



ID:0072-062

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Burnside Primary School Year 4

Crystal Growing Investigation

For our crystal growing investigation, we decided to test the effects of the growing environment on the quality of an alum crystal. Based on this, we each came up with our own hypothesis and tested it using the crystal growing instructions from the Royal Australian Chemical Institute's Crystal Growing Competition as a guide. Throughout the growing, we kept our own logbooks and shared our successes and failures with each other to help each other find solutions to any problems we had. At the end of the experiments, we shared our logbooks, analysed our results and came up with a group conclusion.

HYPOTHESES		
Selina	Charlotte	Bethany
If you keep the temperature, light, evaporation, sound, and how the crystal moves just right, the crystal will grow faster. This is because crystals like to grow in special places like caves where these things are controlled. Also, if you make the Alum solution extra strong, it will help the crystal grow better.	Crystals often grow in caves and you don't see them growing on busy city streets. I think that a crystal can grow in a city-like environment, that is warm, light, noisy and unstable. However, I think a Crystal in a cave-like environment that is dark, cool, quiet and steady will grow much bigger, smoother and clearer.	A crystal grown in a dark quiet space will grow clearer and have sharper edges with greater clarity, while a crystal grown in a lit, noisy space will grow cloudy and less likely to be well formed.

Charlotte- Crystal Investigation

Hypothesis:

Crystals often grow in caves and you don't see them growing on busy city streets. I think that a crystal can grow in a city-like environment, that is warm, light, noisy and unstable. However, I think a Crystal in a cave-like environment that is dark, cool, quiet and steady will grow much bigger, smoother and clearer.

Materials Used

Potassium aluminium sulphate (alum)
 Distilled water
 4 x 250mL Beakers
 2 x large dishes
 2 x petri dishes
 Microwave
 Digital Scales
 Paper towel
 Thermometer
 20 cm Fishing line
 2 x Pop sticks
 Aluminium foil
 Ruler
 2 x cardboard Labels
 1 x texta
 Teaspoon
 1 x long tweezers
 Paper tape

Method

Method for growing a seed crystal

1. Measure 50mL distilled water into a beaker
2. Heat the water to 56°C using a microwave, checking the temperature with a thermometer
3. Tip 19g of the alum crystals into a beaker and then add the heated up water and stir it.
4. Pour the solution through the paper towel to make sure no bits of dirt or molecules got into the solution.
5. Pour the solution into a petri dish and put the dish into a dark cupboard for 3 days.




Method for growing a crystal



6. Measure 100mL distilled water into a beaker
7. Heat the water to 58°C using a microwave, checking the temperature with a thermometer
8. Tip 39g of the alum crystals into a beaker and then add the heated up water and stir
9. Pour the solution through paper towel to make sure no bits of dirt or molecules got into the solution and let it cool
10. Tie a seed crystal to one end of the fishing line and tie the other end to a popstick
11. Sit the pop stick across the top of the beaker so that the seed crystal hangs half way down into the solution, wind the line around the pop stick to adjust the depth and use the paper tape to hold it in place
12. Put alfoil over the beaker and pop stick, poke 3 holes in it with the tweezers, to slow down evaporation


Photos

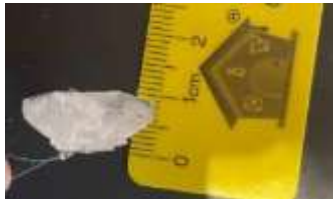









Charlotte - Log Book

Date	Actions and observations	Problems and solutions	
<p>Day 1</p> <p>24/5/24 @ 7:30pm</p>	<p>Completed steps 1-5 in the crystal growing method.</p>	<p>Problem: Not all of the alum dissolved, even with lots of stirring. Solution: Reheated the alum and water solution to 55°C and the alum dissolved more easily.</p>	
<p>Day 2</p> <p>25/5/24 @ 7:00pm</p>	<p>I noticed that crystals are starting to form but are very delicate and small and covering the bottom of the dish. I think I'll dissolve them and start again. I think I'll use a beaker next time so that it's not so shallow.</p>	<p>Problem: lots of small crystals that are all stuck together Solution: heated the solution to 56°C using a microwave and completed steps 4 and 5</p>	
<p>Day 5</p> <p>28/5/24 @ 7.00am</p>	<p>I can see 6-7 seed crystals, but many are stuck together. I will complete steps 1-5 to grow seed crystals again.</p>	<p>Problem: some are joined together and there isn't a good sized seed crystal Solution: grow some more by repeating steps 1-5 again.</p>	

<p>Day 6</p> <p>29/5/24 @ 5.00pm</p>	<p>Completed steps 1-5 in the crystal growing method.</p>	<p>Problem: Mum microwaved the water too long Solution: I waited for it to cool down 2°C</p>	
<p>Day 12</p> <p>4/6/24 @ 5.00pm</p>	<p>Today I kept the 2 best seed crystals that are both just under 1cm. They are pretty clear, but not perfect. I hope they will smooth out a bit when they grow bigger. I completed steps 6- 12 to grow my crystal. I covered it with alfoil, put small holes in it and placed it in a dark, quiet cupboard. [crystal A]. I then repeated this but left it on a bench in a busy, noisy and light part of our house. [crystal B].</p>	<p>Problem: I couldn't tie the crystal on the fishing line and get it at the right depth in the solution Solution; my mum helped me tie the fishing line to the crystal and hang it Problem: I couldn't get the seed crystal out of the solution with the tweezers easily and I damaged one Solution; I used a teaspoon</p>	

