

UNIT 6: Electricity and Magnetism

Static electricity Lesson 1

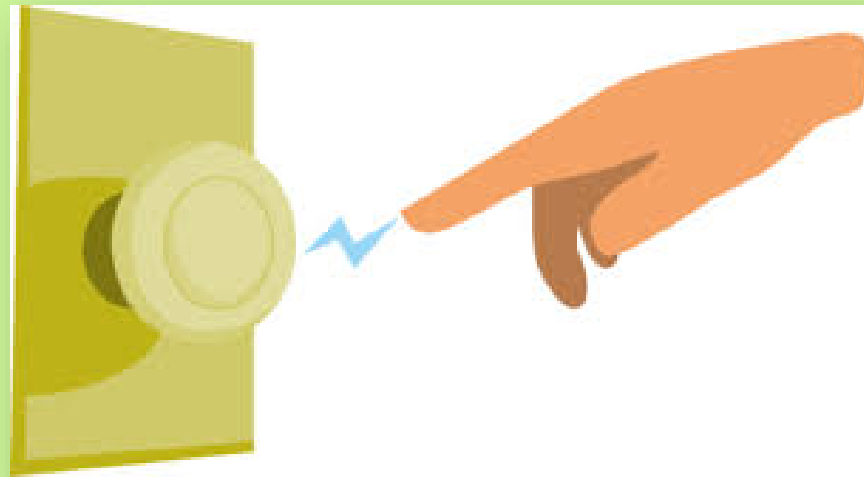
Unit 5: Electricity.

Static Electricity: the build up of electrical charges on an object.



Unit 5: Electricity.

Have you ever reached out to open a door and received a shock from the knob?

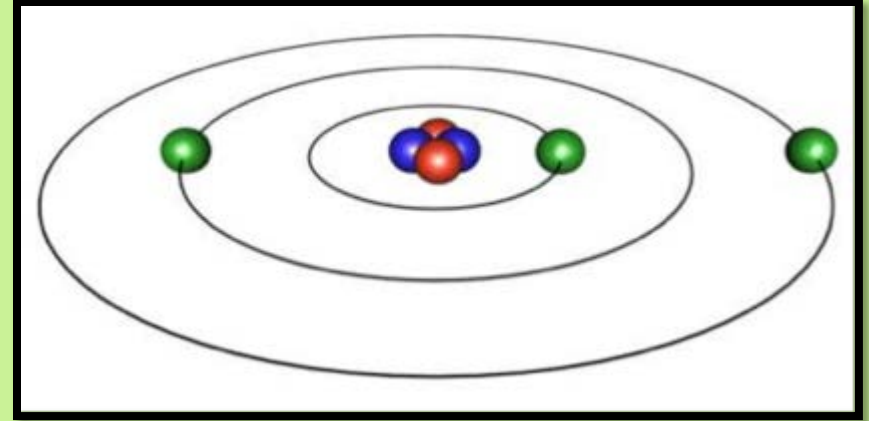


These shocks are a result of static electricity!!!

Electric Discharge: the loss of static electricity as charges move off an object

Unit 5: Electricity.

To understand electrical charge... Let's think back.

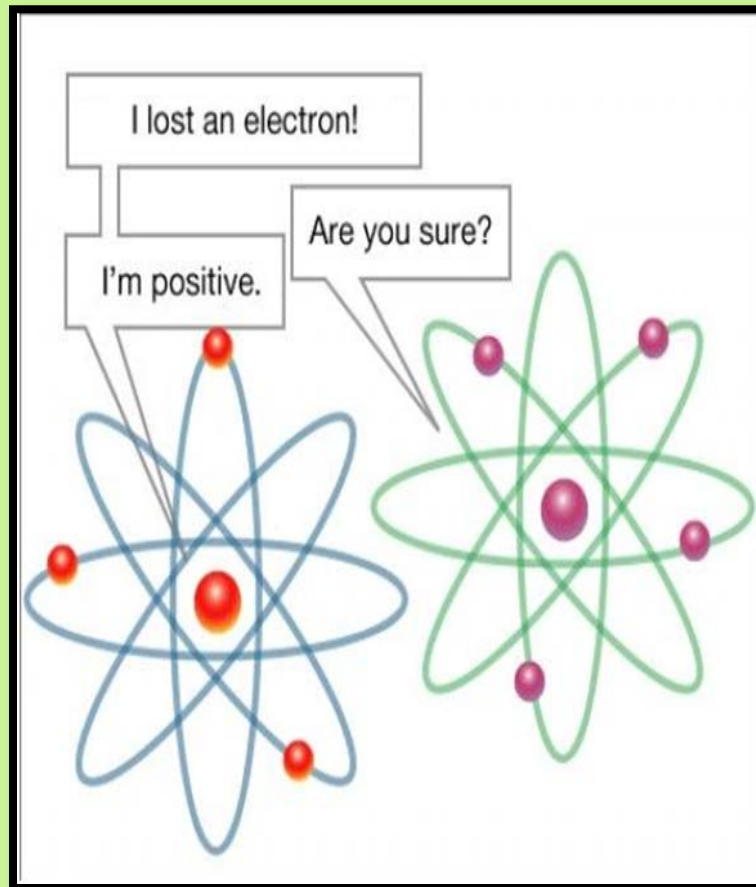


Protons (+) and electrons (-) are charged

Objects can become charged when atoms gain or lose electrons.

Unit 5: Electricity.

An atom that loses an electron becomes positively charged.



Unit 5: Electricity.

The Law of Electric Charges states...

Like charges repel each other



Opposite charges attract each other



Unit 5: Electricity.

We can charge objects THREE way:

1. Friction:

Rubbing two objects together can cause electrons to be “wiped” from one object and transferred to the other.



Unit 5: Electricity.

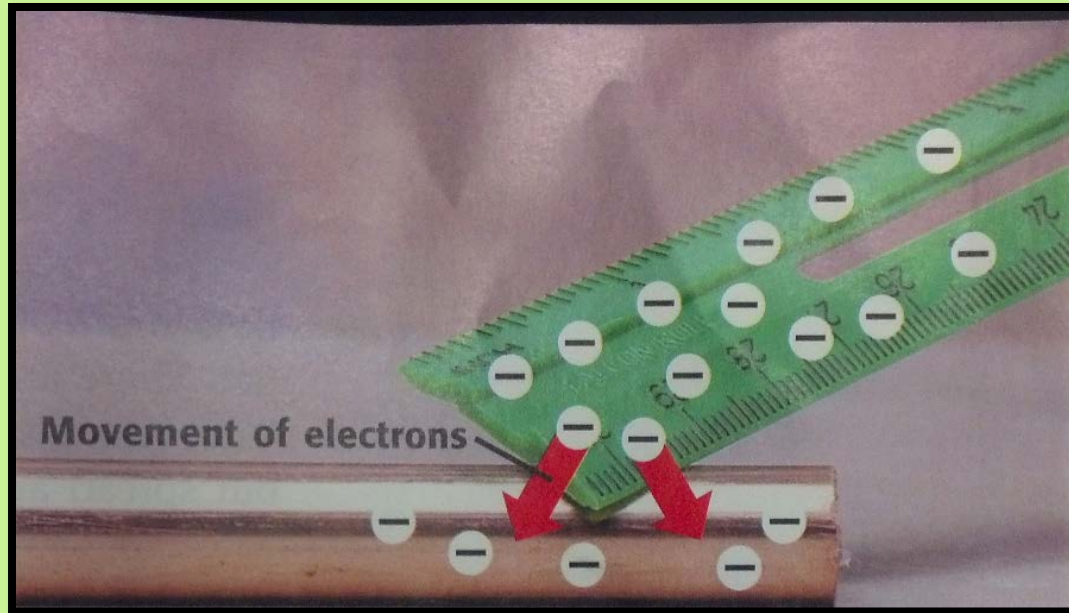


Late at night, and without permission, Reuben would often enter the nursery and conduct experiments in static electricity.

Unit 5: Electricity.

2. Conduction

Transfer of electrons from one object to another
THROUGH direct contact

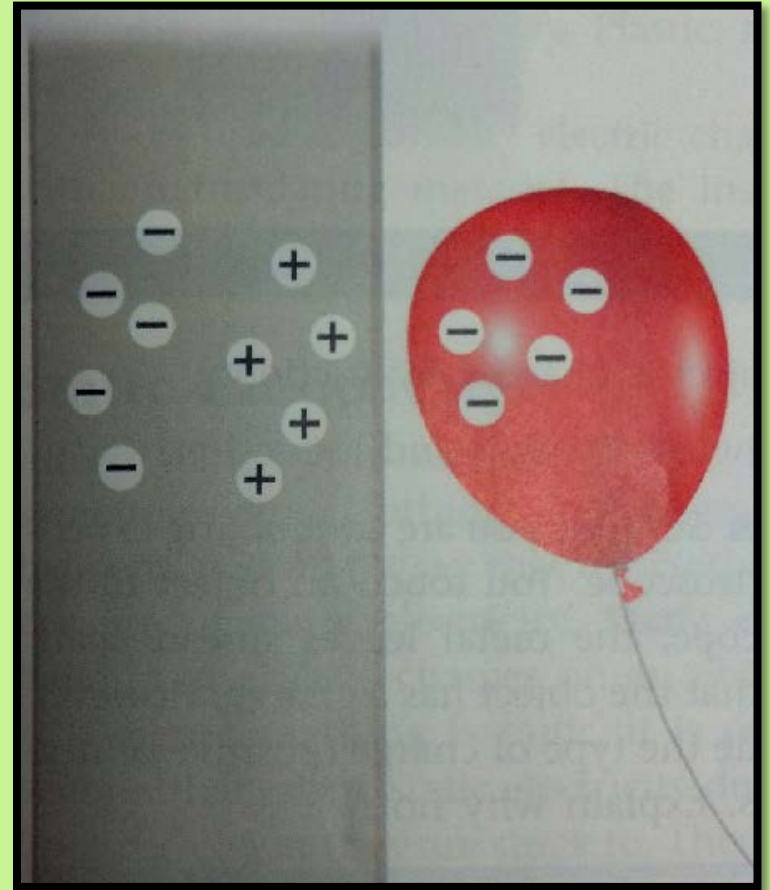


Touching a negatively charged plastic ruler to an uncharged metal rod causes electrons from the ruler to travel to the rod. The rod becomes negatively charged by conduction.

