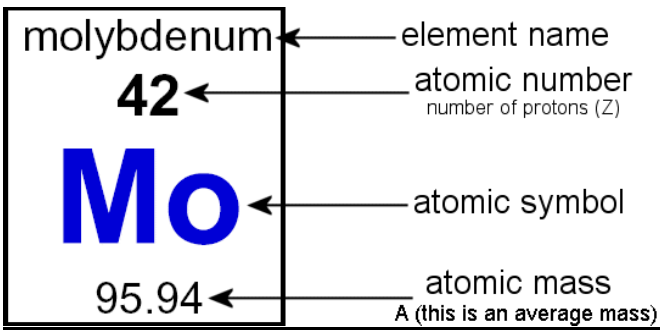
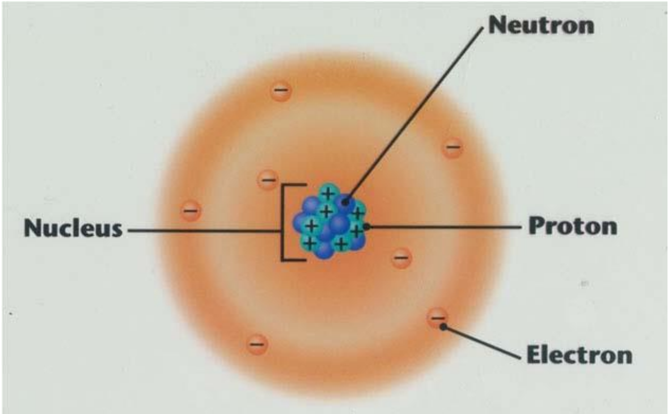
SPS1: Students will investigate our current understanding of the atom.

a. Examine the structure of the atom in terms of

- *proton, electron, and neutron locations.*
    - *Proton has a charge of __ POSITIVE_ and is located in the __NUCLEUS___ of the atom.*
        - *Protons are also the elements __ATOMIC__ number of the identity of the element, so protons are found by looking at the atomic number*
    - *Neutron has a charge of _NEUTRAL___ and is located in the __NUCLEUS___ of the atom.*
        - *Neutrons are found by subtracting the __ATOMIC_ Number from the __ATOMIC_ Mass or the BIG #- SMALL #.*
    - *Electron has a charge of __NEGATIVE_ and is located in the __ELECTRON CLOUD__ of the atom.*
        - *Electrons are equal to the number of __PROTONS__ in a neutral atom.*
    - *The nucleus is made up of these 2 particles ___PROTONS___ and __NEUTRONS__.*
    - *The electrons are located in this region of the atom, known as the _ELECTRON CLOUD_.*
    - *The electron cloud is divided in to energy levels or energy shells, the first level will hold ___2___ electrons and the second level will hold __8__ electrons.*
    - *The valence shell or valence level is the ___OUTER_ energy shell of the atom.*
- *Atomic mass and atomic number.*
    - *Atomic number is equal to the number of __PROTONS__ in the atom and is also the atoms identity—it's the small number of the periodic table.*
    - *Atomic mass is equal to the average mass of all the isotopes of a particular element—it the big number on the periodic table.*
- *atoms with different numbers of neutrons (isotopes).*
    - *Define Isotope___HAS THE SAME NUMBER OF PROTONS BUT DIFFERENT NUMBER OF NEUTRONS___.*
    - *Ex. Carbon-12 and Carbon-14*
        - *Carbon 12 has ___6___P ____6_____N _____6___E*
        - *Carbon 14 has __6_____P _____8____N _____6___E*
- *explain the relationship of the proton number to the element's identity.*
    - *The _ATOMIC___ number is equal to the number of ___PROTONS___ in the atom which is how the element is identified.*
    - *Ex. Nitrogen has an atomic number of ____7____, which means that is has ____7______* ***protons.***

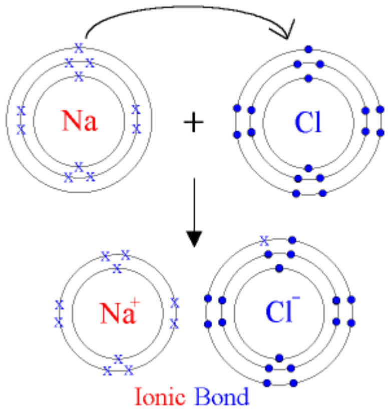




- ***Number of Protons = Atomic Number***
- ***Number of Electrons = Number of Protons = Atomic Number***
- ***Number of Neutrons = Mass Number - Atomic Number***

b. Compare and contrast ionic and covalent bonds in terms of electron position.

- ***Define Ionic bond _______TRANSFERS ELECTRONS___.***
- ***Define Covalent bond: ______SHARES ELECTRONS______________________________.***
- ***Ionic bond is between a __METAL____and a ___NONMETAL____ on the periodic table.***



- ***Covalent bond is between a __NONMETAL_____and a ___NONMETAL___ on the periodic table, the are CO-Workers on the same side.***

SPS2: **Students explore the nature of matter, its classifications, the naming system for types of matter.**

a. Calculate density when given a means to determine a substance's mass and volume.

- Density=Mass/Volume: remember My Dear Valentine.
- Ex. A student determines that a piece of an unknown material has a mass of 5.854 g and a volume of 7.57 cm^3. What is the density of the material?

  D= 5.854g / 7.57cm^3 = .77 g/cm^3
- In science lab you are given a rectangular shaped solid made from some synthetic (manmade) substance. Its dimensions are 3.5 cm by 2.4 cm by 14.6 cm. If this substance masses 20 g, what is its density in g/cm^3? (DA)
  V= 3.5 cm X 2.4 cm X14. 6 cm = 122.6 cm^3 D= 20g/122.6 cm^3
  D= 0.163 g/cm^3

b. Predict formulas for stable binary ionic compounds based on balance of charges.

1. Find the charge for each element based on what group it is in. (Group 1= +1 charge)
2. Criss-Cross the charges to make the correct formula.

Ca^{+2} Cl^{-1} = $CaCl_2$

c. Use IUPAC nomenclature for transition between chemical names and chemical formulas of

- **Binary ionic compounds (containing representative elements).**
- <u>Steps for writing Binary Ionic Compounds:</u>
  1. Write the symbol for the ions side by side. Write the cation first.
  2. Cross over the charges by using the absolute value of each ion's charge as the subscripts for the other ion.
  3. Check the subscripts and divide them by their largest common factor to give the smallest possible whole number-ratio of ions.
- (2 x +3 = +6 and 3 x-2 = -6 which cancel each other out)
  *NAME THE 1ST ELEMENT AND SLAP –IDE ON THE BACKSIDE OF THE SECOND ELEMENT. EX. MAGNESIUM CHLORIDE $MgCl_2$

