Quick review

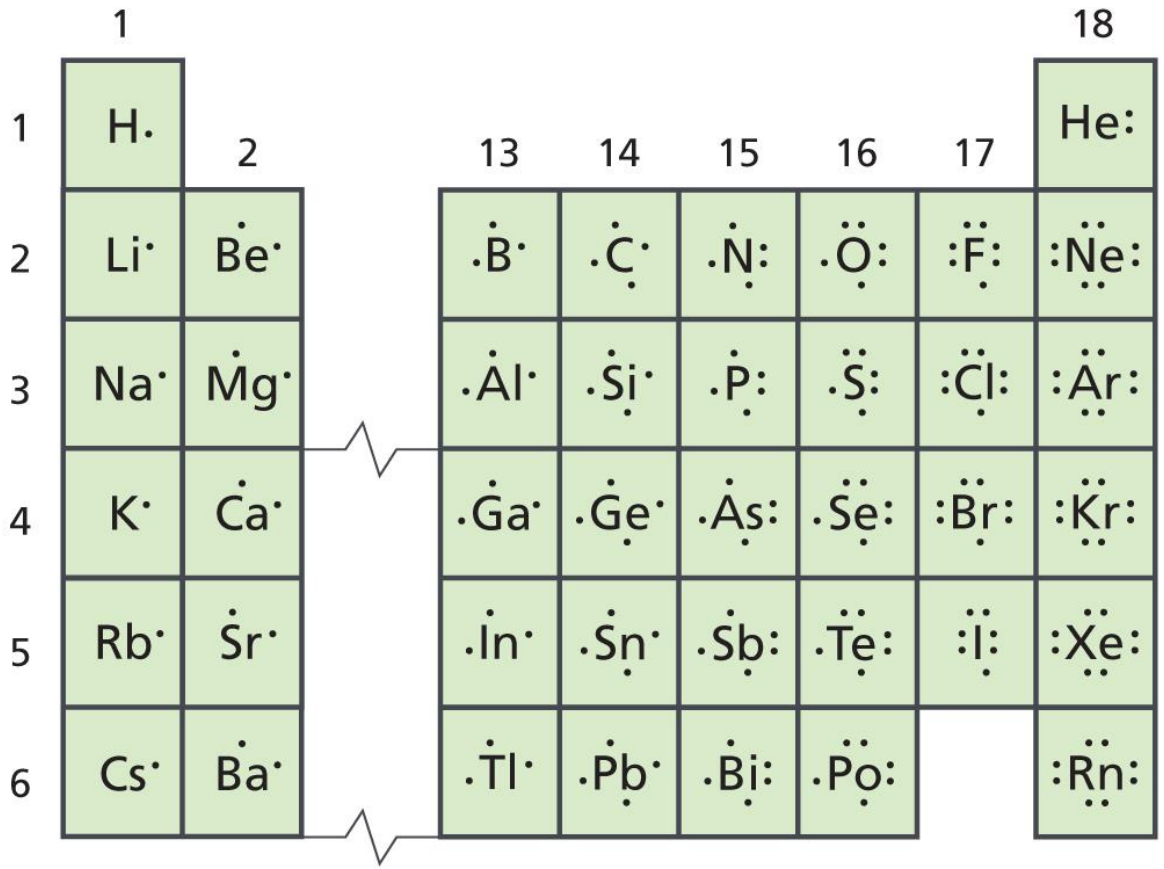
- All types of chemical bonds involve electrons
- Valence electrons, the electrons in the outermost occupied energy level of an atom, are usually the electrons involved in bonding

- The representative elements have the same number of valence electrons as their family number in the American system
  - Example: Mg, column IIA, 2 valence electrons
- The transition metals all have two valence electrons

  $\Rightarrow ns^2(n\text{-}1)d^x$

- Lewis dot structures are used to represent the valence electrons
  - each dot represents a valence electron
  - no more than 8 dots total
  - no more than 2 dots on a side
  - example = Mg: Na·

Lewis dot structures of representative elements



- Atoms that lose electrons easily have little attraction for additional electrons (and *vice versa)*
  - –metals have low IE, low EA
  - –Nonmetals have high IE, high EA

The Octet Rule

- Atoms of representative elements tend to gain, lose, or share electrons until they achieve an ns^2np^6 valence configuration
- **Losing or gaining more than that would require too much energy**
- "Isoelectronic" with noble gas
- "pseudonoble gas"

Electron Configuration of Ions

$Na \Rightarrow 1s^2 2s^2 2p^6 3s^1$

- Lose one electron…

$Na^+ \Rightarrow 1s^2 2s^2 2p^6$

- Lose two?

$Na^{2+} \Rightarrow 1s^2 2s^2 2p^5$

- NOT LIKELY!!
- Why not?
- The 2p electrons are **held more tightly**!
  - Closer to nucleus
  - Larger effective nuclear charge

Electron Configuration of Ions

S $\Rightarrow$ $1s^2 2s^2 2p^6 3s^2 3p^4$

- Large effective nuclear charge (~ +4)
- Attracts electrons strongly

gain 2 e-

- $S^{2-} \Rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6$

gain 3?

