



Prize Winner

Crystal Investigation

Year 3-4

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.

Crystal

Investigation

by

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Year 4

2023

Age: 9 years

Introduction

I am interested in things around me, and I want to know more about them, for a long time I have had a secret science notebook and I write about the experiments that I do. I wanted to grow crystals because I got inspired by something I read in a book. The book was Chinese, so I asked my mum to tell me what I needed to make one. Mum said I needed to get some alum, so I asked my dad to buy me some alum. He ordered some copper sulphate as well as the alum for me to grow into crystals. The copper sulphate arrived first so my dad showed me how to grow some of those crystals. Then the alum arrived! So I tried to grow some crystals the same way dad showed me with the copper sulphate crystal, but it didn't work! The mixture in the bowl was foggy and only a few shiny sparkles were in it after a week or so.

Then mum told me about the Oliphant Science Awards and told me about the **Crystal Investigation** so, I decided to have another go at growing crystals using more scientific methods.

Hypothesis

A guess that needs to be proved!

I think the reason the alum crystals didn't work is because I did it the wrong way and I needed better alum. So, I did some research about it in the SASTA Oliphant Science competition and on the internet. I discovered that there were different types of alum and different ways to grow alum crystals. Then I asked my dad to get some better alum. Then I tried different ways to grow crystals and used different alum.

I tried three different ways to grow the best crystal because the first one didn't work and because I wanted to get different results.

My materials were :

- Domestic alum from supermarket
- Industrial alum from ace chemicals
- Ultrapure alum from scientific supplies
- Copper sulphate from internet

The growing processes :

- Hang string in solution
- Made seed crystals then tied string around them
- Super saturated hot solution with fishing line

There are 12 possible experiments because 4 materials x 3 processes = 12 experiments

So, I started my experiments.

Details of equipment and method :

I researched and discovered more about how to grow crystals and I needed better quality materials and tools.

This is the list of my materials and tools:

Alum:

- Domestic
- Industrial
- Ultrapure

Water:

- Unfiltered tap water
- Filtered and boiled water
- Ultrapure distilled water

Equipment:

- Saucepan
- Stove
- Glass flasks
- Glass beakers
- Glass rod
- Petri dish
- Funnel
- Filter paper
- Paper towel
- Spoon
- Glass
- Scales
- Thermometer
- The mad scientist's ultimate lab aka (house kitchen)

Process:

Domestic alum and tap water first experiment (that didn't work)



25 February 2023

Hot tap water and I put alum in it until no more alum dissolved.



25 February 2023

It was too foggy and cloudy so, I filtered it with a paper towel.



25 February 2023

This is what was left when I filtered the solution.



25 February 2023

I put the filtered solution into a clean red bowl but after a week it only had a few sparkles 😞.



2 March 2023

The rest of the solution was in the glass which made a lumpy, short, not nicely shaped, but looks okay for my first crystal ever grown in my life.

Using more scientific methods!

I got some better materials and equipment 😊!

Second experiment, Industrial alum:



2 March 2023

I have 3 different types of alum and 3 different types of water to experiment with 😊!

I decided not to use the domestic alum and plain tap water anymore.

So now I only have 2 different types of alum and two types of water.

There are different ways of growing the crystals:

- Hanging a woven thread in the saturated solution
- Tying string around a seed and putting it in the saturated solution
- Hanging a mono-filament (fishing line) in the super saturated solution

All these are ways of putting a starter crystal (seed crystal) on a string in a solution of alum to make a big alum crystal.

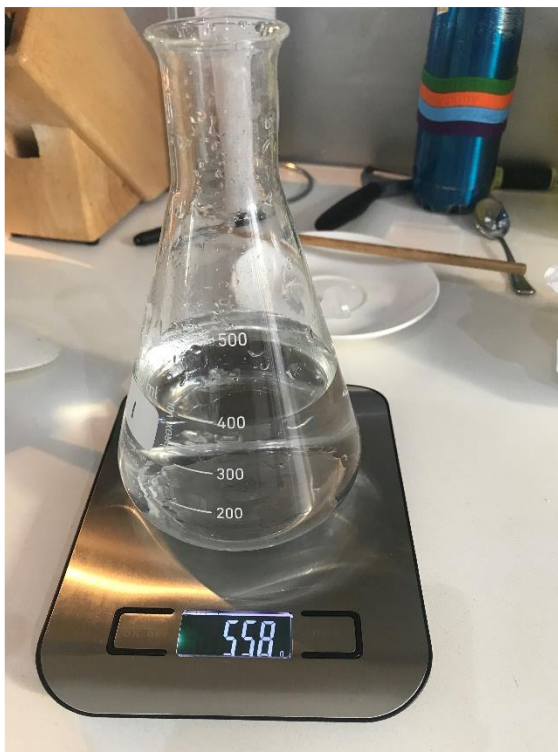
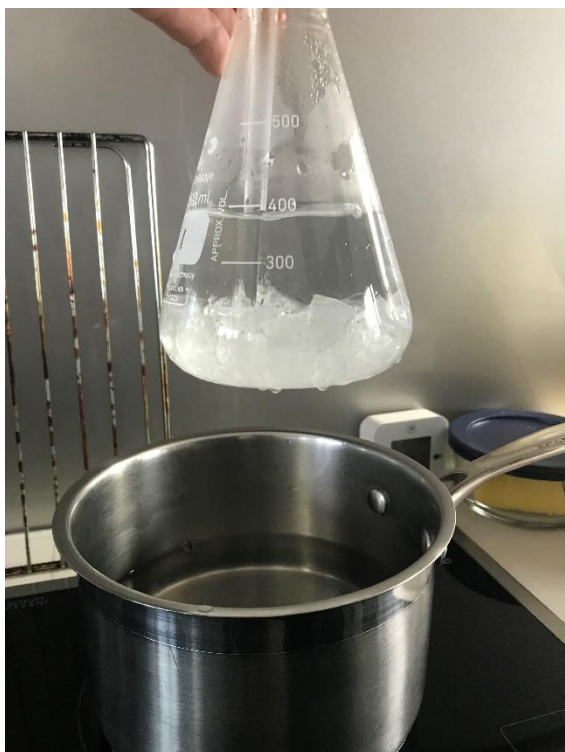
Surprisingly I still have 12 methods to grow crystals: 2 types of alum x 2 types of water x 3 methods = 12 in total!

