

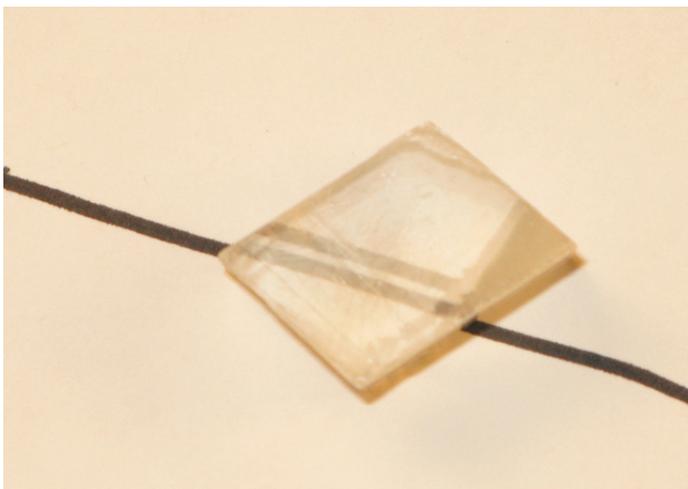
“Minerals that do things...”

Hands-on demonstrations of mineral properties

Provided for the Mineral Information Institute by Andrew A. Sicree, Ph.D.

I’m Seeing Double

Object: **Double refraction** is easily observable in optically-clear calcite. Students observe double refraction and prove that calcite not only refracts light to produce two images, but that light passing through calcite is also polarized.



Procedure description: Students draw a line across and write several letters or symbols (“+”, “#”, and “\$” work well) on a white sheet of paper.

They take a cleavage fragment of optically-clear calcite; place it on the sheet, over a symbol. Observe how the marks look through the calcite. How many images do you see? What happens when you rotate the calcite sitting over the mark? Then they hold a sheet of Polaroid polarizing material between the calcite and their eye. How many images do you see now? What happens when you rotate the calcite sitting over a mark while looking through the Polaroid polarizing sheet?

Specimens to test: Calcite, optical-grade (“Iceland spar”) cleavage fragments are necessary, the bigger the better. As control, you can use another clear mineral such as quartz.

Equipment needed: Polaroid polarizing sheet (Edmund Scientific sells polarizing demo discs, cat# D30386-05; call 800-728-6999); paper; pen.

Scientific discussion: Double refraction is easily observable in optically-clear calcite. Students observe that the calcite breaks an image viewed through the calcite into two images: this is double refraction or birefringence. Polarization of the images can be proven by placing a polarizing screen over the calcite. You can rotate the polarizing screen to a position where one of the two images disappears. This happens because the polarizing screen eliminates light that is polarized in one direction while passing light polarized at right angles to that direction. When the polarizing screen is aligned correctly it will eliminate completely the light that carries one of the images. Rotating it will eliminate the other image; intermediate positions will partially weaken the images.

I'm Seeing Double Page 2 of 2

Additional possibilities: It is theoretically possible to observe double refraction in rutile if you can get an optically clear crystal (difficult except in very small natural specimens). Synthetic rutile, sometimes called Titania, can be a very clear light yellow and can be used. Synthetic colorless silicon carbide (moissanite) is sold as a diamond simulant and exhibits double refraction (unlike true diamonds). Usually moissanite gemstones are cut so that the double refraction is only apparent when looking at them from the side.

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 double refraction is a simple but impressive demo. Obtain as large of pieces of optically-clear calcite as possible (nice Mexican cleavage fragments that are three inches across can be purchased). Just place the calcite on a sheet of white paper on which you've made some black marks (letters, lines, etc.) – crisp clear edges are important for maximum effect. Note that calcite is a soft material and will scratch easily. Try to keep dust and sand away from the faces of calcite. If a calcite fragment does get badly scratched you can always, with care, cleave a fresh face.

If you are going to include a polarizing sheet in the demo, try clamping it to an upright stand to keep it in place over your marked paper. Then allow the visitor to rotate the calcite between the two. Polarizing screens will also scratch and you want to limit contact.