Let's Explore Electricity Basics!

Instructor Guide

Subject Area	Unit	Grade	Time
Science	Physical Science	5th grade	45 minutes

Overview

This lesson provides instruction on static electricity and the two types of electric circuits. It provides reinforcement of the properties of conductors and insulators related to the flow of electrons through a circuit.

Learning Objectives

This lesson meets the typical state criteria for Physical Science in the 5th grade levels.

Extension Activities

1. Science Experiment: Swinging Cereal
2. Science Experiment: Bending Water
3. Science Experiment: Light a Light Bulb with a Balloon
4. Science Experiment: Testing for Conductivity (Demonstration)
5. Science Activity: Series and Parallel Circuits: Paths for Electrons

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What You'll Need

Lesson Plan Notes
Extension Activity Supplies
Access to **Kids Korner** Website
Student Experiment and Activity Sheets

Steps

1. Review teacher lecture notes with students.
2. Visit Kids Korner website to show demonstration of the two types of electric circuits, series and parallel.
3. Choose one of the extension activities to reinforce

Evaluation

Ask questions: What are two types of electricity? What is the difference between an insulator and a conductor? Which type of circuit provides more than one path for electrons to travel through it?

Sources/References: www.sciencenetlinks.com, www.enchantedlearning.com, Energy Exchange

Teacher Lecture Notes

Let's Explore Electricity Basics

Electricity is the flow of electrons or negative charge. Within a wire it is called electric current. Static electricity is the buildup of negative charge due to friction

WHAT'S IT ALL ABOUT?

What is Electricity?

Electricity comes in many forms. Electricity is a basic part of nature and it is one of our most widely used forms of energy. In nature, we see naturally generated electricity in the form of lightning caused by friction within rain clouds. We may also see natural electric charge after we shuffle our shoes on the carpet, creating friction and a buildup of negative charge. If we then touch a metal object, the negative charge is transferred or discharged to the object. Lightning is the discharge of that buildup of negative charge within the clouds, just like in our shoes. It is a very powerful phenomenon.

We also get electricity from the conversion of other sources of stored energy, like sunlight, coal, natural gas, oil, nuclear power and water. Using various mechanical or chemical means, we can convert one type of stored energy (potential energy) into another one that is more useful. We use coal to burn and produce heat to turn a turbine. We can burn gasoline to propel the motion of our automobiles (kinetic energy). We also use this energy to provide light energy to our homes changing the mechanical action of the turbines into electricity. We use the term electricity interchangeably with the term electric current. This implies a movement of electrons through a circuit.

Electric Charge Originates in the Atom

Atoms are the building blocks of matter. They are composed of neutral particles with no electric charge and protons with a positive charge in the center or nucleus. On the outside of the nucleus, electrons with a negative charge encircle the positive charge of the protons within the nucleus. Opposite charges, positive and negative, are attracted to one another. When many like charges are near one another, they try to get far away from the same charge because charges that are alike tend to repel one another**.**

So when you rub a balloon on your hair, the electrons move to the balloon leaving all positive charges on your hair. Your hair responds by trying to get as far away from the other strands of positively charged hair strands. The result is hair standing straight out from your head and a very bad hair day! The balloon, being more negative, is able to then "stick" to a dry wall because it is now attracted to the positive charges in the wall.

Static Electricity

Like the balloon in the above example, lightning is the result of the buildup of negative charge within an object due to frictional forces. Whenever you have an imbalance of positive and negative charges, you have static electricity. Static electricity is noticed usually in the winter months when the air tends to be very dry. During the summer, the air is more humid. The moisture in the air tends to move electrons off of us more quickly, so we cannot build up as big a static charge.