Unit 5: Electricity.

3. Induction:

Occurs when charges in an uncharged object are rearranged **WITHOUT direct contact** with the charged object



A negatively charged balloon induces a positive charge on a small section of a wall because the electrons in the wall are repelled and move away from the balloon

Unit 5: Electricity.

Stacy clothes in a dryer?



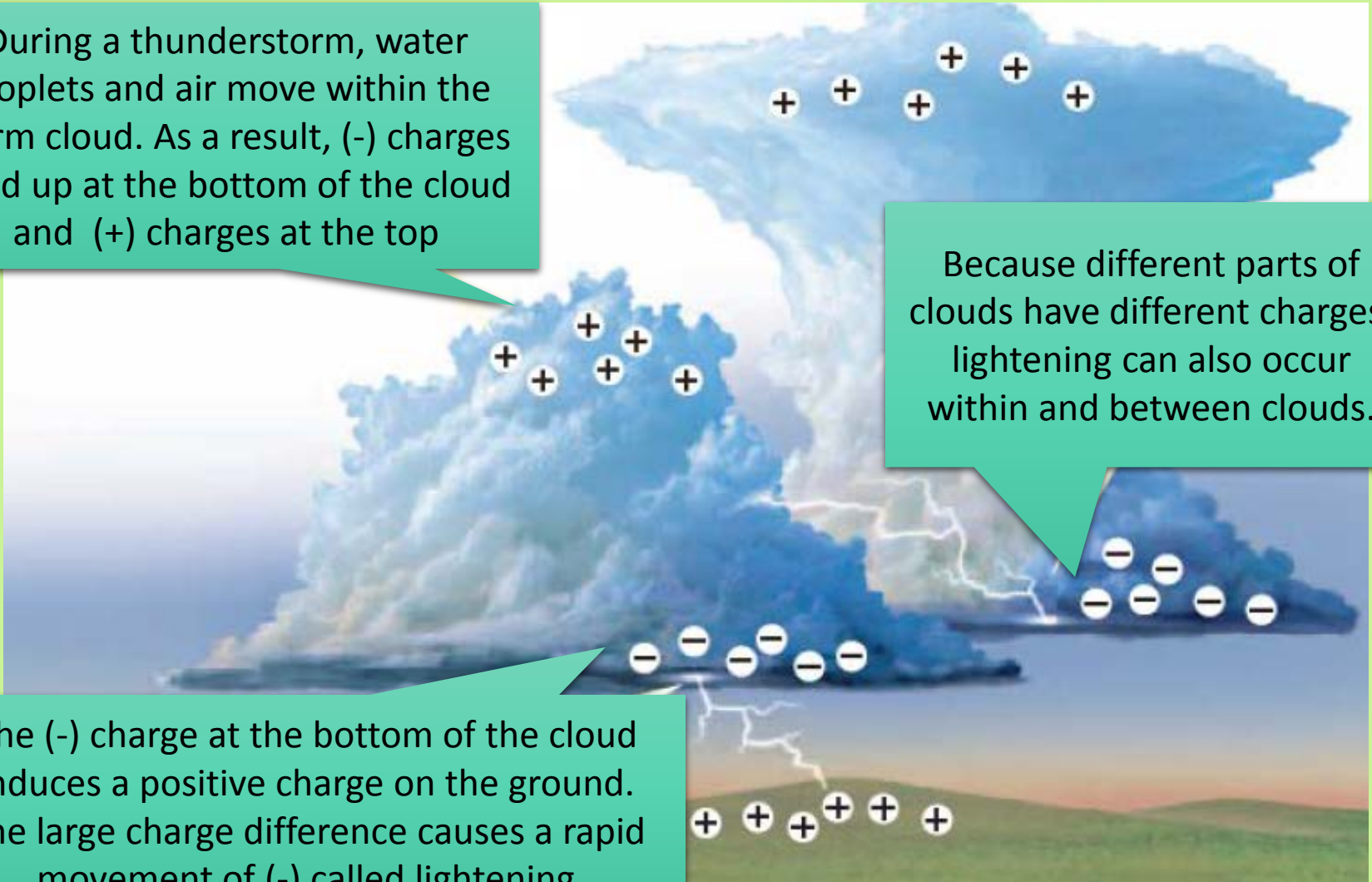
Unit 5: Electricity.

So how does lightning form?!

During a thunderstorm, water droplets and air move within the storm cloud. As a result, (-) charges build up at the bottom of the cloud and (+) charges at the top

Because different parts of clouds have different charges, lightning can also occur within and between clouds.

The (-) charge at the bottom of the cloud induces a positive charge on the ground. The large charge difference causes a rapid movement of (-) called lightning



Unit 5: Electricity.



Unit 5: Electricity.



Lake Keystone - Mannford Ok Oct 1995
(c) 1995 Dave Crowley www.stormguy.com

Unit 5: Electricity.



Broken Arrow Ok Aug 27 1999
(c) 1999 Dave Crowley www.stormguy.com

Unit 5: Electricity.

Circuits

Lesson 2

Electric Discharge: the loss of static electricity as charges move off an object

Unit 5: Electricity.

Electricity is a form of energy that involves the movement of electrons from one point to another



Unit 5: Electricity.

Have you ever noticed that the cords coming out of the wall are made with plastic AND metal?



Unit 5: Electricity.

Conductors are materials that allow charges to flow easily throughout
E.g. Metals

Semi-Conductors are materials that conduct electric current better than an insulator but not as well as a conductor
E.g. Silicon

Insulators are materials that DO NOT allow charges to flow easily throughout
E.g. Wood, glass, or plastics



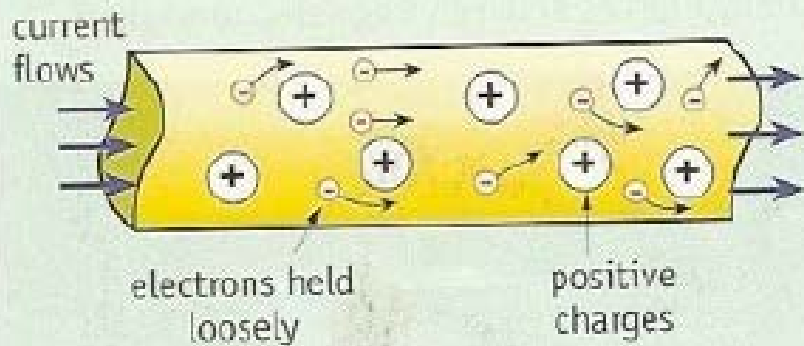
ELECTRONS FLOW MORE EASILY

Unit 5: Electricity.

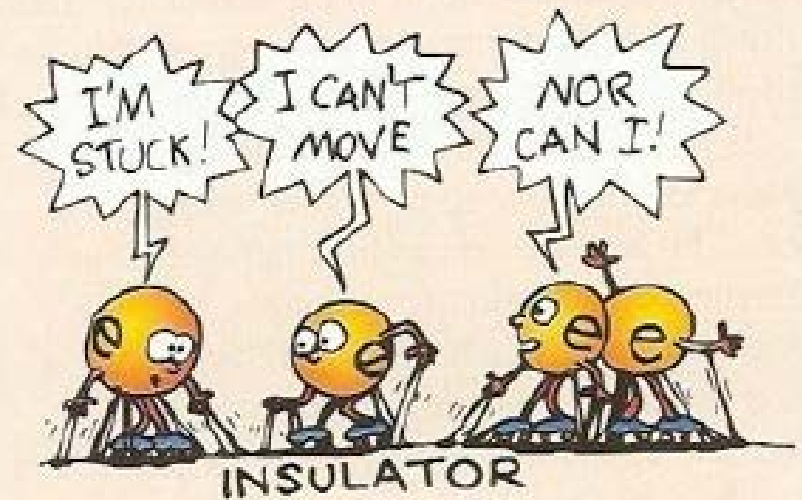
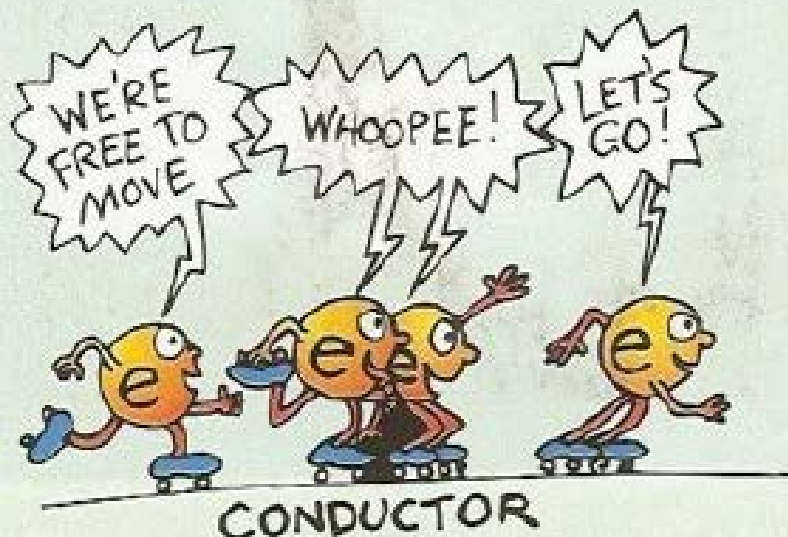
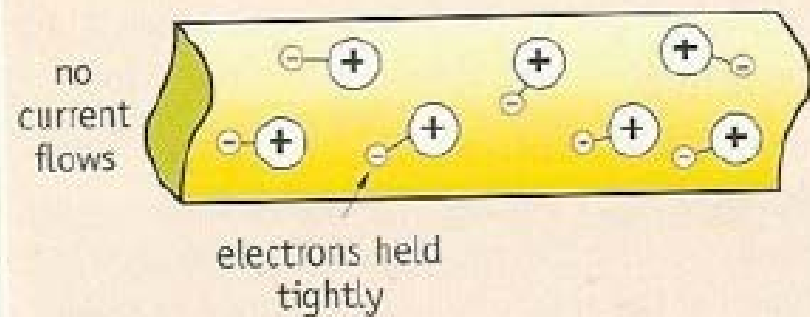
In a conductor, **electrons are free to flow**

