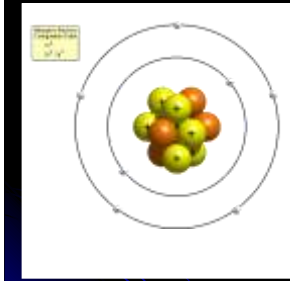
Essential Principles of Chemistry for Mineralogists

Lecture 3

Generalized Atomic Structure

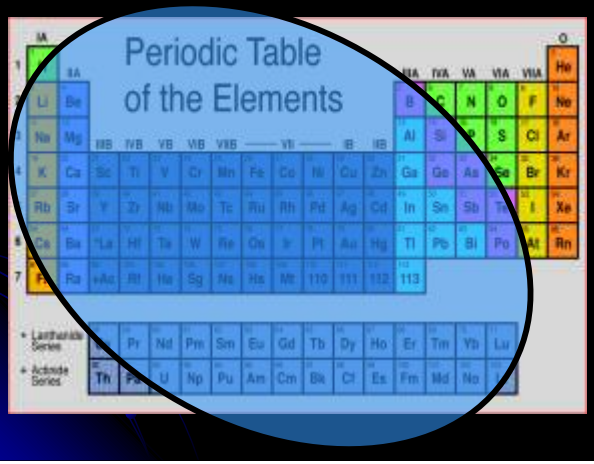


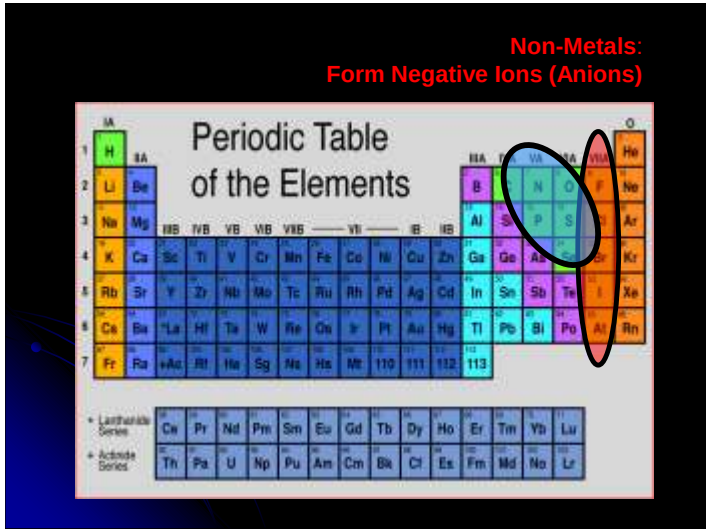
- Nucleus houses massive particles (protons and neutrons)
  - # Protons = Atomic Number
  - # Protons + Neutrons = Atomic Mass
  - Responsible for mass and density
- Electrons in orbitals surrounding nucleus
  - # Electrons = # Protons
  - Responsible for bonding