Imagine if we did all the experiments that would be 3 alum x 3 water x 3 methods = 27 experiments
(3 x 3) x 3 = 27

This would take too long so I only decided to do:

1. Ultrapure alum and ultrapure distilled water with the method hanging a mono-filament (fishing line) in the super saturated solution.
2. Industrial alum with ultrapure distilled water with the method hanging a mono-filament (fishing line) in the super saturated solution.
3. Industrial alum with boiled filtered tap water with the method tying string around a seed and putting it in the saturated solution.
4. Industrial alum with ultrapure distilled water with the method hanging a woven thread in the saturated solution.

So, I asked dad to help me with the hot and dangerous stuff and mum let us use the kitchen. We were super-duper careful.



How much alum can we dissolve in 400 mL water?

*I started off with 400 mL of water with 5 spoonful's of alum at 25°C (room temperature).
I think we can put 2 or 3 more spoonful's of alum into the water if we heat it up to 100°C.
3 more dissolved in 40 °C (dad found degrees sign for me)
I think we can put 5 more when we heat it up to 100 °C.
5 more dissolved in 50 °C.
I think we can put 10 more when we heat it up to 100 °C.
10 more dissolved in 60 °C.
I think we can put 15 more when we get up to 100 °C.
15 more dissolved in 70 °C.
I think we can put 10 more when we get up to 100 °C.
10 more dissolved in 80 °C.
I think we can put 10 more when we get to 100 °C.
10 more dissolved in 90 °C.
In the end we carefully put in a final 7 more and no more alum dissolved, and the total amount of spoonful's were an unbelievable **65!!***

Observation: The hotter the water gets the more alum dissolves in it.

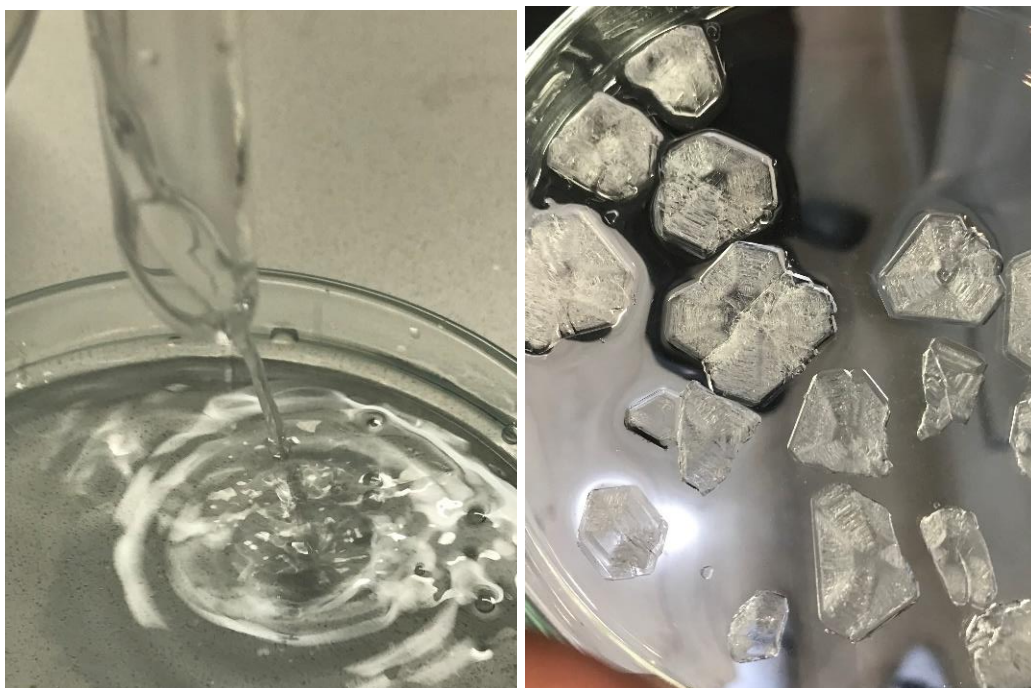
Conclusion:

I started with 400 mL of water in a flask, when I finished, the flask showed 550mL of solution.

400 mL of water and the flask added together weighed 563g.

The total of water, flask and dissolved alum was 727g, therefore 164g alum dissolved in 400 mL of hot water.

