead of more batteries?

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RECORDER REPORT, Chem 444A “Fire & Ice”

Group Member Name	Role
Nicholas	Bouchard → manager
Becky Pettis	recorder
Kaleigh Zakowski	Spokesperson

Date: 4/14/2015

Part #1

Temp °C initial	22.1 °C
Temp °C final	21.7 °C

1.) when ammonium chloride was dropped in it went to the bottom of the cup. this is different because we have never added a substance in order to remove heat from a mixture. We also usually record temps for a longer period of time. usually when we do cool something it's with ice and a barrier. this instead was direct mixture of two substances to cool. over time some of the ammonium chloride is rising to the surface. it is diluting throughout the liquid.

2.) the ammonium chloride gained heat from the water + water. this explains the ↓ in temp of the ammonium chloride also why the majority of the ammonium started at the bottom. However the longer the molecules are molecules remain in the water, the more the molecules gain ...ble to participate in a heat transfer + the ammonium ions up throughout ...at from the water. the movement of the ammonium as the molecules ...e water + to the surface exhibits the heat temp. as the water molecules slowed down + the ...ain more energy + heat, the water molecules ... the ammonium gained heat + rose ...mmonium molecules sped up. eventually the ammonium ... this is the first time we ...cause it is less dense. ★ observation is that this is the first time we ...ve mixed solid + liquid. when solid was mixed in with the liquid, ...e solution must reach thermal equilibrium. since solid is moving slower, must gain kinetic energy from the water to the ammonium chloride, causing a ↓ in the temp of water. solution needs to be equal throughout.

Part #2

	Initial	Final Temp °C	amt Δ
loop	23.3	23.1	0.2
loop	22.7	21.8	0.9
loop	22.6	20.8	1.8

1.) observations seem consistent with part #1 this experiment does further our understanding, as it supports our ~~further~~ previous hypothesis. What we see illustrates an endothermic reaction because the ammonium chloride is gaining heat from the water. →

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.. Heat is going from the water (liq) to the ammonium chloride (solid). We also found that as we added more ammonium chloride, the temperature of the water ↓ significantly more. This indicates the amount of energy transfer is proportional to the amount of ammonium chloride added to the solution.

4

Questions

arium Hydroxide + Ammonium Nitrate

- What is it that causes the ↓ in temp since they mixed 2 solids?

inegar, Baking Soda + Heat

- Besides visual observations, how are you sure the reaction speed increased?

lydrogen Peroxide + Baking Soda

- What do you think contributed to the baking soda results not showing as hypothesized?

teel Wool

- What causes the reaction between vinegar + steel wool?

vater + Ammonium Chloride

- our presentation → Does the state of the substances make a difference? (solid vs liquid)

Exothermic Process

- How much of an effect does the type of container affect the heat increase?

hemical Reaction in Battery

- What evidence do you have of the chemical reaction?

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Group Member Name	Role
Miriam	Recorder
Emily	Manager
Amanda	Spokesperson

Date: 4/14/15

Temp. of wire before 76.5°

after 75.7° / 75.4° / 75.0° / 74.7° — every 30s, 1st Trial

2nd trial: 78.0°, 81.0°, 82.4°, 76.0°, 103.0°, 104.8°, 102.8°, 102.6°, 99.8°, 100.8°, 101.9° — every 15s, High = 116°

Battery Before to After 73° → 83°

PART 1

1. Can't directly visualize what is happening. Can't see inside battery. This experiment involved something chemical. we were not directly adding heat to warm the wire. A battery of 73° caused a wire to heat up to 116°.
2. saw temperature fluctuate, couldn't see much. Could feel wire and battery heating
→ not conduction, convection, or radiation

Part 2

1. Expect wire to heat up more with more batteries.

2 batteries every 15s: 108.6°, 116.7°, 170.0°, 195.0°

Battery After = 180°

Wire cools much faster than battery

Exothermic

1. Movement of electrons generate energy which is exhibited as heat energy.

2. Heat is going from the negative end to the positive. The end of the wire on the positive terminal is hotter.

Electrons move (-) to (+). More batteries = more electrons travelling.

→

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Q Bank

(5)

- What is the make up of a battery that causes a chemical reaction to occur?

