Science is Power! Energy Everywhere!
Public Science Day 2002 at OMSI

History of Electricity

Objective

In this presentation, students will learn about the historical sequence of discoveries that allowed electricity to become the most versatile and useful form of energy we use today.

Science Topic	Process Skills	Grade Levels
History Physics Chemistry	Questioning Experimentation	7-12

Materials

If your school doesn't already have some of these props, the following websites may be useful for making or purchasing them:

www.sargentwelch.com
www.carolina.com
www.eskimo.com/~billb/scied.html
www.howstuffworks.com
www.billnye.com

Presentation

Electricity is probably the most versatile and useful form of energy that we use today, but it's not really a source of energy; we have to use something else as a source of energy and then convert that into electricity. Think for a moment about all of the sources of energy you've studied, and how many of them are used to create electricity. Can you name some for me? *(coal, hydropower, nuclear, solar, wind, natural gas, geothermal...)*

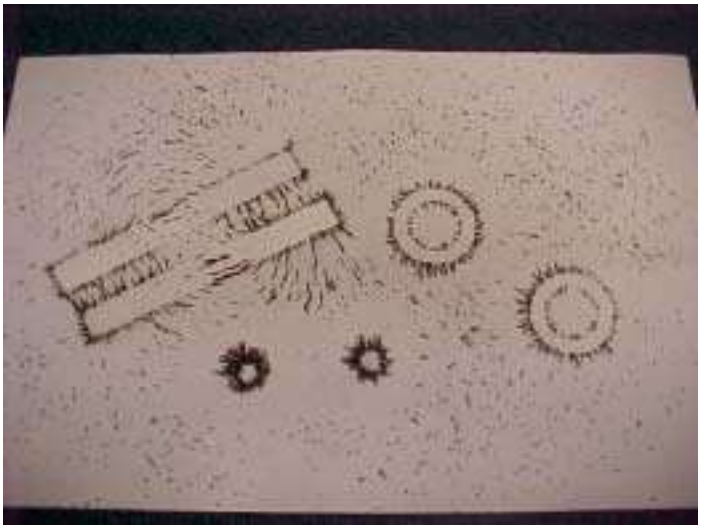
Electricity History

It took scientists many years to figure out what electricity is, how to produce it, and how to use it to create all the things we have today. As long ago as 600 BC, a fellow in Greece named Thales experimented with static electricity. One of his observations that he wrote down was that static electricity has attracting properties similar to magnetism.

Lets compare the attracting powers of magnetism and static electricity for our-selves. Back then they probably experimented with naturally occurring magnets called "lodestones".

Show a lodestone; use it to attract paperclips.

And here are some modern day magnets. We can study this mysterious attractive force by making it visible with iron filings:



Put a variety of magnets under a large sheet of paper, sprinkle iron filings on it.

Now lets look at static electricity. Back then they could create static electricity by rubbing chunks of amber, which is fossilized tree sap. Today we can create static electricity much easier than the ancient Greeks because we have so many newer types of materials to rub together.

Rub a balloon on your hair,
Use it to attract paper punch holes.

Electricity History
This is the sort of attractive power that Thales compared to magnetism. Many centuries later in the 1500's it was decided to use the Greek word for amber – "electron" - to name this force, and so we call it electricity. Notice that even in this simple example of we have to use some other source of energy to create the electricity. Can anyone tell me what that source is? *(the mechanical energy of rubbing the balloon*)

Can some of you tell me where you've seen or experienced static electricity?
(Possible answers include: shuffling feet on the carpet and touching a door knob, petting a cat on a dry day, plastic slides, trampolines, getting out of a car, clothes dryer, lightning)
Here's another example that you can try at home:

Run a plastic comb through your hair several times, then hold it very near a thin, smooth falling stream of water (laminar flow). The charged comb will pull the stream to the side.

For a couple of thousand years after Thales in Greece, static electricity was still the only kind of electricity anyone knew about, but by the 1800's scientists were pretty clever creating bigger sparks of static electricity to study. Benjamin Franklin used a device with a big glass jug to create static electricity. He would turn a crank to spin the jug, and then rub various materials against it. Another scientist invented a machine with rotating glass disks like this. It's called a Wimshurst machine, named after James Wimshurst:

Turn the crank on a Wimhurst machine to create big sparks.