- **Binary covalent compounds (i.e. carbon dioxide, carbon tetrachloride).**

- Naming Covalent Compounds-USES PREFIXES!!!
- 1. The less electronegative element is given first. It is given a prefix only if it contributes more than one atom to a molecule of the compound.
- 2. The second element is named by combining (a) a prefix indicating the number of atoms contributed by the element, (b) the root of the name of the second element, and (c) the ending –ide. With few exceptions, the ending –ide indicates that a compound contains only two elements.
- 3. The "o" or "a" at the end of a prefix is usually dropped when the word following the prefix begins with another vowel. Ex: monoxide or pentoxide
- Ex: P_4O_{10} TETRAPHOSPHORUS DECOXIDE

- Numerical Prefixes
- 1- MONO 4- TETRA 7- HEPTA 10- DECA
- 2- DI 5- PENTA 8- OCTA
- 3- TRI 6- HEXA 9- NONA

Fill in the blanks

• ELEMENTS	TYPE OF COMPOUND	NAME	FORMULA
Nitrogen, Fluorine	**Covalent**	**Di nitrogen tetra fluoride**	**N2F4**
Copper (II) & sulfur	**Ionic**	**Copper (II) sulfide**	**CuS**
Phosphorus, Chlorine	**Covalent**	**Phosphorus tri chloride**	**PCl3**
Sulfur, Chlorine	**Covalent**	**Sulfur dichloride**	**SCl_2**
Magnesium and oxygen	**Ionic**	**Magnesium Oxide**	**MgO**
Barium & fluorine	**Ionic**	**Barium Fluoride**	**BaF_2**

d. Demonstrate the Law of Conservation of Matter in a chemical reaction.

State the Law of Conservation of Matter :MATTER IS NOT CREATED OR DESTROYED .

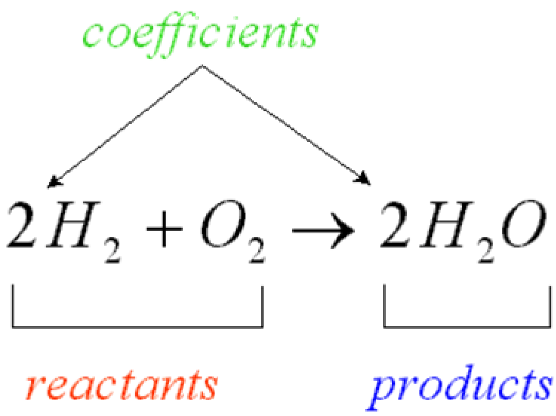
- Steps for balancing an Equations
  - 1. Divide the equation in half. Reactants on the left and Products on the right.
  - 2. Count the number of atoms for EACH element on the Reactants side.
  - 3. Count the number of atoms for EACH element on the Products side.
    - Hint: if you write them in the same order on each side it is easier to see what needs to be balanced.
  - IMPORTANT: you can only add/change the coefficient, not the subscript (the little number).
  - 4. Write the newly balanced equations with the Coefficients.

Examples:

$P_4 + 3\ O_2 \rightarrow 2\ P_2O_3$

$N_2 + 3H_2 \rightarrow 2\ NH_3$

$2\ Al + 2\ HCl \rightarrow\ H_2 + 2AlCl_3$



e. Apply the Law of Conservation of Matter by balancing the following types of chemical equations:

- **Synthesis**is _COMBINES TO FORM A LARGER COMPOUND___
  - Ex. Element + Element→Compound or
  - A +B= AB
  - $2Na + Cl_2= 2NaCl$

$2Na + Br_2 \rightarrow 2NaBr$

- **Decomposition** is__SEPARATES OR BREAKS DOWN INTO SMALLER PARTS___
  - COMPOUND→ _Element__ + __Element_ or
  - COMPOUND → _Compound____ + _Compound___
  - AB=A + B or $2\ H_2O= 2H_2 + O_2$

$2Al_2O_3 \rightarrow 4Al + 3O_2$

- **Single Replacement** is__1 ATOM CHANGES PLACE______
  - ELEMENT + COMPOUND→ ELEMENT + COMPOUND
  - A+BC = B+AC
  - $Cu+2AgNO_3=2Ag+Cu(NO_3)_2$

$Cl_2 + 2NaBr \rightarrow 2NaCl + Br_2$

- **Double Replacement** is___2 ATOMS CHANGE PLACES______________________

- COMPOUND + COMPOUND→ COMPOUND + COMPOUND
- AB+CD=AD+CB
- $CaCO_3+2HCl=CaCl_2+H_2CO_3$

$CuCl_2 + H_2S \rightarrow CuS + 2HCl$

1. $C_4H_8 + 6O_2$ ---> $4CO_2 + 4H_2O$ ___SingleReplacement or Combustion	***2. HCl + NaOH ---> H_2O + NaCl*** Double Replacement
3. $2KNO_{3(s)}$ ---> $2KNO_{2(s)} + O_{2(g)}$ ***Decomposition***	***4. $AgNO_3$ + NaCl ---> $NaNO_3$ + AgCl*** Double replacement
5. 2Mg + O_2 ---> 2MgO ***Synthesis***	***6. 2Ag + S ---> Ag_2S*** Synthesis
7. $MgCO_{3(s)}$ ---> $MgO_{(s)} + CO_{2(g)}$ ***Decomppposition***	***8. Cl_2 + 2KBr ---> 2KCl + Br_2*** Single Replacement

SPS3: **Students will distinguish the characteristics and components of radioactivity.**

a.Differentiate between alpha and beta particles and gamma radiation.

Define Alpha (α) ____2 PROTONS AND 2 NEUTRONS____________

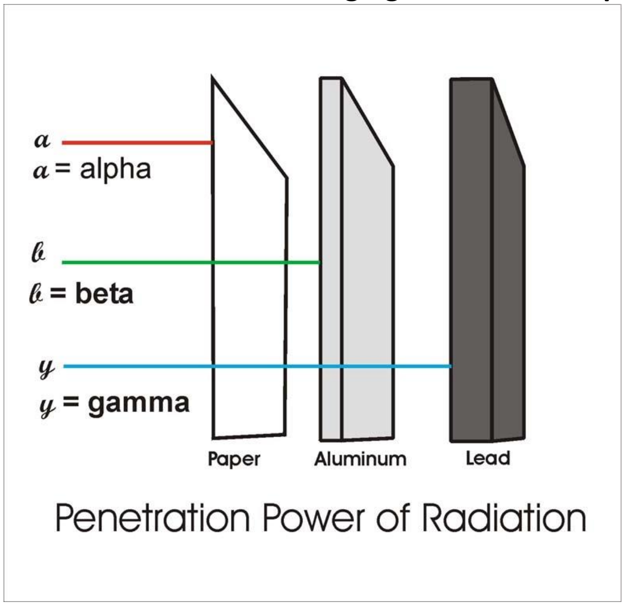
- **Alpha particle consists of a large _HELIUM_nucleus.**
- **Alpha particles can be stopped by __PAPER______________________________________, but is the most damaging when inside the body.**

Define Beta (β) ___ELECTRON EMITTED BY AN UNSTABLE NUCLEUS______________________________

- **Beta particles consist of small electrons that can be stopped by _ALUMINUM_______________.**

Define Gamma (γ) _____ENERGY EMITTED BY AN USTABLE NUCLEUS___________________________

- **Gamma can be stopped by ______LEAD____, is the least damaging because it can pass through the body and not be stopped by skin.**



