Drexel-SDP GK-12 ACTIVITY

Subject Area(s): Earth Science

Associated Unit: None

Associated Lesson: None

Activity Title: Growing Gem (Crystals)

Grade Level: 7 and 8 (7-9)

Activity Dependency: None

Time Required: 45 minutes and then two to three weeks for the crystals to grow

Group Size: 3

Expendable Cost per Group $8.5

Summary

Students grow crystals from three different types of salts, leaning about crystalline and amorphous materials and how crystal structures are different depending on the material. This lesson takes a couple weeks to complete, but the initial set up to start the crystals growing is only one lesson period.

Engineering Connection

Crystalline materials are used in many engineering applications; understanding their crystal nature and structure is a start to being able to understand more complicated concepts like the mechanical and electrical properties of the materials. This lesson gives the students an introduction to the concept of crystalline versus amorphous materials and how not all crystalline materials are the same.

Keywords: crystal, mohr hardness, gem, refraction, crystal growth

Educational Standards

- Science: 3.5.7.
- Math: None.

Learning Objectives

After this lesson, students should be able to:

- Explain what Mohr hardness is.
- Explain why the crystals are different when you start from different salts.
- Explain diffraction.

Materials List

Each group needs:

- 200 grams alum powder (available at local pharmacy, will probably need to be ordered by pharmacist)
- 200 grams table salt
- 200 grams Epsom salt (available at local pharmacy)
- 3 pieces of string, 15 cm long
- 3 paper clips or washers
- 3 sheets of aluminum foil, 30 cm square
- 3 large plastic cups, at least 12 oz each
- hot tap water
- 3 plastic teaspoons

To share with the entire class:

- roll of masking tape
- marking pen
- pocket magnifier
- Mohs hardness testing kit

Introduction / Motivation

One of the things that makes gemstones look so spectacular is the way the light bends and bounces inside them. This light show is mainly due to the internal arrangement of atoms within the crystal's structure. As the chemistry of the mineral changes, so does the crystal shape, or "habit." In this activity, you'll see for yourself how different chemical compounds produce different-shaped crystals when you cook up your own "gems."

Vocabulary / Definitions

Word	Definition
Crystalline material	Have a very orderly, three-dimensional arrangement of particles. The particles are arranged in repeating pattern of rows. Examples are iron, diamond and ice.
Amorphous material	Are made of particles that do not have a special arrangement, each particle is in one place but are not arranged in a pattern. Examples are glass and rubber.
Diffraction	When light is bent to a different angle.

Procedure

Background

Crystals are structures that are formed from a regular repeated pattern of connected atoms or molecules. Crystals grow by a process termed nucleation. During nucleation, the atoms or molecules that will crystallize (solute) are dissolved into their individual units in a solvent. The solute particles contact each other and connect with each other. This subunit is larger than an individual particle, so more particles will contact and connect with it. Eventually, this crystal nucleus becomes large enough that it falls out of solution (crystallizes). Other solute molecules will continue to attach to the surface of the crystal, causing it to grow until a balance or equilibrium is reached between the solute molecules in the crystal and those that remain in the solution.

Before the Activity

- *None.*

With the Students

1. Fill each plastic cup about half full of hot tap water. In the first cup, begin stirring in spoonfuls of table salt until you can dissolve no more (usually about 68 spoons). Use a piece of masking tape and the marking pen to label this first cup NaCl. With a clean spoon repeat the procedure with the second cup, only this time use the Epsom salt. Label this cup MgSO4. In the third cup, stir in the alum powder and label it KAl(SO4)2.

2. Tie a paper clip on the end of each string. Wet one string with water and rub some salt crystals on it. Take a piece of aluminum foil and poke a small hole in the middle of it. Thread the free end of the salted string through the hole in the foil, and then cover the cup marked NaCl with the foil. Pull up on the string so that the paper clip is just touching the bottom of the cup and then secure the free end of the string to the top of the cup with a piece of tape.

3. Repeat step 2 first with the Epsom salt and then the alum powder. When all three solutions have been set up, place them in a safe location away from any direct heat or sunlight. In about one week, visible crystals should start to develop on the end of each string.

4. Using a magnifier, observe each crystal and draw a picture of its habit (shape). Compare the crystals you are growing to the three materials you started with and record your observations.

5. Allow the crystals to grow for another two to three weeks and use a millimeter ruler to keep track of their growth rate. Make sure that you note any changes in their appearance over time.

6. Use the Mohs kit to test the hardness of the crystals.

Safety Issues

- None

Troubleshooting Tips

There are no common issues with this activity.

Assessment

Pre-Activity Assessment
Class Discussion:
- What crystalline materials are
- What amorphous materials are
- What you might expect from the crystals made from the different salts

Activity Embedded Assessment
Class Discussion: Each week while you are checking on the crystals talk to the students about what they are seeing, take pictures so you can display them on the overhead and discuss them in detail together. They should notice that the crystals don't all look exactly the same. Have them explain why in their science notebooks.

Post-Activity Assessment
None

Activity Scaling

- For upper grades, could look at X-ray diffraction patterns of the crystals formed and discuss what X-ray diffraction is and why it is useful.

References

http://reachoutmichigan.org/funexperiments/agesubject/lessons/newton/gems11.html

http://chemistry.about.com/cs/growingcrystals/a/aa012604.htm

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Mercer, I. (1987) Gemstones. New York: Gloucester Press.

Earth Magazine. Published bimonthly by Kalmbach Publishing Co. Lists regional mineral and gem shows: (800) 533-6644.

Lapidary Journal. Published monthly by Lapidary Journal, 60 Chestnut Ave, Suite 201, Devon, PA 19333-1312.

3-2-1 Classroom Contact: Crystals - they're habit-forming. Available from GPN: (800) 228-4630.

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