- Would the temperature difference continue as you used more ammonium nitrate & barium hydroxide?
- Does the fact that Baking soda is a solid and hydrogen peroxide is a liquid affect the experiment?
- Why was it important to keep the flask sealed in the steel wool experiment?
- Why some materials/substances more important to certain reactions than other materials/substances.

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RECORDER REPORT, Chem 444A "Fire & Ice"

Group Member Name	Role
Jacob	Manager
Timothy	Spokesperson
Taylor	Recorder

Date: 4/14/15

Part 1:

Initial Temp = 24.2°C

inal Temp = 23.1°C

hen baking soda is added to the hydrogen peroxide, the temperature immediately decreased. The baking soda sank to the bottom of the cup. Over time a paste type material formed.

This exploration of heat is different because there is a chemical reaction taking place. We are not adding or removing heat, the chemical reaction itself is the reason for the decrease n temperature.

What we are seeing is a chemical reaction that is taking in heat. The decrease in temperature an be explained by the reaction between the chemicals. Heat needed to be taken in in order to reak apart the bonds.

rt 2: We hypothesize that as more of the substances are mixed together, the end temp. will be lower.

Experiment 1

mL Hydrogen Peroxide w/ 1 scoop Baking Soda
nitial Temp = 24.5°C
inal Temp = 22.6°C
Total change = 1.9°C

L Hydrogen Peroxide w/ 2 scoops Baking Soda
nitial Temp = 23.7°C
inal Temp = 21.7°C
Total change = 2°C

Hydrogen Peroxide w/ 3 scoops Baking Soda
nitial Temp = 23.7°C
inal Temp = 21.4°C
Total change = 2.3°C

Experiment 2

2 scoops Baking Soda w/ 5 mL Hydrogen Peroxide
Initial Temp = 24.6°C
Final Temp = 21.5°C
Total Change = 3.1°C

2 scoops Baking Soda w/ 10 mL Hydrogen Peroxide
Initial Temp = 24.5°C
Final Temp = 21.3°C
Total change = 3.2°C

2 scoops Baking Soda w/ 15 mL Hydrogen Peroxide
Initial Temp = 24.3°C
Final Temp = 21.4°C
Total Change = 2.9°C
↳ We believe this result was due to human error - We expected the temp. to be lower

The experiments add to our understanding of heat. Based on our results (except for 1) the more materials that were added, the greater the temperature change. More heat will be needed n order for the reaction to take place. More bonds must be breaking apart than are eing made because energy (heat) is being taken in from the enviroment.
(↳ making bonds releases energy)

e heat is being taken from the enviroment, which is why we see the decrease in emperature. The heat is going into the molecular bonds in order to cause a emical reaction.

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Question Bank: | Why are some exothermic and some reactions endothermic?

(c)

ndothermic Reaction of Barium Hydroxide + Ammonium Nitrate

If even more of each substance was added, could you eventually see water freeze underneath as a result?

negar, Baking Soda, & Heat

If enough of each substance was added, would it all turn to the gas phase?

teel Wool

hat was occuring that caused the steel wool to change color?

dothermic Reaction Between Water and Ammonium Chloride

low did the water molecules cause the Ammonium chloride molecules to speed up? Conduction?

othermic Process

hy was there condensation? And why did more appear when more aking soda was added?

emical Reaction in a Battery

hy did the battery physically change? What caused the coating to peel off? What keeps electrons from flowing across the battery on the inside?

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RECORDER REPORT, Chem 444A "Fire & Ice"

Group Member Name | Role | Date: 4-14-15

Group Member Name	Role
Sean King	Manager
Kyle	Spokesperson
Emma Addison	Recorder

~~Initial temp ~~24.2°C~~~~ look
~~Final temp: 1.0°C~~ below

We aren't produceing or removing any heat. We don't have a source of heat. Instead it's a chemical reaction.

We think it might be an endothermic reaction. The mix of the two is making water, amonia, and barium nitrate

Description	Initial temp.	Final temp
even amount of each 1:1	24.2°C	17.8°C
even amount bigger scale 2:2	23.7°C	1.0°C
more amonium nitrate 2:1	24.1°C	18.8°C
more BaOH 1:2	24.3°C	19.8°C

The heat is coming from the surrounding air and it is going to the forming / breaking of chemical bonds. It makes sense that the temperature dropped more when we increased the mixture size because needed more heat from its surroundings

Questions: Is the gas carrying heat out or is the heat stored in chemical bonds? (vinegar / baking soda)
Which is more endothermic (showed a greater change) vinegar or peroxide? (peroxide + baking soda)
What was the coating on the steel that the vinegar removed? (steel wool)

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more questions: How did you observe changes in density? (water/ammonium)

What differences between baking soda and vinegar cause the chemical reaction they saw ($CaCl_2$ / baking soda)

How did they measure the temperature in the wires? (battery?)

