"Minerals that do things…"

Hands-on demonstrations of mineral properties

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Time to Split

Object: Students will break minerals and observe their **cleavage** or **fracture**. How a mineral breaks depends upon the mineral's structure. Cleavage is an easily demonstrated property of minerals such as calcite, halite, and mica.

Procedure description: Students, wearing safety goggles, place a specimen on a block of wood. Then, using a small hammer and a cleaving chisel, they break the specimen to show its cleavage or fracture.

Specimens to test: Calcite; muscovite mica; halite; chert; flint; quartz.

Equipment needed: Safety glasses or goggles; small hammer (full-size hammers give too much power to an ambitious youngster – I favor using a small aluminum meat tenderizer with the faces ground flat – it is lighter than a steel hammer); wood block to use as a chopping block; and a cleaving chisel. Cleaving chisels are hard to find but you can easily make your own. Take a cheap one-inch-wide wood chisel and dull the sharp end with a grinding wheel. Then use a grinder to sharpen a knife-edge along one side of the chisel. You use the cleaving chisel by placing its sharpened side edge against a crystal (it is best to try to align the chisel in the direction of an existing cleavage surface) and then firmly striking the other side of the chisel.

Scientific discussion: Cleavage is related to the underlying structure of the mineral. In the case of mica, the mineral consists of planar sheets of atoms with relatively weak bonds between the sheets. This enables us to easily split micas into very thin sheets. We call this perfect basal cleavage. You don't need a chisel to cleave mica – you can use your fingernail or a knife blade. It's possible to peel off sheets of mica that are thinner than a piece of paper. Thin sheets of mica are transparent enough to see through.

Halite has three directions of perfect cleavage each perpendicular to the others. Cleavage fragments tend to be cubes or rectangles with right-angle corners reflecting the underlying isometric (cubic) atomic structure.

Calcite has three directions of cleavage that are inclined to each other. A calcite cleavage fragment will take the shape of a rhombohedron.

Additional possibilities: It is possible to demonstrate four different directions of perfect cleavage in fluorite. One can cleave fluorite into an octahedron by knocking off the corners of a cubic crystal. Fluorite is frequently sold in the form of single octahedra – these are cleavage fragments, not complete crystals. Good cleavable fluorite is more expensive than calcite, so you may just wish to have one or two cleavage octahedra to show students.

Quartz and flint or chert will show conchoidal fracture – they break with a shell-like pattern on the fracture surface. Quartz, flint, and chert, will not exhibit any flat cleavage surfaces. You can demonstrate conchoidal fracture in quartz but you have to be careful – fragments will have very sharp edges.

Notes for demo tables: If you are doing demonstrations for large numbers of visitors (such as at a booth at a trade show), I've found that it is simplest to use small cleavage fragments of calcite – they will lay flat on the chopping block and it's easy to see how to align the cleaving chisel parallel to a cleavage plane. Be sure to select clean calcite for cleavage demos – it doesn't have to be optical grade – but it should be untwinned. Block crystalline halite (not the coarse granular halite) works even better than calcite, but it is a little bit harder to obtain in quantity.

I have youngsters put on safety glasses before trying their hand at cleaving calcite or halite and allow them to keep samples of the cleavage fragments they produce.