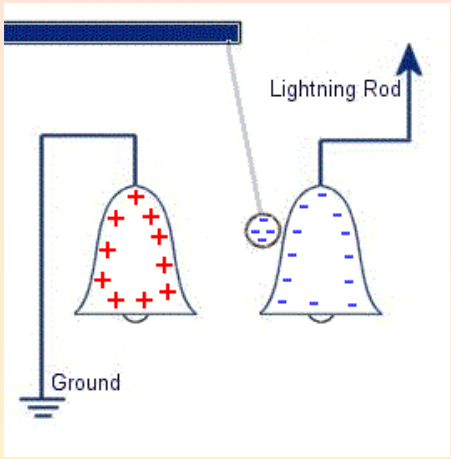
Introduction to Electricity & Electrical Current

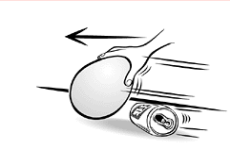


Physical Science Georgia Performance Standards:

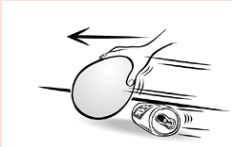
SPS10a. Investigate static electricity in terms of friction, induction, and conduction.

SPS10b. Explain the flow of electrons in terms of alternating and direct current; the relationship among voltage, resistance and current; simple series and parallel circuits.

SPS10c. Investigate applications of magnetism and/or its relationship to the movement of electrical charge as it relates to electromagnets, simple motors, and permanent magnets.



Opening/Activation



"Remote Control Roller"

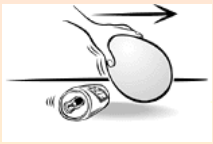
(What makes the can roll?)

1) Put an empty soda can on its side on a table or the floor -- anyplace that's flat and smooth. Hold it with your finger until it stays still.

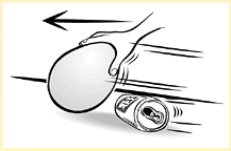
2) Rub the balloon back and forth on your hair really fast.

3) Hold the balloon about an inch in front of the can. The can will start to roll even though you are not touching it.

4) Move the balloon away from the can slowly and the can will follow the balloon.



5) If you move the balloon to the other side of the can, the can will roll in the other direction.



6) How fast will the can roll? How far can you roll it before the can stops? Will it roll up a hill?

Electricity

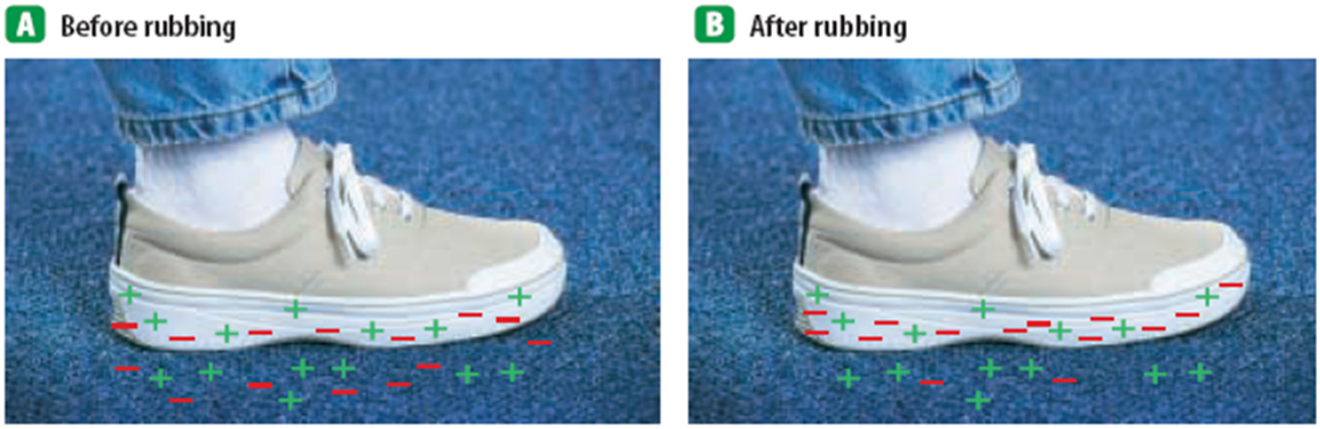
Overarching Essential Question: Does an electric company really sell electricity? How might you explain what they sell?

Essential Question: How might electricity power various devices? Explain your answer.

What did you observe with the balloons? What caused the cans to move? What force was behind it? Explain.

There are two types of charges: Protons - positive, and Electrons - negative. The world is full of electrical charges.

The accumulation of excess charge on an object is known as static electricity. Static electricity is potential energy. It is stored. How might this relate back to the balloon?

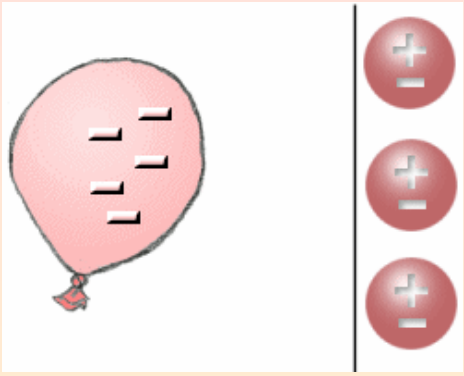


Like the shoes rubbing against the carpet. Electrons transferred from the carpet to the shoes.

