Chemical Bonding and Molecular Attraction

I. Electron dot structure
   A. Representation of valence electrons
   B. Paired valence electrons not likely to participate in bonding
   C. Unpaired valence electrons transferred or shared to bond
II. ions
   A. when number of electrons does not equal number of protons
      1. residual charge
         a. positive when electron is lost—called cat-ion
         b. negative when electron is gained—called anion
      2. which happens depends on valence electrons in shell
         a. lost from nearly empty shells
         b. gained into nearly filled shells
      3. shown with superscript of + or – with numbers greater than 1
      4. periodic table can be used for reference to determine charge of ion likely to form
   B. the model works well to determine formation of ions for alkali metals, alkaline earth metals, oxygen group (chalcogens), and halogens. Too simple for transition metals
III. molecules can become ions also by imbalance of total electrons
   A. some bonds are very persistent, and remain through reactions
   B. 'poly-atomic ions'—you have to memorize them
   C. Anionic groups: carbonate, hydroxide, sulfate, phosphate, nitrate, bicarbonate, cyanide, acetate
   D. Cat-ionic groups: hydronium, ammonium
IV. ionic bonds form when one atom donates an electron to another,
   A. both substances are then ions
      1. have an ionic bond
      2. called ionic compound
      3. properties different than its constituent atoms
   B. positive and negative charges must balance
      1. if they have the same amount of charge: 1 to 1 ratio
      2. if they have different amount of charge: increase one or both to have the charges balance
      3. write chemical formula of compound with the subscripts
   C. tend to form crystalline arrangement of atoms

V. metallic bonds
   A. properties of metals: conduct electricity, malleable, opaque, shiny
   B. electrons held weakly, leaving positive metal ions surrounded by a flow of negative electrons—this holds atoms together as a metallic bond
      1. electrons vibrate in presence of light: shiny, opaque
      2. held by the electron fluid allows them to rearrange: malleable
      3. can bond to other types of metal atoms: alloy such as bronze (CuSn)or brass (CuZn)
   C. metals often bond with chalcogens also: ores of sulfides and oxides

VI. covalent bonds
   A. mutual attraction for shared electrons—not transferred like ionic
      1. co=shared valent= the valence electrons are shared
      2. molecule: group of atoms held together by covalent bonds
      3. note the dot diagram has unpaired electrons
         a. available for covalent bonds
         b. sometimes bonds drawn as lines for a pair of shared electrons
   B. often formed from atoms that both tend to gain electrons
      1. again the dot diagram is helpful
         a. determining how many covalent bonds can be formed
         b. number of unpaired electrons is number of covalent bonds
         c. form bonds until all electrons are paired
      2. two unpaired electrons in two different atoms can both be covalently shared…now you have a double bond O_2, CO_2
      3. triple bond N_2—note the dot diagram of N, had 3 unpaired electrons
   C. polar bonds: covalent with uneven sharing of electrons
      1. identical atoms share evenly
      2. non-identical atoms have different attractions for electrons
         a. the electronegativity of atoms increase dramatically across period
         b. electronegativity declines slightly down groups
         c. upper right have greatest, lower left the least
      3. described as a dipole,
         a. represented by a little delta $\delta+$ or $\delta-$, the signs showing which has less (+) and more (-) electronegativity
         b. or a crossed arrow pointing toward the more negative end+→ of the compound…sometimes size of arrow shows relative polarity of bond
         c. the further apart they are on the Periodic Table, the more polar the bond
         d. electronegativity difference of ionic bonds is extreme compared to covalent bonds—there is a gradual change from one type to the other, as the elements involved are greater or less different in their electronegativity

VII. molecular polarity

A. consequences
   1. low polarity molecules are not attracted to one another, results in property of low boiling temperature--oxygen
   2. highly polar molecules would be attracted more, high boiling temperature—sodium chloride

B. determining the polarity of molecules
   1. only one bond, easy to see
   2. more than one, its like multiple-direction tug-of-war
      a. some molecules form bent shapes because of large dipoles formed by the atoms—water
      b. these molecules have great attraction for one another

C. polar molecules disrupt compound attractions
   1. water dissolves ionic compounds
   2. dipoles also attract one another—hydrogen bonds due to large dipole
   3. strong dipoles such as hydrogen compounds can induce a temporary dipole in a non-polar molecule—return to normal when not in presence of that dipole
   4. large atoms and molecules are more likely to become temporary dipoles than smaller ones—even when not in presence of polar molecules