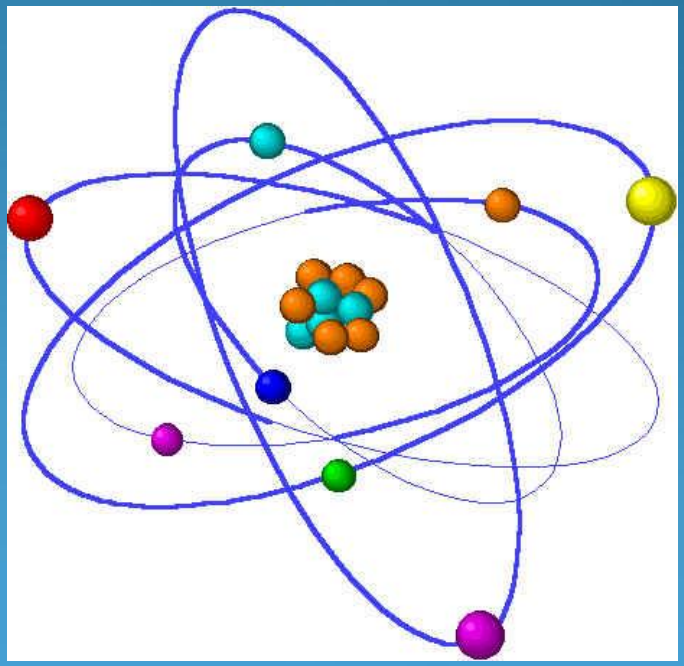
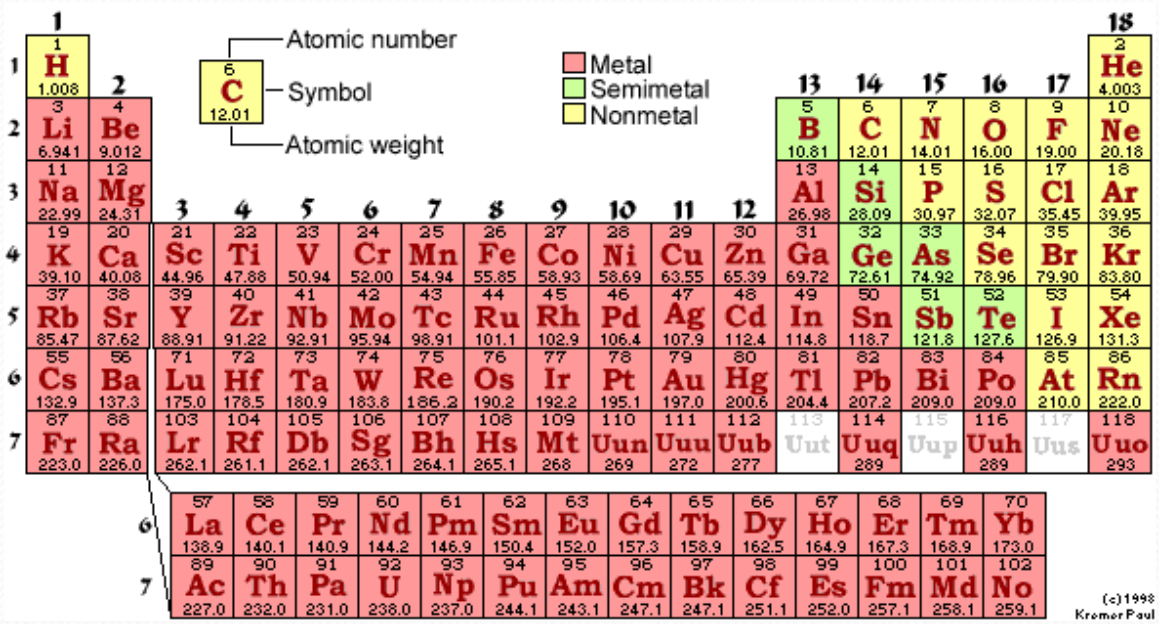
Ch 5 Atomic Structure and the Periodic Table

5.1 Atoms are the smallest form of elements

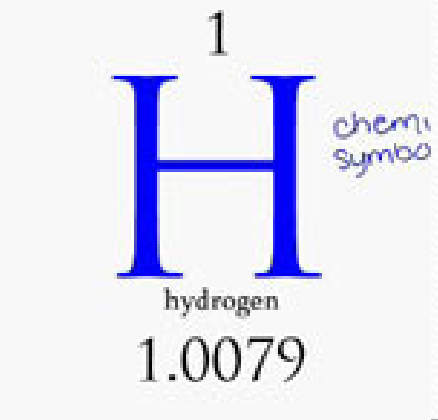


All matter is made of atoms

- Same type of atoms = element
- There are approximately 100 elements known today

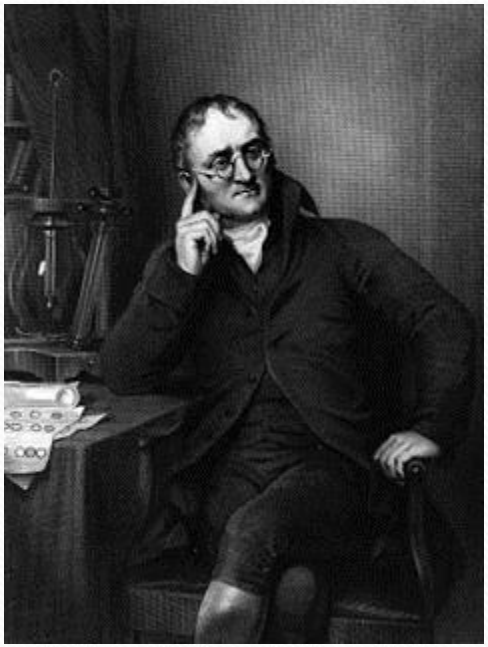


- Each element has its own symbol & properties
  - Hydrogen is the most abundant in the universe
  - Oxygen is the most abundant in the Earth's crust



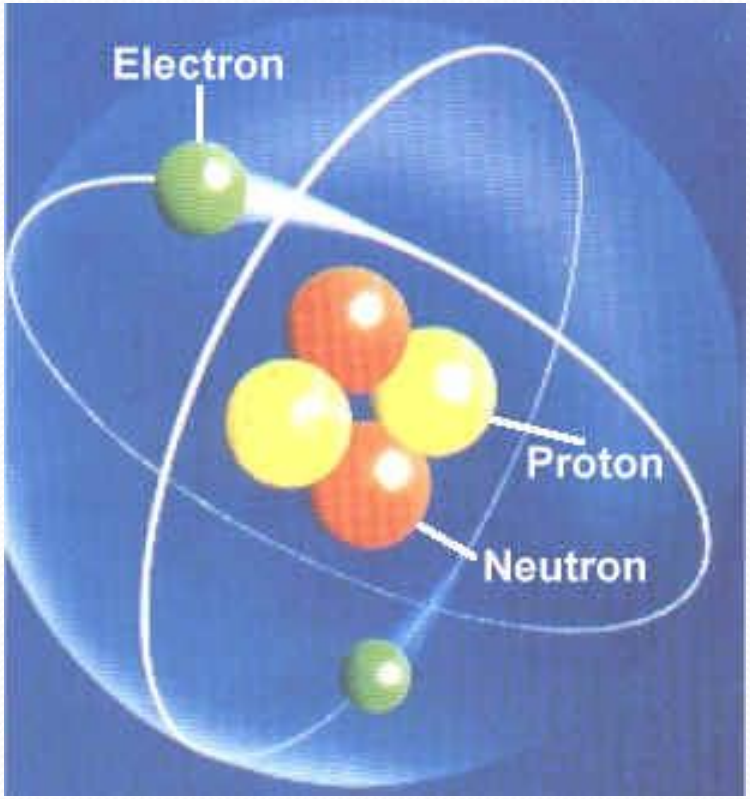
John Dalton is famous for studies involving atoms (early 1800s)

His work helped contribute To the modern-day atomic Theory.

