"Minerals that do things…"

Hands-on demonstrations of mineral properties

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

Very Attractive Minerals

Object: Students will determine that some minerals, rocks, and other materials are naturally **magnetic**.

Procedure description: Test specimens with a magnet to see if the magnet will stick to them. If the magnet won't stick, hold it lightly between your thumb and index finger and pass it over the specimen. Do you feel a slight tug? Then take the specimen and pass it slowly around a magnetic compass that is sitting still on a firm flat surface (a table top). Does the specimen cause the compass' needle to deflect?

Specimens to test: Magnetite crystals, lodestone, franklinite, chromite, specular hematite, limonite, iron meteorite, stony meteorite, refrigerator magnets, iron or steel, copper pennies, aluminum foil.

Equipment needed: Magnets, large compass; mini-compasses.

Scientific discussion: Strongly magnetic materials will be attracted by a magnet. You'll be able to feel the pull when you hold the magnet close to the specimen. A compass needle is more sensitive to weakly magnetic materials. A mineral that is too faintly magnetic to be felt may still be observed to deflect a compass needle.

Iron and steel will be attracted by a magnet. These metals will also deflect a compass needle, but metals such as aluminum and copper won't. The (rare) mineral native iron and iron found in meteorites are strongly attracted by a magnet. (Iron meteorites are mostly nickel-iron; many stony meteorites also have small blebs of nickel-iron scattered throughout their interiors.) Iron, steel, and nickel-iron are magnetizable, meaning they can be made magnetic. For instance, stroking an iron paper clip a hundred times in the same direction with a strong magnet will make the paper clip into a magnet – the clip can then be used to pick up other paper clips.

You will find that magnetite will deflect the compass needle. Some magnetite crystals are much more strongly magnetic than others. Lodestone is massive magnetite and by definition is strongly magnetic. Frequently, lodestone samples will be found covered with a black "fuzz." This magnetic fuzz consists of small chips or dust from the lodestone and/or small metal filings.

Additional possibilities: Magnetite and maghemite are strongly magnetic. Minerals that are weakly magnetic include chromite, franklinite, ferberite, siderite, tantalite, babingtonite, and ilmenite. Pyrrhotite specimens are erratic: some are strongly magnetic others are weak. Some specimens of hematite may be magnetic, too. This may be because they are really mislabeled magnetite, or it could be because small amounts of magnetite are intermixed with the hematite. Limonite may form from weathered magnetite and a residue of unaltered magnetite may render some limonite specimens magnetic.

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 only lodestone, one or two magnets, and a compass.

Another way to demonstrate magnetism is to make a "compass-board." Obtain at least four to as many as twelve mini-compasses (they can be purchased from Edmund Scientific or other science supply houses). Glue compasses in a circle (about 3-4 inches in diameter) around a spot on a flat board. Put specimens in center – watch for movement of compasses. If the specimen is strongly magnetic, note how the north ends of some compasses point toward the specimen while others point away. Move the specimen around the circle of compasses and watch how they swing back and forth.

Iron filings can be used to show the pattern of the magnetic field around a lodestone. One way to keep the iron filings from escaping and contaminating everything is to build a magnetic field viewer. Take two clear pieces of clear, rigid Plexiglas, each cut to about 6 inches square. Lay one piece flat on a table and run a bead of silicone cement around just inside the edge of the piece. Distribute several small scoops worth of iron filings or magnetite dust in the center. Then place the other piece of Plexiglas on top and push down so that the silicone cement contacts both sheets and traps the magnetic iron filing inside the resulting "sandwich." Try not to get the filings into the cement – do not move the magnetic field viewer until the cement has set. Once the cement has set, the finished magnetic field viewer can be used. Set a magnet or a piece of lodestone on top of the center of the Plexiglas sheets. Observe how the iron filings arrange themselves parallel to the lines of the invisible magnetic field surrounding the lodestone. Note that the lodestone has two magnetic poles.