Fast Crystallization – Instructor's Guide

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MATERIALS: for 5 groups of students (grades 3-6)

Advance preparation materials	Equipment for the students
200 mL distilled water 50 g Sodium Chloride (NaCl) 1 spatula 1 stirring rod 1 hot plate 1 500 mL beaker (for the ice) 1 250 mL beaker Ice Safety glasses Variety of rock/mineral specimens	5 petri dishes (or glass slides) 10 droppers (2/group) 5 microscopes 50 mL rubbing alcohol 10 sticker labels 10 50 mL beakers

Advance preparation procedure
For instructors: 1) Put on your safety glasses. 2) Measure 50 g of NaCl. 3) Pour 200 mL of distilled water into the 250 mL beaker. 4) Prepare a super-saturated solution of NaCl. To make this solution, heat the distilled water to near boiling and remove from heat (do not boil). 5) Add some of the salt to the beaker. 6) Agitate the mixture until the salt is completely dissolved (reheat if needed). 7) Continue adding salt until no more will dissolve. 8) Cool the solution completely by placing the beaker in the larger beaker half filled with ice. This will produce a super-saturated solution. 9) Place 10 mL of rubbing alcohol in 5 beakers and label. 10) Pour about 50 mL of super-saturated salt solution into each of the 5 remaining beakers.

BACKGROUND FOR STUDENTS

Q: What is the difference between rocks and minerals? *Rocks are composed of one or more minerals.*	Show examples of each rock type and a variety of minerals (e.g. granite, basalt, metamorphic, obsidian, geode, fluorite, halite, quartz, sandstone)
Q: What is a mineral? *A naturally occurring, inorganic substance that has a solid, crystalline structure with a defined chemical composition.* **Q:** Do you know any mineral names?	Briefly illustrate some mineral properties such as colour, lustre, specific gravity, crystal shape and cleavage.

EXPERIMENTAL PROCEDURE

OBJECTIVE: Observe salt crystals growing under a microscope.

PRE-EXPERIMENT DISCUSSION: use the PowerPoint slides to help illustrate the concepts below.

A type of salt has been dissolved in water to form a solution. **Q:** What is a solution? *A liquid with a substance completely dissolved in it.*	Have a student add salt to beaker and swirl to dissolve Solution illustration
Salts like other minerals are made of chemical elements. **Q:** What are some examples of elements? An atom is the smallest component of an element. But atoms have even smaller parts making them up, including electrons that are found outside the nucleus (center) of the atom. Electrons have a weak negative charge and the protons in the nucleus have a small positive charge (sort of like magnets).	Periodic table Atom example
The atoms that make up minerals are bonded (stuck) to one another in a regular pattern. This pattern can be reflected in the crystal shape that the mineral forms. **Q:** What shape does the fluorite crystal have? (Ca + F)	Arrangement of atoms and crystal shape Fluorite example - octahedron
The bonds that hold the elements together in a salt are very weak which allows salt to dissolve or breakdown in water.	Use balls to demonstrate a weak

These **ionic** bonds are formed through a transfer of electrons from one atom to another. This causes one atom to be weakly positively charged and the other to be negatively charged. Other minerals like quartz have very strong bonds (covalent) and will not dissolve in water (demonstrate). Here, atoms share the electrons rather than transferring them.	bond (pass e-) in calcite and a strong bond (share e-) in quartz.
When the salt dissolves the atoms separate and form ions that have a weak positive or negative charge. **Q:** What is evaporation? **Q:** What do you think would happen to the salt dissolved in the water? As the water evaporates, the elements form bonds again because they are oppositely charged. As more elements group together over time, the shape of the crystal can start to be seen.	

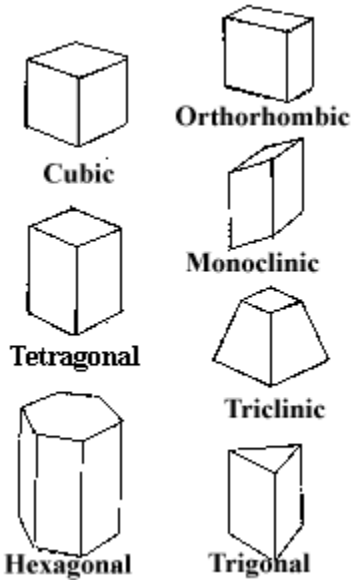
SAFETY FOR INSTRUCTORS AND STUDENTS:

1. **Wear your safety goggles.**
2. **Be careful with the glassware as it can break.**
3. **Only add the few drops of each liquid.**
4. **Wipe any excess solution with a paper towel and do not taste the salt solution as it was prepared with laboratory equipment.**

Procedure for Students

1. Use one of the droppers to add <u>1 or 2 drops</u> of the salt solution in the center of the glass slide.
2. Add 1 drop of rubbing alcohol using the second dropper.
3. Observe crystal growth using the microscope as the water evaporates.
4. In the circle below, draw the shape of the crystal that forms. Look closely at the shape of the crystals when they just start to form.

POST-EXPERIMENT QUESTIONS:



Discussion

Q: What type of crystals formed from the solution? And what type of salt is it? *Cubic crystals; sodium chlorite.*

Q: Why do you think the particular shape formed?

- *The shapes of the crystals reflect the orderly arrangement of atoms inside them. In this case, the sodium ions are small and fit between the chlorine ions forming a cubic shape.*

Q: How fast do minerals normally grow?

- *Slowly, minerals need room to grow. (Show geode)*

Q: In what type of rocks do minerals grow?

- *Igneous: as magma or lava cools, different minerals begin to grow at different temperatures.*
- *Metamorphic: as rocks undergo extreme temperature and pressure beneath the surface of the earth, minerals can melt and reform as other minerals.*

Q: What is the difference between lava and magma? Which would cool more quickly? If lava cools more quickly, what size of mineral crystals would you expect?

- *Lava comes from volcanoes and cools quickly at the Earth's surface. This results in very small crystals as they do not have time to grow.*
- *Magma is found below the Earth's surface and cools slowly over time. This results in larger crystals as there is sufficient time for mineral growth.*