

CRYSTAL INVESTIGATION

Project Logbook

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PAC Preparatory School Year 2

Project Coordinator

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Our Super Team

MR. OLIVER RAESIDE



MR. ELON YOU



MR. CHARLES YIN



& MR. DANIEL CHEN (ELON'S 4YO BABY BROTHER)

QQRT - Approach

Q – Quality – how good?

Q – Quantity – how many?

R – Resource – what do I need?

T – Time – when do we need it by?

Together: End of this year

Elon: I want it to be diamond-like

Oliver: I want it to be an amethyst

Oliver: Three

Elon: two

Elon: 700mL of water Oliver: special powder

Elon: probably salt Oliver: microwave

Elon: teaspoon because we need to

Elon: beaker cook it to make it

Elon: aluminium foil to cover the beaker

Together: we need minions to assist us

Elon: we need food colouring, goggles, and living spray

Daniel: minions to grow one BIG crystal



QQRT - Approach



shows sharpness of edges, smoothness of faces and has good clarity (transparency)

Will answer an investigation question or investigate a hypothesis (prediction).

Q – Quality – how good?

Q – Quantity – how many?

at least one crystal

We will make three (one for each) crystals and pick the best for our entry

R – Resource – what do I need?

The crystals must be made from potash alum (common alum, potassium aluminium sulphate).

T – Time – when do we need it by?

Monday 22 July - Friday 26 July - journal / log book [submitted online](#)

Tuesday 30 July - Packaged crystal & hard copy log book delivered onsite

Risk – What is it?



Elon: a challenge you need to confirm or complete

ChatGPT:

1. The chance of a bad thing that could happen
2. How serious it can be once happened?

Daniel: anyone cannot build something

Oliver: jumping into a volcano Charles: Walking on a fence

Event

Probability

Consequence

Jason: a plane's engines blown up in the air

Elon: happens every year

Oliver: it will crash, everyone will be afraid

Charles: 10 out of 100 chance

Daniel: someone bumps his head

Max: you dip your finger into a green stinky pungent liquid

Elon: 50% chance I will dip my finger in the liquid no matter what it is

Charles: it might be made of acid, and it may burn your finger. Acid is green

Oliver: it might be a dangerous liquid, and it may kill you.

The Chemical We Will Be Using



Elon: Alum?

$KAl(SO_4)_2 \cdot 12H_2O$ – Aluminium Potassium Sulphate (Potash alum)

MSDS – Material Safety Data Sheet – whenever you are about to use any chemical, you will need the MSDS of it

HOMEWORK:

Complete the OSA Risk Assessment Form with your parents, brainstorm possible hazards and how you will do to prevent/control it.

EASTER BREAK: There will be no session for next week, we will start our experiment after easter. Get prepared! I am excited.

Practice Run

6 Apr. 2024



We use table salt and tap water for our practice run.

Let our team understand the basics of lab equipment handling, measurement reading, and lab operation procedures.

1. How to correctly wear PPE

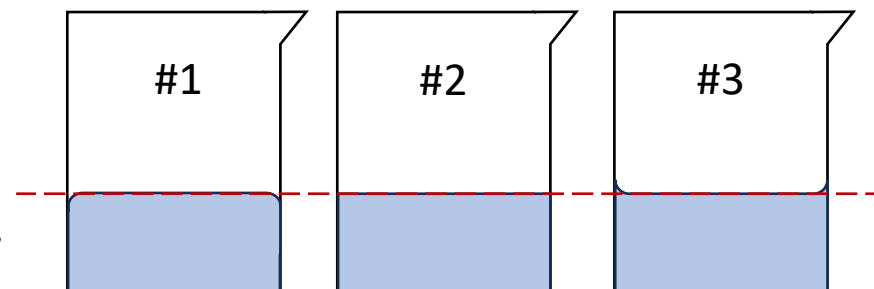
Wear gloves and goggles before any lab experiments

2. How to read liquid levels.

Observe liquid surface types

Water and solutions using water as solvent normally looks like #3.

Read surface level on flat surface align with the dotted line.



3. How to transfer liquid from one beaker to another, how to top-up, how to wash the beaker

Transfer with the target beaker on flat surface, pour from the beak without touching the other beaker, till about 90% full, then use a washer bottle to top-up to the mark.

4. How to measure solid using scale.

Use a piece of paper on top of the scale. Tare every time. Use tare to remove weight of the beaker if needed.

5. How to transfer solid

Use spoon to transfer solid from the container, gently to the centre of the paper on the scale until about 1-2g to target. Then use finger to tap on spoon's stem, until hit target.

6. How to smell substance – hold the beaker half an arm away, use the other hand to gently fan the scent to nose.

7. How to mix – use the stirring rod to gently mix solid (solute) with liquid (solvent), try not to knock on the beaker too much.

Crystal Investigation Lab Rules

1. Safety first, always wear safety goggles and gloves when conducting experiments.
2. Never taste any chemicals or solutions, even if they look tempting!
3. Listen carefully to instructions from your supervisor before starting any experiment.
4. Always handle glassware with care to avoid breakage and potential injury. If something does break, inform your supervisor immediately.
5. Keep your workspace clean and organised to prevent accidents and spills.
6. Wash your hands thoroughly after handling any chemicals or laboratory equipment.
7. Never mix chemicals unless instructed to do so by your supervisor.
8. Use caution when heating substances; always use heat-resistant gloves when handle hot stuff.
9. Never leave experiments unattended, especially if they involve heat or other hazards.
10. Dispose of chemicals properly according to your supervisor's instructions; never pour them down the sink without permission.
11. Be mindful of others around you in the lab; don't run or horseplay.
12. Report any accidents or spills to your supervisor immediately, no matter how small they may seem.
13. Always follow the scientific method: make observations, ask questions, form hypotheses, conduct experiments, analyse data, and draw conclusions.
14. Have fun and enjoy the wonders of science, but always respect the rules and safety guidelines in the lab.

