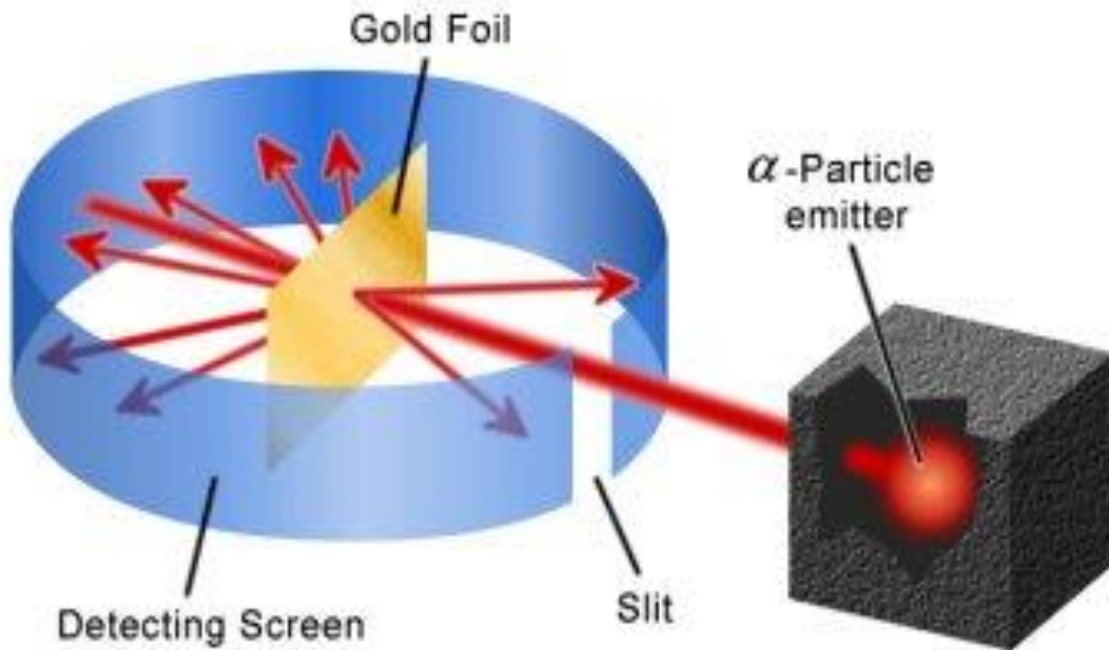


Atoms and Periodic Table Unit Notes

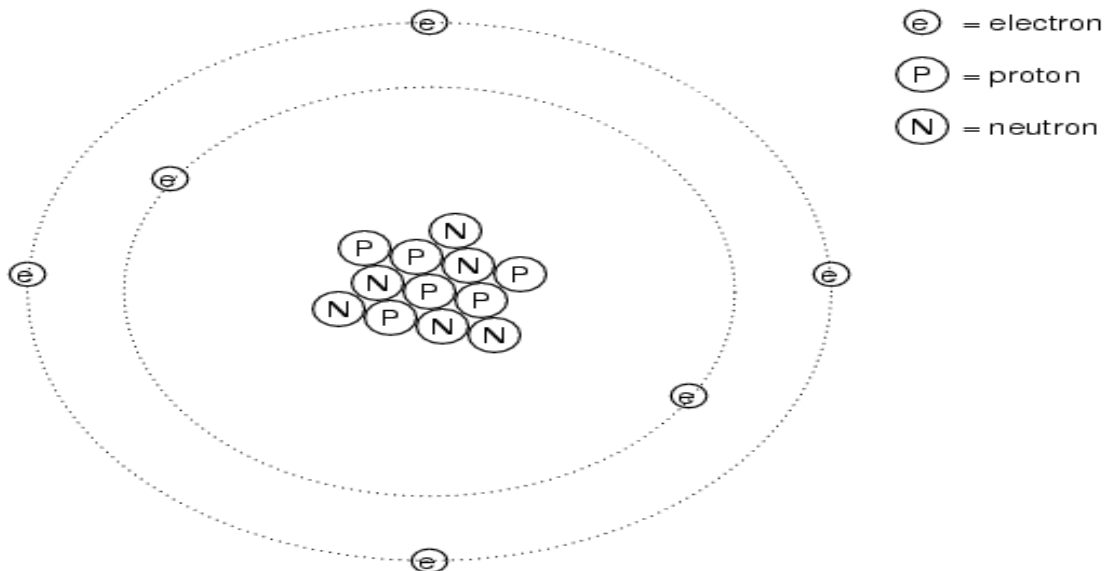
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(DO NOT LOSE!)

