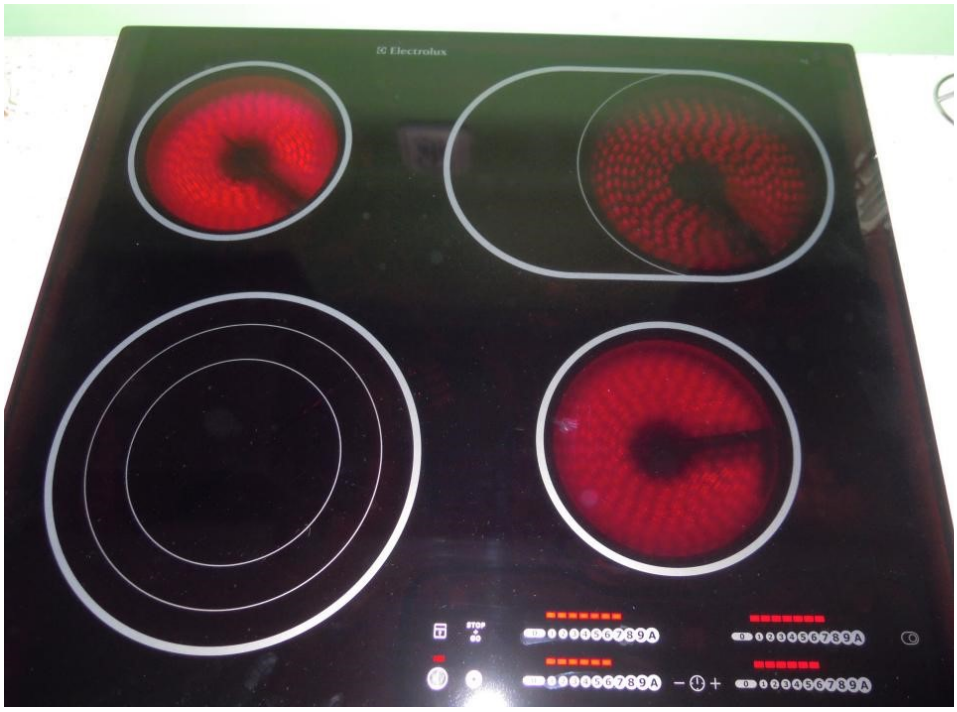
Electricity:

Let's Light It Up!

A Family Inventors' Lab Original

Look around you. What can you see that runs on electricity?

Here’s some hints: if it has a power switch, plugs in, or has a battery, it’s using electricity.



Electricity can make things glow with light, heat up, move around, or make sounds.

Learning about Electricity

Over 2,500 years ago, a Greek mathematician named Thales (*TAY-leez)* was polishing a piece of amber with fur. He noticed that after he did this, the amber would attract lightweight objects like dust, hair, or feathers.

Static Electricity

We now call that effect *static electricity.*

Have you ever experienced it?

On a slide?

In a ball pit?

When playing with a parachute?

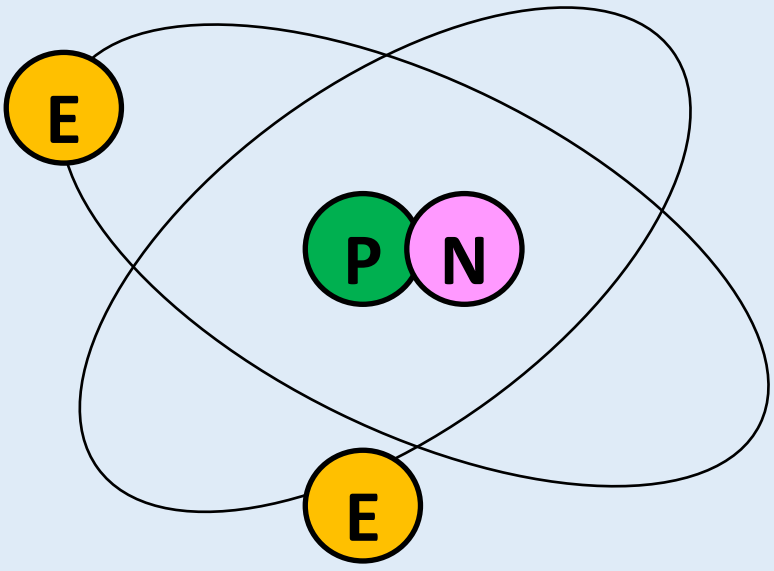
When you took clothes out of a dryer and they were stuck together?

(That's called *static cling*.)

Have you ever gotten a shock when you touched a friend or touched something metal?

What causes static?

Everything around us is made up of atoms—teeny tiny little particles – way too small for you to see. Atoms have electrons spinning around them, that can jump from one atom to another. That causes static.



