HONORS CHEMISTRY: IN THE BEGINNING… DATE:_____

Learning Goal: **SWBAT. . .**
…explain the development of chemistry through history, including early atomic laws.

CHEMISTRY IN HISTORY!

DEMOCRITUS of Greece came up with the first theory of the atom in 400 B.C**.**

- He imagined…
- The tiniest particles would be… ,
- In Greek word for indivisible is
- Would remain the leading theory regarding matter for over 2200 years!

ALCHEMY: was one of the earliest 'sciences' (term used loosely). It is the precursor of: *modern chemistry.*

- Ancient Chinese alchemists tried…
- Medieval European alchemists tried…
- Though chemically impossible...

AS CHEMISTRY BECAME MORE ORGANIZED, PEOPLE BEGAN DISCOVERING IMPORTANT IDEAS…

1. LAW OF CONSERVATION OF MASS: (Credited to **Antoine Lavoisier** ~ late 18th century)

- States **'when two or more elements react to produce a compound, the total mass of the compound is the same as the sum of the individual elements.'**

- Could also be stated…
- This happens when…
- analogy)
- example)

2. LAW OF DEFINITE COMPOSITION: (Credited to **Joseph Proust** ~ early 19th century.)

- States **'a compound contains the same elements in exactly the same proportions regardless of the size or source of the sample.'**

- ex)

3. Law of multiple proportions: (Credited to **<u>John Dalton</u>** ~ early 19th century)

- States **'when elements combine, they do so in a ratio of small, whole numbers.'**
  - You can have _____ and _____ but you can't have _____.

- Also states **'the masses of one element which combine with a fixed mass of the second element are in a ratio of whole numbers.'**
  - Look at H_2O and H_2O_2 …
  - Water
  - Hydrogen Peroxide
  -
  - This was a big deal! The idea that those simple mass ratios were due to simple ratios of atoms would lead to the first modern atomic theory!

DID YOU KNOW... Alchemy was born in ancient Egypt, where the word **Khem** was used in reference to the fertility of the flood plains around the Nile.

When Egypt was occupied by the Arabs in the 7th Century, they added 'al-' to the word Khemia and al-Khemia meaning 'the Black Land' is now seen as a possible origin for the word alchemy.

Alchemy was also developed independently in China by Taoist monks. The monks pursued both the outer elixir and the inner elixir. The former being minerals, plants etc. which could prolong life, and the latter being the use of exercise techniques, such as Qigong, to manipulate the chi or life force of the body.

Like China and Egypt, India developed alchemy independently. They had beliefs similar to the Chinese, in that they used external and internal methods to purify the body and prolong life. In their work the Indians invented steel and long before Bunsen and Kirchhoff's work, realized the importance of flame color in the identification of metals. http://www.chm.bris.ac.uk

REVIEW & REFLECTION

"A superior vessel takes a long time to complete." ~ Zen Saying

HONORS CHEMISTRY: DALTON & THOMSON'S CONTRIBUTIONS DATE:_____

LEARNING GOALS: **SWBAT. . .**

…list and evaluate the components of Dalton's Billiard Ball Model of the atom.

…explain how a cathode ray tube works and how it helped advance atomic theory.

…explain J.J. Thomson's Plum Pudding Model of the atom.

DALTON'S ATOMIC THEORY [A.K.A. THE BILLIARD BALL MODEL] (~1810)

1.
2.
3.
4.
5.

WHICH PRINCIPLES HAVE BEEN DISPROVEN OVER TIME?

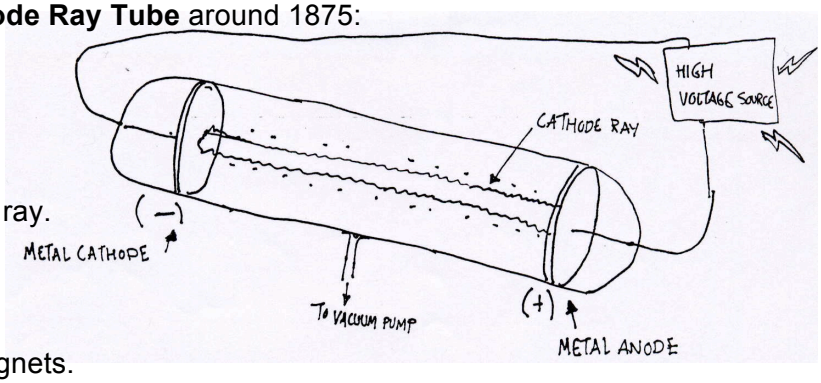
#

#

#

Increases in technology/ingenuity allowed scientists to further Dalton's work.

