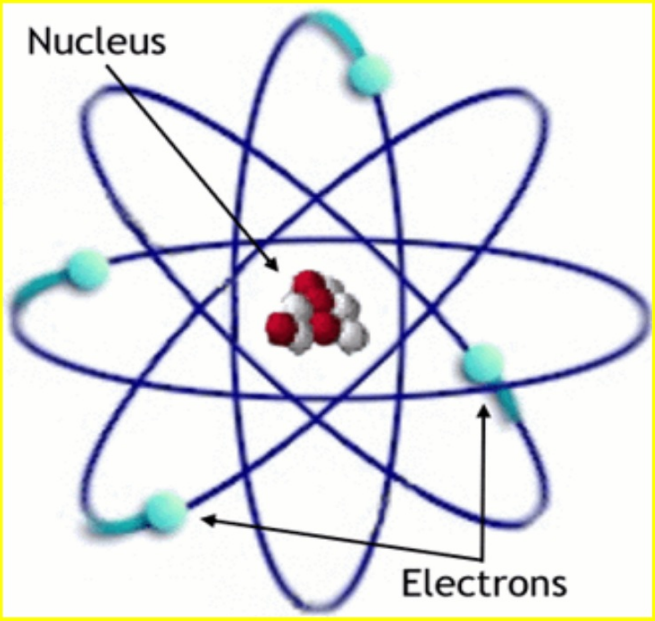
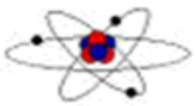
Topics 2 & 12: Atomic Structure



J VENABLES
IB CHEMISTRY
NORTHWESTERN HIGH SCHOOL

- John Dalton's Atomic Theory:
- Each element is composed of atoms
- All atoms of an element are identical.
- In chemical reactions, the atoms are not changed.
- Compounds are formed when atoms of more than one element combine.