■ Rutherford's gold foil experiment



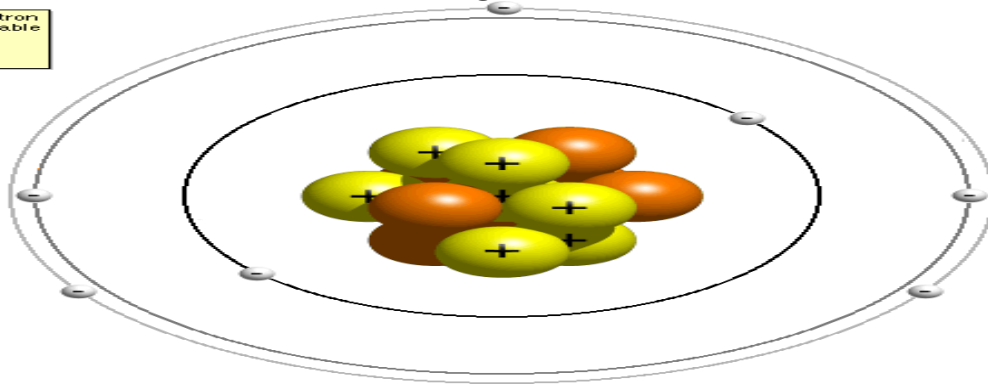
■ An **Atom** is the smallest part of an element which can take part in a chemical reaction



- The atom consists of three fundamental particles
 - **Proton** + (positive charge)
 - **Neutron** 0 (neutral charge / no charge)
 - **Electron** – (negative charge)