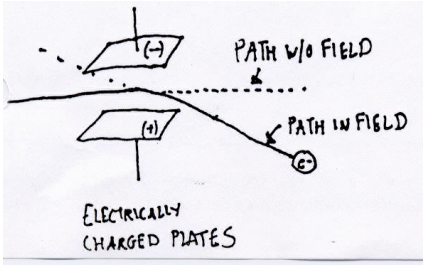
SIR WILLIAM CROOKES invented the **Cathode Ray Tube** around 1875:

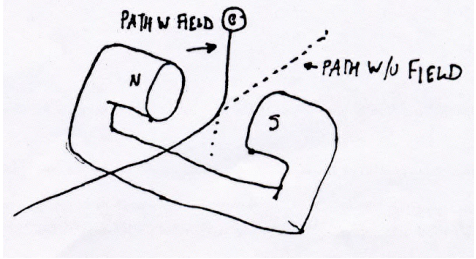


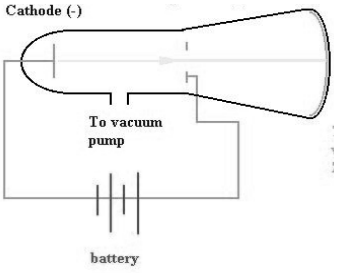
CATHODE:

ANODE:

- Mostly emptied of gas which interferes with ray.
- Ray moved from cathode to anode.
- Ray could be bent by electrical fields or magnets.
- With some modifications, CRTs were eventually used as…







J.J. THOMSON (~ 1897)

- He was studying the particles that made up the cathode ray current.
- These particles had already been named _____ by G.J. Stoney (1894).
- He knew that this ray was produced from negative electrode and was repelled by negative charge.

WHAT HE DID NEXT WOULD DESTROY THE BILLIARD BALL THEORY AND ESTABLISH THE FIRST NEW MODEL OF THE ATOM IN THE HISTORY OF HUMANITY!

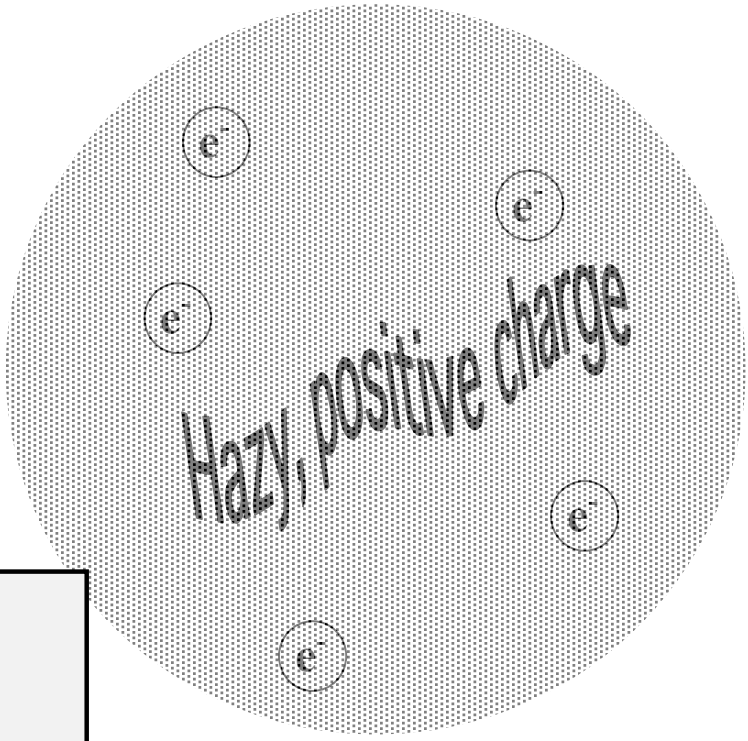
HE REASONED. VERY SIMPLY. …

...

…

(Further experimentation by J.J. would confirm the presence of positive particles.)

- He postulated that the atom was…



- This reminded him of how the raisins were suspended in a popular dessert at the time. Hence the name, **PLUM PUDDING MODEL**.

SO HOW LONG WOULD THIS NEW MODEL OF THE ATOM LAST?

REVIEW & REFLECTION

"Your treasure house is within; it contains all you'll ever need." ~Hui-Hai

HONORS CHEMISTRY: MILLIKAN'S & RUTHERFORD'S CONTRIBUTIONS DATE:_____

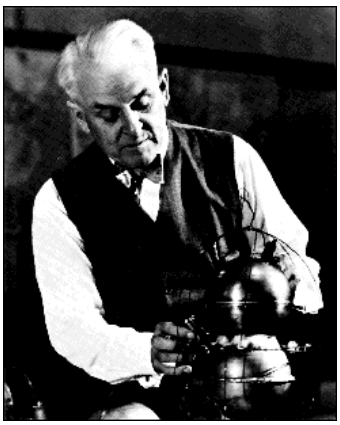
LEARNIN GOALS: **SWBAT. . .**

…explain the importance of Millikan's Oil Drop experiment.