Solve these decay problems:

ALPHA

$$^{210}_{84}\text{Po} \rightarrow \_\ ^{206}_{82}Pb + {}^{4}_{2}\alpha$$

$$^{238}_{92}\text{U} \rightarrow {}^{234}_{90}Th + {}^{4}_{2}\alpha$$

BETA

$$^{90}_{38}\text{Sr} \rightarrow {}^{0}_{-1}e + {}^{90}_{39}Y$$

$$^{40}_{19}\text{K} \rightarrow {}^{40}_{19}K + \gamma$$

GAMMA

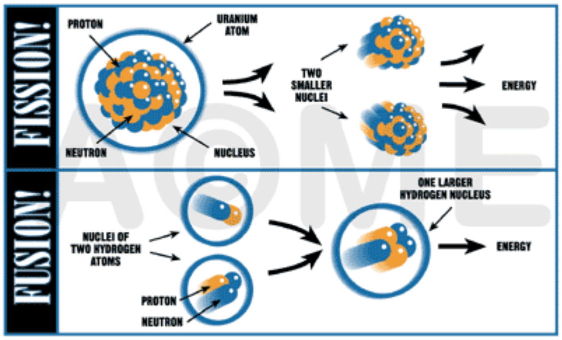
How do you know this equation gamma decay?

$$^{99m}_{43}\text{Tc} \longrightarrow {}^{99}_{43}\text{Tc} + \gamma$$

b. Differentiate between fission and fusion.

Define Fission__SPILTS A LARGE ATOM INTO 2 SMALLER ATOMS____________.

Fission occurs where__NUCLEAR POWER PLANTS LIKE PLANT VOTGLE AND PLANT HATCH_



Define FusionCOMBINING 2 SMALLER ATOMS TO FORM A LARGER ATOM_____

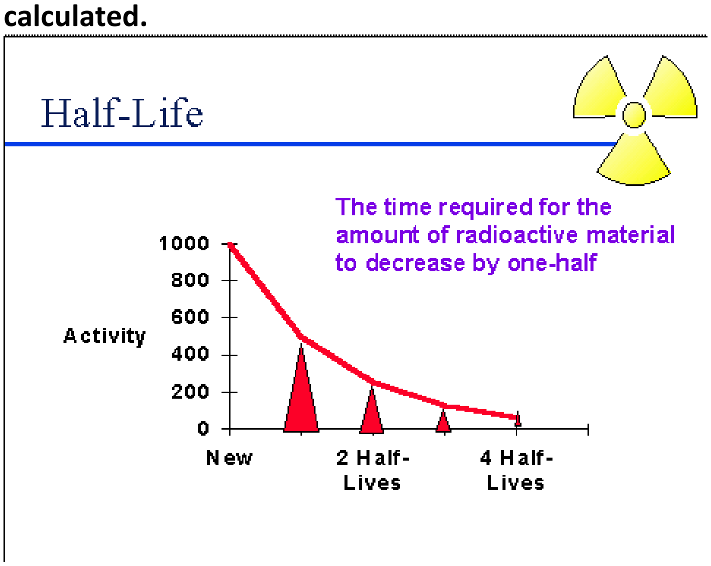
Fusion occurs where___SUN AND STARS

c. Explain the process half-life as related to radioactive decay.

Define half-life___AMOUNT OF TIME IT TAKES FOR ½ OF A RADIOACTIVE ELEMENT TO DECAY__.

Define Radioactive decay___PROCESS IN WHICH AN UNSTABLE NUCLEUS BREAKS DOWN____________.

Radioisotopes decay through a process known has a half-life. The half-life of an atom can be calculated.



- 100.0 g of carbon-14 decays until only 25.0 g of carbon is left after 11 460 y, what is the half-life of carbon-14?

  100g -------------------------- 25 11460 y

  100 ---------------50 11460/2 = 5730 y

- Thallium-208 has a half-life of 3.053 min. How long will it take for 120.0 g to decay to 7.50g?

  120 ----------------60-----------------30----------------15------------------7.5

  1 2 3 4

  4 half-life 4x 3.053 = 12.212 min

- The half-life of hafnium-156 is 0.025 s. How long will it take a 560 g sample to decay to one-eighth its original mass?

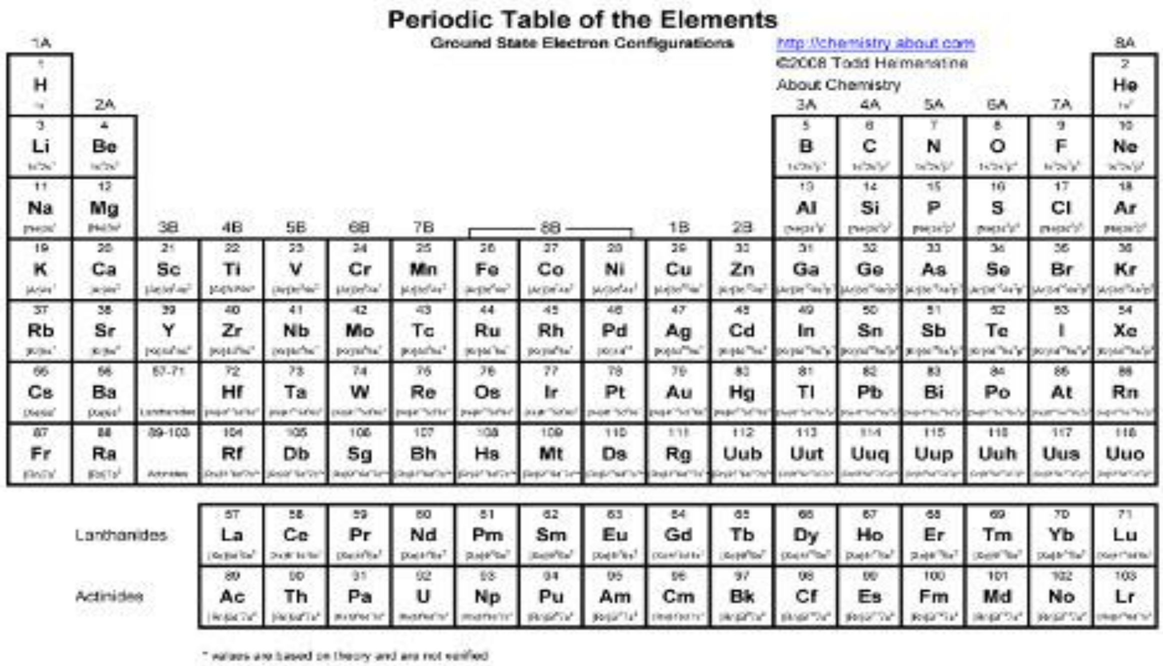
  560---------------------560/2 -----------------------------560/4 ---------------------- 560/8

  3 half-life 3 X 0.025 = 0.075 s

d. Describe nuclear energy, its practical application as an alternative energy source, and its potential problems.