■ **Nucleus** - The positively charged dense center of an atom

Nitrogen's Electron Configuration Table
 $1s^2$
 $2s^2 2p^3$

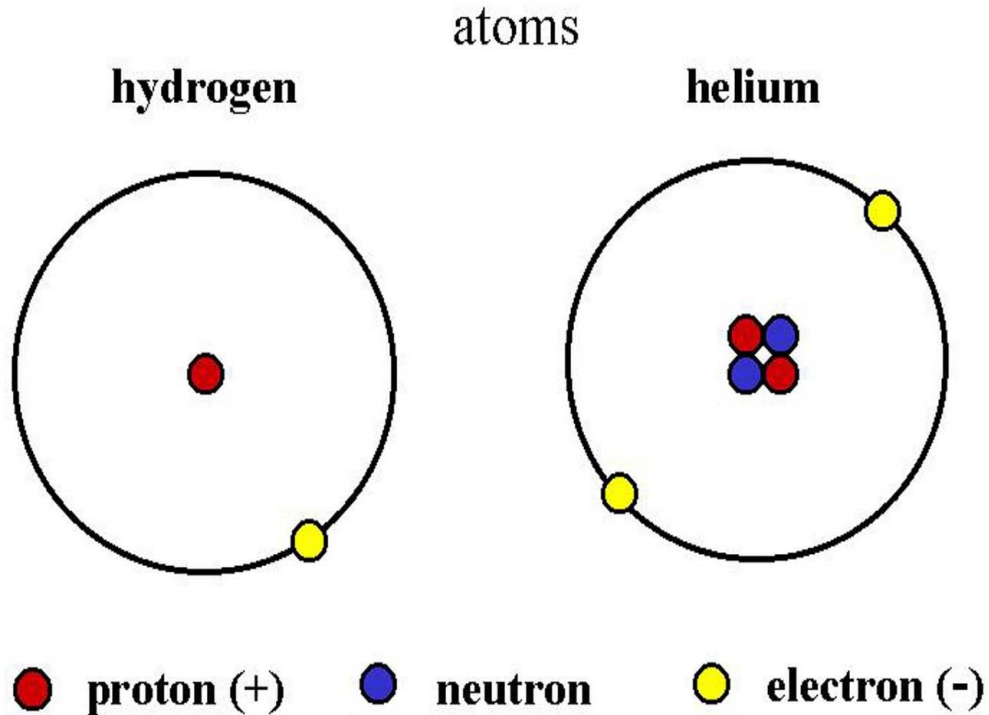


- Atoms always have the same number of protons and electrons, this called the **atomic number**.
- **APE A=P=E** (Atomic Number = # Protons which = # Electrons)

Atomic Number → 47

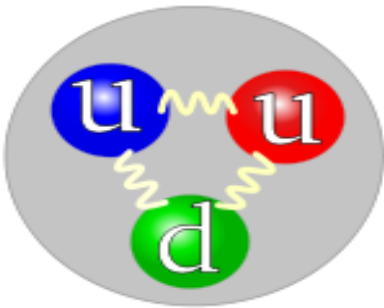
47
Ag
Silver
107.8682

- The Nucleus has almost all the mass of the atom. It is made up of protons (+) and neutrons (0)

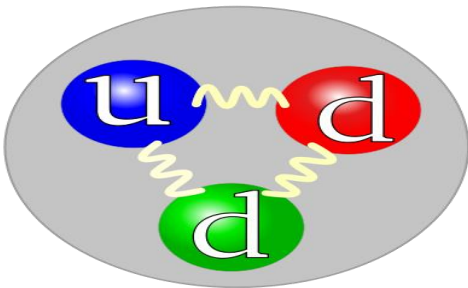


- **Isotope:** atom with same number of protons and electrons but different numbers of neutrons.
- To find the number of neutrons: Subtract the atomic number from the atomic mass.
 - **MAN** (Atomic Mass – Atomic Number + Number of Neutrons in the Atom)
- Most of an atom is empty space, electrons orbit far away from nucleus
- 1800 Electrons = Mass of 1 proton
- 1 Neutron = little bit more mass than proton
- Physicists have discovered that protons and neutrons are composed of even smaller particles called **quarks**. Just bigger than an electron.

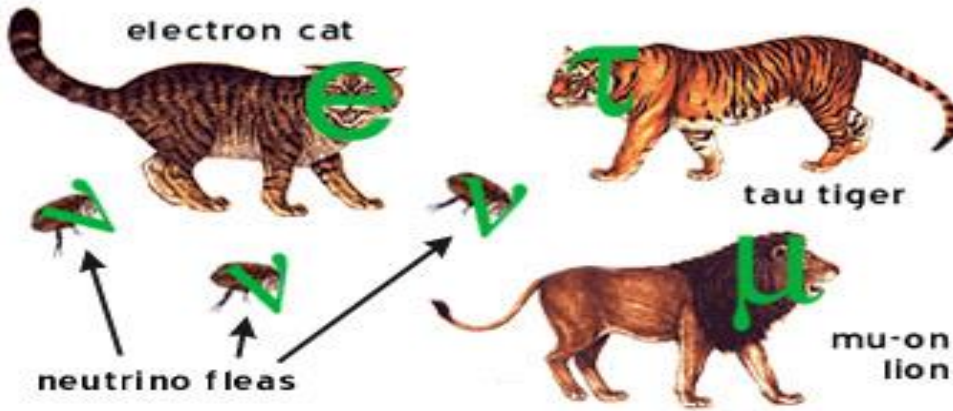
- **Particle:** A tiny piece of anything.
 - An atom or nucleus.
 - Elementary particle, quark, gluon.
- Proton is composed of two up quarks, one down.



- A neutron is composed of two down quarks and one up quark.



