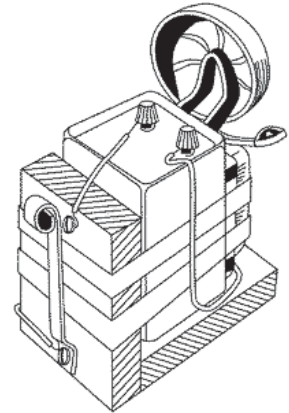




Intruder Alert

Make your very own portable alarm system. Use it when you want to make sure your little brother or sister doesn't snoop in your room. The alarm has a component that begins the action, a power supply, and a way to open and close the circuit. Put this along the bottom of any door. When someone pushes the door to get in, you'll hear the alarm go off!



What you need

- Two 4" x 3" wood blocks
- 3 nails
- 5" x 1/2" metal strip (make sure you can bend it)
- 2 roundhead screws
- 2 feet of hook-up wire
- Doorbell (available at hardware stores)
- 6-volt battery (the power supply)
- Hammer
- Tape

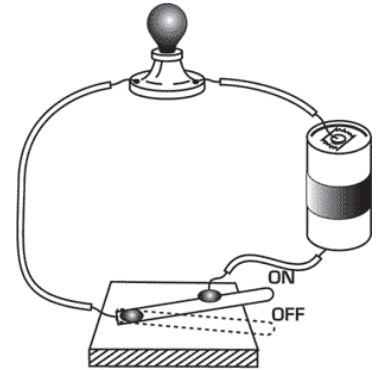
- 1** Nail the wood blocks together to form an "L" shape.
- 2** Put one of the screws halfway into the upright portion of the "L," about 1/2" down from the top.
- 3** Wind the stripped end of a 6" piece of wire around the screw a few times and then finish putting the screw all the way in.
- 4** Take your doorbell and connect two 9" pieces of wire to each terminal.
- 5** Place the battery on the bottom portion of the "L" shape and then place the doorbell against the battery.
- 6** Wrap tape around the "L" shape, doorbell, and battery to make them all one piece.
- 7** Shape your metal strip as shown and make a hole in the flat part.
- 8** Screw the metal strip into the upright portion of the "L" shape. This is your contact arm, which closes the circuit to sound the alarm.
- 9** Now, connect one doorbell wire to the battery and the other doorbell wire to the contact arm.
- 10** Finally, connect the wire from the top screw to the battery.

Presto, your personal security system!



Visit Thomas Edison's Lab

Young Tom Edison had a small lab in his cellar as a boy. His tinkering with this experiment (and many more like it) led him to become one of the most successful inventors in the world. Try it yourself! You'll build a basic electrical circuit and find out what happens when the current is "open" compared with when it's "closed!"



What you need

- Penlight bulb
- Flashlight battery
- Two 6" pieces of insulated wire (any kind will work)
- Switch (see The Safety Catch experiment to find out how to make a switch.)
- Tape

- 1 Connect the first piece of wire to a thumbtack on the switch.
- 2 Place the light bulb in the center of this wire piece.
- 3 Tape the end of the first piece of wire to one end of the battery.
- 4 Tape your second piece of wire to the opposite end of the battery.
- 5 Attach the end of your second piece of wire to the remaining thumbtack on the switch.

You've created an electrical circuit!

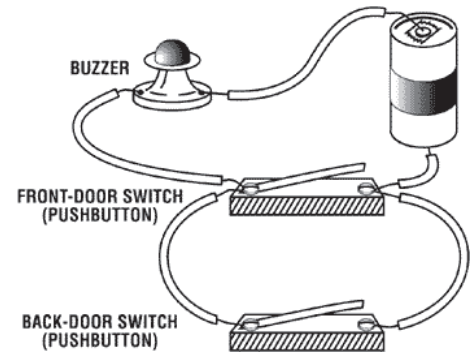
When you press the switch down, your circuit is "closed" and your current flows--turning your light bulb on.

When your switch is up, your circuit is "open" and your current can not flow--turning your light bulb off. Just like Thomas Edison's once did!



Say the Password, Please

Here's how you can make your very own doorbell to your room. Privacy at last! This experiment expands on the basic electrical circuit experiment you may have already completed.



What you need

- Electronic buzzer (available from electronic component stores)
- Flashlight battery
- Four 12" pieces of insulated wire (any kind will work)
- Two switches

For each switch, you'll need a small block of wood. Put two thumbtacks about 2" apart on the block. Attach a twisted paper clip to one of the thumbtacks, making sure it can touch the second thumbtack when you press it down. Now you have a switch!