In an insulator, **electrons are fixed**

Conductor

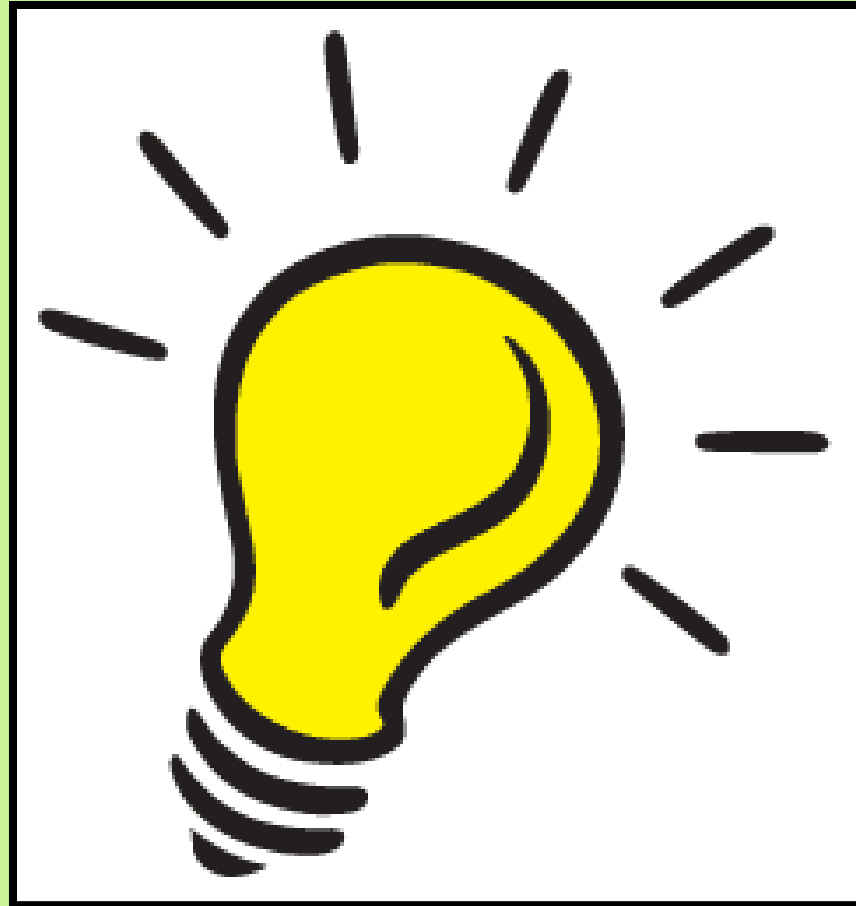


Insulator



Unit 5: Electricity.

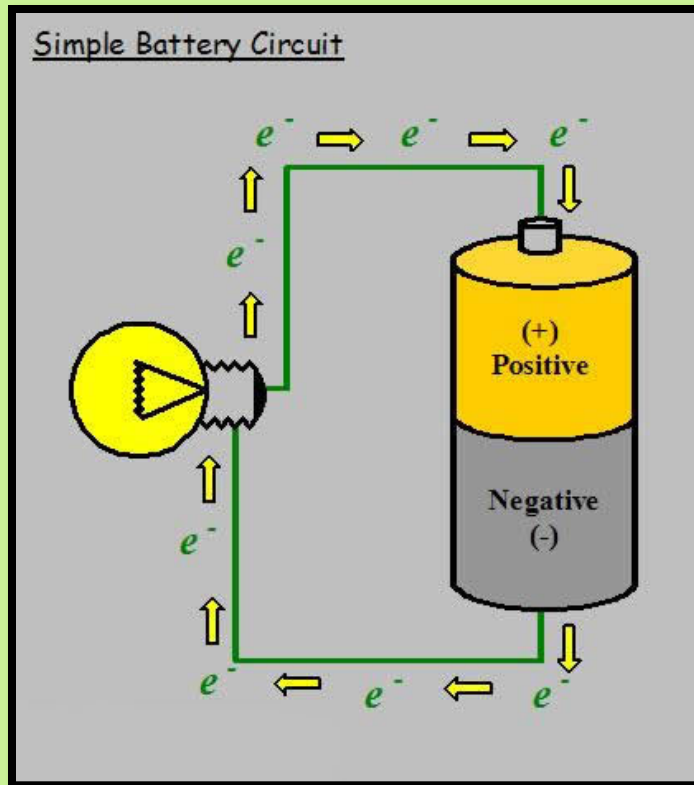
How many ways can you light the light bulb?



Unit 5: Electricity.

Did you create a circuit?

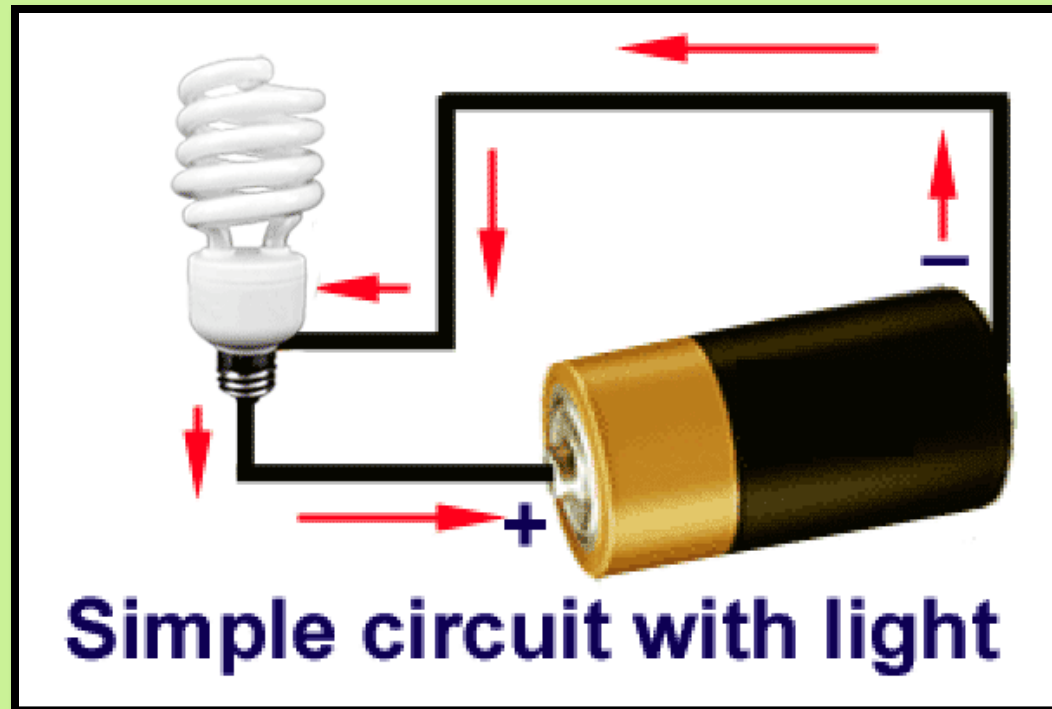
A **circuit** is a complete, closed path for an electric current to flow



All circuits consist of an energy source, a load, and wires to connect the parts together.