…explain Rutherford's Gold Foil Experiment and the ensuing Planetary Model.

SO HOW DO YOU FIND THE MASS OF AN ELECTRON?

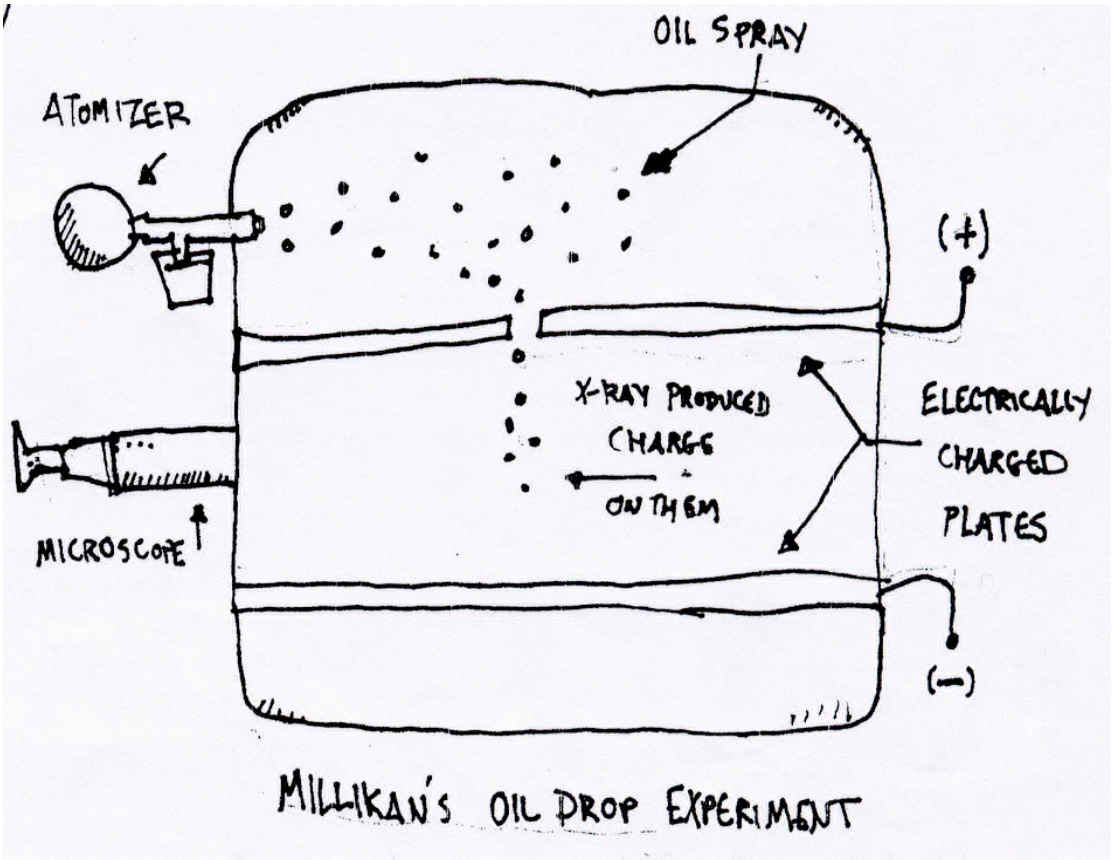
J.J. Thomson was able to figure out the charge/mass ratio of an electron (e/m = 1.76 x 108 coulombs/gram), but could not figure out either the mass or the charge separately.

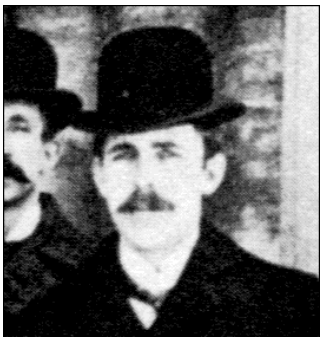


- If he could only figure out one, he could calculate the other.

- **ROBERT MILLIKAN** used a very clever oil drop experiment, to determine…

- He was able to plug the charge of an electron into Thomson's ratio to determine the mass of an electron to be _____... in 1909!!!