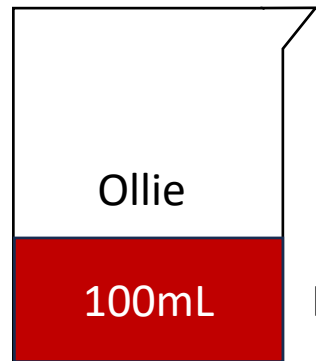
1st Experiment with Alum

13 Apr 2024



Purpose: let the kids to handle real chemical and make their first batch of solutions. Understand solubility's relationship with temperature

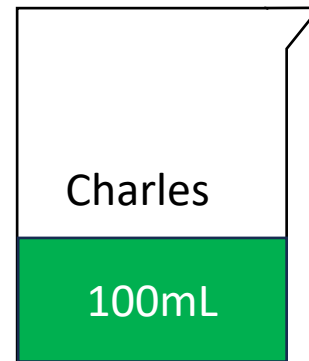
25g in 100mL



Hot

All dissolved

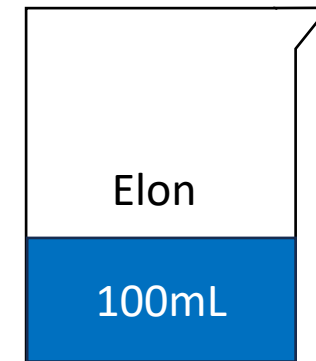
25g in 100mL



Warm

More than half dissolved

25g in 100mL



Cold

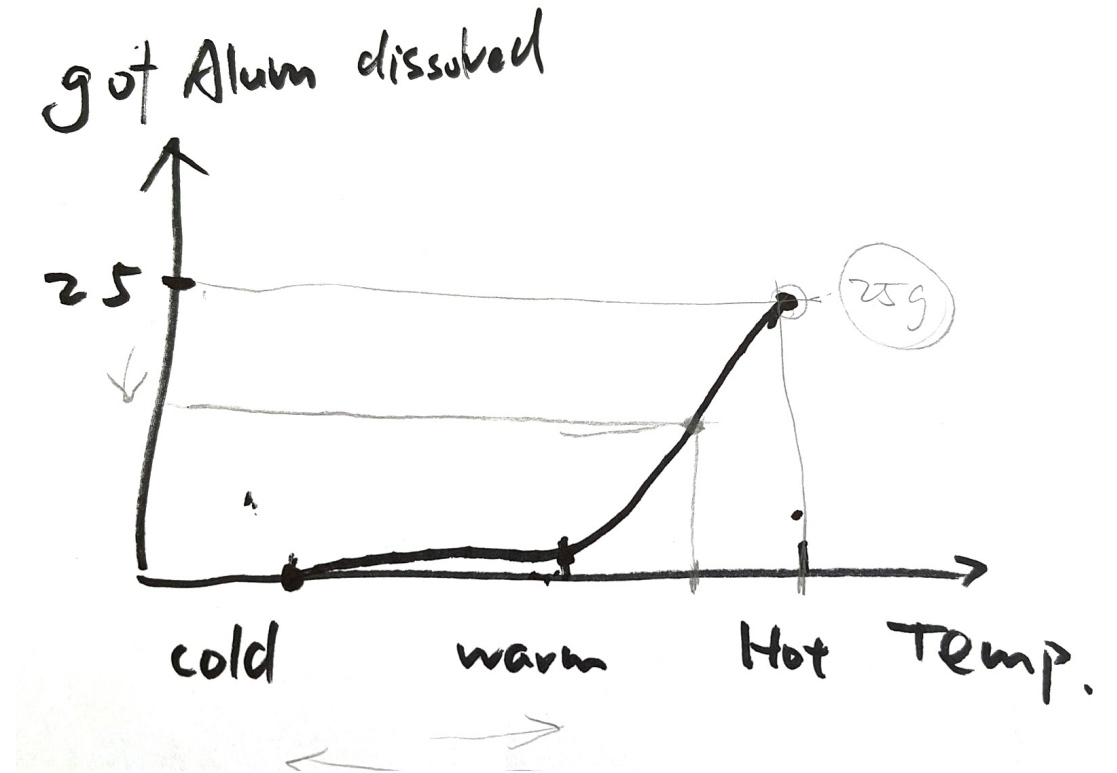
Only a little bit dissolved

Observation: the warmer the solution is, the more alum it will dissolve. The cooler the solution is, the less alum can be dissolved into the solution. If too much to hold in the water, alum will 'hold together' and form crystals.

Hypothesis: if we heat up the solution, we can dissolve a lot of alum for our crystal growing. When it cools down, we can have a big crystal.



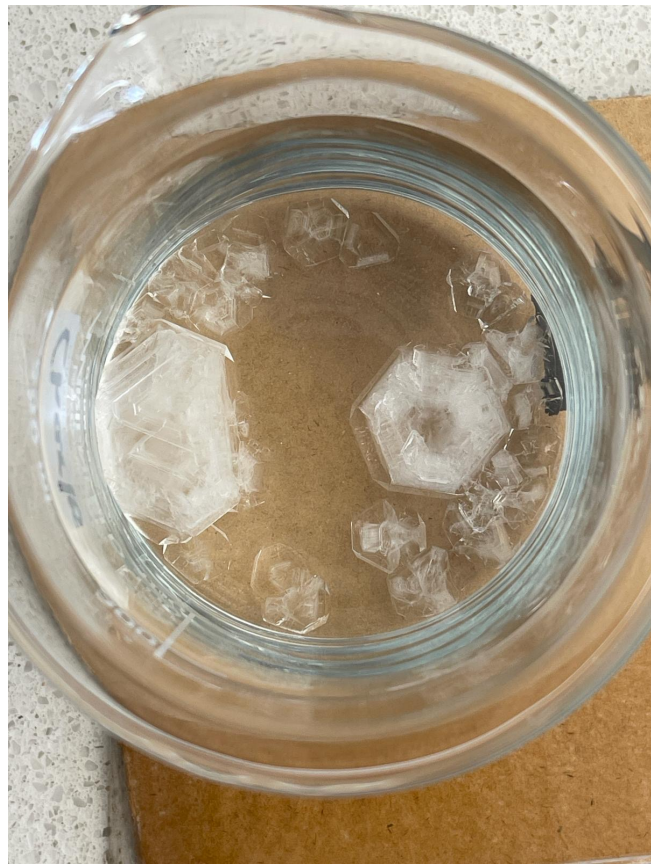
Cold, Warm, and Hot, interesting discoveries on solubility of potash alum under different temperature