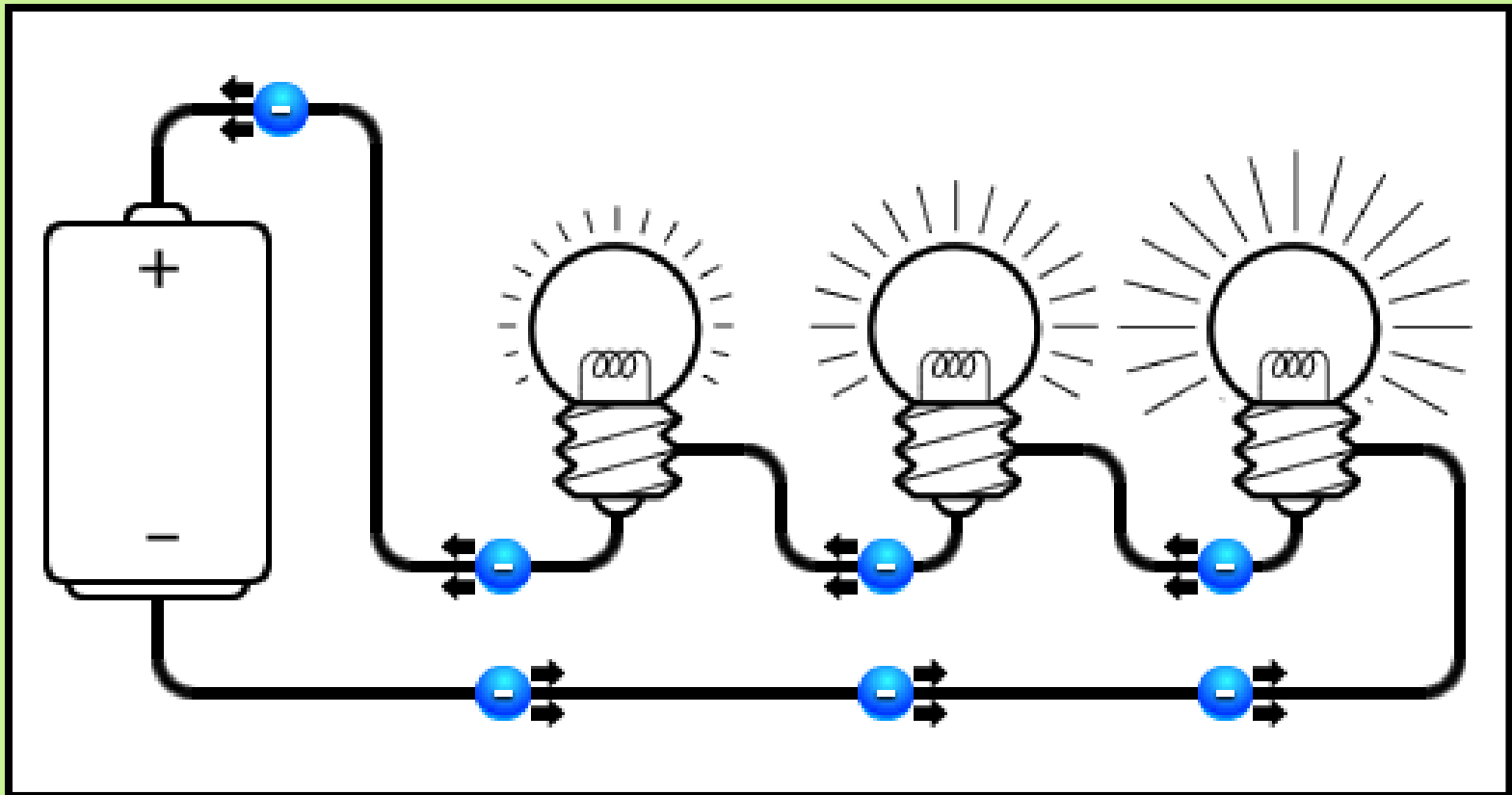
Unit 5: Electricity.

Electrons travel from the negative \rightarrow positive terminal of the battery.



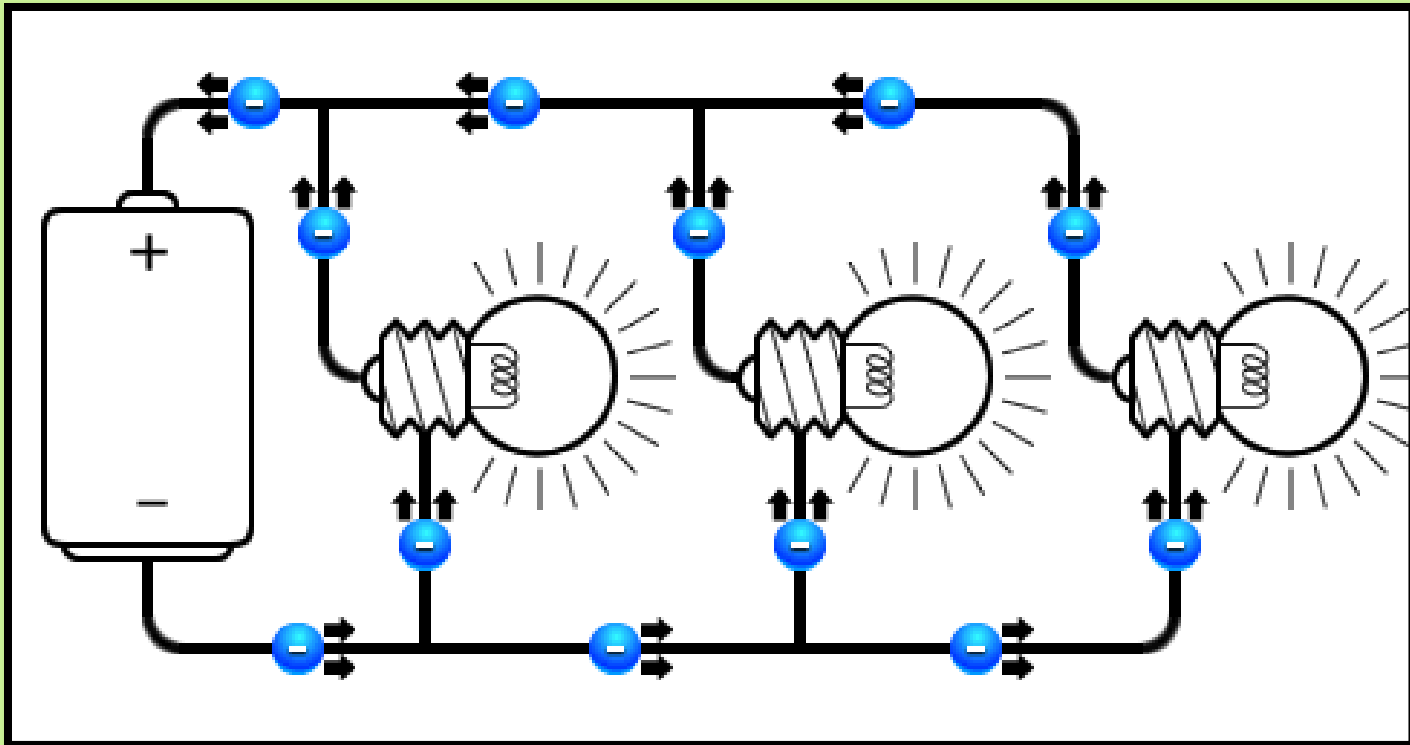
Unit 5: Electricity.

Series Circuit: circuit where all parts are connected in a single loop –only one possible path for charges to flow



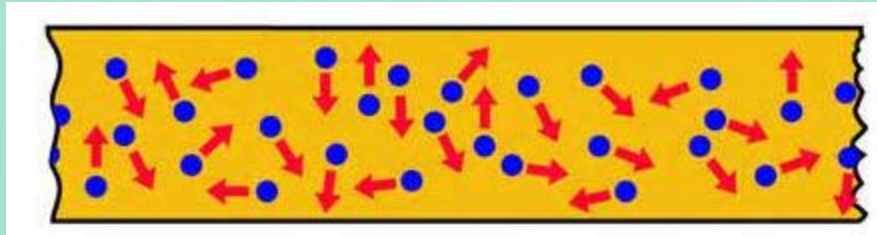
Unit 5: Electricity.

Parallel Circuit: A circuit in which different loads are on separate branches – charges can flow in more than one route

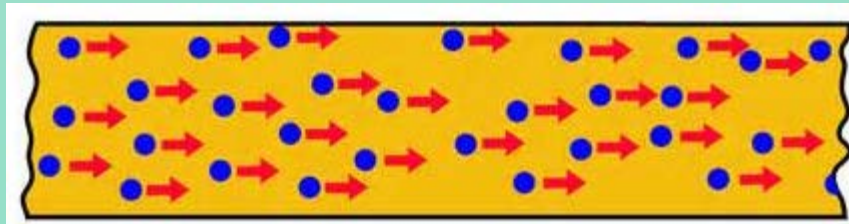


Unit 5: Electricity.

Alternating Current: charges continually switch from flowing in one direction to flowing in the reverse direction. (outlets in your home)



Direct Current: charges always flow in the same direction . (produced by batteries)

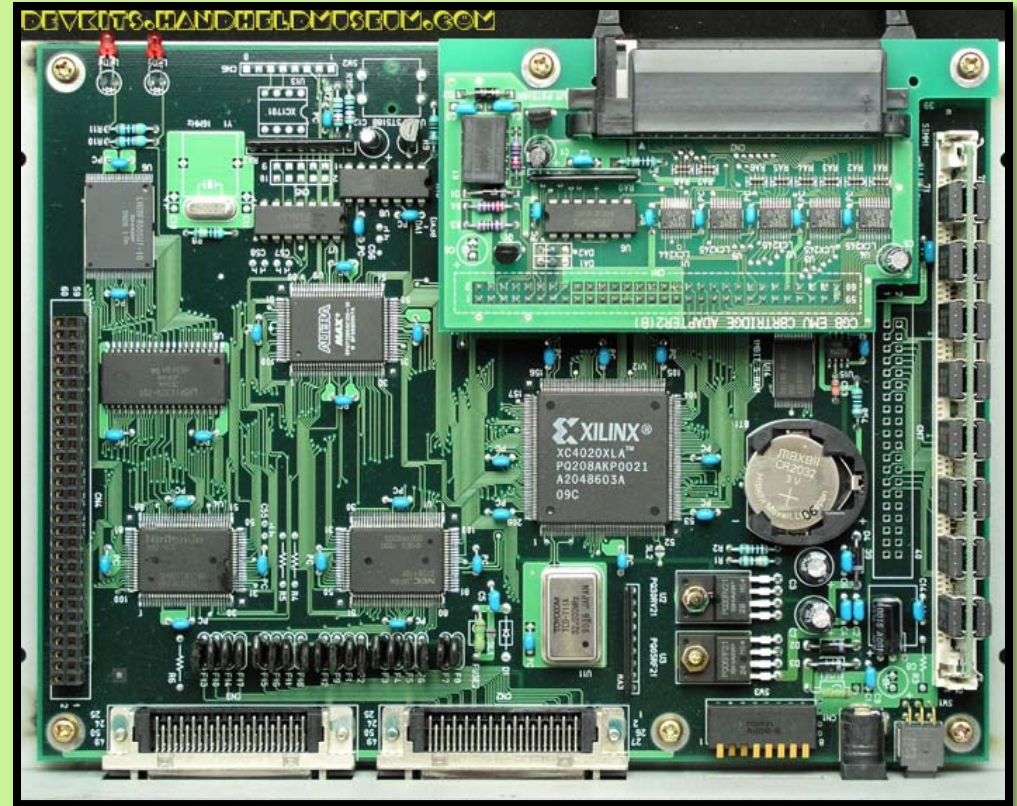
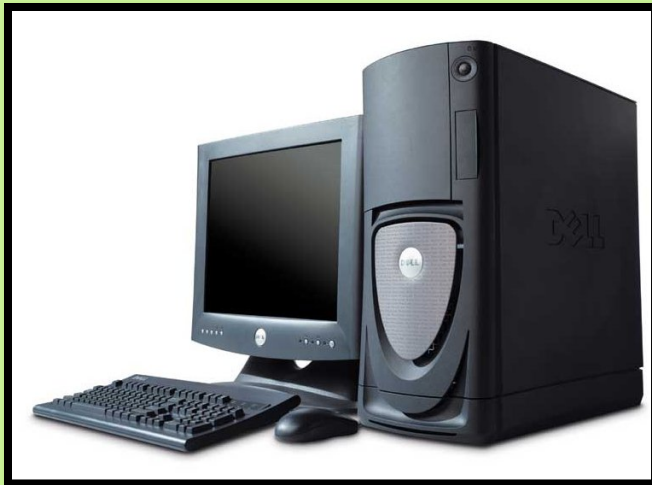


WHEN YOU FINISH THE CIRCUIT LAB...

