



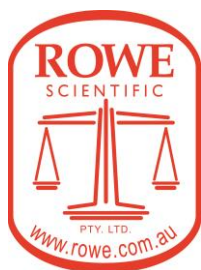
Prize Winner

Crystal Investigation

Year 3-4

Alice Li
Edward Chun Yi Liu

St Andrew's School



SASTA Oliphant Science Award 2023

Environmental Effects
(Temperature and Solution Volume)
on Crystal Size

By

Alice Li & Edward Chun Yi Liu



ID: 0611-021

Category: Crystal Investigation

Year Level: 3-4

Week one

Time and Date: 2:30 pm 30/4/2023 Saturday

Attendant: Edward Liu & Alice Li

Place: Alice's house

1 Background study with Alice's dad

(1) Self learning about the concept of:

"Dissolve" — To make a solution of as mixing with liquid pass into solution.

"Solution" — The process by which a gas, liquid, or solid is dispersed homogeneously in a gas, liquid or solid without chemical change.

"Solubility" — The ability of a substance the solute to form a solution with another substance.

"Saturated solution" — A solution with solute that dissolves until it is unable to dissolve anymore, leaving the undissolved substance at the bottom.

"Precipitation" — The process of transforming a dissolved substance into an insoluble solid from a super saturated solution.



(2) Demonstrated experiments

- Dissolve 39g salt into 100ml boiled water
- Put the solution into the ice-bath until the solution cools down to 0 degree
- Watch the phenomes of this "dissolving-precipitation" progress with changing of temperature
- observation results -

Most of salt got dissolved into the boiled water. When the tempreture of solution dropped down to 0 degree in the ice bath, more salt precipitated at the bottom of the cup.

(3) Study the properties of Alumin Potassium Sulphate.

- Find the solubility at the different tempreture through the link

<https://shop.kremerpigments.com/elements/resources/products/files/64100e.pdf>

Temperature(°C)	0	10	20	40	50	60	70	80
Solubility in 100g water (g)	5.7	8.5	12.0	25	36.8	58.5	94.4	195

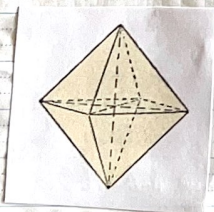
From the result here, it is clear this chemical is sensitive to the change of temperature. Therefore, the saturated solution at 80°C will get more and more solid precipitate with the decreasing of temperature but the increasing of temperature could dissolve more solid.

(b) Crystal Structure

From the link <https://dmishin.github.io/crystals/potassium-alum.html>



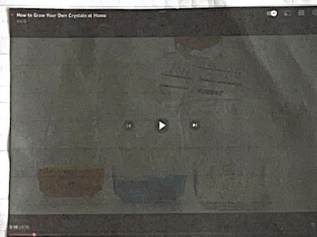
Crystal shape: octahedrons



From the link <https://youtu.be/kKLga-8IMiY>

(4) How to make crystals

Get some idea about crystal making through Youtube video.



Step 1. Making saturated solution

Step 2. Get crystal seeds, hang in the saturated solution

Step 3. wait the crystal growing, add more saturated solution with the evaporation of water.

2. Affected factors on the growth of crystal

- (1) The temperature change
 - Room temperature (floating temperature)
 - Fridge temperature (set up 4°C)
 - small plastic cup
- (2) The size of solution container
 - water glass
 - big water jug

Step 1
make saturated solution
200g chemical + 500 ml
water 70-80°C
well mixed

cool down room temperature 20°C

filter the
saturated solution
to make sure
there are no any
invisible tiny
solid in it

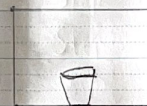
room temperature
Edward's bath room
3
different
size of
container
(Alice's drink fridge)

4- Prepare the items for experiments

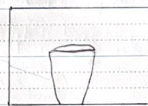
Edward: chemical, water, jugs

Alice: ruler, stick, string, stirring, filter, cups

Dry all little crystals
in a plastic plate
pick up some
shiny ones as crystal
seeds



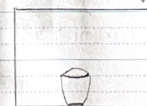
Small



medium



large



Small



medium



large

Week Two

Day one

Time and date: 4:30 pm, Saturday

Attendant: Edward Liu and Alice Li

Place: Alice's house

Content: (1)

(1) Gathering all the experiment items



3 bottles of Aluminium Potassium Sulphate were purchased from Aim Scientific.