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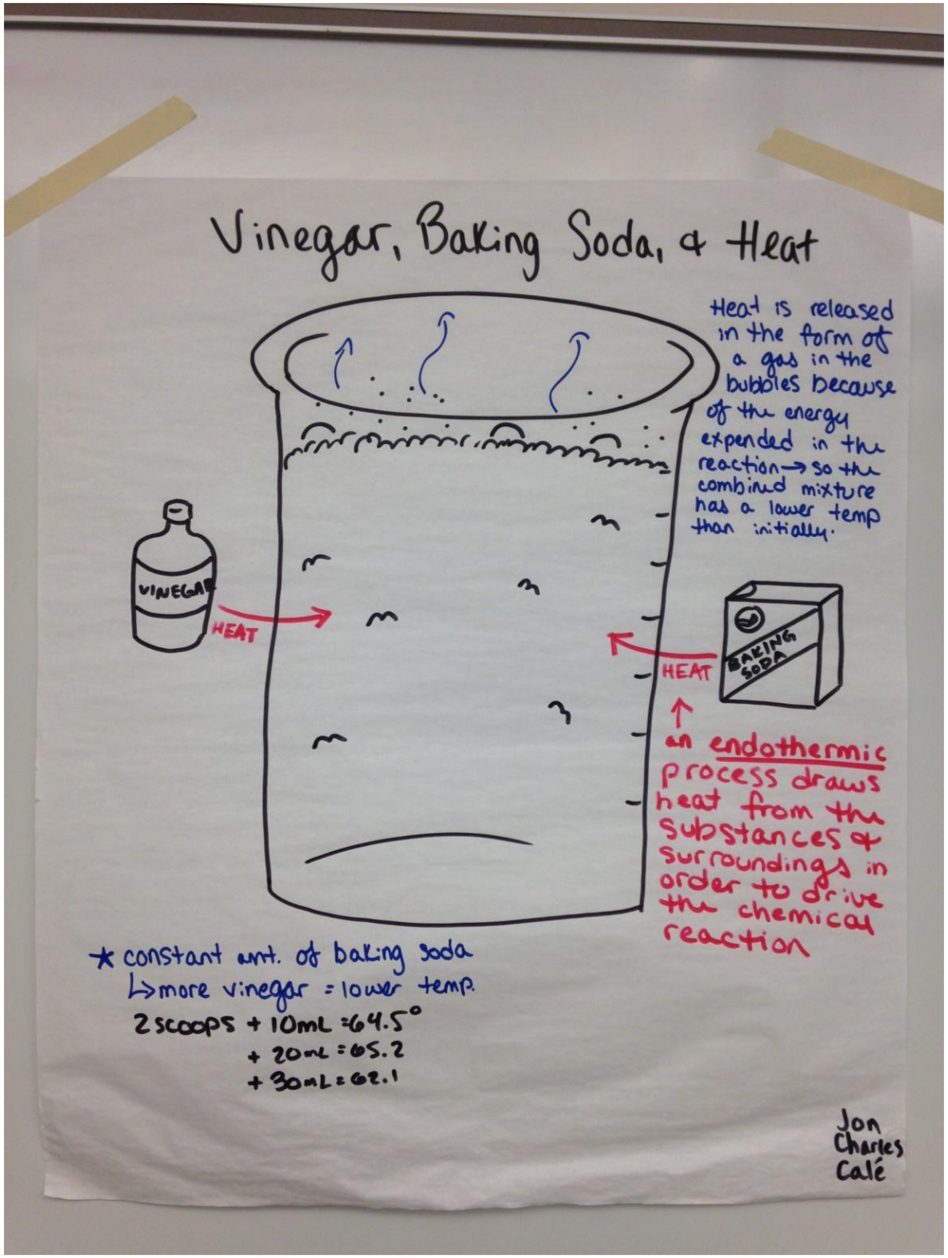

