Electricity

Recommended for Grades 4-8

Ever wonder why, when you flip a switch, the light comes on? It's not magic, it's electricity! So, what is electricity?

Just like **atoms** and **molecules** are the building blocks that make up all the stuff around us, electrons are one of the building blocks that make up atoms. Atoms are really made up of three kinds of building blocks - **neutrons, protons, and electrons**. Neutrons and protons are in the middle of the atom, and the electrons move around them. Neutrons do not have a charge, but protons have a positive charge and electrons have a negative charge. Opposite charges attract each other, while the same charges push each other away (just like magnets). The protons in the atom are attached to the electrons in the atom because they have opposite charges.

Sometimes electrons move from one atom to another atom. If electrons collect and stay on something, they make a negative charge. Electrons can move and keep moving. When they do, it's sort of like water flowing downhill. Water will move from a high place to a low place (like a waterfall). Electrons will do the same thing. They will move from a place with what we call a high potential to a low potential. When electrons move, we say there is an electrical current, just like we say there is a current in the river – a direction the water is moving. Electricity is what you get when the electrons move around (called an electric current) or collect in one place (called a static charge).

We can make electrons move by creating a path for them with metal wires. We also have to make the electrons move by making a difference in potential which is done by putting a positive charge on one end of the wire and a negative charge on the other. We must do one other thing to make the electrons flow - we must make a complete circle, or circuit. Otherwise the electrons would get to the end of the path and just stop. When you flip on a light switch, you complete the circuit - you connect the wires that make a path for the electrons to flow. The electrons flow through the light bulb, and it makes the light glow. Presto!!

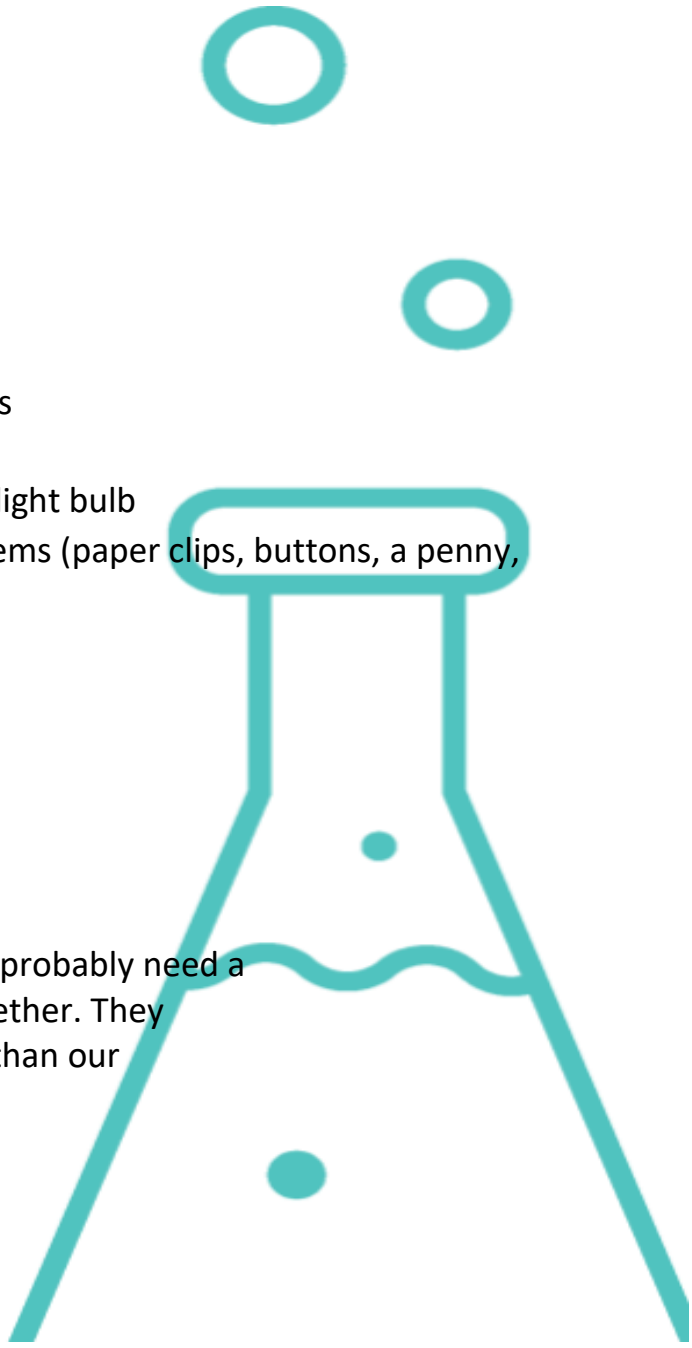
Thank you to the WIN Chapter at Oak Ridge National Lab, Tennessee for lesson plan development.

