

Q ScienceNet A

Make Your Own Crystal Garden

Many everyday things are made of crystals. Look at some salt through a magnifying glass and you'll see that each grain is the same shape, with straight edges and flat surfaces. This is the shape of a crystal. Can you think of other things that are made up of crystals?

You can grow your own crystals quite easily, and with a bit of experimenting, create your own crystal garden with different crystal shapes and colours.

Here's how to grow crystals from alum, but the method is the same whatever you want to grow crystals from. You can buy alum powder from a chemist's shop and growing the crystal will take about 3 weeks.

Growing your crystal

Pour 600ml (1 pint) of water into a saucepan. Add 100g (4oz) of alum powder. Gently heat the mixture and stir it to dissolve the powder. Then add as much alum powder as you can until no more will dissolve.

Let the mixture cool, then pour some into a saucer and stand it somewhere cool. Pour the rest of the solution into a glass jar.

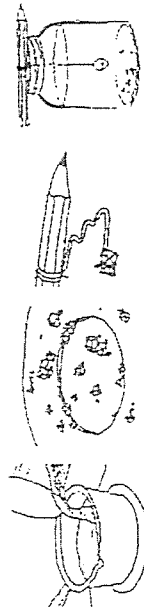
Stir an extra tablespoon of alum into the jar to make a saturated solution. Cover the jar with a cloth.

After a few days, small crystals should start to grow in the saucer. Leave them until all the solution has evaporated then choose the biggest as your seed.

Carefully tie a long thread around the seed crystal and wind the other end around a pencil. Hang the crystal in the solution by balancing the pencil across the jar. Put the jar somewhere warm like the airing cupboard.

The crystal should grow for about two weeks. When it stops growing, take it out of the jar and wrap it in a piece of tissue.

Once you've grown more crystals of different sizes and colours use something other than alum for this - see What Now? for some ideas) you can arrange them in a display.



Something's not working...

Check your crystal everyday to see if it is growing. If it isn't, you probably haven't got a saturated solution and your seed is simply dissolving. Take out the seed crystal, reheat the solution, add more alum and try again.

Or your temperature might not be constant enough or your jar clean enough.

If you don't find seed crystals growing on your saucer, try hanging a piece of thread in the jar. Small crystals should grow on the thread which you can then separate.

What now?

You might like to try growing sugar crystals, copper sulphate crystals, sodium silicate crystals, potassium permanganate crystals or iodine crystals. Use the same method as that for growing alum crystals. Try experimenting with different chemicals - ask your chemist for advice.

Saturated Solutions

When you add a spoonful of sugar to a cup of tea or coffee, you usually stir it to help it dissolve. There are two ways of helping something dissolve in a solution: stirring it and heating it up. But even if you do both of these, there is still a limit to the amount of sugar you can add to your drink. Eventually you'll reach a stage where no more sugar will dissolve no matter what you do: your drink is now saturated.

When you grow crystals, you need a saturated solution or the seed crystal will just dissolve the moment you add it to the solution in the jar. Rather than growing crystals, you'll be dissolving them.

Seed Crystals

The seed crystals are formed as the water in the saucer evaporates. The tiny particles of alum in the solution gradually join together.

The crystal in the jar also keeps growing as the water evaporates. As the solution gets stronger, the alum particles crystallise around the seed crystal.



4: Crystal Growing

Crystals are some of the most beautiful naturally occurring objects. A quartz crystal looks as if the edges have been carved but on closer inspection growth lines can be seen covering the faces. These lines show that the crystal has been formed by the growth of one layer after another across the face. You can grow crystals in the lab using substances such as alum or copper sulphate. There is a limit to the amount of solid (solute) which will dissolve in water. When the solution cannot dissolve any more solute it is said to be a saturated solution. Crystals grow in a saturated solution that is allowed to cool down. Try some out for yourself.