Electricity History
This kind of electricity was not very useful, and it was hard for early scientists to study because it can be very unpredictable and hard to control. Then a fellow named Alessandro Volta came along and invented the battery. Now for the first time he and other scientists and inventors could create a steady flow of electricity. They didn't call it a battery though, they called it a "voltaic pile"; can you guess why? *("Voltaic" for Volta, "pile" because it's a stack or pile of metals)*

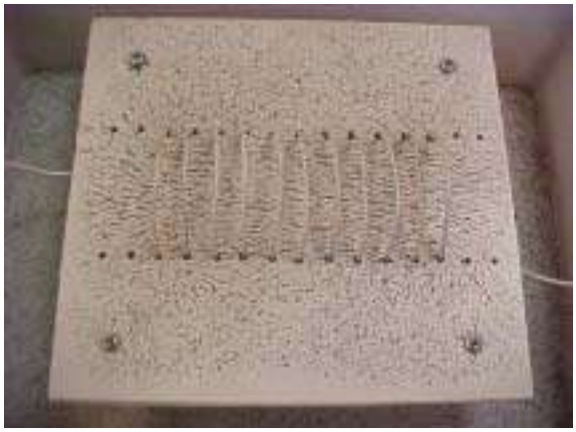
A battery can be made with pennies and zinc with salt-water soaked paper in between. Connect it to a light, motor, or meter.

Can anyone tell me what kind of energy we're using to create electricity now? *(chemical)*

Now that they had a steady flow of electricity, one of them noticed an unusual thing; electricity flowing through a coil of wire seemed to affect a compass nearby.

A 4-6 Amp current at 12 Volts through a thick wire will affect nearby compasses.

They knew there were similarities between "electric "effects and magnetism, but now they had discovered a direct connection; electricity could be used to create magnetism. Let's see if we can see the magnetism we're creating like we did with the magnets.



Sprinkle iron filings onto a surface perpendicular to the wire. 4-6 amps at 12 volts through the thick wire will arrange the filings into circles. Variation of this uses a coil with widely spaced turns. The filings will line up in rows inside this stretched out coil

Now we can combine the magnetic force from several coils of wire to make an electromagnet.

A battery connected to several windings on a large nail will pick up paperclips.

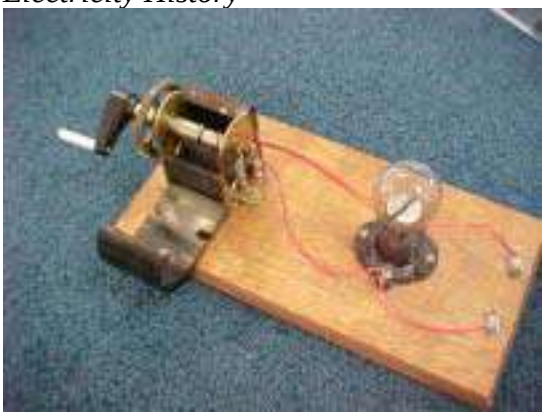
There are also electromagnets available that use only a C battery, yet attract a piece of metal strongly enough that students can't pull them

Here we are converting chemical energy into electrical energy to create a magnetic force.

One Question that scientists, inventors, and engineers will ask is can this process be reversed or used backwards. So the question scientists had next was; can we use magnetism to create electricity. One very famous scientist in the 1700's was Michael Faraday. He tried combining magnets and coils of wire in many ways but nothing happened until he discovered that electricity is created only when one of them is moving past the other.

A magnet pushed back and forth inside of a coil of wire will make a very sensitive meter move.

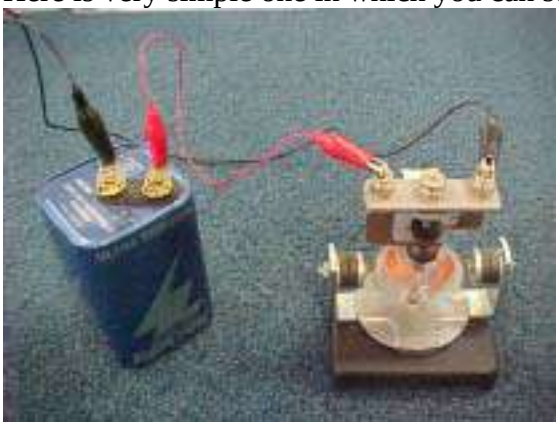
This is a very simple electric generator, but once the basic principles were discovered more complex and powerful generators could be built. Here is a generator used in very early telephones.



Generators from old telephones can light up a light, and can be taken apart to show the magnets and wire coil.

Can you see what our source of energy is here? *(mechanical energy from turning the crank)*

But the next question for Mr. Faraday was: Wouldn't it be great if electricity could be used to do some real work. Wouldn't it be great if he could reverse the process of using mechanical force to create electricity, and instead use electricity to create a mechanical force to run machines and do real work. And so he invented the electric motor.
Here is very simple one in which you can see the magnets and the coils of wire:



A demonstration motor run by a battery.

And so we've come from the simplest effects of magnets and static electricity, some of them known for thousands of years, to the discoveries of scientists up through the 1800's who unraveled the basic principles of this mysterious force, and set the stage for so many of the inventions and conveniences we live with today.