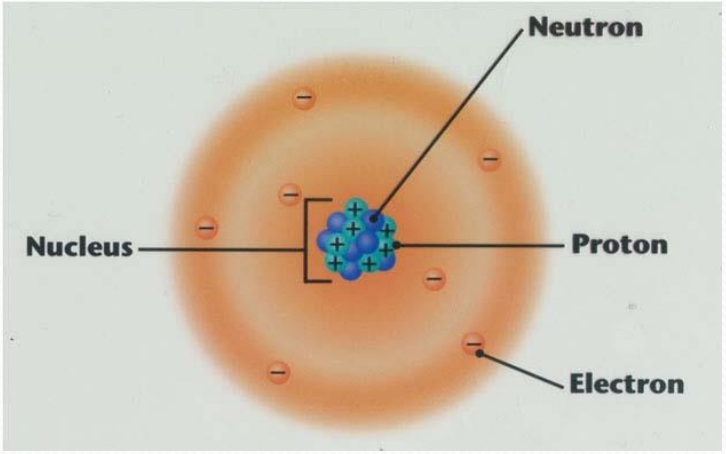


Each element is made of a different atom

- Atoms are made of 3 different particles (subatomic particles)
  - Protons, + charge
  - Neutrons, 0 charge (neutral)
  - Electrons, - charge



- Nucleus—center of the atom; contains the protons & neutrons
- Electron cloud (or energy levels)—contains the electrons which orbit the nucleus
  - Electrons are 2000x smaller than the protons & neutrons

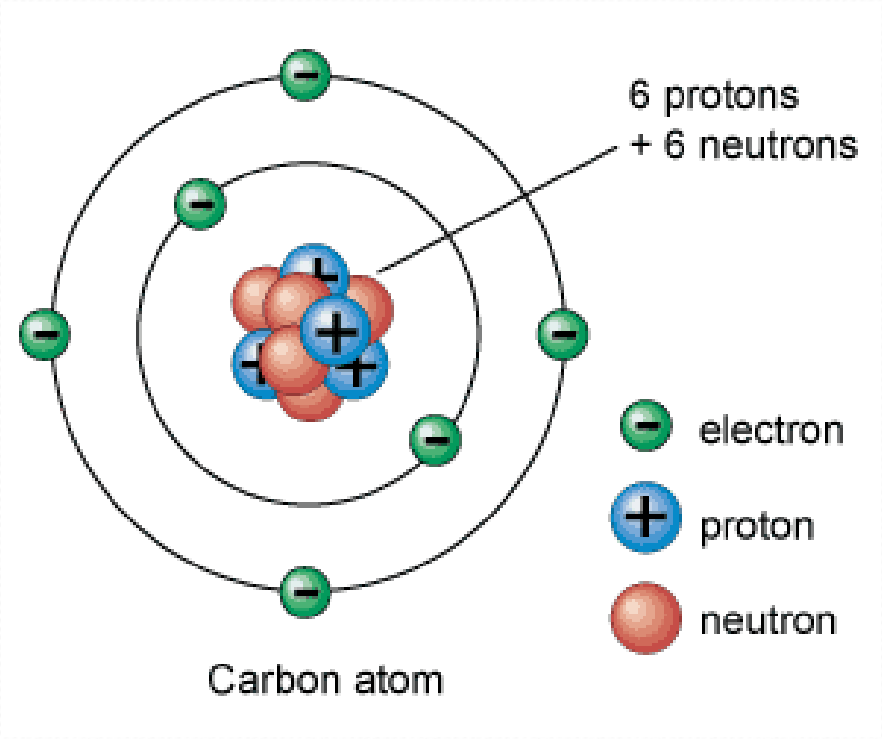


*Mass of electrons is considered to be neglegible

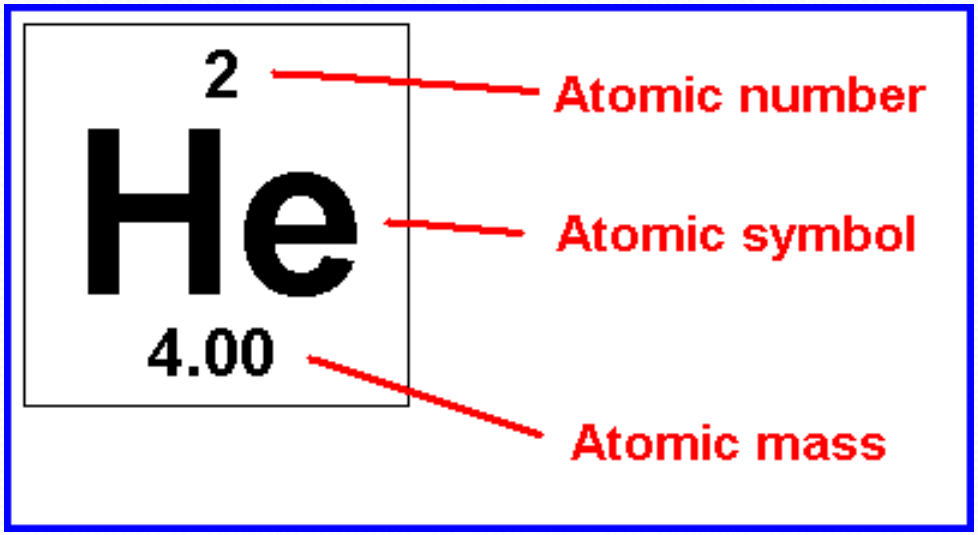
** # Energy Levels—>Period or Row

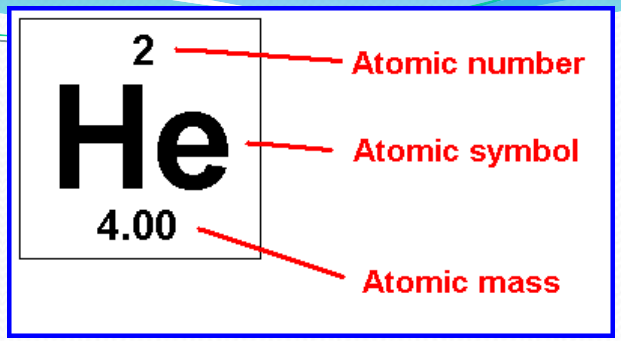
(# of rings to draw around nucleus)

