Chapter 8: Chemical Bonding

Nov 14, 2022

Chemistry Department, Cypress College

Class Announcements

Lab

- Experiment 18 Boyle's Law
- Reminder - Need 70% of laborator points to pass the course

Lecture

- Finish up Ch 8 and begin Ch 9
- Go over homework 10 (EC for students who present)
- Quiz and Homework assignment released Fri, Nov 18th at 3pm

Outline

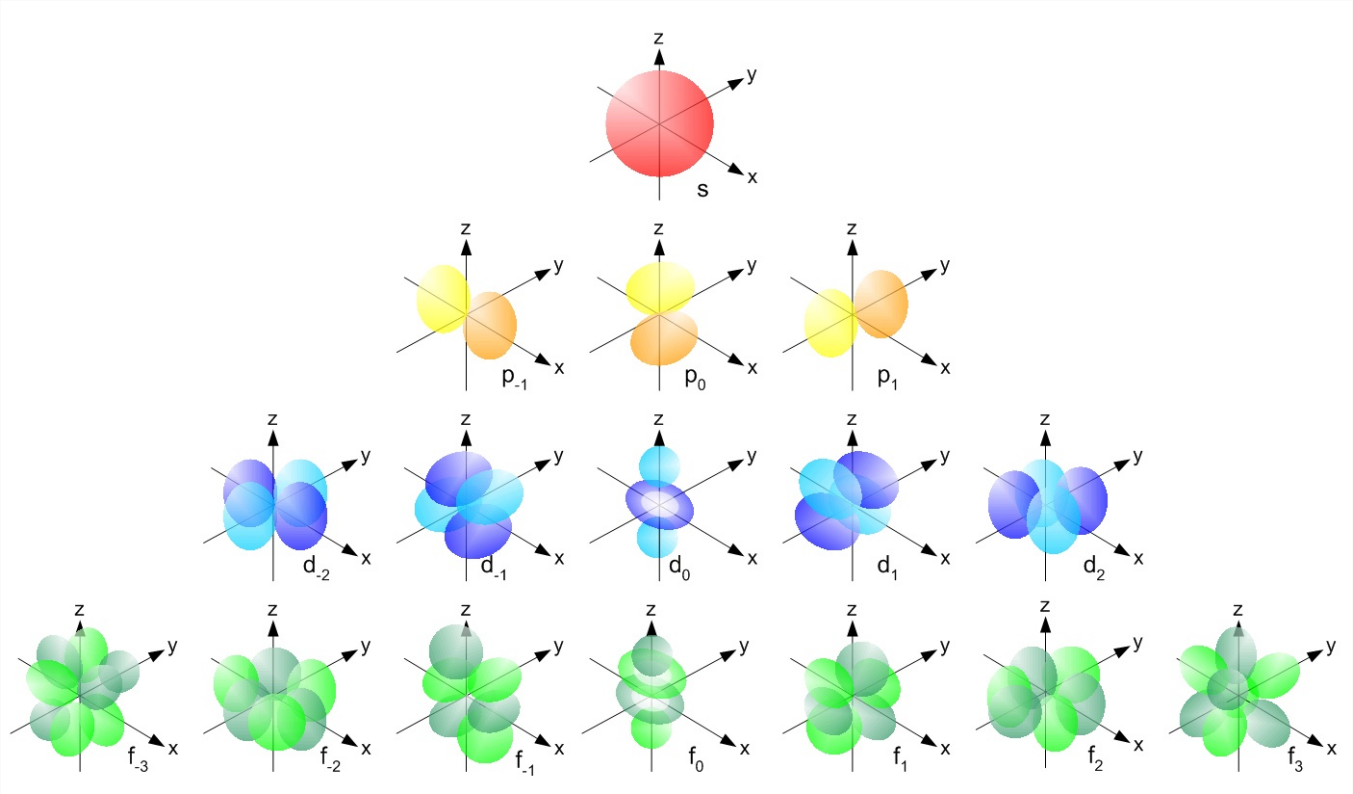
Review: Chemical Bonds

Review: Lewis Structures

Functional Groups

VSEPR Theory

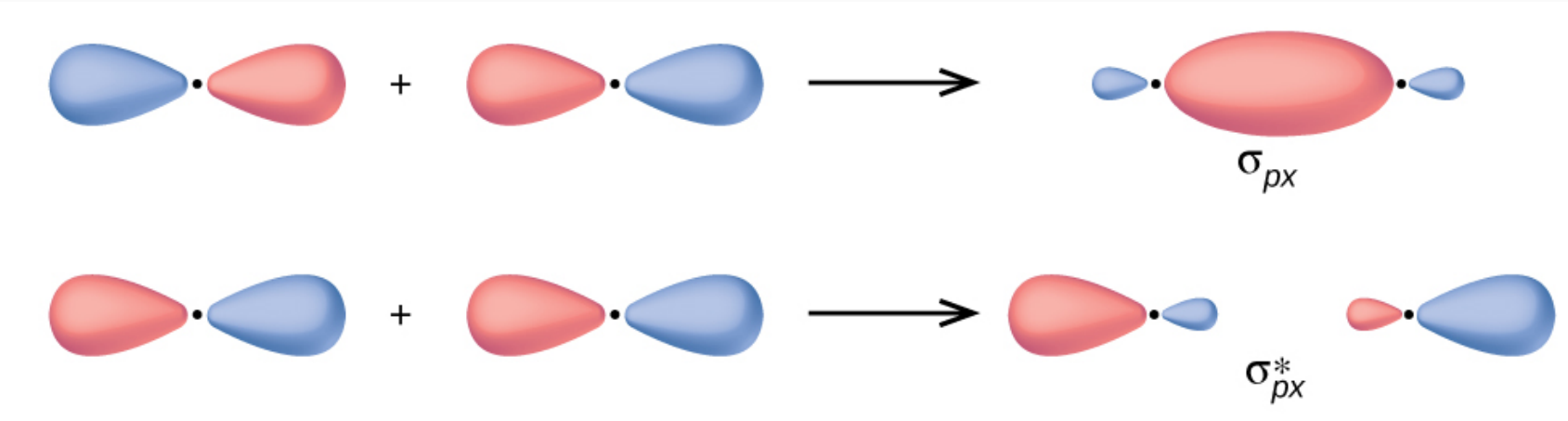
What are Chemical Bonds?