Using tea bags as filters



String and sticks for hanging crystal seeds into solution



Scale and ruler used to measure the weight and size



these different cups employed to be solution containers

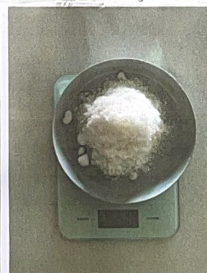


Glass jug for dissolving chemical by water

Plastic bottle to be used as a container of saturated solution

(2) Make Saturated Solution

Measure 200g chemical, and put them big Jug



Heat up 800ml water to 80 degrees, and pour down into the Jug mixing with chemical.



iii. Keep stirring until all chemical dissolve (photo)

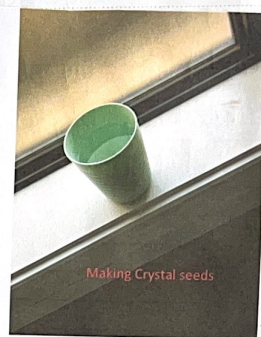
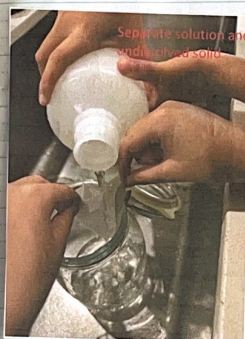


iv. Wait until the temperature of solution drop down the room temperature

v. filter the solution to separate the solid and liquid (photo). Pour the solution into plastic bottle as stock solution

(3) Make the crystal seeds

Pour some saturated solution into the small cup. And leave it at the spare bathroom overnight



Day 2:

Time and date: 3:15 pm, 6/6/2023, Sunday

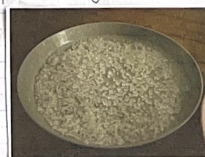
Attendant: Edward Liu and Alice Li

Place: Alice's house

Content:
















(1) Harvest crystal seeds

Take out small crystals from the bottom of small cups. put them into the plastic plate to get themselves air-dried



(2) crystal seeds picking up

with the small crystal seeds dry out, we started to pick up, now and measure some shining and clear crystals. The details of crystal seeds are listed

No.	Name	Size	Photo
1	Crystal	5mm	
2	Saphire	3mm	
3	Chloe	5mm	
4	Kevin	6mm	
5	Lily	5mm	
6	Emma	3mm	
7	Clara	5mm	
8	Apple	6mm	
9	Habbiet	7mm	
10	Ruby	4mm	
11	Robin	8mm	
12	Howard	6mm	
13	Alys	3mm	
14	Edward	5mm	
15	Annie	6mm	

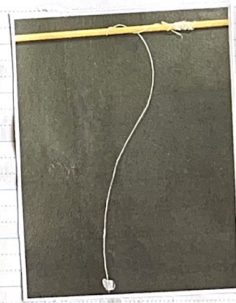
(3) using string to hang crystals in the middle of stick

a) the string we prepared is too thick to tie the tiny crystal seeds, we ungrouped the cotton string into the skinny ones as photo below

b) tie one side of string with the crystal seed and the other side with the stick. And adjust the length of hanging string to make sure all of crystal seeds in the middle of each cup



a)



b)

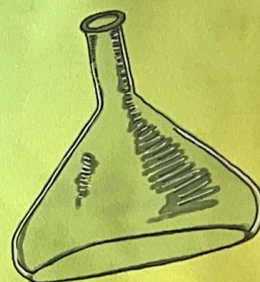
(4) Set up the experiments in the fridge and bathroom
 Hanging the crystals into each water container which contains
 a Saturated solution.
 Make sure the Solution covers the whole crystal
 Seed.

