Unit 6: Chemical Bonding and Molecular Geometry

adapted from http://www.phschool.com/advanced/lesson_plans/chem_brown_2003/index.html

Objectives:

- Be able to write the Lewis symbol for any atom.
- Understand the energies involved in the formation of ionic bonds—ionization energy, electron affinity, and lattice energy.
- Predict the formula of an ionic compound between representative elements using the octet rule, and the periodic table to predict an atom's probable valence.
- Describe what happens to radius when an atom forms an ion.
- Be able to explain the variation in size of an isoelectronic series.
- Describe the nature of the covalent bond in terms of electron cloud overlap.
- Be able to show covalent bond formation using Lewis symbols.
- Be able to draw Lewis structures for bonds between atoms—single, double, and triple covalent.
- Relate bond energies to bond order.
- Explain electronegativity, how it varies on the periodic table, and its relationship to the nature of the bond between two atoms.
- Predict the polarities of bonds between any two atoms from their electonegativities or their positions on the periodic table.
- Write correct Lewis structures for any simple molecule or ion even when there is an exception to the octet rule.
- Be able to write resonance structures when no one structure is adequate.
- Relate the number of electron domains in the valence shell of an atom to the geometric arrangement of electrons around the atom.
- Understand that the relative degree of repulsion between nonbonding pairs is greater than between bonding pairs of electrons.
- Predict the molecular shape of a molecule or ion from its Lewis structure.
- Predict, from its molecular shape and the electronegativities of the atoms involved, whether a molecule is polar (has a dipole).
- Explain the types of hybridization.
- Assign the type of hybridization on the basis of the electron geometry of the valence shell of an atom.
- Describe the bonding between atoms in a molecule as σ or π.
- Explain the concept of delocalization in π bonds.
- Describe how molecular orbitals are formed from atomic orbitals.
- Explain the meaning of bonding and antibonding molecular orbitals.
- Construct the molecular-orbital energy-level diagram for a diatomic molecule or ion predicting the bond order and the number of unpaired electrons.

Lab Objectives:

- Learn typical techniques used in gravimetric analysis.

Suggested Labs:

- Gravimetric Analysis of a Chloride Salt

Key Words:

ionic bond
covalent bond
metallic bond
Lewis symbol
octet rule
lattice energy
single bond
double bond
triple bond
bond polarity
polar covalent bond
nonpolar covalent bond
electronegativity
polar molecule
dipole
Lewis structure
formal charge
resonance structures
octet rule
bond enthalpy
bond length
bond angles
VSEPR,
bonding pair
nonbonding (lone) pair
electron domain
electron-domain geometry
molecular geometry
bond dipole
valence-bond theory
hybridization
hybrid orbitals
sigma bonds
pi bonds,
molecular orbital theory
molecular orbitals
bonding molecular orbital
antibonding molecular orbital
sigma molecular orbitals
energy-level diagram
bond order
pi molecular orbital
paramagnetism
diamagnetism

Tips:

- Ionic and covalent are extremes on a continuum of the bonding spectrum.
- Electronegativity difference alone can only establish the polarity of a bond between two atoms. To determine if a molecule is polar, we also need to also know its geometrical symmetry.
- Formal charge is not a real charge, but a way of telling how severely electrons have been moved from where they were in the Lewis symbol to where they are now in the proposed Lewis structure.
- The type of hybridization is determined from the electron domain geometry in the Lewis structure.