Benefits/Application	Problems
EASY TO MANUFACTURE	NUCLEAR WASTES
VERY EFFICIENT	CONTROLING REACTORS
NO AIR POLLUTION	EXPENSIVE

SPS4: **Students will investigate the arrangement of the Periodic Table.**



a. Determine the trends of the following:

- **Number of valence electrons**
  - **Valence electrons are found by looking at what __GROUP______ the atom is in on the periodic table. Ex. Group 1 has __1__ valence electrons, Group 13 has _3__ valence electrons.**

- **Types of ions formed by representative elements**

Group 1:____+1_______ **Group 14:____+/-4___** **Group 17:___-1_________**
Group 2:_____+2______ **Group 15:____-3_____** **Group 18 ______0______**
Group 13:____+3_____ **Group 16: _____-2____**

- **Location of metals, nonmetals, and metalloids**
  - **Metals are located to the ____LEFT_______ of the stair-step line.**
  - **Nonmetals are located to the ____RIGHT_____ of the stair-step line.**
  - **Metalloids are located ____ON_____ the stair-step line.**

- **Phases at room temperature**
  - **Metals are ___SOLIDS_____at room temperature with the exception to Mercury.**
  - **Nonmetals are __GASES____ at room temperature with the exception to Bromine.**
  - **Metalloids are ____SOLIDS____ at room temperature.**

b. Use the Periodic Table to predict the above properties for representative elements.

Properties of Metals	Properties of nonmetals	Properties of Metalloids
CONDUCT ELECTRICITY	POOR CONDUCTORS	HAVE PROPERTIES OF BOTH METALS AND NONMETALS
SOLIDS AT ROOM TEMPERATURE.	GASES AT ROOM TEMPERATURE.	CONDUCTIVITY VARIES WITH TEMPERATURE.
DUCTILE-MADE INTO WIRES	BRITTLE	SOLIDS AT ROOM TEMPERATURE
VERY REACTIVE	VERY REACTIVE	KNOW AS SEMICONDUCTORS
MALLEABLE-FLATTENS OUT INTO A SHEET.	GOOD INSULATORS	

SPS5. Students will compare and contrast the phases of matter as they relate to atomic and molecular motion.

a. Compare and contrast the atomic/molecular motion of solids, liquids, gases and plasmas.

Description	Solid	Liquid	Gas	Plasma
Shape	Definite	Takes shape of it container	Indefinite	Indefinite
Volume	Definite	Definite	Indefinite	Indefinite
Arrangement of Particles	Packed close with regular pattern	Less dense, random pattern, in contact with each other.	Random, Far apart, disordered	Charged, high energy, Moving.
Examples and Models	Ex. Ice Cube 00000000000 000000000000 0000000000	Ex. Water 0 0 0 0 0 0 0 0 0 0 0	Ex. Water Vapor 0 0 0 0 0	Ex. Lightening + 0 0_ 0 _ + 0 +0 _0

- In the __SOLID___ **phase**, atoms or molecules are held in a rigid structure. They are free to vibrate but cannot move around.
- The ___LIQUID___ **phase** is intermediate between solid and gas. Intermolecular forces hold these atoms or molecules loosely together but do not force them into a rigid structure.

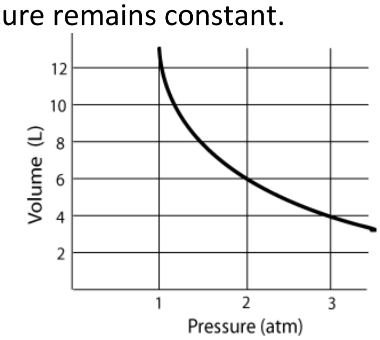
- In the **_GAS_ phase**, atoms and molecules experience their greatest freedom. The forces attracting gas molecules are almost nonexistent. As a result, gas molecules are much farther apart and can move freely about.
- Finally, **__PLASMA___** are gases that have been so energized that their atoms have been stripped of some or all electrons. Solar flares are great examples of plasmas. Solar flares eject extremely hot hydrogen ions (H+) away from the Sun toward Earth.

b. Relate temperature, pressure, and volume of gases to the behavior of gases.
___PRESSURE_______ is the force exerted on a surface per unit area.
Collisions between particles of gas and the walls of a container cause the __PRESSURE___ in a closed container of gas.

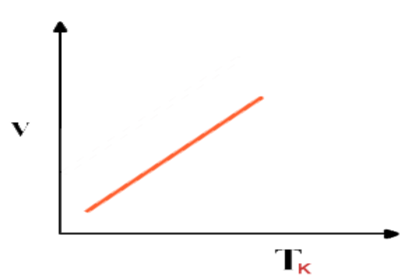
Factors that affect gas pressure

Temperature	Volume	Number of particles
Increasing temperature of a gas will increase ____PRESSURE_______, if the volume and number of particles are constant. Example: CAN IN FIRE	Reducing the volume of a gas will increase __PRESSURE___, if temperature and number of particles are constant. Example: PISTONS IN A CAR	Increasing the number of particles will increase _PRESSURE___, if temperature and volume remain constant. Example: BALLOON IN A FREEZER

Boyles Law states the volume of a definite quantity of dry gas is inversely proportional to the pressure, provided the temperature remains constant.



GAY-LUSAAC Law can be stated as the volume occupied by any sample of gas at a constant pressure is directly proportional to the absolute temperature.



Charles Law, the volume of gas is directly proportional to the absolute temperature and inversely proportional to the pressure.

SPS6. Students will investigate the properties of solutions.
a. Describe solutions in terms of
A **____SOLUTION___** is a special type of mixture. It has a uniform composition throughout and is
made up of two parts—a solute and a solvent.

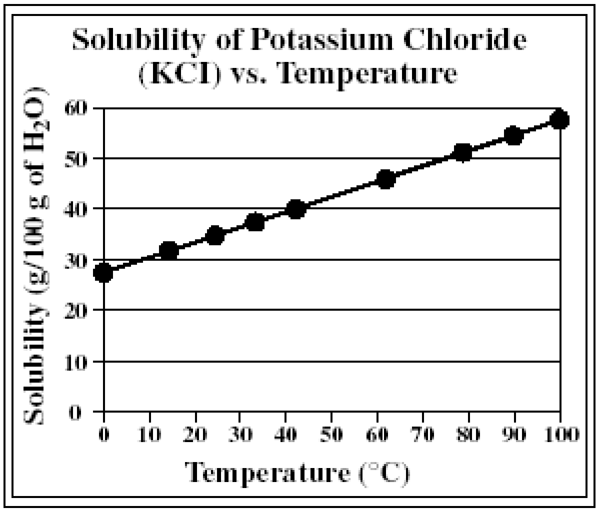
- **Solute-SUBSTANCE BEING DISSOLVED (SUGAR)**
- **Solvent- SUBSTANCE DOING THE DISSOLVING (WATER)**
    - Saturated Solution-NO MORE SOLUTE WILL DISSOLVE
    - Unsaturated Solution-MORE SOLUTE WILL DISSOLVE
- **Conductivity**-ABILITY TO CONDUCT ELECTRICITY (IONIC COMPOUNDS

The conductivity gives important clues as to the type of solute dissolved. In **aqueous** (waterbased) solutions, dissolved ionic compounds yield solutions with high conductivity. Cations and anions readily carry electrical charges through the solution. Strong acids and bases also have a high conductivity for the same reason. All of these solutions are considered **__STRONG___ electrolytes**. Weak acids or bases ionize only partially so they form solutions with low conductivity. These compounds are called **_WEAK__ electrolytes**. Solutions made from covalent compounds have zero conductivity since they dissolve as molecules, not ions. They cannot carry electrical charges. These substances are known as___NON-CONDUCTORS__. Some selected compounds and their electrical conductivity are shown in the box to the right.