Experience it:

Shuffle across carpet wearing socks. Touch a friend's finger, or touch something metal (like a doorknob or faucet) – you'll feel the shock. Turn off the light, and shuffle around – then reach toward metal - you may see the spark.

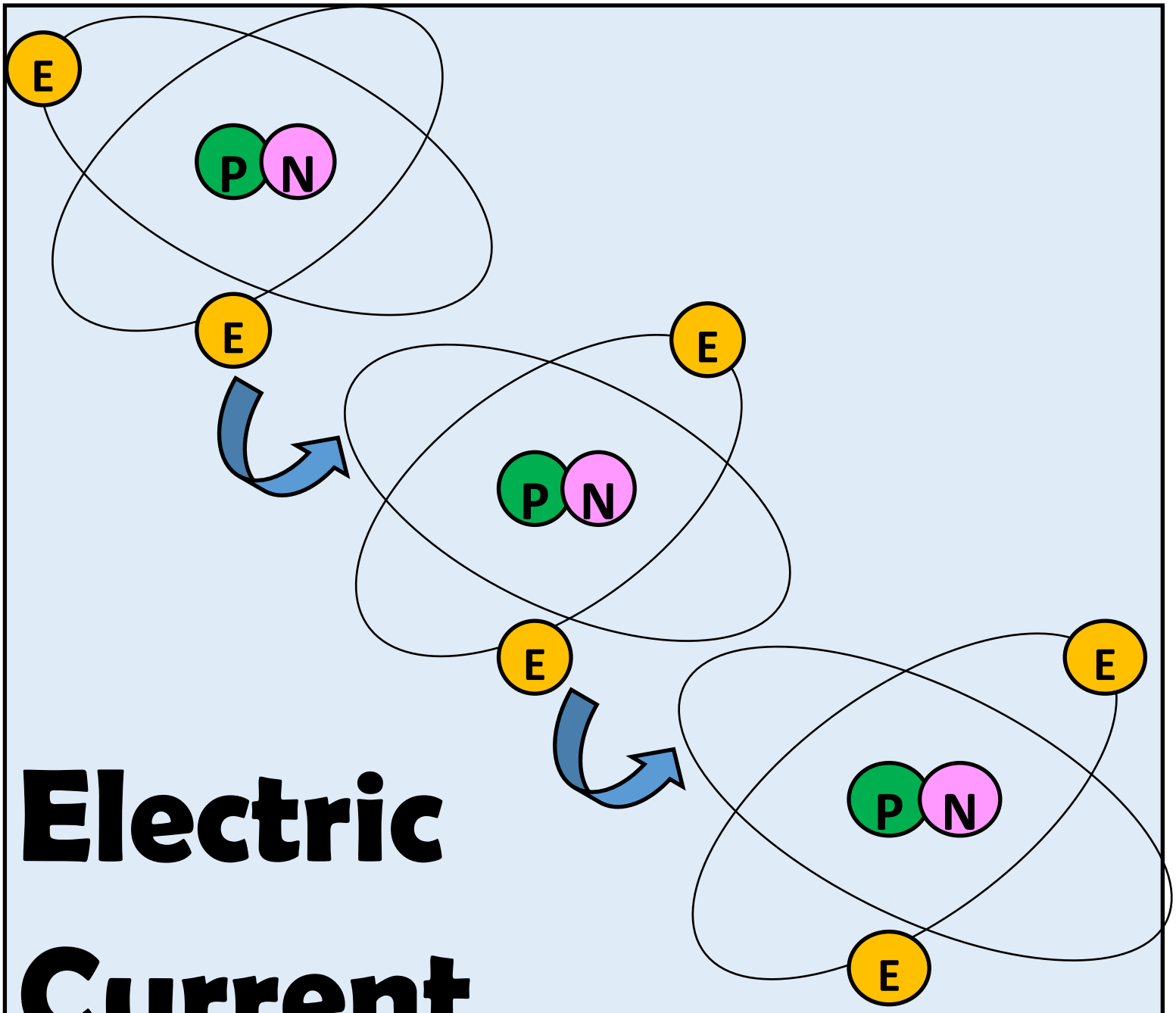
Experience It

Rub a balloon on your hair, or rub a plastic comb on a wool sweater. Wave it over feathers or tissue paper – it attracts. (Pulls things toward it.)

Hold a charged balloon near an empty aluminum can. Does it attract? Or repel (push the can away)?

Static electricity discharges very quickly.

When a lot of static electricity builds up in clouds, a mass of electrons can suddenly flow to the earth, creating a lightning bolt.