- The 6 Leptons
 - Electron
 - Muon
 - Tau
 - 3 types of Neutrinos



- Everything is made of...
 - **6 quarks** that make Protons and Neutrons
 - **6 leptons**. The best-known lepton is the electron.
 - **Force carrier particles**
- The four force carrier particles



Fermions				Bosons		Force Carrier Particles
Quarks	U Up	C Charm	T Top	γ ^{EM} Photon		
	D Down	S Strange	B Bottom	Z ^{Weak} Z Boson		
	Leptons	ν_e Electron Neutrino	ν_μ Muon Neutrino	ν_τ Tau Neutrino		
e Electron		μ Muon	τ tau	g ^{Strong} Gluon		
				Higgs Boson		

John Dalton's Atomic Theories
 -All matter is composed of atoms.

- Atoms cannot be made or destroyed.
- All atoms of the same element are identical.
- Different elements have different types of atoms.
- Chemical reactions occur when atoms are rearranged.
- Compounds are formed from atoms of the elements.

- Each Element is made up of one kind of atom. The number of Protons and Electrons.
- Atoms are arranged on The Periodic Table of the Elements.

Name of element	Hydrogen
Atomic weight	1.0080
Symbol for hydrogen	H
Atomic number	1

- Atomic Mass = AMU Atomic Mass Units, The number of protons, neutrons, and electrons.
- To find # of protons and electrons
 - It is the atomic number
- To find # of neutrons
- Subtract the atomic number from the atomic mass to determine the difference.
- **Valence electrons** – Electron's in the outer most shell.
- The number of valence electrons determines the group placement of an element on the periodic table

1A		2A						3A	4A	5A	6A	7A	8A
Li ·	· Be ·				· B ·	· C ·	· N ·	· O ·	· F ·	· H	· He	
Lithium	Beryllium					Boron	Carbon	Nitrogen	Oxygen	Fluorine	Hydrogen	Helium	
Na ·	· Mg ·				· Al ·	· Si ·	· P ·	· S ·	· Cl ·	· Ar ·		
Sodium	Magnesium					Aluminum	Silicon	Phosphorus	Sulfur	Chlorine	Argon		

- The rules for the first 18 elements are as follows...SPONCH included

- 2 electrons max in the 1st shell.
- 8 electrons max in the 2nd shell.
- 8 electrons max in the 3rd shell.

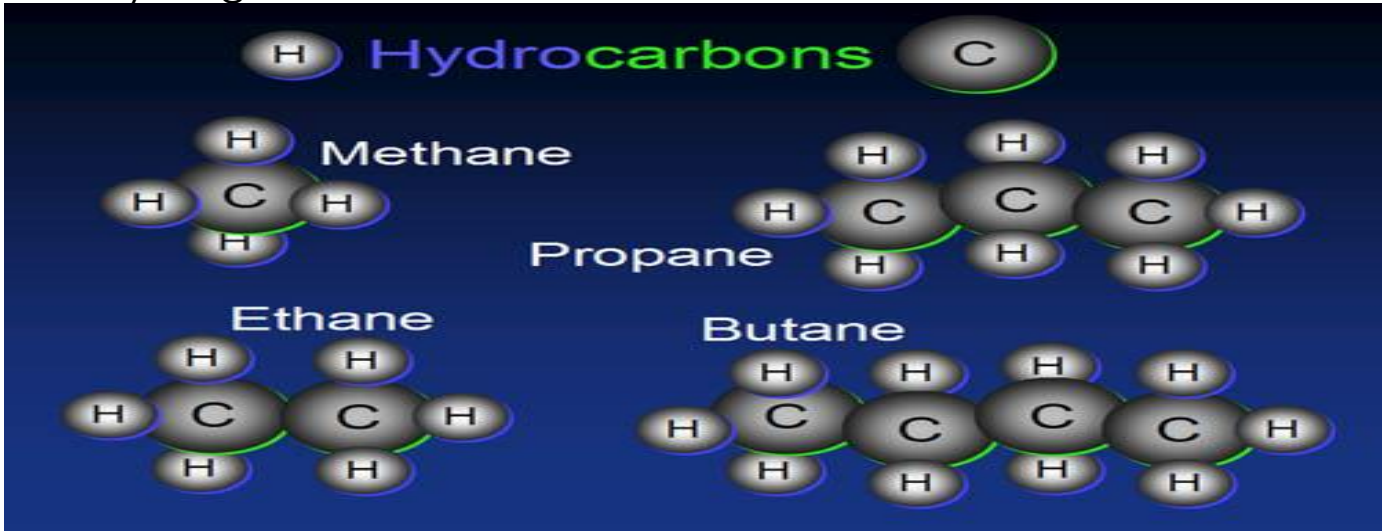
- 18
- 32
- 32
- 18
- 2

- Most of the transition metals...