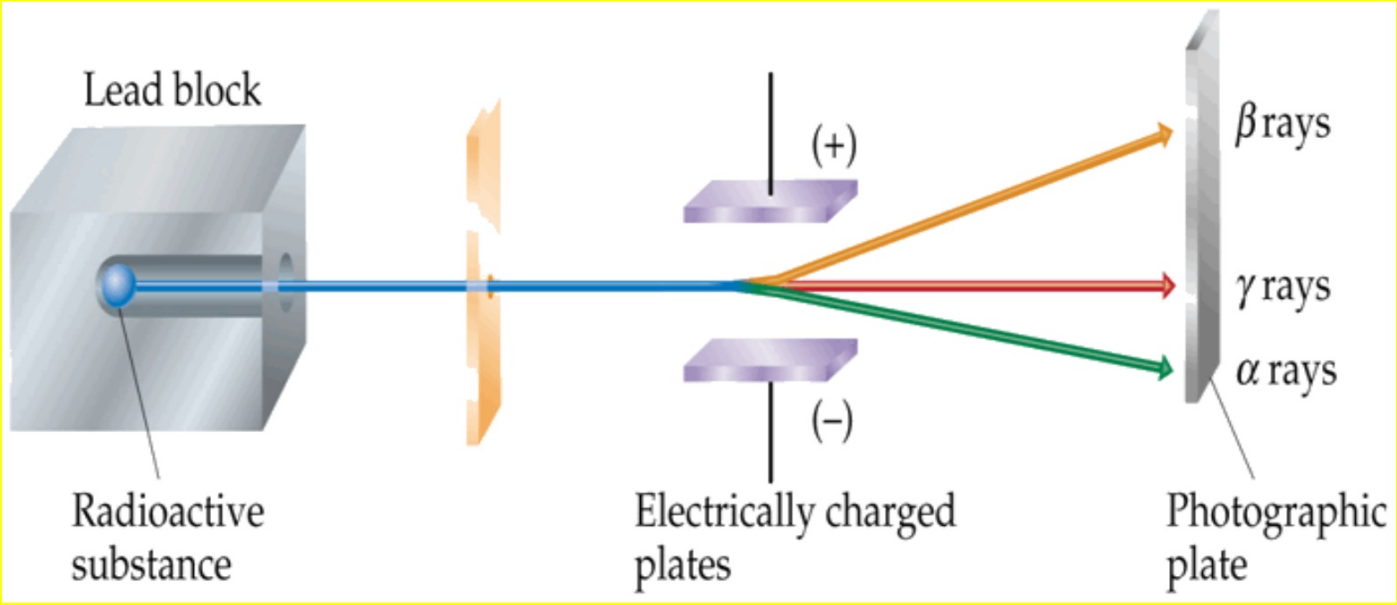
Types of Radiation

Type of Radiation	Symbols	Particle
Alpha		
Beta		
Gamma		

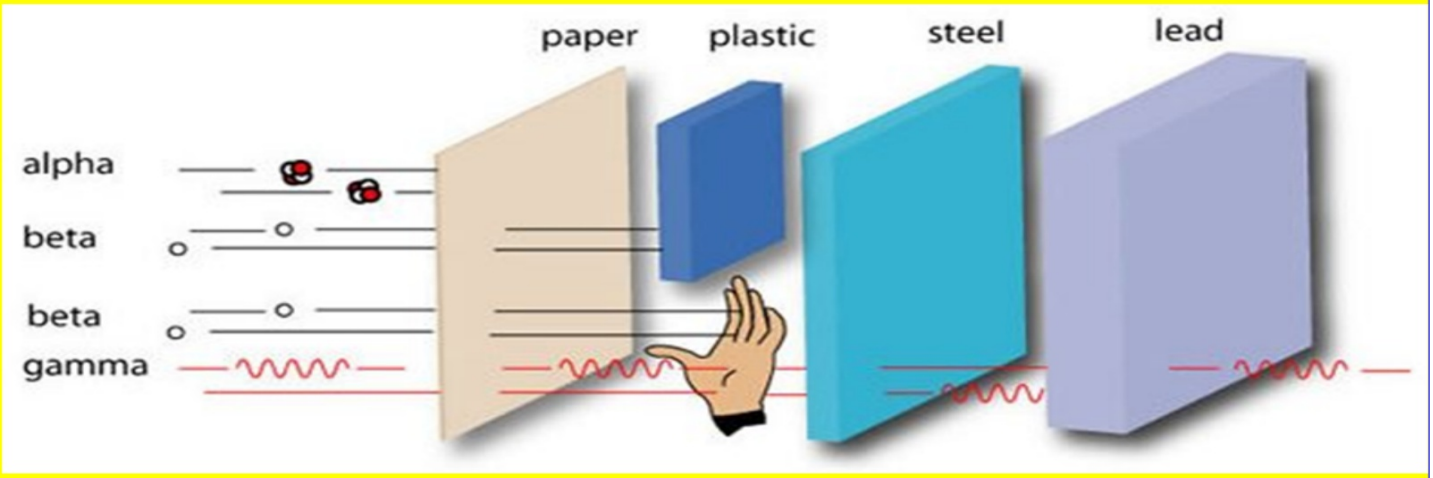
Types of Radiation

Type of Radiation	Symbols	Particle
Alpha	α $^{4}_{2}He^{2+}$	Helium nucleus
Beta	β $^{0}_{-1}e^{-}$	electron
Gamma	γ $^{0}_{0}\gamma$	High energy electromagnetic radiation