- **Concentration-** THE AMOUNT OF SOLUTE DISSOLVED IN THE SOLVENT

b. Observe factors affecting the rate a solute dissolves in a specific solvent.
There are three factors that affect the rate at which a solution dissolves. They are

Agitation	Size of Particles	Temperature	Number of Particles
Define: MOVEMENT OF PARTICLES	Define: SMALLER PARTICLES DISSOLVE FASTER DUE TO INCREASED SURFACE AREA.	Define: MOLECULES INCREASE THE RATE OF CONTACT	Define: FEWER NUMBERS OF PARTICLES, INCREASES SURFACE AREA.
Affect: INCREASE SOLUBILITY	Affect: INCREASE SOLUBILITY	Affect: INCREASE SOLUBILITY	Affect: INCREASE SOLUBILITY



c. Demonstrate that solubility is related to temperature by constructing a solubility curve.

What is a solubility curve?

THE RELATIONSHIP BETWEEN SOLUBILITY AND TEMPERATURE PLOTTED ON A GRAPH.

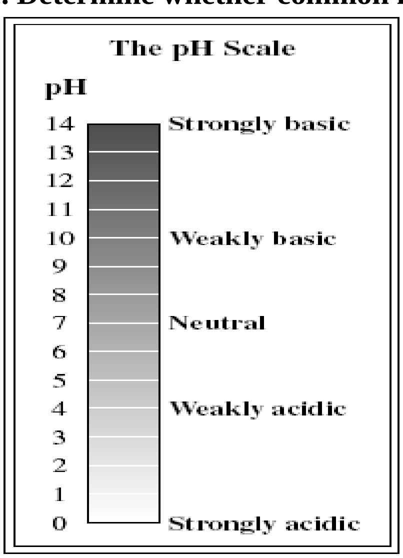
What is the solubility of Potassium Chloride at 45◦ C?

40G/100G OF WATER

d. Compare and contrast the components and properties of acids and bases.

	Acids	Bases
Definition	SOLUTIONS WITH HYDRONIUM	WITH HYDORXIDE
Taste	SOUR	BITTER
Touch	BURN	SLIMEY
Reacts with Metals	CORROSIVE	FORM H+ GAS
Electrical Conductivity	GOOD	GOOD
Litmus Paper Test	RED	BLUE
Ph Scale	0-6.9	7.1-14

e. Determine whether common household substances are acidic, basic, or neutral.



List 5 common acids: ORANGE JUICE, LEMON JUICE, VINEGAR, TOMATO JUICE, and BATTERY ACID.

List 5 common bases: BAKING SODA, DRAIN CLEANER, ANTACIDS, BLEACH, and MALOXX

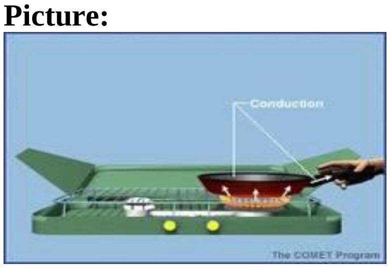
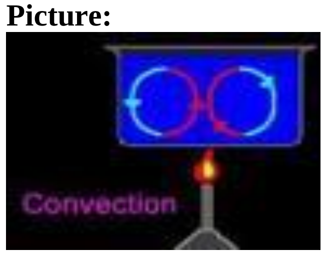
What is an example of a neutral substance? What is its pH?
7 AND WATER

What are the products of a neutralization reaction?
ACID +BASE= SALT +WATER

SPS7. Students will relate transformations and flow of energy within a system.
a. Identify energy transformations within a system (e.g. lighting of a match).
Just as matter is conserved, so is energy. The **law of conservation of _ENERGY__** states that energy, like matter, cannot be created nor destroyed; it can only be changed from one form of energy to another. Energy takes many forms in the world around us. Each form of energy can be converted to and from other forms of
energy.

- **__SOUND___energy** is used in our homesto produce stereo sound through speakers.
- **_LIGHT____energy** produces current from which a fluorescent lamp will work.
- **___THERMAL__ energy** for cooking and heating.
- **___NUCLEAR___ energy**, which is stored in the nucleus of atoms, is harnessed to produce electrical energy in modern power plants.
- **___CHEMICAL__ energy** is stored in the bonds that hold atoms together in molecules. When fuels or foods are broken down, chemical energy is converted to heat energy or to kinetic energy.
- **___KINETIC__ energy** is the energy contained by moving objects due to their motion.
- **___POTENTIAL___ energy**, also known as stored energy, is the energy of position. When a boulder sits on top of a cliff, it has gravitational potential energy as a result of its height above the ground. When the boulder tumbles off the cliff, its gravitational potential energy is converted to kinetic energy. When a ball is thrown up into the air, the kinetic energy of the ball is converted into gravitational potential energy as the ball approaches its highest point. As the ball falls back to the ground, the potential energy it gained during its upward flight turns back into kinetic energy. Kinetic and potential energy are types of ___MECHANICAL___ energy.

b. Investigate molecular motion as it relates to thermal energy changes in terms of conduction, convection, and radiation.

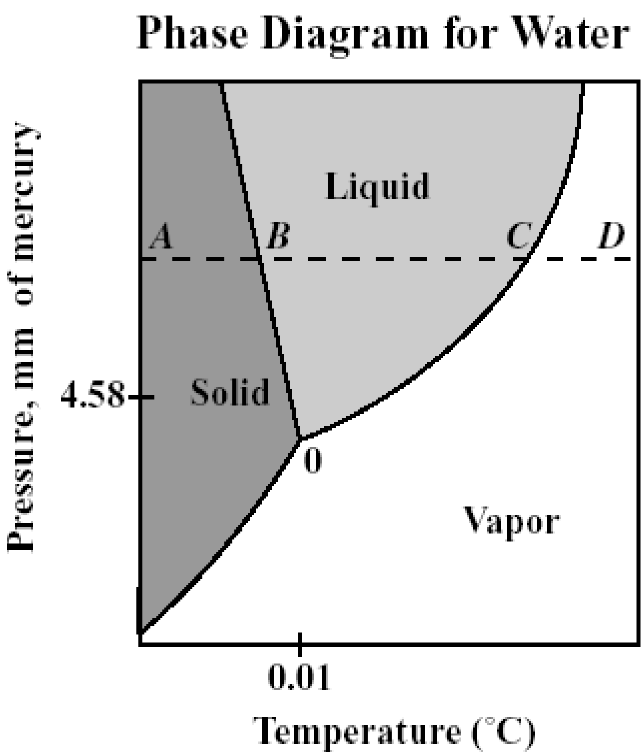
CONDUCTION	CONVECTION	<u>Radiation</u>
Define: the transfer of heat energy between materials that are in direct contact with each other **Picture:** 	**Define:** **CIRCULATING OF AIR OR WATER PARTICLES** **Picture:** 	**Define:** **TRANSFER OF ENERGY THROUGH SPACE/AIR.** **Picture:**

c. Determine the heat capacity of a substance using mass, specific heat, and temperature.
What is specific heat capacity? AMOUNT OF ENERGY NEEDED TO RAISE THE TEMPERTATURE 1kg/1^{o}C
The amount of heat energy that a substance gains or loses, *Q*, depends on the mass (*m*), the specific heat,

(c), and the change in the temperature (ΔT) of the substance. The formula for finding the heat energy is simply the product of the three factors, $Q = mc\Delta T$.

