Chapter 2
Chemical Foundations; Elements, Atoms, and Ions

4.6,7 Introduction to the Modern Nuclear Atom, 12S 3,2

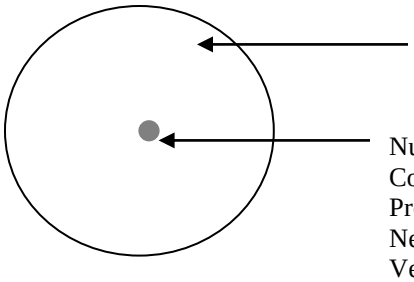
Power Point, Atomic Theory and Modern Nuclear Atom

Atomic Structure:

Invisible with any light microscope and not an indivisible sphere. Contains sub-atomic particles.
J.J. Thompson (the negatively charged electron) neutral atom (positively charged protons) in "plum Pudding – Model".
Rutherford's Gold Foil Experiment showing that the atom has a dense, positive nuclear core but mostly empty space with the electrons occupying the empty space region.

Modern Nuclear Atom:

If nucleus was size of grape, closest electron would be 1 mile from nucleus.
Mostly (99.999999%) empty space
Diagram:



Electron Cloud (10^{-8} cm), e- negative charge

Nucleus with nucleons: 10^{-13} cm diameter
Contains the mass
Proton (+ charge)
Neutron (0 charge)
Very large density ~10^{9} tons/cm^3!

Summary Table

Particle	Location	charge	mass
Electron	Outer cloud	Negative	1/1836 of proton ~ 0
Proton	Nucleus	Positive	1 (amu)
neutron	nucleus	Neutral	1 (amu)

Isotopes (atomic number and mass number) and atomic notation:

Electrons (e-):

Accounts for bulk of volume of atom.
Number and arrangement determines chemical properties.
Neutral free atoms have the same number of electrons as protons.
Q: all sodium atoms have 11 protons, how many electrons will each Na atom have?

Protons (Z), atomic number:

All atoms of same element have the same number of protons.
Found in nucleus and contributes to mass of atom
Determine the number of protons in an atom of Cr?
What is atomic number of Ca?
Z=15, name element and atomic number.

Mass Number (A):

Sum of protons and neutrons (nucleons) in an atom.

Notation:

$${}^{A}_{Z}X$$

Sample problems in table form. **Power Point Concept Check**

Isotopes: Nuclides of same element (same Z, atomic number, number of protons), but a different number of neutrons. Results in a different mass number. Isotopes of an element have the same chemical properties. **Homework: P.77 #1-18, 22-32, 34, 36, 38, 42**

Introduction to the Periodic Table.
Ions and substances that contain ions

Periodic Table:

Dimitri Mendelev: Russian Scientist who arranged elements according to similarities.
Family Groups (vertical columns); similar chemical properties
- Group 1: Alkali metals *(YouTube: Activity of alkali metals)*
- Group 2: Alkaline Earth metals
- Group 7: Halogens
- Group 8: Noble gases (noble, refers to inert)
- Transition metals

Staircase Line: separates metals from non-metals. (more metals)
Metalloids / Semi-metals: B, Si, Ge, As, Sb, Te

Elements:

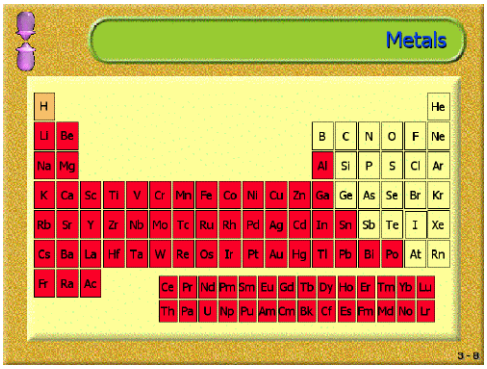
Noble metals; Au, Ag, Pt
Diatomics: H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2 (indicate state of matter)
States of matter: At RT (25°C) only 2 liquids: bromine and mercury (Cs and Ba melt ~30°C)
Allotropes: different structural form of the same element. Ex., S, C

Ions:

Loss or gain of 1 or more electrons (never protons, why?) from an atom. A charged particle.
Cation; positive ion formed by the loss of electron(s)
- Ex. Na → Na+ + e-

Anion; negative ion formed by the gain of electron(s)
- Ex. Cl + e- → Cl-
- Nomenclature; chlorine → chlor*ide*, etc.

Periodic Table Trends of charges Group 1 (+1), 2(+2), 3(+3), 6(-2), 7(-1)
- Metals lose electrons + cations Non-metals gain e- to form – anions



Ionic compounds:

Substances composed of ions; "salts" (ion =wander)
Demonstrate with conductivity apparatus (d· H_2O and salts or molecules). Electrons are free to move as $(_l)$ or $(_{aq})$
High melting point. Overall charge is neutral, zero.
Q: Write formulas for the following substances:
- Aluminum, Oxygen
- Compound that contains (Na^+ and Br^-), name it.
- Compound that contains (Mg^{2+} and Cl^-), name it.
- Compound that contains (Al^{3+} and S^{2-}), name it.

Homework: P. 81 #86-90, 94-108, 125, 130, 131-133