Crystals

1. Grow our own crystals for a permanent collection from some of the following: ALUM, SALT, SUGAR, BORAX, ROCHELLE SALT (or others). Grow at least four different crystals.

2. Learn to spell and define:
   a. Efflorescent
   b. Deliquescent
   c. Piezoelectric
   d. Refraction

3. Spell, define, and memorize the six systems of symmetry.

4. Make a collection of at least 10 crystals made by nature. (Examples: quartz, iron pyrite, natural ruby, and other gemstones.)

5. To show a useful electrical trait of crystals, grow a Rochelle salt crystal at least two inches thick and conduct an experiment to show the piezoelectric effect to the satisfaction of your instructor.

6. To show a useful optical trait of crystals, grow a sodium nitrate crystal at least two inches wide and demonstrate the phenomena of double refraction to the satisfaction of your instructor.

7. State at least five consumer items that require the use of crystals or are crystals in useable form.

Submitted by Bennie & Emma Lee Tillman

References

All About Crystals. http://www.minsocam.org/MSA/K12/crystals/crystal.html
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Crystals Lesson Plan. http://www.beloit.edu/~SEPM/Rocks_and_minerals/growing_crystals.html
Crystals Lesson Plan. http://www.lessonplanspage.com/ScienceArtMDChristmasCrystals46.htm
Crystals and Crystal Growing by Allen Holden & Phylis Morrison (The MIT Press, 1982, ISBN: 0-262-58050-0)
Growing Crystals *(True Books)* by Ann Squire (Children's Press, 2002, ISBN: 0-516-26984-4

Crystals Answers

2. a. Efflorescent—to lose moisture and turn into a fine powder upon exposure to air OR to become covered with salt particles.
   b. Deliquescent—becoming liquid or having a tendency to become liquid OR tending to absorb moisture from the air and dissolve in it.
   c. Piezoelectric—Substances that are able to convert mechanical signals (such as sound waves) into electrical signals and vice versa. They are widely used in microphones, phonograph pickups, and earphones.
   d. Refraction—the fact or phenomenon of light, radio waves, etc. being deflected in passing obliquely through the interface between one medium and another or through a medium of varying density.

3. The six systems of symmetry include the monoclinic, orthorhombic, triclinic, hexagonal, tetragonal, and cubic.

   a. Monoclinic—Crystals belonging to the monoclinic systems have three unequal axes. Two axes intersect obliquely; the other one is perpendicular to this intersection. Sugar, borax, gypsum, nickel ammonium sulfate belong to the monoclinic system.
   b. Orthorhombic—The unit cell of crystals belonging to the orthorhombic system has three unequal axes, each at right angles to the other. Rochelle salt crystals belong to this system.
   c. Triclinic—The unit cell of the lattice of any crystal belonging to the triclinic system has three axes of any relative length and inclined to each other at various angles. Cupric sulfate has this kind of unit cell.
   d. Hexagonal—In the crystal lattice of the hexagonal system of symmetry there are three equal axes all in the same plane cutting each other at angles of sixty degrees. A fourth axis of different length is perpendicular to these. Quartz crystals are in the hexagonal system.
   e. Tetragonal—The unit cell of the lattice of crystals belonging to the tetragonal system has two axes equal in length, a third of another length, and all perpendicular to each other. Crystals of nickel sulfate hexahydrate have tetragonal symmetry.
   f. Cubic—The crystals of the cubic system have three axes of equal length and are perpendicular to each other. Salt and chrome alum belong to this group of crystals.

7. Crystals are everywhere in today's consumer market: From silicon chips in computers and watches to electronic "brains" in kitchen mixers and all sorts of electronic equipment. Lasers are crystals made to emit light waves when pressured by certain frequencies and have been used for everything from surgery to communications. Also, crystals are used in concrete, chemicals we eat like sugar and salt, and numerous medicines. Diamonds are used in industry as grinding and cutting items and other stones of gem quality are used as decoration for jewelry.

Crystals Helps

Growing Crystals: Recipes

Alum Crystals

Here's how to grow crystals from Alum, but the method is the same whatever you want to grow crystals from.