- 1. HAND IN LAB**
- 2. Get a computer to share with your group**
- 3. Go Google. Click on the first link after searching GIZMO.**
- 4. Click on Enroll in a Class**
- 5. Enter the Class code: P9RRBMEYFB**
- 6. Click on “I need to create an ExploreLearning Account”**
- 7. Type in your first name, last initial, create a user name, and password**
- 8. Play with Gizmos on electricity and magnetism**

Unit 5: Electricity.

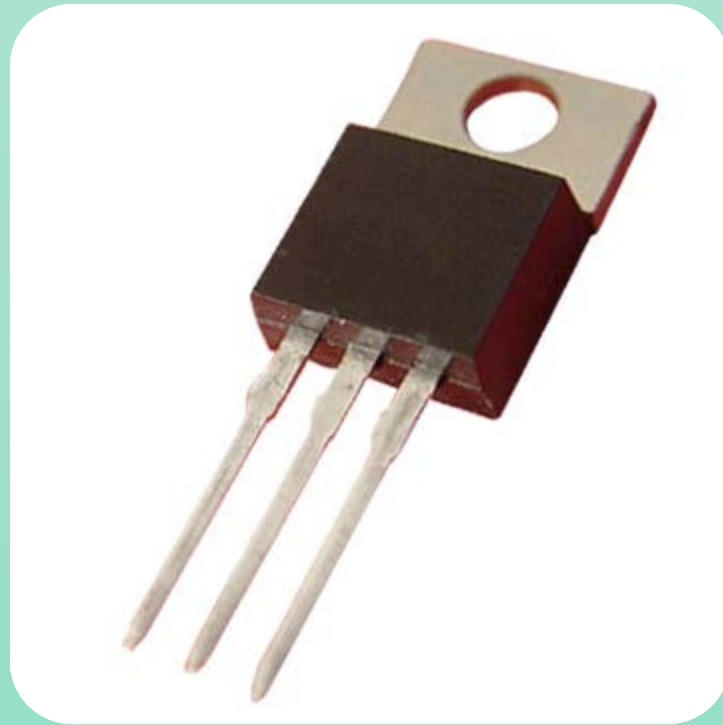
Circuit Board: a collection of hundreds of tiny circuits that supply electrical current to various parts of electronic devices



Typically made of a semiconductor material, silicon.

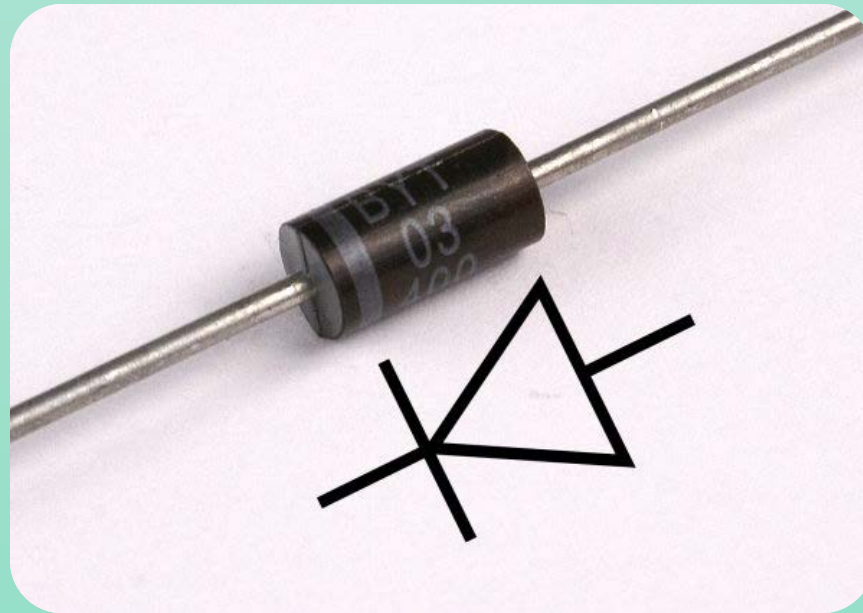
Unit 5: Electricity.

Transistor: part of an electronic device that can be used as an amplifier or a switch. Made of 3 layers of *semiconductor* material.



Unit 5: Electricity.

Diodes: part of an electronic device made of semi-conductive material, that only allows electric current to go in one direction



Bell Ringer

What is electromagnetic induction?

Draw what it looks like.



Bell Ringer

Take 10 minutes to review the following vocab words...

Electromagnet

Transistor

Electromagnetic induction

LED

Poles

Conductor

Generator

Silicon

Semiconductor

Electric motor

Direct current

Insulator

Diode

Solar cell

Unit 5: Electricity.

Examples of devices that use diodes: LED lights and Solar Cells

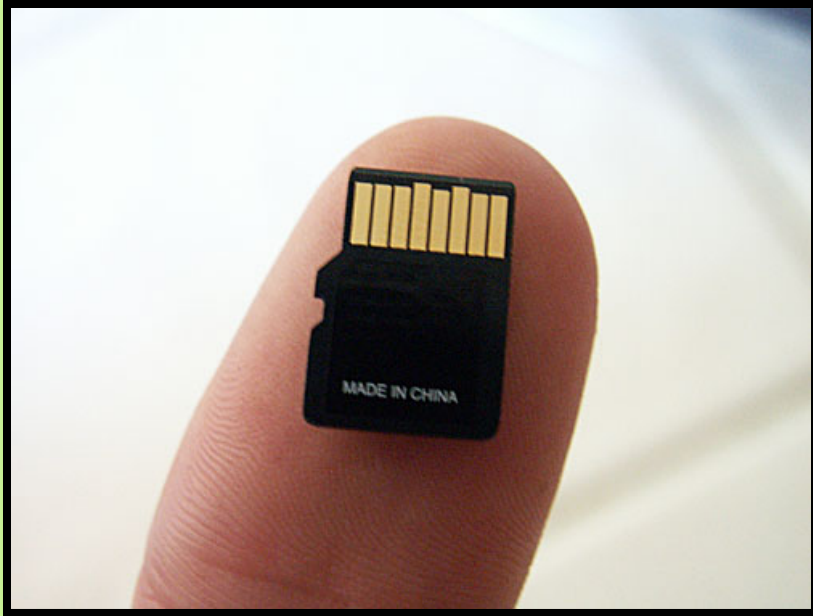


Converting electrical
energy to radiant energy



Converting radiant energy
to electrical energy

Unit 5: Electricity.



Integrated Circuit Board:

an entire circuit containing many transistors and other electronic components formed on a single chip

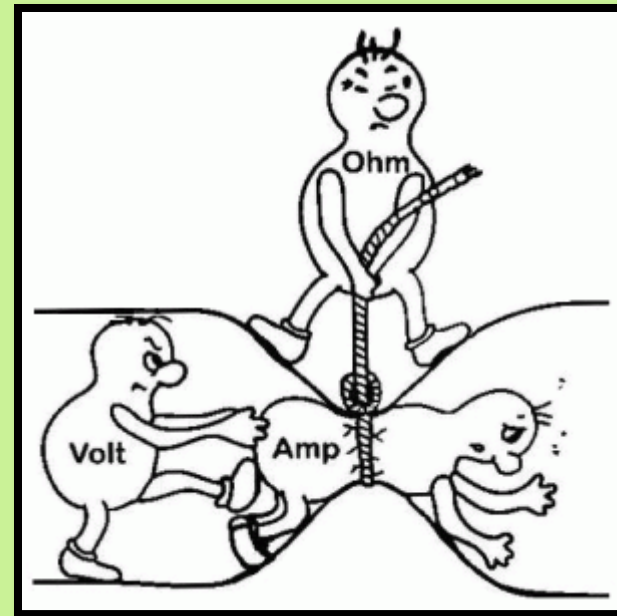
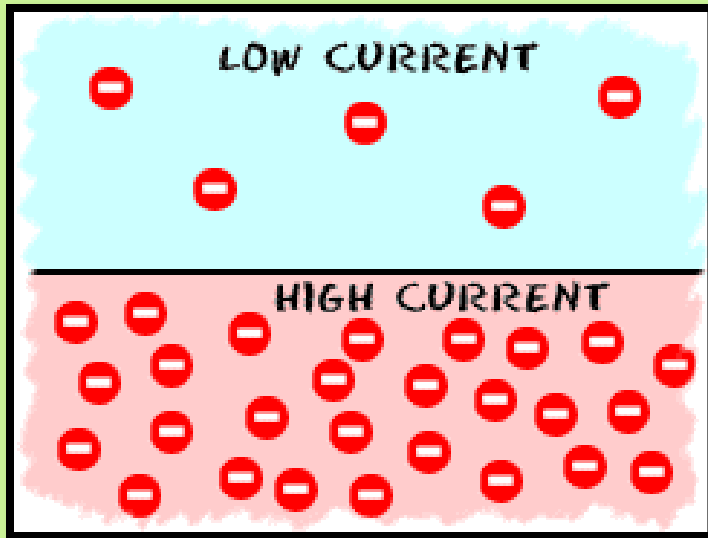
Resistance

Lesson 3

Unit 5: Electricity.