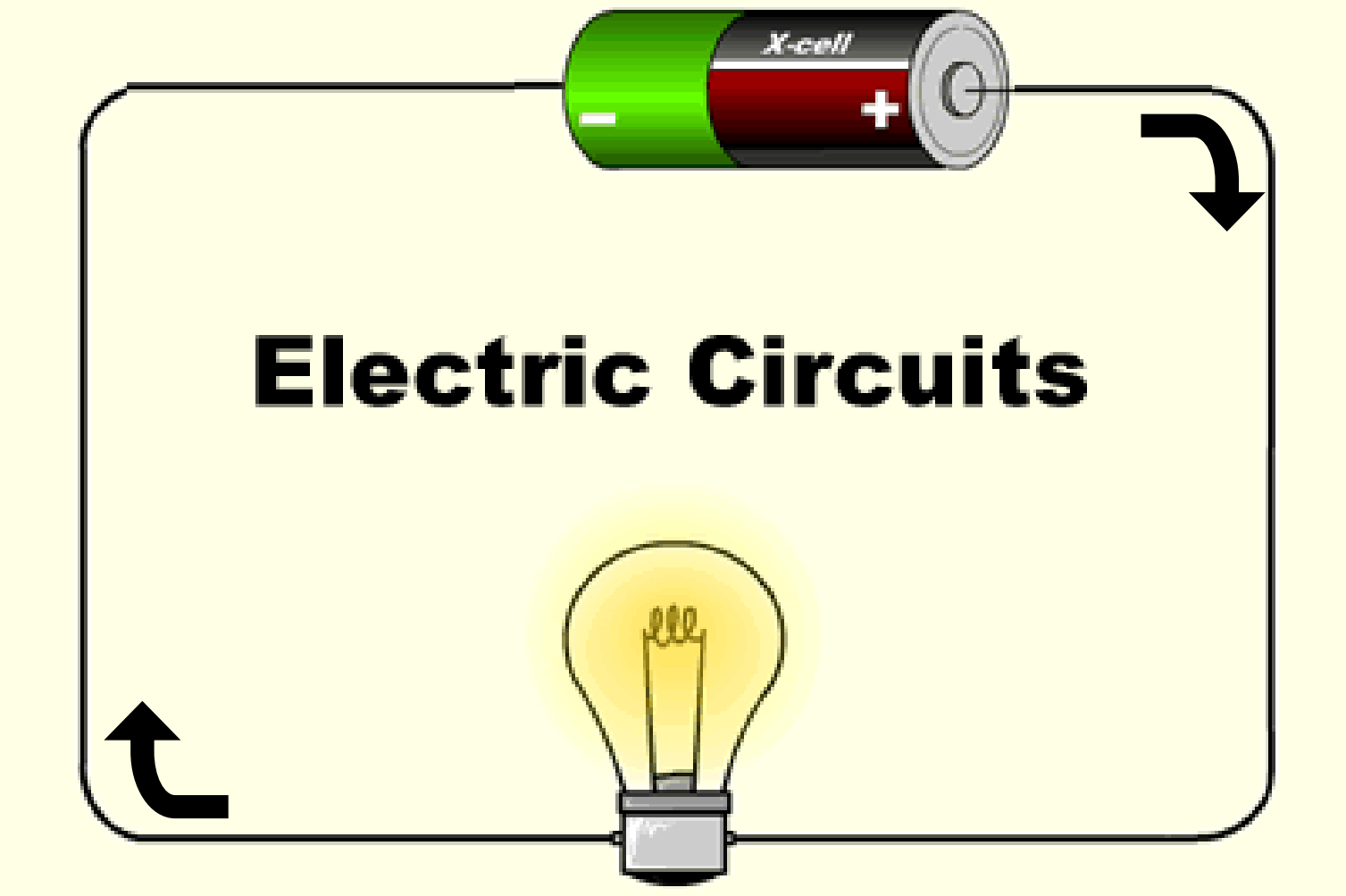
Electric Current

An electrical current is like a stream of water, where there is a flow of electrons jumping from atom to atom.

Experience it:

Play “Pass the Electron” game with friends. Stand in a line. Everyone is holding one ball. That’s your electron. The first person passes their ball down the line. When the second ball comes to each person, they have to pass a ball on, down the line. When the extra ball reaches the end, stop. The first person in line doesn’t have an electron. They are “positively charged.” The last person has two electrons. They are “negatively charged.” The negative charge and the positive charge attract each other – so let them wrap the ends of your line around to turn it into a circle. The last person hands the extra electron to the first, and the cycle can begin again and keep repeating. You’ve just created a circuit.

Electrical current can be harnessed in a circuit. If the circle is complete, current will flow.