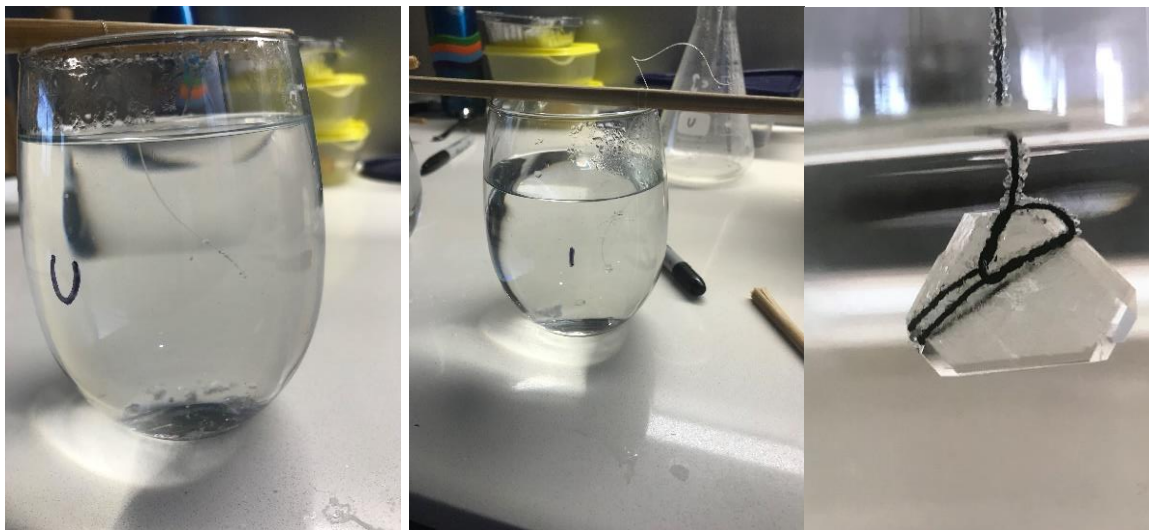
Now I have my super saturated solution and can start growing crystals! 😊



I put some of the super saturated solution in the petri dish to grow seeds.

The next day we had some seed crystals.

I then did another two saturated solutions with ultrapure alum, ultrapure water, industrial alum, and industrial water.



Ultrapure

Industrial

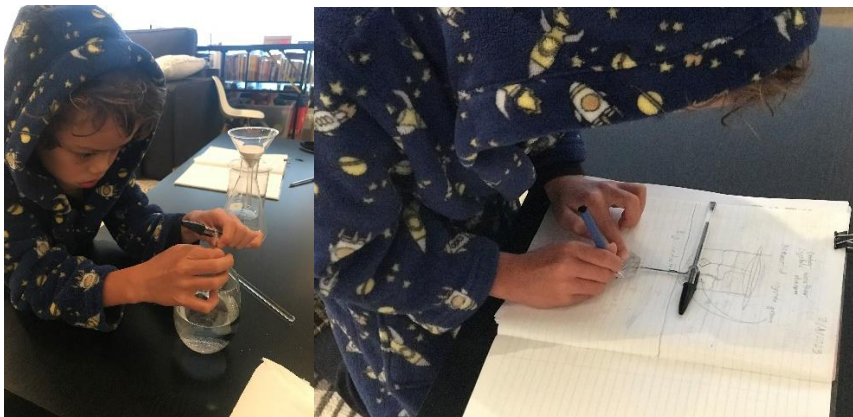
Industrial seed

I left them there for a day and then looked at them the day after and not much had changed.

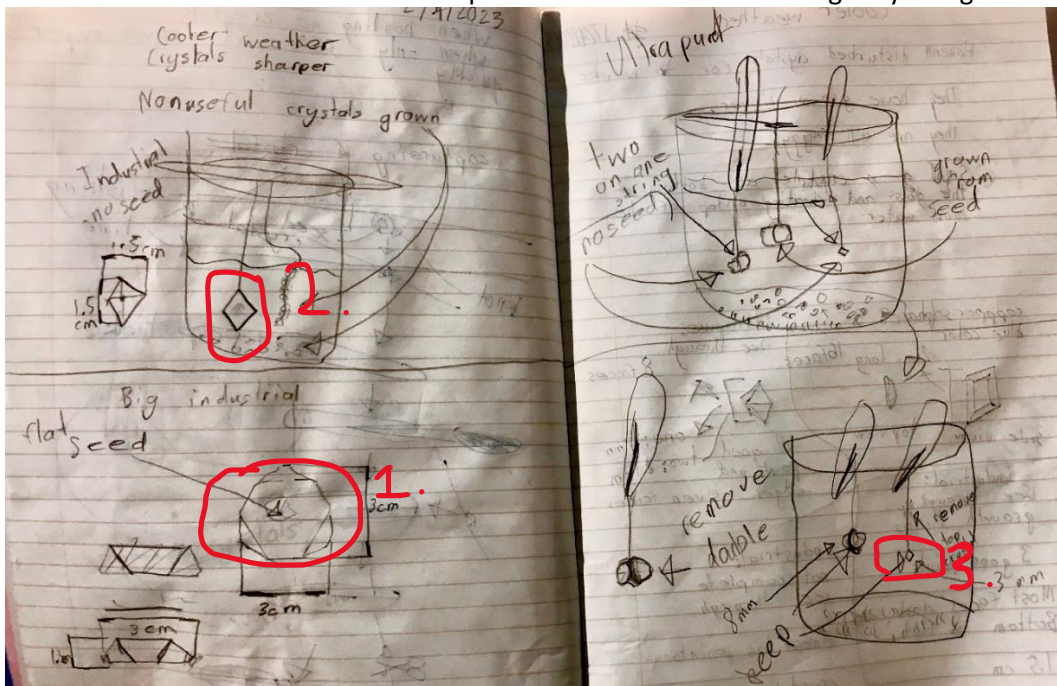
A week later:



02/04/2023 the crystals had grown, and I noticed that there were some excess crystals growing on the string and on them bottom of the glass so I took them off the string and filtered the liquid to get them off the bottom of the glass.