Radioactivity

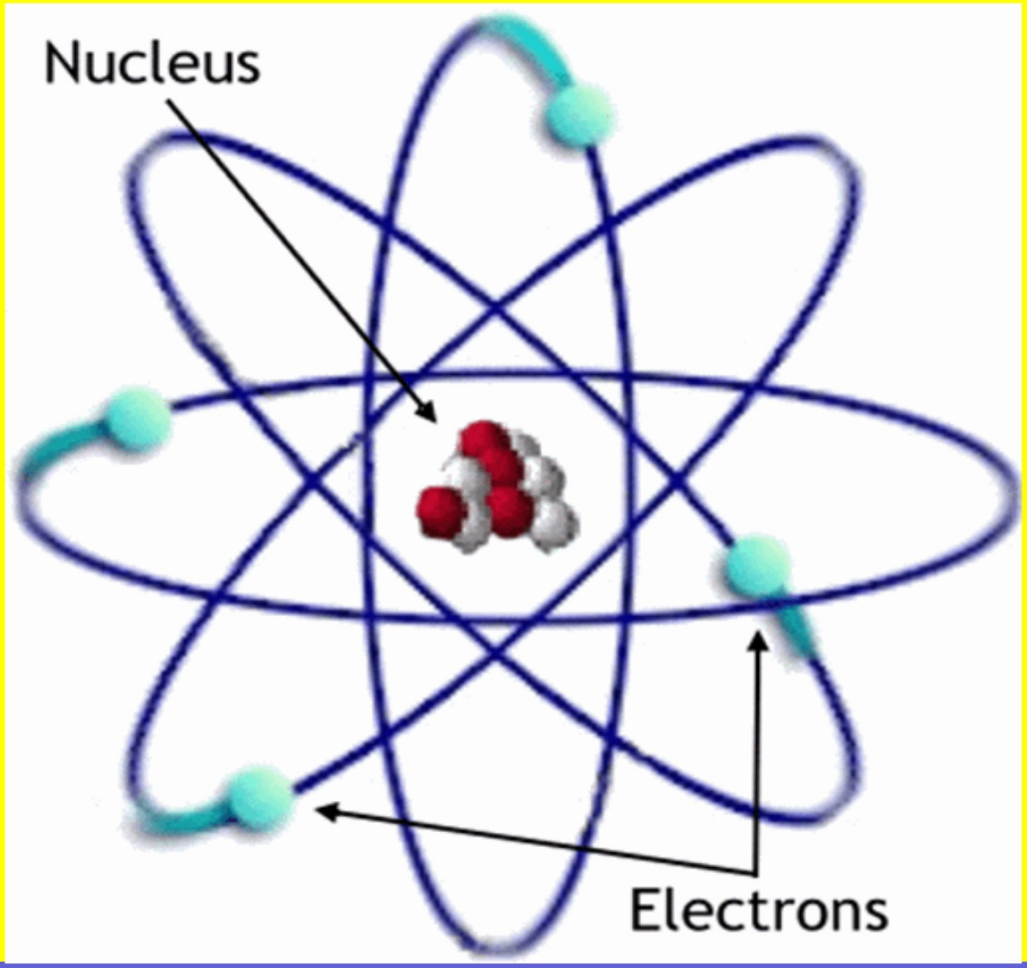


Radioactivity



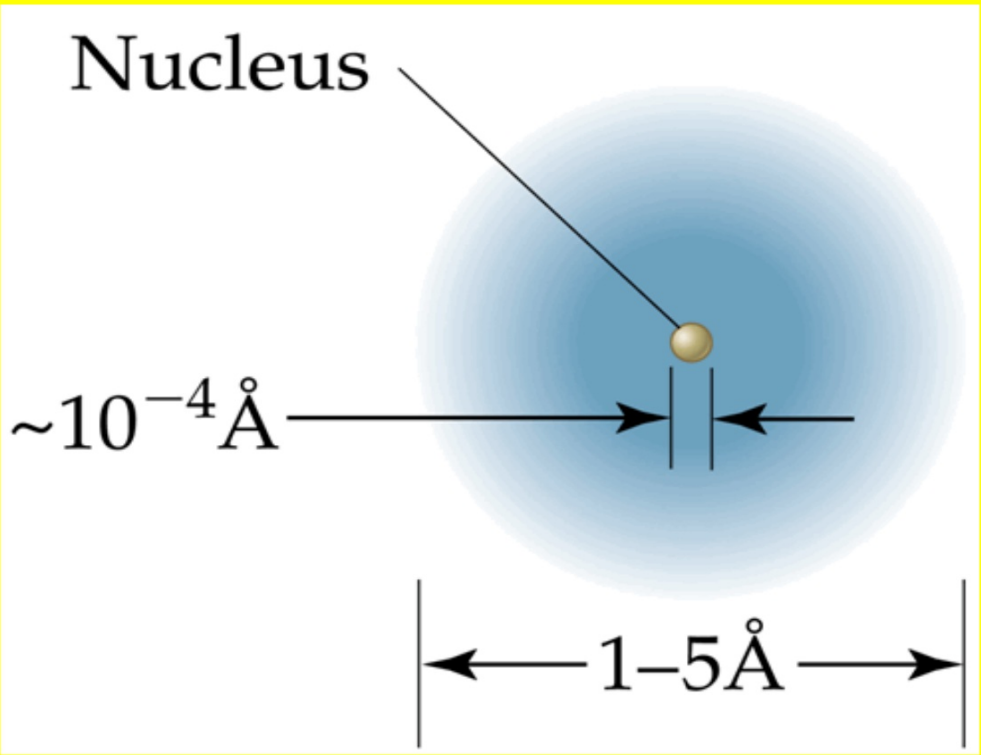
The Nuclear Atom (2.1.1)