A copper ornament has a mass of 0.0693 kg and changes from a temperature of 20.0°C to 27.4ºC. How much heat energy did it gain?Copper's Specific Heat is 390 J/k X ^{0}C.
0.0693kg · 390 J/kgºC (27.4 – 20.0)ºC = 200 J
27.027 · 7.4

d. Explain the flow of energy in phase changes through the use of a phase diagram.
A **phase diagram** shows how a pure substance changes from one phase to another based on the temperature, T, and the pressure, P.

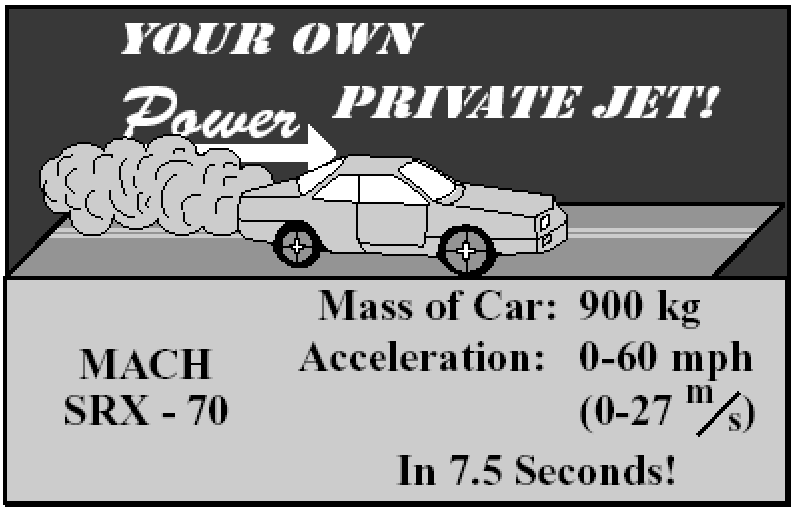


What is the change called from a solid to a liquid?
MELTING
What is the change called solid to a gas?
SUBLIMATION
What is the change called from a liquid to a solid?
FREEZING
What is the change called from a liquid to a gas?
EVAPORATION
What is the change called from a gas to a solid?
DEPOSITION
What is the change called from a gas to a liquid?
CONDENSATION
Which reactions are exothermic, or give off heat?
FREEZING, DEPOSTION, CONDENSATION

Which reactions are endothermic, or take in heat?
MELTING, SUBLIMATION, EVAPORATION

SPS8. Students will determine relationships among force, mass, and motion.
a. Calculate velocity and acceleration.

- The distance an object moves per unit of time is known as the _**SPEED**_. The __VELOCITY____is the speed of the object plus its direction. The average speed can be found by dividing the change in the displacement of an object by the change in time.
  Ex. A car traveling west goes 10 meters in 5 seconds. What is its velocity?
  2 m/s WEST
- __**ACCELERATION**__, like velocity, has magnitude and direction. The average acceleration of anobject is found by dividing the change in the velocity of the object by the change in time.
  Ex. Calculate the average velocity of the new power jet car.



V_f - V_i
60 mph – 0 mph = 60 mph

b. Apply Newton's three laws to everyday situations by explaining the following:

	Summary	Example
Newton's First Law	AN OBJECT AT REST STAYS AT REST UJLESS ACTED UPON BY AN UNBALANCED FORCE	BOULDER
Newton's Second Law	THE GREATER THE FORCE, THE GREATER THE ACCELERATION	BASEBALL- PITCHING
Newton's Third Law	EVERY ACTION HAS AN EQUAL AND OPPOSITE REACTION	CAR CRASH RECOIL ON A SHOTGUN

c. Relate falling objects to gravitational force

- ___**GRAVITATIONAL**___ **force** is a force between any two objects. The strength of the force is related to the mass of the objects and the distance between them. The more mass an object has, the greater the gravitational force it exerts. The Moon has less mass than Earth. The resulting lower gravitational force made the astronauts appear nearly "weightless" as they moved across the lunar surface.
- __**ELCTROMAGNETIC forces**. These forces include both electric forces and magnetic forces.
- The forces exerted within the nucleus of an atom are called __**NUCLEAR**__ **forces**. These forces hold the protons and neutrons together.

- __FRICTIONAL__ **forces** tend to stop the motion of an object by dispersing its energy as heat. There are three types of frictional forces: sliding friction, rolling friction, and static friction.
    - **Sliding friction** occurs when one solid surface slides over another solid surface.
    - **Rolling friction** occurs when an object rolls across a solid surface.
    - **Static friction** occurs between the surfaces of two objects that touch but do not move against each other. Static friction must be overcome for one of the objects to move.

d. Explain the difference in mass and weight.

One should note that mass and **weight** are not the same quantity. An object has __MASS__ regardless of whether gravity or any other force is acting upon it. Weight, on the other hand, changes depending on the influence of gravity. The relationship between weight, *W*, and mass, *m*, can be written as the following equation: $W = mg$. In this equation, *g* represents the acceleration due to gravity. At the surface of Earth, the acceleration of gravity is 9.80 m / s². The value of *g* decreases the farther away from the center of Earth an object gets. This means the weight of an object would __DECREASE__ if it was placed on top of a mountain or put into space.

e. Calculate amounts of work and mechanical advantage using simple machines.

_____**WORK__ i**s the transfer of energy when an applied force moves an object over a distance. For work to be done the force applied must be in the same direction as the movement of the object and the object must move a certain distance. A person may push on a wall and get tired muscles as a result, but unless the wall moves, the person has done zero work. Work can be summarized using the following equation:

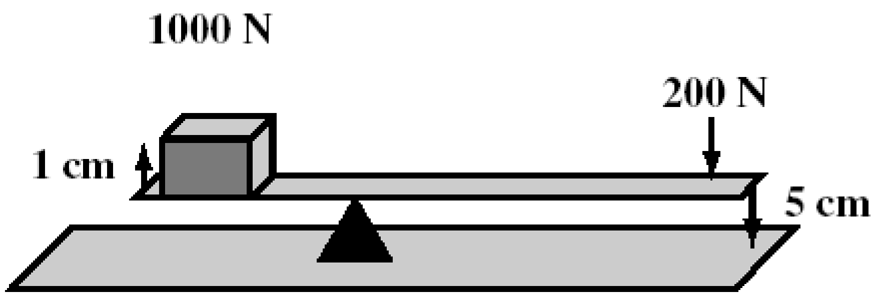
$W = Fd$, In the equation, *W* is equal to work, *F* is equal to the force applied, and *d* is equal to the distance that an object has moved. Remember, force is measured in newtons (N) and distance is measured in meters (m). A unit of work is the newton-meter (N-m), or the joule (J).