Static Discharge

It occurs when there is a loss of static electricity due to three possible things:

* Friction - rubbing
* Conduction - direct contact
* Induction - through an electrical field (not direct contact)



Create an analogy and illustration for the three things above.

Example: Friction is like your teenager refusing or delaying cleaning up their room.

What is the discharge of electrons in the atmosphere called?

Lightning occurs when the negative charges in the thundercloud builds up and jumps to the positively charged ground.

Law of Conservation of Charge

According to this law, charge can be transferred from object to object, but it cannot be created nor destroyed. The charge simply moves from one place to another.

(Click to watch the clip)

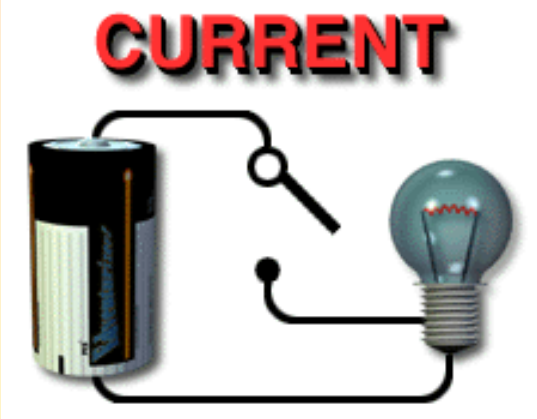
Current Electricity

Is electricity that is caused by a continuous flow of electrons. Electric current is measured in amperes. One ampere is equal to 6,250 million billion electrons flowing past a point every second.

The path that this current flows through is called a circuit. A circuit must be closed to allow the flow of electricity. You can control the flow with a switch.

Voltage Difference

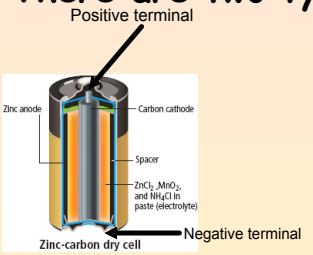
Types of Currents



Batteries

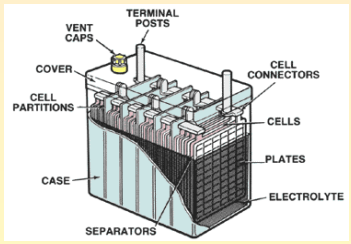
A battery can provide a voltage difference that is needed to keep current flowing in a circuit.

There are two types: a dry cell, a wet cell/lead-acid battery.



In a dry cell, when the two terminals are connected to a circuit, a reaction involving the zinc and several chemicals occurs. Electrons are transferred between compounds in this reaction.

In a wet cell, it contains two connected plates made of different metals or metallic compounds in a conducting solution. The chemical reactions transfer electrons from lead plates to lead dioxide plates.



A lead-acid battery is like a wet cell, it is composed of a series of six wet cells made up of lead and lead dioxide plates in a sulfuric acid solution.

Conductors and Insulators

A conductor is a material that allows the flow of electricity to pass through it.

An insulator is a material that does not allow the flow of electricity through it.

(Click on the image to watch a clip)

Examples

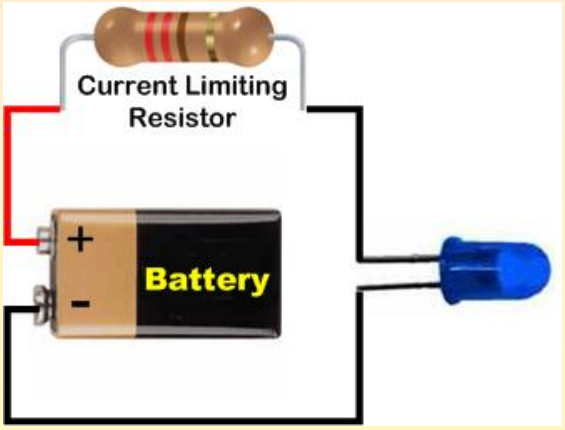
Conductors
* Metal
* Water

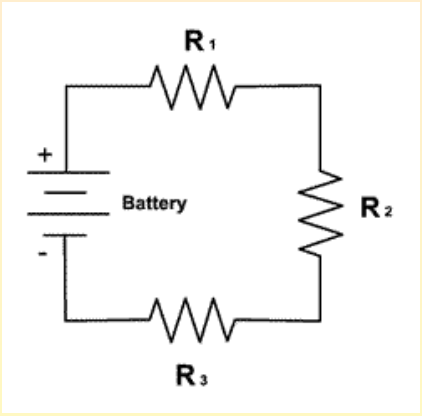
Insulators
* Styrofoam
* Rubber
* Plastic
* Paper

Resistor

Is a poor conductor. Resistance is the tendency of electrons to resist flow, changing electrical energy into thermal energy and light. Resistance is measured in ohms (Ω).

The three types of energy that electricity can be changed into include heat, light, and mechanical energy.





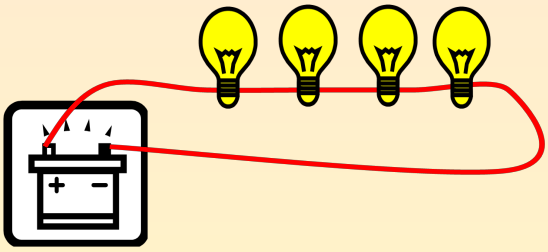
The greater the resistance, the less current gets through. Good conductors have low resistance.

