

Crystal Growing Home Lab (crystal = 50 pts, journal = 30 pts)

Name: _____

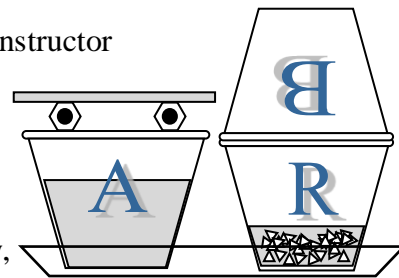
When a salt solution is allowed to evaporate, it is important to realize that it is only the water (solvent) that is evaporating; the salt (solute) is left behind. So, what would happen if some of the water in a saturated salt solution is allowed to evaporate?

Materials:

20 g of “alum” [AKA: potassium aluminum sulfate: $KAl(SO_4)_2$] obtained from the instructor

3 clear plastic cups -- clear, clean and preferably wide mouth (SOLO brand work well*) water -- tap water works OK, distilled* is even better two pencils, a piece of cardboard or stiff paper, and a plastic spoon

*available at supermarkets



Procedure: This lab project will take 8-10 WEEKS to complete. Start it immediately, however, to get the best results, and then spend 4-5 minutes each day (or every other day) attending to the project. **KEEP A JOURNAL.** Start this journal on GoogleDocs the same day you start your crystal. Include a good photo of your set-up. See below for more information on what goes in the journal.

1. Day 1 – Pick a spot for this project. Use a place that won’t get disturbed by people or pets. And pick a part of the house that maintains a fairly constant temperature. (So... a windowsill is a bad idea!) Tell everyone in the house about the project so it doesn’t get thrown away. Also, make signs like “DO NOT DISTURB.”

Set up: Place a large plate down to put the cups on. Label your three cups **R**, **A** and **B**. Place your entire sample of alum in cup **R**, and add 120 mL ($\frac{1}{2}$ cup) of warm water. **DO NOT USE MORE THAN 120 mL.** Stir continuously for 3-4 minutes to try to saturate the solution. (It’s OK if you still have some undissolved alum at the bottom of the cup.) Let the solution settle and cool for 2-3 hours (or overnight!). Then decant* about 90% of the solution into cup **A** -- it should appear clean and clear (& dark blue if you have chrom alum mixed in). Place the two pencils across the top of cup **A** and then place the piece of cardboard over the pencils. The cardboard must be larger in size than the mouth of the cup (see Figure above). The cardboard serves as a dust cover. The pencils serve as spacers to keep the cup open and allow for evaporation. Balance cup **B** mouth to mouth on top of cup **R**, to keep dust out of either one.

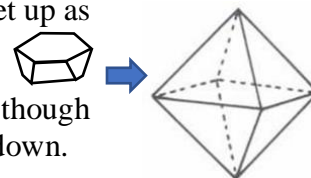
* Decant means to carefully pour off just the liquid, leaving all the undissolved crystals behind.

2. Day 2 – Pick your crystal! Check for crystals on the bottom of cup **A** (if none appear, that’s OK, just check again the following day, if a bunch of tiny ones have appeared looking like sand, then see below). When you finally see crystals, pick one that seems especially clean and crisp. Place cup **B** upright on the table, then use the spoon to carefully transfer the one crystal from **A** to **B**. Then carefully decant the solution into cup **B**. Place the pencils and cardboard over cup **B**, and set aside. Add a few mL ($\frac{1}{2}$ tsp) of water to cup **A**, swirl around and quickly pour into the recovery cup (**R**). If some crystals remain in cup **A**, decant the liquid back from cup **R** into cup **A**, swirl and quickly pour. The idea is to clean the extra crystals out of cup **A** and into the recovery cup using as little additional water as possible. When cup **A** is clean, place it mouth to mouth on top of cup **R** as you did before. The set up should now look like the above figure with two exceptions: **A** and **B** are switched, and there is a small growing crystal in the cup with the solution.

* if the crystals are all too tiny, like sand, just leave them in the bottom, decant about 90% of the cup **A** solution into cup **B**, and then swirl and dump all the tiny crystals and the rest of the solution into cup **R**, making sure to get all the tiny crystals into the **R** cup. Then just leave it set up as above and see if there aren’t some larger crystals in cup **B** the next day.

** Sometimes you might actually see crystals forming at the top of the solution, floating even though they’re more dense. (How is this possible?) If this happens, just use the spoon to knock them down.

Although they will end up as octahedra, the crystals often start off more like flattened hexagons.