Term	Unit	Meaning
Current (I)	Amperes (A)	The rate at which a charge passes a given point
Voltage (V)	Volts (V)	The difference in energy between 2 points in a circuit (potential difference)
Resistance (R)	Ohms (Ω)	Anything that opposes the flow of electric charge (act like friction) Anything in a circuit can act as a resistor

Unit 5: Electricity.



Unit 5: Electricity.

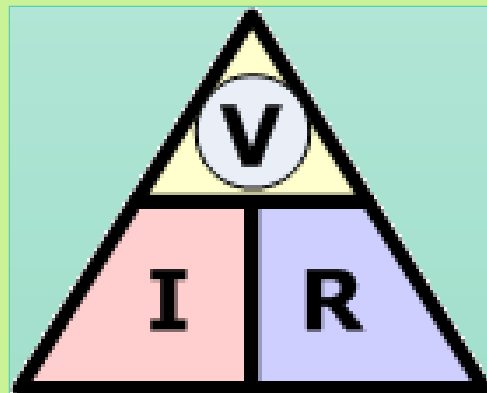
A German school teacher named Georg Ohm found the relationship between current (I), voltage (V), and resistance (R)



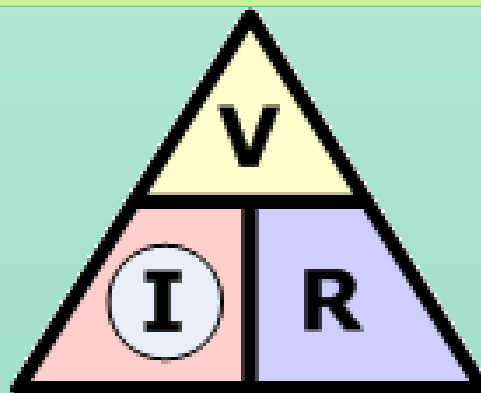
Ohm's Law

$$I = \frac{V}{R}$$

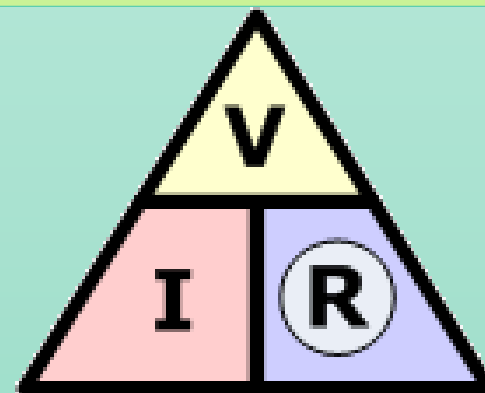
Unit 5: Electricity.



$$\textcircled{\mathbf{V}} = I \times R$$



$$\textcircled{\mathbf{I}} = \frac{V}{R}$$

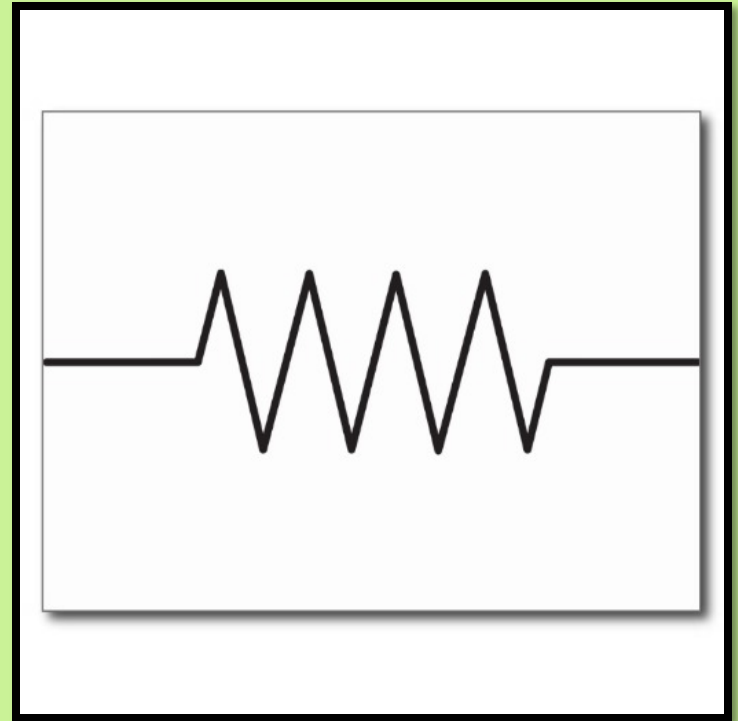
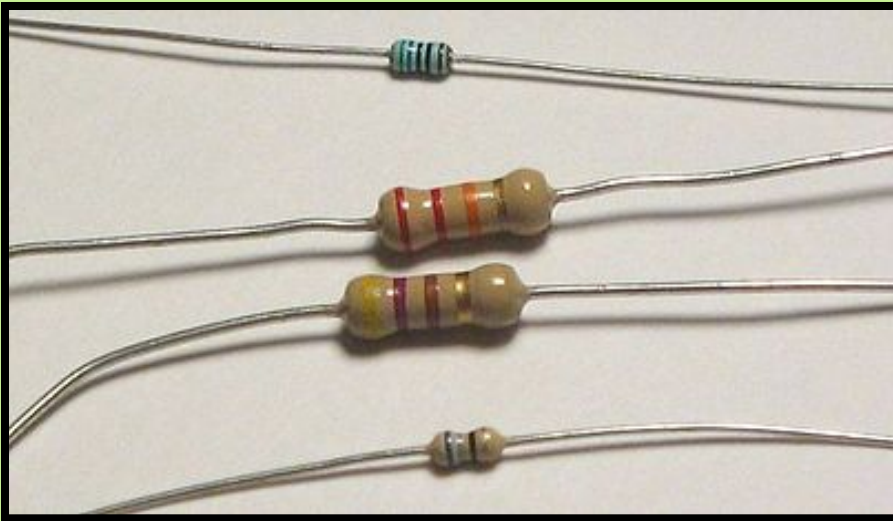


$$\textcircled{\mathbf{R}} = \frac{V}{I}$$

Unit 5: Electricity.

→ What is a resistor?

A resistor restricts the flow of electric current.



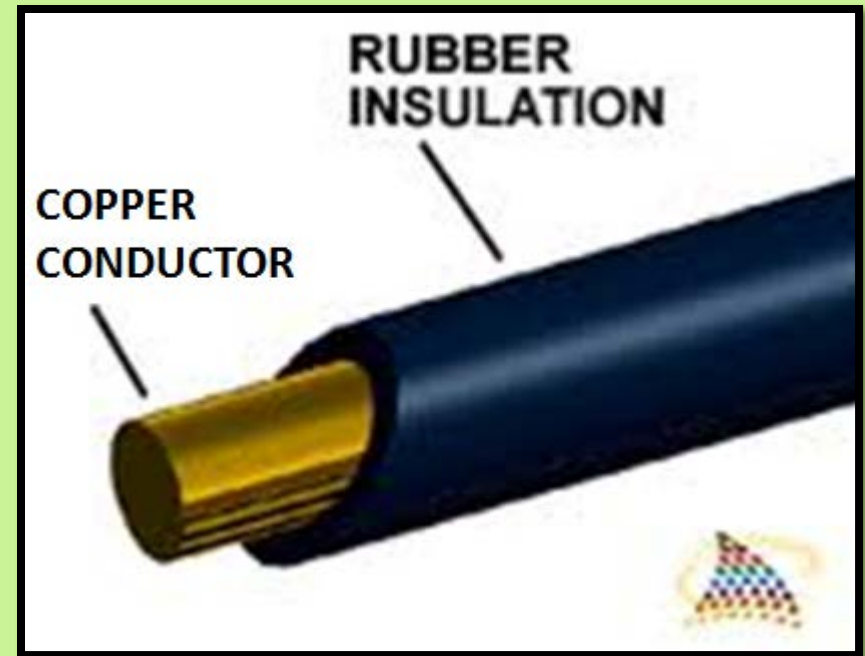
Four Factors that affect resistance

Unit 5: Electricity.

1. The material itself

Good conductors have low resistance.

Insulators have high resistance.



Unit 5: Electricity.

2. The thickness of the wire

THICKER WIRE = Less Resistance



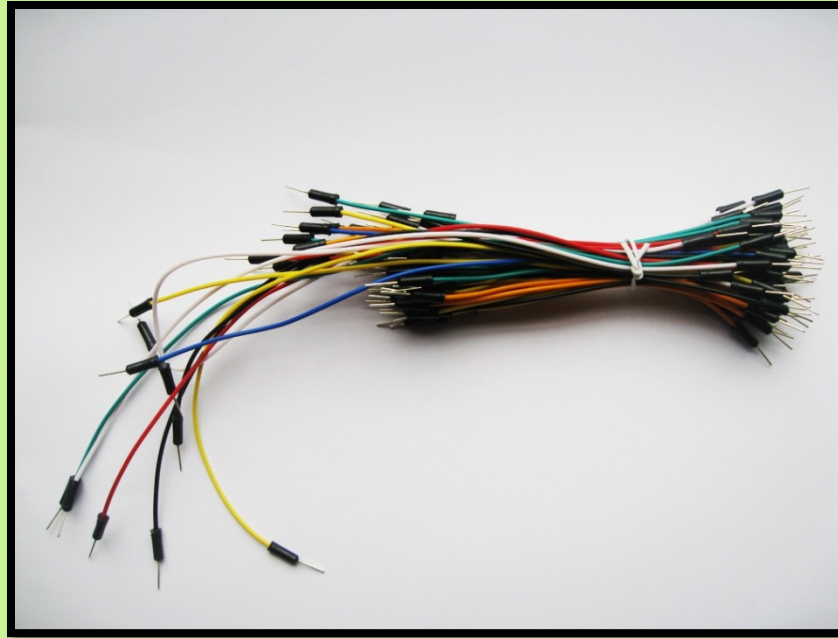
ANALOGY

Think of the wire like a hallway:

If the hall is very wide, it will allow a high current through it, while a narrow hall would be difficult to get through.