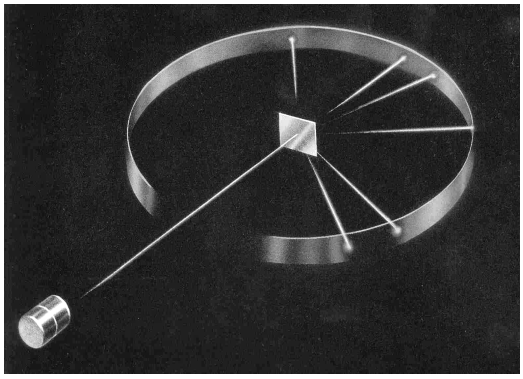


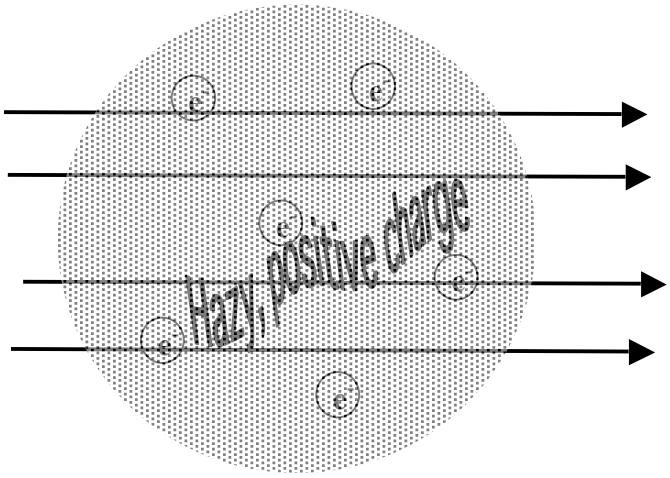


In 1911 a one-time student of J.J. Thomson's named **ERNEST RUTHERFORD** decided to…

~ In his now infamous ***Gold Foil Experiment***, he…

He figured…



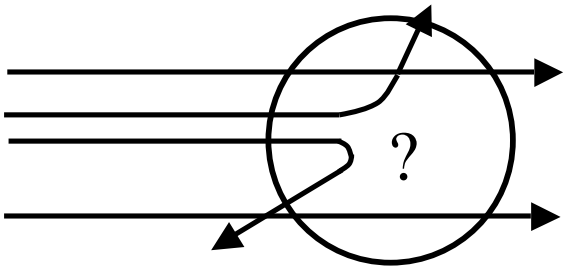


Most of the alpha particles did pass straight through, however…

Rutherford was shocked!!! In his own words, it was…

THE PLUM PUDDING MODEL HAD TO BE WRONG!!

Rutherford realized there must be…



He called the positive cluster _____. He figured…

Hence the name of his model: _____.

Interesting note: To make sense of the small number of deflections, the nucleus had to be…

Review & Reflection

"A sudden bold and unexpected question doth many times surprise a man and lay him open."
~Sir Francis Bacon

HONORS CHEMISTRY: ATOMIC STRUCTURE FUN-DAMENTALS DATE:_____

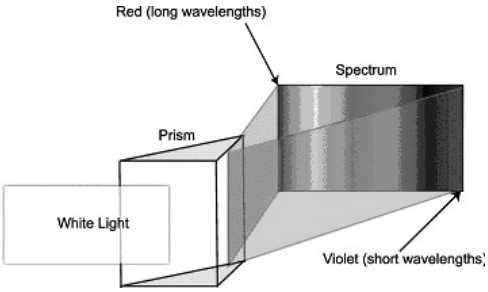
Assignments Due: Reading through chapter 4.

Objectives: **SWBAT. . .**

…interpret chemical symbols and formulas.

…identify the number and types of subatomic particles within an atom.

…identify an element's atomic number and atomic mass.



HOW DID EARLY SCIENTISTS DISCOVER NEW ELEMENTS?

- In 1826, W.H. Fox Talbot concluded…

- William Swan realized ~ 1856 that…

- Those samples were heated and a _____ was used to analyze the light spectrum given off.

- If the sample gave a unique spectrum, then was likely that a new element had been discovered.

THE SCIENTIST(S) WHO SUCCESSFULLY IDENTIFY A NEW ELEMENT GET TO NAME IT.

- Some names logical (based on properties), or based on dedications to people or places.

- Symbols consists of one, two, three letters, first letter always capitalized, others always small case.

- Formulas can be written for compounds. Subscripts indicate how many atoms of each element there are.

ex) How many atoms of each element are in the following compounds?

H_2O CH_4 NH_4NO_3 $Ca(OH)_2$

- Coefficients go in front of the formulas and equal the number of complete molecules present.

ex) How many atoms of each element are in the following compounds?

$2\ H_2O$ $3\ CH_4$ $4\ NH_4NO_3$ $10\ Ca(OH)_2$

A REVIEW OF THE SUBATOMIC PARTICLES:

PARTICLE:	CHARGE	MASS (AMU)
-		
-		
-		

AN AMU =

- An amu is simply a convenient unit when dealing with the incredibly small masses involved with atoms.