A Brief History of Electricity

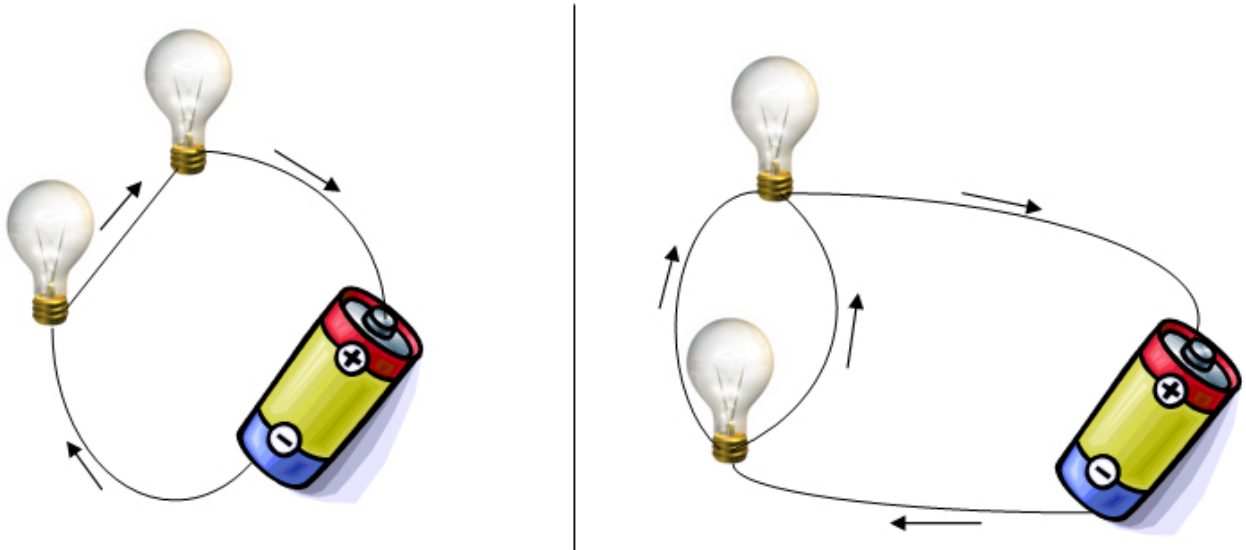
Beginning with Benjamin Franklin's experiment with a kit one stormy night in Philadelphia, the principles of electricity gradually became understood. His experiment proved static electricity and lightning were one and the same. In the mid 1800's, everyone's life changed with the invention of the electric light bulb by Thomas Edison. The light bulb's invention used electricity to bring indoor lighting to our homes. Today we use many different energy sources, like sunlight, coal, natural gas, crude oil, nuclear energy and hydropower, to generate the electric current that continues to light out home and power the appliances we use each day.

Electric Current and Circuits

Electric current is the flow of electrons through a wire and its components. It moves in the same way as water through a pipe. Just like water in the pipe needs a pump to move it, a circuit needs a battery to provide the push the electrons need to flow through the wire. In order to have a complete electric circuit, we must have a power source or battery, wires and a load, like a lamp or toaster. For the circuit to be complete, all components in the circuit must make contact. Without complete contact, there is a break in the "pipe" and the current will not flow through. Examine the diagrams below. The arrows indicate the direction of the flow of electrons through the circuits.

There are two types of circuits: series and parallel. In a series circuit, the load, wires and battery or power source are in a single loop and there is only one path for the electrons to take back to the battery.

By contrast, in the parallel circuit, the elements are arranged in such a way as to provide multiple paths back to the battery.



SERIES CIRCUIT

PARALLEL CIRCUIT

Electric Conductors and Insulators

Electrons flow through the circuit from negative to positive. The ease through which the electrons flow is known as resistance. The greater the resistance of the materials in the circuit, the more difficult it is for the electrons to flow through the circuit. There is always some amount of resistance to the flow of electrons in a circuit. The more resistant materials are known as **insulators** while those through which the electrons pass more easily are known as **conductors**.

Examples of insulators include:

plastic,
rubber,
glass,
oil,
asphalt,
fiberglass,
porcelain,
ceramic,
quartz,
cotton,
paper,
wood,
air,
diamond,
and pure water.