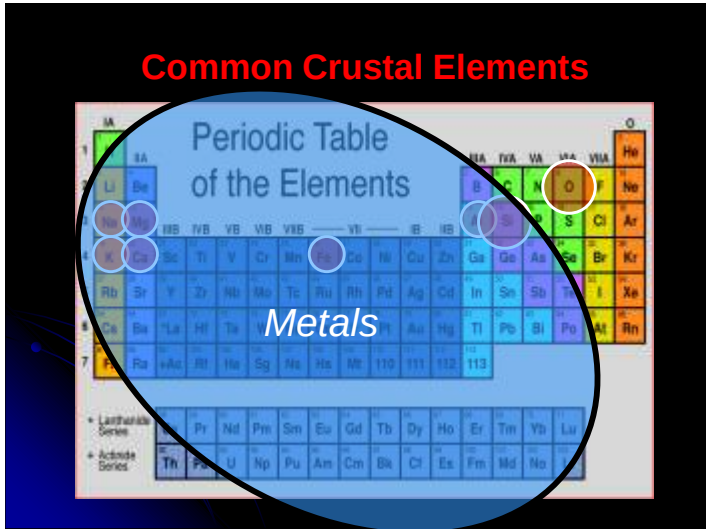
Ions

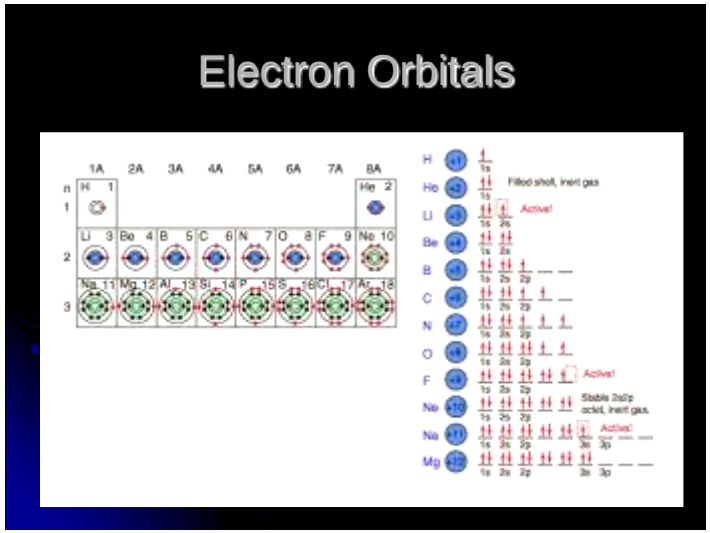
- Ions: Electrically charged particles due to gain or loss of electrons
  - Cations: positively charged
  - Anions: negatively charged
- Metals: readily form cations
- Non-Metals: readily form anions

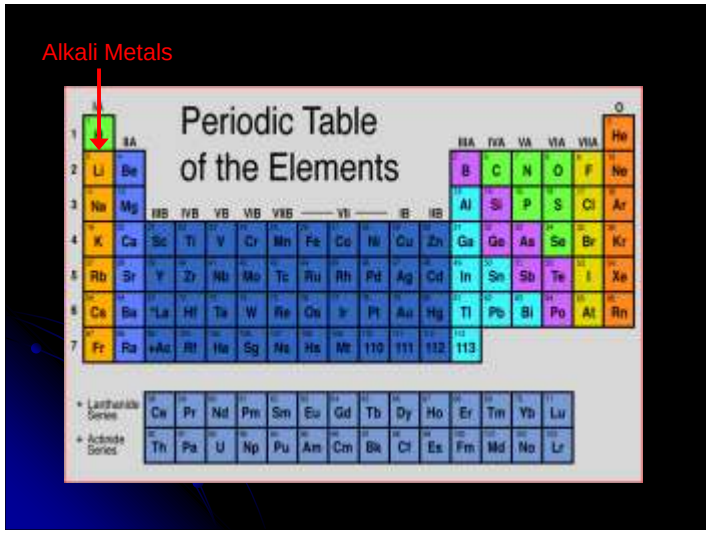
Metals: Form Positive Ions (Cations)