- 2, 8, 18, 32, 32, 18, 2

- S-Sulfur
- P-Phosphorus

- O-Oxygen
- N-Nitrogen
- C-Carbon
- H-Hydrogen
- **Hydrocarbon** is an organic compound consisting entirely of hydrogen and carbon.



- **Alcohol** – Mostly carbon and hydrogen with a OH group

Protein: Group of nitrogenous organic compounds that are essential parts of living cells. ONCH

New Area of Focus: Atomic Bonds

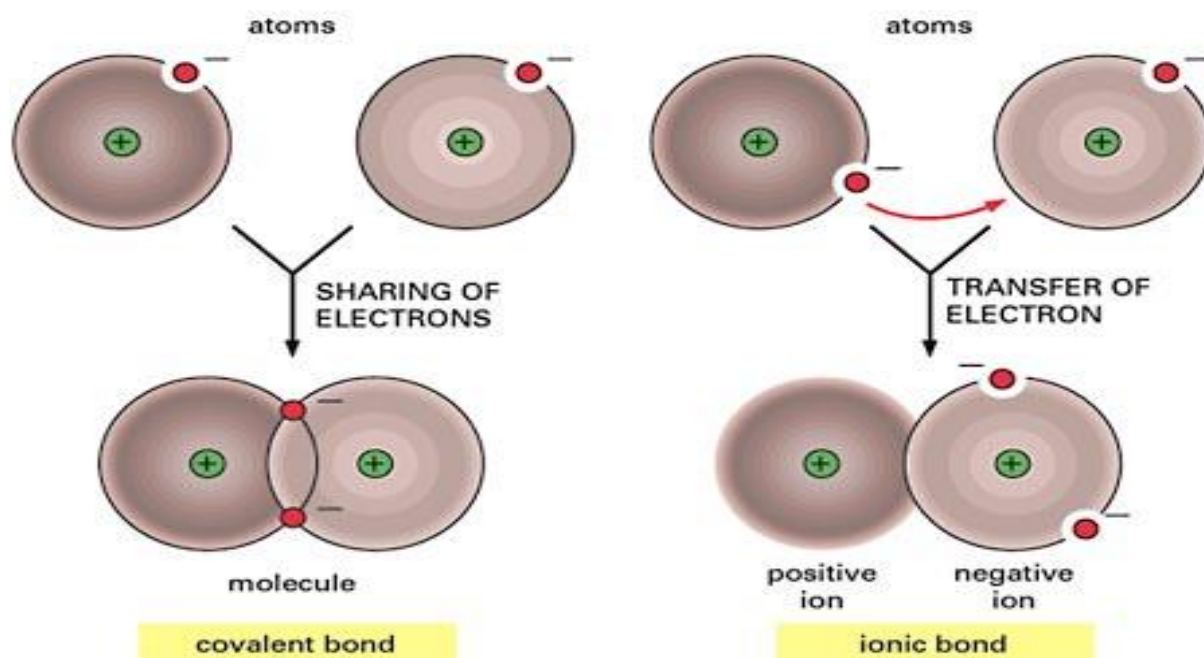
- **Chemical Bonding** – The attraction that holds atoms close to each other.

Chemical Change: The change of substances into other substances through a reorganization of the atoms.