3. Days 3 through...: Keep it growing! On each successive day – or every other day – simply use the spoon to transfer the one main crystal from the solution cup (**A** or **B**) into the empty cup (**B** or **A**), then decant the solution onto that crystal, and rinse any extra little crystals back into the recovery cup **R**. Replace the pencils

and dust cover, just as you did above. Repeat this technique each day, just alternating cups **A** and **B** as you go. After several days, the solution level may get a little low. It is important to keep the solution level above the top of the main crystal, so it can continue to grow evenly on all sides. If it starts to get too low, DO NOT ADD WATER TO THE MAIN CRYSTAL CUP (this should be obvious). Instead add some of the saturated solution left in the recovery cup. If there is none, add 10-15 mL of fresh warm water to the crystals in the recovery cup. Stir it well (3 min) to make sure it's saturated, let it settle over-night. The next day, if there are still some undissolved crystals in the recovery cup, it is safe to add this saturated solution into the main crystal cup. If there are no crystals left in your recovery cup, DO NOT ADD this solution to the main crystal cup. It is unsaturated (because you added too much water), and it will dissolve your crystal. Instead, leave this recovery cup open to let the extra water evaporate. When you start to get crystals in your recovery cup, it is safe to add the solution to your main crystal growing cup.

CRYSTAL DUE DATE: _____ **5 bonus points for returning all three cups in good condition!**

On the day the crystal is due to be turned in, whether it is finished growing or not, place it in a plastic bag, then wrap the bag in some tissues and bring it with you to school to turn. Discard any solution, clean out the cups and bring them in with you. You may submit just one octahedral crystal. If you submit a glob of joined together crystals, the instructor will break off the largest one and grade that. Your crystal will be graded for **50 points** based on the following criteria below.

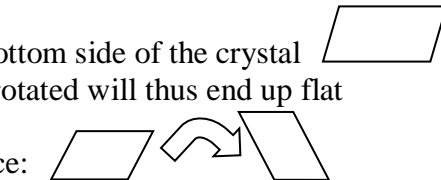
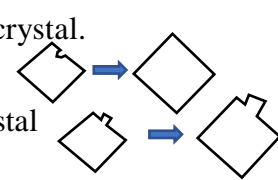
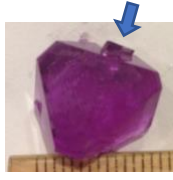
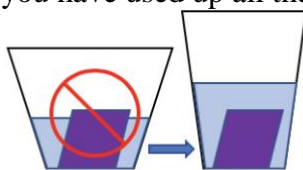
SIZE (Based on how much it weighs) = 20 pts This will simply be you're your crystal's mass (in g) x 2.5. Just to give you an idea: a crystal with an average edge length of 2.1 cm weighs about 8 g and would receive full credit. A crystal which is only 1.5 cm on an edge weighs only about 3 g and would receive only 7.5 out of 20 pts. You will have plenty of time to grow an 8 g crystal, but if it's not growing as fast as you think it should, then you must do some creative problem solving to figure out how to make it grow faster.

PROPORTIONS (Evenly shaped) = 10 pts. This will be the ratio: (smallest height/greatest height) x 10

PRECISION (Sharp edges & vertices) = 10 pts Chips, flat corners, rounded edges will all be deductions.

CLARITY (transparency/no impurities) = 10 pts Can you read these words through your crystal?

Important Crystal growing tips:

- 1) It's a good idea to put the entire set-up (along with the spoon) on a tray or large plate to catch any spills
- 2) Attend to your crystals on a regular basis to be sure no other crystals get too attached to it and to ensure that it is growing evenly.
- 3) Once it gets big enough, rotate your crystal, so that it grows evenly. The bottom side of the crystal touches the cup and therefore does not grow as quickly. A crystal that is not rotated will thus end up flat (as shown at right). To avoid this, once a crystal gets large enough (about the size of a pea) keep rotating it, by always leaving it balanced on its smallest face:
 
- 4) To maintain crystal clarity, wash your hands before and after handling the crystal.
- 5) If any little crystals attach themselves to the main crystals, do your best to brush them off. Nicks will usually repair themselves, but an attached side-crystal that is not removed, will end up as an inclusion, which you do not want.
 

- 6) You may "buy" a second bag of crystals for 5 pts off your grade. You may need to do this if you have to start over, or you may want to do this to add to your R cup to keep growing your crystal and earn bonus points!
- 7) Very important: Once you run out of crystals in the recovery cup, and the solution level drops to a point where the main crystal starts to stick out, then you will want to transfer the crystal into a narrower cup, where the same amount of solution will give you a greater depth (see figures at right). This will give you a few more growing days/weeks(?), and let you take better advantage of the entire amount of alum you were given. In the narrower cup, once the crystal has outgrown the narrowest cup possible (and you have used up all the crystals in your recovery cup), then you have grown as large a crystal as you possibly can. (Congratulations!) Take your award-winning (bonus winning?) crystal out, pat it dry with a paper towel, and place it in a plastic bag to keep the crystal from drying out and getting brittle and keep it in a safe place until the turn in date.
 