Unit 5: Electricity.

3. The length of the wire



THE LONGER THE PATH = the more resistance encountered

Unit 5: Electricity.

4. Temperature

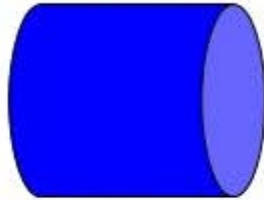
As the conductor (hallway) heats up, the protons start vibrating faster. They are more likely to get in the way and make it harder for the electrons to flow.

HIGHER TEMPERATURE = MORE resistance



Unit 5: Electricity.

Short/thick/cold wires = low resistance (easy for electrons to flow)



Long/thin/hot wires = high resistance (hard for electrons to flow)



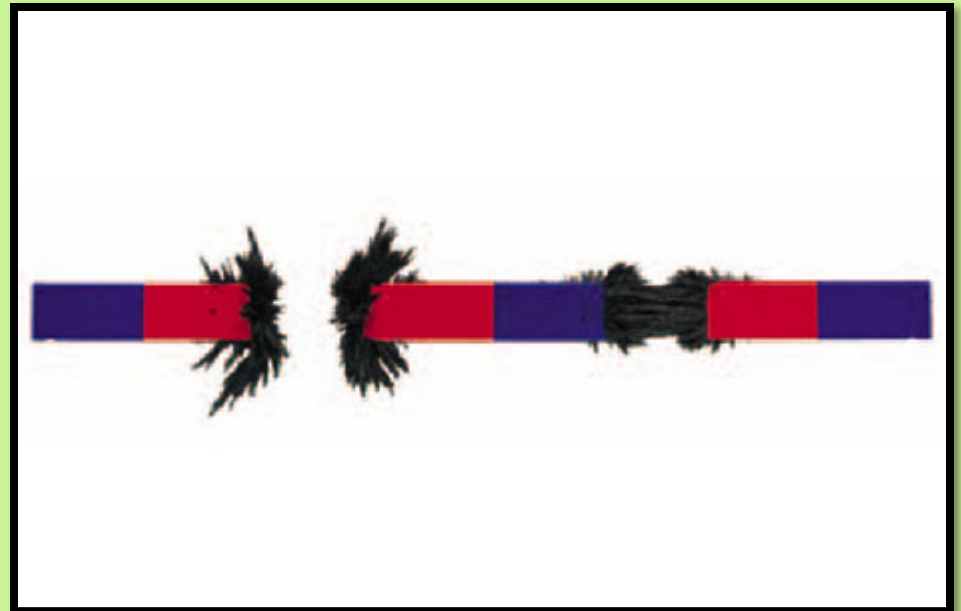
Electromagnets

Lesson 4

Unit 5: Electricity.

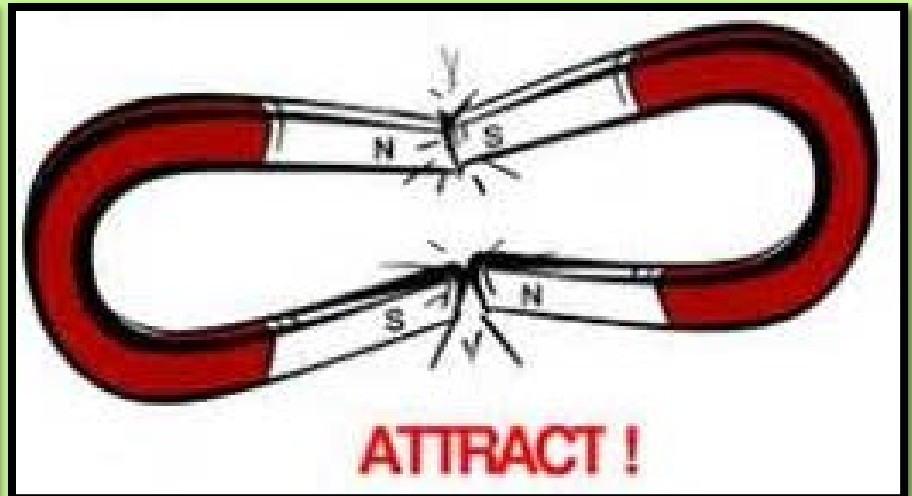
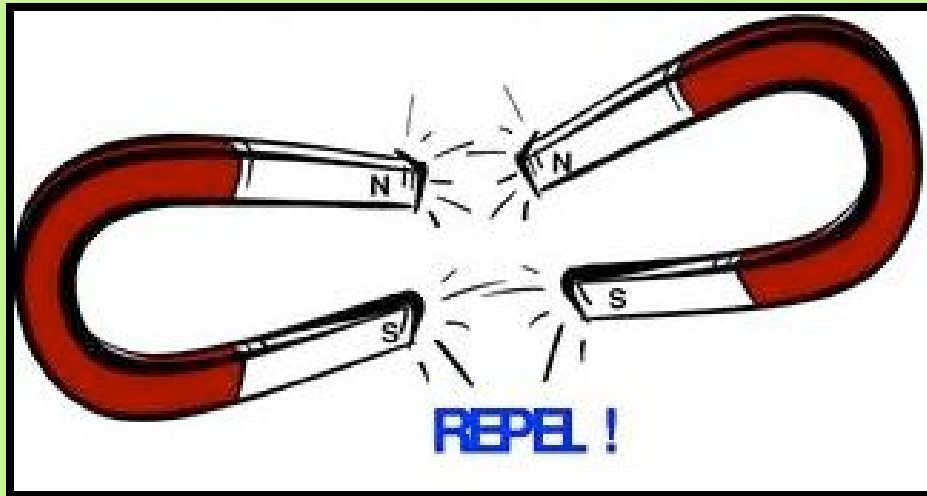
Magnets: any material that attracts iron or materials containing iron

Magnetic effects of a magnet are the strongest at the POLES



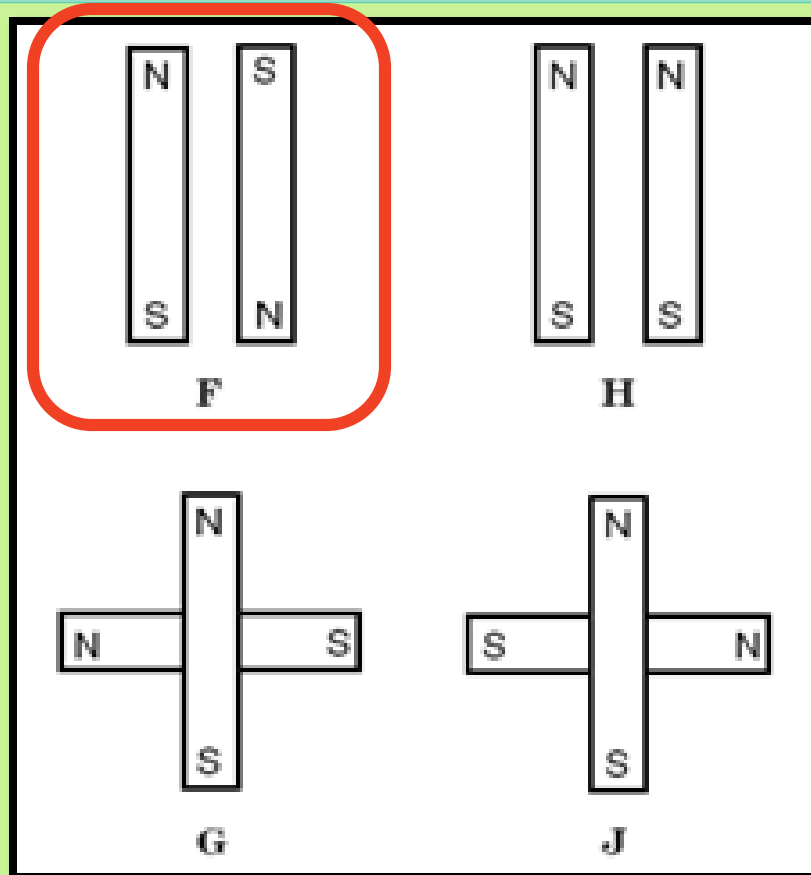
Unit 5: Electricity.