Carbon has 2 energy levels



- Atomic #--number of protons and total # of electrons in an atom

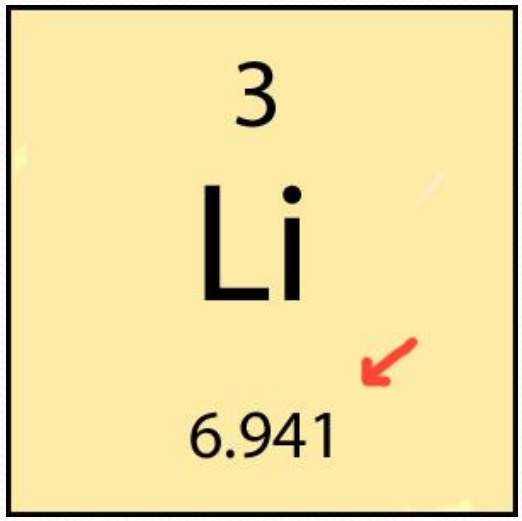




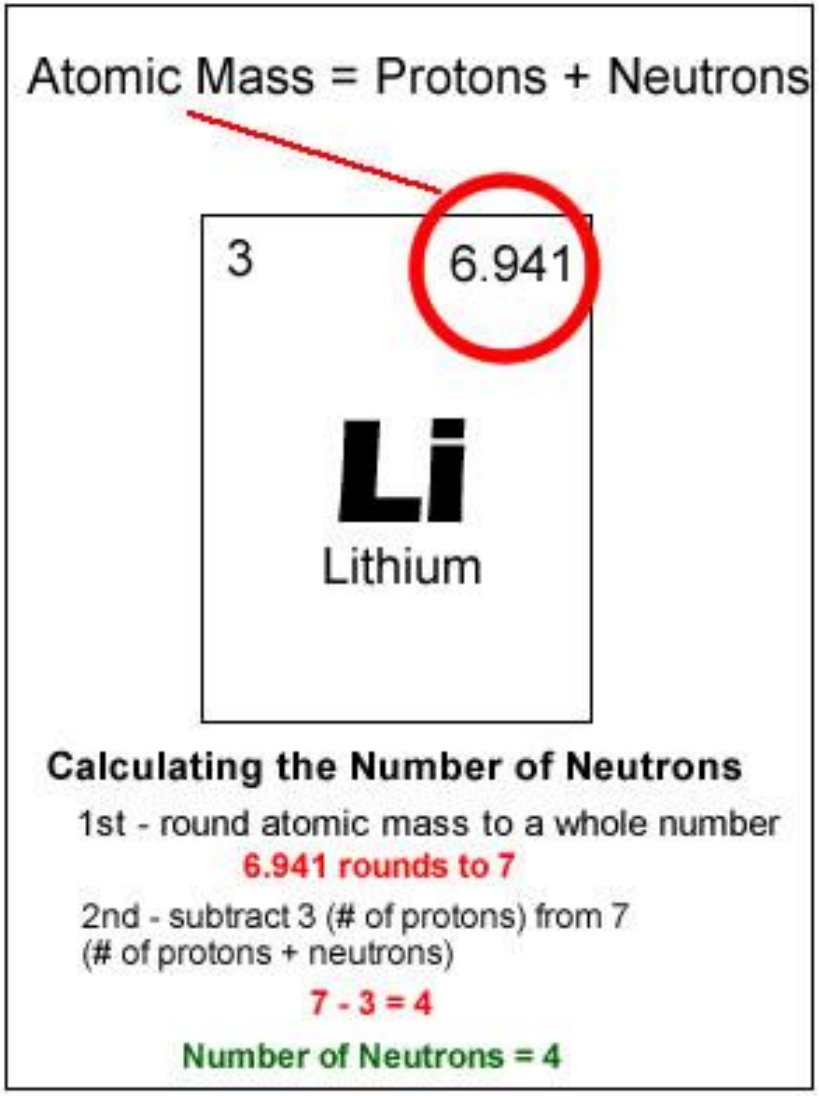
- Atomic mass --

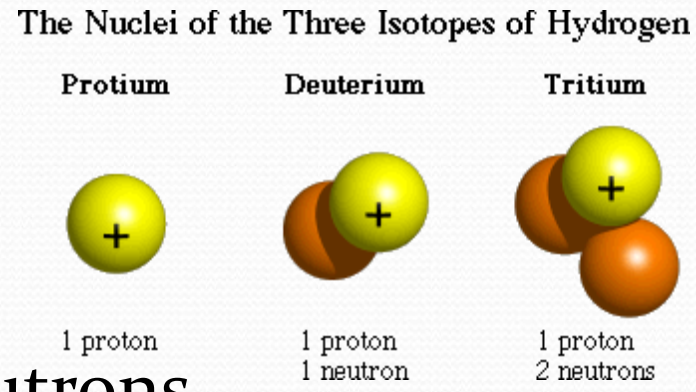
# of protons & neutrons combined

- Avogrado's # = 6.022 X 10 to the 23rd power
- 7 grams of Lithium would have Avogrado's # of atoms in it
- This is also considered to be 1 mol

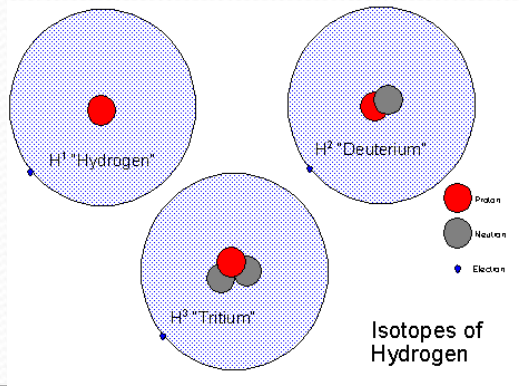


Neutrons = Atomic mass – atomic



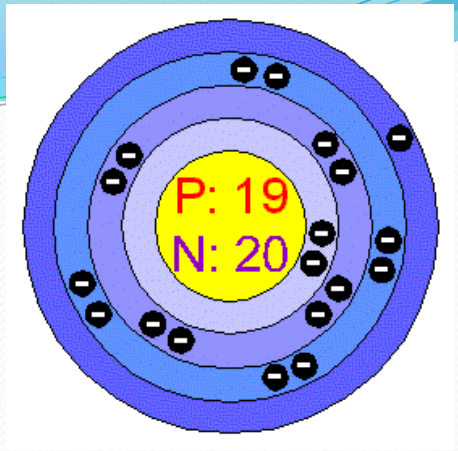


- Isotopes—atoms of the same element with different #s of neutrons
  - Atomic mass # on periodic table is the ave. # of all isotopes
  - An isotope is written with a numeral after the name; the numeral represents the atomic mass