Room Temperature (Bathroom)		Set Temperature 4°C (Fridge)	
Small Plastic Cup	No.5 Lily 5mm	Small Plastic Cup	No.8 Apple 6mm
Medium Glass	No.14 Edward 5mm	Medium Glass	No.12 Howard 6mm
Large Water Jug	No.4 Kevin 6mm	Large Water Jug	No.2 Saphire 3mm



(5) observation plan for the next few weeks

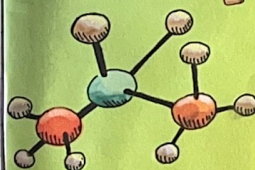
Every day: all experiments need to be checked, to make sure
 the crystal seeds still get fully covered by the solution,
 otherwise the saturated solution needs to be topped up.
 Every week: we need to measure the size of each crystal
 every Sunday for 10 weeks at least and also record
 the experimental progress into our logbook.



OUR
 CRYSTAL
 LOGBOOK!



$i < 3 u$



$$e^{i\pi} + 1 = 0$$

PIC-COLLAGE

Week Three (1st week of crystal growth)

		8/5/23	9/5/23	10/5/23	11/5/23	12/5/23	13/5/23	14/5/23
Fridge Small	Crystal Seed	↑	↑	↑	↑		↑	↑
	Solution	—	—	—	—		—	—
Fridge Medium	Crystal Seed	↑	↑	↑	↑		↑	↑
	Solution	—	—	—	—		—	—
Fridge Large	Crystal Seed	↑	↑	↑	↑		↑	↑
	Solution	—	—	—	—		—	—
Room Small	Crystal Seed	↑	↑	↓				
	Solution	—	—	—				
Room Medium	Crystal Seed	↑	↑	X				
	Solution	—	—	—				
Room Large	Crystal Seed	↑	↑	X				
	Solution	—	—	—				

Fridge: not much changed on the solution. Crystal seeds started to grow and formed into the diamond shape. Some small crystals precipitated at the bottom of each size container.

Room: solution keeps dropping from each jug; slightly bigger on crystal seeds on Monday and Tuesday. Crystal seeds disappeared in the medium and large jug on Wednesday.

not much change on the seed in the small cup. On Sunday we re-made the saturated solution again and picked up other three crystal seeds. Reset the experiments in the bathroom.

+ "add solution"

"Δ" change solution

"—" checked

↑ bigger

↓ smaller

crystal size

Fridge: small: 15 mm

medium: 14 mm

Large: 9 mm

We think properly solution could dissolve crystal seeds since the solution cannot keep saturated anymore with the increasing of the environment temperature.

Room Temperature (Bathroom)	
Small Plastic Cup	No. 1 Crystal 5mm
Medium Glass	No. 6 Emma 6mm
Large Water Jug	No. 7 Clara 5mm

Week four (1st week of room-temperature Sample & 2nd week of Fridge Sample S)

		15/5/23	16/5/23	17/5/23	18/5/23	19/5/23	20/5/23	21/5/23
Fridge Small	Crystal Seed	↑	↑	↑	↑	↑	↑	↑
	Solution	↓	↓	↓	↓	↓	↓	↓
Fridge Medium	Crystal Seed	↑	↑	↑	↑	↑	↑	↑
	Solution	↓	↓	↓	↓	↓	↓	↓
Fridge Large	Crystal Seed	↑	↑	↑	↑	↑	↑	↑
	Solution	↓	↓	↓	↓	↓	↓	↓
Room Small	Crystal Seed	↑	↑	↑	↑	↑	↑	↑
	Solution	↓	↓	*	↓	↓	↓	↓
Room Medium	Crystal Seed	↑	↑	↑	↑	↑	↑	↑
	Solution	↓	↓	*	↓	↓	↓	↓
Room Large	Crystal Seed	↑	↑	↑	↑	↑	↑	↑
	Solution	↓	↓	↓	↓	↓	↓	↓

Fridge: Crystal seeds kept on increasing, and Solution kept losing (size slightly bigger)