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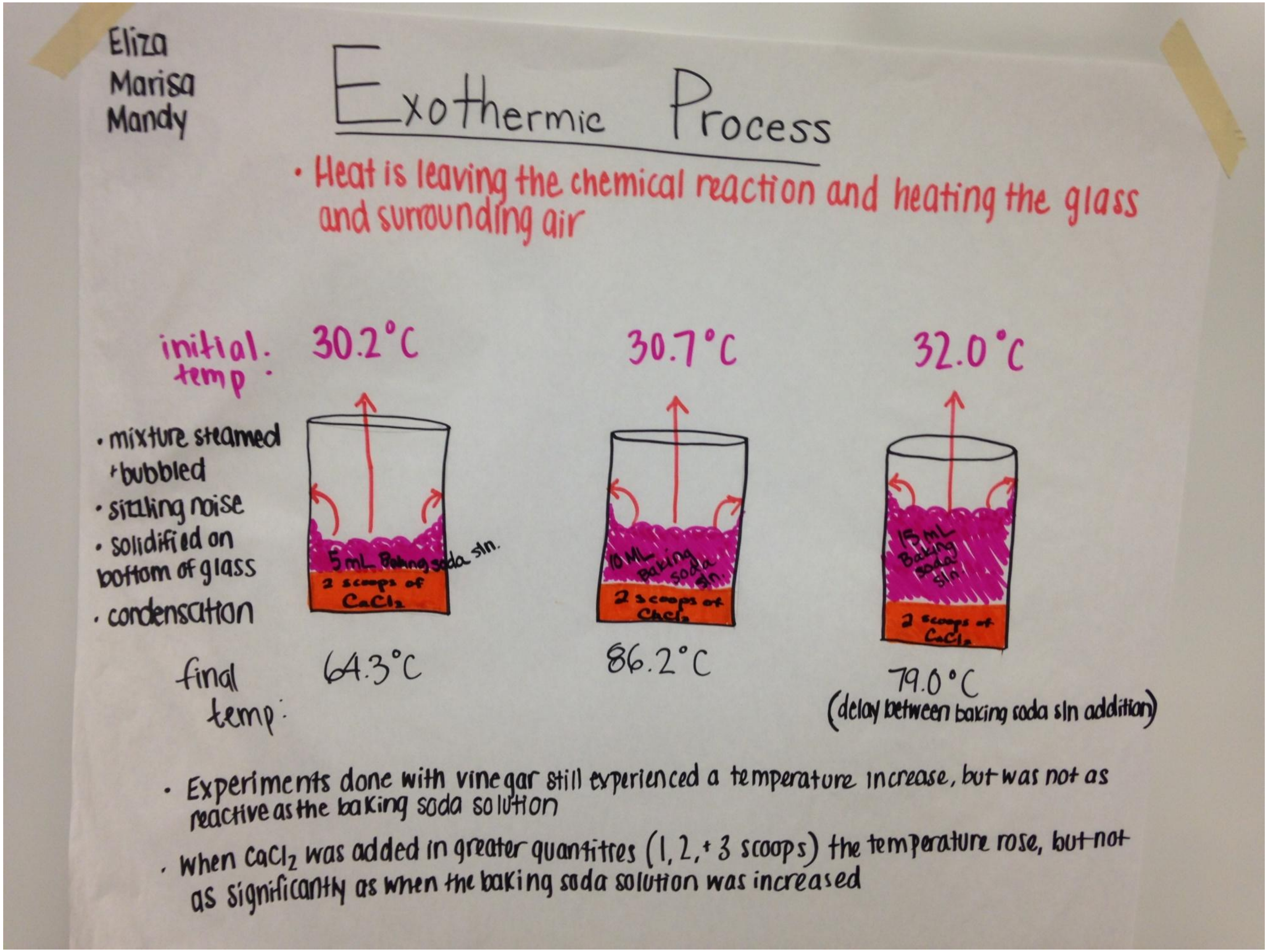