HERE ARE THE ACTIVITIES WE'LL DO AS WE INVESTIGATE ELECTRICITY:

- See a static charge by making an electroscope
- Make a test circuit and see how well different objects conduct electricity
- Put your knowledge to use and make a flashlight

THINGS YOU WILL NEED:

1. Clear plastic cup
2. Large paper clip
3. One sheet of colored stickers
4. A balloon
5. Sheet of tin foil
6. Two "AA" batteries and a battery holder
7. Two wires with alligator clips on the ends
8. Plain piece of wire
9. A flashlight bulb and a base for the flashlight bulb
10. Electricity test kit with assorted small items (paper clips, buttons, a penny, clothes pin, etc.)
11. Sheet of white stickers
12. A white plastic cup
13. One sheet of white card stock
14. One sheet of blue card stock
15. Empty toilet paper or paper towel tube
16. Newspaper



Note for Educators and Parents: Children will probably need a little more help putting these experiments together. They are not difficult, but they are just a bit longer than our usual experiments.

See a Static Charge- Make an Electroscope

Have you ever rubbed a balloon on your head to make your hair stand up? When you do this, you are making a **static charge**. You can't see a static charge, but you can see what it does. This project makes something called an **electroscope** that shows you a static charge.

What is a static charge? All materials are made up of billions of atoms. Each atom has a center, or nucleus, with electrons swimming around it. Rubbing can make the electrons move. When electrons move from one material to another, it gives one material a positive charge, and one a negative charge. The charges stay, or remain static, on the surface of the material until they have a path to move on or discharge. Static charge can pull things together or push them apart because, like magnets, opposite charges attract and like charges repel (push apart).

YOU WILL NEED:

- Clear plastic cup
- Aluminum foil
- Metal paper clip
- Sheet of colored stickers
- Balloon
- Scissors and ruler

WHAT TO DO:

TO MAKE THE ELECTRROSCOPE

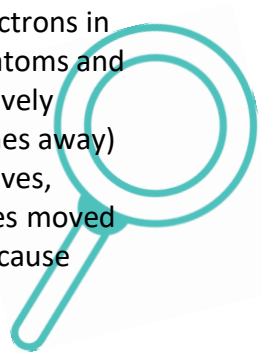
1) Unfold the paper clip so that it looks like a long J.
2) Cut two strips of foil that measure roughly ¼ inch by 1 ½ inch. Use your fingers to gently smooth out the foil strips and remove any wrinkles.
3) Use the end of the paper clip to punch small holes in the one end of each foil strip. Wad the rest of the aluminum foil into a little ball.
4) Use the paper clip to make a small hole in the bottom of the clear plastic cup.
5) Hang the foil strips, called leaves, on the curved end of the J.
6) Holding the cup upside-down, put the straight part of the J paper clip through the hole in the cup, so the leaves hang inside the upside-down cup without touching the table or desktop.
7) Fix the paper clip in place with the colored stickers.
8) Put the aluminum foil ball on the top of the paper clip that is sticking out from the cup. **The electroscope is complete and ready for use!**

TO USE THE ELECTROSCOPE

1) Blow up the balloon and tie it off.
2) Charge the balloon by rubbing it in your hair.
3) Slowly bring the charged balloon near the foil ball on the electroscope and watch how the leaves react. DON'T touch the balloon to the foil ball, or you will remove the static charge. (If you do, just charge the balloon again!)
4) Move the balloon away and watch the leaves of the electroscope.