- It would take 1836 electrons to equal the mass of one proton.

- So where is most the mass of an atom located?

Atoms are small!

- Most are between $1x10^{-10}$ to $5x10^{-10}$ meters. or _____ to _____ pm.
- Another convenient scale is ***the angstrom***. (Å) which equals $1x10^{-10}$m.
- So most atoms are between _____ and _____ Å.

Atomic Number:

- VERY IMPORTANT NUMBER, as the number of protons determines…
- The number of protons equals…

Atomic Mass: [A.K.A. Mass Number A.K.A. Atomic Weight]:

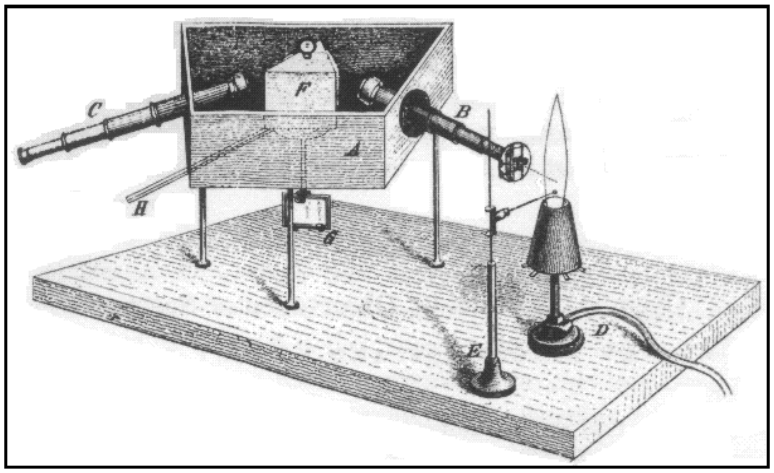
- Given the atomic mass and atomic number you can find the number of _____.
- Atomic mass - atomic number = # of neutrons

So for the following atoms, fill out the information requested:

Element	Chlorine	Lead
Symbol		
Atomic Number	17	82
Atomic Mass	36	207
# of Protons		
# of Neutrons		
# of Electrons		

Why aren't the atomic masses on the periodic table whole numbers? We'll learn why next class.

Review & Reflection



"May you live in interesting times." ~ Chinese Curse

HONORS CHEMISTRY: ISOTOPES & IONS

DATE:_____

Objectives: **SWBAT. . .**

…define and calculate average atomic masses for isotopes.

…identify and write symbols for chemical ions.

In 1937, while studying radiation, **JAMES CHADWICK** discovered _____.

These particles are located in the nucleus and help hold it together.

ISOTOPES :

- The atomic mass on the periodic table is an average of all the isotopes found in nature for that element.
- That is why atomic mass isn't a whole number.

Ex.) 90.0% of element X is atomic mass 13.0 but 10.0%is atomic mass 14.0. What is the average?

To confuse you, isotopes are written…

…with the _____ as a superscript,

…and with the _____ as a subscript,

… both to the left of the chemical symbol.

(This is different than those properties appear on the periodic table.)

$$^{14}_{6}C$$

ex) Hydrogen has three important isotopes:

If hydrogen's atomic mass is 1.00794 amu,

then which isotope is the most prevalent?

$$^{1}_{1}H \quad ^{2}_{1}H \quad ^{3}_{1}H$$

Note: water made up of hydrogen-2 is called_____

Since the number of protons equal the number of electrons in an atom, the charges of each balance out.

- This makes atoms electrically neutral.

Sometimes atoms will…

– We call these **IONS.**

The charge of an ion is indicated by…

$$Mg^{2+} \quad F^{-}$$

CATIONS:

- ex) $M \rightarrow M^+ + e^-$ - Cations are usually _____

Cations are usually just named the same as the element (though sometimes a charge will be indicated)

ANIONS:

- ex) $M + e^- \rightarrow M^-$ - Anions are usually _____

Anions have the ending of the element dropped and –ide is added. ex) *oxygen = oxide, sulfur = sulfide*

IONS ARE NEVER FORMED BY GAINING OR LOSING PROTONS!

The columns in the periodic table can be used to predict which ions elements commonly form…

ex) group 1 = group2 = group 13 =

group 15 = group 16 = group 17 =

group 18… Transition metals…

Predict whether the following atoms will gain, lose, or not form ions. Write down the formula for the process.

Potassium: $K \rightarrow K^+ + e^-$ Oxygen:

Calcium: Fluorine:

REMEMBER: ONLY THE NUMBER OF PROTONS DETERMINES AN ELEMENT'S IDENTITY!

ELECTRONS AND NEUTRONS CAN VARY!

