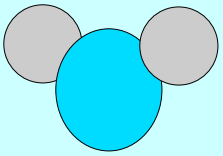
ELECTRICITY

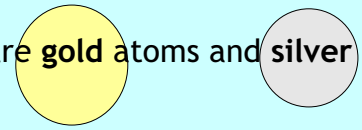
Everything around us is made of atoms:

Atoms are little round objects

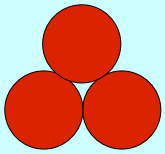
There are over one hundred different kinds of atoms

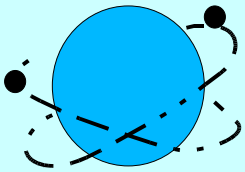


There are **gold** atoms and **silver** atoms and oxygen atoms



You can put atoms together in different combinations to make everything that you see around us





Electrons orbit each atom

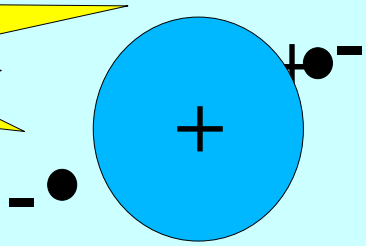
So, atoms are a little like a sun, with orbiting planets

Each different type of atom has a different number of electrons that orbit it

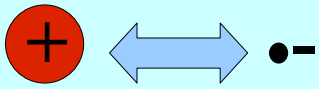
A Hydrogen atom has ONE electron

An oxygen atom has EIGHT electrons

Atoms have a POSITIVE (+) charge
Electrons have a NEGATIVE (-) charge

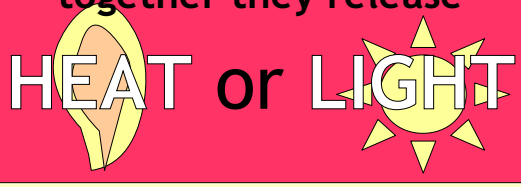


The electrons and atom are attracted to each other, kind of like magnets
If you somehow pull electrons away from an atom this leaves the atom with a POSITIVE charge

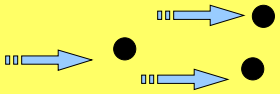


An atom that is missing electrons (and is positively charged) is attracted to any nearby or passing electrons

When atoms and electrons come together they release



Electricity is all about moving electrons around



BALLOON ACTIVITY

The balloon activity is used to show how strong the attraction is between charged atoms and electrons

MATERIALS

- 1 balloon
- A tap with running water

PROCEDURE

- Blow up a balloon
- Rub the balloon on your hair
- Turn on a water tap
- Move the balloon close to the running water
- Watch the water stream move towards the balloon

HOW IT WORKS

- We add electrons to the atoms in the balloon by rubbing the balloons on our heads (electrons leave some of our hair atoms since the balloon atoms want the electrons more).
- With friction we pull the electrons off our hair and leave them on the balloon.
- Notice how our hair gets all frizzy?
- Adding the electrons to the balloon's surface leaves the surface of the balloon negatively charged.
- To show that the balloon was negatively charged, we needed to bring the balloon near to atoms that are free to move.
- Liquids are good sources of freely moving atoms.
- So, we brought the balloon near to water.
- Flowing water is an excellent test subject for our experiment.
- The water atoms were pulled towards the charged balloon.
- These atoms wanted to share the extra electrons of the balloon atoms.
- The electrons don't leave the balloon atoms, unless the water and balloon are directly touched.
- If you leave water running over the balloon for a few seconds the water will wash away the electrons off the balloon surface.