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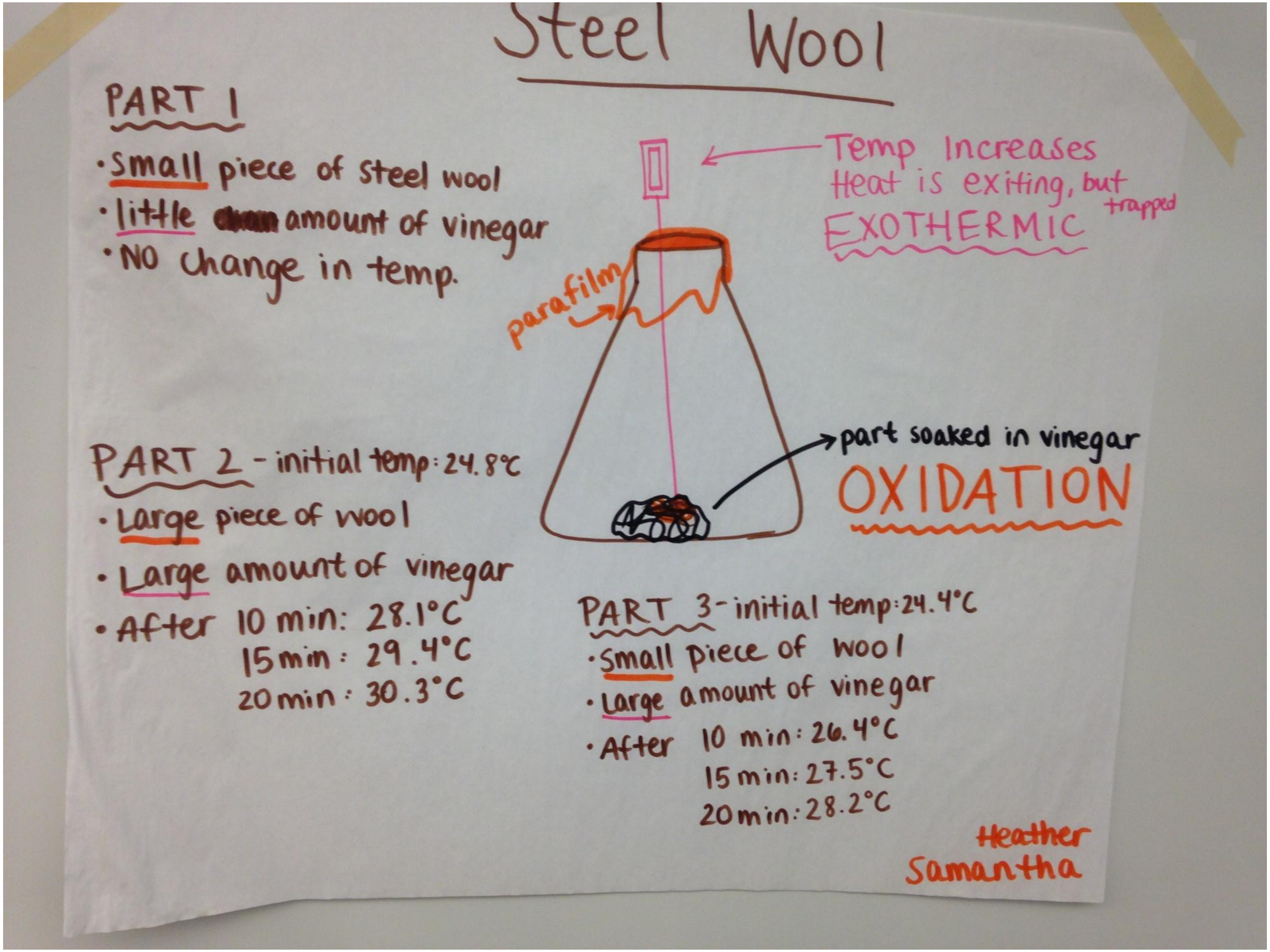

