2.1 Atomic Structure

Review of Terminology

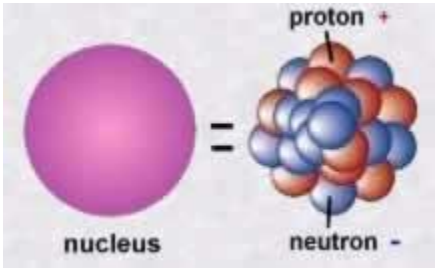
The following is a list of words and terms that you should be familiar with. Use your textbook or other resources to help define these terms using words and a diagram or an example:

Term	Definition	Diagram/Example
1. atom		
2. nucleus		
3. electron		
4. proton		
5. ion		
6. energy level (electron shell)		
7. valence electron		

Components of an Atom

The modern atom as viewed by scientists today consists of three main particles located in two regions.

1. The nucleus or central core of the atom
   - is composed of **positively charged protons** and **neutrons with a neutral charge.**
   - It is believed that the neutrons are needed to hold the positively charged protons together in the nucleus.
   - The force that holds these particles together is termed the nuclear binding force and it is believed to be one of the strongest forces that exists in nature.
   - The nucleus takes up a very small portion of the atom.



2. Electron cloud is the second region and surrounds the nucleus.
   - The cloud holds the **third particle, which is a negatively charged electron.**
   - Electrons circle the nucleus in the electron cloud; we never know both the location and speed of an electron (*Heisenberg's Uncertainty Principle*)
   - However, we do know the electrons are arranged in energy levels about the nucleus.
   - The electrons in their lowest energy state (termed ground state) occupy these energy levels from lowest (closest to nucleus) to highest energy.
   - Only certain numbers of electrons can be placed in each energy level; thus, we can take an estimated guess as to the location of a specific electron in general.

Ions: The number of electrons in a neutral atom (no charge) is equal to the number of protons (atomic #). Atoms may either gain or lose electrons during chemical interactions with other atoms. If they gain electrons they become negatively charged, if they lose electrons they become positively charged. We term these charged atoms ions.

For Example: If Magnesium loses two electrons it would have 12 + charged protons and only 10 - charged electrons and would become a +2 ion. If Chlorine gains one electron it would have 35 protons (+) and 36 electrons (-) and become a - 1 ion. The charge on the ion indicates the number of electrons gained or lost.

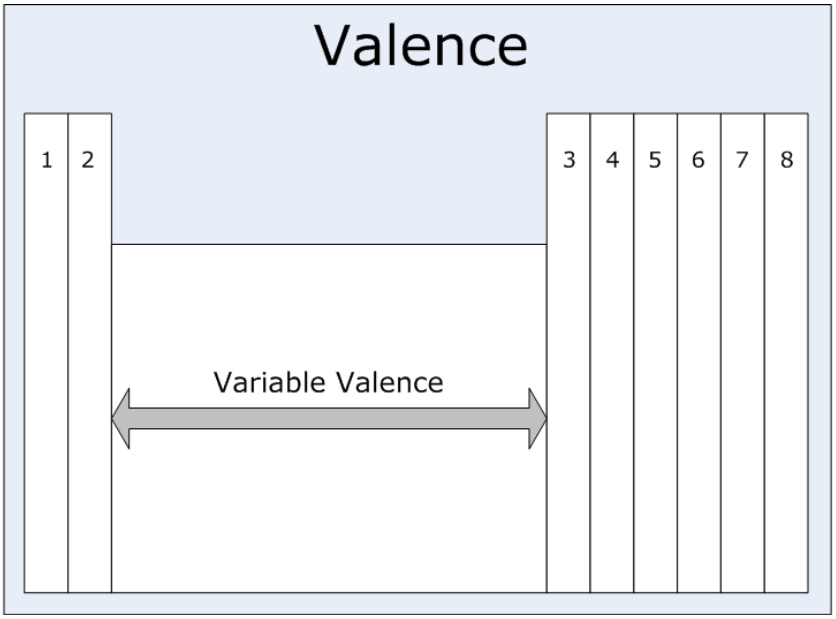
Electron Dot Diagrams:

- The *octet rule* states that atoms are most stable when they have a full shell of electrons in the outside electron ring (or energy level).
    - The first shell has only two electrons in a single subshell. Helium has a full shell, so it is stable, an inert element. Hydrogen, though, has only one electron. It can lose an electron to become H+, a hydrogen ion or it can gain an electron to become H-, a hydride ion.
    - All the other shells have 2 subshells, giving them at least eight electrons on the outside. These subshells often are the only valence electrons, thus the octet rule is named for the eight electrons found here.
    - The Transition Elements, Lanthanides, and Actinides are all metals. Many of them have varying valences because they can trade around electrons from the outer shell to the inner subshells (these elements can have up to 4 subshells in energy levels 4-6) that are not filled. For this reason they sometimes appear to violate the octet rule.

- **Valence electrons are the electrons in the outermost shell of the atom.** These are the electrons most likely to interact when chemical reactions occur and are therefore of great interest to chemists. (refer to periodic table)

Electron Arrangement and the Periodic Table

The columns in the periodic table represent the number of valence electrons an atom has to work with. The table below illustrates these numbers. We can use these number to draw Lewis Dot Diagrams predict an atoms chemical behavior.



For example, Magnesium **For example, Polonium**

2.1 Assignment

1. Chemical bonds are formed when atoms share, donate or accept electrons. In your own words, explain how Dalton's, Thomson's and Rutherford's models do not allow for chemical bonding.

2. The Bohr model is useful for representing electron shells, however, this model has been replaced by the Quantum Mechanical Model. Explain how this is more accurate representation of the atom.

3. Use the characteristics of the atoms described above, and the examples given below to complete the following chart.

Atom	Closet Noble Gas	Most Common Ion
a. Sodium	Neon	Na^+
b. Chlorine		
c. Silicon		
d. Aluminum		
e. Oxygen		

2.1 ATOMIC STRUCTURE

4. Draw the Lewis Dot Diagrams for the **atoms** below:
    - Aluminum
    - Calcium
    - Sulfur
    - Silicon
    - Neon
    - Bromine

5. Draw the Lewis Dot Diagrams for the **ions** below:
    - Al^{3+}
    - Cl^{-}
    - S^{2-}

6. CHALLENGE! Draw the Lewis Structure for the following **compounds**. Hint: to begin, determine if the compound is ionic or covalent.
    - Sodium Chloride
    - Potassium Oxide
    - Silicon dioxide
    - Oxygen gas
    - Aluminum chloride
    - Boron Tribromide