I also took some notes and drew some pictures and measured how big they had grown.



02/04/2023

These are the three crystals we are working with:

1. Industrial and grown from a big seed and is now 3 cm across and 13 mm thick, quite flat.
2. Industrial and grown without seed and is now 1.5 cm across and 1.5 cm thick.
3. Ultrapure and grown without seed and is now 3 mm across and 3 mm thick.

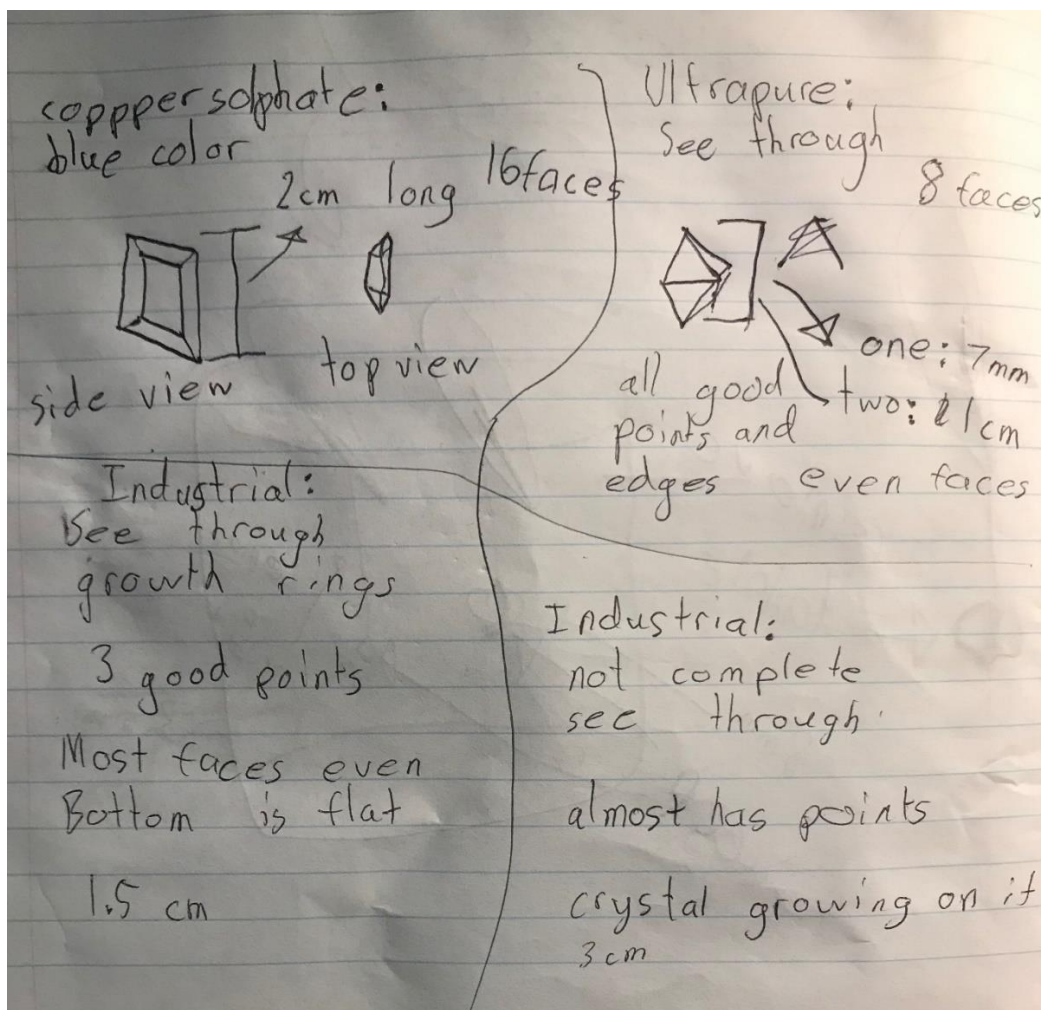
Then I removed all the extra crystals off the string and bottom of the jar and left it alone in a cool room because they would infest the crystals that I actually wanted to grow.

Observations:

- The seeded industrial crystal was growing big but flat and was growing quickly but cloudy with layers.
- The industrial crystal was growing well and quicker than the ultrapure one but was foggy and had many growth lines.
- The ultrapure one was growing a little slowly but had sharp edges and was clear.

17/04/2023

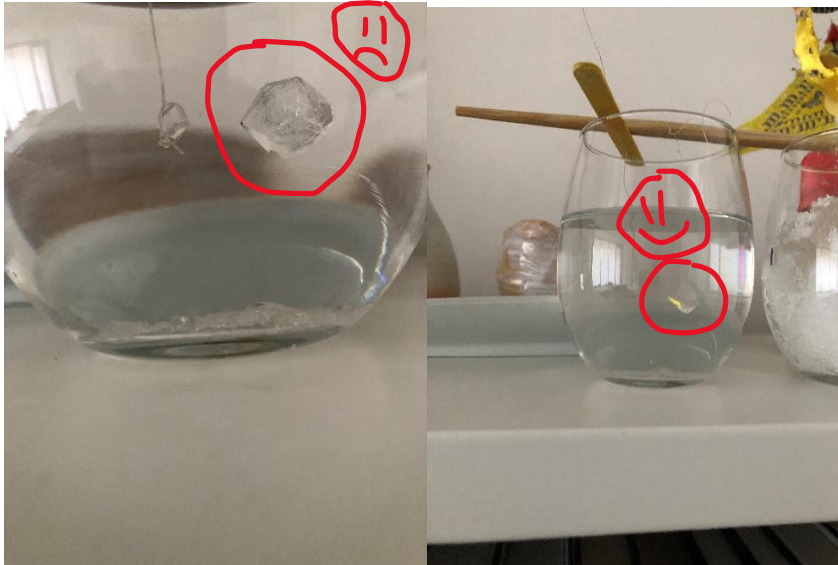
I haven't disturbed the crystals for 2 weeks. They have grown a little bigger. They are still a little foggy except for the little one which is quite clear. Small crystals have grown at the bottom of the glass, and some have floated at the top.