Examples of Isotopes

Potassium Bohr Model

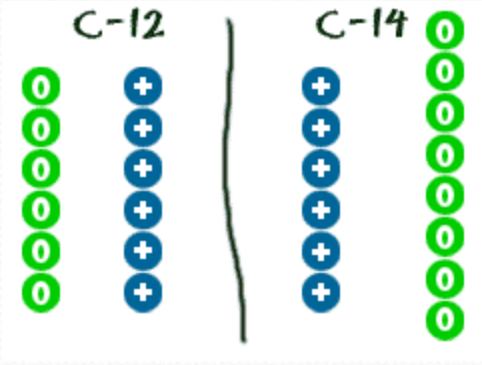


Potassium 39= 20 neutrons

39 is the atomic mass

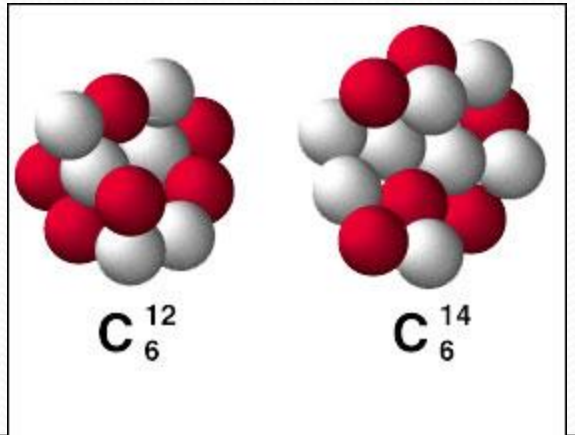
atomic mass – atomic #

39 – 19 = 20



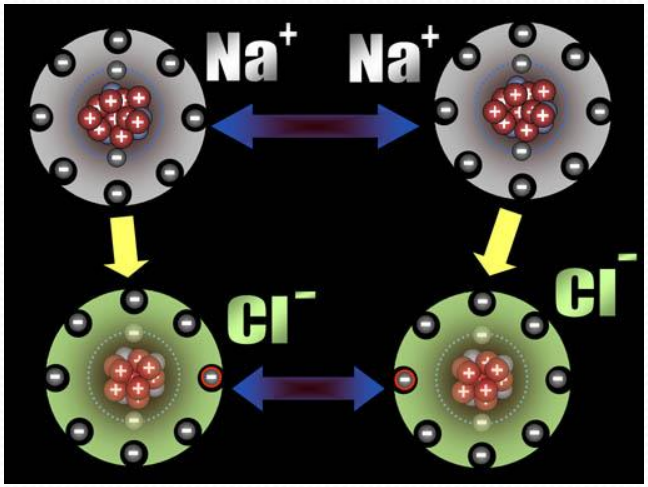
Potassium 41 = 22 neutrons

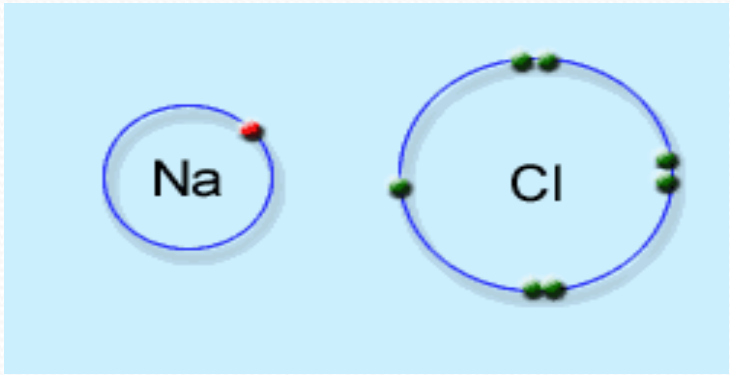
Potassium 42 = 23 neutrons

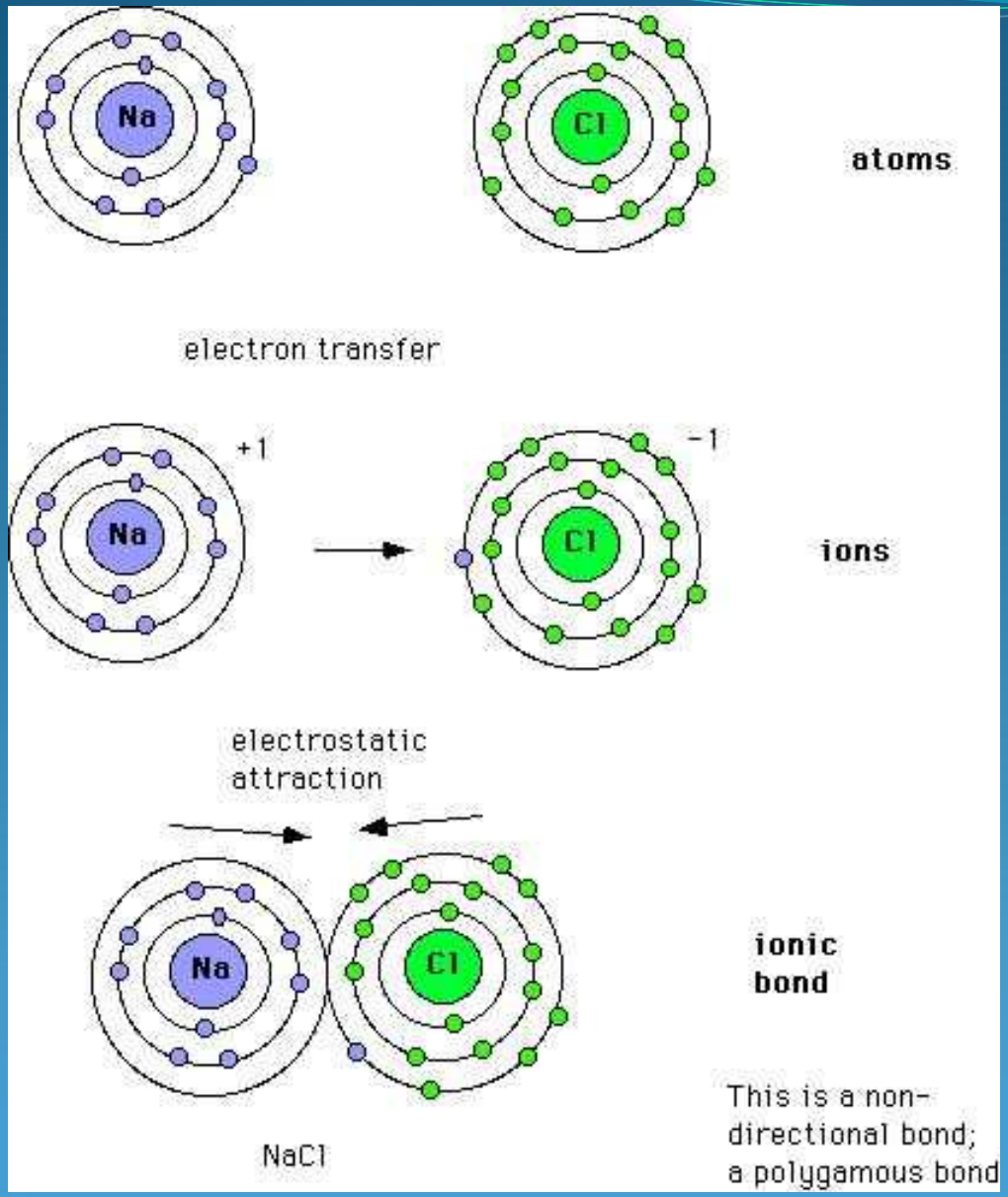


Atoms form ions

- Ions form when atoms gain or lose electrons
- Electrons have a negative charge
  - Gaining = negative ions (anions)
  - Losing = positive ions (cations)






Na
Cl
atoms
electron transfer
+1
Na
Cl
-1
ions
electrostatic
attraction
Na
Cl
ionic
bond
NaCl
This is a non-
directional bond;
a polygamous bond

