RAFT IDEAS

Topics: Electricity (circuits, energy, resistance), Physical Properties

Materials List
(for each hot wire cutter)

- ✓ 2 craft sticks
- ✓ Aluminum foil
- ✓ Nickel chromium wire, 26 gauge, 6" long
- ✓ D sized heavy duty or alkaline battery
- ✓ Styrofoam™ to cut with the cutter

This Activity can be used to teach:

- Electrical Energy (CA Science Standard: Grade 4, 1.g)
- Energy carried by electric current (CA Science Standards: Grade 3, 1.d)
- Properties of Metals (CA Science Standards: Grade 5, 1.c)

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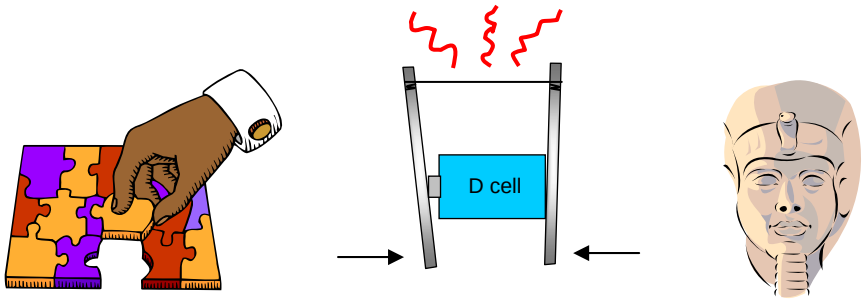
A Hot Wire Through Styrofoam™



Press together with one hand

This nifty tool can make detailed cuts in Styrofoam™ and is an example of a circuit.

Assembly

1. Carefully wrap each craft stick with a 4 x 15cm (1½"x6") piece of aluminum foil.
2. Twist an end of the nickel chromium wire around each foil wrapped craft stick, about 1 cm (½") from the end of the craft stick, as shown. Coil the wires around the craft sticks until there is a 5 cm – 6 cm (2 - 2½") length of wire between the craft sticks. Shorter lengths will heat up faster and be **hotter**! Adjust as needed.

SAFETY NOTE: Use only a heavy duty or, for longer use, an alkaline battery. The battery may become hot during use so **a rechargeable battery is not recommended!**

To Do and Notice

1. Position the D sized battery between the craft sticks about 2 cm – 5cm (~1"-2") from the end as shown above. With one hand press the lower ends of the craft sticks below the battery, as shown. The wire will become taut and the foil will be pressed against the ends of the battery, completing the circuit. The wire will quickly heat up and melt through Styrofoam™. Simply pull the wire through the Styrofoam™ to cut. Thicker foam will take longer to cut than thinner foam.
2. These hot wire cutters can be used for many projects, including: creating sculptures, for making puzzles (use as a scroll saw), and for making models of topographic mapping.

The Science Behind the Activity

When the sticks are squeezed an electrical current flows through the circuit made up of the aluminum-covered sticks, wire, and battery. An electric current is the bumpy flow of electrons through the atomic structure of the material, kind of like water flowing in a riverbed. As electrons (~water or better yet marbles!) flow through a material, they interact with the atomic structure (~riverbed) of the material. Imagine billions of collisions between the electrons (~marbles) and the atomic structure (~riverbed). These collisions will increase the motion of the atoms. The temperature of a material is greater if the atomic motion is greater. Nickel chromium wire has more resistance (~rougher riverbed) than the aluminum. The wire is also thinner (~narrower riverbed) than the foil wrapping. The nickel chromium wire will thus become **much hotter** than the aluminum foil as the electrons flow through the circuit.

Taking it Further

Different gauges and lengths of wire with different amounts of electrical resistance will heat up differently. The amount of electrical current depends on the total electrical resistance of the circuit and the voltage (~slope of the riverbed) of the battery. Experiment with different lengths and types of wire and note the difference.

Written by RAFT Education Department
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