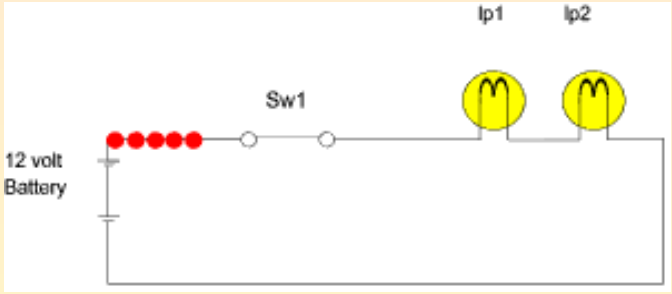
What are electric circuits?

Circuits typically contain a voltage source, a wire conductor, and one or more devices which use the electrical energy.

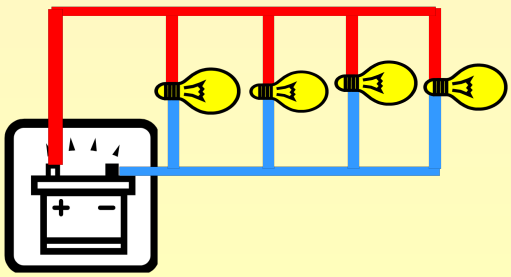
There are 2 types of circuits

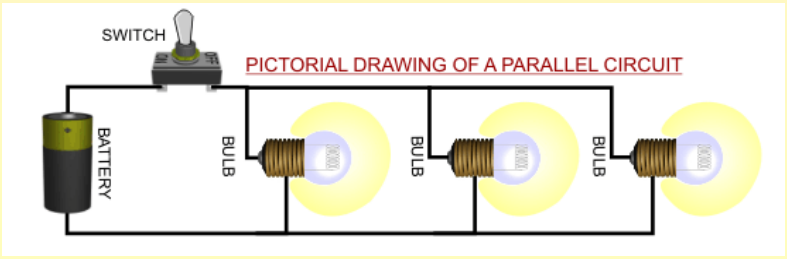
Series Circuit: the components are lined up along one path. If the circuit is broken, all components turn off.





Parallel Circuit - there are several branching paths to the components. If the circuit is broken at any one branch, only the components on that branch will turn off.





What is the difference between an open circuit and a closed circuit?

A closed circuit is one in which the pathway of electric current is complete and unbroken.

An open circuit is one in which the pathway of electric current is broken. A switch is a device in the circuit in which the circuit can be closed (turned on) or open (turned off).

What Influences Resistance?

Material of wire - aluminum and copper have low resistance.

Thickness - the thicker the wire the lower the resistance.

Length - shorter wire has lower resistance.

Temperature - lower temperature has lower resistance.

Voltage

Is the measure of energy given to the charge flowing in a circuit.

The greater the voltage, the greater the force or "pressure" that drives the charge through the circuit.

What is the difference between Volts and Amps?

* Amps measure like how much water comes out of a hose.

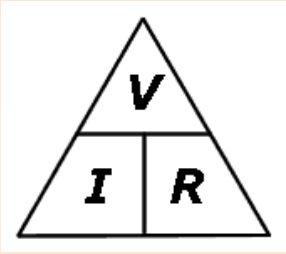
* Volts measure like how hard the water comes out of a hose.

Ohm's Law

Resistance = Voltage / Current

Or

R = V / I
(Ohms = Volts / Amps)



Practice

Ohms	Volts	Amps
	100	25
	150	10
	30	15
9		5
6	48	

How is household wiring arranged?

Most household wiring is logically designed with a combination of parallel circuits. Electrical energy enters the home usually through a breaker box or fuse box and distributes the electricity through multiple circuits. A breaker box or fuse box is a safety feature which will open.

A

B

The two useful devices used to prevent electric circuits from overheating are A) fuses and B) circuit breakers.

Household Electricity

Electric power is so useful because it can be converted into many things such as light from lightbulbs, thermal energy from a hair dryer, or mechanical energy from the blades of a fan that cools you.

The electric power used depends on the voltage difference and the current.

electric power (in watts) = current (in amps) x voltage difference (in volts)

OR

$P = IV$

Solve the following problem:
The current in a clothes dryer is 15 A when it is plugged in a 240-volt outlet. How much power does the clothes dryer use?

Electric energy

It can be calculated by the following:

Electric energy (kWh) = electric power (in kW) x time (in hours)