The boys are encouraged to plot their discoveries to find regularities. They pinned their respective observation and joined the dots.



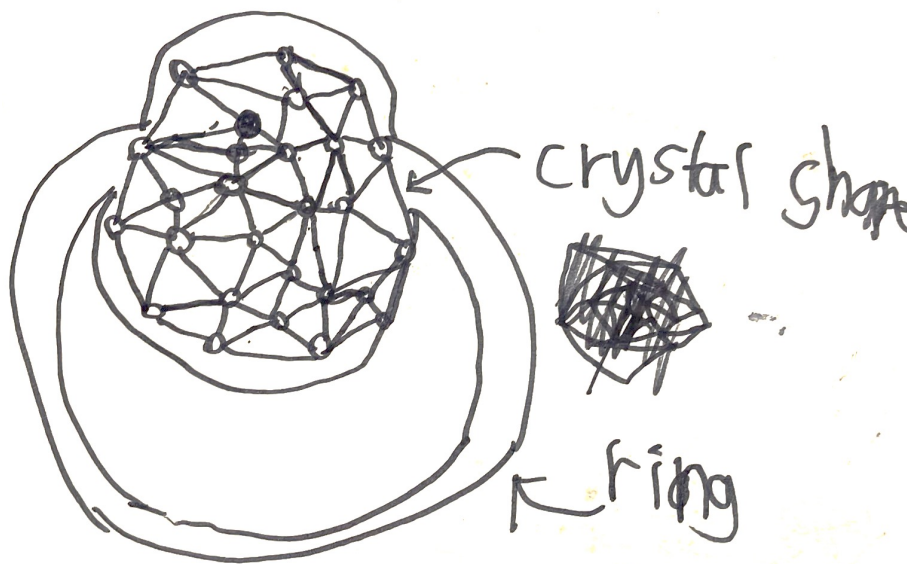
Kids are encouraged to top-up the last gram by gently tapping on the stem of the spoon.



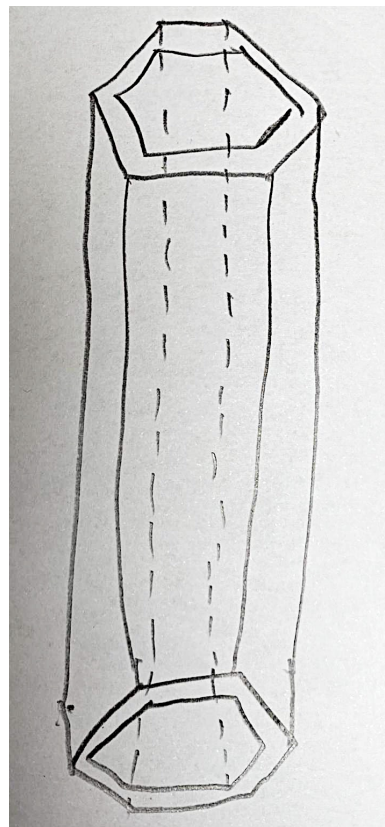
All solutions are combined and heated till all alum is fully dissolved. Crystals quickly emerge over night. A few seeds are taken out for first growing attempt.



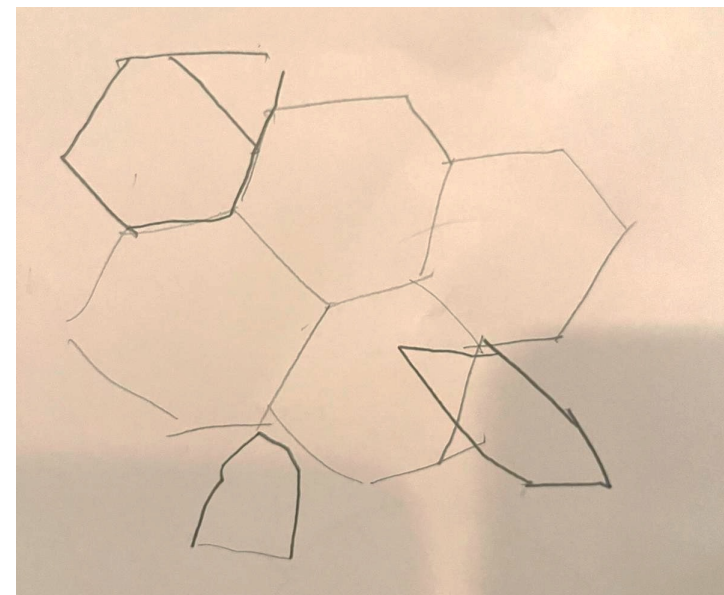
Kids' initial understanding of crystalline structure of potash alum