Families & Ions/Oxidation #s

Family 1 = +1

Family 2 = +2

Family 13 = +3

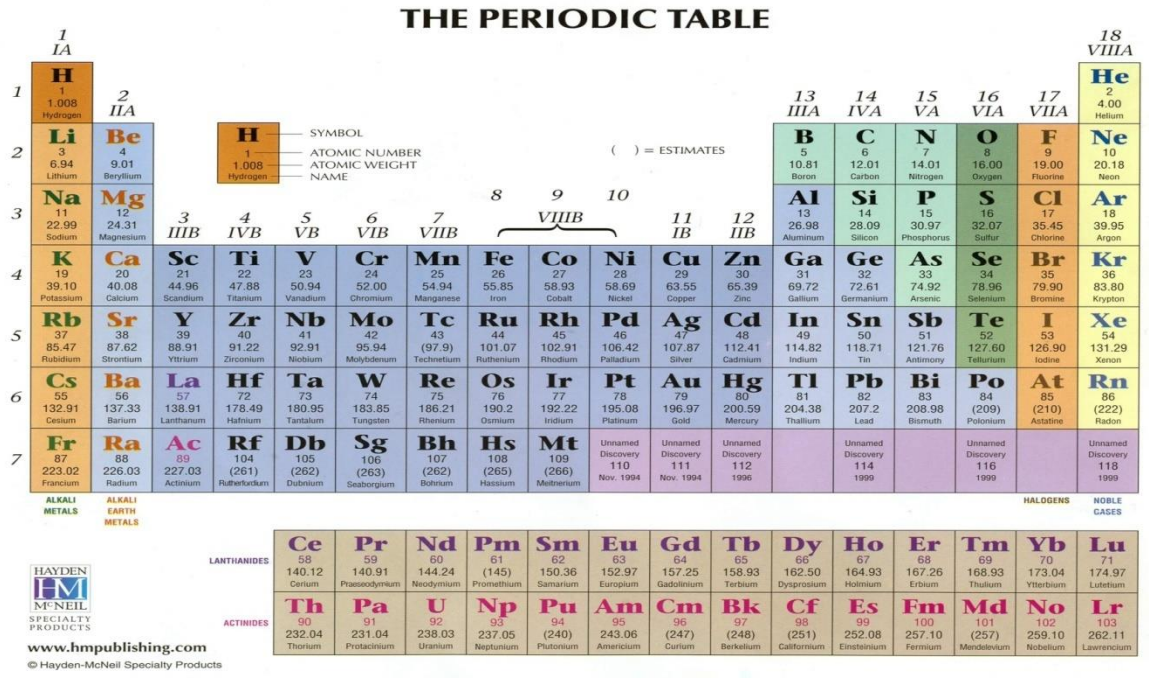
Family 14 = + -4

Family 15 = -3

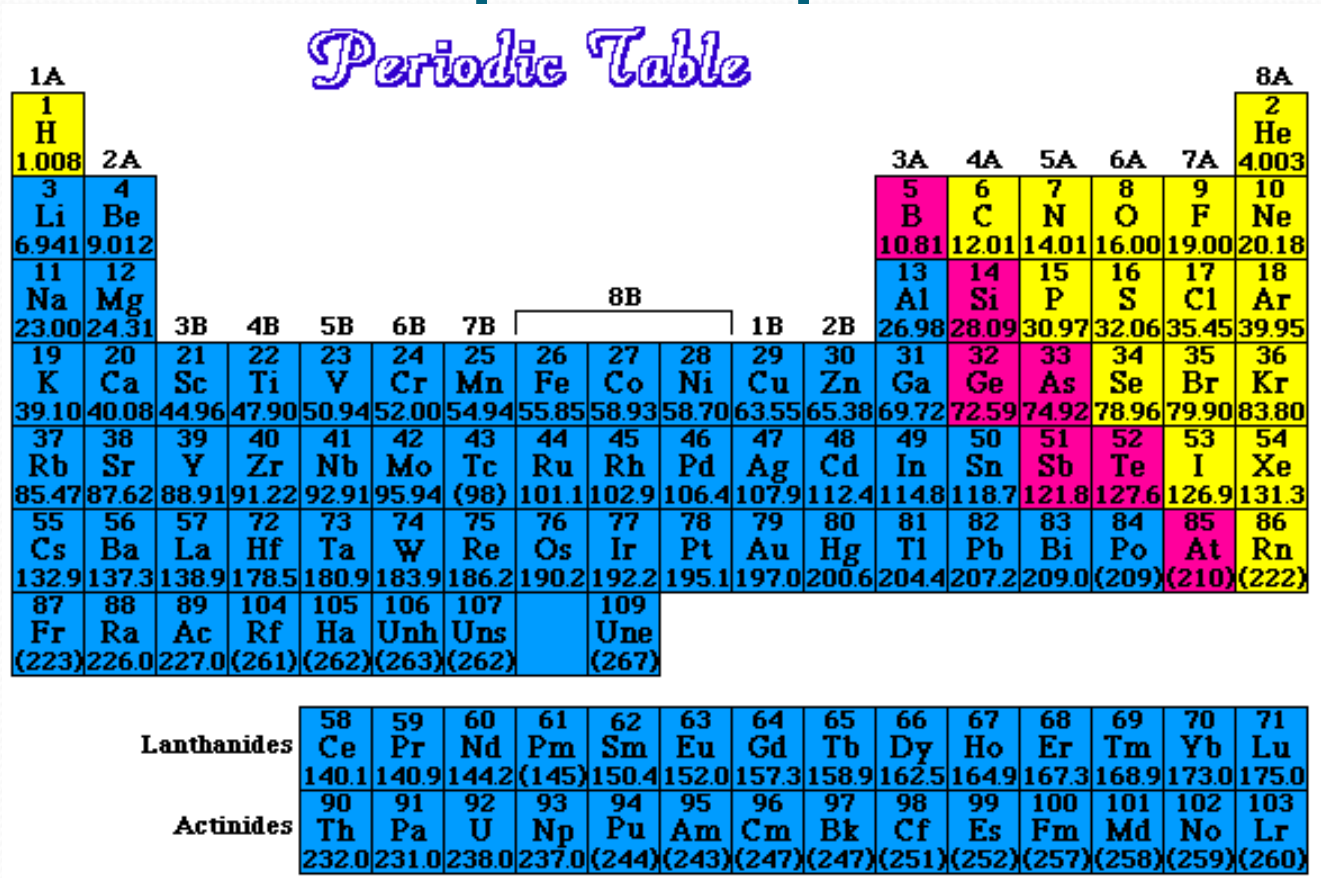
Family 16 = -2

Family 17 = -1

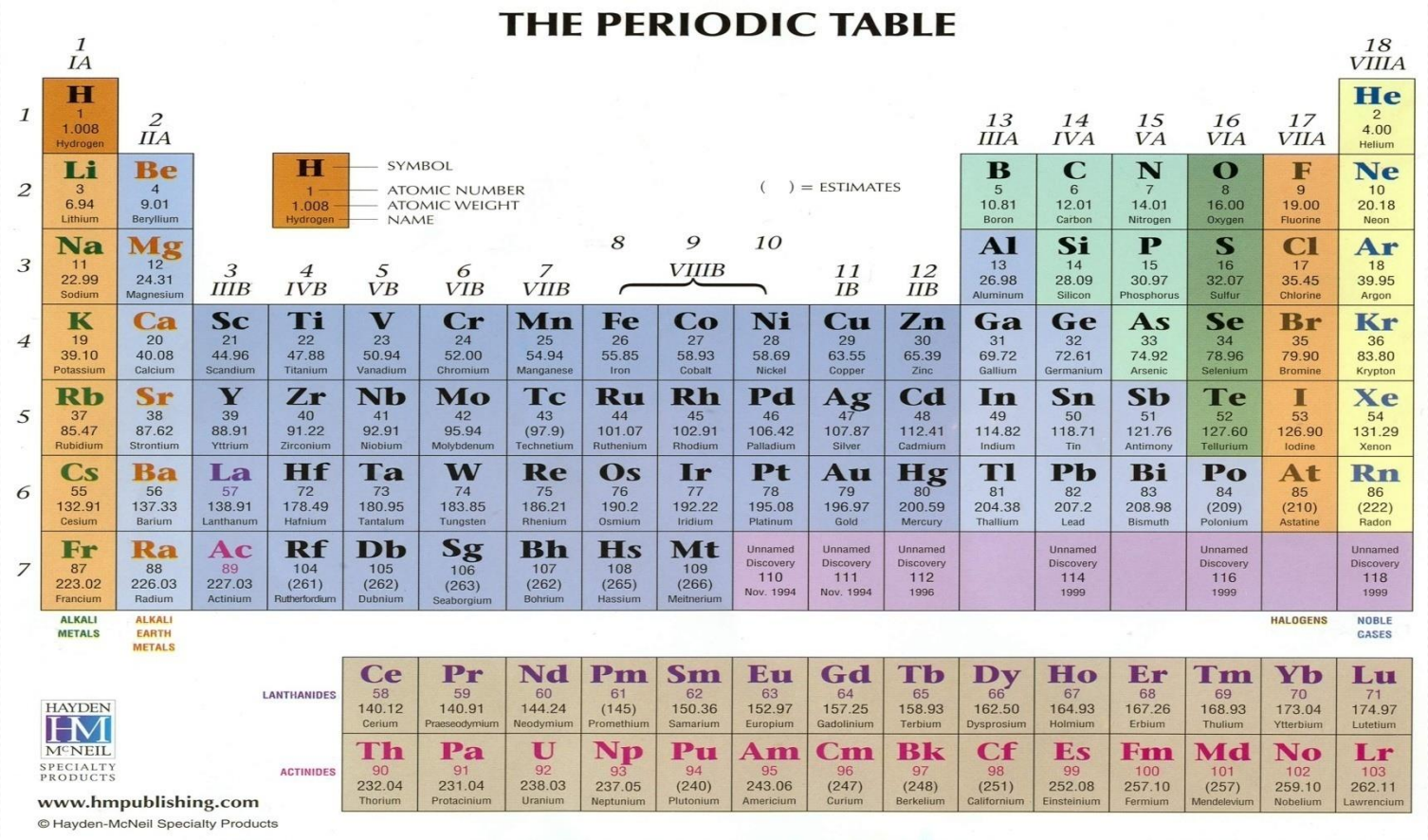
Family 18 = 0



Draw Concept Map…

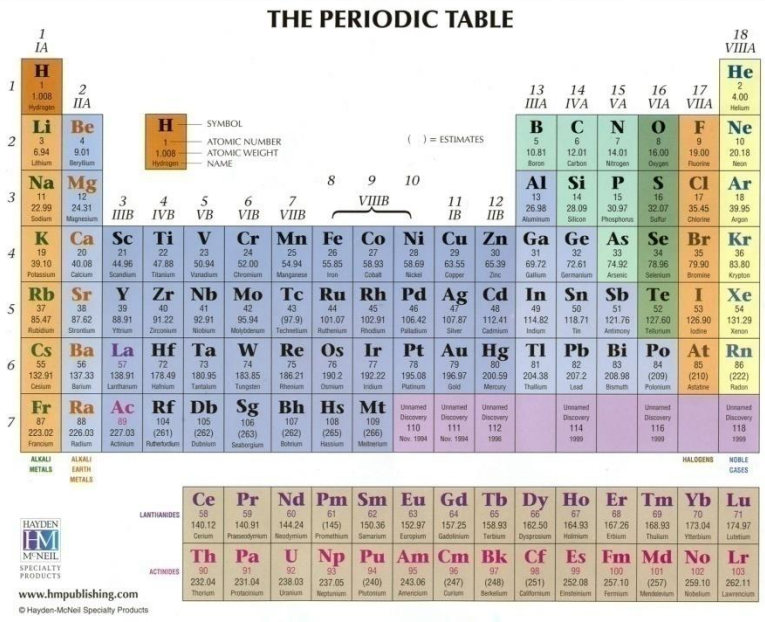


5.2 The periodic table organizes the atoms of the elements by properties & atomic

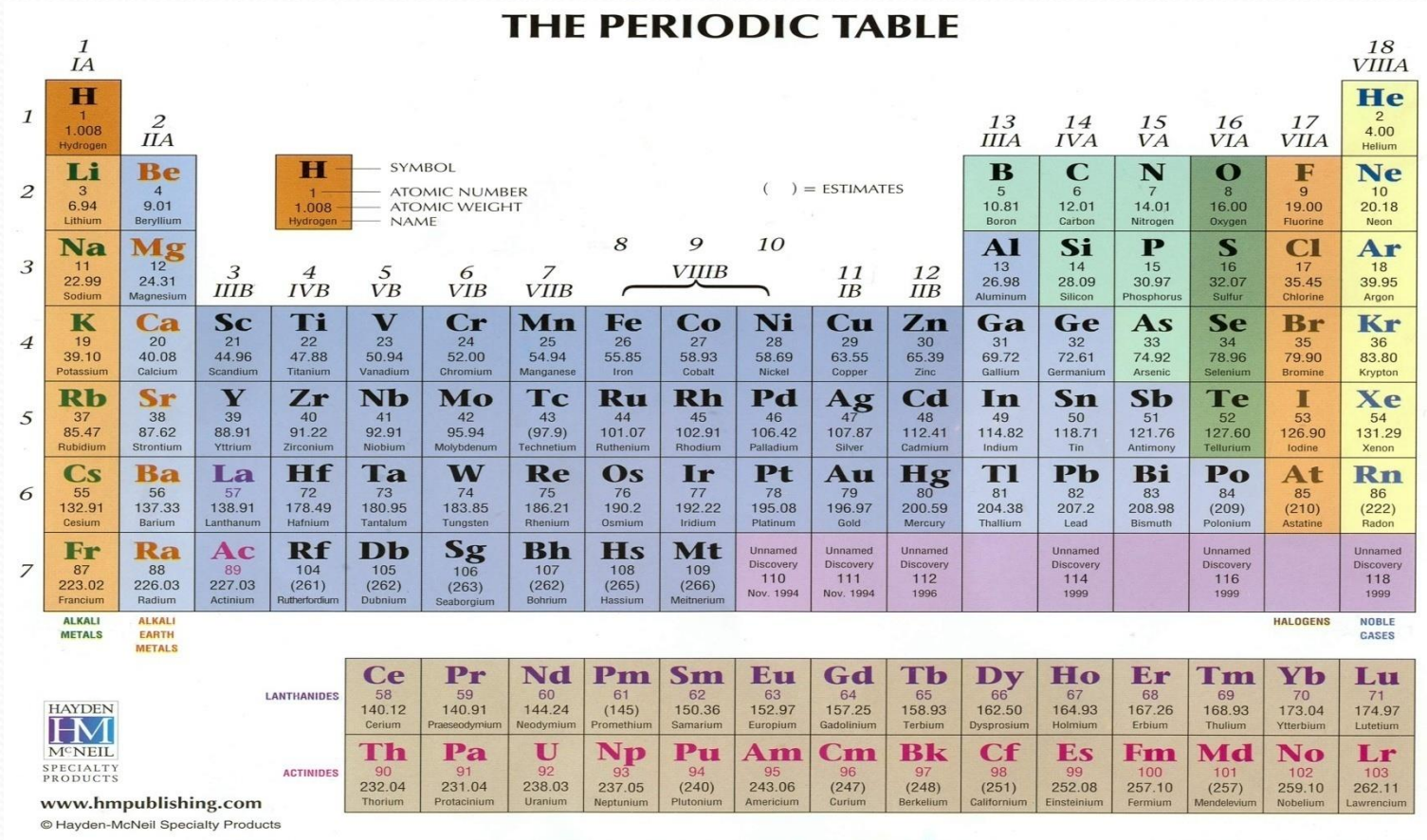


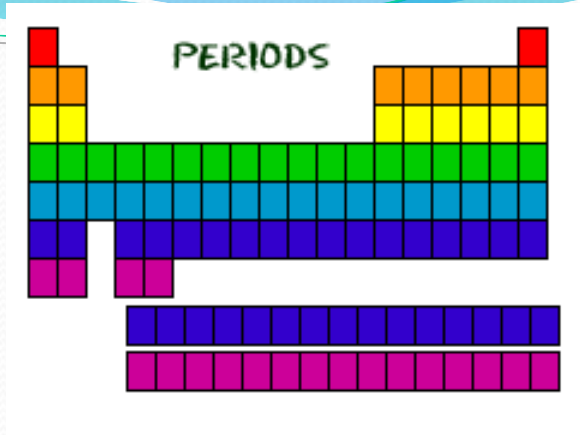
Elements make up the periodic table

- Elements can be organized by similarities
- Mendeleev made the 1st periodic table
  - He ordered the elements according to atomic masses