OR

$E = Pt$

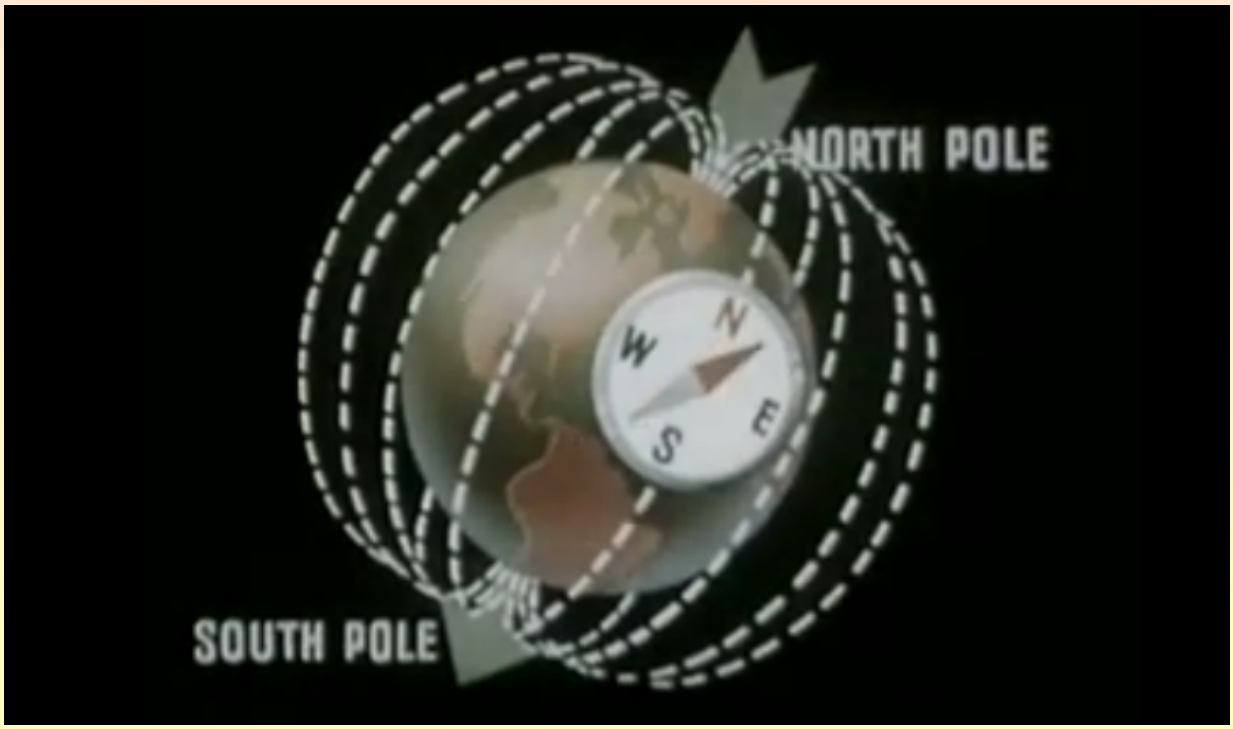
Closing/Reflection

Key Ideas

List 5 key ideas from the lesson and explain why each is important.

Opening/Activation

Essential Question: What are magnets and how might they be useful along with electricity?

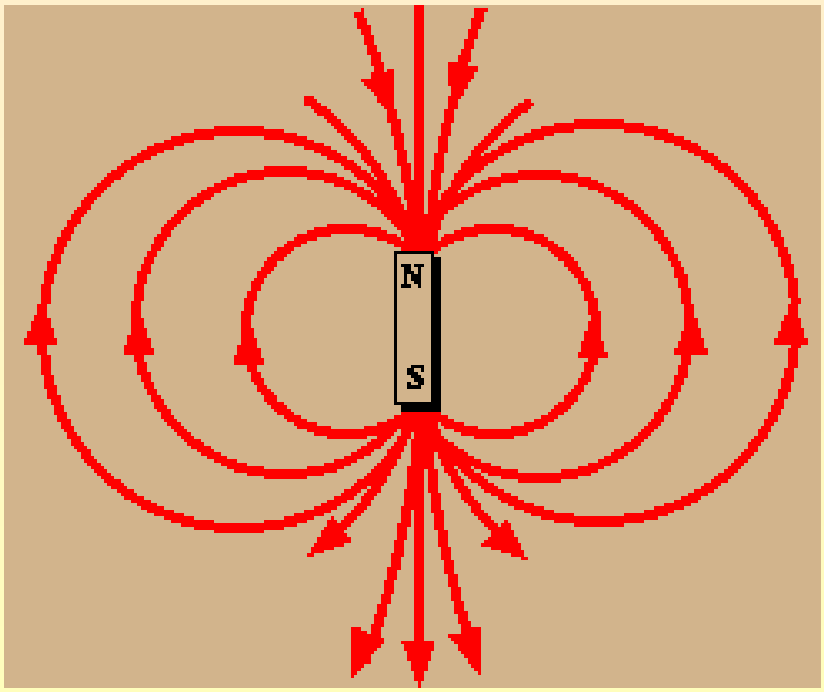


Magnetism

Refers to the properties and interactions of magnets. A magnet is surrounded by a magnetic field. All magnets have a north and a south pole. Two magnets can either attract or repel each other.