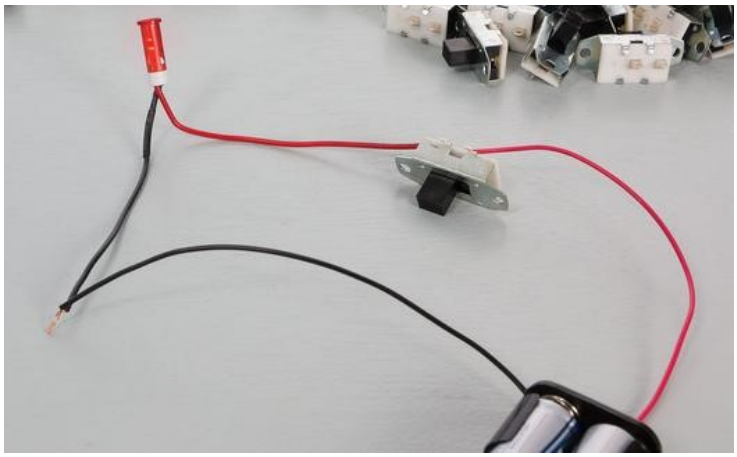
Electricity doesn't flow by itself. It needs a push. A battery can push electricity through a circuit (like a pump pushing water through a hose).

Experience it

Create an electrical circuit by connecting a wire to the positive terminal on a battery, then to a *component* – like a light, buzzer or motor.

Then use another wire to connect that component to the negative terminal of the battery.

The battery will push electrons along the wire, moving through the component, which converts the energy into light, sound, or motion. Then the current flows back to the battery.



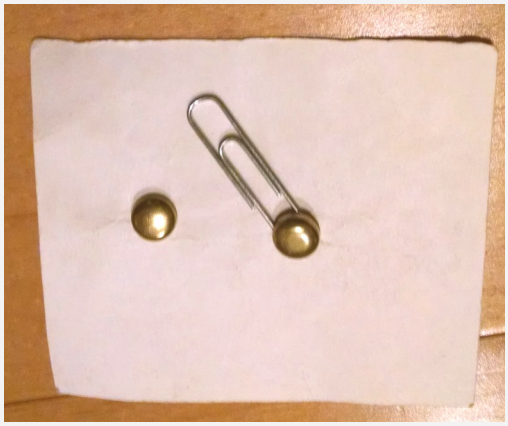
Switches

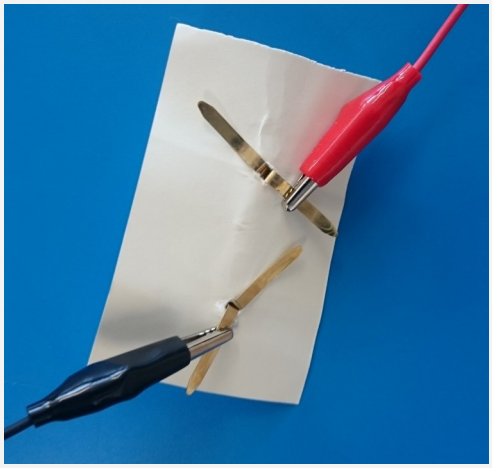
Lots of electrical objects have a switch to turn them on and off. When the switch is flipped one way, the circuit is complete, and the energy flows. Flipping the switch the other way breaks the circuit and the power goes off.