- Tape

- 1 Connect the first piece of wire to a thumbtack on Switch 1.
- 2 Place the buzzer in the center of this wire piece.
- 3 Tape the end of the first piece of wire to one end of the battery.
- 4 Tape your second piece of wire to the opposite end of the battery.
- 5 Attach the end of your second piece of wire to the remaining thumbtack on Switch 1.
- 6 Use your third piece of wire to connect the thumbtack with the paper clip on Switch 1 to the thumbtack with the paper clip on Switch 2.
- 7 Use the fourth piece of wire to connect the remaining thumbtack on Switch 1 to the remaining thumbtack on Switch 2.

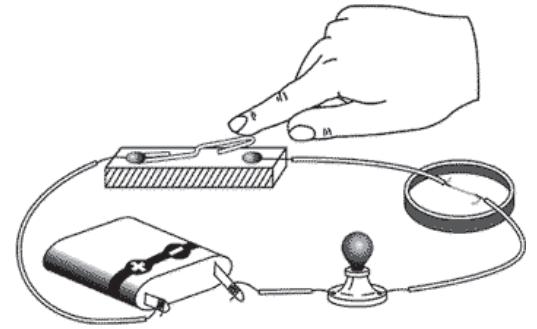
Try your doorbell out. You have a "front-door switch" and a "back-door switch." Since the switches are connected in "parallel," each one works separately. Hook up three, seven, a dozen, or even more switches using this method. All it would take is a lot of wire—and a lot of secret passwords!



Your Safety Catch-the Fuse

Has your sister ever turned on the hair dryer in the bathroom at the same time your brother was using the microwave in the kitchen while your father was doing some vacuuming in the living room and your mother was using a power saw in the garage?

If so, you know what happens next. If not, you can probably guess what happens! Most likely, everything stops. That's when someone has to run to the fuse box to "fix things."



Why does this happen? Because the levels of electricity are reaching dangerous amounts. If there is too much electricity passing through a circuit, a fuse will "pop," breaking the potentially overheating circuit. A fuse is what protects you from fire, burns - even death - from electricity.

Here's how to make your own fuse. Then you can test this safety catch yourself!

What you need

- 9-volt battery
- Small flashlight bulb (Make sure it is in a holder.)
- Three 6" copper wires
- Steel wool
- Small can or lid
- Switch (You make it yourself.)
You'll need a small block of wood. Put two thumbtacks about 2" apart on the block. Attach a twisted paper clip to one of the thumbtacks, making sure it can touch the second thumbtack when you press it down. Now you have a switch!

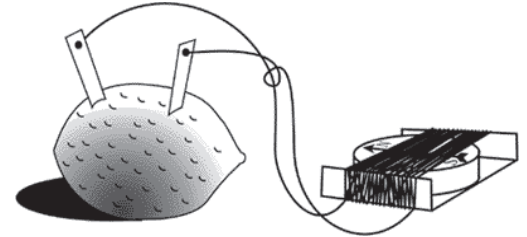
- 1 Join the flashlight bulb to one terminal on your battery with the first piece of copper wire.
- 2 Move the bulb to the middle of the wire piece.
- 3 Join the end of the first piece of copper wire to one end of your second piece of copper wire using a single strand of steel wool.
- 4 The steel wool strand acts as your fuse for this experiment.
- 5 Attach the other end of the second piece of copper wire to the thumbtack with the paper clip on it.
- 6 Use your third piece of copper wire to join together the remaining thumbtack and the remaining terminal on the battery.
- 7 Put your small can or lid under the steel wool connection to catch any hot pieces that fall.

You're ready to test the fuse. Press the paper clip to the thumbtack. Your bulb will work until your fuse overheats and breaks the circuit—just like at home!



Fruity Electricity

You'll create an electric current with a piece of fruit and watch the current move a compass needle. Keep your eyes open--a piece of fruit doesn't last long as a source of electricity!