The Six Types of Chemical Reactions

- Combustion: When oxygen combines with another compound to form water and carbon dioxide.
 - $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
 - Synthesis Reaction: When two or more simple compounds combine to form a more complicated one. $A + B = AB$
 - $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2(\text{g})$
 - Decomposition Reaction: A complex molecule breaks down to make simpler ones.
 - Opposite of Synthesis Reaction. $AB \rightarrow A + B$
 - $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$ (Electrolysis of Water)
 - Single Displacement: When one element trades places with another element in a compound. $BC + A \rightarrow AC + B$
 - Double Displacement: When the anions and cations of two different molecules switch places, forming two entirely different compounds.
 - $AB + CD \rightarrow AD + CB$
 - $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$
 - Acid / Base: When an acid and base react with each other.
-
- Ionic, Covalent, Metallic
 - **Ionic** – Gain or lose electrons
 - **Covalent** – Share electrons
 - **Metallic** – Many free electrons

- Covalent bonding occurs by a sharing of valence electrons (Strongest) (SPONCH)



- **Ionic bonding** (+/-) Bonds created by the attraction of opposite charges.
 - **Ionic** – Forms crystal lattice
 - **Ion** – A charged atom
 - When strips electron, now one atom has 1+ (cation), and the other has 1 – (anion),
- **Ionization**: The process of removing electrons from an atom to form ions.
- **Metallic** bonding is the bonding between atoms within metals. The sharing of many free electrons.
- Balancing a chemical equation refers to establishing the mathematical relationship between the quantity of reactants and products.
 - Reactant: Starting
 - Products: Ending

- Remember the Law Conservation of Mass: Matter cannot be created or destroyed. That means we need to have the same amount of chemicals on each side of the equation.
- For this reason, put a square around the chemical formulas.



- Begin balancing chemical equations by putting numbers (coefficients) in front of them.
 - Example H₂O on one side could become 2 H₂O
 - Remember that each side needs to have same number of Hydrogen and Oxygen
 - Note – Don't change the subscript
 - Example H₂O becomes H₃O
 -
- Oxidation number of an element: The number of electrons lost, gained, or shared as a result of chemical bonding.
 - Oxidation: An increase in oxidation number
 - Reduction: A decrease in oxidation number

OIL RIG → Oxidation is Losing Electrons, Reduction is Gaining Electrons

LEO Says GER → Losing Electrons is Oxidation, Gaining Electrons is Reduction

NEW AREA OF FOCUS – PERIODIC TABLE OF THE ELEMENTS

- The periodic table of the elements is a...
 - A chart of all the known elements.
 - Is in order of increasing atomic number and mass.
 - The table puts elements into groups with similar characteristics.
 - Allows us to recognize trends over the whole array of elements.
- **Period** is horizontal
- **Group/Family** vertical

Periodic Table of the Elements

	1	IA																	O		2															
1	H																				He															
2	3	Li	4	Be																		10														
3	11	Na	12	Mg																		18														
4	19	K	20	Ca	21	Sc	22	Ti	23	V	24	Cr	25	Mn	26	Fe	27	Co	28	Ni	29	Cu	30	Zn	31	Ga	32	Ge	33	As	34	Se	35	Br	36	Kr
5	37	Rb	38	Sr	39	Y	40	Zr	41	Nb	42	Mo	43	Tc	44	Ru	45	Rh	46	Pd	47	Ag	48	Cd	49	In	50	Sn	51	Sb	52	Te	53	I	54	Xe
6	55	Cs	56	Ba	57	*La	72	Hf	73	Ta	74	W	75	Re	76	Os	77	Ir	78	Pt	79	Au	80	Hg	81	Tl	82	Pb	83	Bi	84	Po	85	At	86	Rn
7	87	Fr	88	Ra	89	+Ac	104	Rf	105	Ha	106	Sg	107	Ns	108	Hs	109	Mt	110	111	112	113														