Elon



Charles



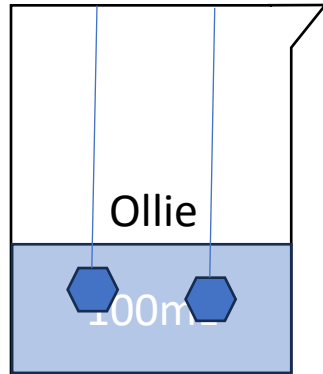
Oliver

1st Growing Attempt

20 Apr 2024

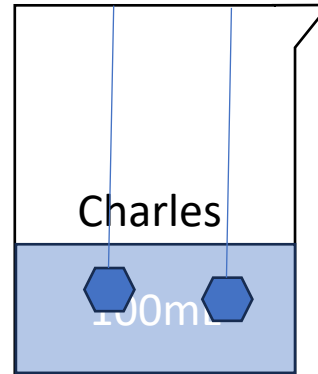


25g in 100mL



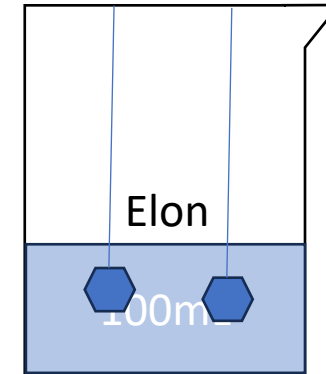
Two large but a bit blurry crystal seeds

25g in 100mL



One large blurry seed with a little triangle on top, one crystal clear small seed

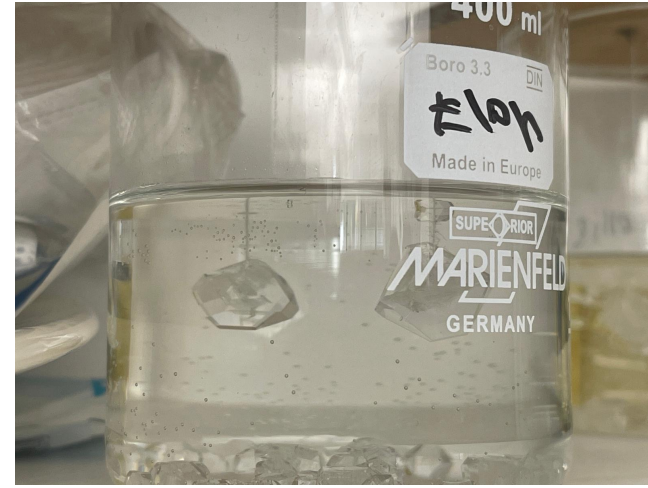
25g in 100mL



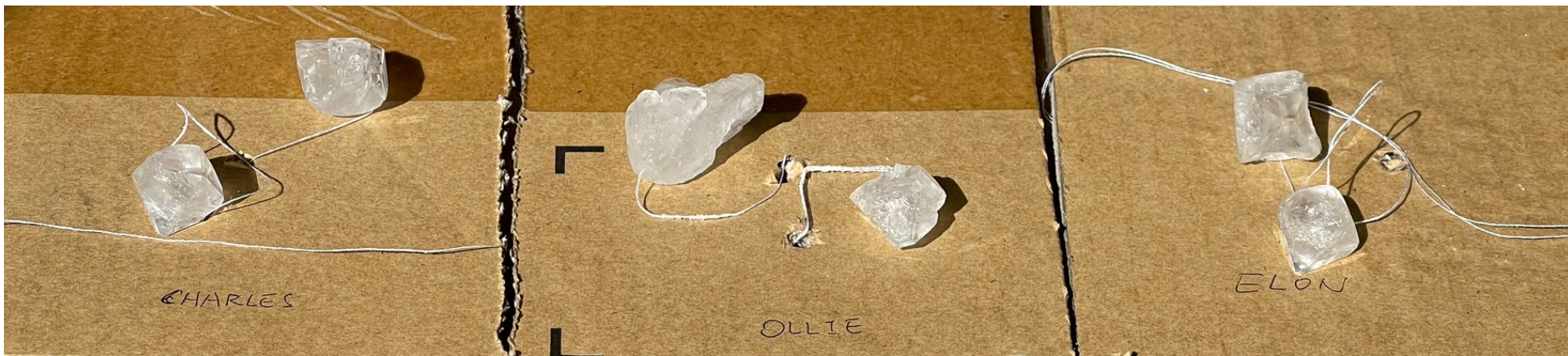
Two crystal clear small seeds

Each boy made another batch of solution with 25g of alum and 100mL of demineralized water. Solutions are heated to let alum to be fully dissolved, then they are cooled to room temperature. Two selected seeds are stringed and introduced into respective solutions.

Day 1



Day 7 27 April 2024



Charles

Ollie

Elon

Day 1 Observations

1. It looked like crystals were growing on the string???
2. I didn't have small crystals at the bottom/side of the beaker.
3. The shape isn't hexagonal but like cube/rectangular prism.
4. I purposely chose a blur and a clear to find out the difference of them but they both grown on the string and in similar shape.

heat up the ^{little} crystals on the string by taking the seeds out then cool it down and put the seeds back in so it will not grow on the string again and grow it on the seeds

Charles

Mine doesn't have any crystals on the bottom which is good, but the shape of my crystals aren't good and they aren't very clear

Oliver

Why they are irregular and not clear?

Elon: we disturbed them too much, and there might be contaminations in the solution.

My crystals look like diamonds and a little house, but only the bottom part is clear

Elon

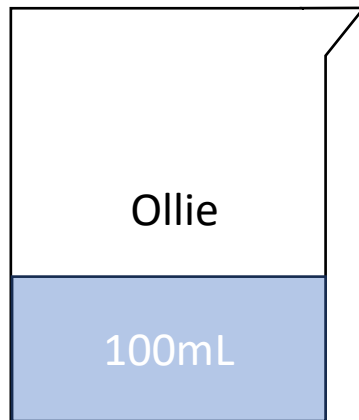
2nd Run

11 May 2024



10g of Alum in 350mL of water

3g in 100mL



About 90 mL of water

I see about 10g of alum

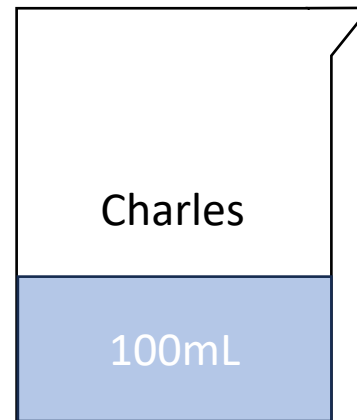
There might not be enough alum in my beaker bird

My suggestion is 7.6g of alum

No, I will not change it.

