FAST CRYSTALLIZATION – Instructor's Guide

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MATERIALS: for 5 groups of students (grades 7-12)

Chemicals	**Equipment**
750 mL distilled water 50 g Magnesium sulphate 50 g Aluminum-potassium sulphate 50 g Copper sulphate 50 g Sodium Chloride Ice	20 petri dishes or glass slides 4 250 mL beakers 25 50mL beakers 25 pipettes or droppers (5 per group) 25 pipette bulbs 1 500 mL beaker 5 microscopes 4 stirring rods 50 mL rubbing alcohol 25 sticker labels 1 hot plate 20 safety glasses 1 spatula 1 box gloves Paper towel for spills
Rock specimens	
Variety of rock/mineral specimens for discussion Pumice, basalt, granite and obsidian specimens for students to use in their activity	

SAFETY FOR INSTRUCTORS AND STUDENTS

1. **Wear your safety goggles and gloves.**
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.**

Advance preparation procedure

For instructors:

1) Put on your safety glasses.
2) Measure 50 g of each salt type.
3) Pour 150 mL of distilled water into each of the 250 mL beakers.
4) Prepare a super-saturated solution of each salt. To make these solutions, heat the distilled water to near boiling and remove from heat (do not boil).
5) Add some of each salt to its respective 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 each 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 each super-saturated salt solution into 50 mL beakers, one beaker per group.

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.

Different types of salt have been dissolved in water to form four solutions. **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	Use balls to

weak which allows salt to dissolve or breakdown in water. 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.	demonstrate a weak 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.	

Procedure for Students
1. Put on your safety glasses and gloves. 2. One at a time, use one of the droppers to add 1 or 2 drops of a salt solution to the center of a glass slide. 3. Add 1 drop of rubbing alcohol using a separate dropper to drop the vapor pressure and speed up evaporation of the water. 4. Observe crystal growth using the microscope as the water evaporates. 5. In the circles below, draw the crystals that form. Be sure to label your drawing. 6. Repeat steps 1-5 for the remaining three salt solutions.

POST LAB QUESTIONS:

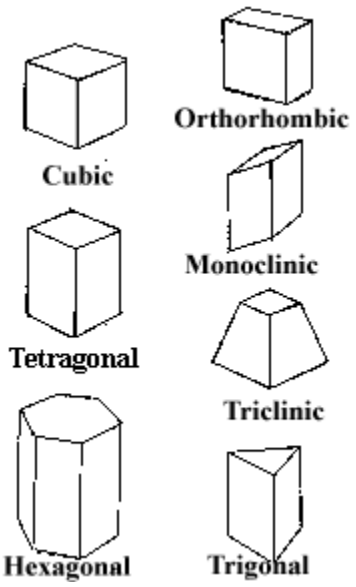
Discussion

Q: What type of crystals formed in the each solution?

- *$MgSO_4$: monoclinic (rhombohedral)*
- *$AlK(SO_4)_2$: trigonal to massive*
- *$CuSO_4$: triclinic (pyramids)*
- *NaCl: cubic*

Q: Why did the salts form different shapes?

- *The shapes of the crystals reflect the orderly arrangement of atoms inside them.*



Everyday uses: have the students take a few minutes to match the salt to the everyday use, and then discuss.

- *Magnesium sulfate is also called Epsom salts and is used for bath salts.*
- *Aluminum potassium sulfate is used in medicine and for dyeing fabrics.*
- *Copper sulfate is used as a fungicide and in hair dyes (think about that one!).*
- *Sodium Chloride is used as a Food additive, preservative, ice melt*

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 recrystallize as other minerals.*

Q: What is the difference between intrusive and extrusive igneous rocks?

- *Cooling lava = extrusive*
- *Cooling magma = intrusive*

Q: Which type of igneous rock cools more quickly?

- *Extrusive*

Q: What would be the difference in crystal size between intrusive and extrusive rocks?

- *Extrusive = small crystals*
- *Intrusive = larger crystals due to slower cooling rates beneath the surface of the earth*

Igneous Rocks: figure out the cooling rate and origin of the igneous rocks.

- **Pumice** is formed as pyroclastic material is ejected into the air as a froth containing masses of gas bubbles or vesicles, the lava solidifies quickly and the vesicles are contained in the rock.
- **Obsidian** is a rock which is a type of naturally occurring glass, produced by volcanoes when lava cools rapidly and freezes without sufficient time for crystal growth.
- **Basalt** forms from cooled lava, but often mineral grains are just barely visible to the naked eye.
- **Granite** cools beneath the Earth's surface giving time for mineral crystals to grow.

Rock Name	Crystal size	Rate of cooling	Intrusive or Extrusive
Pumice	Very small	rapid	Extrusive
Basalt	Small	fast	Extrusive
Granite	Large (> 1mm)	Very slow	Intrusive
Obsidian	No crystals/glassy	Very rapid	Extrusive