DID YOU KNOW... 'One application of isotopes is **carbon-14** dating. All biological organisms contain a given concentration of carbon-14. When an organism dies, it has a specific ratio by mass of carbon-14 to carbon-12 incorporated in the cells of its body. (The same ratio as in the atmosphere.) At the moment of death, no new carbon-14 containing molecules are metabolized, therefore the ratio is at a maximum. After death, the carbon-14 to carbon-12 ratio begins to decrease because carbon-14 is decaying away at a constant and predictable rate. Remembering that the half-life of carbon-14 is 5700 years, then after 5700 years half as much carbon-14 remains within the organism. Example: If an organism such as a tree contained 1 gram of carbon-14 while it was living, then after 5700 years it would contain half that amount, or 0.5 grams of carbon-14. This method is only good for organisms or artifacts that are biological by nature and on the order of tens of thousands of years old.' ~ www.chem.duke.edu

"If the facts don't fit the theory, change the facts." ~ Albert Einstein

HONORS CHEMISTRY: Periodic Table Overview DATE:_____

LEARNING GOALS: **SWBAT. . .**

…identify the four main regions of the periodic table & differentiate their properties.
…differentiate between groups and columns of the periodic table.
…explain the role of valence electrons in chemical behavior.

The periodic table is based off of **DMITIRI MENDELEEV'S** published work (1869)

4 Main categories:

Metals:

-

-

Nonmetals:

-

-

Metalloids:

-

-

Noble gases:

-

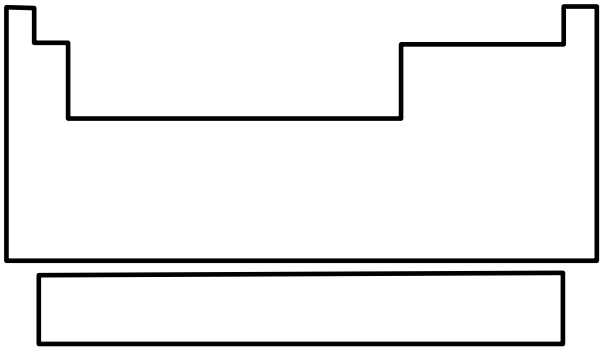
-

Hydrogen, due to its unique properties...

The current table based on **PERIODIC LAW:**

PERIODICITY:

ROWS/SERIES:



GROUPS/FAMILIES:

-

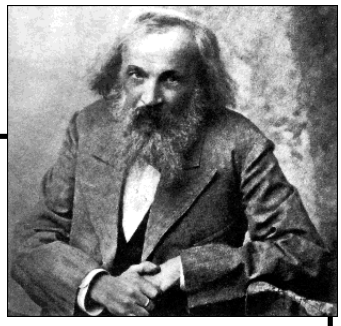
-

HUGE CONCEPT TO FOLLOW:

- The most important electrons are the _____ electrons.
- This is because these are the electrons that are always…
- Those outermost electrons are called the **VALENCE ELECTRONS**.
- Atoms start with between ____ and ____ valence electrons.

OCTET RULE:

- Knowing how many valence electrons an atom has gives you a big advantage of predicting reactivity.
- Similar valence shells mean similar reactions:
  - ~ A full valence shell means…
  - ~ Closer to full means…
  - ~ Closer to empty means…



DID YOU KNOW… Dmitri Mendeleev (1834 - 1907)

"Born in Siberia, the last of at least 14 children, Dmitri Mendeleev (1834 - 1907) revolutionized our understanding of the properties of atoms and created a table that that probably adorns every chemistry classroom in the world. After his father went blind and could no longer support the family, Mendeleev's mother started a glass factory to help make ends meet. But just as Mendeleev was finishing high school, his father died and the glass factory burned down. With most of her other children now out on their own, his mother took her son to St. Petersburg, working tirelessly and successfully to get him into college.

In the late 1860s, Mendeleev began working on his great achievement: the periodic table of the elements. By arranging all of the 63 elements then known by their atomic weights, he managed to organize them into groups possessing similar properties. Where a gap existed in the table, he predicted a new element would one day be found and deduced its properties. And he was right. Three of those elements were found during his lifetime--gallium, scandium, and germanium. They provided the strongest support for his periodic table, a cornerstone both in chemistry and in our understanding of how the universe is put together." ~ www.pmi.itmonline.com

REVIEW & REFLECTION

There are admirable potentialities in every human being.
Believe in your strength and your youth.
Learn to repeat endlessly to yourself, 'It all depends on me.' ~ Andre Gide

HONORS CHEMISTRY: NOBLE GASES & ALKALI METALS DATE:_____

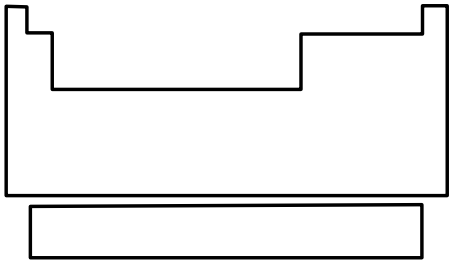
LEARNING GOAL: **SWBAT. . .**
…describe the characteristics and behaviors of both the noble gases and alkali metals.