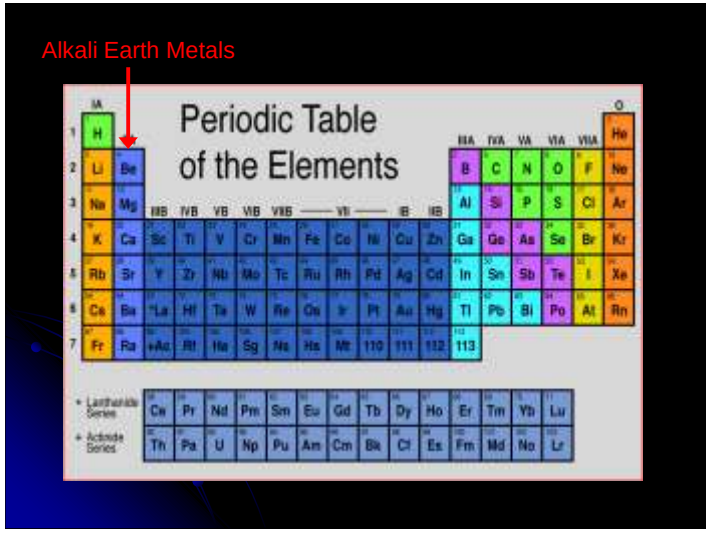


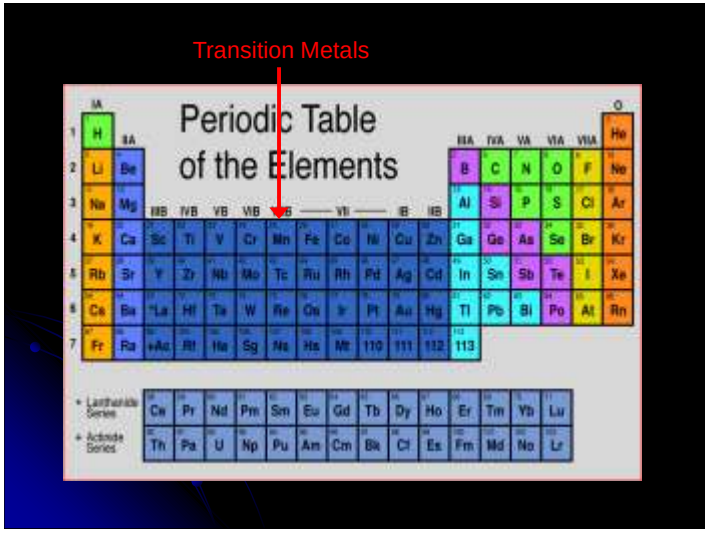

Non-Metals:
Form Negative Ions (Anions)
Periodic Table
of the Elements

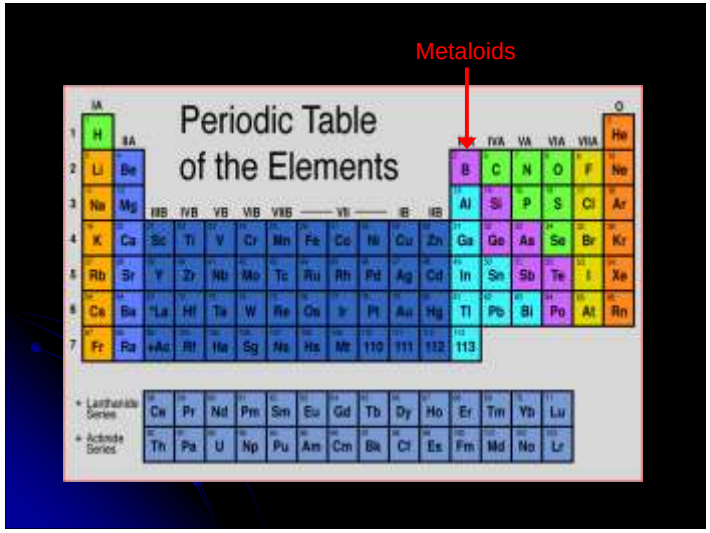

Common Crustal Elements
Periodic Table
of the Elements
Metals

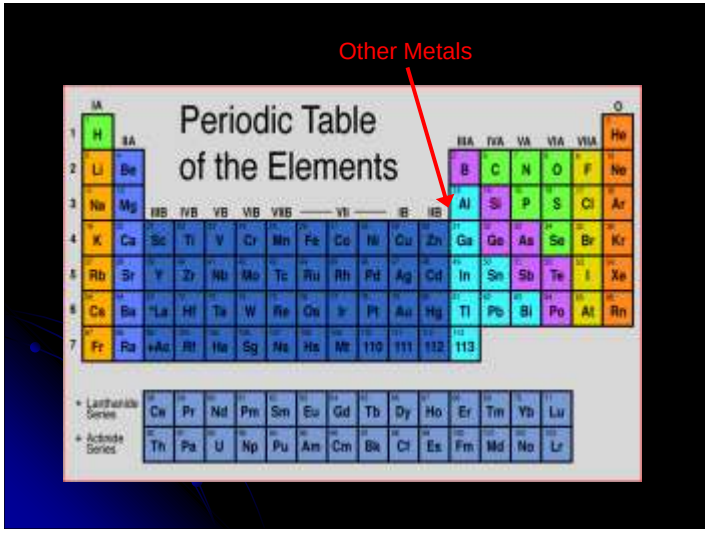

Electron Orbitals

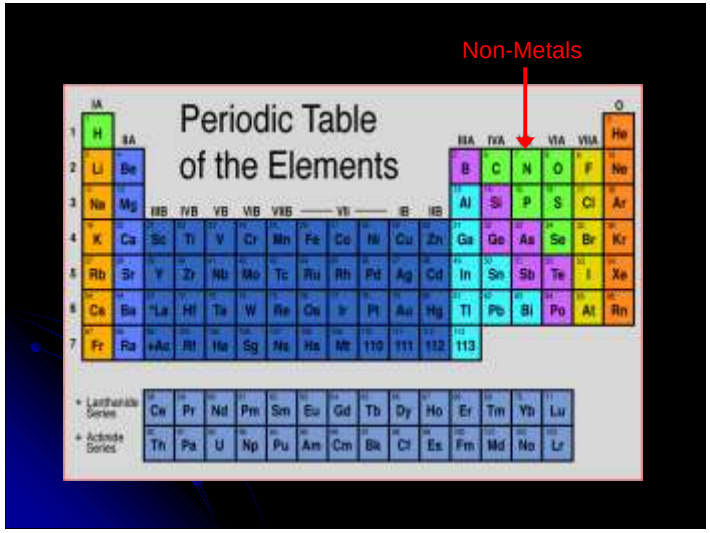

Alkali Metals
Periodic Table
of the Elements

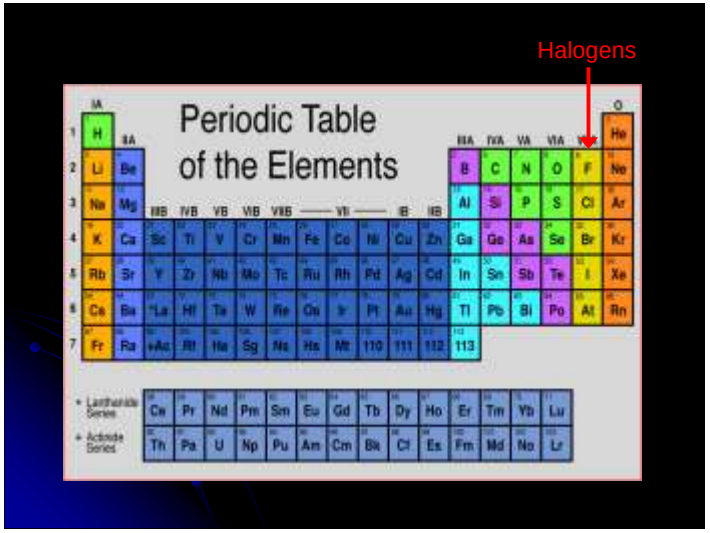

Alkali Earth Metals
Periodic Table
of the Elements

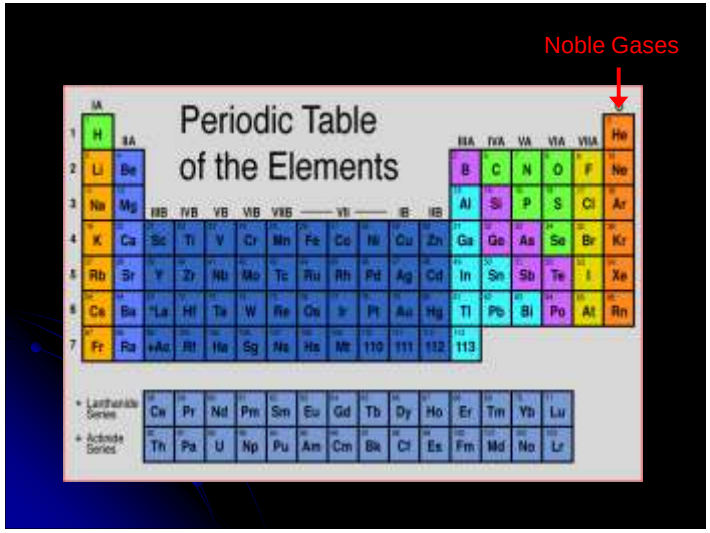

Transition Metals
Periodic Table
of the Elements

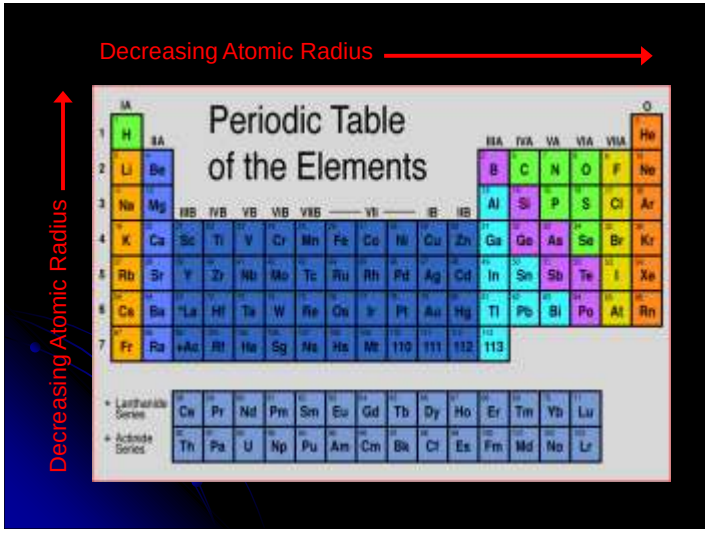

Metaloids
Periodic Table
of the Elements


Other Metals
Periodic Table
of the Elements

