"Minerals that do things…"

Hands-on demonstrations of mineral properties

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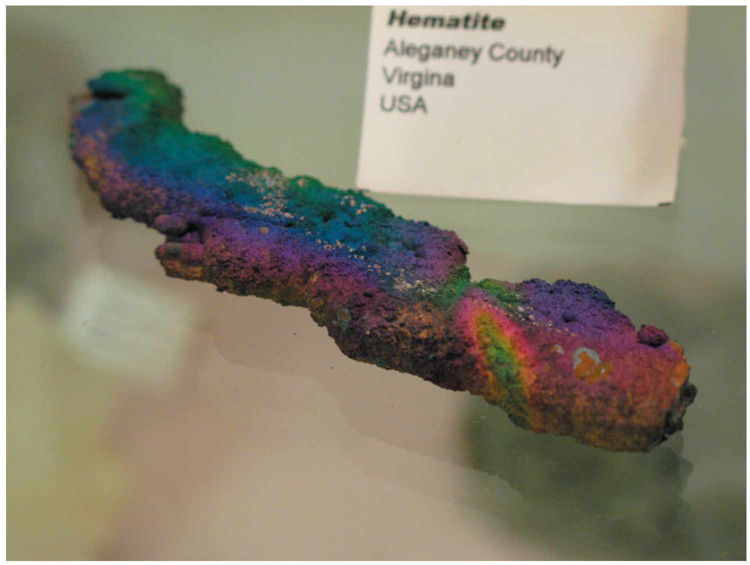
Wild and Cool Colors



Object: Everyone knows the fascinating play of colors that mark a good fire opal. A variety of minerals exhibit similar interesting optical effects such as **schiller**, **iridescence**, and **pleochroism**. Students can observe these properties in hand specimens.

Procedure description: The procedure is very simple: students pick up stones, look through them and observe their colors. What colors are observed? Does the color change dependent upon direction? Hold them under and incandescent lamp, then a fluorescent lamp. Do the colors change?

Specimens to test: Blue labradorite (a plagioclase feldspar) can show fascinating displays of schiller (you can get large chunks or this material from the scrap yards of stone cutters who make stone kitchen countertops or monuments). Opal and iris agate display iridescence (rough scraps of low-grade opal can be purchased at many mineral shows). Iolite (variety of cordierite), kunzite (a variety of spodumene), and other minerals show pleochroism. Alexandrite (a variety of chrysoberyl) shows the alexandrite effect but can be very expensive – a cheaper substitute is to buy rough chunks of synthetic "alexandrite effect" doped glass (also often for sale by lapidary suppliers at mineral shows).

Equipment needed: A small, high intensity incandescent lamp is best for viewing effects such as iridescence, pleochroism, and schiller. For the alexandrite effect, you'll also want a small fluorescent (white, not UV) lamp.

Scientific discussion: Iridescence in opal and iris agate is caused by the diffraction of light (breaking of white light into its constituent colors). In opal, light is diffracted by the many small silica spherules that make up the opal structure. In iris agate, light is diffracted when the spacings between the fine bands of the agate are close to the wavelength of visible light. A similar diffraction effect called "schiller" is seen when the lamellae (fine plates having different chemical compositions) within the structure of the feldspar labradorite are fine enough to diffract light.

Pleochroism is observed because the light moving through a crystal can be absorbed differently depending upon the crystallographic direction it is following. Isometric (cubic) minerals cannot show pleochroism, and in most other minerals any color differences are impossible to see. But some minerals (such as kunzite, the pink variety of spodumene) exhibit distinctly different colors or shades when looked at from different directions. The iolite variety of the mineral cordierite is trichroic. Small samples can be purchased that have been cut into cubes to maximize the trichroic display. When you hold one of these cubes up to a light and look through it in one direction, it appears dark blue or violet, in another direction a lighter blue, and in a third direction it is yellowish-gray (brownish).

The "alexandrite effect" is different than pleochroism in the alexandrite effect depends not on the viewing direction but upon the color of the incident light. Fluorescent lights tend to give off more blue light and incandescent lights give off more yellowish or reddish light. Alexandrite (a variety of the mineral chrysoberyl) absorbs these lights differently. Thus it appears blue-green in daylight or under a fluorescent lamp and red under an incandescent lamp or a candle.

Additional possibilities: Rotating a polarizing screen between the light and a stone will help accentuate the pleochroic effect.

Notes for demo tables: If you are doing demonstrations for large numbers of visitors (such as at a booth at a trade show), it is best to attach your specimens to a small cardboard panel. It is difficult to secure a small polished cube of iolite that allows one to still look through it in all directions, so you'll just have to keep an eye on the specimen,