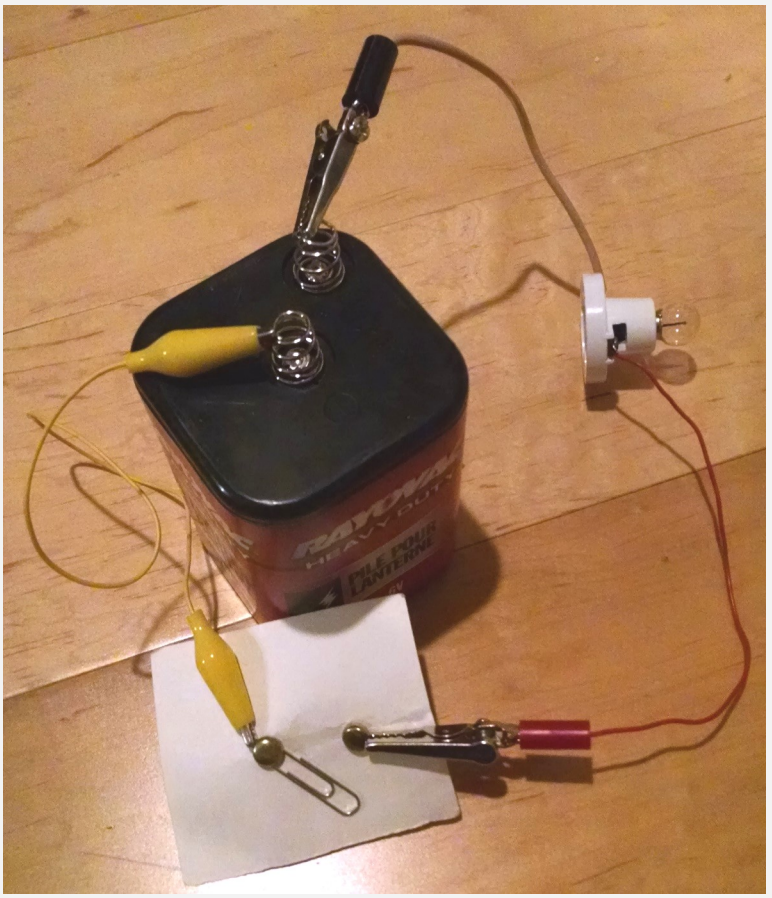
Experience it

You can make your own switch with an index card, paperclip and two paper fasteners!

When the paperclip is touching both fasteners, it completes the circuit. What happens to the light? If you move the paperclip so it's not connecting the fasteners, the circuit is broken. What happens to the light?



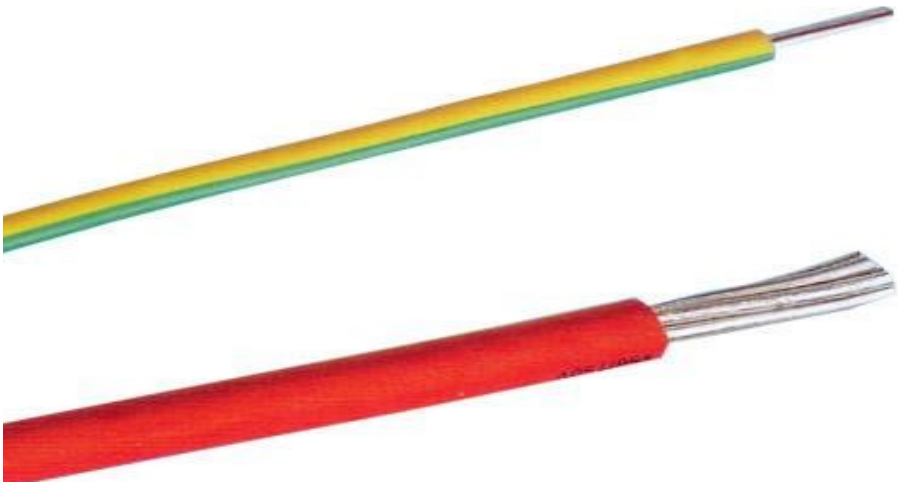




Conductors and Insulators

Electricity flows well through some things, like metal, water, and acid. These are *conductors*. Electricity doesn't flow through *insulators*, like glass, rubber, plastic, and air.

Metal wire that conducts electricity is often wrapped in plastic to insulate it.

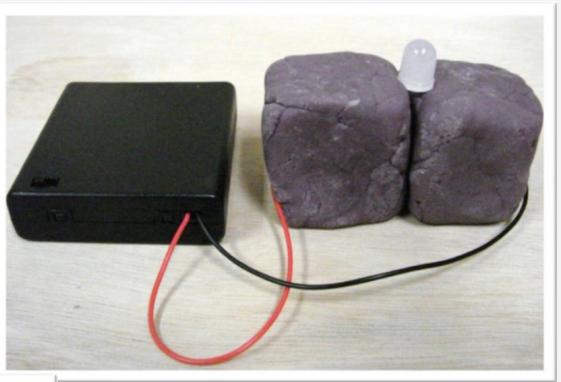


Caution: Electricity can be dangerous. Don't ever push anything into electrical outlets, or touch bare exposed wire.

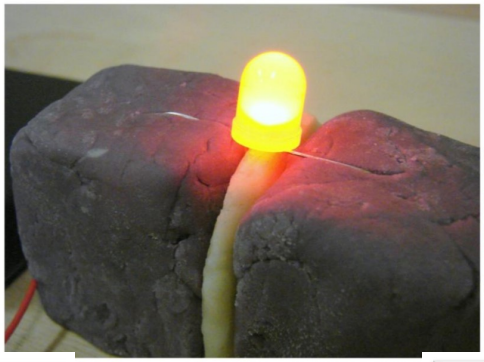
Experience it

Playdough has lots of salt. Salt is a conductor. Electricity can pass through it like it does through a wire. We can make a special playdough with sugar in it instead. Sugar is an insulator which blocks the current. You can play with these "squishy circuits."