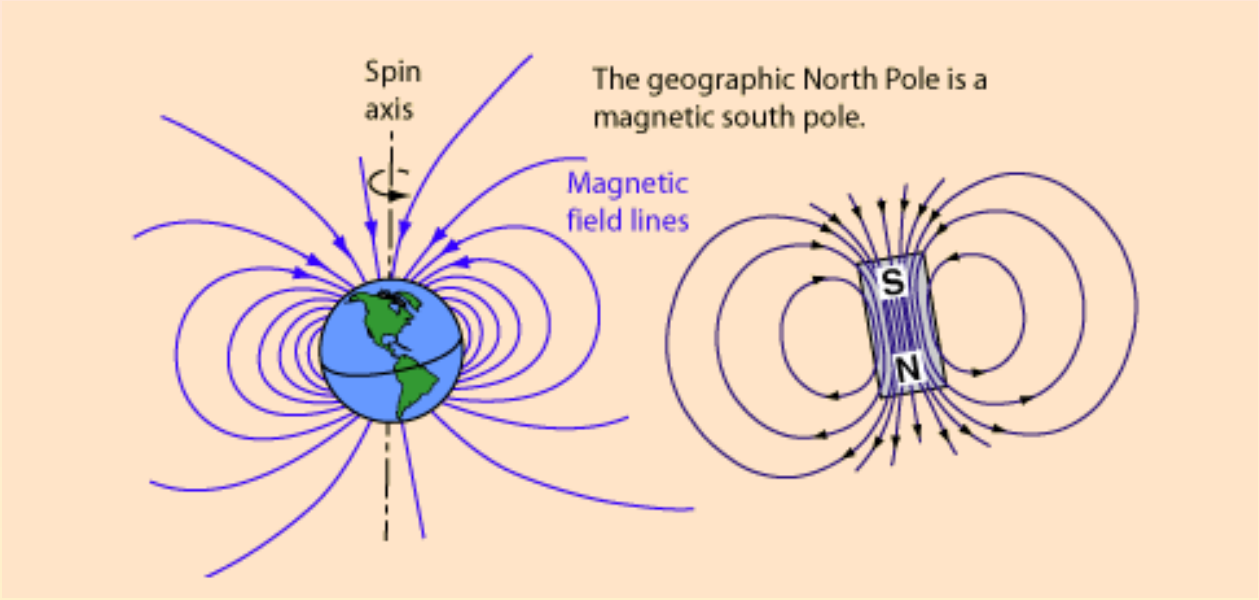
Magnets cannot attract all metals. Iron, cobalt, and nickel are attracted to magnets and can be permanent magnets.

Just as an electric current has an electric field, so does a magnet. It has a magnetic field that is created by moving charges.



The Earth is a Magnet

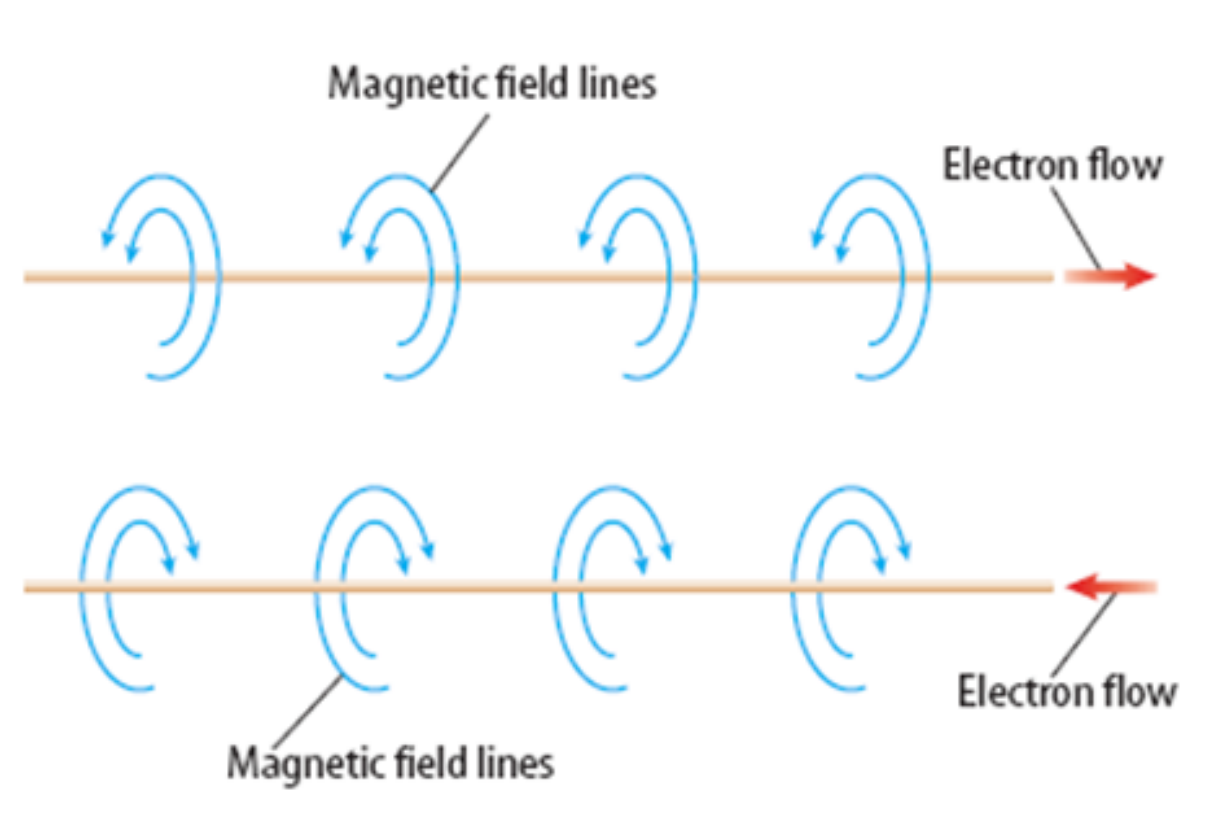
It exerts magnetic forces and is surrounded by a magnetic field that is strongest near the North and South magnetic poles.



We use Earth's magnetic field to find direction. The needle of a compass always points toward the magnetic south pole. We call this direction "North" (remember, opposites attract).

Electricity and Magnetism - how are they related?

When electric current passes through a wire a magnetic field is formed.



The direction of the magnetic field depends on the direction of the current in the wire.