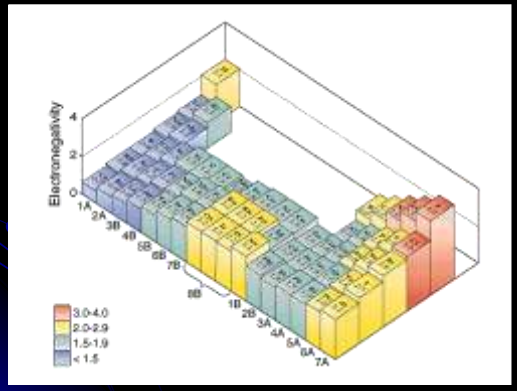

Non-Metals
Periodic Table
of the Elements


Halogens
Periodic Table
of the Elements

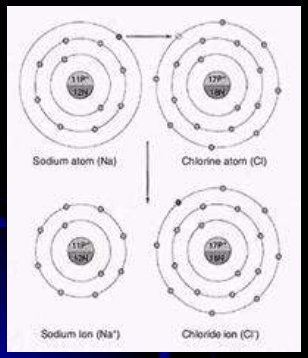

Noble Gases
Periodic Table
of the Elements


Decreasing Atomic Radius
Decreasing Atomic Radius
Periodic Table
of the Elements

Electronegativity: measure of an atom's ability to attract electrons in a chemical bond



Ionic Bonds

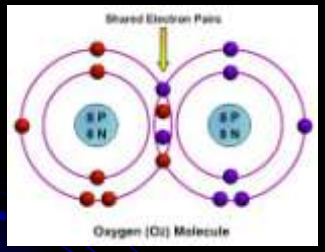


- Electron transfer to atom with higher electronegativity
  - Metal to non-metal
- Results in charged ions
- Oppositely charged ions attract
  - Form weak bond

Ionic Bonds

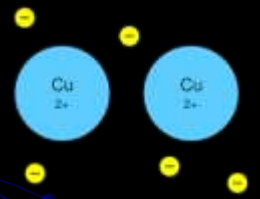
- Ions not "attached"
  - Bonds are relatively weak
  - Soft minerals