- NOT LIKELY!
- Third e- would go on an entirely new E level ($4s^1$)

Most likely ionic charge

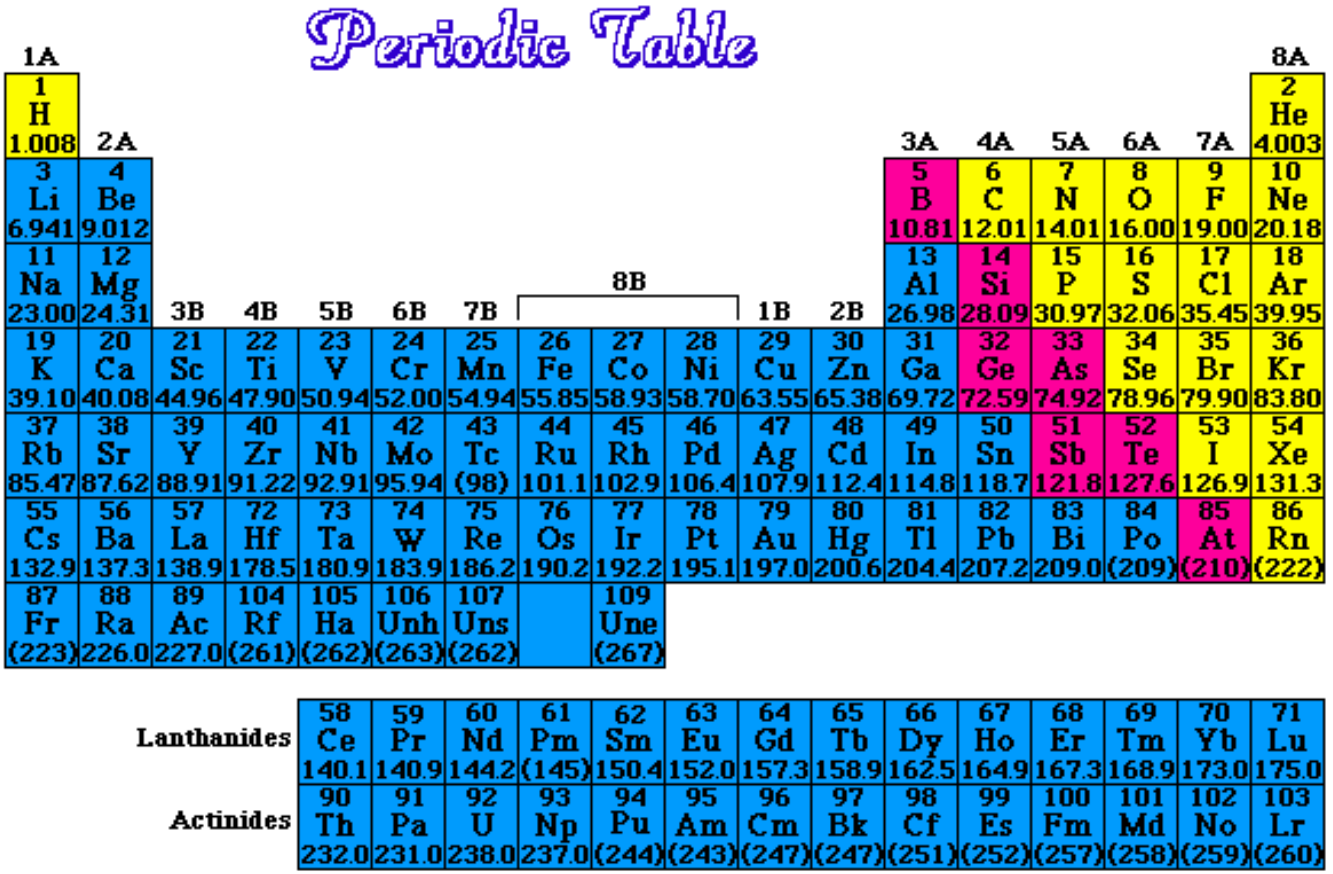
- 1A = 1+
- 2A = 2+
- 3A = 3+
- 4A = +/- 4
  - Covalent bonding more likely for ↓Z
- 5A = 3-
- 6A = 2-
- 7A = 1-
- Note: H can form 1+ ions or 1- ions (H^{1-} = hydride ion)

Basic idea…

- All chemical bonds form because they result in lower energy for the atoms involved
- lower energy = greater stability

Ionic Bonding

- Metals lose electrons easily, nonmetals have a strong attraction for more electrons
- metal atoms will lose electrons to nonmetal atoms, causing both to become ions



- Blue = metals
- Pink = semi-metallics (metalloids)
- Yellow = nonmetals

1. Metals, having lost one or more electrons, become cations (+)
2. Nonmetals, having gained one or more electrons, become anions (-)
3. Opposites attract: the cations and anions are held together electrostaticly

– called “ionic bonds”

In summary...

- Ionic bonds are electrostatic attractions between cations and anions formed when electron(s) are transferred from the low IE, EA metal to the high IE, EA nonmetal