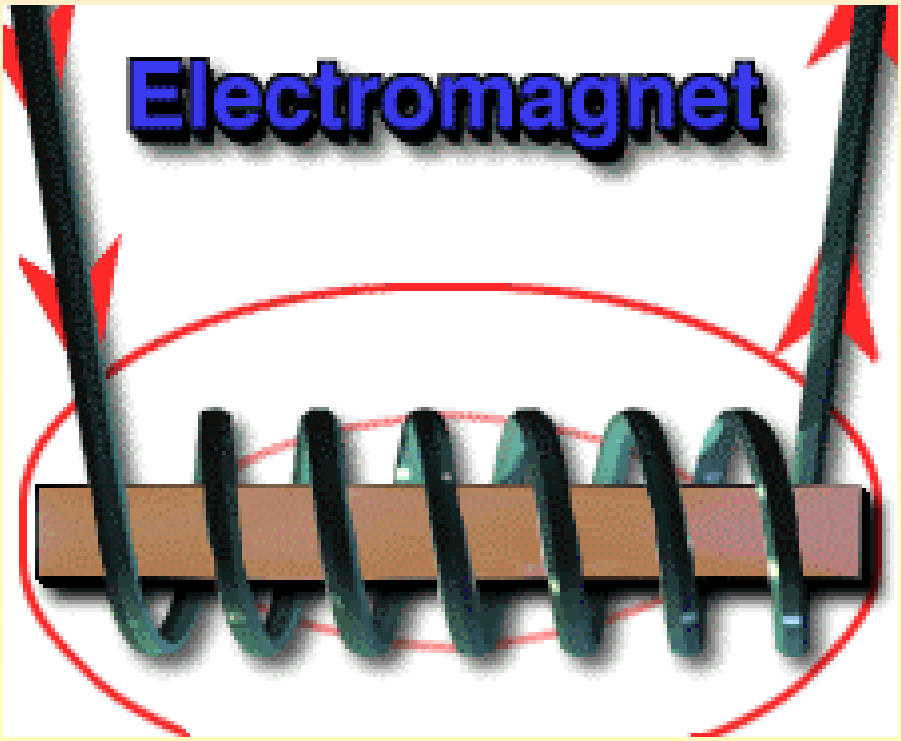
What is an electromagnet?

Electromagnet - a magnet made from a current bearing coil of wire wrapped around an iron or steel core.

Current is stronger flowing through a loop than a straight wire. A single wire wrapped into a cylindrical wire coil is called a solenoid.

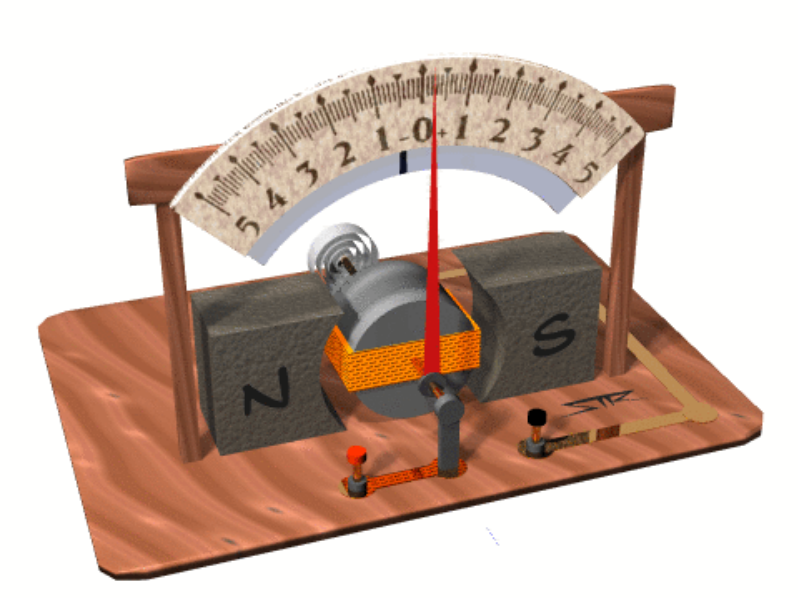
Properties of Electromagnets

* they are temporary
* their strength can be increased with more coils
* their properties can be changed by changing the current
* they can be turned on and off



What is a galvanometer?

A galvanometer is an electromagnet that interacts with a permanent magnet. The stronger the electric current passing through the electromagnet, the more it interacts with the permanent magnet.



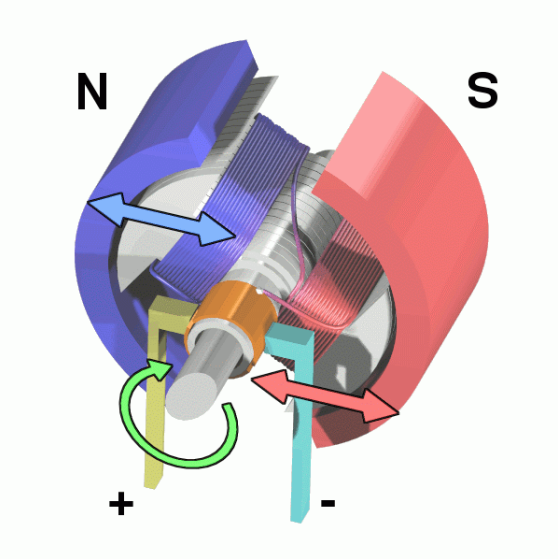
The galvanometer includes a permanent magnet, an electromagnet that rotates against a spring, and a scale that measures current.