- Ions attracted by other charged particles
  - Soluble in water

Covalent Bonds



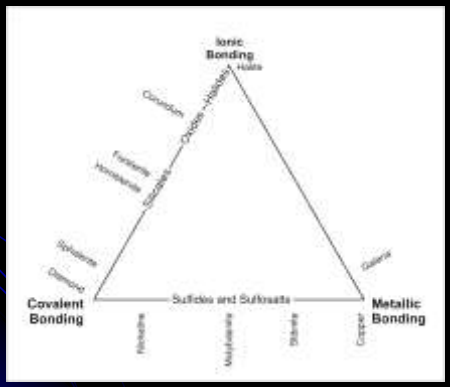
- Approximately equal electronegativity…
  - share one or more electrons
- Merging of electron clouds
  - Forms strong bond
  - Hard minerals

Metallic Bonds

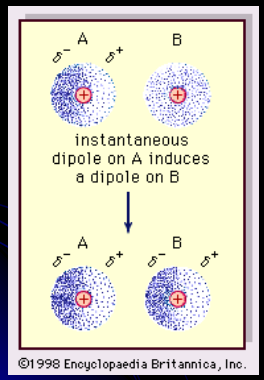


- Little/no difference in electronegativity in metals
  - Delocalized sharing of free electrons
- One continuous electron cloud
  - Soft, malleable
  - Conductive

Natural Bonds Usually Share Characteristics



Van der Waal's "Bonds"



- Imbalance in the distribution of electrons (dipole)
- Fleeting and fluctuating weak attractions
  - Soft minerals
  - Low melting point
  - Allows for the basal cleavage in micas