Bonds are made up of atomic orbitals

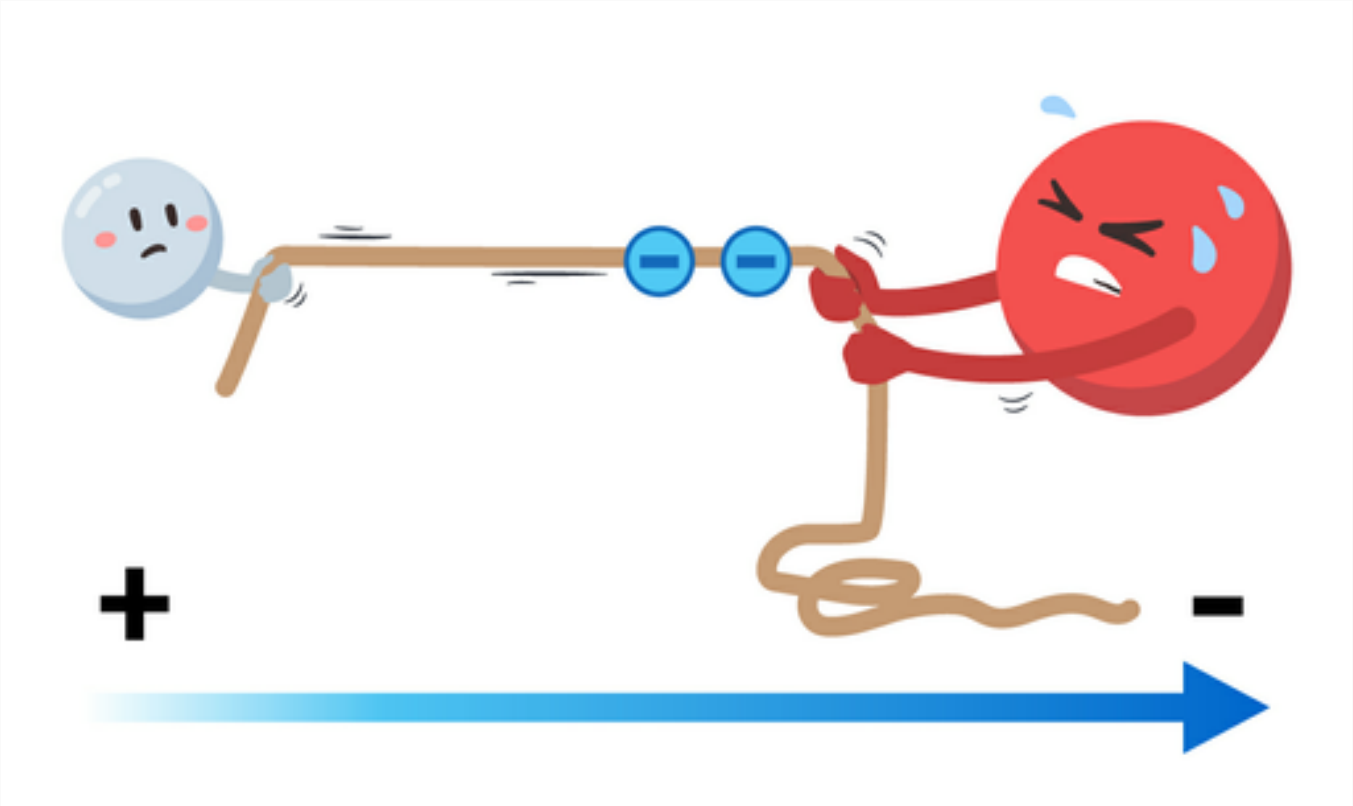
- Overlap of atomic orbitals lead to the formation of molecular orbitals (same energy and specific orientation)