	Crystal A (seed 1):	Crystal B (seed 2):	Problems and solutions	
<p>Day 18</p> <p>10/6/24 @ 4.00pm</p>	<p>Crystal A looks like it has grown slightly, and it was not very clear and shaped like a square.</p>	<p>Crystal B doesn't look like it's grown that much. It's pretty clear and shaped like a diamond but with more curved points. little crystals are at the bottom.</p>	<p>Problem: micro crystals are starting to form at the bottom of the beaker Solution: we waited to see what would happen next.</p>	

<p>Day 23 15/6/24 @ 5.00pm</p>	<p>Crystal A has grown some more but looks a bit cloudier because the inside is turning white with a bit of fog to it.</p>	<p>Crystal B doesn't look like it has grown at all as it is the same as day 6. I'm wondering if the little tiny crystals are having something to do with it.</p>	<p>Nothing</p>	
<p>Day 28 20/6/24 @ 7.15pm</p>	<p>Crystal A is looking big and in good shape, it looks very rectangular but it's cloudy and hard to see through</p>	<p>Crystal B has disappeared and there is weird blobby stuff as well as all of the little tiny crystals in the bottom of the beaker. I'm starting this crystal again.</p>	<p>Problem: WHERE HAS CRYSTAL B GONE! Solution: I completed steps 1-5 from day one to make a new seed crystal.</p>	
<p>Day 33 25/6/24 @ 6.30pm</p>	<p>Crystal A is even bigger but is very cloudy and I cannot see through anymore.</p>	<p>I repeated the steps from day 6 and hung the crystal in solution on a fishing wire and put it on the same bench as before.</p>	<p>Problem: I couldn't tie the crystal on the fishing line again or get it at the right depth in the solution Solution; my mum helped me tie the fishing line to the crystal and hang it</p>	
<p>Day 38 30/6/24 @ 2:00pm</p>	<p>Crystal A is over 2cm in length now and around 1cm tall.</p>	<p>The seed crystal has disappeared and there are lots of little crystals in the bottom of the beaker. this warm, light and busy environment may not be good for crystal growing.</p>	<p>Problem: CRYSTAL B HAS GONE AGAIN!! Solution: I completed steps 1-5 from day one to make new seed crystals.</p>	
<p>Day 43 5/7/24 @ 6:00pm</p>	<p>Crystal A is approx. 2,5cm long. 1.4cm wide and 1.4cm tall. But it is really cloudy so not very good. I'm going to grow another to see if I can improve my method and outcome, I grew lots of good seed crystals this time.</p>	<p>The seeds are looking good, I'll do steps 6-12 tomorrow.</p>	<p>Problem: My experiment really ended when I discovered crystal B was gone, again. Solution: I want to see how good a crystal I can grow with an accurate method and the right conditions (dark, still etc), so I will grow 2 crystals but put both in a dark cupboard (in different cupboards).</p>	

<p>Day 44 6/7/24 @ 800pm</p>	<p>I repeated the steps 6-12, and my mum helped me hang the crystal in solution on a fishing wire and put it on the same bench as before</p>	<p>I repeated the steps 6-12, and my mum helped me hang the crystal in solution on a fishing line and put it on the same bench as before</p>	<p>Problem: I had trouble tying the crystal on the fishing line again to get it at the right depth in the solution Solution: mum helped me tie and hang the crystal</p>	
<p>Day 49 11/7/24 @ 800pm</p>	<p>Crystal A is looking good and has grown, except it has a white middle again.</p>	<p>Crystal B has disappeared! I think the solution may have been a little warm when I put the seed crystal in there because I was in a rush.</p>	<p>Problem: Crystal B has disappeared, which I didn't expect. Solution: Complete steps 6-12 using a seed crystal I saved</p> 	
<p>Day 55 17/7/24 @ 7.00pm</p>	<p>Crystal A has grown to around 2cm wide and 2cm tall. It is shiny and has nice straight edges, it is just white in the middle and not as clear as I hoped. There is some of the white sludgy, fluffy stuff growing so there must be some contamination in the solution.</p>	<p>The new Crystal B is nice and clear and shiny. It has straight edges and is reflecting the light into rainbows. It is approx. 1.5cm wide and almost the same in height. I hope it keeps growing over the next few weeks.</p>	<p>Crystal A</p> 	<p>Crystal B</p> 

Conclusion

This experiment had a lot of trial and error, it took many tries to get good seed crystals, which I think was due to having the right amount of alum and the right temperature of the water. I'm not sure that the digital scales I used were very accurate which might have affected this. I think that crystal B kept disappearing because it was on top of a bench in our loungeroom, which is noisy, busy and has the heater going on and off all the time. I think that the days we used the heater a lot might have heated up the solution for a long time and dissolved the crystal. I think my hypothesis was sort of correct, because Crystal B grew a little bit each time before it disappeared. But it was mainly incorrect, because the crystal disappeared each time.

I'm glad I tried to grow more crystals at the end, and try to not let the crystal disappear. Overall, I think that the experiment was good because I learnt a lot about growing crystals and the conditions that grow them the best, and I learnt a lot about experiments. I also learnt what the shape is called that my first seed crystals started as (triangles with the corners round), I looked it up and it's called a truncated triangle. If I did the experiment again, I would probably test the room temperature and try and work out which room temperature is best for growing crystals, because I think it was a major problem for my crystal B.