What you will need

sodium chloride	weighing balance
copper sulphate	filter funnels
sodium sulphate	filter paper
potassium chromium sulphate	250cm ³ beakers
(chrome alum)	evaporating basins
iron sulphate	cotton thread
ammonium sulphate	electrical wire (small gauge)
potassium aluminium sulphate (alum)	object to coat in crystals (e.g. a cross)
potassium hexacyanoferrate(III)	stirring rods
forceps	

eye protection
disposable gloves for handling crystals

What you do

SMALL CRYSTALS



eye protection must be worn



wear gloves for handling crystals



HARMFUL
copper sulphate
iron sulphate

1. To make small crystals of different varieties you need to warm 100cm³ of water and add the amounts of solute below. Stir until no more crystals will dissolve.
sodium chloride 33g in 100cm³ water
copper sulphate 30g in 100cm³ water
sodium sulphate 20g in 100cm³ water
potassium aluminium sulphate (alum) 39g in 100cm³ water
2. Pour this saturated solution into a large evaporating basin and leave for several days to crystallise.

GROWING LARGE CRYSTALS FROM SMALL ONES



1. Make a new saturated solution of copper sulphate and allow it to cool down.
2. Place the dish or beaker of new saturated solution in a place where the temperature will vary as little as possible.
3. Using forceps, pick out the best copper sulphate crystal from the evaporating basin.
4. Drop this into the cold saturated solution and leave it for a few days.
5. Using forceps, turn the crystal every day so that it can grow

5. Using forceps, turn the crystal every day so that it can grow equally on all sides.
The secret is to keep the solution in a place which is no warmer by day than by night.
6. An alternative method of growing your crystals is to tie a piece of thread around the starting crystal, then suspend it in the cold saturated solution. Leave in a constant temperature environment. (Alum crystals also grow well using this method).



Use forceps or gloves to handle the crystals.

7. You can grow crystals around a wire shape which can be suspended in the saturated solution. Crystals form best on rough surfaces, so use cotton-covered electrical wire or plain wire wrapped with thread or light string.

UNUSUAL CRYSTALS

1. Dissolve 500g of potassium hexacyanoferrate(III) in 1dm³ of water. Allow this to cool to a manageable temperature and filter the solution while it is still slightly hot.
2. Stand the object you want to coat in crystals in a beaker and pour the filtered solution into this so that it covers the object.
3. Leave to cool. Crystals should start to form after a few hours.

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RECRYSTALLIZATION - AN INTRODUCTION

In recrystallization, one tries to prepare a solution that is supersaturated with respect to the solute (the material you want to crystallize). There are several ways to do this.

One is to heat the *solvent*, dissolve as much *solute* as you can (said to be a "**saturated**" solution at that temperature), and then let it cool. At this point, all the solute remains in solution, which now contains more solute at that temperature than it normally would (and is said to be "**supersaturated**").

This situation is somewhat unstable. If you now suspend a solid material in the solution, the "extra" solute will tend to come out of solution and grow around the solid. Particles of dust can cause this to occur. However this growth will be uncontrolled and should be avoided (thus the recrystallization beaker should be covered). To get controlled growth, a "**seed crystal**", prepared from the solute should be suspended into the solution.

The supersaturation method works when the solute is more soluble in hot solvent than cold. This is usually the case, but there are exceptions. For example, the solubility of table salt (sodium chloride) is about the same whether the water is hot or cold.

The rate at which crystallization occurs will affect crystal quality. The more supersaturated a solution is, the faster growth may be. Usually, the best crystals are the ones that grow SLOWLY.

Thus, if you heated the solvent to near the boiling point to get a highly supersaturated solution on cooling back to room temperature, crystals may start to form before the solution had completely cooled.

This is where the "*art*" of science comes into play. One has to experiment a bit to get the right conditions.

A second way to get supersaturation is to start with a saturated solution and let the solvent evaporate. This will be a slower process.

The above will apply to most situations. It is necessary to match the proper solvent with a given solute.

To see the steps to be followed in recrystallization, [CLICK HERE](#).

WARNING: the solubility of some salts is quite sensitive to temperature, so the temperature of recrystallization should be controlled as best you can. There have been reports in the past of students having a nice big crystal growing in a beaker on a Friday, the room temperature rising in a school over the weekend, and by Monday morning the crystal had totally gone back into solution!

Good luck. :-)

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