Example with p-orbitals



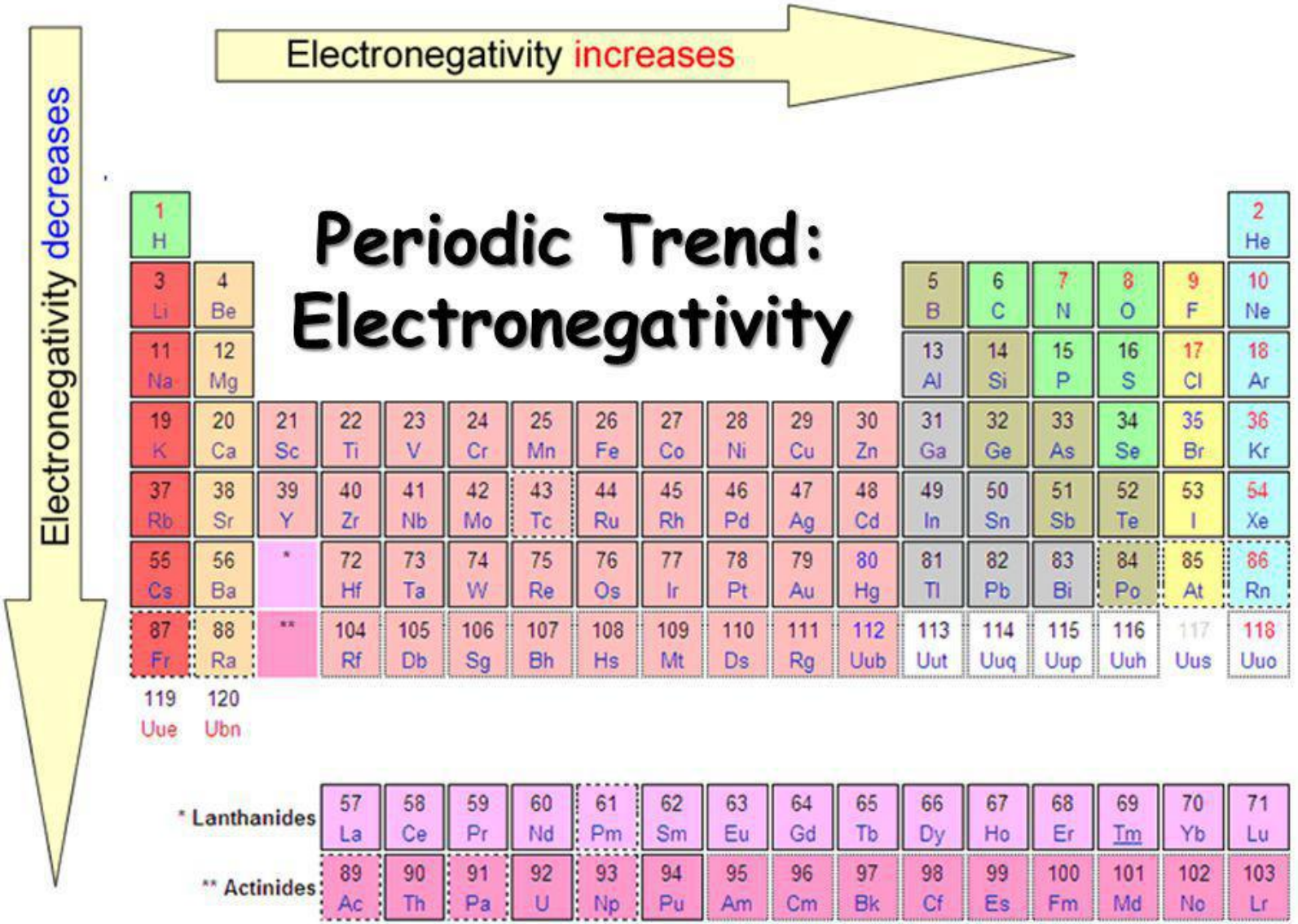
- Depending on the orientation, p-orbitals will form a bond

Electronegativity: Tug-of-War



- Sharing of electrons can lead to unequal pull (electronegativity)

