

“Minerals that do things...”

Hands-on demonstrations of mineral properties

Provided for the Mineral Information Institute by Andrew A. Sicree, Ph.D.**Object:** Students can process a raw mineral, vermiculite, into its expanded or exfoliated form. By heating the vermiculite they'll see how physical changes can be related to the mineral's structure.

Procedure description: Students take a small piece of unexpanded vermiculite, holding it with tongs or long tweezers, and insert it into the flame of a propane torch. The vermiculite expands rapidly to many times its original thickness.

Specimens to test: Unexpanded vermiculite.

Equipment needed: Propane torch with narrow tip (use clean, uncorroded tips); propane tank; long pair of tweezers (10 inches) or laboratory tongs; small metal pan or tray, safety glasses or goggles; fire extinguisher.

Scientific discussion: Vermiculite is a hydrated mica. The name vermiculite is derived from the Latin root *vermi* (worms) or *vermiculare* (to breed worms), which is descriptive of the way vermiculite looks when heated: the fragments writhe about like worms.

Vermiculite expands for much the same reason that popcorn pops. In popcorn, water vapor pressure inside the kernel builds up as it is heated. The water flash boils when the outer shell cracks a little and the resulting explosive boiling blows the kernel open. Vermiculite, like all micas, is a sheet silicate. When heated, water between the layers of the vermiculite expands and pushes the sheets apart (to the point where the water vapor can escape).

Expanded vermiculite can be dozens of times thicker than the original unexpanded mineral. The sheet push apart and the result is a drastic increase in surface area (which helps its ability to absorb chemicals).

Additional possibilities: It is possible to heat several pieces of vermiculite at the same time by employing a stainless steel tea strainer (the kind that have a long handle with a wire mesh spoon). Put a teaspoon worth of unexpanded vermiculite in the strainer and hold the mesh in the propane flame. You'll see the whole batch of vermiculite begin to exfoliate and squirm around – it never fails to impress students.



The Popcorn Mineral Page 2 of 2

An interesting classroom lab exercise is to weigh the vermiculite with an accurate balance before expansion and then again after expansion. Next, students can put the vermiculite in water to see how much water it absorbs. It is important to shake off the excess surface water before weighing to get an accurate measure of the absorbance. Does the expanded vermiculite absorb more or less water than it lost upon expansion?

Notes for demo tables: If you are doing demonstrations for large numbers of visitors (such as at a booth at a trade show), I use a chemical hot plate because of concerns about open flames. To be effective, a hot plate must be turned up high. I spread a spoonful of unexpanded vermiculite on the hot plate and within a minute the material will start to expand, looking like a bunch of writhing worms. I made a wire mesh barricade (from an old wire mesh trash basket) to keep kids hands away from the hot plate. After the vermiculite is expanded, I use a spatula to scrap it into a tray. It cools quickly and I let kids take samples of the material. Typically, I put the exfoliated vermiculite in a small (two-inch by two inch) zip-lock bag for the students to take home. (It is harmless and it cannot be reused.)

Special notes: It is always a good idea to have a fire extinguisher handy when working with flames.