

## ***“Minerals that do things...”***

Hands-on demonstrations of mineral properties

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

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### **It's Useless to be a Resistor**

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Object: Students will observe that some minerals are natural electrical **conductors** while others are good **insulators**. They use a simple electrical circuit to test whether a sample is conductive.



Procedure description: Students bring both of the leads of a conductivity tester into contact with a specimen to test if it will pass electricity.

Specimens to test: Native copper; native silver; native gold; graphite; molybdenite; mica; quartz; pyrite; pyrrhotite; magnetite; specular hematite; galena; chalcopyrite; pennies; copper wire; pencils.

Equipment needed: A conductivity or continuity tester – these can be purchased at hardware stores and science supply houses. (Elenco makes an inexpensive lab meter kit – available from American Science & Surplus for \$4.95, cat # 37977, call 888-724-7587 for a catalog.)

You can make your own conductivity tester with a simple battery-powered circuit. Use lightweight electrical wire and strip the ends to serve as probes. Connect one wire to one terminal of a battery pack, and connect the other wire to a small flashlight light bulb. Then wire the other terminal of the battery pack to the alternative connection point for the light bulb.

Test your work by crossing the stripped ends of the wire – the bulb should light up. Alternatively, you can wire a buzzer in place of the light bulb. The bulb will light or the buzzer will sound if you touch both stripped ends (the “probes”) firmly to a specimen that is an electrical conductor. This apparatus is only sensitive to good conductors.

Scientific discussion: Minerals that are native metals are natural conductors. Thus, native gold, copper, and silver (as well as rarer minerals such as native lead) are good conductors of electricity. These minerals look like we expect conductors to look. It is important to realize that even a minor amount of tarnish or oxide coating on native silver or native copper can interrupt electrical continuity. Experimenters should also be aware that some native copper specimens are sold after they have been coated with a clear layer of varnish (to protect them from tarnishing). A coating of varnish will interrupt electrical continuity.

Graphite is a good conductor even though it doesn't look like the metals. Large chunk graphite can be obtained from Madagascar. Graphite is rather common in metamorphic rocks such as marble. One interesting way of demonstrating that graphite is a conductor is to sharpen both ends of a No. 2 pencil. Touch the conductivity tester's probes to opposite ends of the doubly-sharpened pencil; the pencil “lead” will pass electricity. Pencil “lead” is, of course, really graphite – but a certain amount of clay may also be mixed in during its production. The addition of clay causes the pencil lead to be a poorer conductor than pure graphite, but all of the pencils I tested still passed enough electricity to register on my conductivity tester.

You can have students test the conductivity of sulfide minerals such as pyrite, pyrrhotite, chalcopyrite, or galena that have metallic luster. Molybdenite (molybdenum disulfide) is similar to graphite in appearance (it is blue-gray rather than just gray). Including examples of known conductors such as copper pennies and electrical wires is useful. Sulfide minerals are poorer conductors than the native metals and a small amount of surface oxidation will significantly lower their conductivity. Test freshly broken surfaces where possible. The response you get with your conductivity tester will also depend upon the voltage of its circuit.

Not everything that looks shiny is a conductor. Muscovite mica, even though it has a bright silvery look, is an excellent insulator. Quartz is another insulator.

Additional possibilities: Iron meteorites are good conductors of electricity as long as any rust coatings have been removed. A polished slab of an iron meteorite, or a mesosiderite, make a fascinating addition to the conductivity demo. Magnetite and specular hematite are also interesting to test.

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 attaching the conductivity tester and gluing the minerals to be tested to a single wooden board is a good way to keep all of the various parts together. If you put out a native gold sample to test, you don't want it to disappear.