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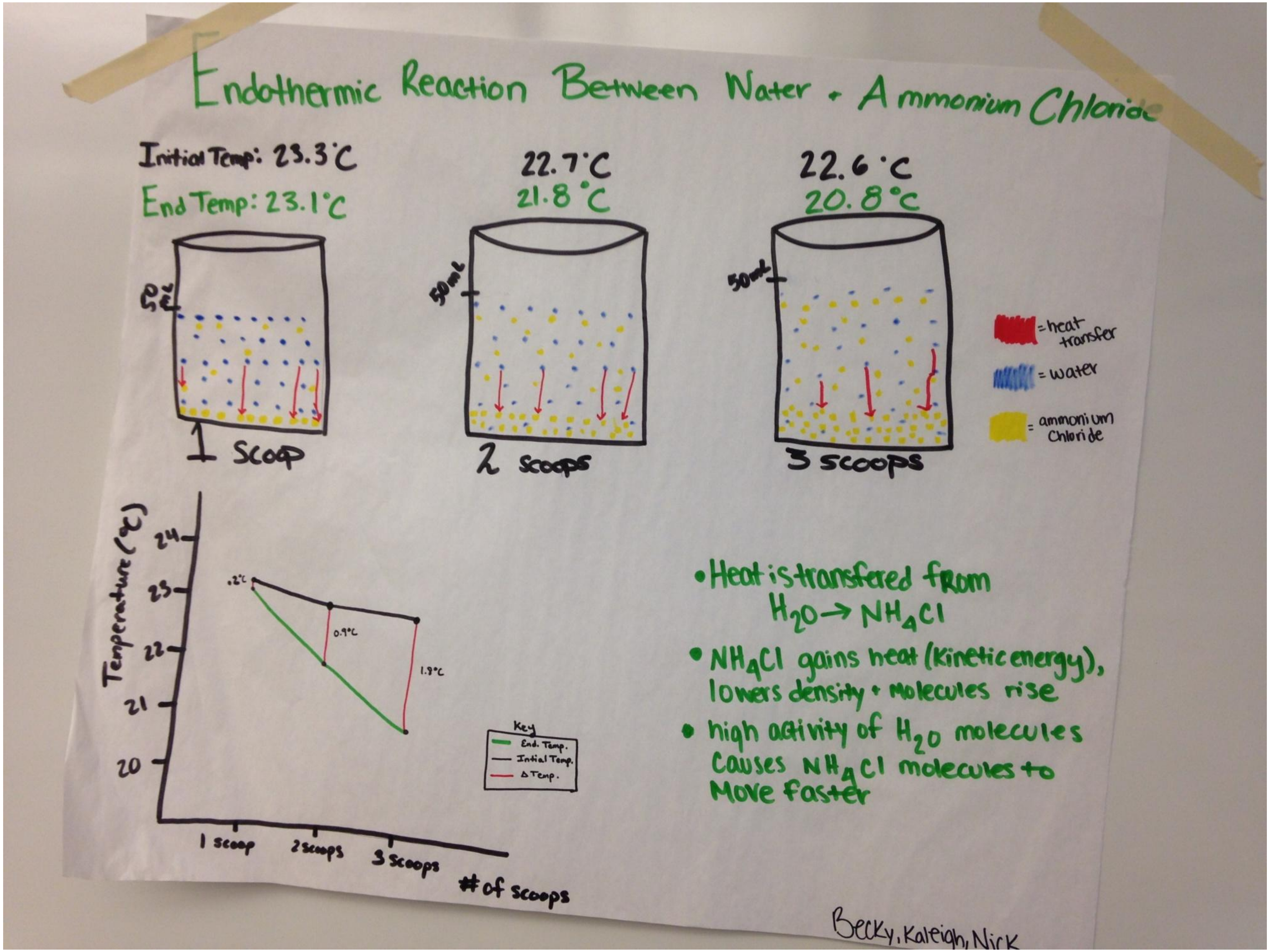