10g of Alum in 200mL of water

5g in 100mL



About 100 mL

I see about 0g of alum in the beaker

There might not be enough alum in my solution

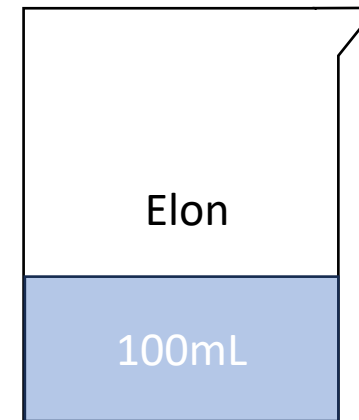
Maybe next time 10g of alum?

It sits in the middle of my 5g and Elon's 15g

I think 10 should be OK

15g of Alum in 100mL of water

15g in 100mL



It looks like 99mL

I see 27 crystals in my beaker

They look weirdly irregular.

There is way too much alum in my solution

My beautiful suggestion is 7.5g of alum

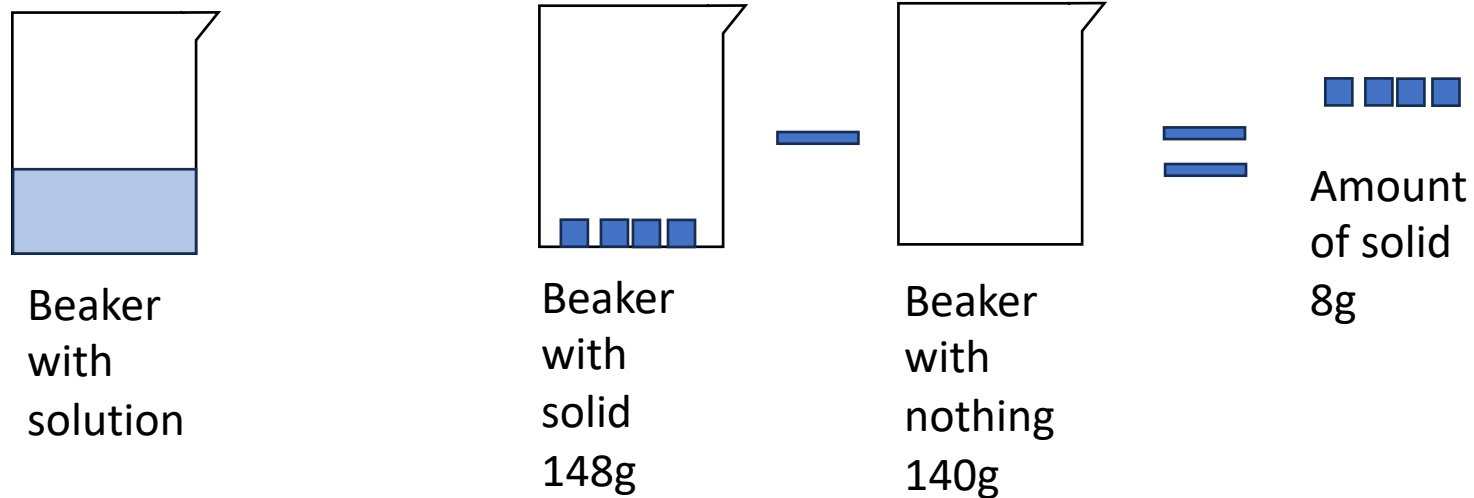
I will not change my suggestion

Q: we have a beaker with solid crystals and a beaker with solution, how can we measure the amount of solid in one of the beakers?

Charles: we put Ollie's beaker with solution on the scale, tare it, then pour solid into Ollie's beaker.

Ollie: put Elon's beaker bird on the scale, put the scale on tare then you can measure the beaker bird.

Elon: get a piece of paper and put my solid on to measure.



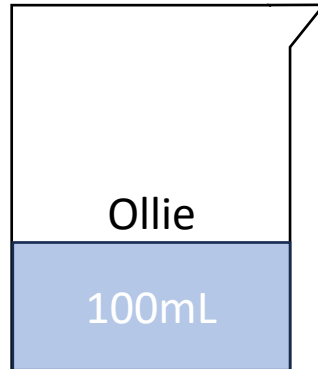
We learnt that with 15g of alum, we produced 8g of crystal
We still have 7g of alum in our solution

3rd Run

18 May 2024



8g of Alum in 100mL of water



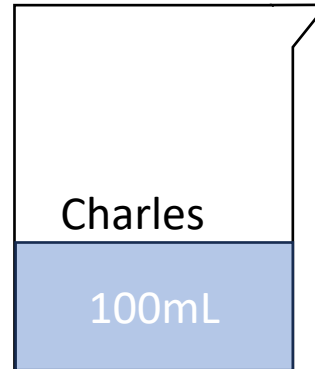
Outcomes: I can see that the number has dropped to 98
I see nothing, just the 98 mL of water

Conclusions: The water exploded, I know it

Suggestions:

I want to evaporate the water in my beaker until next time we meet. I expect to see no water in my beaker. I want to remove 40mL of water from my beaker.