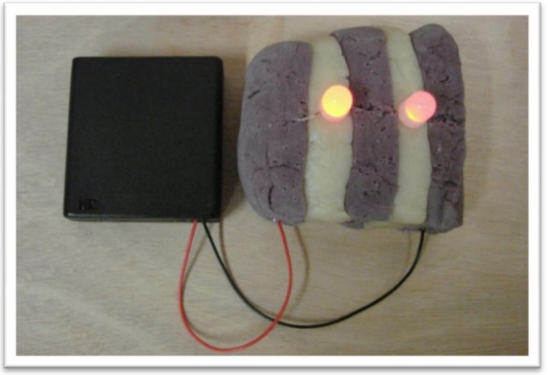
Basic Circuit



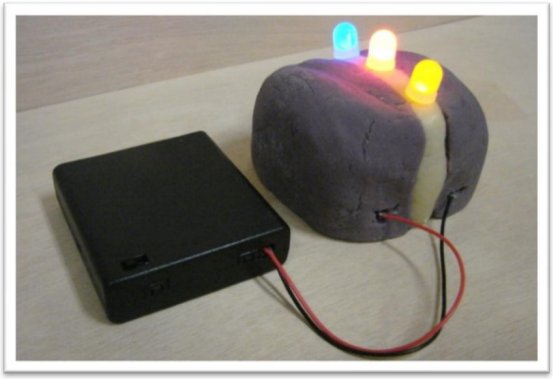
Short Circuit



Insulator



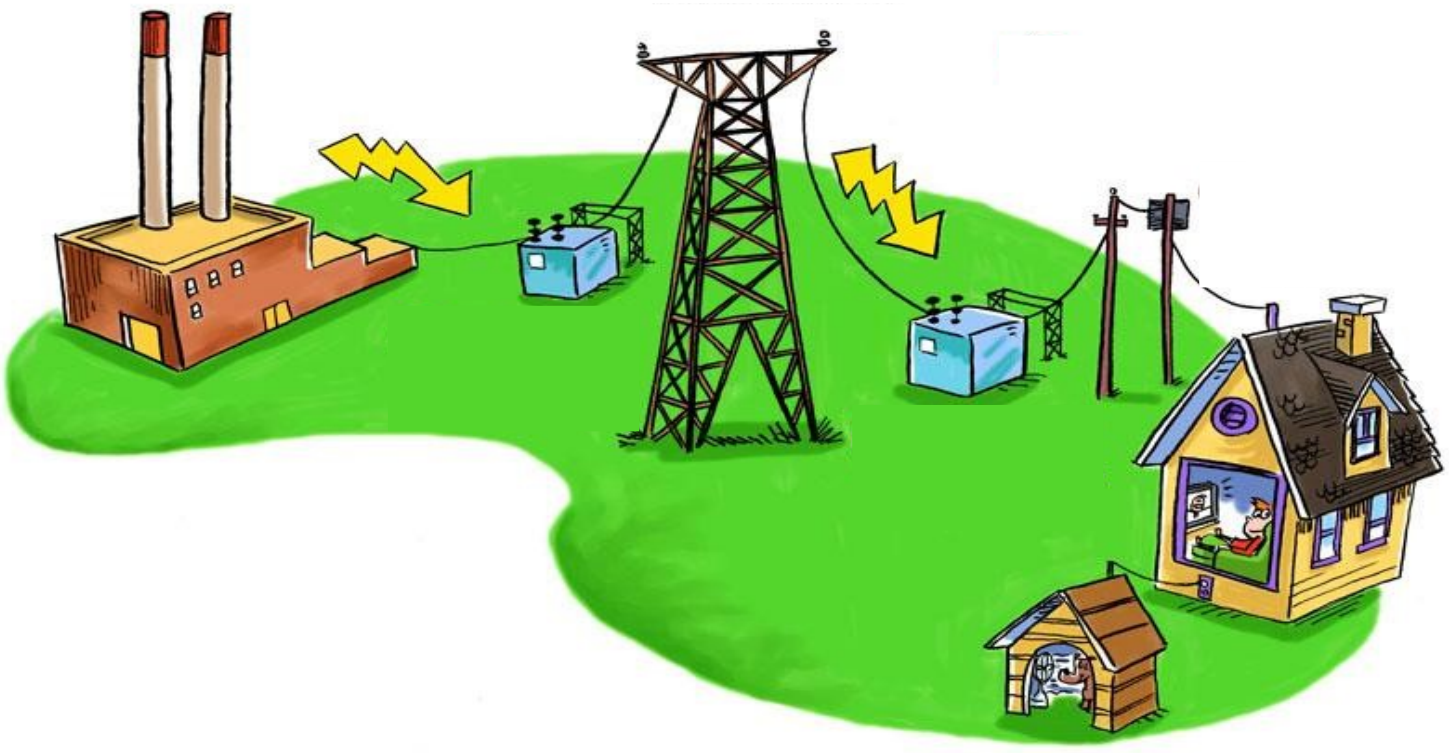
Series Circuit



Parallel Circuit

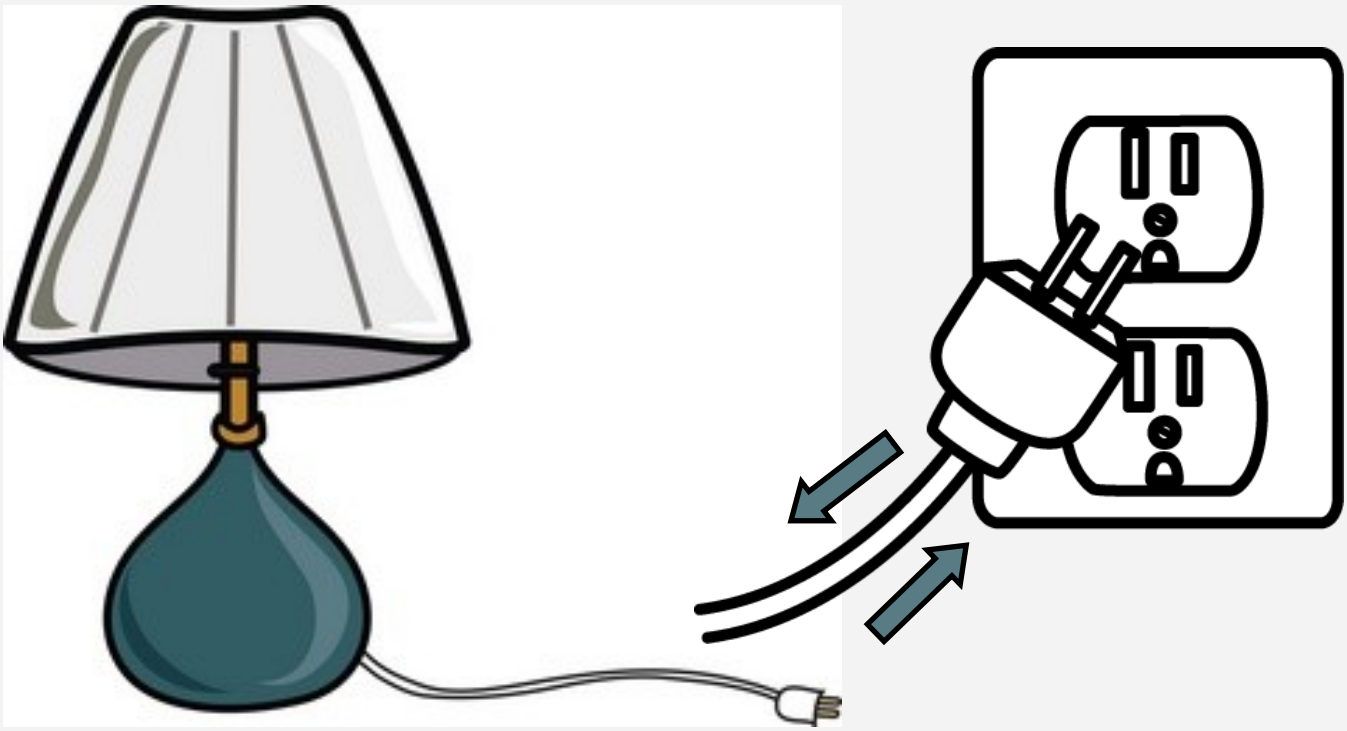
How does electricity get to your house?

Electricity is generated at a power plant. Energy from wind, water, coal, or other resources is used to turn a turbine. The magnet in the turbine then pushes electricity from the generator into power lines that travel to your home.



At home, the electricity travels on wires hidden inside your walls. When you flip a light switch, that completes a circuit. Electricity flows, and the light comes on.

Experience it.



Find a lamp. Ask an adult to unplug it and show you the two prongs on the plug, then ask the adult to carefully plug the lamp into the wall. Then you can switch the lamp on. When you turn the switch, electricity flows from the house through one prong of the outlet, through one wire inside the cord, into the lamp to light the bulb. Then the electricity travels out along a second wire inside the cord to the second prong, and back into the house circuit.

For Parents and Teachers—

Hands-On Activities to Inspire the Inventors of Tomorrow

Electrical Inventory

Have your child walk around the house or classroom and find all the things that use electricity. You can remind them of the hints from page 2—look for power switches, plugs, and batteries. Ask them what the electricity does for the device—does it make it glow, heat up, move, make sounds, or some other action? Point out items they miss.

Static Play

Look for ways to create static: rubbing stocking feet on the carpet, playing with a parachute, sliding down a plastic slide, rubbing a balloon in their hair, or rubbing a plastic comb on wool or silk.