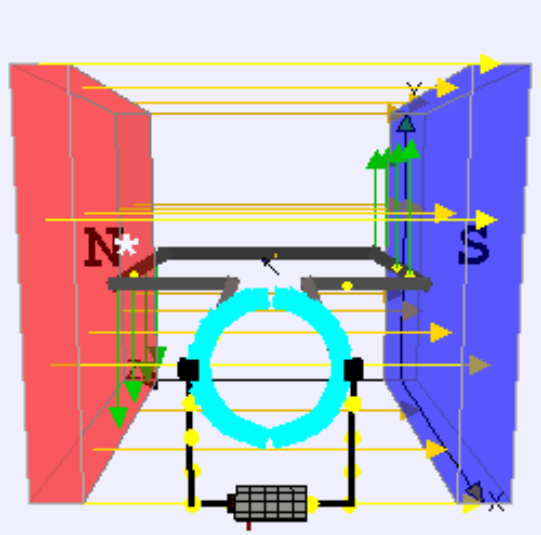
Galvanometers are used as gauges in cars and many other applications.

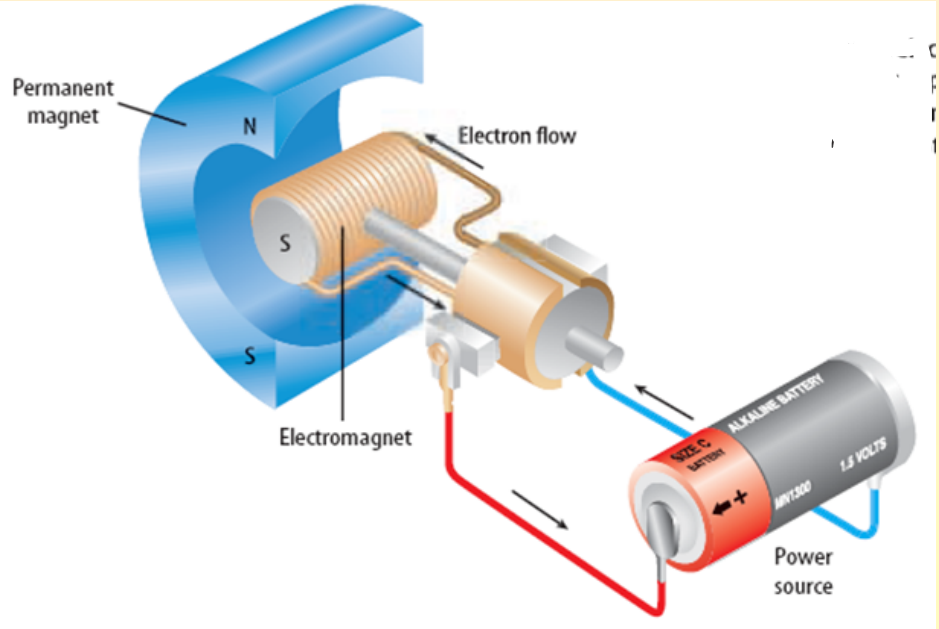
The greater the current passing through the wires, the stronger the galvanometer interacts with the permanent magnet.

What are electric motors?

An electric motor is a device which changes electrical energy into mechanical energy.

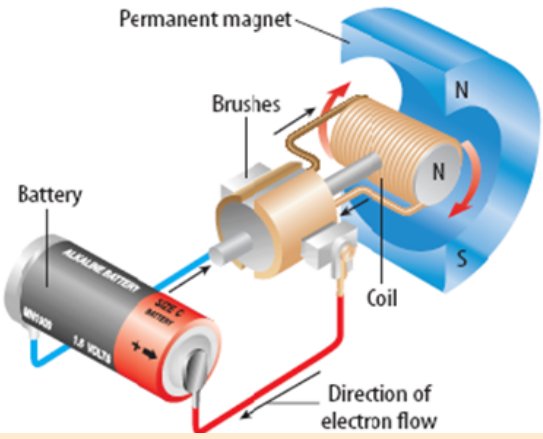


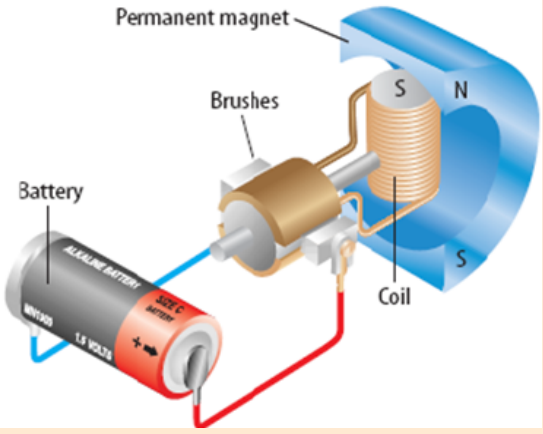




A basic electric motor has a power supply, a permanent magnet, and an electromagnet that can rotate.

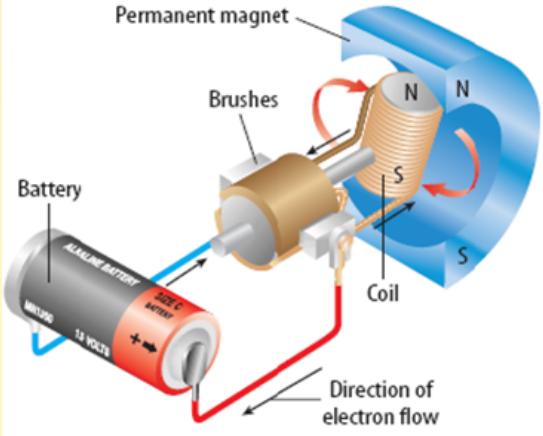
How does an electric motor work?