Room: Crystal Size increasing much faster than those in the fridge; the shape formed up; and the Solution lost faster as well (Size increased more than the fridge)

Size

Fridge small: 19mm

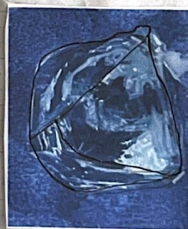
medium: 19mm

large: 14mm

Bathroom small: 13mm

medium: 12mm

large: 15mm



→ Diamond shape

Week five (2nd week of room + Sample & 3rd week of Fridge Samples)

		22/5/23	23/5/23	24/5/23	25/5/23	26/5/23	27/5/23	28/5/23
Fridge Small	Crystal Seed	↑	↑	↑	↑	—	—	—
	Solution	—	—	+	—	—	—	—
Fridge Medium	Crystal Seed	↑	↑	—	—	—	—	—
	Solution	—	—	+	—	—	—	—
Fridge Large	Crystal Seed	↑	↑	↑	↑	↑	↑	↑
	Solution	—	—	—	—	—	+	—
Room Small	Crystal Seed	↑	↑	↑	↑	↑	↑	↑
	Solution	—	+	—	—	—	—	—
Room Medium	Crystal Seed	↑	↑	↑	↑	↑	↑	↑
	Solution	—	+	—	—	—	—	—
Room Large	Crystal Seed	↑	↑	↑	↑	↑	↑	↑
	Solution	—	—	—	+	—	—	—

crystal size

Fridge small: 22 mm

medium: 20 mm

large: 17 mm

Bathroom: small: 21 mm

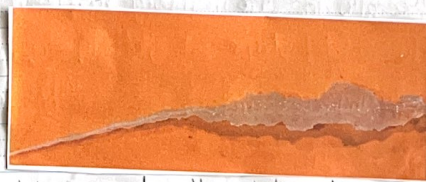
medium: 21 mm

large: 17 mm

Fridge: Top up the Solution to the medium and small cups on Wednesday, Thursday. Some tiny crystal formed up along the string in the medium and small cups. Saturday, top up the large Jug. Sunday, as same, small crystals sitting alone on the string. Also all of the crystals not much change at all.

Room: Top up the Solution for medium and small cups on Tuesday and the big Jug on Thursday. Crystal size increased. Did not see any small crystals along the string after topping up.

Discuss: The temperature dropping too fast of solution after adding into the Jugs in the fridge could be the reason to form the small crystals along the string. put the well-sealed Saturated Solution into the fridge, which will be used only for fridge samples.



Small crystals formed along the string!

week six (3rd week of room + sample 4th week of fridge samples)

		29/5/23	30/5/23	31/5/23	1/6/23	2/6/23	3/6/23	4/6/23
Fridge Small	Crystal Seed	—	—	↑	—	—	—	↑
	Solution	—	↓	—	—	—	↓	—
Fridge Medium	Crystal Seed	—	—	↑	—	—	—	—
	Solution	—	—	↓	—	—	—	—
Fridge Large	Crystal Seed	—	↑	—	—	↑	—	—
	Solution	—	—	—	—	—	—	—
Room Small	Crystal Seed	—	—	↓	—	—	↓	—
	Solution	—	↓	—	—	↓	—	—
Room Medium	Crystal Seed	↑	—	↓	—	—	↓	—
	Solution	↓	—	↓	—	↓	—	—
Room Large	Crystal Seed	↑	—	↓	↓	—	↓	—
	Solution	—	—	↓	—	↓	—	—

size (mm)

Fridge small: 24

medium: 21

large: 18

both room small: 20

medium: 20

large: 16

highest temperature on the day



31/05: 20.4°C

1/06: 18.4°C

2/06: 20°C

3/06: 25.30°C

4/06: 18.8°C

Fridge: Small and Medium Jugs lost a little bit of solution. All three crystals grew a bit, but not much like the last few weeks.

