

**Education Transfer Plan
2004**

**Watching Crystals Grow:
An inquiry generating investigation
for grades 4-6**

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Watching Crystals Grow

Abstract

Students will observe crystal growth of Epsom salts and observe the variables that aid or inhibit their nucleation and growth. Students will record their observations by drawing a series of pictures as the crystals grow and will be encouraged to focus on the shape and growth patterns. Students will then compare the Epsom salts crystals to other common crystals such as salt and sugar. This lesson is designed to generate a number of questions and to trigger discussion.

Connection to Summer Experience

One major interest of the group that sponsored my research experience was the development of organic and polymer materials to be used in flexible plastic electronic devices. An essential part of the research is the investigation of crystals with promising characteristics for use as organic semiconductors. One challenge in this area is the discovery of methods and conditions for growing single crystals of the purest form. This lesson will both introduce elementary students to crystallography, and help them discover the variables involved in crystal growth.

Subjects

- chemistry/crystallography
- inquiry

Background

Salt, sugar, and Epsom salts are all examples of crystals-solids with flat sides and symmetrical shape because their molecules are arranged in a unique, repeating pattern. All crystals of the same type have the same internal structure. That's why Epsom salts crystals may be large or small but are all needle-shaped, and salt crystals are always cube-shaped.

How do the Epsom salts crystals grow? Hot water holds more Epsom salts crystals than cold water does. That's because heated water molecules move farther apart, making room for more of the Epsom salts crystals to dissolve. When no more of the crystals can be dissolved, you have a saturated solution. As this solution cools, the

water molecules move closer together again. Now there's less room for the solution to hold onto as much of the dissolved salts. Crystals begin to form and build on one another as the water lets go of the excess and evaporates.

Pre-lesson Exploration

Have students look at and think about the way different materials fit together. Students may extend this knowledge later and apply it to their reasoning about why crystals form particular shapes.

- Have students build a simple object using Legos. Have them describe the shape of their structures and compare their structure to that of others. What was similar? (square edged) Why? (because the pieces fit together that way). Now challenge students to make a round object. Can you do it? (No, not easily because the pieces don't connect to form a circular shape.
- Have students pour marbles into a dish. Watch the pattern they make. You should be able to see a "flower" with six petals and a center. Can you induce the marbles to make a seven petal flower? Why?

Objectives

- Observe and record factors that influence crystal growth.
- Identify the structure of crystals.

Materials

- Ten or more shallow bowls (such as petri dishes)
- Five small, clean rocks
- Four small miscellaneous objects (such as nails, aluminum foil, shells, or marbles.)
- Pan for heating, heat source
- Spoon and measuring cup
- Four cups Epsom salts (not table salt, but crystals of hydrated magnesium sulfate available at most pharmacies)
- Two cups water
- Magnifying glass or microscope
- Flashlight
- Observation sheets

Procedure

1. Separate the bowls into five pairs. Place small rocks in one of each pair. Let the students choose several small, miscellaneous objects to put into four of the other bowls. Leave one bowl empty. Number each bowl.
2. Heat two cups of water in the pan, slowly adding the four cups of Epsom salts. Continually stir the mixture so that the salts dissolve, but don't allow it to boil!
3. Divide the mixture among the ten bowls. Don't worry about dividing it exactly, but make sure that the mixture completely covers the objects in the bowls.
4. Put two drops of food coloring in the center of several of the bowls.
5. Put five of the bowls in a cool part of the room and five in a warm part, where they will not be touched or disturbed.

Observation

1. Prepare an observation sheet for the students. Make sure that it has enough space for observations and sketches of each bowl. See sample observation chart
2. Students should observe the bowls at the start (immediately after the water is poured into the bowl) and write down what they see. At this point the liquid should be clear and not have any solid particles in it.
3. Have students observe the bowls again after a few hours if possible and write down any changes they see. At this stage the crystals should begin forming, but there will also be a lot of liquid left.
4. Continue the observation for several days until crystal formation has stopped. As the crystals form, remove a few for observation under a magnifying glass or microscope. Ask students to draw a series of pictures of the crystals as they grow, encouraging them to focus on the shape and growth patterns.
5. Use these questions to shape an in-class discussion:

- Do the crystals have any similarities in terms of shape and symmetry when observed under the microscope or with a magnifying glass?
- How many sides (faces) does each of the crystals have?
- Does shining a flashlight on the surface of the crystals affect their appearance?
- When did the crystals stop growing? Did some stop growing before others?
- Did temperature affect the rate of crystal growth or the size of the crystals? Were warm or cold temperatures more favorable?
- How did the crystals "use" the food coloring? Did the food coloring affect the rate or size of crystal growth?
- Did crystals grow in all the bowls? If not, what may be some of the reasons why the crystals did not grow?
- Did crystals appear to grow more easily on rocks or metal? On smooth or rough objects?

6. Compare and contrast: Have the students look through a magnifying glass at commonly occurring crystals such as table salt, alum powder, and refined sugar. They may use glue sticks to make nickel-sized dots on their journal pages and then sprinkle a few grains of each substance on the squares.

- How are these crystals similar to - and different from - those grown in class?

This exercise will generate a number of questions about crystal growth. Have students compile their observation sheets into a lab notebook and make a list of questions generated from the experiments.

There may not be an easy answer for every inquiry - the important thing is that the students learn to ask good questions?

Art Extension

Have students put their new knowledge about crystals to work and encourage further dialogue and inquiry with an art project. Encourage students to share their projects with their family and explain what they learned.

- Grow crystals on a piece of string to make a bracelet or necklace. Prepare Epsom salts solution, pour into jars and allow to cool.

- Pipe cleaners may be used to make decorative shapes for dipping in the Epsom salts solution. Tie one end of an 8-inch piece of string or thread to the shape. Tape the other end to a craft stick

(Sample student observation sheet)

Bowl 1

Object in bowl: a white marble

Location of bowl: next to heater

Food coloring used: none

Appearance at start: water is clear

Appearance after 3 hours:

Crystals have formed a layer of crust on the top of the bowl

Appearance after 1 day:

Most of the water has crystallized, but some water remains.
The marble is difficult to see.

Appearance after 2 days:

We removed the marble. There were no crystals on it. This may be because its surface is too smooth. The rest of the bowl is solid crystal. Under a microscope a crystal looks like this.