10g of Alum in 100mL of water

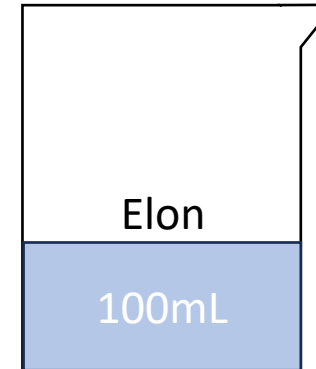


The volume of the water dropped
I can see at least 8 small crystal seeds

10 g of alum can make at least 8 crystal seed.

I want to grow the crystals now with two of the biggest and clearest seeds.

7g of Alum in 100mL of water



The number of the water is smaller
I see nothing, just water

Nothing happened, the water just evaporated away

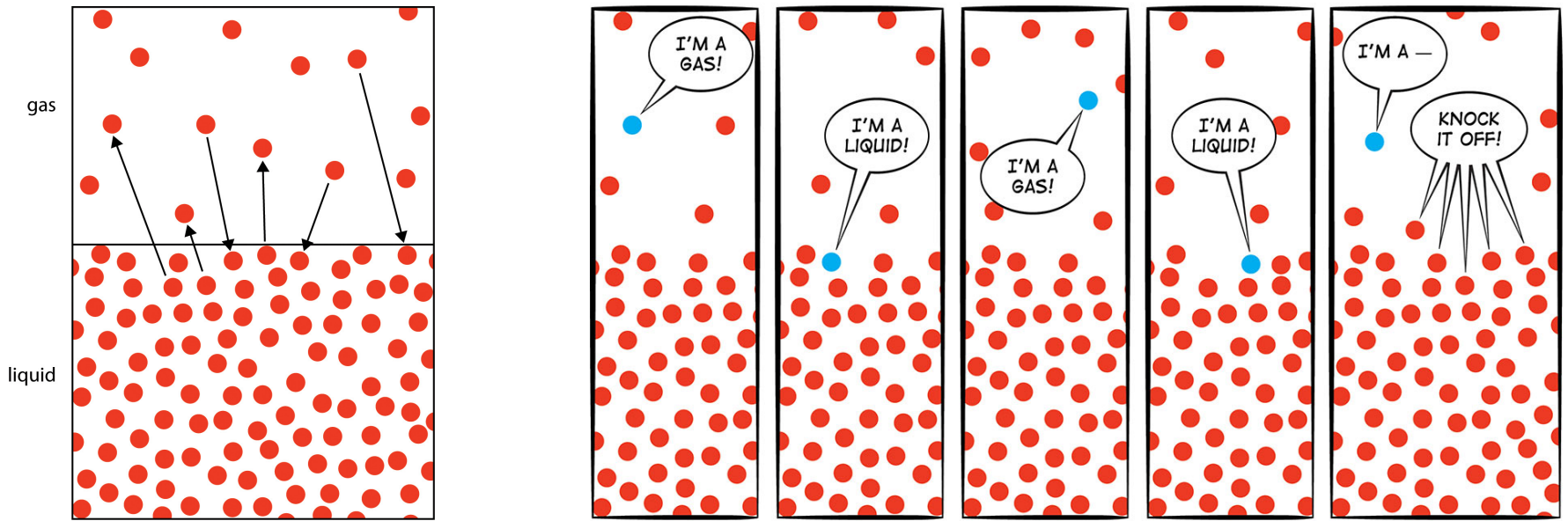
I want to add 3g of alum to my solution in order to make the most crystal clear, sharp, big and smooth crystals



Question: What is evaporation?

What is vapor?

Change from liquid into air? Mist?



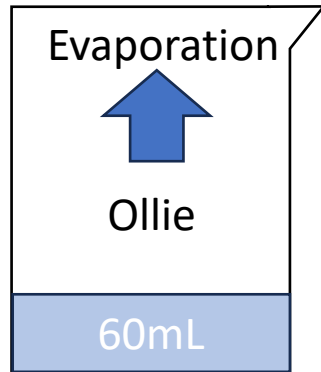
Kids: Put it in the sun. the sun makes it hotter.
JY: Heat is introduced.

Kids: If you turn on the fan, the water vapor will be generated
JY: Air circulation helps the evaporation process.

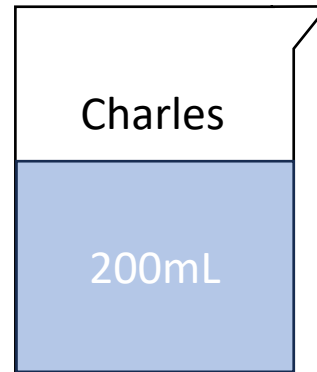
4th Run

25 May 2024

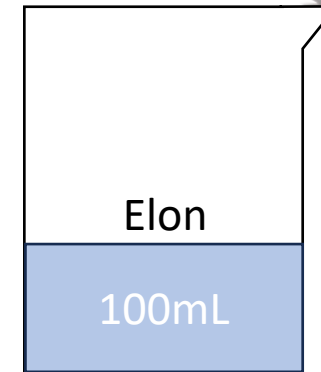
13.3g of Alum in 100mL of water



10g of Alum in 100mL of water



10g of Alum in 100mL of water



Observations:

About 25mL of liquid now
I can see 6 crystal clear crystals.
They look like one square, two diamonds, and three triangles.

No, I did not change my concentration.
The coordinator gave me additional 100mL of solution at the same concentration.
One of my crystals fell during the growing phase over last week.

My solution evaporated by approximately 40mL
I can see two crystals in my beaker, one is not sharp but crystal clear, the other is sharp but not crystal clear.

Are the concentrations of your solutions the same?

Conclusion from last week: What is left in all three beakers should be at the same concentration.

I expected no water left in my beaker, but I still have 60mL left. I ended up with some crystal seeds to my big crystal that is bigger than my beaker.

I thought my crystals will grow bigger, but they didn't.

I want to make my crystals grow bigger by evaporating 50mL of water so that more alum will join my crystals.

Also I want to take the distracting crystal at the bottom of my beaker out from the growing phase, so that the crystals on the strings can grow faster.

