Chapter 13 – Chemical Bonding

Section 1

Electrons and Chemical Bonding

Essential Questions

- What is chemical bonding?
- How do you identify the number of valence electrons in an atom?
- How can you predict if an atom is likely to form bonds?

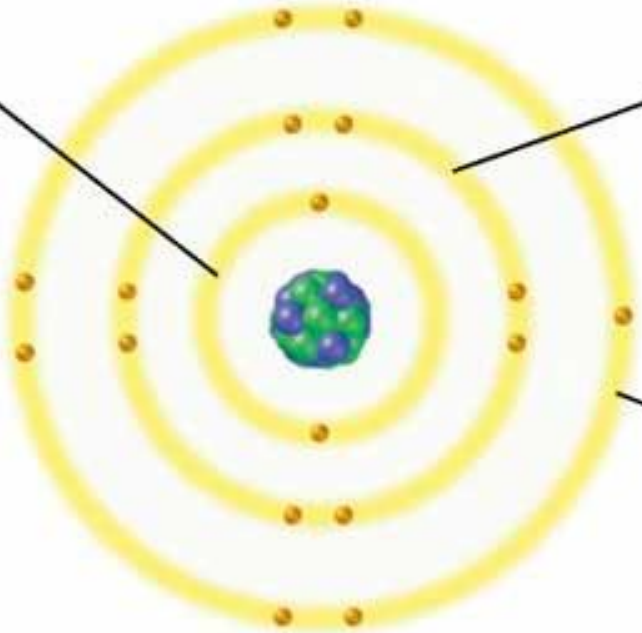
Definitions

- Chemical bonding – joining of atoms to form new substances
- Chemical bond – interaction that holds two atoms together
- Valence electron – electrons in the outermost energy level

Electron Number and Organization

- Atomic number tells the number of both protons and electrons
- Electrons are organized in energy levels
  - 1st level – closest to the nucleus; can only hold two electrons
  - 2nd level – fills only after 1st level is full; can hold up to 8 electrons
  - 3rd level – fills only after 2nd level is full

Electron Arrangement in an Atom



a The **first energy level** is closest to the nucleus and can hold up to 2 electrons.

b Electrons will begin filling the **second energy level** only after the first level is full. The second energy level can hold up to 8 electrons.

c The **third energy level** in this model of a chlorine atom has only 7 electrons, so the atom has a total of 17 electrons. This outer level of the atom is not full.

Outer-level Electrons and Bonding

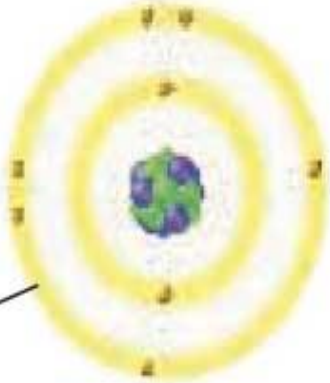
- Only electrons in the outermost energy level can form a bond
  - how many energy levels an atom has depends on the element
- These are valence electrons
  - the atom can bond by sharing the valence electron(s)

Counting Valence Electrons

Oxygen

Electron total: 8
First level: 2 electrons
Second level: 6 electrons

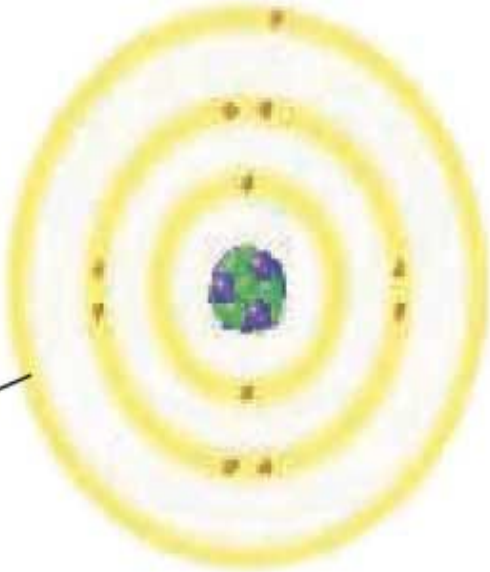
An oxygen atom has 6 valence electrons.



Sodium

Electron total: 11
First level: 2 electrons
Second level: 8 electrons
Third level: 1 electron

A sodium atom has 1 valence electron.



Valence electrons and the periodic table

- The periodic table can show the number of valence electrons
- Groups (or families) of elements have the same number of valence electrons
  - Groups 1 & 2 – same number of valence electrons as their group number
  - Groups 3-12 – no rule relating valence to group number
  - Groups 13-18 – have 10 fewer than their group number

To Bond or Not to Bond

- The number of valence electrons determines which atoms will bond
- Noble gases (group 18) do not usually form bonds
- Outermost energy level is considered full if it has 8 electrons (like group 18)

Filling the Outermost Level

- An atom with less than 8 electrons in the outermost level is more likely to bond
- An atom with two or fewer energy levels may never reach 8 electrons