Once you've charged something with static, what will it attract: try Styrofoam packing pellets, tissue paper, salt and pepper. Test it with an empty aluminum can to see what happens.

Make artwork with tissue paper cutouts, where you only glue down part of the tissue paper, and leave some hanging loose (such as a drawing of a tree with tissue paper leaves). Move a charged balloon over it—the tissue paper will rise up to meet the balloon.

Stick static charged balloons to the wall, to the furniture, or to each other. Blow bubbles and use e a static charged balloon to chase them.

Flashlight Tag

Outside after dark, give one child a flashlight. He counts to 20 while they hide. He then seeks them out, with his flashlight off. When he thinks he's spotted someone, he flashes the light on and off at them. He must be able to name them for the "tag" to count. Then he gives the flashlight to that person, who counts to 20 while he hides. (Other children can remain in their hiding place, or change to a new one at this time.

In a preschool setting, this can be played indoors in a dark room, without strict rules. Each child has a flashlight. They can turn it on and off whenever they want. If they catch someone in their beam of light, they shout out their name.

Song—Electricity is a Powerful Thing by teacher Cymbric. Make up your own tune.

"Electricity is a powerful thing, I know, I know. Electricity is a powerful thing, I know, I know. Electricity [heats our homes], I know, I know. Electricity [heats our homes], I know, I know."

Ask children to name other things that electricity does, and fit them into a verse, substituting them for the words 'heats our homes.'

Pass the Current Game

Have kids hold hands in a circle. Squeeze a child's hand, they squeeze the next hand, and so on, to pass the current all the way around a circle. Optional: declare one kid to be the switch, and the person next to them to be the light. Child A says "switch on" and the "current" has to pass all the way around the circle to reach child B, who says "the light's on."

Circuit Demonstration—page 14

For the demonstration, you'll need the following supplies: batteries, wires, a component such as an LED light, a buzzer, or a motor. If you're buying these for the first time, teachergeek.com is a good resource. Get a two-AA battery holder with wire leads, and some 3-volt LEDs.

Make a simple circuit, and demo it a few times so kids can really see that when a circuit is complete, the component works (e.g. the light comes on), and when the circuit is open, it does not work.

DIY Switch—page 16

Take an index card. Set a paper clip on top of it. Then poke a metal paper fastener (a brad) through one end of the paperclip and through the card, then open up the prongs of the brad on the back of the card. Put a second brad where the paperclip can touch it. Then swing the paperclip away, push that brad through the card. Open the prongs, being sure they do not touch the prongs on the other brad. Wind the wires from the positive terminal around the prong of one brad, and the wires from the negative terminal around the other. To turn the switch on, swing the clip down so it is touching both brads, connecting them. To turn it off, move the paperclip so the brads are not connected.

Squishy Circuits—page 18

Make two batches of playdough. (Or you can use store bought playdough for the conducting dough.)

Conductive dough: In a bowl, mx together 1.5 cups flour, 1/2 cup salt, 3 tbsp cream of tartar, and 2 tbsp of vegetable oil. In a pot, boil 1 cup water, add plenty of food coloring. Mix the water into the flour, a little at a time, till mixed. Once dough has cooled enough to hand, spread some flour on a counter, place the ball of dough on it, and knead it till it is a nice consistency, adding flour if needed.

Insulating dough: Mix 1 cup flour, 1/2 cup sugar, 3 tbsp of vegetable oil in a bowl. Mix in a half cup of water by adding a little at a time, and stirring. Flour the counter and knead the dough, as above.

Simple circuit: Make two balls of conductive dough. Make sure they're not touching. Put the wire from the positive battery terminal into one. Put the wire from the negative terminal in the other. Take the wires on the bulb, and put one into one ball of dough, and one in the other. The bulb will light.

(Please go to www.squishycircuits.com to learn about the other circuits and lots more!)

Books

- Oscar and the Bird by Waring. Oscar the kitten has lots of questions about electricity, and his friend Bird knows the answers. Ages 4—8.
- Switch On, Switch Off by Berger. Or Electricity: Bulbs, Batteries and Sparks by Stille. Non-fiction overviews for ages 5—8.
- The Boy Who Harnessed the Wind by Kamkwamba. The true story of a boy in Malawi during a drought, who explored science books in the library, then built a windmill from scrap metal and old bicycle parts which brought electricity to his home and helped his family pump the water they needed. There is a picture book version for ages 5 to 8, or a memoir for middle school ages.

Note to Parents and Teachers: This book is intended to introduce children age 5—6 to some basic concepts of electricity. Have fun experimenting together! If you'd like ideas for more hands-on STE(A)M activities for kids, check out my website, www.InventorsOfTomorrow.com