I thought my crystals will be very sharp, but they are not

In order to make my crystal crystal clear, I need to stop shaking my beaker. I want my crystal to grow bigger. I want to grow my crystals at the bottom of my beaker.

To prevent my crystals from drying up, I need to add more saturated solution.

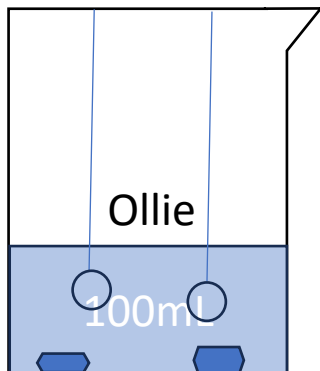
Suggestions for next week:

I want to string them, and I expect them to grow 3D in all directions.

5th Run

1 June 2024

Top up with saturated solution



Observations:

It has way too many small crystals and two bigger ones. There are blurry stuff inside that looks like pompom or feather. My reading is 101mL.

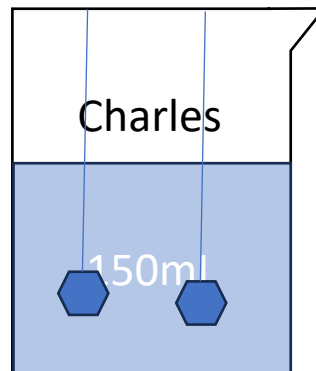
What might have happened

There might be too much dust or particles in the beaker, acting as seeds for unwanted crystals to grow. The dust or feathery stuff may come from the threads

Suggestions for next week:

Risks

Top up with saturated solution



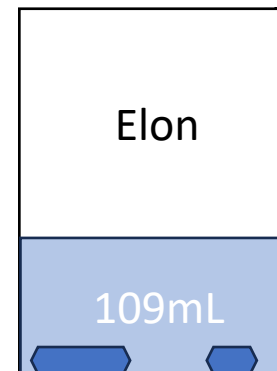
The strings are inside of my crystal, meaning my crystals have grown bigger over the last week. There are very very little crystals at the bottom of my beaker. There is about 150 mL of solution left in my beaker

There are only a few unwanted crystals at the bottom of my beaker, which means most of the alum has grown on the seeds. I filtered my solution to reduce dust in my solution, preventing unwanted crystals from growing on those dust particles.

Maybe evaporate more water from my beaker so that my alum will find no place to swim and jump on my seeds. Next week we can top up with more solution, continuing my seed growth.

If I leave my string heights unchanged, my crystals may be exposed to the air when the solution evaporates below them

Top up with saturated solution



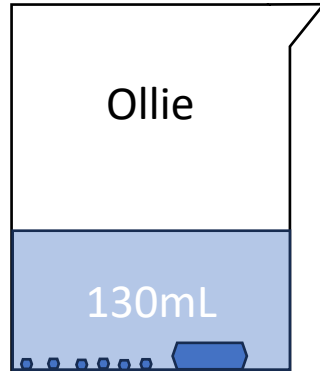
My water level has dropped from 150mL to 109mL. I also see a lot of unwanted little crystals at the bottom of my beaker. The crystals I want have grown bigger but showing chippings at the edges, which is unfavourable. I can also see there are little particles suspending in my solution and they agglomerate into furry blobs.

My solution may have evaporated, and my smaller crystals may have been disturbed and chipped the big one's edge away.

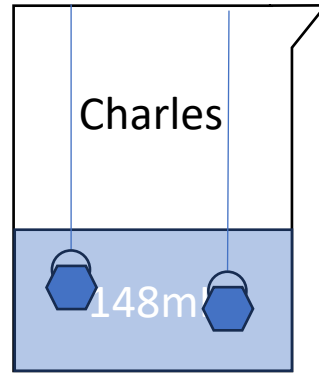
Maybe I could try remove the unwanted crystals, keeping only the big crystal in my solution. I need to use filtration to remove unwanted furry blobs.

5th Run (cont..)

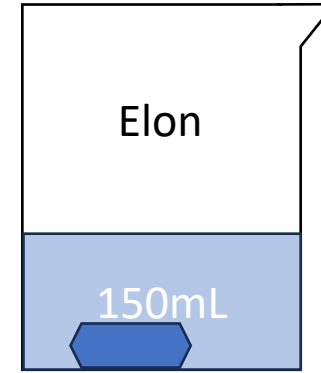
15 June 2024



Picked the larger one and heat up the rest
Re-introduce when cooled



Heat up and re-introduce when cooled



Removed the smaller one and kept the big one
inside

Observations:

There are a billion tiny crystals and one ginormous crystal. And they are all connected.
The liquid level is about 130mL.

My water level is exactly 148mL.
There are about 100 small crystals at the bottom of the beaker.
The crystals moved downward while the thread hooks are exposed on top.

There are tiny dust particles at the bottom of my beaker, and one gigantic crystal which is a little bit cloudy.
My liquid level is exactly 150mL.

What might have happened

The big crystal grew legs and jumped into a connection machine and connected to the small crystals

I think my crystals shrank a bit, dissolved a bit back into the solution. At the same time, some alum jumped back to the bottom of the seeds, growing clearer crystals.

The big crystal has more hands to hold new alum to continue the growth, small crystals have no chance to grow on their own.

Suggestions for next week:

I want to put TNT in it, and it will blow the small crystals away from my big crystal.
Heat up my beaker until the small crystals get loose, and I can take the big crystal out while continue to heat up, until all small crystals get dissolved.

Take the seeds out of the beaker and dissolve the little crystals to put a little bit of alum back to my seeds when I introduce it back to the cooled solution.
My solution is clear, so I don't need filtration this time.

