



## Crystal Stars (25 minutes)

Please read all of the instructions and take note of the precautions on the back before starting

### Apparatus

500 ml measuring jug  
Kettle  
Wooden spoon  
Jam jar or plastic sample jar (sold at the pharmacist)  
Pipe cleaners  
Teaspoon  
Rubber Gloves

### Ingredients

Food colouring  
Borax cleaning powder  
Water

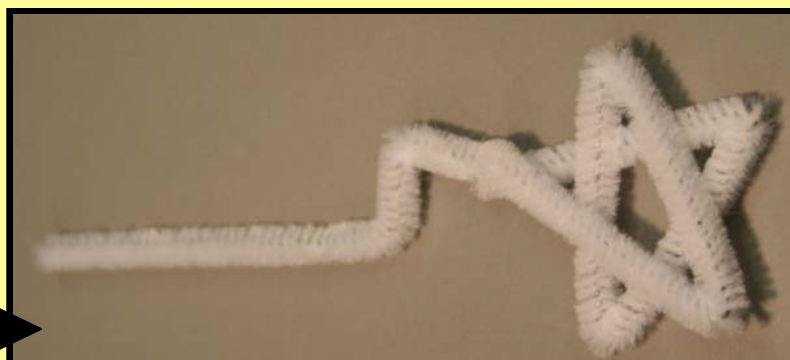
### Making a borax solution

Boil a kettle full of water

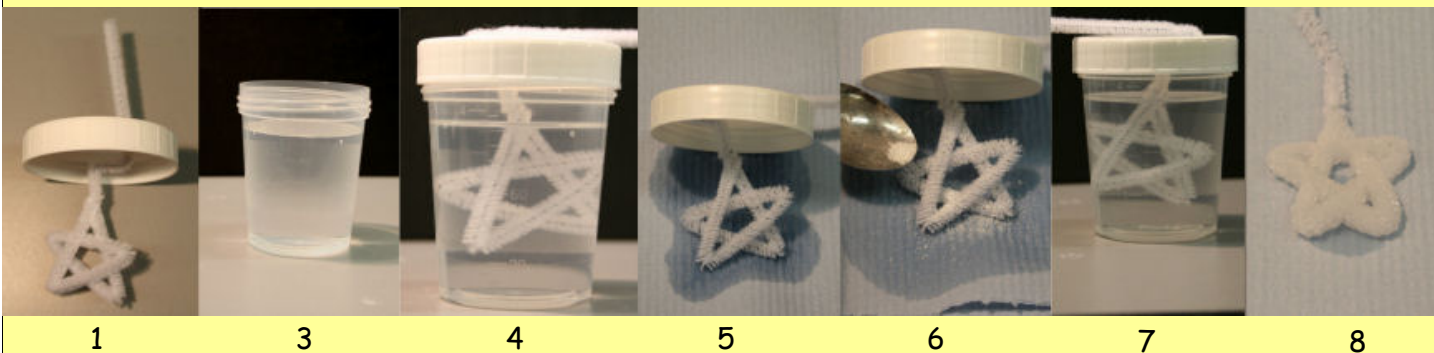
- Pour borax powder into the 500 ml jug up to the 100 ml line
- Fill up to 500 ml with boiled water
- Stir and then leave to cool for about an hour. If you have a thermometer you can measure the temperature of the solution - crystals form fastest when the solution is at 40 °C.

### Growing the crystals

- Collect a sample jar and write your name on the side
- Make a hole in the lid of the jar
- Make a pipe cleaner shape - it is important that it fits in the jar!
- If you want to make a star you can use this picture as a template



1. Thread the pipe cleaner shape through the hole in the lid of the jar and bend the pipe cleaner to stop it falling off
2. Put on a pair of gloves
3. Fill your jar with borax solution up to the 100 ml mark
4. Dip your pipe cleaner into the borax solution
5. Take it out and put it on a piece of kitchen roll
6. Using a teaspoon sprinkle some borax powder on your pipe cleaner - this is called '**seeding**'
7. Put the pipe cleaner back into the jar and screw on the lid
8. Leave it for at least 15 minutes - the longer you leave it the more crystals there will be





### Precautions

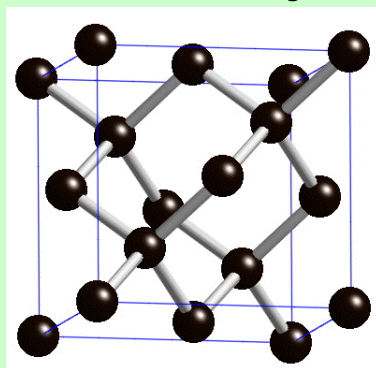
- Some steps, especially those involving boiling water, should be carried out by adults or under their supervision.
- Borax powder and borax solution are poisonous **DO NOT EAT OR DRINK THESE!**
- Borax powder may be an irritant to sensitive skin - gloves should be worn during this experiment
- Wash waste borax solution down the sink with lots of hot water

### What is happening?

All living and non-living things are made up of tiny building blocks called atoms and molecules. A crystal is formed when atoms or molecules are arranged in a regular way.



A carbon atom



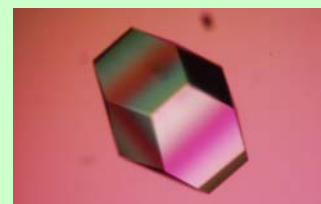
The arrangement of carbon atoms in a diamond crystal



A cut diamond

In this experiment, when we mix the borax (chemical name sodium tetraborate decahydrate) powder with hot water, the borax molecules become surrounded by water molecules and the borax dissolves to make borax solution. The amount of borax that can be dissolved in water depends on the temperature - more borax will dissolve in hot water than cold water. As we cool the borax solution some of the borax will form a solid. If the conditions are right this solid will form as borax crystals. We use the borax 'seeds' as a kind of template for other borax molecules to attach to so that crystals are made.

In our laboratory we grow crystals of proteins. Proteins are biological machines that are vital in the function of all living things. We use x-ray crystallography to work out how the atoms are arranged in protein molecules. This picture of a crystal of an egg white protein was taken with a powerful microscope - the crystal measures about a tenth of a millimeter in length.



For more information search the Internet for 'crystallization' and 'x-ray crystallography'.

### Other things to try

Ask an adult to help you make the borax solution then:

- Follow all of the steps for making a crystal star, but then leave the jar to cool in the fridge - how does this change the crystals?
- Try leaving out the 'seeding' step - do you still get crystals? If you do, how are they different to the ones we made when seeds are added?
- What happens if you leave the borax solution for less time before you add the star?