25/4/2023

The weather got hot, and I looked at my crystals and got very disappointed because they melted! 😞
The crystals had dissolved a little and had become smaller. The edges were lumpy, and the crystals looked like sad rocks not happy shiny crystals. Mum said we should throw them away and start them again. 😞 But dad said that we should wait and see...

So, I left them for some time!

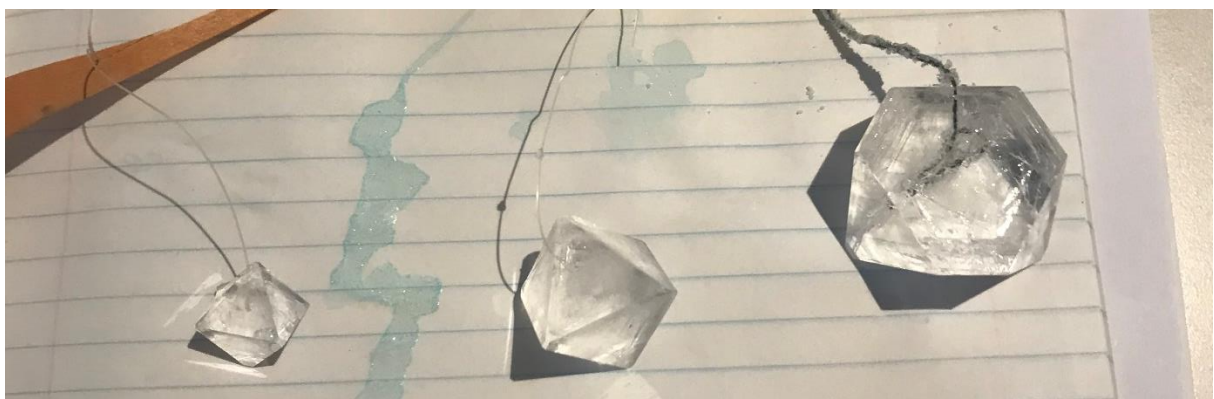


😞: the lumpy crystal in the hot weather.

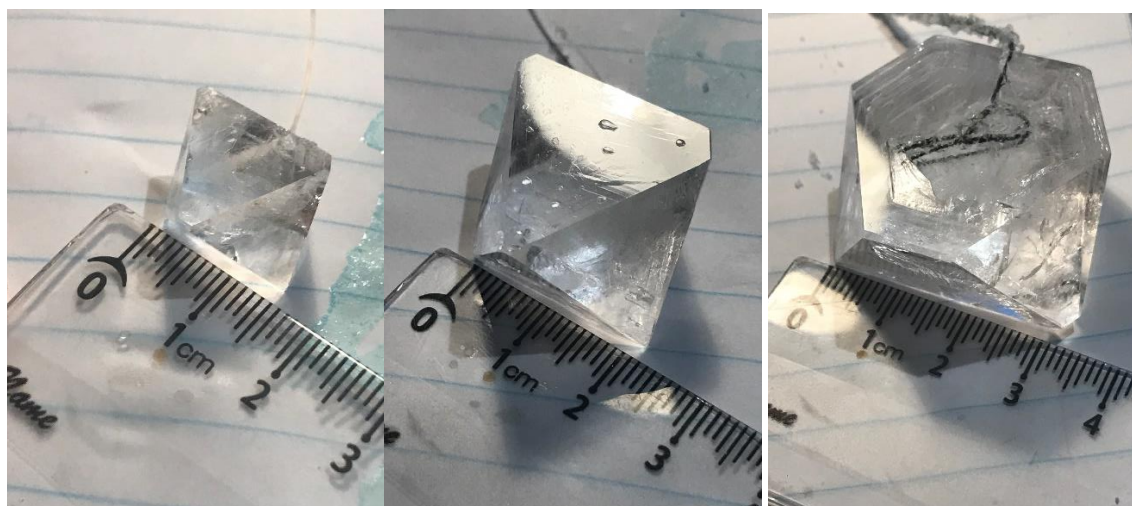
😊: the crystal before the hot weather.

22/6/2023

I'm glad I waited because the crystals grew back and were bigger and sharper.



Then I weighed them.



And measured them.

Crystals	Ultrapure	Small seed industrial	Big seed industrial
Measurement	1.4cm	2.1cm	3.2cm
Weight	4g	12g	26g

Summary and conclusion

I enjoyed the science experiment, it was fun, and I learnt lots of things. I learnt how to grow crystals, how to make solutions and I learnt that it takes time to grow crystals. When the crystals slowly form, they are quite clear because the molecules have time to line up properly. There are growth lines in some of them because there was a change of temperature, so they dissolved a little and came back. The clearest and best shaped one is the ultrapure one because it has less contamination. The ultrapure one has only alum and water and nothing else, so it wasn't as contaminated. The big industrial one is foggy because the water and alum are a little contaminated with other things, so it grows quickly.

Biggest crystal: industrial alum with tap water which has many growth lines, poorly shaped, cloudy and it grew the fastest. It was grown from a large flat seed. It didn't grow fully into the proper shape and stayed rather flat.