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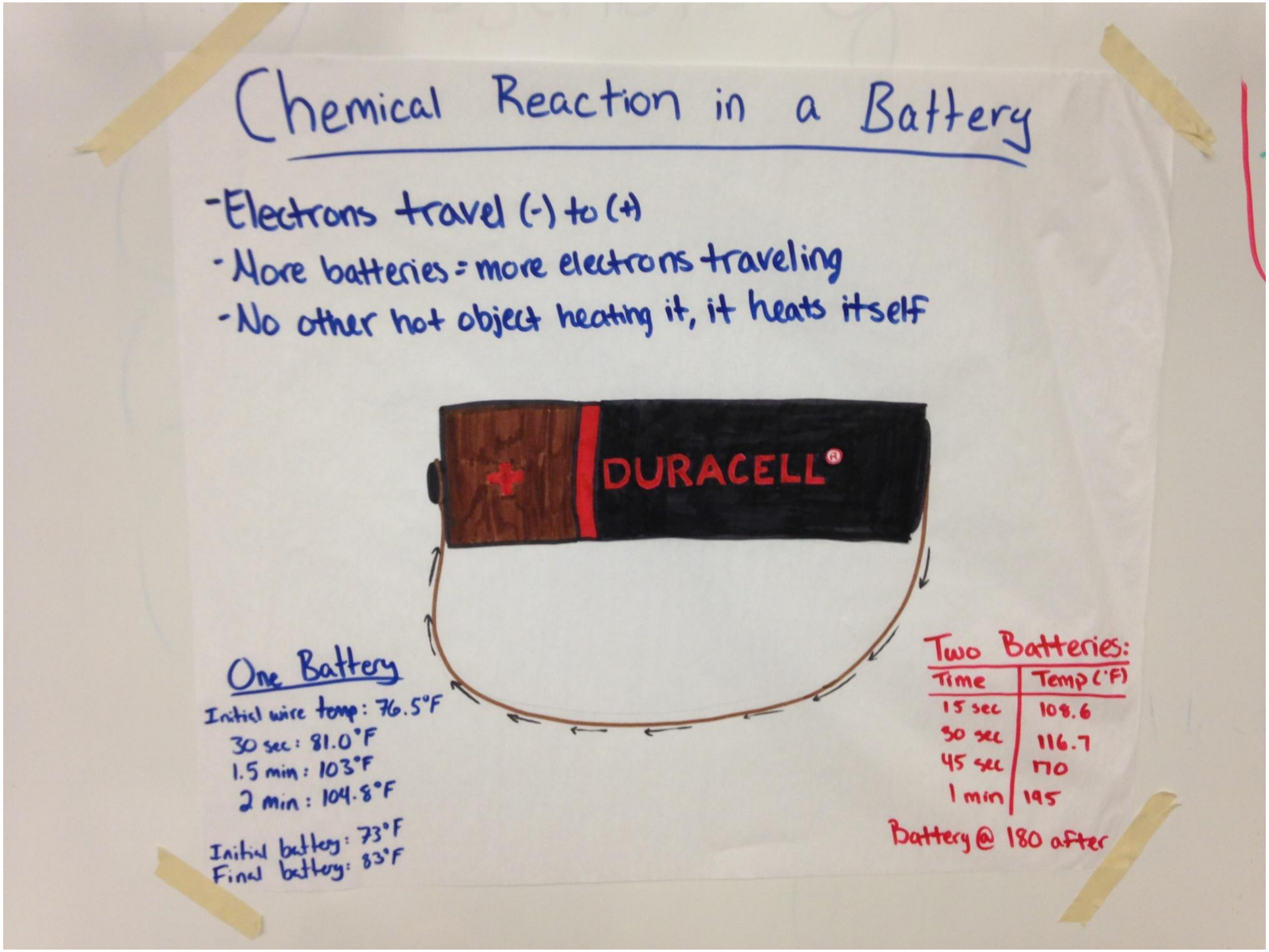