TO TRY AT HOME

- Different sizes of balloon
- Roll a pop can along the floor with a balloon
- You can use a comb instead of a balloon – it gets charged with electrons as you comb your hair

FRUITY BATTERIES

BACKGROUND

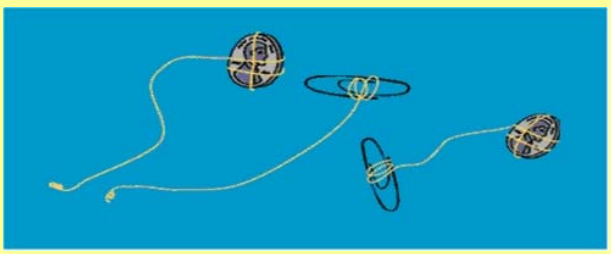
- When you take away electrons from a surface and leave a bunch of positively charged atoms this is known as “Statically” charging a surface (Static means not moving)
- The charged atoms on the balloon are good examples of static electricity
    - The balloon has gained electrons from the surface that it was rubbed against
- Some types of atoms pull electrons away from other atoms really easily
- Metals atoms, like gold, silver, and copper are really good at sharing electrons
    - If you put a bunch of metal atoms together, like if you a metal wire, they will share electrons
    - This makes metal wire a really good material for moving electron around with
- When electrons move around this is usually just called “Electricity”

WHAT YOU NEED TO MAKE A LEMON BATTERY

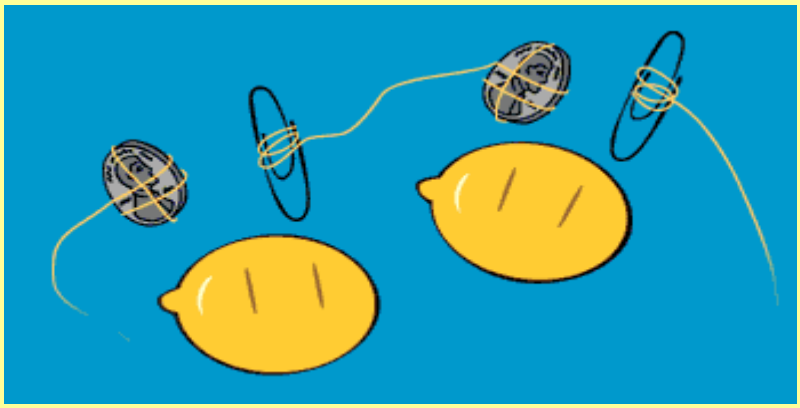
- 2 lemons
- 4 copper pennies
- 4 galvanized nails or screws or paperclips
- 5 pieces of bare wire (without a plastic coating)
- A multimeter or voltmeter with probes (red and black)
- A low-voltage and low-current LED (~2V, <30mA)
- 4 plates, yogourt container lids, or something similar
- A knife
- Sandpaper

PROCEDURE

- Rub the lemons around on the table to “get the juices moving”
- Cut each lemon in half and place each half (you should have four) on its own plate
- Lay the plates out in a line
- Rub the sandpaper on the pennies to shine them up
- Wrap the end of each penny with ~1.5inches of of one end of the wire
- Wrap the other end of three of these penny-wires to the paperclip
- Wrap the remaining wire to the remaining paperclip



- Insert a penny (attached to a wire) into each half lemon piece
- Join the lemons by inserting the paperclip, which is joined by a wire to one of the pennies, into the next lemon
- Insert the remaining paperclip into the lemon with only a penny in it



- Turn on the voltmeter
- Set the voltmeter to the V(DC) setting in order to the voltage across the lemon battery (this value indicates whether you have a lot of electrons waiting to be used in a circuit)
- Touch one of the voltmeter probes to the wire sticking out of the first lemon
- While holding this connection in place (perhaps with an “alligator” clip) touch the other probe of the voltmeter to the other wire sticking out of the last lemon
- Observe the voltage displayed on the voltmeter
- You should see ~2V or greater
- Disconnect the voltmeter
- Now try connecting the two wires to the LED
- See if you can get the LED turn on
- If it doesn’t work, try flipping the LED around

HOW IT WORKS

- The acid in the lemon reacts differently with each of the two metals
- The acid pulls electrons away from the penny and carries them to the nail
- This leaves the atoms in the penny positively charged
- The nail/paperclip ends up with many electrons
- These extra electrons flow along the wire to the LED
- When they join with the atoms in the LED they give off light
- The flow of electrons through the wire and LED is called current