Room: solution from each cups keep getting lost also crystals are getting smaller as well. specially the one in the big jug still can see the crystal shape but getting closer to the starting size properly hot weather caused this happen.

week seven

		5/6/23	6/6/23	7/6/23	8/6/23	9/6/23	10/6/23	11/6/23
Fridge Small	Crystal Seed	—	—	—	—	↑	—	—
	Solution	—	+	—	—	—	—	—
Fridge Medium	Crystal Seed	—	—	—	↑	—	—	—
	Solution	—	+	—	—	—	—	—
Fridge Large	Crystal Seed	—	—	—	—	↑	—	—
	Solution	—	+	—	—	—	—	—
Room Small	Crystal Seed	—	—	—	—	—	—	—
	Solution	—	+	—	—	—	—	—
Room Medium	Crystal Seed	—	—	—	—	—	—	—
	Solution	—	+	—	—	—	—	—
Room Large	Crystal Seed	—	—	—	—	—	—	—
	Solution	—	+	—	—	—	—	—

size cm m?

Fridge small 25

M 22

L 14

bathroom S 20

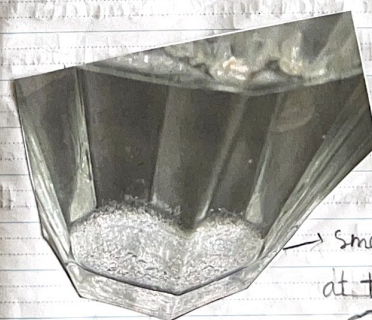
M 20

L 6

Fridge: Add a bit of solution, which was placed in the fridge into each jug. we cannot see many now formed tiny crystals along the string which approved our assumption.

Room: top-up the solution as well but add more than the fridge, since solution evaporates faster. small crystal seeds sank down at the bottom of medium and small jugs. There are not many crystal seeds found in the large one. Crystals are almost kept the same from small and medium jugs,

but slightly increased from the large jug. Filter the solution from small and medium jugs and took those crystal seeds out.



→ small crystal seeds at the bottom of the cup.

Week eight (5th week of room + sample & 6th week of fridge samples)

		12/6/23	13/6/23	14/6/23	15/6/23	16/6/23	17/6/23	18/6/23
Fridge Small	Crystal Seed	—	—	—	—	—	↑	—
	Solution	—	↓	—	—	—	—	—
Fridge Medium	Crystal Seed	—	—	—	—	—	—	—
	Solution	—	—	—	—	—	↓	—
Fridge Large	Crystal Seed	↑	—	—	—	—	—	↑
	Solution	—	—	—	—	—	—	—
Room Small	Crystal Seed	—	—	—	↑	—	—	—
	Solution	—	—	↓	—	—	—	—
Room Medium	Crystal Seed	—	↑	—	—	—	↑	—
	Solution	—	—	↓	—	—	—	—
Room Large	Crystal Seed	—	—	—	—	—	↑	—
	Solution	—	—	↓	—	—	—	✓

size (mm)

Fridge: S 25.5

M 22

L 19.5

Bathroom S 21

M 24

L 7

Fridge: Not much change on the crystals but the Solution kept dropping but the crystals along the string are getting bigger. we are wondering whether those crystals took the chemicals from the Solution rather than the crystal hanging there. Try to take some off from there.

Room: Some crystals formed along the string and sunk down on the bottom again. The amount of Solution decreased, the crystals get slightly bigger.



the crystals are getting bigger on the string.

Week nine (6th week of room + sample and 7th

		19/6/23	20/6/23	21/6/23	22/6/23	23/6/23	24/6/23	25/6/23
Fridge Small	Crystal Seed	—	—	—	—	—	↑	—
	Solution	—	—	—	—	—	—	—
Fridge Medium	Crystal Seed	—	—	—	—	—	↑	—
	Solution	—	—	—	—	—	—	—
Fridge Large	Crystal Seed	—	—	—	—	—	↑	—
	Solution	—	—	—	—	—	—	—
Room Small	Crystal Seed	—	—	—	—	—	—	—
	Solution	—	—	+	—	—	—	—
Room Medium	Crystal Seed	—	↑	—	—	—	↑	—
	Solution	—	—	+	—	—	—	—
Room Large	Crystal Seed	—	—	—	—	—	↑	—
	Solution	—	—	+	—	—	—	—

week of fridge samples)

crystal size (mm)

Fridge Small 27

Medium 22.5

large 20

bath room small 23

Medium 21

large 8

Fridge: Nothing special. No need to add the solution. main crystal slowly increased. other crystals along the string grow fast.

