exploratorium

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rent flowing through ire heats the wire. The length of a wire affects its resistance, which determines how much current flows in the wire and how hot the wire gets.

Note: Electricity can really heat things up! The wires in this Snack can get hot, so be careful.

Tools and Materials

A note about materials for this Snack: Braided copper wire and aluminum wire will not work here. Iron wire can work, but is not commonly available. Be sure to stay away from plastic-coated wire, which can burn if it gets hot.

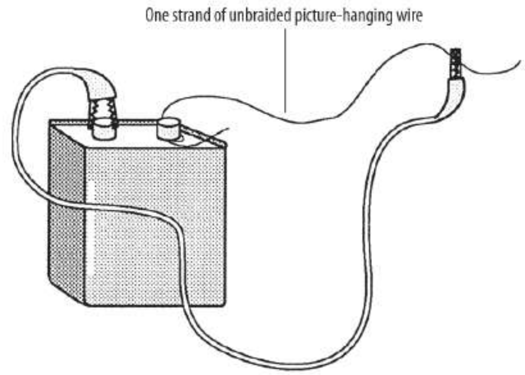
- A length of copper wire with alligator clips attached to each end (or a test lead) from any electronics supply store
- A fresh 6-volt or 12-volt lantern battery
- A 5- to 6-inch (13- to 15-cm) length of very fine steel wire, obtained by separating one strand from ordinary braided galvanized picture-hanging wire

Assembly

1. Attach one end of the clip lead to one of the battery terminals.
2. Attach one end of the fine steel wire to

the other terminal.

3. Attach the other end of the clip lead to the other end of the steel wire, placing the clip as far from the terminal as possible. (Click diagram below to enlarge.)



To Do and Notice

Observe what happens to the steel wire after you connect the clip. Move the clip on the steel wire a little closer to the battery and watch what happens. Keep moving the lead closer until you see the final dramatic result. (Be careful! The steel wire will get very hot!)

What's Going On?

The thin steel wire is a good conductor of electricity, but not as good as the copper wire, which is deliberately chosen to have very low resistance. Thus most of the resistance of the circuit is in the steel wire.

When you connect the clip to the steel wire, the voltage of the battery pushes electrons through the circuit against the resistance of the steel wire, causing the steel wire to heat up. As you move the clip closer to the battery, the resistance of the steel wire decreases. Because the same voltage is applied across a lower resistance, more current flows, and the wire heats up more. Eventually, when you make the steel wire short enough, so much current flows that it melts the wire. Even the copper wire becomes warm.

In a normal electric circuit, an electric current powers an appliance, such as a refrigerator or TV. Every such appliance has a certain amount of resistance to the current flow, which keeps the current from reaching very large values. A short circuit occurs when the current finds a way to bypass the appliance on a path that has little or no resistance—for example, where frayed insulation bares a wire and allows it to touch the frame of the appliance, so the current can flow straight to the ground. In this situation, a very large current can occur, producing a lot of heat and a fire hazard.

Although houses today often have circuit breakers instead of fuses, fuses are still around. A fuse contains a thin strip of wire, somewhat like the thin steel wire in our experiment. The current that goes to appliances must also pass through this strip of wire. If a short circuit occurs—or even if too many appliances get hooked up to one wire so that too much current flows—the wire in the fuse heats up quickly and melts, breaking the circuit and preventing a fire from starting.

Going Further

Try this Snack with pieces of aluminum foil 1/4 inch (6 mm) wide and 6 inches (15 cm) long in place of the thin steel wire. Observe the striking colors made by the aluminum-oxide layers formed when the aluminum gets hot.