SOURCES

- http://www.scienceaid.co.uk/physics/electricity/charge.html
- http://pbskids.org/zoom/activities/sci/lemonbattery.html
- http://www.ushistory.org/franklin/fun/lemon.htm
- http://www.sciencemadesimple.com/static.html

MAGNETISM

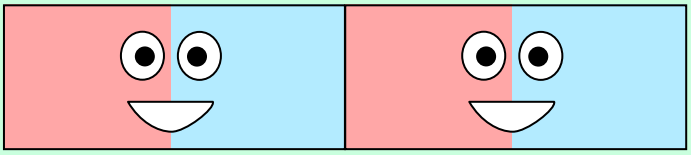
Magnets are basically objects that can attract or repel each other because of what is called a "magnetic field"

A familiar example is a fridge magnet that sticks to the refrigerator door

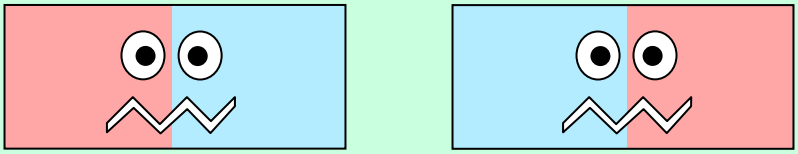
Every magnet has a north pole and a south pole

The rule to remember is: OPPOSITES ATTRACT

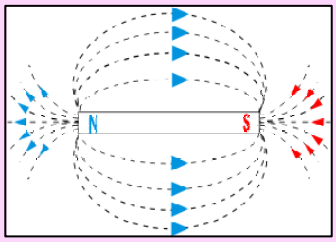
It's hard to keep these magnets apart:



And it's really hard to push these magnets together:



Using iron filings, we can see the magnetic field lines:



It turns out that current flowing through a wire also produces a magnetic field!

This is called an electro-magnet, and is the basis of most electric motors

WORLD'S SIMPLEST MOTOR

BACKGROUND

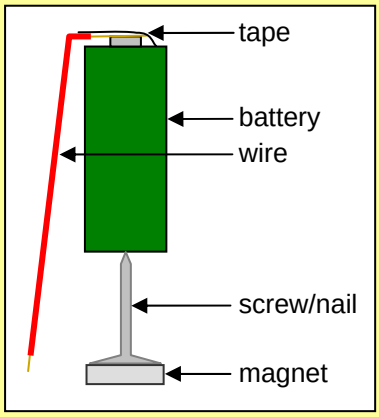
- Moving electrons create a magnetic field
- Interestingly, electrons moving through a magnetic field feel a special kind of force
- Using a regular magnet, a battery, and a wire, we can create a small electric motor
    - We are converting the energy in the battery into the energy of motion (kinetic)
    - This is a special type of motor called homopolar, which means that it is not based on the interaction between north and south poles, but rather on the force exerted by a magnetic field on moving electrons

WHAT YOU NEED TO MAKE THIS MOTOR

- 1 AA battery
- 1 strong disc magnet
- 1 small screw or nail (that the magnet sticks to)
- 1 short piece of wire
- Some tape to hold it all together (black electrical tape is best)

PROCEDURE

- Using the tape, stick one end of the wire onto the (+) side of the battery
- Put the magnet onto the flat head of the screw
- Holding the battery with the (+) side up, put the point of the screw on the (-) side (the magnet should keep it there)
- Make sure that your motor looks like the picture
- Bring the remaining end of the wire into contact with the magnet, making sure that the (+) side is firmly stuck down
- Watch the motor spin! You should know that this motor will drain the battery pretty quickly, and the wire can get hot, so be careful.



SOURCES

- http://www.youtube.com/watch?v=py-0dVJ4K_s
- http://en.wikipedia.org/wiki/Homopolar_motor