What you need

- Lemon – this serves as the electric cell in your electric circuit. Electric cells allow electric current (which is a flow of electric charge) to flow through them. The citric acid in the lemon acts as the electrolyte for our lemon battery.
- 1/2" x 3" copper strip and a 1/2" x 3" zinc strip-these will act as your electrodes. Electrodes are two different kinds of metals that can make electricity between each other.
- Scissors and a knife
- Galvanometer (you will make this)

- 1** Making a galvanometer is easy! You need a compass, a thick piece of cardboard, and small spool of #28 magnet wire. Make a "bed" for the compass by sizing and cutting two pieces of cardboard to fit the compass, with enough cardboard left at the top and bottom to fold up to match the thickness of the compass. Glue the pieces back to front to make the "bed." Put the compass in its "bed" with N-S at the top. Take your wire spool and wind it from top to bottom 100 times around the compass. Make sure you leave 12" of wire free before you start winding. Twist the free ends together so the wire won't unwind. Cut the end piece of the wire so you leave another 12" free. Finally, scrape 1/2" of the insulation off both 12" wire ends. You're done with your galvanometer! You'll use this to see the effect of the electric current.
And now for your lemon battery...

- 2** Roll your lemon on a counter to get its inside juices flowing. (Remember, that's your electrolyte.)

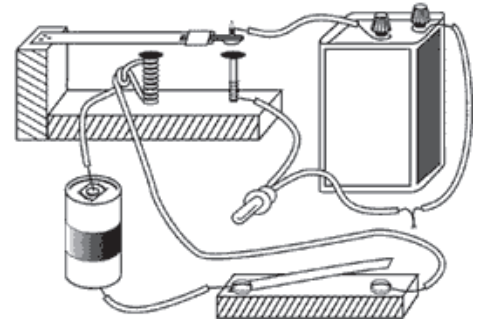
- 3** Cut two slits about 1/2" apart on the lemon.
- 4** Insert your copper and zinc electrodes. They should not touch each other in the lemon.
- 5** Hook up your galvanometer to the electrodes. Make sure the compass is level.
- 6** Watch the compass needle swing! The electric current should make your compass needle swing to the E-W direction.

For a variation on this experiment, replace the lemon with a small glass jar filled with vinegar. Instead of a galvanometer, use a light-emitting diode (LED) connected to two wires with alligator clips on each end. You'll put the copper and zinc strips in the vinegar to create a current that will light your LED.



Reach Out and Click Someone—By Telegraph

Long before cellular phones, way before faxes, and years before beepers, people kept in touch a very different way from today. They used a telegraph to send messages over distances. (You can see telegraphs being used in old western movies.) People received messages through a telegraph line as clicks on a “sounder.” The telegraph operator decoded the message.



Telegraphic communication was based on the electromagnetic relay. Build your own electromagnetic relay, using a light bulb to receive the message instead of a “sounder.”

What you need

- Two 4" x 2" x 3/4" wood blocks
- 2" x 2" x 3/4" wood block
- Nails
- Two roundhead screws
- 12 feet of hookup wire
- 4" x 1" ferrous (iron-based) metal strip
- 4" x 1/2" ferrous metal strip
- Popsicle stick
- Thumb tack
- Flashlight battery
- 6 volt battery
- 6 volt bulb—with socket and wires attached.

Experiment continues on the other side of this sheet, “Building your relay frame and electromagnet.”



Building Your Relay Frame and Electromagnet

Let's break this experiment into a couple parts

- 1 Nail a small wood block to the end of the larger wood block to make an 'L' shape.
- 2 Drive a nail into the longer piece about 1-1/2" in from the end. Make sure the top of the nail is lower than the top of the upright block.
- 3 Leaving some extra wire at the beginning, wind your wire around the nail 100 times, keeping the wire turns touching as you wind. Twist the ends so they won't unwind.
- 4 Drive another nail into the block 1/4" from the end.
- 5 Tape a piece of popsicle stick on top of the end of the 4" x 1" metal strip so that it sticks out 1/2".
- 6 Stick a thumbtack into the popsicle stick, head side down. The head needs to be scraped clean.
- 7 Nail the metal strip to the wood frame, lining up the thumbtack with the outside nail head.

Building your telegraph key

- 1 Bend the 4" x 1/2" metal strip and attach it to the remaining wood block with a screw.
- 2 Place the other screw at the end of the metal strip so they will touch each other when the strip is pressed down.

Make the following connections to send a message

- 1 Connect one telegraph key terminal to your flashlight battery.
- 2 Connect your flashlight battery to the wired screw, which in turn connects with a wire back to the other terminal on your telegraph key.
- 3 Connect one terminal of your 6-volt battery to the thumbtack stem on your relay frame.
- 4 Connect the other terminal to the bulb.
- 5 Connect the bulb to the outside screw on the relay frame.

When you press down on your telegraph key, an electromagnetic field goes into action and pulls the strip down. Your circuit is closed and the bulb lights up. Chances are kids back then didn't fight over the telegraph the way kids today fight over who gets to use the phone!