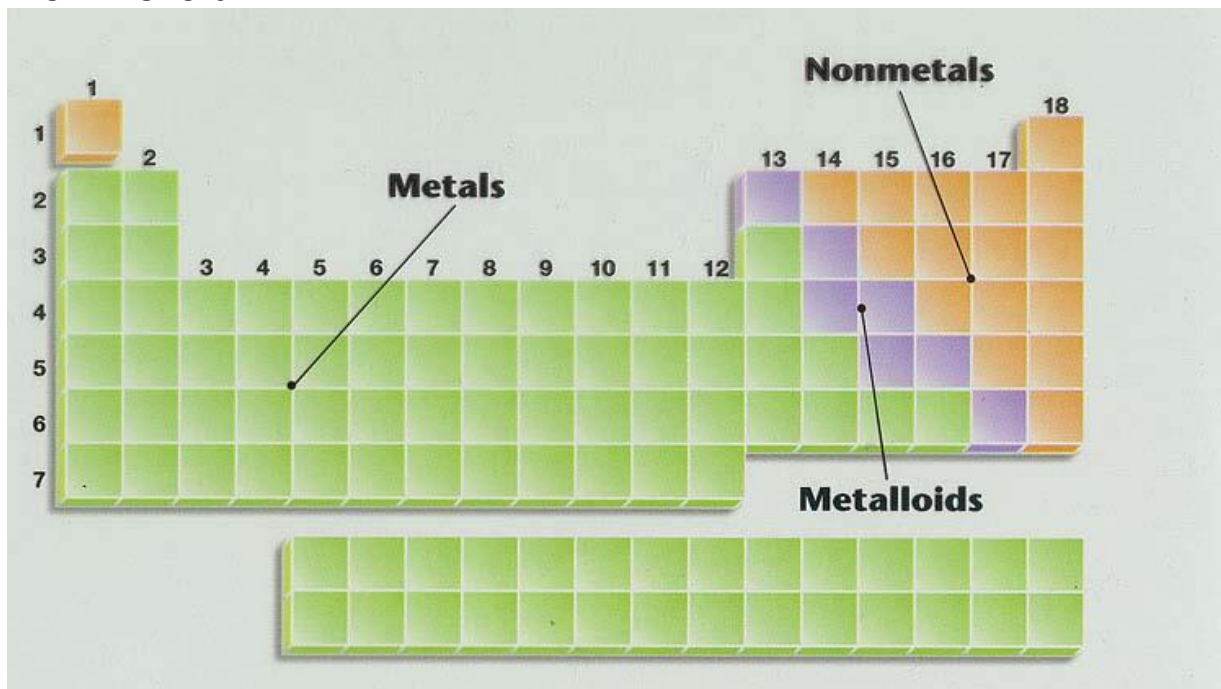
* Lanthanide Series	58	59	60	61	62	63	64	65	66	67	68	69	70	71
	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
+ Actinide Series	90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

- AMU increases from left to right and top to bottom.
- Electron negativity increases from lower left to upper right.
- Transition Metals, found in middle
 - Metal's that are malleable and ductile

TRANSITION METALS

- **Ductile**- Made into wire
- **Malleable** - Made into sheets
- **Metals** are also...
 - Good conductors of electricity.
 - Have a high luster (shine).
 - Mostly solid (Hg is a liquid).
 - Most have a high density.
- **Non-Metals**

- Not metals



- **Non-Metals continued**

- H and He are non-metals
- They are poor conductors.
- They are brittle, not ductile
- They show no metallic luster
- They may be transparent or translucent
- They have low density
- Covalently bonded.

- Percentage of SPONCH elements in living things.

- **S.** Sulfur Trace
- **P.** Phosphorus 1.0%
- **O.** Oxygen 65.0%
- **N.** Nitrogen 3.3%
- **C.** Carbon 18.5%
- **H.** Hydrogen 9.56%
- Other (Trace) 3.0%
- Sulfur, Sodium, Magnesium, Copper, Zinc, Selenium, Molybdenum, Fluorine, Chlorine, Iodine, Manganese, Cobalt, Iron Lithium, Strontium, Aluminum, Silicon, Lead, Vanadium, Arsenic, Bromine

Metals

- **Conduction:** Metals are good at conducting electricity.
- **Reactivity:** Metals are very reactive (Alkali Metals)
- **Alloys:** Metals are easily combined

Metalloids/Semimetals

- Properties of metals and non-metals
- Semi-conductors
- Brittle
- Can have luster

Noble Gases (Full outer shell of electrons, Very stable and non reactive) Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenon (Xe), and Radon (Rn)

SAVE THESE NOTES FOR THE UNIT ASSESSMENT!
DO NOT LOSE!