Group (or family)—Column of elements with similar properties

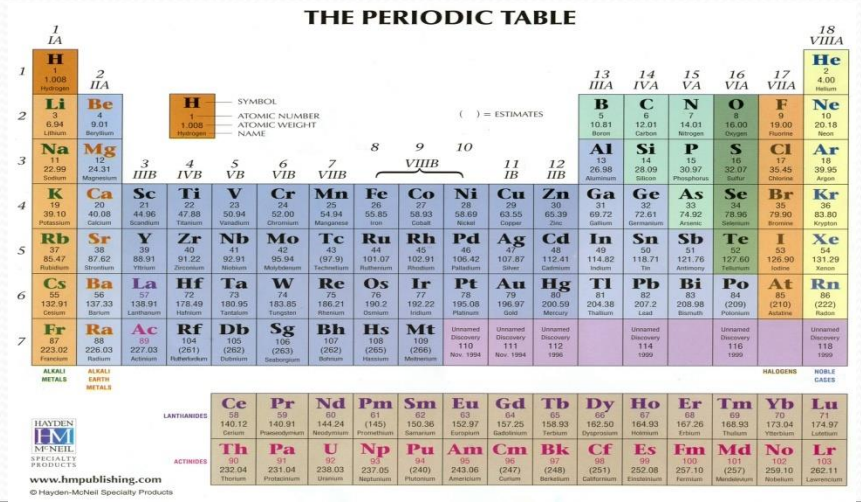




- Period—row of elements
  - The # of energy levels an element has
  - The period # tells you how many rings to draw around the atom's nucleus
  - Properties like atomic size, density, & likelihood to form ions vary in regular ways up, down, & across the chart

5.3 Periodic Table is a map of the elements

- Periodic table has distinct regions
  - Position on the table reveals something about the element (like how reactive it is)
  - Groups 1 & 17 are the most reactive
  - Group 18 is the least reactive (they are stable)



Most elements are metals

- Metals—usually shiny, conduct electricity & heat well, can be easily shaped (malleable) & drawn into a wire (ductility)

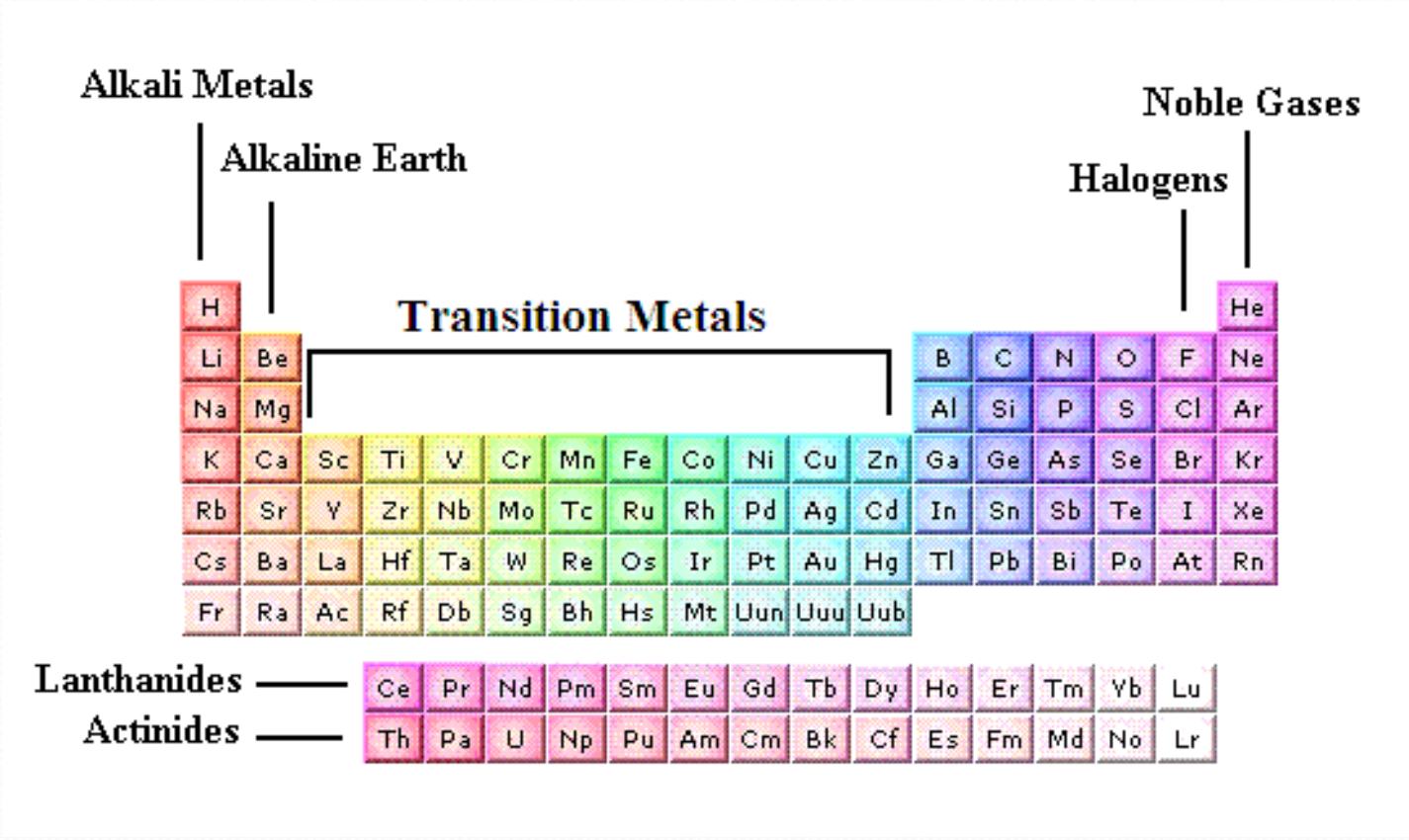
Metals

- 1. Reactive—families 1 & 2
  - Alkali metals (family 1)
  - Alkaline earth metals (family 2)