Room: some small crystals along the string came out as well, which is totally different from what we guessed before. Add more solution on wednesday. crystal along the string keep growing.

Week ten (7th week of room-t sample and 8th week of fridge sample)

		26/6/23	27/6/23	28/6/23	29/6/23	30/6/23	1/7/23	2/7/23
Fridge Small	Crystal Seed	—	—	—	—	↑	—	—
	Solution	—	—	+	—	—	—	—
Fridge Medium	Crystal Seed	—	—	—	—	—	↑	—
	Solution	—	—	+	—	—	—	—
Fridge Large	Crystal Seed	—	—	—	—	—	↑	—
	Solution	—	—	+	—	—	—	—
Room Small	Crystal Seed	—	—	—	—	—	—	—
	Solution	—	—	—	—	—	—	—
Room Medium	Crystal Seed	—	↑	—	—	—	↑	—
	Solution	—	—	—	—	—	—	—
Room Large	Crystal Seed	—	↑	—	—	—	—	—
	Solution	—	—	—	—	—	—	—

crystal size (mm)

Fridge s 28

M 23

L 20

Bathroom s 23

m 30

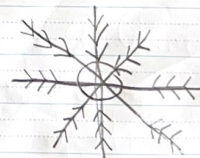
L 9

Room: The size of each crystal got slightly increased. Solution dropped down. Also the new formed crystals along string kept growing and more and more crystal piece at the bottom.

Fridge: In the small cup, white powder precipitates out along the string as well above those small crystal. Not much change can be visualize on all main crystals. Top up a bit solution for each jug.



crystal flakes are at the bottom of the cup!



week eleven (8th week of room-t and 9th week of fridge samples)

		3/7/23	4/7/23	5/7/23	6/7/23	7/7/23	8/7/23	9/7/23
Fridge Small	Crystal Seed	-	-	-	-	-	-	-
	Solution	-	-	-	-	-	-	-
Fridge Medium	Crystal Seed	-	-	-	-	-	-	-
	Solution	-	-	-	-	-	-	-
Fridge Large	Crystal Seed	-	-	-	-	-	-	-
	Solution	-	-	-	-	-	-	-
Room Small	Crystal Seed	-	-	-	-	-	-	-
	Solution	+	-	-	-	-	-	-
Room Medium	Crystal Seed	-	-	-	-	-	-	-
	Solution	+	-	-	-	-	-	-
Room Large	Crystal Seed	-	-	-	-	-	-	-
	Solution	+	-	-	-	-	-	-

Crystal size (mm)

Fridge S 28

M 23

L 20

Bathroom S 25

M 20

L 10

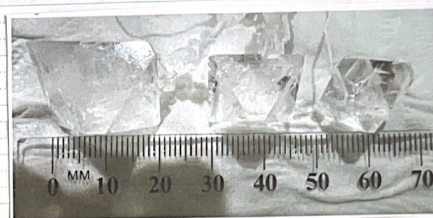
Fridge: Not much changes at all, similar as last week.

Room: Not much size increasing on each crystal

Other things are quite similar. Add a bit more solution into each cup on wednesday

Week Twelve (9th Week of Room-t Sample & 10th Week of fridge samples)

		10/7/23	11/7/23	12/7/23	13/7/23	14/7/23	15/7/23	16/7/23
Fridge Small	Crystal Seed	-	-	-	-	-	-	-
	Solution	-	-	-	-	-	-	-
Fridge Medium	Crystal Seed	-	-	-	-	-	-	-
	Solution	-	-	-	-	-	-	-
Fridge Large	Crystal Seed	-	-	-	-	-	-	-
	Solution	-	-	-	-	-	-	-
Room Small	Crystal Seed	-	-	-	-	-	-	-
	Solution	-	-	-	-	-	-	-
Room Medium	Crystal Seed	-	-	-	-	-	-	-
	Solution	-	-	-	-	-	-	-
Room Large	Crystal Seed	-	-	-	-	-	-	-
	Solution	-	-	-	-	-	-	-



crystal size (mm)