Electronegativity Trends



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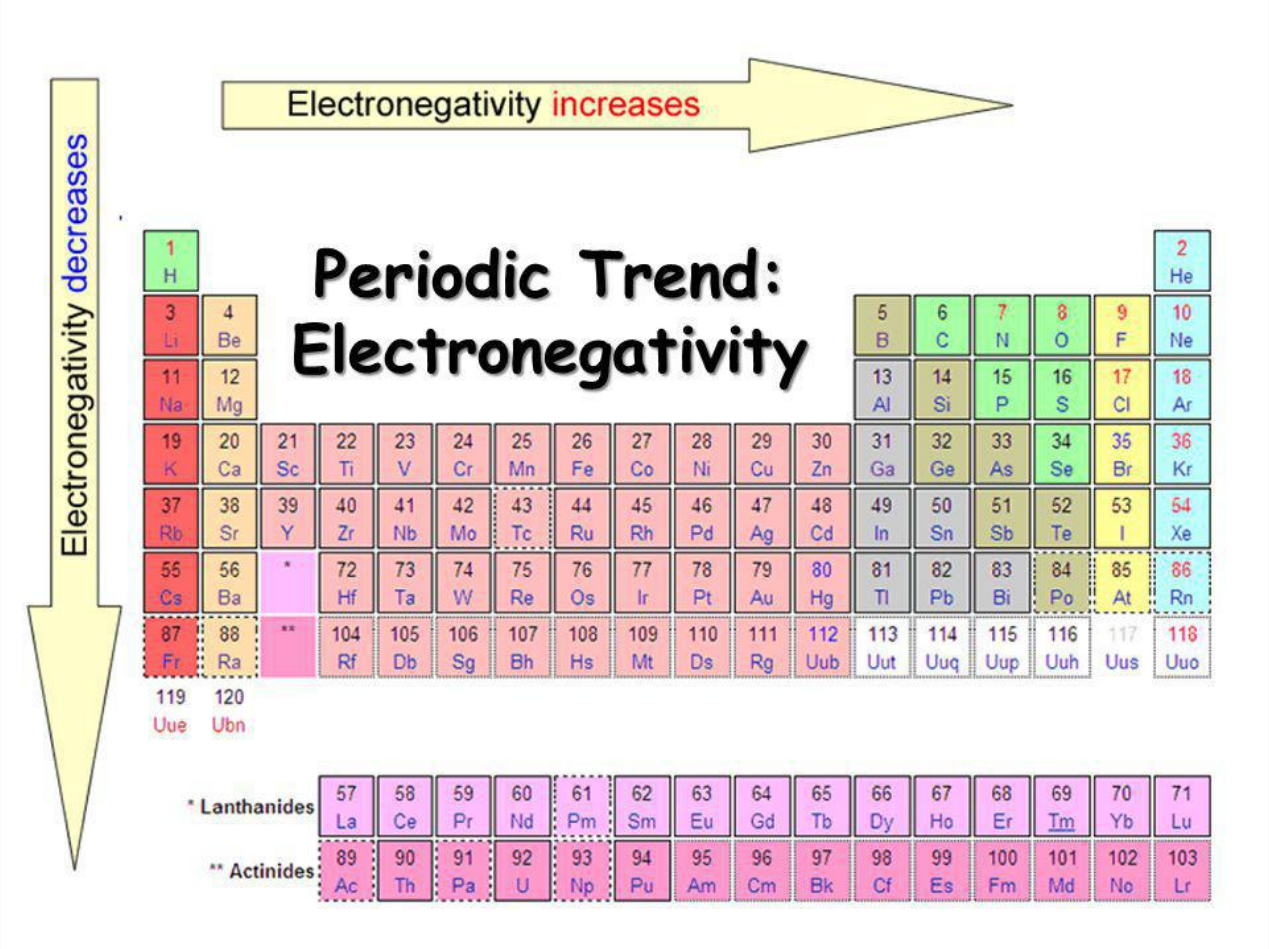
Octet Rule

Octet Rule - Atoms have a tendency to achieve an electron configuration having 8 valence electrons

Q: How many electrons are needed for the following atoms to achieve the octet rule: C, N, O, F, Xe, and Ne

Exception to Octet Rule



Exceptions: Atoms starting in the 3rd row can break the octet rule

Q: Why are these atoms able to break the octet rule?

Drawing Lewis Structures

1. Count the total number of valence electrons
2. Draw the atomic skeleton by determining the central atoms (generally the one capable of making many bonds)
3. Add single bonds (each counts as 2 electrons) to atoms and add lone pairs if needed to satisfy the octet rule
4. Check that if the amount of valence electrons counted match the Lewis structure
5. Check formal charges on the atoms