Medium crystal: industrial alum with boiled tap water which grew well, is a little bit foggy and has some growth lines. It is grown from a small seed.

Smallest crystal: ultrapure alum and distilled ultrapure water, which is the least contaminated, has a good shape and is pretty clear.



This report has taken me 1 whole week (if not more) to do, so, here is my last measurement and observation.

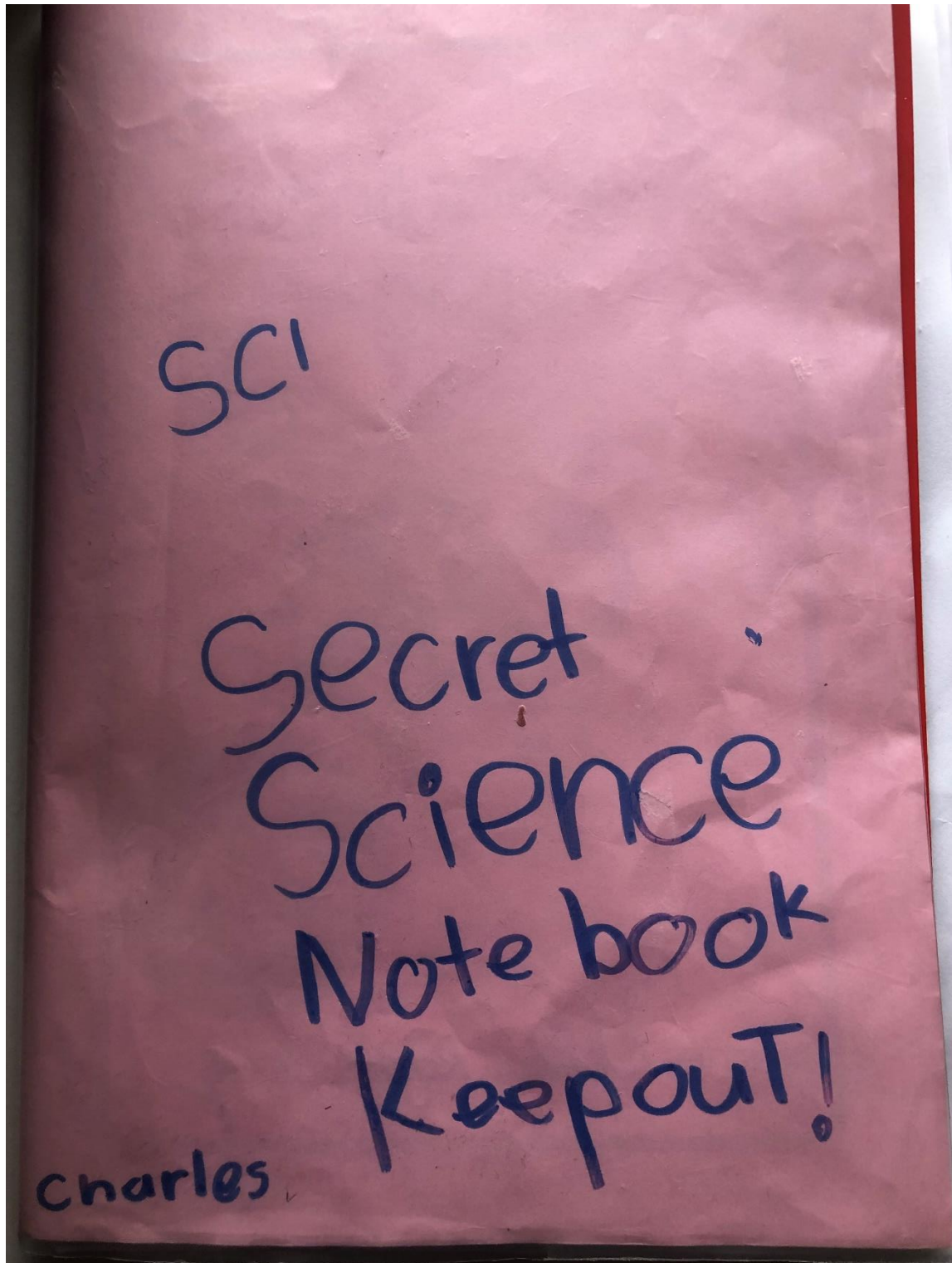
Something I learnt is that small changes can make big differences.

Now I have seen how crystals grow, next I want to understand why they grow.

I discussed it with my family, and we all decided on the smallest but clearest and best formed crystal to be my final crystal and my entry.

Appendix

These are some pages from my secret science note book that talk about what I did for the crystal investigation.



24°C

Crystals

21/3/23

alum {
 cooking
 industrial
 ultra pure

water {
 unfiltered tap ~~water~~
~~tap~~ filtered and boiled
 ultra pure

put ultra pure alum in ultra pure water 5 spoonfuls then heat

I think we can put 2 or 3 more when we heat it up to ~~100°C~~ 100°C
 spoonfuls

3 dissolved in ~~to~~ 40°C

I think we can put 5 more when we heat it up to 100°C

5 spoonfuls dissolved in 50°C

I think we can put 10 more

10 spoonfuls dissolved in 60°C

I think we can put 15 more

15 dissolved in 70°C

add 10 more

10 dissolved in 80°C

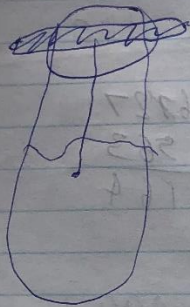
add 10 m

10 dissolved in 90°C

and 7 more and finally

Crystals

ultrapure



the crystal dissolved
because of the hot
weather.