Work can be made easier or done faster by using machines. Machines that work with one movement are

Called **simple machines**.

Simple Machines	Examples
Inclined Plane	STAIRS, WHEEL CHAIR RAMP
Lever	SEE-SAW, GEARS, WHEEL BARROW
Pulley	OLD-FASHION WELL, ELEVATOR
Screw	LIGHT BULB
Wedge	KNIFE, NAIL
Wheel and Axle	CAR

Simple machines cannot increase the amount of work done, but they can change the size and direction of the force applied. The force applied to a simple machine is called the **effort force**, F_e. For a machine to do work, an effort force must be applied over a distance. The force exerted by the machine is called the **resistance force,** F_r. An effort force is applied over a distance, known as the **effort distance**, d_e. This force can move over the **resistance distance**, d_r. The number of times a machine multiplies the effort force is called the **mechanical advantage**.



What is the mechanical advantage of the lever?

It decreases work…

$$MA = \frac{\text{output force}}{\text{input force}}$$

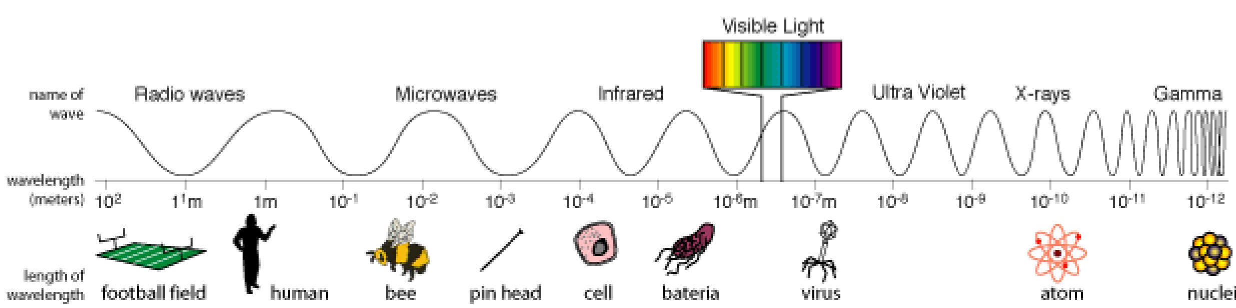
MA=<u>1000N*1cm</u> = <u>1000N/cm</u>=
200N*5cm 1000 N/cm

=1N/cm

SPS9. Students will investigate the properties of waves.
a. Recognize that all waves transfer energy.
Waves are phenomena that occur, seen and unseen, all around us. __WAVES__ by definition are disturbances that repeat the same cycle of motion and transfer energy through matter or empty space.
Example: OCEAN WAVES, MICROWAVES, GAMMA WAVES, RADIO WAVES

b. Relate frequency and wavelength to the energy of different types of electromagnetic waves and mechanical waves.

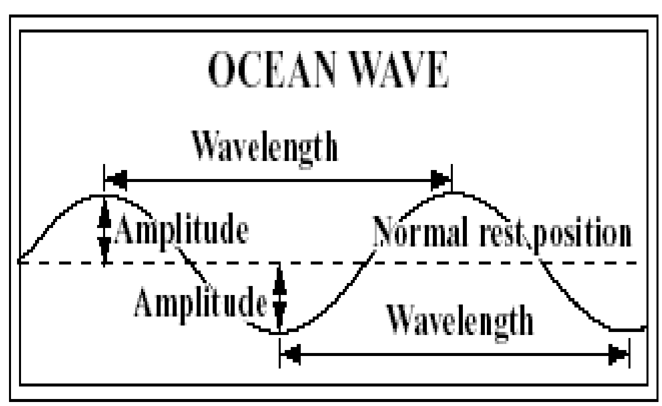
Electromagnetic Waves	Mechanical Waves
Examples: light and radio waves Does not require a medium	Examples: SOUND WAVES Requires a medium. The medium can be _SOLID___, __LIQUID___, or gas.



c. Compare and contrast the characteristics of electromagnetic and mechanical (sound) waves.

Define wavelength.

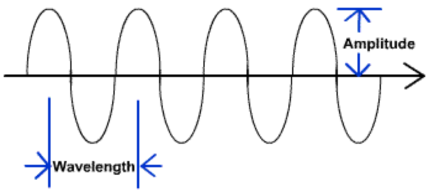
DISTANCE BETWEEN 2 CRESTS OR TROUGHS.



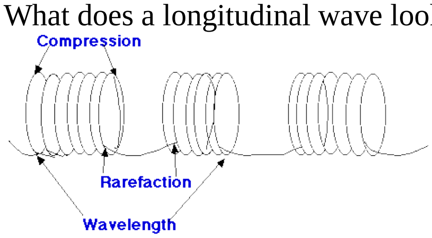
Define Amplitude.
DISTANCE FROM REST POSITIONS TO CREST/TROUGH

Define frequency.
NUMBER OF COMPLETE WAVES.

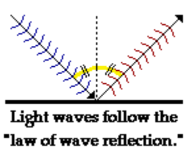
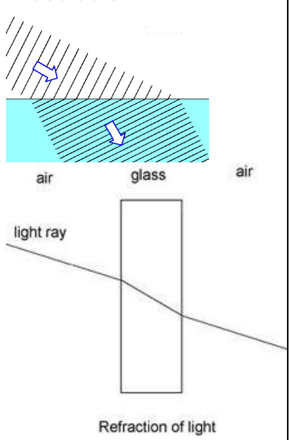
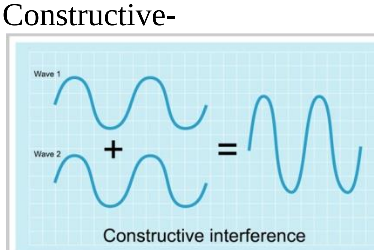
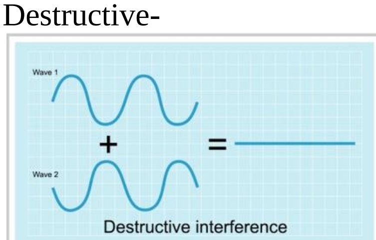
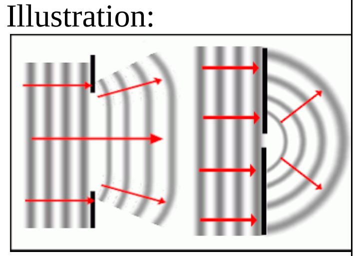
Define Crest and label it on the Ocean Wave.
HIGHEST POINT ON A WAVE
Define Trough and label it on the Ocean Wave.
LOWEST POINT ON A WAVE
What does a transverse wave look like?



