Aqueous solution chemistry (chapter 4)

Thinking about aqueous solutions at the molecular level
- be able to predict whether a substance will *dissolve* in water (solubility rules)
- be able to predict whether a substance will *dissociate* in water
    - ionic compounds vs. covalent/molecular compounds
        - covalent polyatomic ions do NOT dissociate
    - *strong* vs. *weak* *acids* and *bases*
- be able to predict whether a mixture will conduct electricity (i.e., is it an *electrolyte*?)
- be able to describe the state of substances in solution by writing *net ionic equations*
    - what is a *spectator ion*?

Precipitation (or solubilization) reactions
- typically involve formation of an insoluble solid by double-displacement (*metathesis*)

Acid/base reactions
- in the cases we are concerned with, acid/base reactions involve transfer of *hydrogen ions*
- be able to identify acids and bases based on what they do in reactions
- be familiar with the strong acids and strong bases listed in table 4.2

Oxidation-reduction reactions
- be able to assign *oxidation numbers* (see table 4.3)
- be able to identify what is being oxidized or reduced in a reaction on the basis of oxidation numbers of products and reactants

Light and atoms (chapter 7 and 8.1-8.3)

General properties of electromagnetic radiation
- know the relationship between the wavelength, energy, and frequency of different colors of light
- have a casual understanding of the dual nature of light -- both particle-like and wave-like
- have a casual understanding of the *Heisenberg uncertainty principle*

Line spectra
- what they are, where the lines come from, what determines their position
- *emission* vs *absorption* of energy in the form of light

The modern model of the atom

- be able to describe the differences between the *Bohr model of the atom* and the *quantum mechanical model of the atom*
- *quantum numbers*, *orbital diagrams*, and electron configurations
    - be able to designate the position of electrons in atoms by their quantum numbers, by their positions in an orbital diagram, or by their electron configuration notation (e.g., $1s^2 2s^2 2p^4$)
    - be able to write a ground-state electron configuration for any element or ion in the periodic table (for large atoms, use condensed electron configurations with a noble gas core)
    - understand how the arrangement of the periodic table reflects shared chemical properties and shared valence electron configurations
    - understand how the arrangement of the periodic table reflects the arrangement of orbitals and sub-orbitals in the quantum-mechanical model of the atom

Using electron configurations to predict properties of atoms and ions (Sections 8.4&8.5)

Be able to understand and predict the periodic trends in:

- *atomic size*
- *effective nuclear charge*
- *ionization energy*
- *electron affinity*
- *ionic size*

Molecular Bonding (Chapter 9 and 10.1)

Ionic vs. *polar covalent* vs. "pure" *covalent* bonding

- how are they different?
- be able to predict what kind of bonding will occur between atoms based on *electronegativity* differences (see figures 9.18 and 9.19)
- be able to estimate *relative* electronegativities from position of elements on the periodic table

Lewis structures, electronegativity, and bond polarity (section 10.1)

- be able to construct *Lewis-dot structures* for atoms and ions
- understand the principle of (and underlying reason for) formation of *octets* of electrons
- be able to indicate bond formation with Lewis structures
- be able to indicate bond *polarity* with Lewis structures
- be able to compute formal charges, and understand the differences between formal charge, electronegativity, and oxidation numbers
- understand the meaning of *resonance* structures (this is also an issue with regards to molecular geometry!)
- don't be confused by atoms with '*expanded octets*'