Fridge S 28

M 23

L 20

bathroom S 25

m 30

L 10

Fridge: The last week of crystal growth in the fridge. Seems like nothing changed there. Took all of the crystals out from the solution and used the kitchen Paper towel to dry them after cutting the string off. Wrote the labels for each one in case to mess them up in the future.

Room: Don't know the reason why the three main crystals stopped growing; and those little crystals along the string got bigger. And more and more of the flat crystals flat sunk at the bottom of the Jugs.

Week thirteen (10th week of Room T-Sample)

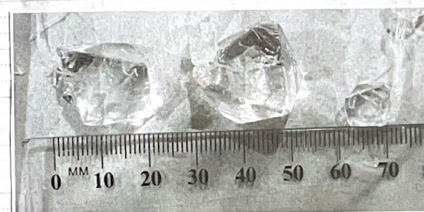
		17/7/23	18/7/23	19/7/23	20/7/23	21/7/23	22/7/23	23/7/23
Fridge Small	Crystal Seed							
	Solution							
Fridge Medium	Crystal Seed							
	Solution							
Fridge Large	Crystal Seed							
	Solution							
Room Small	Crystal Seed	-	-	-	-	-	-	-
	Solution	-	+	-	-	-	-	-
Room Medium	Crystal Seed	-	-	-	-	-	-	-
	Solution	-	+	-	-	-	-	-
Room Large	Crystal Seed	-	-	-	-	-	-	-
	Solution	-	+	-	-	-	-	-

crystal size

bathroom small 20

medium 30

large 10



Room: Topped up a bit of Solution on Tuesday. No major change on crystals. Took all of them out on Sunday, and repeat the same operation as we did for those samples from the fridge last week.

Result and Discussion

1 Temperature

Fridge	Week	starting	1	2	3	4	5	6	7	8	9	10
Crystal size (mm) from different jugs	S	6	15	19	22	24	25	25.5	27	28	28	28
	M	6	14	19	20	21	22	22	22.5	23	23	23
	L	3	9	14	17	18	19	19.5	20	20	20	20

Crystal size from each Jug increased really fast in the first week, although they kept growing until week 8. It is hard to say that the Jug size would affect the final crystal size.

Bathroom	Week	starting	1	2	3	4	5	6	7	8	9	10
Crystal size (mm) from different jugs	S	5	13	21	20	20	21	23	23	25	25	25
	M	6	12	21	20	20	24	27	30	30	30	30
	L	5	15	17	6	6	7	8	9	10	10	10

As same as the samples from the fridge, the crystals grew fast in the first couple weeks but all three crystals got smaller at week 3. From week 5, they started to grow again. After checking the temperature history, we found the environment temperature increased up to 25°C from 31/05-7/6 which caused the solution could dissolve more chemicals. This can be used to explain why the crystal from the big jug got much smaller than the others.

2 water evaporation

The largest crystal we made is from the medium jug located at the bathroom which could suggest the open area should be good for the crystal growing. So we think the water evaporation is the other important factor of the size of the crystal.

3. Container size

The result we got here is hard to approve the container size would affect the final size of crystals under the stable temperature.

4. Others

we can see the crystal flakes at the bottom of each container and other crystals along the string kept getting bigger, which could be reason why many crystals we made stopped growing from week 8. After talking to our parents, we believe that cotton string is not good for this experiment. The cotton string could absorb solution and with

the decreasing of solution levels, crystal seeds come out when the cotton string dries up.

Conclusion

Next time we properly need to use a fishing thread to hang the crystal seeds. And also, we need some ventilation place with stable temperature. If we see some small crystals in the solution we need to change the fresh solution rather than topping it up.