You can buy alum powder from a chemist's shop and growing the crystal will take about 3 weeks. Pour 600ml (1 pint) of water into a saucepan. Add 100g (4oz) of alum powder. Gently heat the mixture and stir it to dissolve the powder. Then add as much alum powder as you can until no more will dissolve.

Let the mixture cool, then pour some into a saucer and stand it somewhere cool. Pour the rest of the solution into a glass jar. Stir an extra tablespoon of alum into the jar to make a saturated solution. Cover the jar with a cloth. After a few days, small crystals should start to grow in the saucer. Leave them until all the solution has evaporated then choose the biggest as your seed.

Carefully tie a long thread around the seed crystal and wind the other end around a pencil. Hang the crystal in the solution by balancing the pencil across the jar. Put the jar somewhere warm like the airing cupboard. The crystal should grow for about two weeks. When it stops growing, take it out of the jar and wrap it in a piece of tissue.

Once you've grown more crystals of different sizes and colors use something other than alum you can arrange them in a display.

Potassium Ferricyanide

Also known as "Red Prussiate of Potash" and has the chemical formula of K_3 $Fe(CN)_6$. This recipe gives red monoclinic crystals.

Dissolve 93 grams of potassium ferricyanide in 200ml of warm water, cover the solution, and allow it to cool. Do not be especially afraid of the word "cyanide" in the name; this substance is no more poisonous (and no less!) than the others in the list.

Copper Acetate Monohydrate

Chemical formula: $Cu(CH_3COO)_2.H_2O$. This recipe gives blue-green monoclinic crystals.

Dissolve 20 grams of copper acetate monohydrate in 200ml of hot water. If a scum of un-dissolved material persists, add a few drops of acetic acid and stir well. Cover this solution, and allow it to cool and stand for a few days; usually it will deposit crystals spontaneously.

Calcium Copper Acetate Hexahydrate

Chemical Formula: $CaCu(CH_3COO)_2.6H_2O$. This recipe gives blue, tetragonal crystals.

Add 22.5 grams of powdered calcium oxide to 200ml of water, pour into the mixture 48 grams of glacial acetic acid, and stir until the solution is clear. If there is a small insoluble residue, filter the solution. Dissolve separately 20 grams of copper acetate monohydrate in 150ml of hot water. Mix the two solutions, cover the mixture, allow it to cool for a day. If it does not deposit crystals spontaneously, let a drop of the solution evaporate and scrape the resulting seeds into the bulk of the solution.

More Recipes for Crystal Forming Solutions

Salt Crystals	Sugar Crystals	No. 3
5 tbsp. Salt	12 tbsp. Sugar	5 tbsp. Epsom Salts
6 tbsp. hot Water	5 tbsp. hot Water	6 tbsp. Water

Green food coloring	Red food coloring	Blue food coloring

You will need eight clear plastic beverage cups. With a permanent marker, label each one. Stir until most of the salt or sugar dissolves. Then scoop out one teaspoon of the liquid from each cup and place it in another set of cups that are labeled like the first set.

This second set will evaporate more rapidly and crystals will be smaller in size. Keep a magnifying glass by the "growing" garden so that you can observe the crystals as they form. If you can get a microscope, put some crystals on a glass slide for viewing. It will probably take up to a month for all of the liquid to evaporate, but you will be rewarded with good-sized crystals for your efforts.

Crystals on a String

Baking soda – 3 tsp, possibly more
Water – ½ cup
Electric hot plate
Spring – 10 cm (5-6 inches)
Small weight for string (e.g. fishing weight)
A clear glass or vial

1. Put 1/2 cup water in pan.
2. Dissolve in as much baking soda as possible, stirring in 1 teaspoon at a time.
3. Heat the solution (do not boil).
4. Remove from heat source, stir, and add more baking soda until no more will dissolve and solution is saturated.
5. Cool solution.
6. Pour into a clear glass.
7. Tie the weight onto the end of the string and hang into solution.
8. After several days crystals will begin growing on the string as the water evaporates.