Lesson: Microscopes and Crystals
Time for Lesson: Varied
Grade Level: 9 -12

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Area: Intro. Course, Chemistry, Earth Science, or Physics

Background: This lesson covers how crystals grow in nature and how students can grow their own crystals. The students can then look at how the light can interact differently with the different types of crystals. This lesson could be implemented in any of the above courses and slightly modified to fit your current needs.

State Requirements:

Ky Learner Goals:

2. Students shall develop their abilities to apply core concepts and principles from mathematics, the sciences, the arts, the humanities, social studies, practical living studies, and vocational studies to what they will encounter throughout their lives.

Academic Expectations:

Academic Expectation 2.5
Students understand that under certain conditions nature tends to remain the same or move toward a balance.

Program of Studies:

S-HS-SI-2
Students will design and conduct different kinds of scientific investigations for a wide variety of reasons.

S-HS-PS-4
Students will investigate how the structure of matter (e.g., constituent atoms, distances and angles between atoms) relates to physical properties of matter.

Materials:
Polarizing Filters
Copper Sulfate, Magnesium Sulfate or Sodium Chloride
Water
Heat Source
String

Procedures:

To begin growing the crystals, the students will need a saturated solution of copper sulfate, magnesium sulfate, sodium chloride or another chemical that has been deemed

acceptable by the instructor. A small amount of this solution can be put in a small container, left to evaporate. This should leave a small crystal of the chemical being used. That crystal can then be tied to a small string/thread and placed into the remainder of the saturated solution. This should be left undisturbed while the water (or other solvent) is being evaporated and the crystal is growing.

This process can be connected closely to the formation of geodes, as well as extrusive and intrusive igneous rocks. For the students to focus on the igneous rocks in particular, they need to develop a way to simulate the two types of situations for them to form. This would be the faster cooling, quicker crystal forming location of the surface and the slower cooling, slower crystal forming location of within the earth. This simplest way to do this is to set one solution in an ice bath while the crystal is forming (for extremely slow growth) and another solution in a warmer area while the crystal is forming (for faster crystal growth). After both crystals have formed, the students can examine the crystals and determine the differences.

The students can examine their crystals with the naked eye, a hand lens, and small crystals with a microscope. One interesting way to look at crystals is to place them between polarizing filters and see how the light interacts differently with different regions of the crystals and how the different types of crystals behave dissimilarly. This has to due with the fact that crystals can be isotropic or anisotropic. Isotropic crystals allow light to pass through with changing its orientation. So, the polarized light coming into the crystal will pass through the crystal and the second filter if it is oriented in the same manner as the first one. If the second filter is turned 90°, then the light will be blocked. In an anisotropic crystal, the light is rotated by the crystal so when the filters are turned 90° to each other, like can still pass through.

For pictures comparing filtered and unfiltered light through crystals, **click here**.

For a video of copper sulfate crystallizing while viewed through polarizing filters that are rotated throughout the process, **click here.** This is a 2 minute video but is worth the wait.

For a short video of magnesium sulfate crystallizing, **click here**.

<u>Extension:</u>

Materials:
Microscope
Pipets
Roughly .1M Silver Nitrate
Small bits of copper or Pennies

If you are talking about river systems, crystal growth, or single replacement reactions, you may want to include this. When metallic copper is placed in a silver nitrate solution, the silver will take on its metallic form while being replaced by the copper. The silver crystals will form in a dendritic pattern attaching to the copper.

Place a penny or small piece of copper on a slide under a microscope. Focus the microscope on the copper. Then add a drop of the silver nitrate solution and watch. Have the students record what they see. This is done often on a larger scale, but this will allow your students to do the lab more many more times because you use such a small amount. They will also 'really' see what is going on as the crystals grow.

To see still photos of the silver crystals, **click here**.

To see four different videos of the silver crystals growing, click **video1**, **video2, video 3, video 4**.