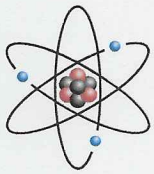
Electricity Study Guide

Most people use electricity every day, but we don't often stop to think about how electricity works. The two basic types of electricity are current electricity and static electricity.

Atoms:

All matter on Earth is made up of atoms. **Atoms** are extremely tiny particles that we cannot see. Atoms are made up of even smaller particles called electrons, neutrons, and protons.

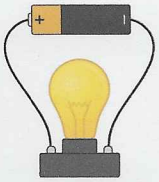


- **electrons**: negatively charged particles on the outside of the atom. They are able to move from one atom to another.
- **neutrons**: neutral particles inside the *nucleus* (the center of the atom). They don't have a charge.
- **protons**: positively charged particles inside the nucleus

Electric Circuits:

When negatively charged electrons move, they move electrical energy from one place to another. A continuous flow of negative charges (electrons) creates an **electric current**. We use **current electricity** to power appliances like toasters and TVs. The pathway taken by an electric current is called a **circuit**.

A simple circuit can be created using a dry cell (a battery), a wire, and a light bulb. In this circuit, electrons flow in a loop from the negative end of the dry cell, through the circuit, and back to the dry cell through the positive end.



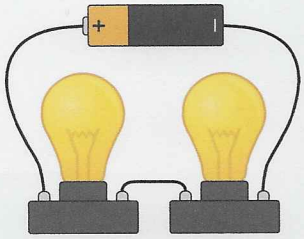
- **Closed circuits** allow the movement of electrical energy. Everything in the circuit is connected, and the electrons can move in a continuous path, so a light bulb will light.

- **Open circuits** prevent the movement of electrical energy. There is a break somewhere in the circuit, so a light bulb will not light.

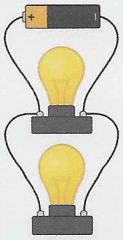
Series and parallel circuits are used to light multiple bulbs.

- In a **series circuit**, there is only one pathway in which the current can travel. If one bulb goes out, the others will, too.

- In a **parallel circuit**, there are two or more pathways in which the current can travel. A parallel circuit uses parallel wires for the electrons to flow through; if one part of the circuit is incomplete, electricity can still flow in the other parts.



series circuit



parallel circuit

Resistance occurs when a material *opposes*, or pushes against, the flow of electrons. The more resistance a material has, the harder it is for electrons to flow through it. All materials have some amount of resistance, but it is easier for electrons to flow through some materials than others.

- As you increase the number of bulbs in a series circuit, you also increase the resistance, and the bulbs will become more dim.
- As you increase the number of bulbs in a parallel circuit, no matter how many bulbs you add, the bulbs will stay bright.

Conductors & Insulators:

Electricity moves through materials that are **conductors**. Most metals are conductors. The rate at which energy flows through a conductor depends on the material's resistance.

Insulators, like rubber, plastic, and wood, do not conduct electricity well. Insulators are useful when you want to slow or stop the flow of electricity. For example, plastic or rubber coatings on electrical cords insulate the metal wire inside them and make the cords safe to touch. (When the coating on a wire wears away, and bare metal wires touch each other, the resistance of the circuit is lowered. Much more current will flow through the circuit, which can create a dangerous *short circuit*.)

Some materials can be both conductors and insulators, depending on what part of the object you connect to the circuit. For example, a pencil is both a conductor and insulator.

conductor

insulator

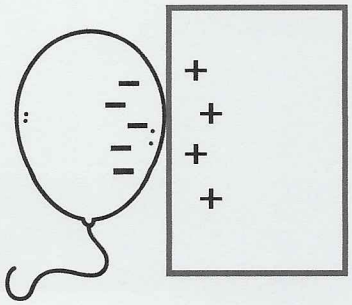
conductor

insulator

Static Electricity:

You've probably experienced static electricity before. For instance, you might have touched a doorknob and felt a little shock. **Static electricity** is created when an electrical charge builds up on the surface of an object.

Rubbing certain materials together can create static electricity. For example, when a balloon is rubbed on a piece of cloth, electrons gather on the balloon. This buildup of electrons gives the balloon a negative charge. Sometimes, the electrons find a way to move to a positively charged object since opposite charges attract. When this happens, it will sometimes create a shock or spark.



After building up a negative charge, this balloon is sticking to the wall.

Static electricity is also found in nature. *Lightning* is the discharge of static electricity in the atmosphere. It occurs when negative charges in a cloud are attracted to the positively charged ground.

Energy Transformations:

Electrical energy can be transformed into other types of energy, including thermal, radiant, and mechanical energy.

- **thermal energy**: energy of heat
- **radiant energy**: light energy
- **mechanical energy**: energy of motion

Household appliances, when used, can transform electrical energy. Examples:

- a lamp can transform electrical energy into thermal and radiant energy 
- a toaster can transform electrical energy into thermal and radiant energy 
- a fan can transform electrical energy into mechanical energy 

Important Scientists:

Benjamin Franklin, Michael Faraday, and Thomas Edison made important contributions to our understanding of electricity.

- Benjamin Franklin proved that lightning is a form of electricity. He also invented the lightning rod. 
- Michael Faraday discovered that he could use electricity to make magnetism (electromagnetism). He built the first electric motor. 
- Thomas Edison made a better version of the light bulb. He did not invent the light bulb, though many people believe he did!