Crystal Journal

Start a google doc document, name it as follows: Period #/your last name/Crystal Journal. For example, if you are in period 4 and your name is Jason Brown, your google doc title will be **4/Brown/Crystal Journal**.

USE DATES (like “Feb 17”) not day #'s (like day #12).

On day one, take a photo of your set-up. (This will help me catch any big mistakes!) And explain in the journal what you did and what you observed. Each week thereafter you should have a minimum of:

* Two separate journal entries on different days (no less than 30 words per entry). These entries should include observations, insights, inferences, reflections... humor! Just write what comes to mind as you work on this project. Two entries is the minimal requirement. If you like, do 3 or 4!

* One well-lit, well focused photo showing the crystal with one of its edges along a metric ruler.

Here are some examples of well-done photos: (zoom in to see how easy they are to read!)



AND here are some examples of photos that for a variety of reasons are less than adequate



Background is too dark to see crystal	Edge length is not next to ruler. Hard to read	Reflected light off ruler makes it hard to read	Crystal blocking measurement	Ruler needs to be metric!	Not well focused
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At the end of the last journal entry, a graph of side length as a function of time (in days)

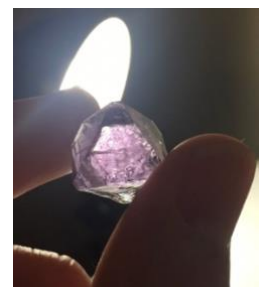
Journal grading rubric below (30 pts)

Only about 1 entry every other week 3 pts	Only about 1 entry per week 5 pts	Two entries per week 7 pts	3-4 entries per week 9 pts
Most entries are redundant/boring 2 pts	Many entries are redundant/boring 4 pts	Most entries are creative/original 6 pts	Every entry is a witty/creative gem 8 pts
Too few photos & poorly taken 2 pts	Too few photos or poorly taken 4 pts	Enough photos, fairly good 6 pts	Enough photos, great quality 8 pts
Graph is sloppy and incomplete 2 pts	Graph is sloppy or incomplete 3 pts	Graph is neat and complete 4 pts	Graph neat complete and well-labeled 5 pts

Examples of well-done journal entries. (Actual student journal entries from two students from 2017)

Feb 27

WOW! Minstrile keeps growing at, in my humble opinion, a very satisfying rate! The longest side has now reached 1.50 cm, with the smallest side now just narrowly trailing behind at 1.35 cm! However, Minstrile is taking the clear out of the phrase “crystal clear” right now. As shown in the photograph at right, there could be another crystal growing inside of it. I don’t know whether this will disappear, but I hope it plans to. It would be unfortunate for this to undermine the rapid growth Minstrile is experiencing.



2/20/17

I transferred Percy to cup A and then added about 10 mL of water to my recovery cup because I am starting to run low on solution. (I have also decided to call Percival Percy from now on, partially because Percival takes longer to say and to type and partially because I very much like the name Percy as a nickname.) I stirred it for approximately three minutes and will check it tomorrow before adding it to the same cup as Percy.

Examples of poorly-done entries. (These are the only two entries this student had for that whole month!)

Day 5:

Crystal has grown in size, one side flat while others are rough

Day 34:

Crystal is growing larger but is a bit misshapen, the crystal is octahedral but a bit bumpy, needs to be smoothed out

Directions for signing up for a Google Acct

1. Sign onto the Internet, and type in <http://docs.google.com>
2. On the right side of the screen, click on **Don't Have a Google Account?**
Create an account now
3. **Fill in your current e-mail address, and choose a password (at least 8 characters).**
 - **Reenter your password in the space provided. * Write down your password in your notes or notebook.**
 - **Type your birthday – (numerically) ex.10/07/1990**
 - **Copy the word verification**
 - **Click on "I accept. Create my account."**
4. **"Account Creation Confirmation" screen will appear**

On this screen, you will see the following message: "In order to verify that the email address associated with your account is correct, we've sent an email to [**your e-mail address**]. Please make sure you click the link provided in the email.

5. **Now go to your e-mail address. You will see the following message:**
accounts-noreply@google.com **Google Email Verification**
Click on the link.

This link will lead you to an e-mail that says:

Welcome to Google Accounts. To activate your account and verify your email address, please click the following link, (which will look something like the following:)

<https://www.google.com/accounts/VE?service=writely&c=CKCUxOHc-LnwlwEQ7bue9PjPs-TAQ&hl=en>

6. You may see this message:
Email already verified
Thank you for verifying your Google account. However, your email has already been verified.

In the right hand side of this screen, you'll click "sign in."

Enter your e-mail address (unless it's already provided), and your password.