Periodicity
and the Periodic Table

Mendeleev, Father of the Periodic Table

Mendeleev ordered the elements according to chemical properties and atomic mass.

Henry Moseley and Atomic Number

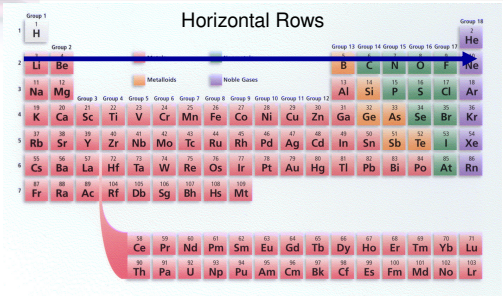
Henry Moseley's work included examining the spectra of elements using Xrays to determine the atomic number. It was his work that determined that chemical properties were dependant on atomic number and not atomic mass.
This work explained away some of the anomalies in Mendeleev's periodic table.

The Periodic Table

Periodic Table – An arrangement of the elements in order of their atomic numbers so that elements with similar properties fall in the same group.

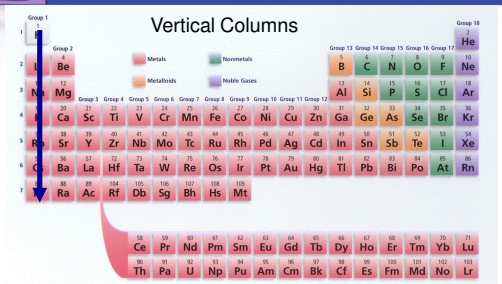
Periodic Law – The physical and chemical properties of the elements are periodic functions of their atomic numbers.

Periods or Series



Each period indicates the addition of a higher energy level in the atomic structure.

Groups or Families



Elements within groups have similar chemical properties because they have the same number of valence electrons.

The Modern Periodic Table

The main classes of elements on the periodic table are defined as: Metals, Nonmetals, and Metalloids.

- Metals – Left of the Stair step.

The properties of metals include: they have luster, conduct heat and electricity, bend without breaking, they are malleable and ductile. Most are solids at room temperature (except Hg) and have extremely high melting points. They have loosely held valence electrons.

The Modern Periodic Table

- Nonmetals – Right of the Stair step

The properties of nonmetals include: Low luster, poor conductors of heat, do not conduct electricity, are brittle when solid. Most are gases at room temperature. Those that are solid at room temperature have low melting points

- Metalloids – on the stair step. Properties of both metals and nonmetals. Many are used semiconductors. B, Si, Ge, As, Sb,Te, Po, At

Knowing whether an element is a metal, nonmetal, or metalloid, you can make predictions about its behavior.

The Modern Periodic Table

- Alkali Metals – Group 1
- Alkaline Earth Metals – Group 2
- Transition Elements – Groups 3-12 to the stair step. Transition metals are less predictable than the main group metals because of their more complicated atomic structure.
- Inner Transition elements – Bottom two rows. Lanthanides (Rare Earth elements) natural abundance is less than 0.01% and Actinides (Radioactive elements) do not occur naturally after U.

The Modern Periodic Table

- Halogens – Group 17

The halogens exist in all three states at room temperature. They have 7 valence electrons. They are often referred to as “salt formers”. They are highly reactive. Compounds formed with halogens are referred to as halides.

- Noble Gases – Group 18

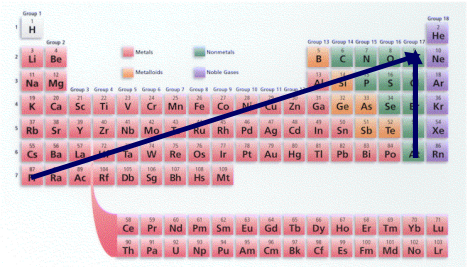
These gases have a full complement of valence electrons (8) which make them unreactive.

Ionization Energy

- Amount of energy required to remove an electron from an atom.

$$\text{Atom A} + \text{IE} \rightarrow \text{Ion A}^{+} + e^{-}$$

Ionization Energy



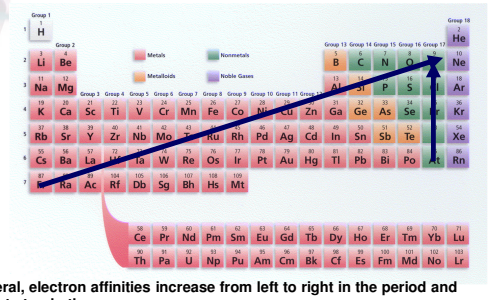
In general, ionization energies increase across a period and decrease down the groups.

Electron Affinity

- - Amount of energy given off or released when an atom takes on an electron.

$$\text{Atom A} + e^- \rightarrow \text{Anion A}^- + \text{EA}$$

Electron Affinity

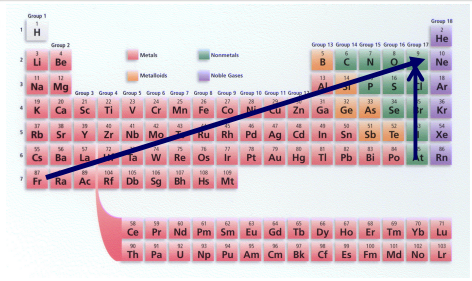


In general, electron affinities increase from left to right in the period and bottom to top in the group.

Electronegativity

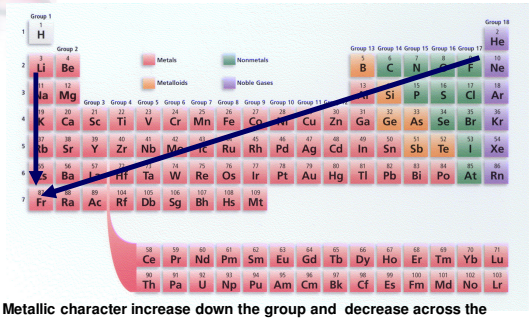
- Electronegativity is a measure of the tendency of an atom to attract a bonding pair of electrons.

Electronegativity



In general, electronegativity increases across the period and decreases down the group.

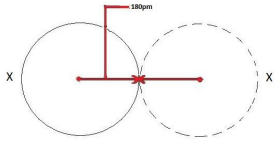
Metallic Character



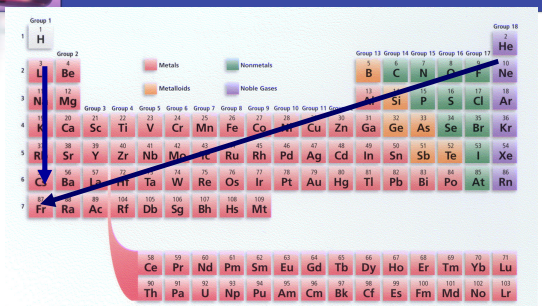
Metallic character increase down the group and decrease across the period.

Atomic Radius

- One half the distance between the nuclei of identical atoms that are bonded together.



Atomic Radius



In general, atomic radius increase down the group and decreases across the period.