- The atom consists of positive, negative, and neutral entities (protons, electrons, and neutrons).
- Protons and neutrons are located in the nucleus of the atom, which is small. Most of the mass of the atom is due to the nucleus.
  - There can be a variable number of neutrons for the same number of protons. Isotopes have the same number of protons but different numbers of neutrons.
- Electrons are located outside of the nucleus. Most of the volume of the atom is due to electrons.


Nucleus
Electrons

2.1.2 – Masses and Volumes of subatomic particles

	Relative Mass	Relative Charge
Proton		
Neutron		
Electron		


Nucleus
~10⁻⁴ Å
1–5Å

Isotopes, Atomic Numbers, and Mass Numbers (2.1.3)

- Atomic number (Z)
  = number of protons in the nucleus.
- Mass number (A)
  = total number of nucleons in the nucleus (i.e., protons and neutrons).
- By convention, for element X, we write ${}^{A}_{Z}X$
- Isotopes have the same Z but different A.
- We can find Z on the periodic table.

Examples (2.1.4)

Complete the following table:

Symbol	Protons	Neutrons	Electrons
$_{1}{}^{3}H$			
	12	13	12
^{35}Cl			
	92	146	92

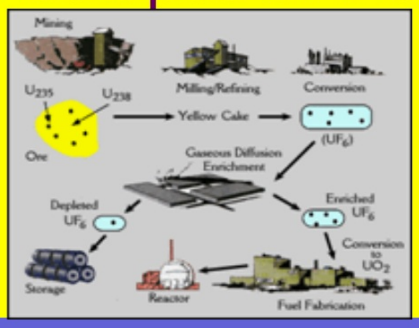
Ion Formation (2.1.5)

- Ions are formed when atoms gain or lose electrons.
  - Positive (+) ions are produced by the loss of electrons.
  - Negative (-) ions are produced by the gain of electrons
-

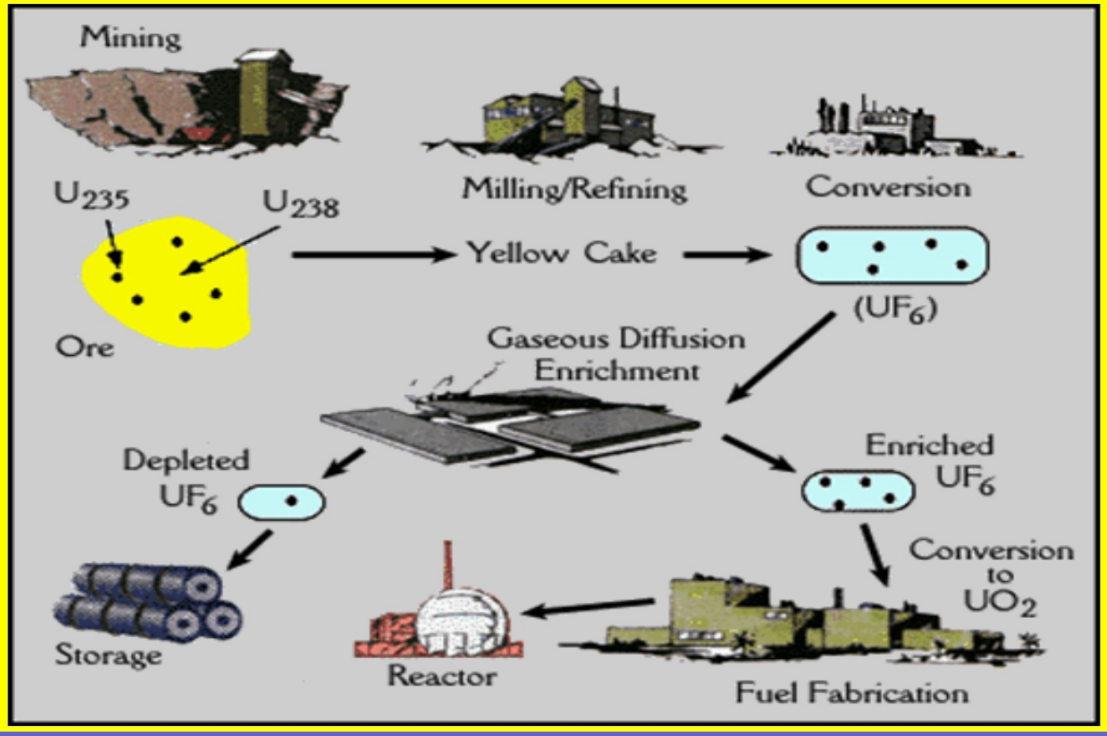
Symbol	Protons	Neutrons	Electrons
$^{7}Li^{+}$			
	12	12	10
$^{19}F^{-}$			
	82	126	78