Magnetic Force: forces of repulsion or attraction between the **poles** of magnets



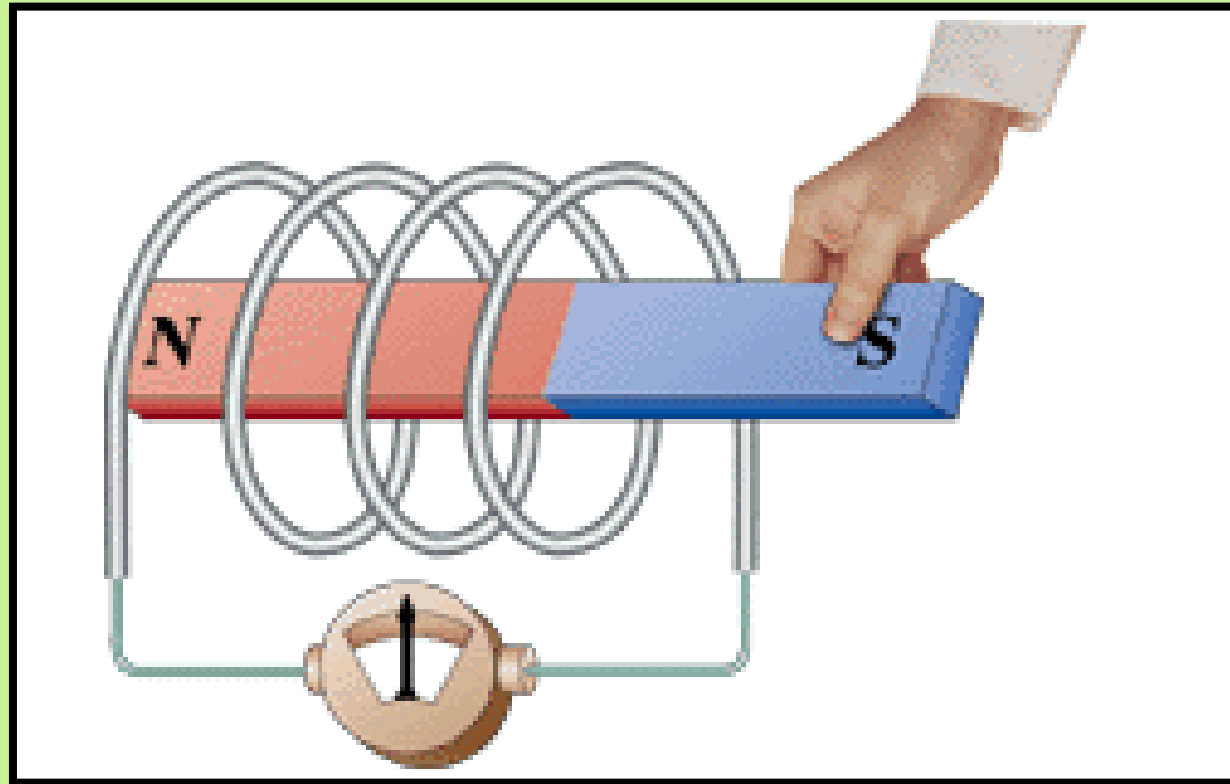
Unit 5: Electricity. Let's Try

Which of these pictures shows the magnets in a way that will result in the greatest attraction between the magnets?

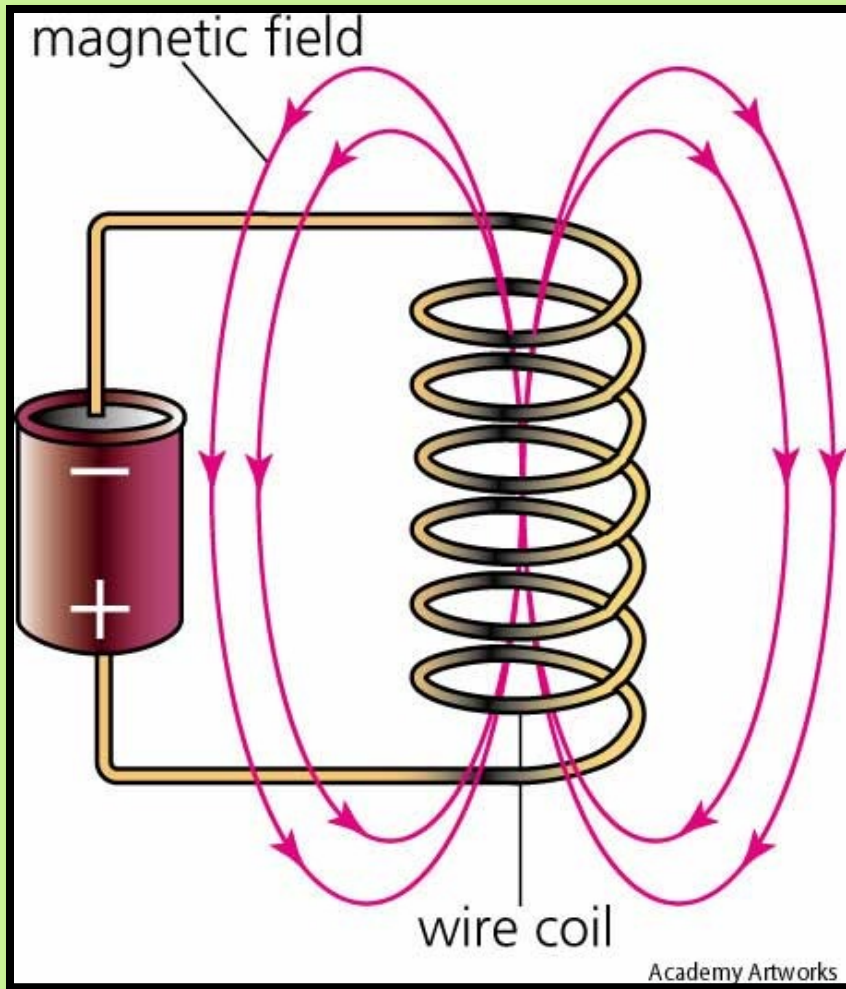


Unit 5: Electricity. Let's Try

Electromagnetic Induction: Process by which an electric current is produced by a changing magnetic field



Unit 5: Electricity.



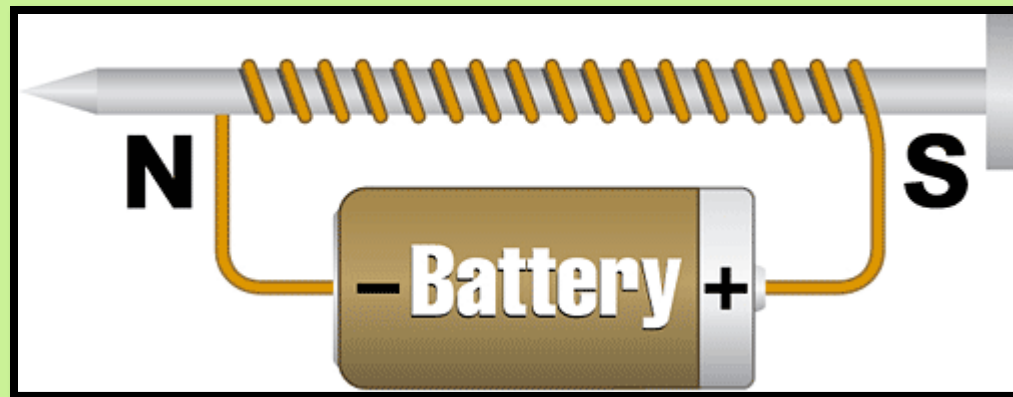
Solenoid:

A coil of wire that produces a magnetic field when carrying an electric current

Unit 5: Electricity.

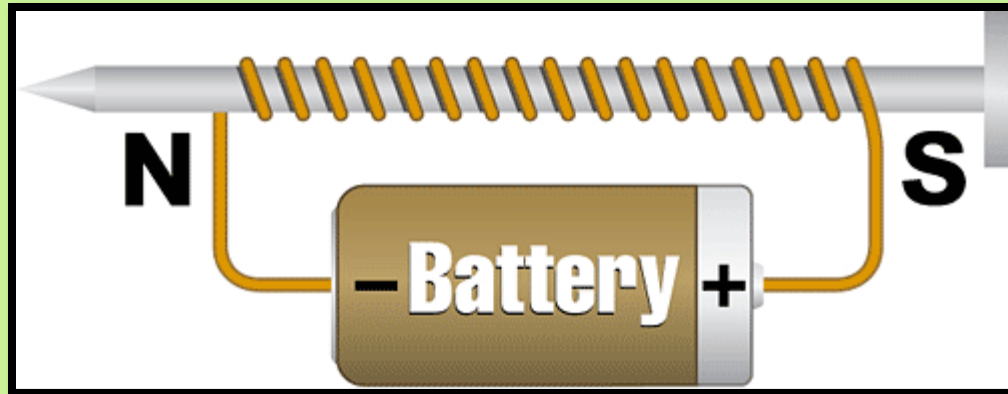
How to INCREASE the strength of the magnetic field produced by a solenoid...

1. Increase the number of loops in the coil
2. Increase the current
3. Put an iron core inside the coil (which is called an ELECTROMAGNET)



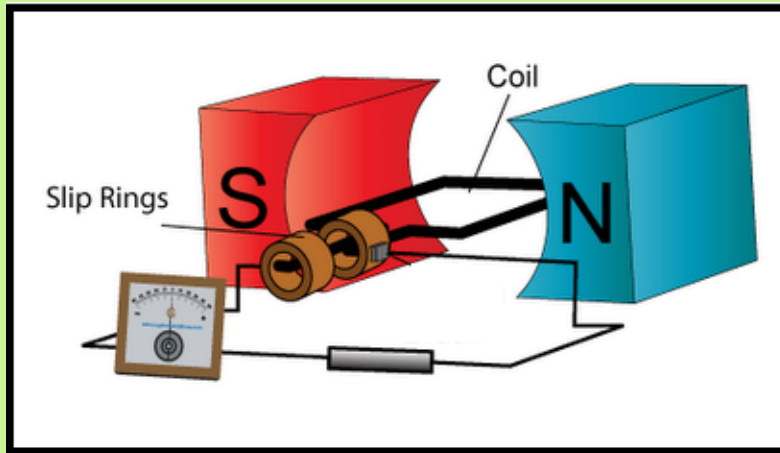
Unit 5: Electricity. Let's Try

Electromagnet: A magnet that consists of a solenoid wrapped around an iron core



Unit 5: Electricity.

A **generator** is a device that uses electromagnetic induction to convert kinetic energy into electrical energy.





Unit 5: Electricity.

Electric Motor: Device that changes electrical energy into kinetic energy





Unit 5: Electricity.



Transformers It is a device that increases or decreases the voltage or an alternating current.



Unit 5: Electricity.



Electricity comes from high voltage power lines and must be “stepped-down” by a transformer before entering our home.

Electricity & Magnetism

Lesson 5: Review Day