Walnut Shell Geodes

(from http://www.womeninmining.org/activities/GEODES.pdf)

Geodes are stones—commonly globular or ellipsoidal—usually at least partially hollow, and often lined inside with sparkling mineral crystals or concentric layers of minerals. They are formed by the inward growth of minerals upon the walls of cavities in rocks. This manner of growth distinguishes geodes from nodules or concretions, which grow outward from a nucleus. Geodes can range in size from less than 0.1 inch to over 36 inches, but the average size range is about 2 to 6 inches.

An outstanding feature of the geode is the outer shell, usually composed of chalcedony, commonly with an outer film of clay. The shell varies in thickness from a mere film to over an inch, but the thickness of the shell is not related to the size of the geode. The outer surface of the shell is rough and pitted. The shell is usually quite distinct from the layers of crystals on the interior, as well as from the enclosing bedrock because of the difference in composition.

One of the most abundant minerals of geodes is quartz. The most common color is milky white, although some clear crystals are often present. The variety of shades of the quartz crystals is due to different oxidation stages of an included iron compound. Calcite displays more variations than any other mineral deposited in the geode and is most commonly found as isolated crystals or crystal aggregates on quartz, but in some instances calcite lines the shell.

Some exotic minerals are occasionally found in geodes. Some of the minerals more frequently found include dolomite, ankerite, barite, magnetite, hematite, pyrite, chalcopyrite, sphalerite, limonite, malachite, kaolin and gypsum.

Here are two activities that will allow your students to create a model of a geode.

OBJECTIVE

Students study a model that illustrates the processes involved in the growth of a geode.

SAFETY

The walnut shell geode simulates natural geodes. These experiments will require some student participation with teacher guidance, since students will heat solutions. Potassium alum can be harmful if ingested; ensure that students wash their hands after handling the geodes. Potassium alum is available from laboratory supply companies. Please insure that all safety precautions are followed.

MATERIALS REQUIRED
An old saucepan
A hot plate or other heating source
A large spoon for stirring
Potash alum (potassium aluminum sulfate)
Water
Walnut shell halves
Empty egg cartons to hold walnut shells filled with crystal growing solution.

PROCEDURE (student directions)

1. Put 100 ml of water into a saucepan.
2. Add 36 grams of potassium alum, enough to make a saturated solution. If you cannot weigh the amount of alum, just slowly add it to the water while stirring until no more will dissolve.
3. Gently heat the solution while slowly stirring it with the spoon. As soon as the solution is saturated, remove it from the heat source and let it cool.
4. Place the walnut shell halves in the egg cartons and carefully pour or spoon the solution into the shells.
5. Set the egg carton aside where it won't be disturbed for several days.
6. As the water evaporates, observe and record crystals in the walnut shells that simulate geodes.

EVALUATION
From the model, what conditions do you suppose are necessary for the formation of a geode?

Test those conditions by repeating the model varying the conditions. Remember to change only one variable at a time. Start by listing the possible variables.

TEACHER TIPS
- Conditions for formation of a geode include a solution that is saturated inside the cavity moving into that cavity.
  - The solution can become saturated by evaporation, as in the model, or as occurs in nature by the dissolution or injection of more of the chemical that will eventually precipitate or some other change in conditions such as a temperature change that changes the solution to saturated and precipitating.
- The dissolved chemical needs to precipitate.
  - This can be aided by nucleation sites such as rough spots on the inside surface or by the presence of small crystals of the precipitating chemical.
- In a geode, the dissolved chemical needs to be replenished as it precipitates in order for the crystals to continue growing.
- Limitations of the model
  - This model achieves precipitation only by evaporation. Evaporation is probably not a means by which natural geodes form. Saturation of the precipitating chemical within the cavity must occur by some other means.
  - This model precipitates the crystals very quickly. In nature, the precipitation would occur over a long time period in which the liquid from which the crystals precipitate is replenished and kept at saturation.

COCONUT GEODE CLASS DEMONSTRATION

For lower grade levels, the teacher should do this demonstration. Higher-grade levels should have teacher guidance during the preparation stage.

MATERIALS REQUIRED

Coconut, white removed, sprayed on the outside with lacquer or enamel paint and dried, prepared as below.
Saturated potassium alum solution

PROCEDURE

1. Cut a coconut in half.
2. Clean the white meat out of the coconut shell.
3. Spray the outside of the coconut shell with lacquer or enamel paint and let dry.
4. Drill or punch a hole into the top of the coconut.
5. Then silicone the two coconut halves back together.
6. Carefully pour the crystal growing solution into the drill hole.
7. Let the coconut sit for a few days.
8. If the solution has not totally evaporated after several days, pour it out.
9. Using a sharp knife or razor blade cut the coconut in half where the silicone seam is. SURPRISE!