Properties of Isotopes (2.1.6)

- Chemical Properties
  - All isotopes of an element have the same chemical properties. Why?
- Physical Properties (density, rate of diffusion, melting point, boiling point).
  - Vary slightly for different isotopes of the same element. Why?

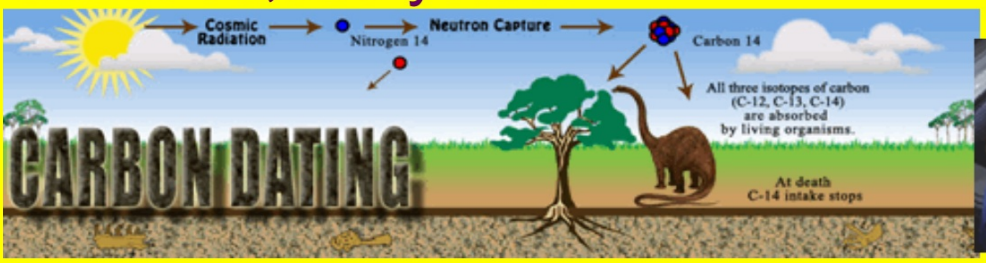


Example – Uranium Enrichment

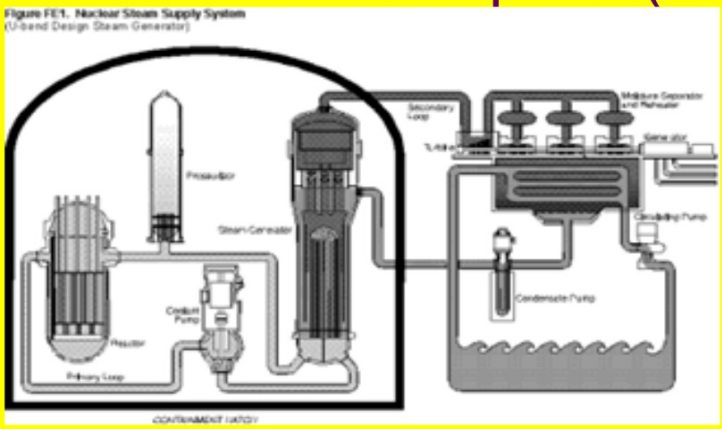


Uses of Isotopes (2.1.7)

- Many isotopes are radioactive – the nucleus breaks down (gives off alpha, beta, and/or gamma radiation).
  - Radiocarbon Dating (^{14}C) – accurate up to about 60,000 years.
  -
  -
  -
  -
  - Radiation Therapy (^{60}Co) – emits gamma radiation to treat cancer.



– Nuclear Power/Weapons (^{235}U and ^{239}Pu)



– Medical Tracers (^{131}I and ^{125}I) – diagnose and treat Thyroid disorders.