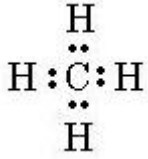
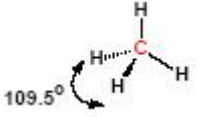
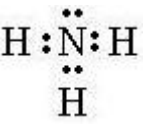
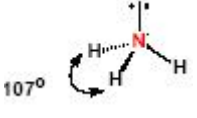
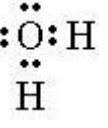
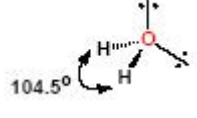
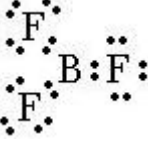
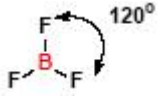
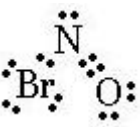
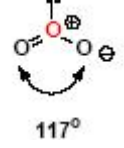
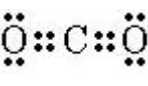
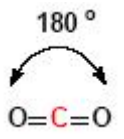


CHE 101 and CHE 111
Basic Lewis Structures Rules (Obey the Octet Rule)

1. Add up the valence electrons
 - (a) Add up the valence electrons for all regular atoms (s and p orbitals with the highest quantum number)
 - (b) Add electrons for molecules with a negative charge (ex: CO_3^{-2})
 - (c) Subtract electrons for molecules with a positive charge (ex: NH_4^+)
2. Write a trial structure
 - (a) Place the least electronegative atom in the center
 - (b) Make molecules as symmetrical as possible
 - (c) Draw one bond between all atoms
 - (d) Typical bond numbers formed (H = 1, O = 1 or 2, C = 4, N = 1, 2, or 3)
 - (e) Oxygen rarely forms bonds with itself (obvious exceptions O_2 and in Peroxides (H_2O_2 bonds to each other
 - (f) F, Cl, Br, and I generally form 1 bond (but not always)
3. Count electrons - Subtract 2 electrons for every bond formed
4. Distribute the remaining electrons to give noble gas configurations (octet rule)
 - (a) Surround each atom with 8 electrons (except H)
 - (b) Start with the most electronegative atoms first
 - (c) If all atoms have 8 electrons around them you are done, if not remove unshared electron pairs from outer atoms and form double and triple bonds
 - (d) CHE 111 only) - If you have extra electrons place them on the central atom (this will violate the octet rule, but you can occasionally do that as shown below)
5. Molecular Geometry and Bond Angles - Next Page!
6. Molecular Dipoles - Use bond polarity and molecular shape to determine if the molecule is Polar/Dipolar (DP) or Nonpolar (NP)
7. Ionic vs Molecular vs Polyatomics - remember the differences in how they are represented with Lewis Structures

CHE 101 and CHE 111
Basic Lewis Structures Shapes and Bond Angles (Obey the Octet Rule)

Lewis Structure	# charge clouds	# bonds	# lone pairs	Molecular Shape	Bond Angle	Bond Polarity	3D Structure
	4	4	0	Tetrahedral	109.5	Non-polar or Dipolar	
	4	3	1	Trigonal Pyramidal	109.5	Dipolar	
	4	2	2	Bent - 109.5	109.5	Dipolar	
	3	3	0	Trigonal Planar	120	Non-polar or Dipolar	
	3	2	1	Bent - 120	120	Dipolar	
	2	2	0	Linear	180	Non-polar or Dipolar	

CHE 111 Only
Advanced Lewis Structure Topics/Rules

1. Assign Formal Charges

- (a) The formal charge is the difference between the number of valence electrons and the number of shared electrons and bonding electrons around an atom.
- (b) Formal Charge = # Valence electrons - # Lone pair electrons - $\frac{1}{2}$ (# Bonding electrons)
- (c) Try to minimize formal charges in molecules when possible

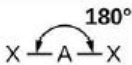
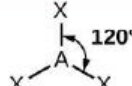

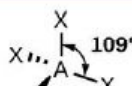


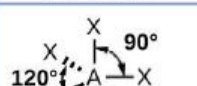
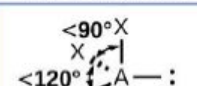

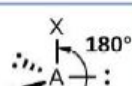
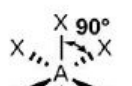
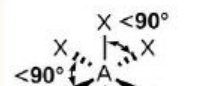
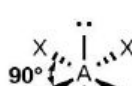

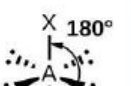
2. Exceptions to the Rules

- (a) Incomplete octets - not enough electrons
- (b) Odd number of electrons - impossible for every atom to have an octet
- (c) Expanded Octets - Atoms with electrons in d-orbitals can have more than 8 electrons around them

3. Resonance Structures - molecules with more than one possible Lewis structure

4. Bond Polarity - Use Electronegativity to determine which element is most positive/negative

CHE 111 Only
Advanced Lewis Structure Shapes and Angles

Number of electron pairs	Electron pair geometries: 0 lone pair	1 lone pair	2 lone pairs	3 lone pairs	4 lone pairs
2	 Linear				
3	 Trigonal planar	 Bent or angular			
4	 Tetrahedral	 Trigonal pyramid	 Bent or angular		
5	 Trigonal bipyramid	 Sawhorse or seesaw	 T-shape	 Linear	
6	 Octahedral	 Square pyramid	 Square planar	 T-shape	 Linear