WHAT IS HAPPENING?

When you rub a balloon on your head, the energy of rubbing, or friction, gives the electrons in your hair and the balloon extra energy. Some of the electrons break away from their atoms and wander off on their own. Some of them collected on the balloon and it became negatively charged. When the negatively charged balloon comes near the foil ball, it repels (pushes away) some of the electrons in the foil. Those electrons travel down the paper clip to the leaves, giving each of the extra electrons a negative charge. Since like charges repel, the leaves moved away from each other. The leaves of the electroscope move away from each other because they both have a negative charge and repel each other.



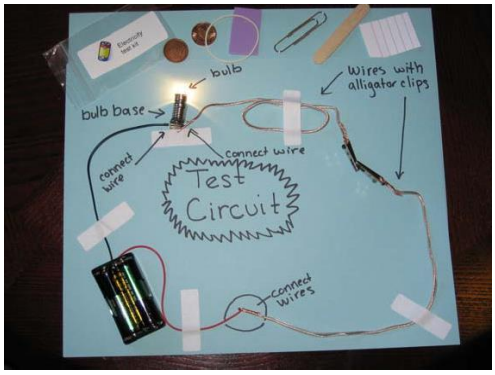
A Basic Circuit

Batteries can store an electric charge. When they are put together with the right things, the stored charge can flow and produce electricity. The things you put together to release the charge in the batteries is called a **circuit**. A circuit gives the electrons a path to move along.

Some materials let electrons travel through them better than others. These are called **conductors**. Let's look at some different materials and see if they conduct electricity.

YOU WILL NEED:

- 2 "AA" batteries and battery holder
- 2 wires with alligator clips
- A flashlight bulb and a base for the bulb
- An electricity test kit with buttons, a penny, clothes pins, clothespin, etc.
- Five stickers (white or colored) - these will help hold things in place
- Sheet of blue card stock



WHAT TO DO:

TO MAKE THE TEST CIRCUIT

1) Unwrap and carefully straighten the wires. Set aside the two wires with alligator clips on the ends.
2) Carefully screw the light bulb into the base. Use a sticker to tape the base to the blue paper- the base has a flat metal piece that sticks off the bottom for this.
3) Put the batteries into the holder, using the pictures on the holder to guide you appropriately.
4) Attach one wire from the battery holder to one side of the bulb base. Use a sticker to hold the wire down to the paper and keep it from moving. The wire from the battery holder just needs to go through the hole and be bent over - it needs to stay in touch with the lamp base for the experiment to work.
5) Attach the other wire from the battery holder to one of the wires with an alligator clip on one end. Attach the wire to the end without the alligator clip. Use a sticker to hold these in place. Again, the two ends of wire need to stay touching each other for the experiment to work.
6) Attach the other wire with an alligator clip to the free side of the lamp base. Use the end without the alligator clip. Use a sticker to hold the wire down on the sheet - you may need to bend the wire so it will fit on the paper.

7) Clip the two alligator clips together. If your circuit is all connected, the bulb should light up, just like the picture. Did it work?
8) If your light is not working, you need to check all the wire connections to make sure the wires are all touching, and the batteries are in the holder correctly. Once your light is working, your test circuit is ready to use!

TEST THE MATERIALS TO CONDUCT ELECTRICITY!

1) Now test different materials to see if they will conduct electricity. Unclip the alligator clips on your test circuit.
2) Pick an item from your electricity test kit, like a paper clip. Clip one alligator clip to one side of the paper clip, and the second clip to the other. MAKE sure the alligator clips are not touching each other!!
3) Did the bulb light up when you completed the circuit? Write what happened in the chart that accompanies this experiment.
4) Test other items in the bag and fill in the chart. If the bulb lights up, it is a good conductor. Which items from your test kit are good conductors?