Acknowledgement of help & Resources

My mum helped me set up my table for my logbook and helped to add the photos. She heated up the water in the microwave for me, checked my measurements (weight of alum, temperature of solution, size of crystal) and hung the seed crystals on the fishing line. She also asked me questions to help me with my thinking and to give more detail. Thank you to Jane Allen, Science Teacher, Linden Park Primary School, for loaning me the beakers, scales, petri dishes and extra alum.

University at Buffalo (2018) How to grow seed crystals. Available at: https://youtu.be/_0F0I3XKiOY (accessed 24/5/2024)

Benedict Research Labs (2014) How to grow crystals. Available at: <https://youtu.be/NfbbrZcUMCM> (accessed 24/5/2024)

Royal Australian Chemical Institute's crystal growing instructions for the Crystal Growing Competition.

Selina - Crystal Project - Log Book

Hypothesis:

If you keep the temperature, light, evaporation, sound, and how the crystal moves just right, the crystal will grow faster. This is because crystals like to grow in special places like caves where these things are controlled. Also, if you make the Alum solution extra strong, it will help the crystal grow better.

Materials used:

- Aluminium Potassium Sulphate Dodecahydrate (Alum)
- Distilled water
- Tweezers
- Thermometer
- Measuring jug
- Filter paper
- 15 cm ruler
- Digital scale
- Teat pipette
- Metal spoon
- Beaker
- Fishing line
- Support stick
- Heat mat
- Large jug





Part A: Method: Growing a Seed Crystal



1. **Make Solution:** Boil 19g of Alum in 50ml of distilled water until it mostly dissolves.
2. **Let It Sit:** Pour the solution into a jug and leave it alone overnight. Seed crystals will start to form as the water evaporates.
3. **Pick Crystals:** Use a magnifying glass to find the best seed crystal. Choose one that's clear and has nice edges, not a bunch of tiny crystals stuck together.

Part B: Method: Growing the Crystal


1. **Prepare Seed Crystal:** Carefully move the seed crystal to a clean surface with tweezers. Tie it to a piece of fine nylon fishing line, being careful not to touch it.
2. **Make New Solution:** Mix another Alum solution in a clean, small beaker.
3. **Hang Crystal:** Tie the other end of the string to a stick and put the stick across the top of the beaker. Hang the crystal in the middle of the liquid without touching the sides.
4. **Cover It:** Put a piece of kitchen paper over the beaker to keep out dust. Put the beaker somewhere safe.
5. **Check Daily:** Look at the crystal every day. If there's any junk on it, clean it off by scraping and melting.
6. **Finish Up:** When the crystal is fully grown, take it out, let it dry on kitchen paper, and cut the string.

Part A: Method: Growing a Seed Crystal Logbook



Day	Steps	Thoughts/extra steps	Images
1	<ul style="list-style-type: none">• Measured distilled water (50ml)• Weighed Alum (19g)• Poured distilled water into a measuring jug and placed it inside a larger jug filled halfway with boiling water (temperature was approximately 50 degrees)• Took the measuring jug out, (temperature was roughly 35 degrees)• Started the process of carefully filtering the solution. Once complete, the crystals were covered with paper• Placed a box over the experiment• Let the crystals sit	<ul style="list-style-type: none">• It took a while for the crystals to dissolve, but eventually most particles were dissolved after roughly 30 minutes• I covered the crystals with a box to eliminate any external factors (the variables that can potentially affect my experiment such as, dust and airflow)	  <p data-bbox="1480 576 1980 608">Measuring Alum and distilled water</p>   <p data-bbox="1480 919 2107 951">Measuring temperature and covering the jar</p>



Day	Steps	Thoughts/extra steps	Images
5	<ul style="list-style-type: none"> • Drained the “seed crystals” into a small beaker • Placed the crystals on a plate to sort out, then selected the clearest and largest. (9 of the crystals were selected and set aside in a small bowl) • Water was warmed to 50 degrees. The remaining crystals were gradually melted. • The crystals were strained into a beaker, which filtered out any leftover crystal particles. • Tape was used to mark the waterline on the beaker • Once the water cooled down to room temperature, the nine crystals were placed back into the water to grow • Placed box over beaker • Let the crystals sit 	<ul style="list-style-type: none"> • There seemed to be at least 70 crystals. Most of the crystals appeared white and crumbly • This produced a crystal water solution, which could help grow the crystals faster • By marking the waterline, I can see when the water evaporates 	<p data-bbox="1576 169 1809 201">Draining crystals</p>  <p data-bbox="1576 659 2018 691">Picking clearest/largest crystals</p> 



Day	Steps	Thoughts/extra steps	Images
6	<ul style="list-style-type: none"> • Examined crystals while they were inside the jar • Placed a box over the experiment and let the crystals sit 	<ul style="list-style-type: none"> • From my view, the crystals appeared to be more rounded than yesterday, but the size was still relatively the same 	
7	<ul style="list-style-type: none"> • Crystals were removed from the jar with a spoon to be placed on a paper towel • Crystals were carefully dried • Observed crystals through magnifying glass • Placed crystals in a container for safekeeping • Covered distilled water with a paper towel to prevent contamination, then set it aside in a box 	<ul style="list-style-type: none"> • It looked like most crystals had turned almost fully transparent 	



