Page 1: Background Research

Date: 11/18 - 11/20

What I Learned:

- Crystals form when extra solid comes out of a liquid and sticks together.
- Hot water can hold more borax than cold water.
- Slow cooling usually makes bigger and clearer crystals.

Sources I Used:

- Science Buddies. *Crazy Crystal Creations: How to Grow the Best and the Largest Crystals.*
- University of Colorado Boulder, Chemistry Department. *Crystallization Basics.*
- Helmenstine, A. M. *How to Grow Crystals.*
- Ducksters Education. *Crystals and Minerals.*
- Royal Society of Chemistry (RSC) Education. *Growing Crystals.*

Page 2: Question and Hypothesis

Date:11/20

Question:
Which temperature makes the biggest and clearest borax crystals: ice bath, refrigerator, or room temperature?

Hypothesis:
I think the room temperature jar will grow the biggest and clearest crystals because slow cooling gives the crystals more time to grow neatly.

Page 3: Materials and Setup

Date: 12/11

Materials Used:

- Jars (3)
- Pencils (3)
- String
- Borax
- Water
- Thermometer
- Ice and bowl
- Plastic wrap

Setup Notes:

- I tied string to each pencil.

- I made an ice bath in a bowl.

Page 4: Procedure Day

Date: 01/09

What I Did:

1. Heated water with adult help.
2. Added borax until no more dissolved.
3. Poured solution into three jars.
4. Put one jar in the ice bath, one in the refrigerator, and one on the counter.

Temperatures:

- Ice bath: 32.7 °F
- Refrigerator: 36.7°F
- Room temperature: 72.0 °F

Page 5: Observations – Trial 1

Date: 01/09

What I Observed:

- Ice bath crystals formed fast.
- Refrigerator crystals formed slower.
- Room temperature crystals formed the slowest.

Data Table:

Cooling Condition					
	Temperature	Time of Crystal Formation (Hours)	Number of Crystals	Size of individualized Crystals	Other Observations
Ice Bath	32.7F	2 hrs	Many	Small	formed quickly; cloudy & odd shaped
Refrigerator	36.7F	3.5 hrs	Some	Moderate	Not as cloudy, better formed
Room Temp	72.0F	5.5 hrs	Few	Bigger	Slow to form; clearer, best shape

Page 6: Observations – Trial 2

Date: 01/13

What Was Different or the Same: Same results, except the crystals took more time to form, except for the ice bath that took less time.

Temperatures:

- Ice bath: 30.1 °F
- Refrigerator: 37.2°F
- Room temperature: 72.3 °F

Data Table:

Cooling Condition					
	Temperature	Time of Crystal Formation (Hours)	Number of Crystals	Size of individualized Crystals	Other Observations
Ice Bath	30.1 F	1.5 hrs	Lots	Smaller	formed quickly; Foggy and odd shaped
Refrigerator	37.2F	4 hrs	Many	Moderate	Formed a little slower; a little clearer, and crystals easier to see separately
Room Temp	72.3F	5.5 hrs	Some	Big	Slow to form; clearest best shape, easy to see individual larger crystals.

Page 7: Observations – Trial 3

Date: 01/14

Patterns I Noticed: each additional trial confirmed my first findings. I also noticed the colder the ice bath the shorter amount of time for crystals to form. The warmer the temperature the longer it took the crystals to form.

Temperatures:

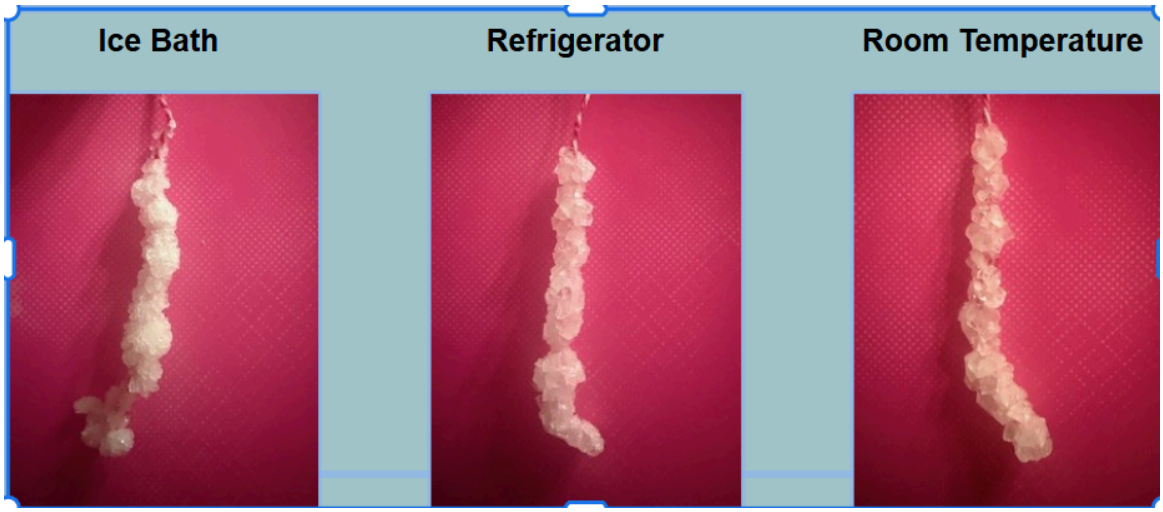
- Ice bath: 28.6 °F
- Refrigerator: 35.3 °F
- Room temperature: 74.0 °F

Data Table:

Cooling Condition					
	Temperature	Time of Crystal Formation (Hours)	Number of Crystals	Size of individualized Crystals	Other Observations
Ice Bath	28.6 F	1 hr	Lots of Crystals	Small	formed quickly; very cloudy; odd shaped, grew on top of each other
Refrigerator	35.3 F	3 hrs	Some	Moderate	Not as cloudy, better formed, easier to see separately
Room Temp	74.0 F	6 hrs	Few	Bigger	Slow to form; clearer, best shape, bigger crystals

Page 8: Photos and Drawings

Date: 11/16



Page 9: Results and Conclusion

Date: 01/15

Results Summary:

- Ice bath: small and cloudy crystals
- Refrigerator: medium and clearer crystals
- Room temperature: big and clear crystals

Did the Results Match My Hypothesis?
Yes. Slow cooling made the best crystals.

Problems or Limits:

- Temperatures changed a little.
- Crystal size was estimated by looking.
- Potential for more or less borax used. It was never the same amount when heating it up

What I Learned: Crystals grow better when they cool slowly.

Page 10: Questions for the Future

Date: 01/20

- Would sugar crystals grow the same way?
- What if the crystals grew for a whole week?
- Would stirring change how the crystals grow?