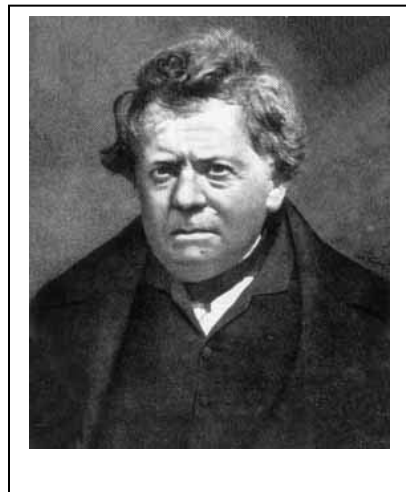




Discovering Ohm's Law

Student Worksheet

Ohm's Law Background

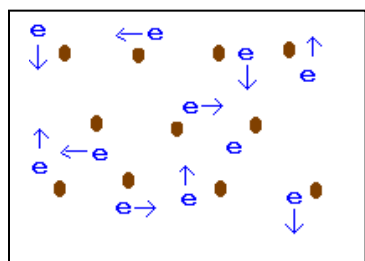


Georg Simon Ohm lived from 1789 to 1854. He was a mathematics teacher. He became interested in the new field of electricity. At the time physicists didn't use mathematics. Ohm combined his mathematics and the results of his electrical experiments to produce Ohm's Laws.

What is electricity? To answer that question we need to review what atoms are. Atoms are composed of 3 kinds of particles-protons, neutrons, and electrons. Protons and neutrons are packed together in the central nucleus. Protons have a positive charge. Neutrons don't have a charge. Neutrons are neutral.

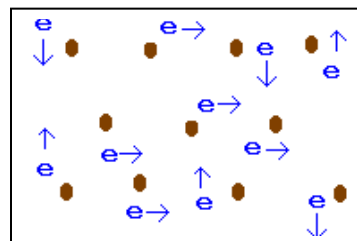
The nucleus is very small and has almost all of the mass of the atom.

The third particle in an atom is the electron. Electrons have a negative charge. Electrons move outside of the nucleus. In most atoms the electrons stay with one atom. In metals the electrons are only held loosely. The metal's electrons can move from one atom to another.



In a gold ring or chain the electrons are moving from atom to atom all the time. The electrons are moving randomly. On average the same number move left as move right. This isn't electricity because there isn't a net movement of electrons.

Electrons feel the push and pull of an electrical field. If you use an electrical field to push the electrons from left to right we can encourage more of the electrons to move right. When more electrons are moving right than left you have an electrical current. Batteries push and pull the electrons to make electricity.

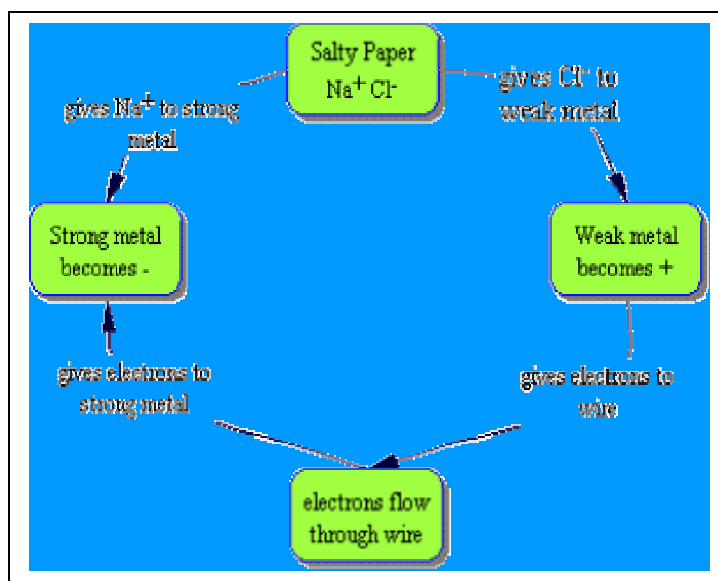




How do batteries work? Remember that metals don't hold their electrons tightly. One difference between metals is how strongly they pull on their neighbors' electrons. In effect some metals can steal electrons from other kinds of metal. You can think of it as a tug of war between the metals. If one metal is very strong it can quickly steal a lot of electrons. If both of the metals are about the same strength very few electrons are stolen. Voltage is the name for how strong the net pull is.

In your battery the electrons in the wire are the rope in the tug of war. The strong metal pulls electrons from the wire. The weak metal gives electrons to the other end of the wire.

Remember that electrons have a negative charge. If one metal steals electrons it becomes negatively charged. When the charge gets strong enough the metal can't steal more electrons. In the experiment you connected the two metals with the salty paper. Salt is made of sodium (Na^+) and chloride (Cl^-) ions. The Salt ions move in the paper to balance the charge on the metals. To keep the electricity flowing, the two metals need to be connected with a loop or circuit.



A flashlight is an example of a circuit. The battery supplies the energy to pull the electrons. The electricity flows to the light bulb and back to the other end of the battery.

The electricity flows through the filament in the light bulb. It is hard for the electrons to move through the filament. As the electrons move they bump into the filament's atoms and give up part of their energy. The filament's atoms get hot as they shake faster and faster. When the atoms get very hot they start to give off light.



A measure of how hard it is for electricity to move through a substance is resistance. If a substance has a high resistance then very few electrons will flow through it. A copper wire has very low resistance. It is easy for a lot of electrons to flow through copper wire. The resistance to the flow of electricity is measured in ohms.

Current is the term used to describe how many electrons are flowing past a point in the circuit. An ampere meter measures current. The unit of current is amperes (or amps).

Scientists use voltmeters to measure voltage. Voltage is the potential difference or difference in push on electrons at two different points in a circuit. You can measure the difference in push at the two ends of a battery. For example a flashlight battery has a potential difference of about 1.5 volts.



How do batteries push electrons to make electricity?

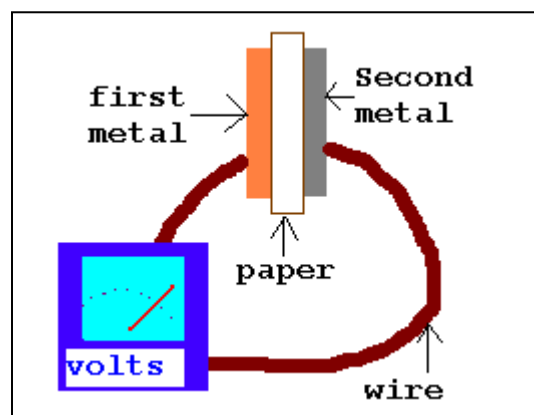
You will need the following items:

- A voltmeter or battery tester to check if you are making electricity.
- Wires to connect your battery to your voltmeter.
- Several different kinds of metals, coins, jewelry, metal chairs, doorknobs, copper pipes, scissors, lead sinkers, etc.
- Paper soaked in salt water.

1. Practice using your voltmeter with a flashlight battery. Be sure that you know what to expect when electricity is flowing through the meter.

2. Select two different kinds of metals. Separate them with the saltwater paper. Both of the metals must touch the paper. Don't let the metals touch each other. This is your battery. Connect your voltmeter the same way you did with the battery.

3. Record the voltage of your battery. Repeat the process with different metals.



Metal 1	Metal 2	Voltmeter reading