Day	Steps	Thoughts/extra steps	Images
8	<ul style="list-style-type: none"> • Observed the crystals through a magnifying glass • Disposed of deformed crystals by melting them, leaving 5 regular crystals. • Crystal solution was strained into the beaker • Placed the crystals back into the container 	<ul style="list-style-type: none"> • <i>The crystals are in the same state as the day before (as I planned)</i> • <i>With a closer look at the crystals, I discovered some of the crystals were two smaller crystals stuck together</i> • <i>If had kept the irregular crystals, they would have grown to be deformed</i> 	
9	<ul style="list-style-type: none"> • With tweezers, 3 of the largest crystals were picked from the selection of 5 crystals • Chosen crystals were observed through a magnifying glass 	<ul style="list-style-type: none"> • <i>They appeared to be more rounded rather than pointy. I suspect that the largest crystal is two smaller crystals merged, but I am unsure for certain</i> 	<p data-bbox="1473 762 1765 794">- 3 selected crystals</p> 



Part B: Method: Growing the Crystal Logbook



Day	Steps	Thoughts/extra steps	Images
9 (partB)	<ul style="list-style-type: none"> • Each of the crystals were tied to a fishing line using a slip knot • Carefully tied the crystals hanging on the string to a supporting stick (a paintbrush) • Placed stick horizontal to the brim of the beaker with the crystals dangling down inside • Used a 15 cm ruler to measure the length of each crystal. (On average they were 5mm) 	<ul style="list-style-type: none"> • I found this part quite tricky to do with tweezers, so I used my hands to tie the knot. The crystals remained unharmed by contamination, since I wore gloves 	
10	<ul style="list-style-type: none"> • Brushed the excess crystal sediment off of the crystals. Afterwards, they appeared normal • The largest crystal was measured after being dusted off. • Placed the crystals back into the beaker and let them sit 	<ul style="list-style-type: none"> • <i>The crystals seemed to be forming rapidly, resulting in extra crystal growth up the string</i> • <i>I found it hard to remove the sediment from the crystals, because I aiming to avoid any potential damage towards the true crystal, and it was hard to see the difference between the crystal and the crystal particles</i> • <i>The crystal was slightly smaller (8mm), which I expected</i> 	<p>- Extra crystal growth</p>  <p>- *8mm crystal*</p> 

Day	Steps	Thoughts/extra steps	Images
11	<ul style="list-style-type: none"> • The fallen crystals were removed from the bottom of the jar, as well as the fishing line they were attached to • Let the crystal sit 	<ul style="list-style-type: none"> • Unfortunately, I found 2 of the crystals have fallen off the sting, luckily there was 1 to spare • In regards to the remaining crystal, think it is noticeably larger and pointier than yesterday (1 cm) 	<p>- Larger and pointier 1 cm crystal</p> 
14	<ul style="list-style-type: none"> • Observed crystals through the beaker • Removed crystal from the beaker • Measured the crystal • Let the crystal sit 	<ul style="list-style-type: none"> • When viewed, the crystal looks the same in size, but when I measured it, the crystal had grown a millimetre (making it 1.1 cm) 	<p>- 1.1 cm crystal</p> 

Day	Steps	Thoughts/extra steps	Images
16	<ul style="list-style-type: none"> • Observed crystals through the beaker • Removed crystal from the beaker • Measured the crystal • Let the crystal sit 	<ul style="list-style-type: none"> • Crystals look slightly larger (1.5 cm) 	<p data-bbox="1579 167 1803 199">- 1.5 cm crystal</p> 
19	<ul style="list-style-type: none"> • Observed crystals through the beaker • Remelted sediment from the bottom of the jar • Marked waterline with tape • Let the crystals sit 	<ul style="list-style-type: none"> • The crystal looks quite pointy, but not much larger 	
21	<ul style="list-style-type: none"> • No observed changes to the crystals form • The bottom of the jar had a bit of residue, so it was removed. 		

Day	Steps	Thoughts/extra steps	Images
24	<ul style="list-style-type: none"> • Observed crystals through the beaker • Removed crystal from the beaker • Measured the crystal • Let the crystal sit 	<ul style="list-style-type: none"> • It was unclear that the crystal had grown in plain perspective, but when measuring it, I found it had grown a millimetre (making the crystal now 1.6 cm) 	<p style="text-align: center;">1.6 cm crystal</p> 
27	<ul style="list-style-type: none"> • No observed changes to the crystals form • The bottom of the jar had a bit of residue, so it was removed. 		
30	<ul style="list-style-type: none"> • Observed crystals through the beaker • Removed crystal from the beaker • Measured the crystal • Placed crystal back into the beaker and 	<ul style="list-style-type: none"> • It was clear to me that the crystal had grown. When measured, I found it had grown 4 mm (making the crystal 2 cm) • I noticed that the water-level in the beaker has dropped by 7 mm. 	<p style="text-align: center;">2 cm crystal</p> 

Day	Steps	Thoughts/extra steps	Images
43	<ul style="list-style-type: none"> No observed changes to the crystals form The bottom of the jar had a bit of residue, so it was removed. 		
50	<ul style="list-style-type: none"> Observed crystals through the beaker Removed crystal from the beaker Measured the crystal Weighed the crystal (14g) Placed crystal back into the beaker and covered with a box 	<ul style="list-style-type: none"> The crystal has grown to become quite large (3 cm) I noticed again that the water-level in the beaker has dropped, this time by 8mm 	 <p data-bbox="1585 667 1823 699">3 cm, 14g crystal</p>
51	<ul style="list-style-type: none"> Observed crystals through the beaker Removed crystal from the beaker and cut the string Heated the crystal-water in the beaker, along with a significant amount of additional water. Cautiously placed the crystal in the beaker Let the crystal sit at the bottom of the jar in the warm water 	<ul style="list-style-type: none"> The crystal was foggy in the middle but clear outside. I think it got contaminated when I handled it, and adding more water may have made the outer layers clearer. I accidentally dropped the crystal, and it cracked. Even after adding water, the level was still below the previous mark. It was tricky because I had just cut off the string. 	<p data-bbox="1787 807 2007 839">Cracked Crystal</p> 

