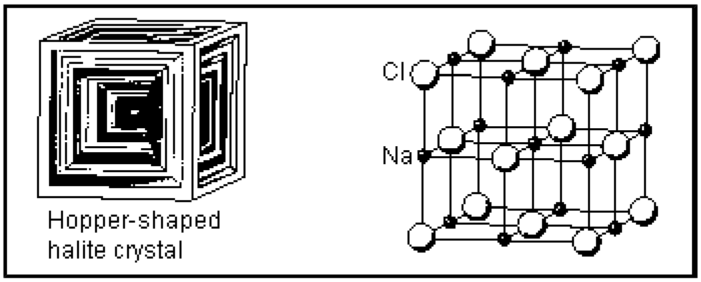
Crystal Structure Lab

by Ray Fetcho

Introduction:

During this lab we will look at crystals - the basic building units that make up rocks and minerals. If we start with the smallest whole unit that could form a unique crystal, that block would be called a *unit cell.* A unit cell would have all the properties of a large crystal such as a diamond, but it would be only molecular size (submicroscopic). If a crystal starts to form - let's say from a slowly cooling magma or from a drying up pool of salty sea water, unit cells add themselves one on top of another in to develop the large crystals we can see and handle. To become big crystals usually need a lot of time to grow.

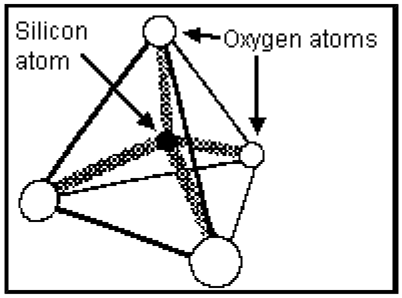


That unit cell is a seed where a crystal begins, it is 3 dimensional and 3 dimensional objects are hard to visualize on 2 dimensional paper. The crystal structure and chemical composition are both important for identifying a mineral. Graphite is pure carbon in one form but diamond is pure carbon in another form. Since both are made of the same element *carbon*, the difference between the two is the internal arrangement of the atoms in their architectural structure. Graphite has a weak structure while the diamond structure is immensely strong in all directions.

Prelude:

Use tables and figures in the textbook to do the following tasks and answer the following questions.

1. Using your reference table, what is the most abundant element by mass in the Earth's crust?
2. This element typically has a positive (+) or negative (-) charge. Tell why in complete sentences. (Hint: if the element is large it probably has extra electrons).
3. What is the second most abundant element by mass and what is its charge?
4. These two elements readily combined with each other and with other elements to form the largest rock group on the surface of the Earth, the **silicates.** The unit cell for the simplest silicate is the silicon oxygen tetrahedron. Here is a 2 dimensional drawing. The large oxygens at the corners of the molecules take up the most space, the tiny silicon atom in the center just fits between the huge oxygens. The silicon and oxygen having different charges are attracted to each other (the silicon's charge is stronger).



Silicon-oxygen tetrahedron

5. What do the lines between the atoms represent? The four thick shaded lines are one thing, and the thin black lines are different.
6. The **Silicon-oxygen tetrahedron** can form crystals with itself, or combine with other elements to form different minerals with different external characteristics. The internal structural arrangement of the atoms or tetrahedra give each mineral formed different physical properties, such as crystal shape, hardness, cleavage, and or fracture.

Purpose:

To Make a minimum of 2 basic unit cells (the first must be a tetrahedron) and to identify the location of the bonds between the atoms.

Materials:

Heavy scissors.

Pipe cleaners, cut to lengths of about 2 inches.

Hollow plastic stirring straws.

Dish detergent water in pails, with a few drops of glycerin added to each.

Procedure:

Part A: silicon-oxygen tetrahedron

1. Make a tetrahedron with all sides equal. Be certain the tubes are snug and securely attached to each other.
2. Dip the model into the soapy water. See if you can form a bubble representing a silicon atom in the center of the tetrahedron.

   Where would the oxygen atoms be on this model?

   How many sides does this model really have?

   What shape does one side make by itself?

Save this model and turn it in to your instructor at the end of the period; we will use it for another activity (single, double, and cyclic silicates).

Internet links:

Pictures of minerals

Science labs web page
Pedagogy web page

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