2. Transition—more stable than the reactive metals

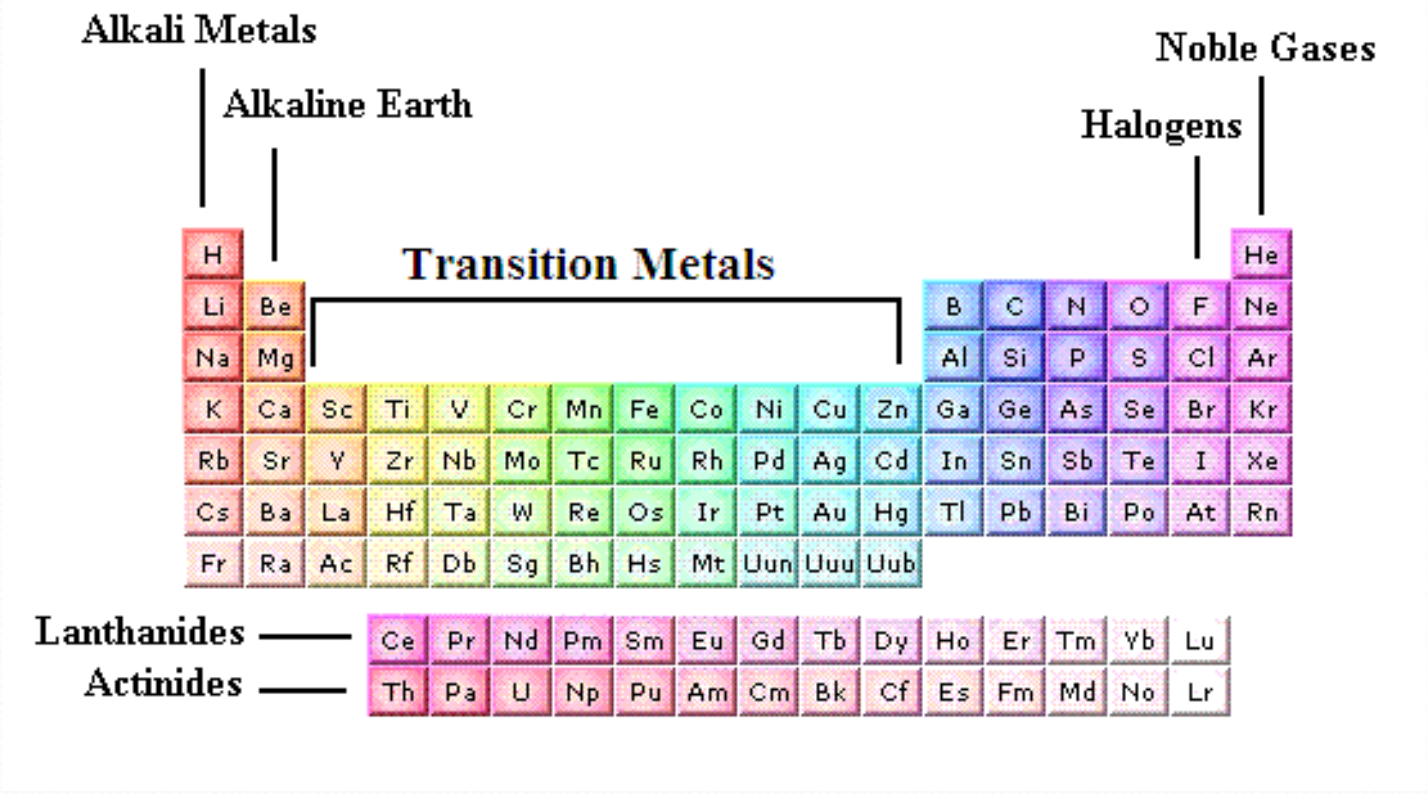
- 3. Rare earth –referred to as the “lathanides”
- 4. Radioactive-”actinides”

Alkali metals & alkaline earth metals—at the left of the table & are very reactive

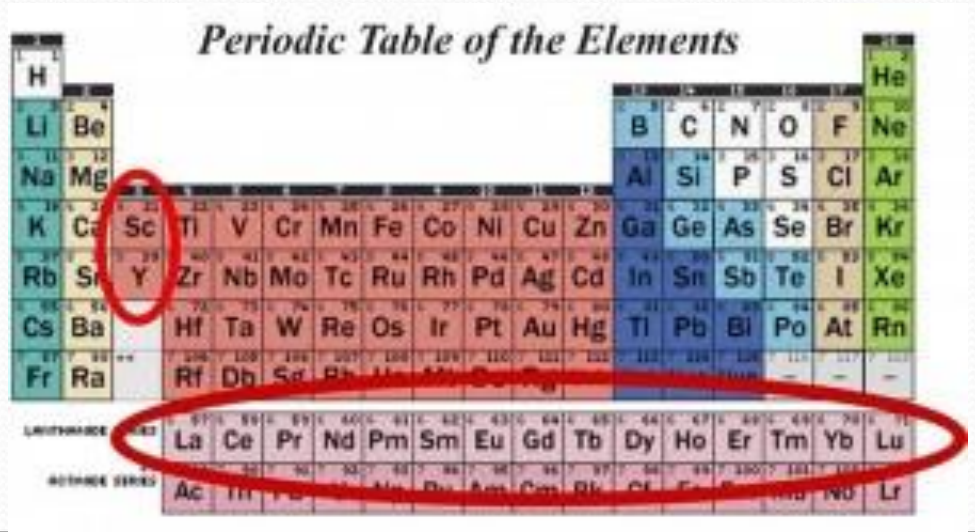


Transitions metals—near the center & include copper, gold, silver, iron

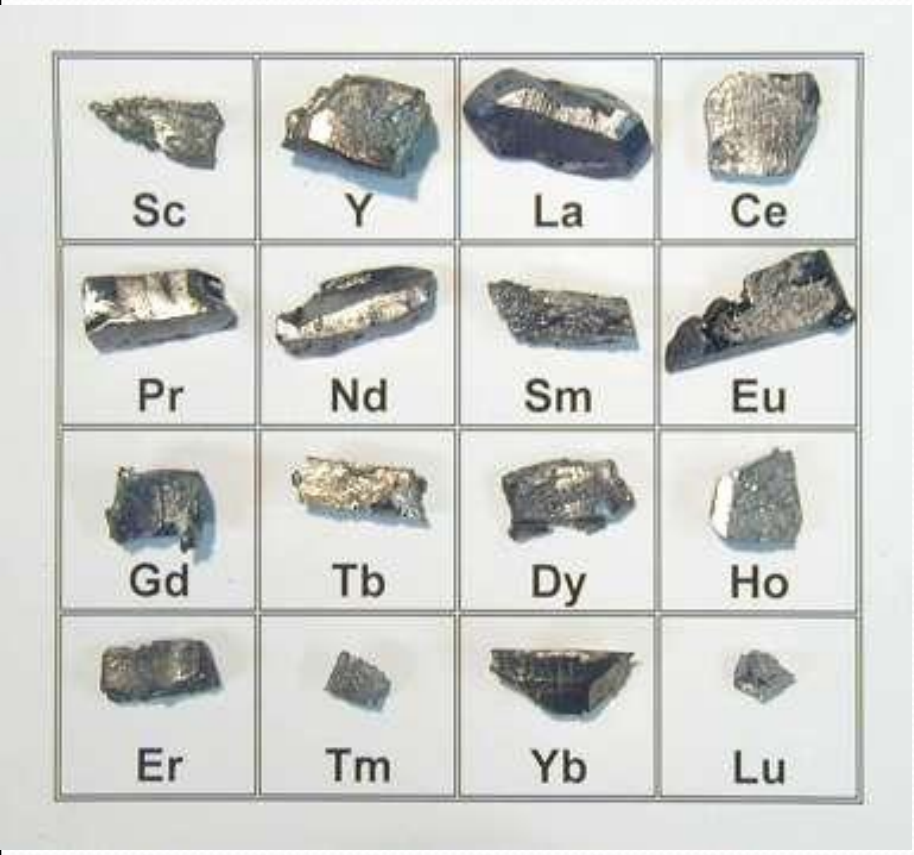
Alloy—mixture of metals



- Rare earth metals—next to bottom row (Lanthanides)
- Radioactive—bottom row (Actinides)
- Bottom 2 rows—separated from the table to save space



- **Common Properties of the Rare Earths**
- These common properties apply to both the lanthanides and actinides.
- The rare earths are silver, silvery-white, or gray metals.
- The metals have a high luster, but tarnish readily in air.
- The metals have high electrical conductivity.
- The rare earths share many common properties. This makes them difficult to separate or even distinguish from each other.
- There are *very* small differences in solubility and complex formation between the rare earths.



Periodic Table of Elements

	IA												IIIA	IVA	VA	VIA	VIIA	0
1	1 H	IIA																2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg	IIIB	IVB	VB	VIB	VIIB	— VII —		IB	IB		13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
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	106 106	107 107	108 108	109 109	110 110								

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

Legend - click to find out more...

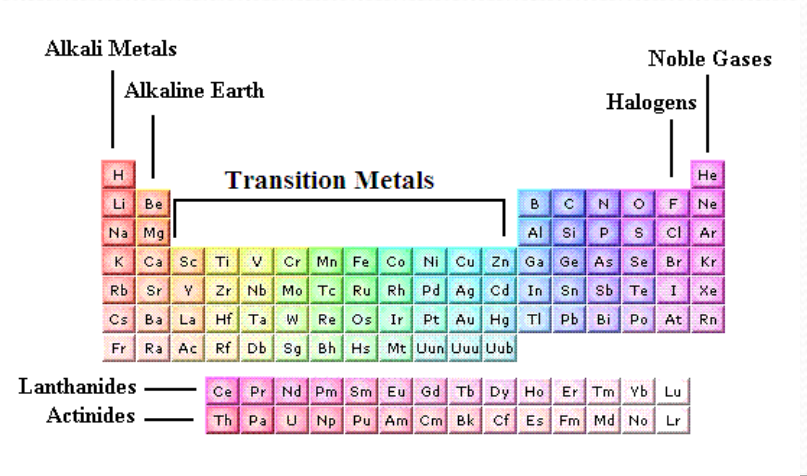
H - gas | Li - solid | Br - liquid | Tc - synthetic