Day	Steps	Thoughts/extra steps	Images
52	<ul style="list-style-type: none"> Observed crystals through the beaker Let the crystal sit 	<ul style="list-style-type: none"> It is quite shocking to me how much the crystal has decreased in size. I plan to shrink the crystal, allowing it to re-assemble and eventually grow again I estimate the crystal is 2 cm (1 cm less than yesterday) 	<p>2.5 cm crystal</p> 
53	<ul style="list-style-type: none"> Observed crystal through the beaker Let the crystal sit 	<ul style="list-style-type: none"> The crystal does not appear to be any smaller or larger than the previous day. The crack has slightly merged together. The crystal has begun to form irregularly; sides are uneven 	
54	<ul style="list-style-type: none"> Observed crystal through the beaker Ended experiment due to the water level being lower than the crystal, resulting in improper growth. 	<ul style="list-style-type: none"> The sides of the crystal are not perfectly flat; more so bumpy. The edges are not defined. 	

Conclusion:

In this experiment, I wanted to find out the best way to grow big, clear crystals. I thought using a really strong Alum solution would work, but I was wrong. Too many crystals grew too quickly and started fighting for space. I found that using less heat and more distilled water worked better. Light and noise didn't seem to matter, and covering the container didn't stop evaporation. In the end, leaving the solution uncovered and letting it evaporate at room temperature helped the crystals grow the best. So, crystals grow best when they're left alone, just like in caves.

Acknowledgments

My sister helped me with my logbook and taking photos of my experiment. My dad helped with the experiment by heating the water and putting the crystal on the fishing line. He also asked me questions to help me think of more details. Thanks to my team members for their help and suggestions.


Resources used:

- **Science Buddies** (2020) *How to Grow Crystals*. Available at: Science Buddies (accessed 24/5/2024)
- **National Geographic** (2019) *How to Grow Crystals at Home*. Available at: [National Geographic](#) (accessed 24/5/2024)
- **The Royal Society of Chemistry** (2021) *Crystal Growing Guide*. Available at: RSC (accessed 25/5/2024)
- **Khan Academy** (2022) *Crystal Growth and Structure*. Available at: [Khan Academy](#) (accessed 25/5/2024)




Bethany Crystal Investigation




Hypothesis








A crystal grown in a dark quiet space will grow clearer and have sharper edges with greater clarity than a crystal grown in a lit, noisy space which will grow cloudy and might not have sharp edges with clarity.




Materials and apparatus used	Method	Photos
<p>Aluminium Potassium Sulphate Dodecahydrate (Alum) Distilled water Digital Callipers Digital Thermometer Measuring jug Flat shallow glass dish with glass lid Filter paper Steel rule Funnel Digital Scale Pipette Metal spoon Beaker Stainless steel saucepan Fishing line Glass jars Ice cream sticks Torch</p>	<p>Method for growing seed crystals</p> <ol style="list-style-type: none"> 1. Clean and layout apparatus and materials 2. Weigh 29g of alum with scales 3. Measure 100ml of distilled water in glass measuring beaker 4. Heat water in stainless pot on stovetop to 42°C. 5. Pour alum salt into water while stirring and heating solution until it reaches 50°C. 6. Check to see that salt had just disappeared. Stop the heating and quickly filter solution quickly into a clean beaker. 7. Pour filtered liquid into a large flat glass dish and cover with the glass lid. 8. Carefully place dish in eski in a quiet room and close lid. <p>Method for growing crystals</p> <ol style="list-style-type: none"> 9. Select suitable seed crystal 10. Carefully tie fishing line to seed crystal with enough length to tie to ice cream stick 11. Repeat steps 2-6 above and allow to cool to room temperature checking with digital thermometer. 12. Pour cooled solution into labelled jar. 13. Carefully lower crystal on line into solution to mid depth and sit ice cream stick flat across opening of jar and tie the other end of fishing line securely. 14. Cover carefully with cling wrap allowing air gaps as needed. 	




Bethany - Log Book





Date	Actions and observations	Photos
25/05/2024 Day 1 10.49pm	<p>Measured 100ml of distilled water in glass beaker and heat water in stainless pot on stove to 42°C. Weighed 29g of alum salt and poured it into water while stirring and heating until it reached 50°C.</p> <p>When all the salt had disappeared, we filtered the warm solution quickly into a clean glass beaker and then poured it into a large flat glass dish and covered it with the glass lid. I then carefully put the dish in an eski in a quiet room and closed the lid. We let the seed crystals grow and check if any grew by the next day.</p>	
26/05/2024 Day 2 8:23pm	<p>I checked the seed crystal dish and found that about 50 crystals had formed. I left the seed crystals to grow for another day so that the water has fully evaporated.</p>	
27/05/2024 Day 3 8:41pm	<p>Some seed crystals were clumped together. The crystals don't look like they have grown much more. There are a couple of small crystals with good clarity and sharp edges which I will harvest tomorrow.</p>	