GROUP 18: NOBLE GASES

Inert! ( ) Compounds of ___ , ___ , ____ have been made in the laboratory.

- Discovered between 1894 - 1898, mostly by **SIR WILLIAM RAMSEY.** Won a Nobel Prize in 1904 for this.

START WITH A… *(8 ELECTRONS)*



-

PROPERTIES:

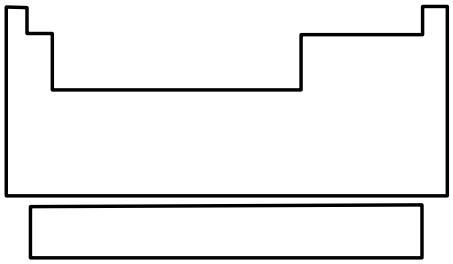
- This makes them…
- Other atoms react to obtain such a state (become)

SOME INTERESTING FACTS:

NEON AND ARGON:

HELIUM:

GROUP 1: ALKALI METALS



START WITH…

- Losing electron gives it…

PROPERTIES:

- Wants to lose that electron! Very reactive!
- Reactivity _____ going down the family.
- Soft, shiny and can be cut with a knife. Quickly dull due to **oxidation** ( )
- Usually stored under oil or kerosene since…
- Form solutions with high pHs when dissolved in water. These basic solutions are also called_____.

SOME INTERESTING FACTS:

LITHIUM:

SODIUM:

FRANCIUM:

How do you think the reactivity of the next column (the alkaline earth metals) compares to the alkali metals?

REVIEW & REFLECTION

"Whenever a man does a thoroughly stupid thing, it is always from the noblest motives." ~ Oscar Wilde

HONORS CHEMISTRY: Alkaline Earth Metals & The Halogens DATE:_____

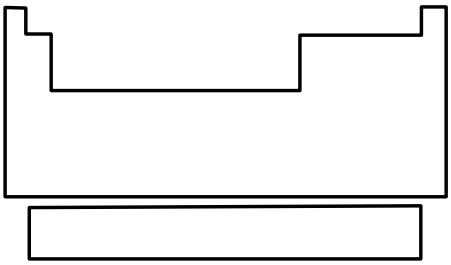
LEARNING GOAL: **SWBAT. . .**

…describe the characteristics and behaviors of both the alkaline earth metals and the halogens.

GROUP 2: THE ALKALINE EARTH METALS: (Do not confuse these with the alkali metals!)

Start with…

Properties:



- This makes them…
- They are…
- Why?
- They are…

Some Interesting Facts:

BERYLLIUM:

MAGNESIUM:

-

-

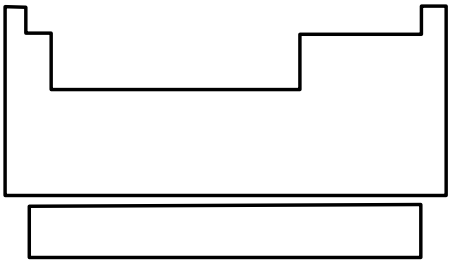
CALCIUM:

-

GROUP 17: THE HALOGENS

Start with…

Properties:



- This makes them…
- Why?
- They are…
- They…
- The name 'halogen' comes from the Latin term _____

Some Interesting Facts:

FLUORINE:

-

-

CHLORINE:

-

-

IODINE:

-

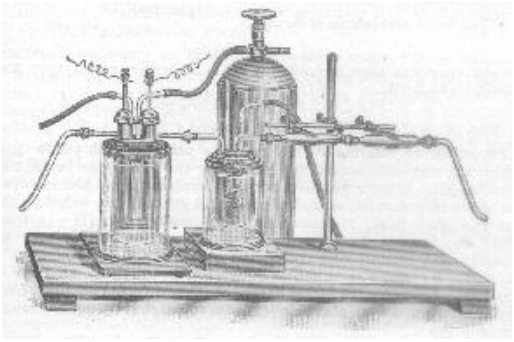
-

REVIEW & REFLECTION

DID YOU KNOW... "The earliest hints of fluorine appeared around around 1670 in a set of instructions for etching glass. Flourine was was discovered by Karl Scheele in 1771, but serious injuries and even even death occurred for many who first tried to isolate it.