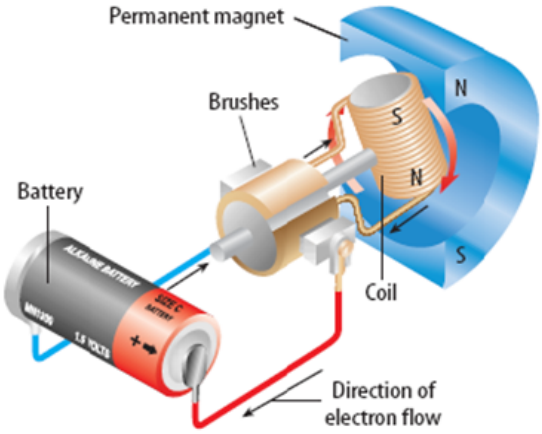




A) A battery causes an electric current to flow through the coil of the electromagnet.

B) Unlike poles of the two magnets attract each other, and the like poles repel. This causes the coil to rotate until the opposite poles are next to each other.





C) If the current in the coil is switched, the direction of the coil's magnetic field also switches. The north and south poles of the magnet switch places.

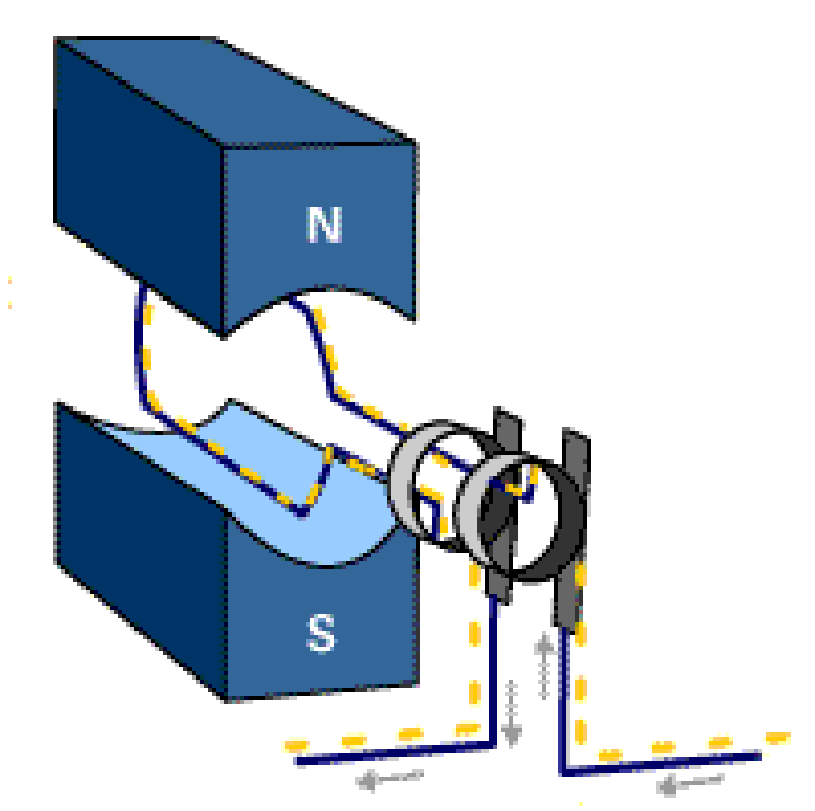
D) The coil is repelled by and attracted once again to the poles of the permanent magnet. The coil rotates until it is again with the permanent magnet's field.

We have learned now that electricity can produce a magnetic field, a magnetic field can also produce electricity! How?

Electromagnetic Induction

Moving a loop of wire through a magnetic field produces electric current. This is electromagnetic induction.

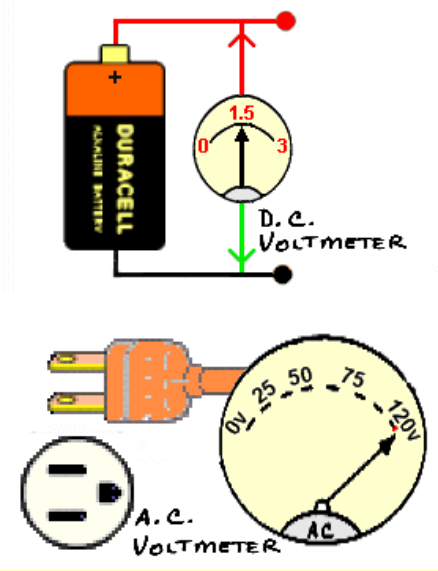
A Generator is used to convert mechanical energy into electrical energy by electromagnetic induction.



Direct current versus Alternating current

Direct current is electrical current which comes from a battery which supplies a constant flow of electricity in one direction.

Alternating current is electrical current which comes from a generator. As the electromagnet is rotated in the permanent magnet the direction of the current alternates once for every revolution.



Closing Reflection

"Be The Teacher"

Pick 4 main ideas from the "Magnetism & Electromagnet concepts" discussed today that you feel everyone should have learned. Write them down as though you were making notes to give an absent student on the overarching main ideas of the lesson.

Graphic Organizer

Attachments

Electricity G.O. 2012.docx