<p>28/05/2024 Day 4 8:15pm</p>	<p>I selected four of the best seed crystals for clarity and form and measured them against a steel rule and labelled them A, B, C and D. I tied each crystal with 0.34mm diameter fishing line attached to an ice cream stick and placed each crystal into separate jars.</p>	
<p>29/05/2024 Day 5 9:00pm</p>	<p>Tied the last seed crystal onto the fishing line and selected two crystals to be grown. I used 700ml of distilled water to dissolve 45g in total of seed crystals with extra alum salt added. Waited for the solution to cool down to room temperature and poured 200ml of filtered alum solution into labelled jars.</p>	
<p>30/05/2024 Day 6 9:30pm</p>	<p>I boiled off the excess water from the 700ml of alum solution until there was about 200ml of solution left.</p>	


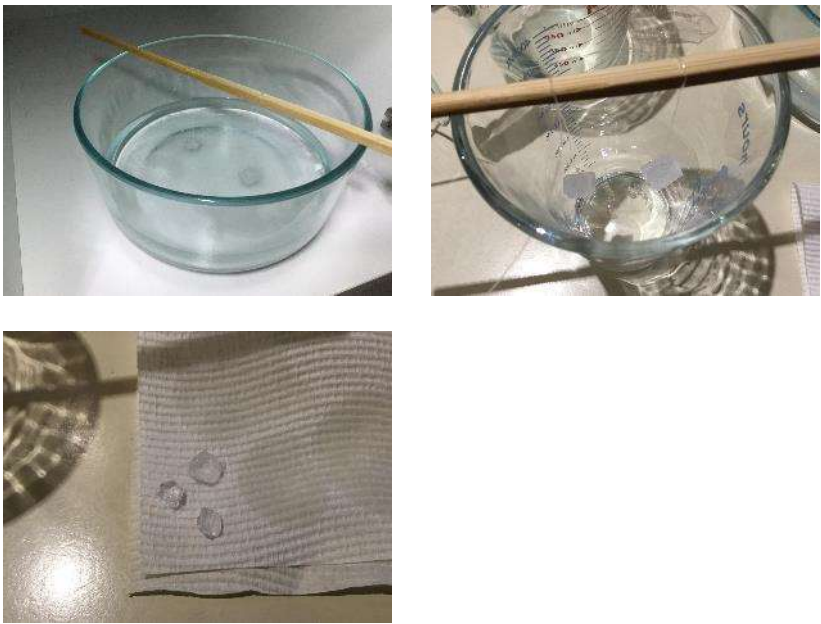
<p>1/06/2024 Day 7 8:26pm</p>	<p>I removed the liquid from the flat dish and reweighed remaining crystals to be about 40g of wet alum crystals. With 100ml distilled water at 40°C, 39g of alum dissolved with few small crystals remaining. Filtered solution into glass beaker. When left to cool to room temperature fine crystals appeared at bottom of glass beaker. With 200ml of solution, 38g of alum all dissolved at 52°C. I let the solution cool to room temperature in the warm pot rather than pouring it straight into cold beaker. Then prepared 4 seed crystals by tying another 2 crystals onto fishing line and placed them in labelled jars.</p>	
<p>3/06/2024 Day 8 8:30pm</p>	<p>Fine and small to medium crystals with good clarity formed. I removed some more good seed crystals. Heated solution to 40°C to redissolve remaining crystals. They didn't dissolve fully, so added an additional 10ml of distilled water. Still not dissolved after stirring for a while so I added another 10ml of water. Added another 3ml of water and crystals finally dissolved at 42°C. Total water added was 23ml. Filtered the solution into warm measuring jug and recovered 150ml of solution slightly cloudy. Left the solution to cool to room temperature. I used the worst seed crystal to test if the solution was saturated enough and to see how well the seed crystal would grow in the solution at 20°C.</p>	 
<p>4/06/2024 Day 9 3:53pm</p>	<p>The seed crystal had grown with some small crystals growing on it and along the line. I decided to remove the test crystal from its solution and use it to grow the first good seed crystal. The solution was filtered into jar A. Covered the top of the jar with cling wrap allowing a few air gaps and placed inside an eski at 9:50pm.</p>	   


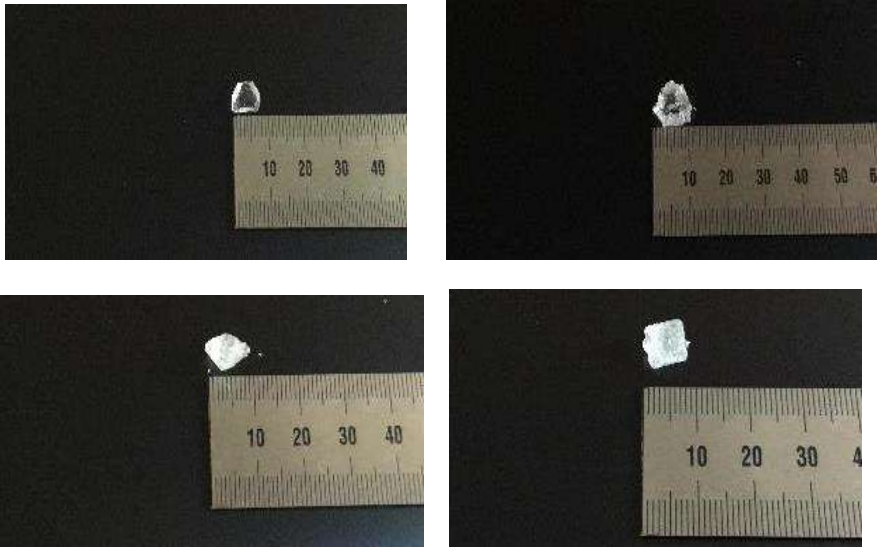

<p>5/06/2024 Day 10</p> <p>3:58pm</p>	<p>Prepared more alum solution by collecting remaining crystals totalling 21g and placed in saucepan with 100ml of distilled water. Then heated the solution to 40°C while stirring.</p> <p>Checked crystal A but it had not grown much. At room temperature of 16 °C some crystals came out of the solution. I put crystal B in a jar with the filtered solution without any cling wrap to have a faster evaporation rate than jar A.</p>	
<p>6/06/2024 Day 11</p> <p>9:30pm</p>	<p>I checked the crystals for any growth. They didn't appear to have grown.</p>	
<p>7/06/2024 Day 12</p> <p>9:00pm</p>	<p>Checked for growth of both crystals. It appears crystal A has grown a pointier tip. Crystal B looks to have grown sharper and more clear edges.</p>	