grew in about 2 mins

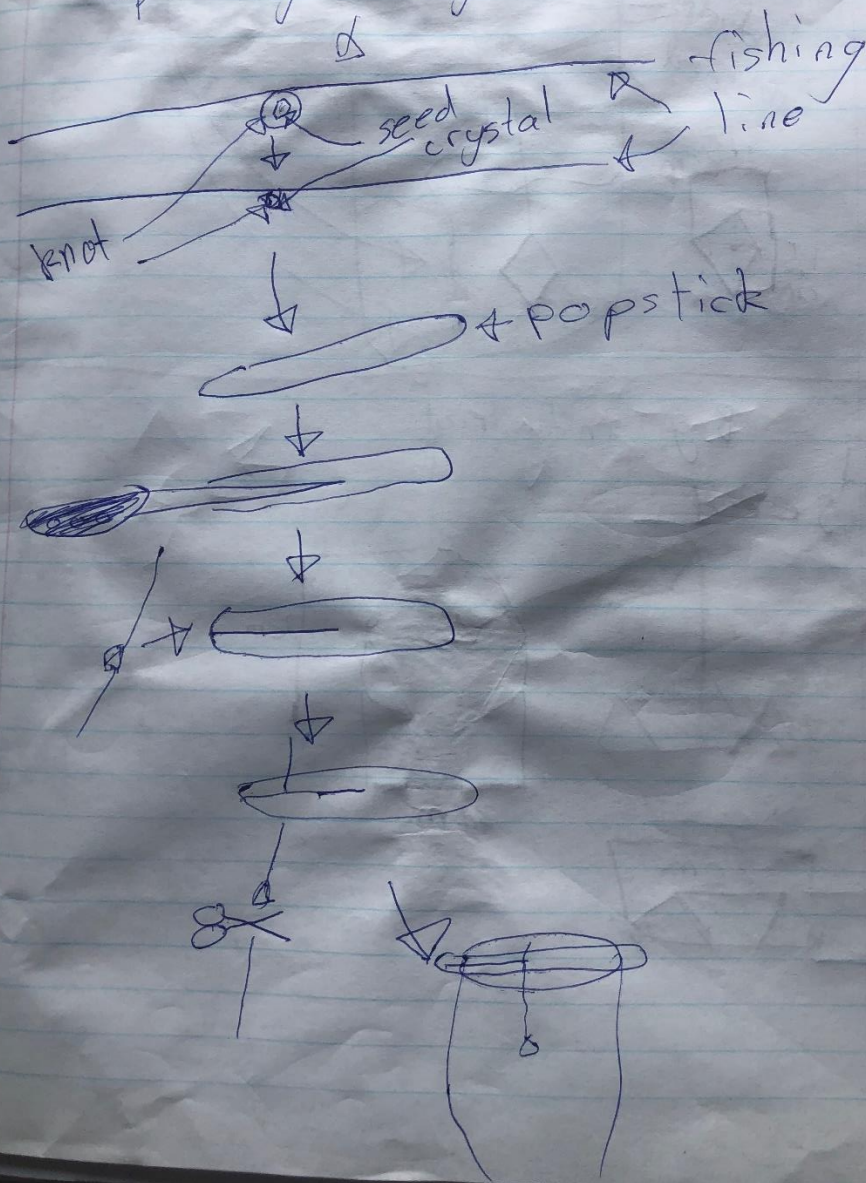
crystals falling

wavy lines

it dissolved again

when boiling no crystals
when only 30°C it grows super
quickly

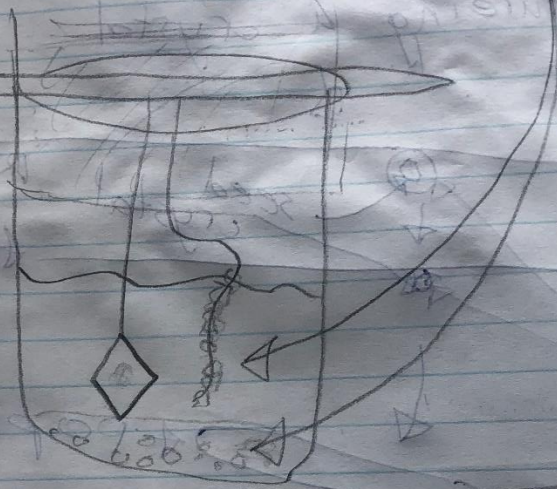
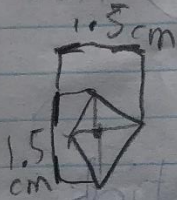
capturing a crystal