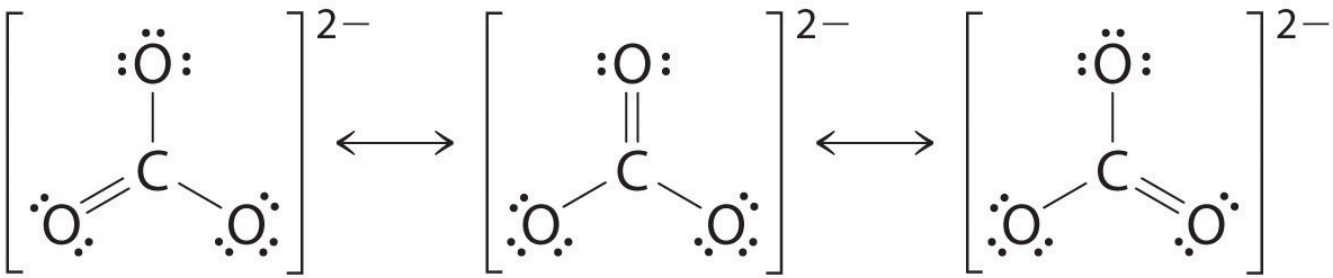
Computing Formal Charges

$$\text{Formal Charge} = \text{VE - } \frac{1}{2} \text{ BE - NBE}$$

where VE is the number of valence electrons, BE is the bonding electron, and NBE is the nonbonding electron aka lone pairs

Resonance Structures

Resonance structures - the movement of electrons satisfying a valid Lewis Structure



Q: What are the formal charges for the atoms in CO_3^{2-}?

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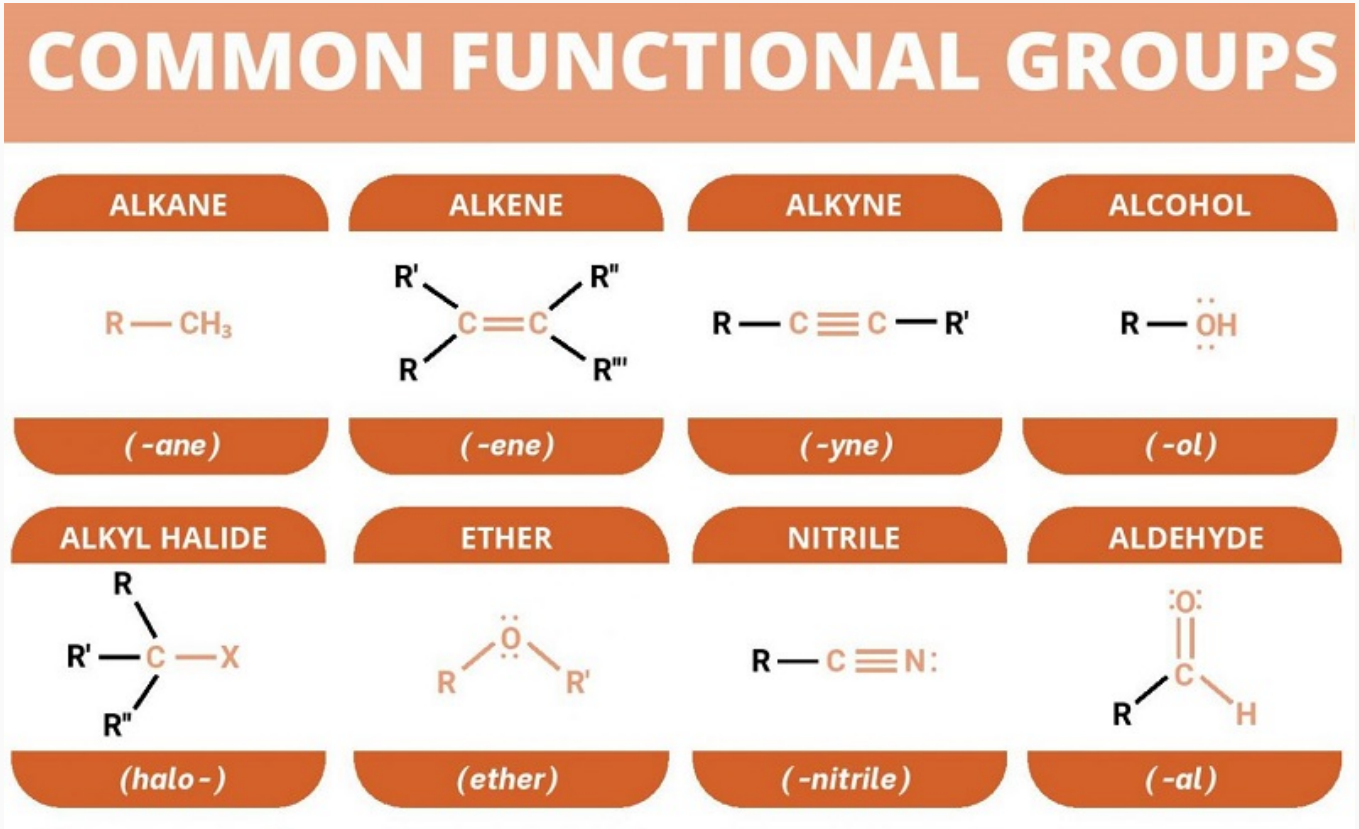
Functional Groups in Hydrocarbons