<p>8/06/2024 Day 13 9:10pm</p>	<p>I checked the growth of the crystals and found that crystal A has grown slightly larger and crystal B appears to have grown sharper edges and slightly larger.</p>	
<p>9/06/2024 Day 14 10:00pm</p>	<p>Checked the growth of the 2 crystals. Crystal A has grown slightly larger at its tip. Crystal B doesn't seem to have grown much in size, but the edges appear to be sharper and more distinct.</p>	
<p>13/06/2024 Day 18 10:20pm</p>	<p>Unfortunately, crystal A and crystal B have fallen off their fishing line as they had both shrunk in size. Crystal A has almost disappeared and Crystal B was much smaller. There were quite a few fine crystals at the bottom of both jars. Will need to retie the seed crystal and redissolve remaining crystals and make more alum solution.</p>	

<p>10/07/2024 Day 53 9:00pm</p>	<p>With new salt I will make new alum solution. Heated 400ml distilled water in large pyrex dish and dissolved 50g of alum by heating solution to 55°C. All alum dissolved at 54°C in pyrex dish. Placed same dish in cushioned eski to cool to room temperature and allow seed crystals to grow. Will use this new alum solution to grow the test crystal larger and put a couple of seed crystals to grow on the bottom of the dish.</p>		
<p>11/07/2024 Day 54 9:00pm</p>	<p>The solution at room temperature some small crystals appeared on the bottom of the dish. With the help of my dad I put the test crystal and crystal C on the fishing line in the solution on a chopstick. Then placed the open dish in a cool dark cupboard in a bedroom but not in an eski. Will see how well the fishing line crystals grow and how well the crystals on the bottom of the dish will grow.</p>		

<p>14/07/2024 Day 57 6:09pm</p>	<p>The seed crystals have grown slightly larger, and their increased weight made them fall to the bottom of the dish, making small crystals grow on them. There were a large number of small crystals at the bottom of the dish. I removed the seed crystals from the solution to stop them from dissolving in the less concentrated solution. Will redissolve the remaining crystals to create a new solution.</p>	
<p>15/07/2024 Day 58 9:11pm</p>	<p>I reheated the remaining crystals and dissolved all the crystals fully at about 61°C in the same pyrex dish. Then transferred the solution into a slightly smaller glass dish so that there was more height of liquid for the crystals to be suspended in. I placed this dish on the cupboard to allow it to cool to room temperature before placing the crystals back into the solution to grow further.</p>	
<p>16/07/2024 Day 58 5:59pm</p>	<p>Checked the dish and found some large crystals at the bottom of the dish as well as a small amount of growth in the square suspended crystal. I decided to remove the suspended crystals and some of the more perfect seed crystals for growing. Reheated the solution 48°C to redissolve the remaining crystals. Cooled the solution down to room temperature at 18 °C on the kitchen bench. Many fine crystals appeared at the bottom of the dish.</p>	

<p>20/07/2024 Day 62 12:30pm</p>	<p>I removed the dish from the cupboard at 12:30pm and took out the suspended crystals as well as the large seed crystals at the bottom of the dish. They all had grown slightly larger but those at the bottom of the dish grew small crystals on their surfaces.</p> <p>Prepared new solution using 25g new crystals plus crystals from the solution totalling 50g. I heated 400ml of distilled water to 53°C in the large pyrex dish and placed the crystals into the water and they dissolved at 54°C. I let the solution cool down slowly on the stove and then put the dish in the cupboard with solution at 30°C to cool to room temperature before putting crystals back in to regrow.</p> <p>I suspended the two growth crystals in the alum solution at room temperature of 14°C and put two of the crystals back in the bottom of the dish as well as another good seed crystal.</p>	
<p>21/07/2024 Day 63 7:53pm</p>	<p>I checked the crystals in the dish for further growth. They appeared to have grown slightly with one on the fishing line growing a pointier tip. As a lot of small crystals were found on the bottom of the dish, I decided to remove all the crystals from the solution. The clear triangular crystal at the bottom of the dish appeared to have grown larger and remained clear and well formed.</p>	

<p>21/07/2024 Day 63 7:53pm</p>	<p>The final diamond shaped growth crystal was the largest and best shaped crystal grown in stages by suspending on the fishing line. The cube shaped crystal cube shaped crystal was also grown by suspending in the alum solution.</p>	
<p>21/07/2024 Day 63 7:53pm</p>	<p>The seed crystals grown at the bottom of the dish had varied results but did not grow as fast as the suspended ones. They also risked small crystals growing on them.</p>	
<p>21/07/2024 Day 63 7:53pm</p>	<p>This was one of the seed crystals that was well formed with sharp edges and great clarity.</p>	

Conclusion

Growing seed crystals in a large flat dish and placing the dish in a dark quiet environment like an eski or in a cupboard in a quiet room was effective. Large amounts of fine crystals coming out of the solution very early before the seed crystal had grown much, happened often. This was annoying and may be due to the very cold air temperature of the room. This needs to be looked into more.