What does a longitudinal wave look like?

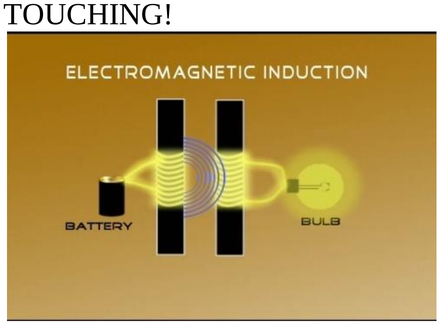


d. Investigate the phenomena of reflection, refraction, interference, and diffraction.

Reflection	Refraction	Interference	Diffraction
occurs when a wave hits an object that it cannot pass through it bounces off the object or medium boundary. Illustration: 	takes place when a wave passes from one medium into another at an angle and bends (changes direction) due to a change in speed Illustration 	occurs when two or more waves arrive at the same point at the same time Illustration: Constructive-  Destructive- 	results when a wave passes through a hole or moves past a barrier and spreads out in the region beyond the hole or barrier Illustration: 

e. Relate the speed of sound to different mediums.
Sound travels faster through solids and liquids than it does through gases because particles are __COMPACT_ together in solids or liquids than in gases. Sound also travels fastest through elastic materials.
f. Explain the Doppler Effect in terms of everyday interactions.
When a sound source moves toward a listener, the pitch, or apparent frequency, of the sound increases. This is because the sound waves are compressed closer together and reach the listener with a higher pitch. As the sound source passes by the listener and moves away from the listener, the same sound waves are stretched farther apart. This results in a decrease in the pitch, or apparent frequency. This phenomenon is known as the **___DOPPLER_____ ___EFFECT___**. It can be heard at a train crossing every time a train approaches, passes, and leaves a crossing while blowing its whistle.

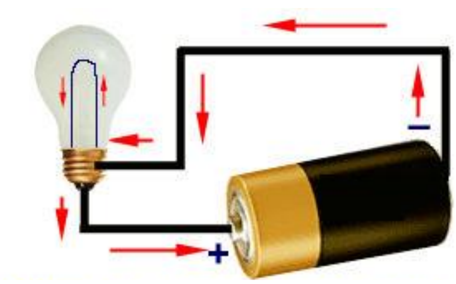
SPS10. Students will investigate the properties of electricity and magnetism.
Electricity-
a. Investigate static electricity in terms of
__STATIC____**electricity**results from the buildup of electric charges on an object. The buildup of charges can be caused by friction, conduction, or induction.

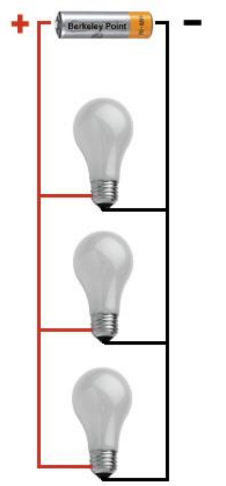
friction	**induction**	**conduction**
RUBBING 2 OBJECTS TOGETHER 	TRANSFER BY NOT TOUCHING! 	ELECTRONS FLOW THROUGH DIRECT CONCACT 

b. Explain the flow of electrons in terms of
- alternating current- electrons changed direction at regular intervals.
  - Example: Gas driven generator or lights in your house
- direct current-electrons move in same direction.
  - Example: Batteries in your car or batteries in your flashlight

Ohms Law: $V = IR$		
Voltage (V)	Current (I)	Resistance (R)
To get electrons flowing through	When charged particles flow	The opposition to current is

a circuit, a voltage (*V*) is applied. **Voltage**, which is measured in volts (*V*), is the potential difference in electrical potential energy between two places in a circuit. In other words, voltage is the energy per unit of charge that causes charges to move.	through the wire in a circuit, an **electric current** (*I*) results. The current is measured in amperes (*A*). The electron is the charged particle that most likely moves through the circuit.	called **resistance** (*R*), which is measured in ohms (Ω). Light bulbs and resistors are examples of objects with a resistance.





Type of circuit illustrated:
Series
Define:

Only 1 path to flow.

Examples:
Flash light

Type of circuit illustrated:
Parallel
Define:

2 or more branches to flow.

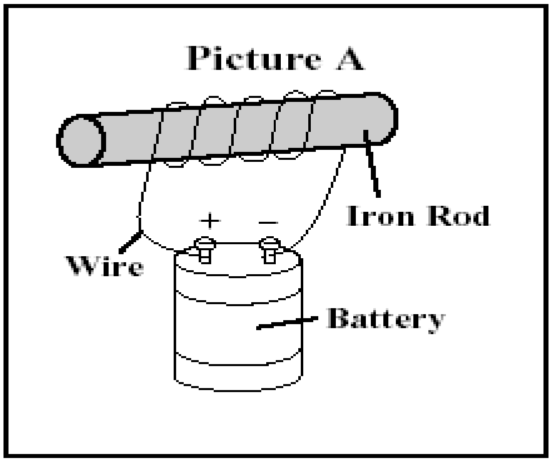
Examples:
House

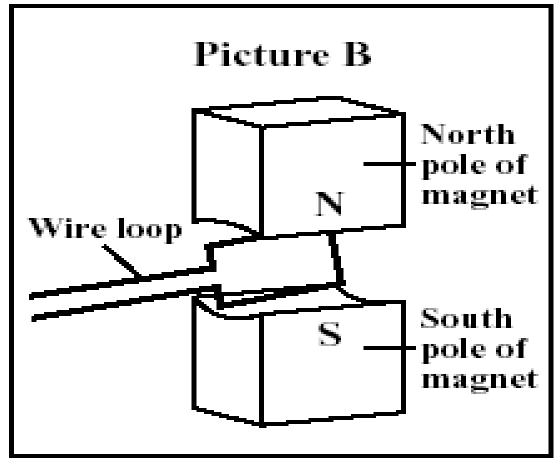
c. Investigate applications of magnetism and/or its relationship to the movement of electrical charge as it relates to

An electric current will also produce a magnetic field. A **magnetic field** is a region around a magnet or current-carrying wire where magnetic forces can be measured. **___magnetism___** is the force of attraction or repulsion that is produced by an arrangement of electrons. Magnets have two poles: a north pole and a south pole. *Unlike m*agnetic poles attract each other, while *like* magnetic poles repel each other. Groups of atoms with magnetic poles aligned are called **magnetic domains**. Materials with most of these domains lined up are considered magnetized. When a metal bar or other object is composed of stable, magnetic domains, a ____permanent________ **magnet** results.

When an electric current is used to produce a magnetic field in a coil of wire, the coil becomes an electromagnet. A rotating electromagnet is used in **__electric____ motors** to convert electrical energy to mechanical energy.

When a magnet is moved near a wire, an electric current is generated. This process, called **electromagnetic induction**, is used to operate a **__generator____.** A generator is a device that converts mechanical energy to electrical energy. In a commercial generator, an electric current is produced when a large coil of wire is rotated in a strong magnetic field.





This picture illustrates ________________ illustrates_________________
_______electromagnet________.

This picture
_electric motor_____.