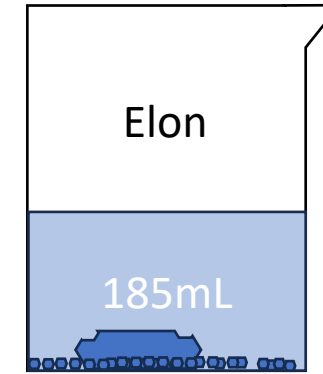
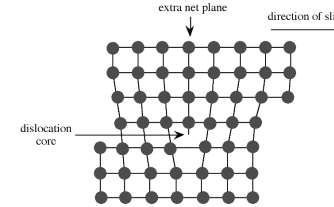
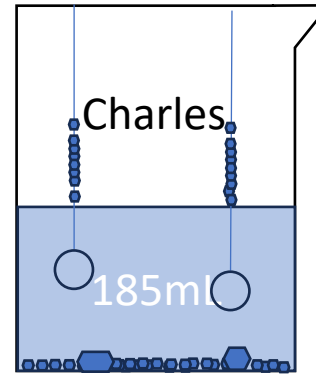
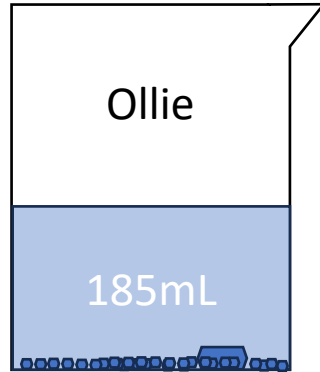
I want to remove the brown particles from the solution by using filtration.
Depend on the result of first filtration, another round of filtration may be required.
The big crystal should be rinsed with alum solution to remove the impurities on the surface of the crystal.
Maybe I should make a new batch of solution means there will be no more impurities, and there will be more alum to fuel my crystal growth.

All topped to 200mL by the end of this run

5th Run (cont..)

6 July 2024

After almost three weeks without any attention...



Observations:

The crystals jumped off the hook, and they are much much smaller than before. (they are 1/12 smaller than what they were a couple weeks ago) There are about 100 more smaller crystals appeared at the bottom of my beaker. My solution evaporated about 15 mL, leaving 185mL in the beaker. I can observe there are more little crystals crystalized on the strings. As a result, the strings look a lot thicker. I notice that the crystallization took place in the air, not in the solution.

The process continued from last run, resulting in the crystals growing out of the hoops. The top part of the crystals dissolved but didn't come back, instead, it joined the little crystals at the bottom of the beaker.

Remove all solids from the beaker, re-introduce two new seeds we preserved from past weeks, and let the saturated solution have a more targeted growth, rather than growing on 100 smaller ones.

My biggest crystal has started to shrink, and the sharp edges are chipping away. My small crystals have duplicated somehow, and some of the crystals adhered to each other and formed agglomerated lump. My big crystal has turned clearer, but the bottom is not very clear.

The liquid level dropped from 200mL to about 185mL. My solution is mostly clear however, I can find tiny little impurities suspending in the solution.

The small crystals started forming again, robbing alum from both the solution and the big crystals, leaving dents on the main crystal.

I want to dissolve the little robbers back into my solution, stopping them from stealing alum from my big crystal. Re-introduce my big crystal only after the solution is cooled down to room temperature.

What might have happened

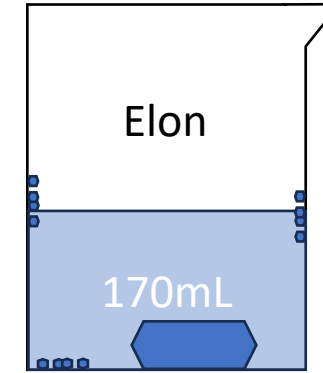
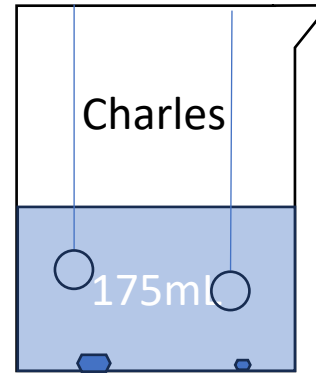
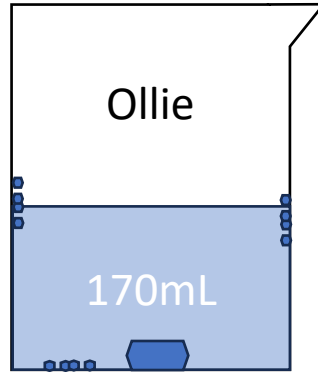
Suggestions for next week:

5th Run (cont..)

13 July 2024

Solution (l) = Solute (s) + Solvent (l)

All small crystals are removed without heating the solution,
Seeds/main crystals are introduced back into room-temp solution



Observations:

The solution is about 175 mL, it evaporated 10 mL over a week. They both dropped off the hoop again. One of my seeds is so small. The smaller crystal is smaller than the hoop, however the bigger crystal is bigger than the hoop.
WHY CAN A BIGGER CRYSTAL FALL OFF THE HOOP?!

My big crystal has grown slightly taller, and the chipped away edges have been healed. The edges are now sharp and pointy. I can spot small brown impurities at the bottom left of my beaker. My solution is at approximately 170mL, it has evaporated roughly 15 mL of water.

What might have happened

The little crystal became smaller, and it was dissolved into the solution and attracted to the bigger crystal, supporting its growth. This happened because I believe the bigger crystal has more "hands", just like a larger magnet, exerting more force to the dissolved alum towards it.

There are no un-wanted small crystals formed at the bottom of the beaker anymore, my big crystal's edges are healed by dissolved alum in the saturated solution. The crystal also continued its growth, supported by alum solute.

Suggestions for next week:

Take the small crystal out, so that the alum will grow on the big crystal.

I want to remove the unwanted small crystals and impurities from the solution by using filtration. When I re-introduce my crystal back to the solution, it can continue its growth peacefully.