Did You Know? *In 1800, Alessandro Volta made the first battery by layering copper, zinc, and pasteboard soaked in saltwater. When these things touched each other in the order Volta put them together, they created the first steady supply of electricity. These days, the steady supply of electricity from batteries is used to power all sorts of electrical devices such as toys, light bulbs, radios, calculators and cars.*

Electricity Test Chart		
What I tested	**Did the bulbs light up?**	**Good or bad conductor?**
Paper clip		
Wood stick		
Real Penny		
Paper		
Rubber band		
Foam sheet		
Other Item		
Other Item		
Other Item		
Other Item		
Other Item		

Let's Make a Flashlight!

A flashlight is the same type of basic circuit you made to test how well materials conduct electricity. It is made from batteries connected to a light bulb. When a flashlight is turned on, all the wires are touching each other and the circuit is closed, allowing the electrons to flow. When the flashlight is off, two of the wires are pulled apart so electrons cannot flow, and the bulb does not light up.

YOU WILL NEED:

Note: Dismantle your basic circuit to reuse your materials and make this flashlight!

- 2 "AA" batteries and a battery holder
- 2 wires with alligator clips on the end and one plain wire
- 1 white plastic cup
- A flashlight bulb and base for the bulb
- An empty toilet paper tube or paper towel tube
- White stickers to help hold things in place
- Sheet of white card stock
- Scissors and colored pencils

TO MAKE THE INSIDE OF THE FLASHLIGHT

1) Carefully screw the light bulb into the base.
2) Look at the batteries. One end of each will have a flat end, and one end will have a bump. Look at the battery holder, and you will see a picture of how the batteries should go into the holder. Put the batteries into the holder.
3) Attach one wire from the battery holder to one side of the bulb base. Use a sticker to hold the wire in place and keep it from moving; the wire from the battery holder just needs to go through the little hole and be bent over – it needs to stay in touch with the lamp base for the experiment to work.
4) Attach the other wire from the battery holder to one of the wires with an alligator clip on one end. Attach the wire to the end without the alligator clip. Use a sticker to hold this in place., the two ends of wire just need to stay touching each other for this to work.
5) Attach the other wire with an alligator clip to the free side of the lamp base. Use the end without the alligator clip. Use a sticker to hold the wire in place.
6) Touch the two alligator clips together. If your circuit is all connected, the bulb should light up. Did it work?
7) If your light is not working, you need to check all the wire connections to make sure the wires are all touching and that the batteries are in the holder correctly. Once your light is working, you can assemble the flashlight.

Note: The wire with the alligator clip coming from the light bulb will need to be long enough to go down through the paper tube and stick out of the bottom of the tube. If it is not long enough to do this, use the extra piece of wire (that doesn't have any alligator clips on it) to make it longer. **Remember, test your light before you go any further!**

TO ASSEMBLE THE FLASHLIGHT

1) If you are using a paper towel tube, cut this to the same length as a toilet paper tube. Cut out the shapes shown on the white card stock.
2) Fold a sheet of newspaper or scrap paper until it is as wide as your paper tube is long. Wrap it around the battery holder and the wires so that the bulb is at the top, and the alligator clips come out of the bottom. This will keep you from squishing your flashlight when you hold it. Make sure the roll will fit inside the paper tube- you may need to remove some of the newspaper. When it will fit, use a sticker or two to hold the newspaper in place.
3) Now push the newspaper and guts of your flashlight into the empty paper tube. The light will stick out one end and the alligator clips will stick out the other.
4) Clip the alligator clips to the side of the paper tube for now. Put one of the cardstock circles over the bottom of the tube- the alligator clips and wires will stick out a little on one side. Fold the tabs down and hold the paper circle in place with some stickers.
5) Poke a hole in the other circle you cut out with a pencil. Put this over the light bulb to cover the top of the flashlight. Fold the tabs down and use two stickers to hold it to the paper tube.
6) Now wrap the large rectangle you cut out around the paper tub. Use stickers to hold it in place.
7) Poke a large hole in the bottom of the white plastic cup. Put the small end of the cup with the hole over the bulb end of the paper tube. Fix it in place to the paper tube with stickers.
8) Decorate your flashlight.
9) Now you should have a working flashlight! Turn it on by clipping one alligator clip to the paper tube and the other alligator clip to the one attached to the paper tube. Presto! Light!