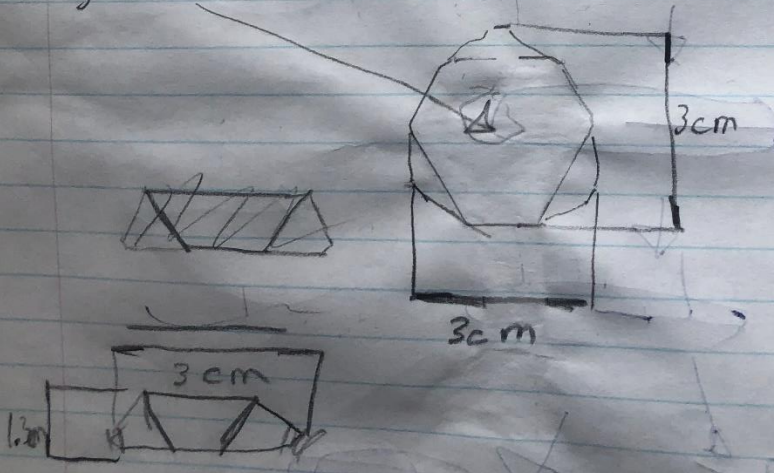
Cooler weather
Crystals sharper

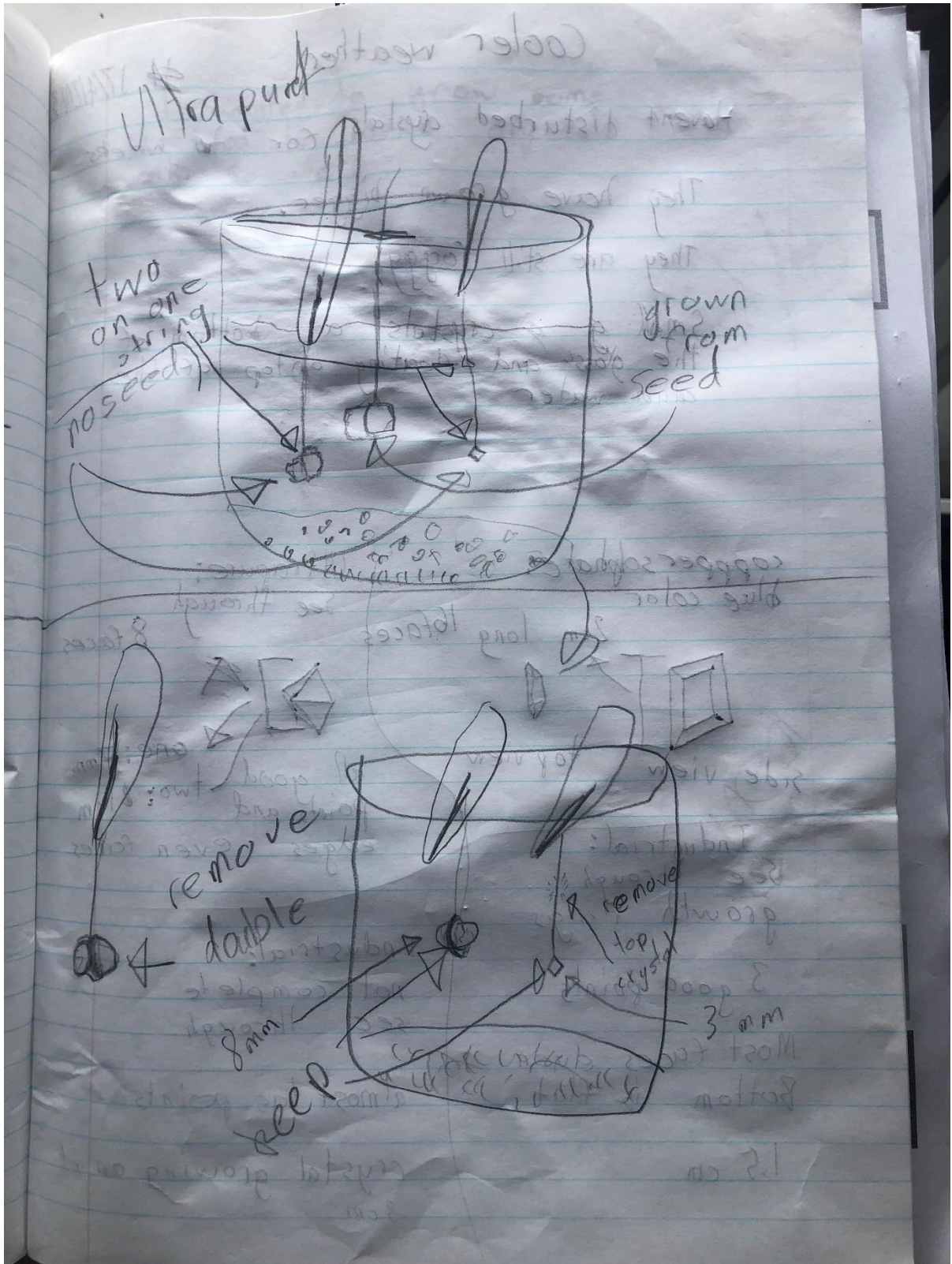
Nonuseful crystals grown

Industrial
no seed



Big industrial
flat seed





Cooler weather

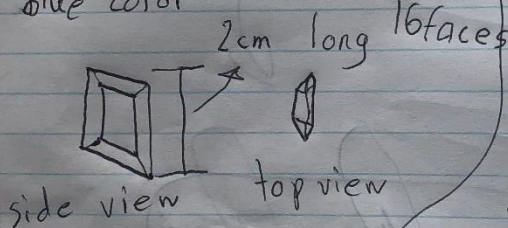
Havent disturbed crystals for 10 weeks

They have grown bigger.

They are still foggy.

Small CuSO_4 crystals at bottom of the glass and floating on top of the alum water

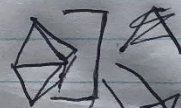
coppersulphate:
blue color



Ultrapure:

See through

8 faces



all good points and edges

one: 7mm

two: 21cm

even faces

Industrial:
See through
growth rings

3 good points

Most faces even
Bottom is flat

1.5 cm

Industrial:

not complete
see through

almost has points

crystal growing on it
3cm

I w
we trie
work.

Addendum

After three weeks (of my trip to China) my crystal had grown bigger! 😊

It had grown to 1.7 cm on each side, 2.5 cm from top to bottom and now weighs 5 grams which is 25% more than last time I checked.

