Periodic Table History & Structure Notes

History of the periodic table

- During the 1800s, the number of known elements double from 30 to 60. This created a need for scientists to be able to classify and arrange the elements.
- Long before electrons and protons were discovered, scientists were able to arrange the elements according to increasing atomic mass.
- *1829, Johann Wolfgang Döbereiner*
  - A German chemist who identified groups of three elements with similar physical and chemical properties. He called these groups triads.
- *1864, John Newlands*
  - A British chemist who noticed that every eighth element has similar properties (Mg & Ca, F & Cl, Ne & Ar), which he called the law of octaves
  - rejected because of use of a musical term
- *1869, Dmitri Mendeleev*
  - A Russian chemist who is considered the Father of the modern periodic table
  - arranged the elements based on the regular periodic pattern of properties [What does it mean for something to be periodic?]
  - This arrangement was done whether the atomic masses lined up properly or not. For example, Ar (39.95) and K (39.10) were switched to make their properties match.
  - This arrangement also allowed Mendeleev to leave blanks for undiscovered elements. Not only did he leave blanks, but he was able to predict the properties of these undiscovered elements with considerable accuracy.

	eka-aluminum (Ea)	gallium (Ga)
atomic mass	68	69.9 (2.8% error)
melting point	low	29.78 °C
density	5.9 g/cm^3	5.94 g/cm^3 (0.7% error)
formula of oxide	Ea_2O_3	Ga_2O_3

- *1913, Henry Moseley*
  - Rutherford discovered the nucleus, but he could not find a way to consistently measure the number of protons in an atom.
  - Moseley was able to measure them using x-rays.

- Learned that the periodic properties line up if elements are arranged by atomic number instead of using atomic mass

Structure of the periodic table

- The periodic table is arranged in groups and periods
  - groups – vertical columns
  - periods – horizontal rows
- The periodic table can also be broken down by electron configuration
  - We have already divided them into s, p, d, & f blocks
  - We have seen that the groups on the periodic table also have a recurring pattern of electron configurations.
    - For example, all of the elements in group 15 have configurations that end in p^3.
    - As we will see later, this recurring pattern is the reason that elements in the same group have similar physical and chemical properties
- Another way to divide the periodic table is into what are known as representative and transition elements.
  - The s & p blocks are called representative elements – these follow the rules without too many exceptions
  - The d block is called the transition metals and the f-block is called the inner transition metals. The presence of the d & f sublevels cause these elements to have unique properties that often make them the exceptions to the rules.
- We can also divide them by the chemical and physical properties
  - The physical properties are divided by a staircase that runs through the p-block
    - metals
      - found to the left of the staircase
      - form positive ions (willing to give up e-)
      - luster
      - conduct heat and electricity
      - solid at room temp (except Hg)
      - malleable & ductile
    - nonmetals
      - found right of the staircase
      - form negative ions (want to gain e-)

- no luster
- poor conductors
- variation of physical properties (s, l, & g)
- brittle if solid

○ metalloids (semimetals)

- touch staircase
  - Some of the elements, like Al & Po, that touch the staircase are often not counted as metalloids.
- share properties with both metals and non-metals
- have luster, are fair conductors, and brittle