I found that leaving the seed crystal in the alum solution for too long after most of the alum had come out as fine crystals would cause the seed crystal to dissolve. That is what happened to two of the seed crystals, so I needed to start again with another seed crystal and a grown test crystal. This wasted crystal growing time.

Creating a new alum solution and letting the crystals grow overnight with fine crystals falling into the bottom of the dish seemed to let the crystals grow more without dissolving as much. I did this quite a few times to grow the crystal in chunks. The problem was having at least 2-3 hours for the alum solution to cool to room temperature before putting the crystals in. I experimented with growing the crystals by putting them at the bottom of the dish. This didn't work so well because although they did grow in size, they often had small crystals stick to them.

In summary, it looks possible to grow a large, well formed, clear crystal in a dark and quiet environment. There were many variables to control including; alum solution temperature, alum concentration, air temperature, container size for growing crystal, quality of seed crystal, method of tying seed crystal to line, depth of crystal in the alum solution, care in handling the crystal, purity of the alum and the solution, time needed for crystal to grow, darkness and quietness of the space the crystal is growing in, rate of evaporation and rate of temperature drop.

Problem: Fine crystals deposited at the bottom of the dish before the suspended crystal had a chance to grow much.

Reason: This may have been because the rate of cooling was faster than the rate of evaporation and so the solution couldn't hold as much alum salt which had to come out.

Solution: Try raising the room air temperature to reduce the air-to-solution temperature difference to reduce the rate of temperature drop. This needs to be explored in the future.

Acknowledgments

I wish to acknowledge the help given to me by the following people;

My science teacher Mr Woods who supplied the alum salt. My dad who helped me check the measuring of the weight of salt, volume of water and temperature of solution. Also helped me to heat the solution on the stove safely, tie the fishing line onto the seed crystals and suspend them in the alum solution, and to check my observations and images.

I also acknowledge the use of the following information sources;

Royal Australian Chemical Institute's crystal growing instructions for the Crystal Growing Competition (Email from H. McCarthy on 20 May 2024).

University at Buffalo (2018) How to grow seed crystals. Available at: https://youtu.be/_0F0I3XKiOY (Accessed 20 May 2024)

Benedict Research Labs (2014) How to grow crystals. Available at: <https://youtu.be/NfbbrZcUMCM> (Accessed 20 May 2024).

CONCLUSION

Selina	Charlotte	Bethany
Hypothesis	Hypothesis	Hypothesis
If you keep the temperature, light, evaporation, sound, and how the crystal moves just right, the crystal will grow faster. This is because crystals like to grow in special places like caves where these things are controlled. Also, if you make the Alum solution extra strong, it will help the crystal grow better.	Crystals often grow in caves and you don't see them growing on busy city streets. I think that a crystal can grow in a city-like environment, that is warm, light, noisy and unstable. However, I think a Crystal in a cave-like environment that is dark, cool, quiet and steady will grow much bigger, smoother and clearer.	A crystal grown in a dark quiet space will grow clearer and have sharper edges with greater clarity, while a crystal grown in a lit, noisy space will grow cloudy and less likely to be well formed.
Conclusion	Conclusion	Conclusion
Selina found out that using too much alum in the solution made too many crystals. When she lowered the temperature and used more distilled water, the crystals grew better and were clearer. Things like light and noise didn't really matter, but keeping the crystals in a stable place without any disturbances was super important for them to grow well.	Charlotte found out that getting the right amount of alum and right water temperature were important for growing seed crystals. The living room was too noisy and unstable, with the heater going on and off all the time, which she thought made the crystals dissolve. Even though the crystals grew a bit in warmer conditions, they really needed a stable environment. Charlotte thinks that next time we should focus on keeping the room temperature stable for better results.	Bethany found that growing seed crystals in a big, flat dish in a dark and quiet place worked well. But if the seed crystals were left in the solution too long, they dissolved. The temperature of the alum solution, how strong it was, air temperature, and handling of the crystals all made a big difference in how they grew. Bethany suggested making the room a bit warmer to slow down how fast the solution cooled, which might help the crystals grow better.

GROUP ANALYSIS AND SUMMARY

As a group we had some similar problems that were easier solved together by sharing what worked or didn't work. Some of the challenges were deciding on our hypotheses, tying tiny seed crystals to the fishing line, and figuring out how to control evaporation and temperature. For example, we had trouble balancing how fast the water evaporated and how quickly the temperature dropped. If the water evaporated too quickly, too many tiny crystals would form, but if the temperature wasn't right, the seed crystals would dissolve. We each had to complete the experiment multiple times and in different ways to keep the crystals growing and to get the best balance. Sometimes, small crystals formed too early, making it hard for the main crystal to grow. We had team discussions and tried different solutions on our own and then shared what we found. This saved us time and gave us better results.

Working together, we kept each other motivated, especially when things went wrong. Like, when one of the biggest, nicely formed crystals fell and cracked, and when our crystals kept dissolving and we didn't know why. The team spirit, a little bit of friendly competition, and helping each other out kept us going and made the experiment more fun and successful.

We learned that crystals grow best when they are in a stable place where nothing changes too much. Lower temperatures and more distilled water help make them clearer and bigger. Light and noise don't really matter, but keeping the crystals still and managing the evaporation and room temperature works best. We found out that growing crystals takes a lot of patience and careful control of many things, but it was fun and we learned a lot!