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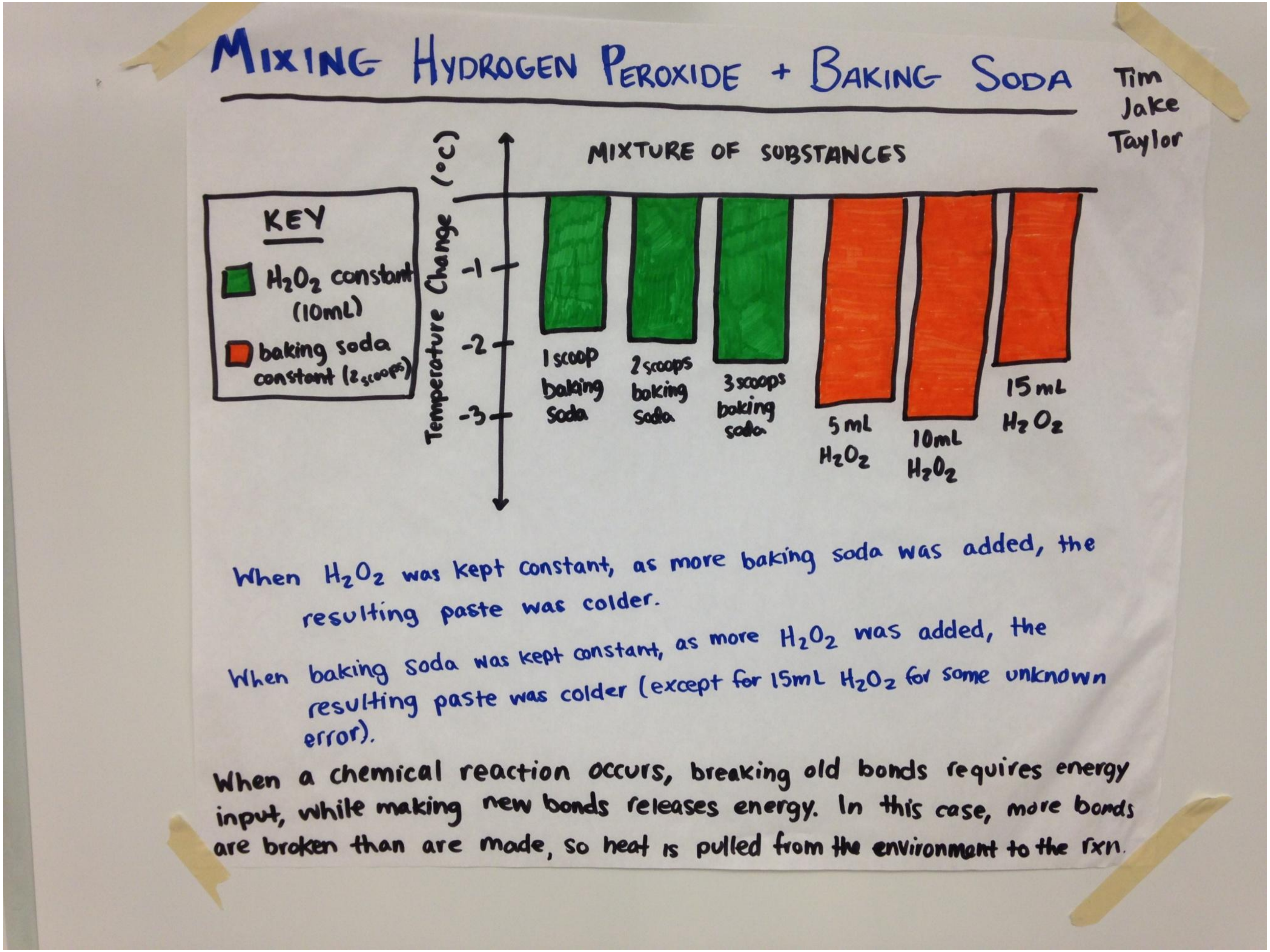

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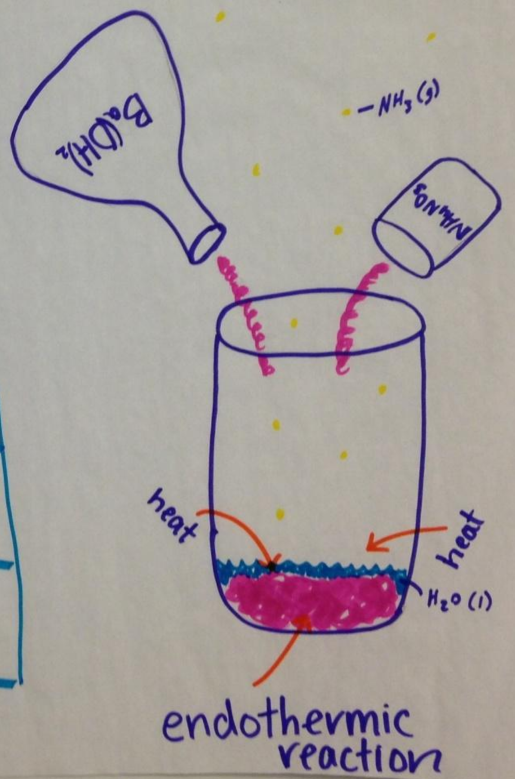
Endothermic Reaction of barium hydroxide and ammonium nitrate

Emma
Sean
Kyle

$Ba(OH)_2 : NH_4NO_3$

	Initial T°C	final T°C
1:1	24.2°C	17.8°C
2:2	23.7°C	1.0°C
1:2	24.1°C	18.8°C
2:1	24.3°C	19.8°C



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