Functional Groups - derivatives of a hydrocarbon



where R represents hydrocarbon component

Practice: Drawing Hydrocarbons

Draw the lewis structures for the following hydrocarbons: CH_4, C_3H_8, CH_8, C_2H_2

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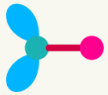
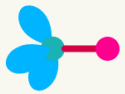
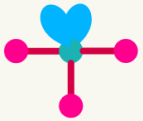
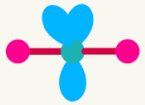
VSEPR Theory

VSEPR Theory - predict the geometric shape of a molecule or an ion; minimizes the electronic repulsion of the lone pairs

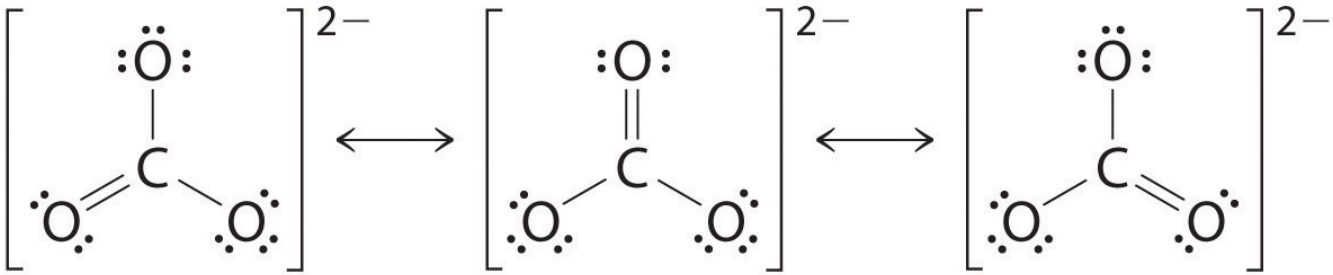
Helps to determine the overall polarity of the molecule

Electron Pairs	L.P: 0	L.P: 1	L.P: 2	L.P: 3
2	 Linear	 Linear		
3	 Trigonal Planar	 Bent	 Linear	
4	 Tetrahedral	 Trigonal Pyramidal	 Bent	 Linear
5	 Trigonal Bipyramidal	 See-saw	 T-Shaped	 Linear
6	 Octahedral	 Square Pyramidal	 Square Planar	 T-Shaped
7	 Pentagonal Bipyramidal	 Pentagonal Pyramidal		

Practice: Determine the Geometry

CO_2, CN, HCl, O_3, SO_4^{2-}, CH_4, C_3H_8, CH_8, C_2H_2

Bond Polarity and Molecular Polarity



Q: Is the C-O bond polar? Does this make the molecule overall polar?

Practice: Classify whether Molecule is Polar

CO_2, CN, HCl, O_3, SO_4^{2-}, CH_3Cl, C_3H_8, CH_8, C_2H_2