Examples of conductors include:

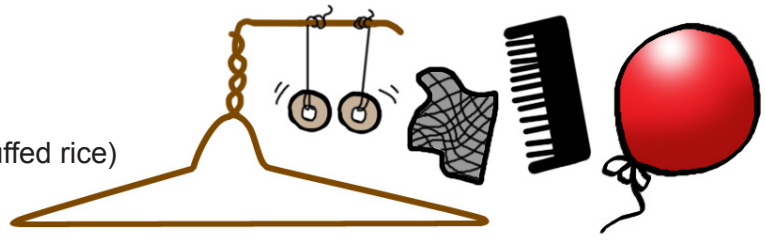
silver,
gold,
copper,
aluminum,
iron,
steel,
brass,
bronze,
mercury,
graphite,
dirty water
and concrete.

Experiments and Activities Pages

EXPERIMENTS WITH ELECTRICITY

SAFETY NOTE: Please read all instructions completely before starting the projects. Observe all safety precautions.

EXPERIMENT 1 – Swinging Cereal



You Need:

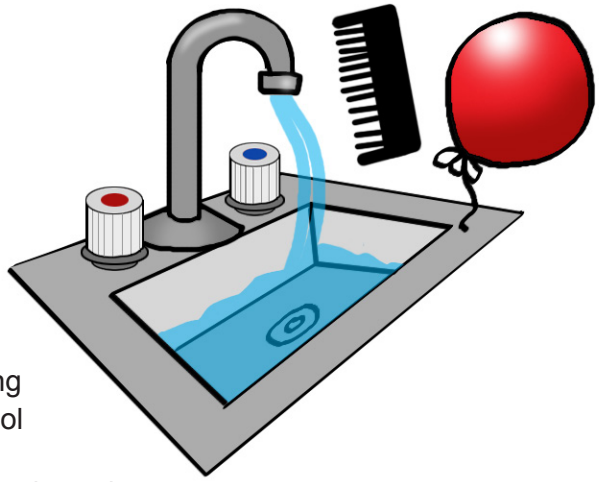
hard rubber, or plastic comb, or a balloon
thread,
small pieces of dry cereal (O-shapes, or puffed rice)

What to do:

1. Tie a piece of the cereal to one end of a 12 inch piece of thread. Find a place to attach the other end of the thread so that the cereal does not hand close to anything else. (You can tape the thread to the edge of a table but ask permission first.)
2. Wash the comb to remove any oils and dry it well.
3. Charge the comb by running it through long, dry hair several times, or vigorously rub the comb on a wool sweater.
4. Slowly bring the comb near the cereal. It will swing to touch the comb. Hold it still until the cereal jumps away by itself.
5. Now try to touch the comb to the cereal again. It will move away as the comb approaches.
6. This project can also be done by substituting a balloon for the comb.

What Happened: Combing your hair moved electrons from your hair to the comb. The comb had a negative static charge. The neutral cereal was attracted to it. When they touched, electrons slowly moved from the comb to the cereal. Now both objects had the same negative charge, and the cereal was repelled.

EXPERIMENT 2 – Bending Water



You need:

A hard rubber or plastic comb, or a balloon, sink and water faucet.

What to do:

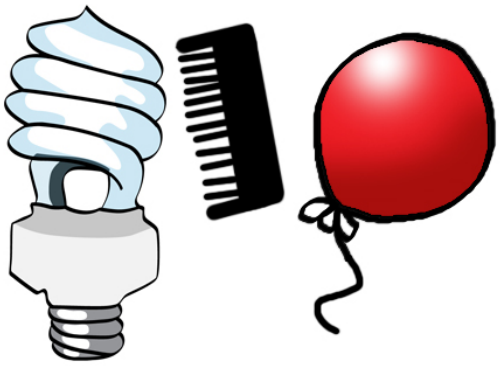
1. Turn on the faucet so that the water runs out in a small, steady stream, about 1/8 inches thick.
2. Charge the comb or balloon by running it over long dry hair several times or rub it vigorously on a wool sweater.
3. Slowly bring the comb or balloon near the water and watch the water “bend.”