Many first tried isolating the element by the electrolysis of hydrofluoric acid. George Gore managed to obtain a small amount in amount in 1869, but his electrolysis apparatus exploded when the the fluorine came into contact with hydrogen gas from the opposite opposite electrode. (The reaction between hydrogen and fluorine is fluorine is second in violence only to that of hydrogen and oxygen. oxygen. The hydrogen - fluorine reaction is more dangerous, however however because it occurs spontaneously at room temperature while while hydrogen - oxygen reactions need to be started with a spark or spark or flame.)

Ferdinand Frederic Henri Moissan finally managed to complete the task that everyone was calling impossible. impossible. He used the electrolysis principle, with some some significant refinements. First, he used a mixture of mixture of potassium fluoride and hydrofluoric acid. Second, he made certain the gasses evolved from the the electrodes would not come into contact with one one another. Finally, he constructed the apparatus from from platinum. After several poisonings, the work was was completed successfully in 1886. Moissan received the received the Nobel Prize for chemistry in 1906."



Interesting side note: Mendeleev lost the 1906 Nobel Prize to Moissan by a vote of 5 to4. Both men died within weeks of each other in the beginning of 1907. (www.doane.edu & www.iupac.org)

"Dare to be naïve." ~ R. Buckminster Fuller

HONORS CHEMISTRY: THE TRANSITION METALS DATE:_____

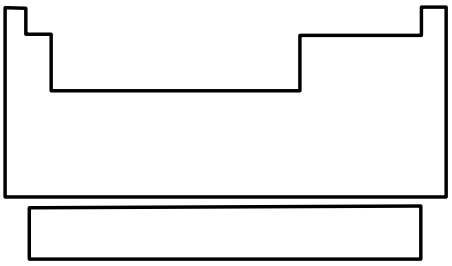
LEARNING GOALS: **SWBAT. . .**

… describe the characteristics and behaviors of the transition metals.

GROUPS 3 – 12: THE TRANSITION METALS

START WITH…

- These irregularities are due to the inner electron shell structures.



PROPERTIES:

- Tend to be _____ reactive than Groups 1 or 2.
- With the exception of _____ , all are harder, denser, and have higher melting points than Groups 1 & 2.
- Most will readily make _____ with other transition metals and other elements.

SOME INTERESTING FACTS:

IRON:

- Incredibly important metal in…

GOLD: Rather unreactive; only dissolves in…

- Very malleable and ductile (1 oz. can be pounded into a _____ sq.ft. sheet!)
- Not a lot of it; estimates put all the gold in the world in a cube about _____!
-

ZINC: Used in **galvanization**:

TUNGSTEN:

-

MERCURY:

- Useful in…
- Readily alloys with other metals in mixtures called _____.

Two special periods of transition elements (dropped out to make table thinner and more manageable)

LANTHANIDES: [58 – 71]

ACTINIDES: [90 – 103]

URANIUM:

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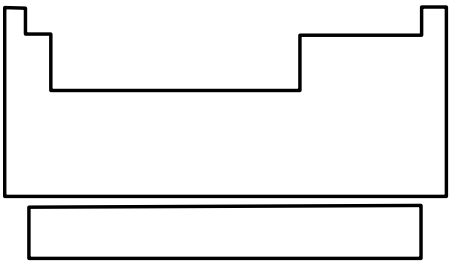
"The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore, all progress depends on the unreasonable man." ~ George Bernard Shaw (1856 - 1950)

HONORS CHEMISTRY: MAIN BLOCK ELEMENTS & HYDROGEN DATE:_____

LEARNING GOAL: **SWBAT. . .**

… describe the characteristics and behaviors of the remaining main block elements and hydrogen.

MAIN BLOCK ELEMENTS: GROUPS 1, 2 13 – 17



PROPERTIES:

- Also called the_____ because they represent…
- Electron configuration varies across periods, so reactivity varies.
- At the extremes lie the alkali metals and halogens.
- Group 16 is also known as:
- Unofficial names:
- Neither of these names are approved by the ***IUPAC***:

SOME INTERESTING FACTS:

CARBON: Central to life:

- Many carbon containing gases: CO, CO_2, CH_4:
- Allotropic forms include:
- Important to industry in plastics, medicine, fuels, clothes, steel. . . EVERYTHING!

NITROGEN:

- Exists as diatomic N_2, which is…
- Usuable nitrogen is very important to civilization:
- ***HABER PROCESS:***

OXYGEN:

- Two allotropes:

SILICON:

- Important to computer industry due to…

HYDROGEN: A truly unique element, considered its own family, if in any at all.

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REVIEW & REFLECTION

"Two men look out through the same bars: One sees the mud and one the stars." ~ Frederick Langbridge