Non-Metals | Transition Metals | Rare Earth Metals | Halogens

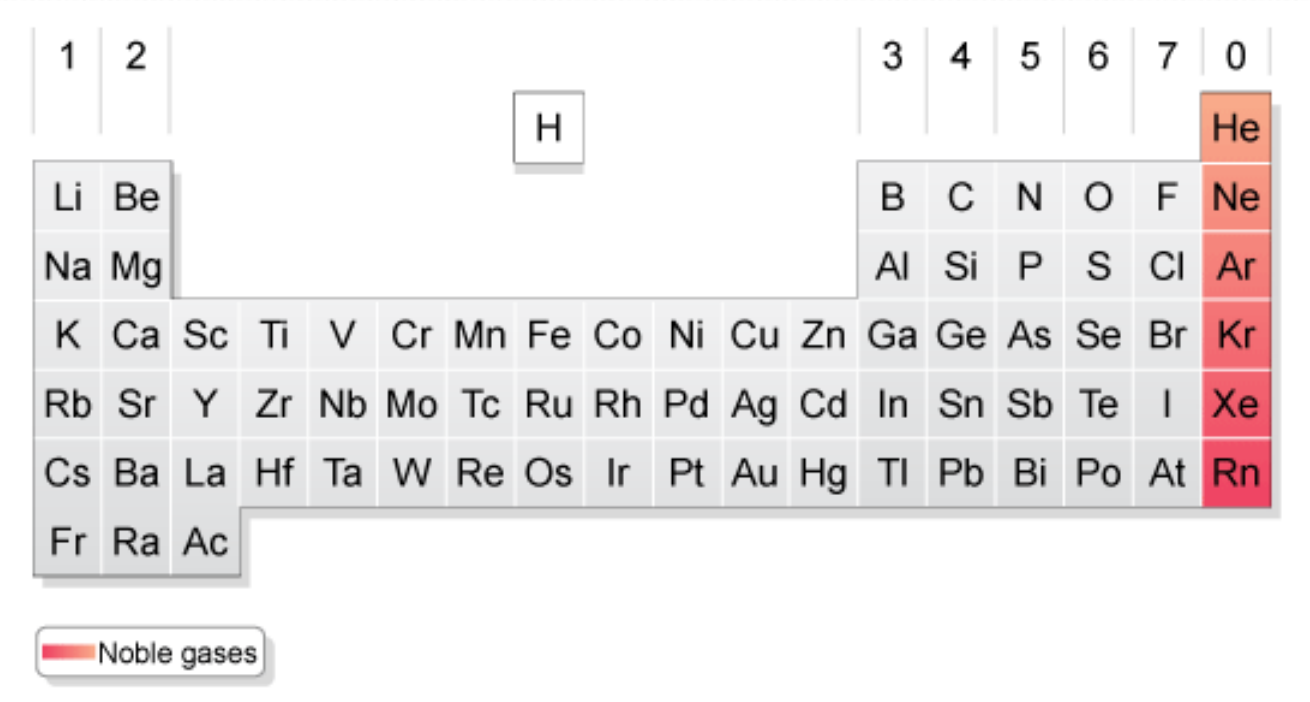
Alkali Metals | Alkali Earth Metals | Other Metals | Inert Elements

Nonmetals

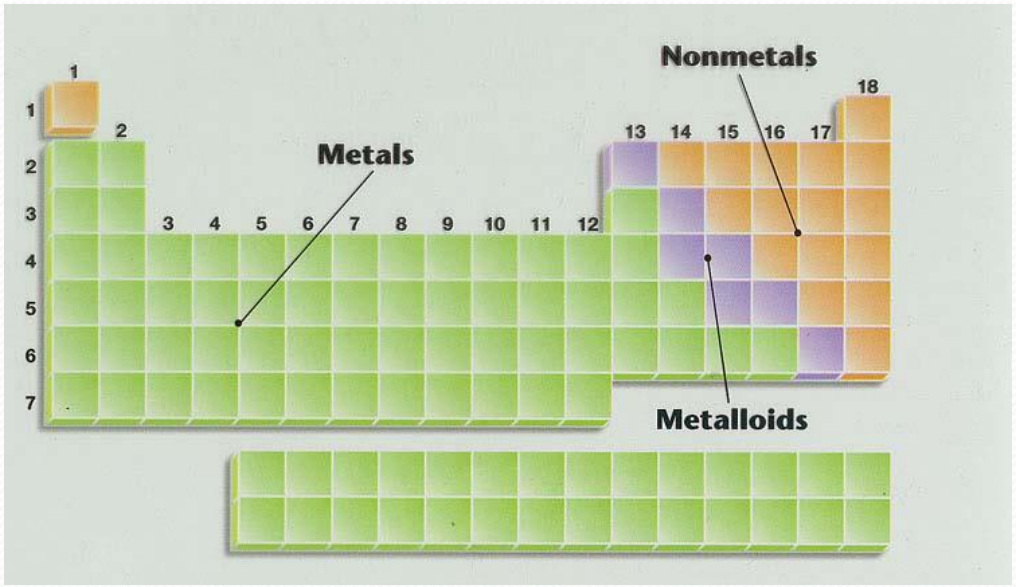
1. Halogens—group 17, very reactive nonmetals that can easily form salts (salt formers)
2. Noble gases—group 18, very stable, can be used to make light bulbs
3. Metalloids—properties of both metals & nonmetals, make good semiconductors found in electronics



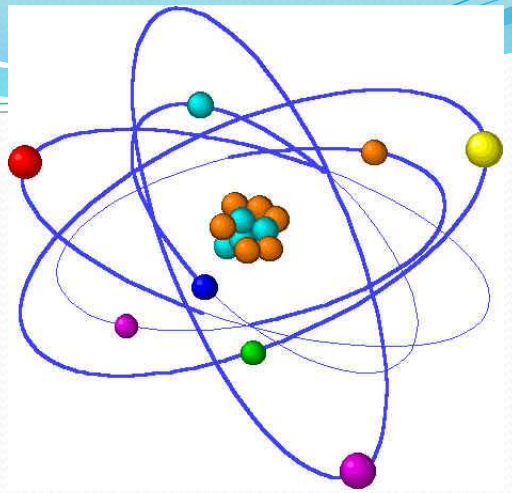
Noble Gases (inert = non reactive = stable)



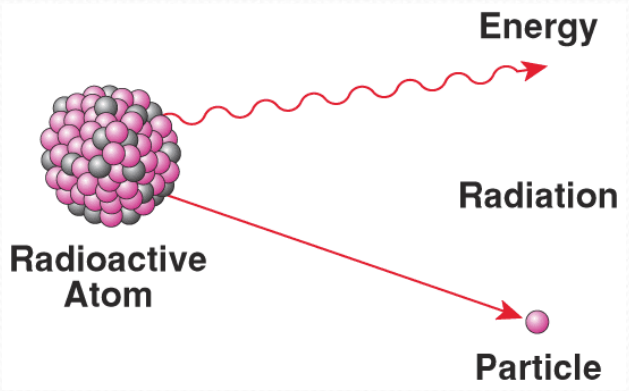
- Metalloids lie between metals & nonmetals—they have characteristics of BOTH metals & nonmetals
  - Make good semiconductors in electronic devices (computer chips)



Some atoms can change their identities

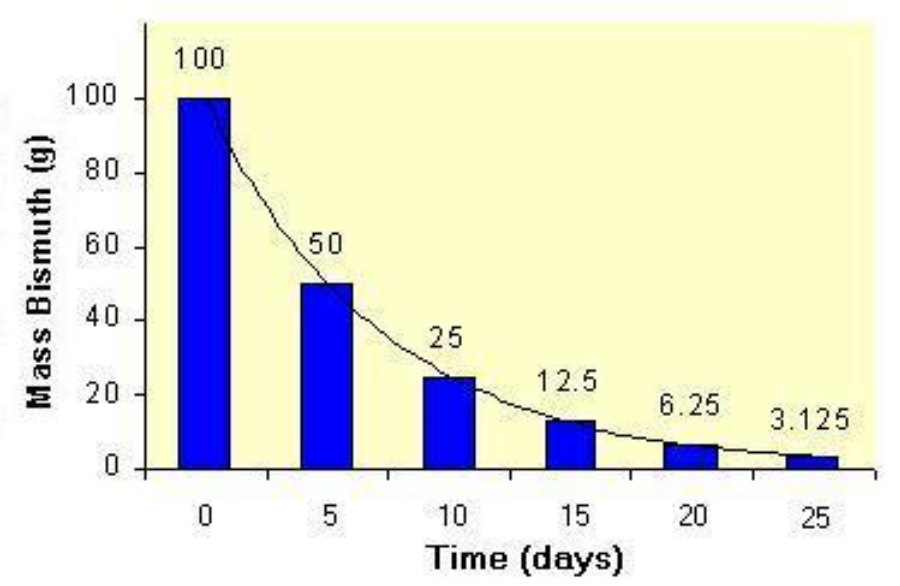


- Radioactive decay
  - Atomic nucleus is held together by forces
  - Sometimes there can be too many or too few neutrons so these forces cannot hold it together properly
  - To regain stability, the nucleus will produce particles & eject them



Radioactivity

- Identity of radioactive atoms changes when the # of protons change
- Half life—amount of time needed for ½ of the atoms in a particular sample to decay
  - Can be thousands or millions of years
  - NEVER decays to zero!!



If half life is 25 years…