What happened: The positive protons in the water molecules were attracted to the negatively charged comb or balloon and moved toward it.

EXPERIMENT 3- Light a Light Bulb with a Balloon

You Need:

Hard rubber, comb or balloon
a dark room
a fluorescent light bulb (**not** an incandescent bulb)



SAFETY NOTE: DO NOT USE ELECTRICITY FROM A WALL OUTLET FOR THIS EXPERIMENT. Handle the glass light bulb with care to avoid breakage. The bulb can be wrapped in sticky transparent tape to reduce the chance of injury if it does break.

What to Do:

1. Take the light bulb and comb into the dark room.
2. Charge the comb on your hair or sweater. Make sure to build up a lot of charge for this experiment.
3. Touch the charged part of the comb to the light bulb and watch very carefully. You should be able to see small sparks. Experiment with touching different parts of the bulb.

What Happened: When the charged comb touched the bulb, electrons moved from it to the bulb, causing the small sparks of light inside. In normal operation, the electrons to light the bulb would come from the electrical power lines and through a wire in the end of the tube of glass. (Fluorescent and incandescent bulbs will be discussed later.)

EXPERIMENT 4 – Static in the Summer

You Need:

a balloon,
and a watch or stopwatch (second hand needed)

What to Do:

1. Rub the balloon on your hair or wool sweater. Stick it to a wall and time how long it stays before falling.
2. Repeat step (1) in the bathroom, just after someone has taken a hot, steamy shower.
3. Compare your results.

What Happened: In the bathroom, water in the air and on the walls helped move electrons away from the balloon more quickly. In the summer, the air is more humid, and static electricity does not tend to build up as much as during the winter, when the air is very dry.

EXPERIMENT 5- Testing for Conductivity (Demonstration)

You Need:

six sample objects of various composition: wood, rubber, metals, glass, plastic, etc.,
a series circuit, complete with battery,
three (3) wires and a light bulb in a socket
and a pair of paper fasteners.

What to Do:

1. Select six objects from the gathered “Classroom Samples.”
2. On the chart below, write the names of each object being tested.
3. Predict whether the object will allow the light bulb to light up or not allow the bulb to light up.
4. Record your predictions in the space provided in the chart.
5. Use your simple circuit to construct a conductivity tester.

a. Your simple circuit should have two pieces of wire- one end of each piece should be attached to the battery, the other end of each piece of wire should be attached to the light bulb.

b. Remove the wire from the bottom of the battery; leave it connected to the light bulb. Wrap a paper fastener around the loose end of this wire.

6. Attach the third piece of wire to the bottom of the battery. Wrap a paper fastener around the loose end of this wire.
7. Test your objects.

a. One at a time, place each object in the circuit between the paper fasteners, making sure they touch and have a good connection.

b. Observe what happens to the light bulb.

8. Record your results for each object with an X in the appropriate column in the chart.
9. Determine whether each object was an insulator or conductor based on your observations of the light bulb.

Object Being Tested	Prediction: bulb will light or bulb will not light?	Light Bulb Lights Up	Light Bulb Does Not Light Up	Conductor or Insulator?
Ex. Paper Strip	Will not light up		X	Insulator
1.				
2.				
3.				
4.				
5.				
6.				

Activity Page:

SERIES AND PARALLEL: PATHS FOR ELECTRONS

Cut out the pictures at the bottom of this page and arrange them in the space provided to represent each of the two types of circuits below. Glue them in place. Draw in wires to connect your circuits together. Remember, each circuit needs a source of electrons (a battery) to power the load (the bulbs).

SERIES CIRCUIT with two lamps

PARALLEL CIRCUIT with two lamps