Chapter 8: Lewis Structure

November 15, 2022

Chemistry Department, Cypress College

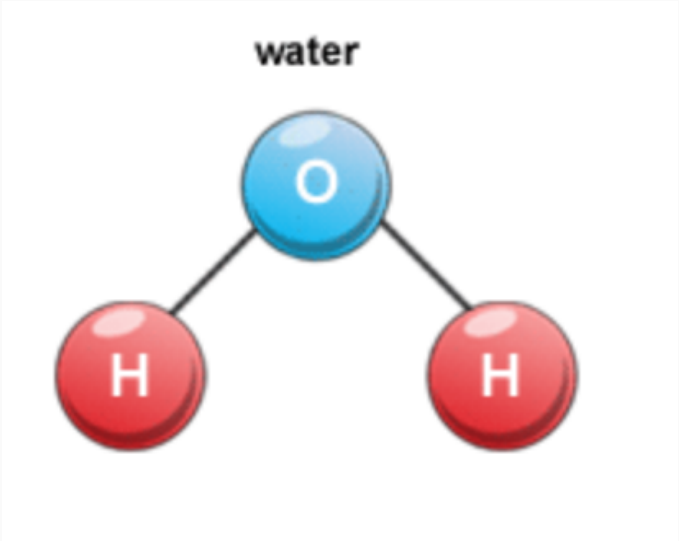
Class Announcements

Lecture

- Finish Ch 7 and begin Ch 8
- Quiz and Homework assignment released Fri, Nov 18th at 3pm
- Exam 3 on Nov 22nd; 10 questions covering Exam 2 and Chs 7-8

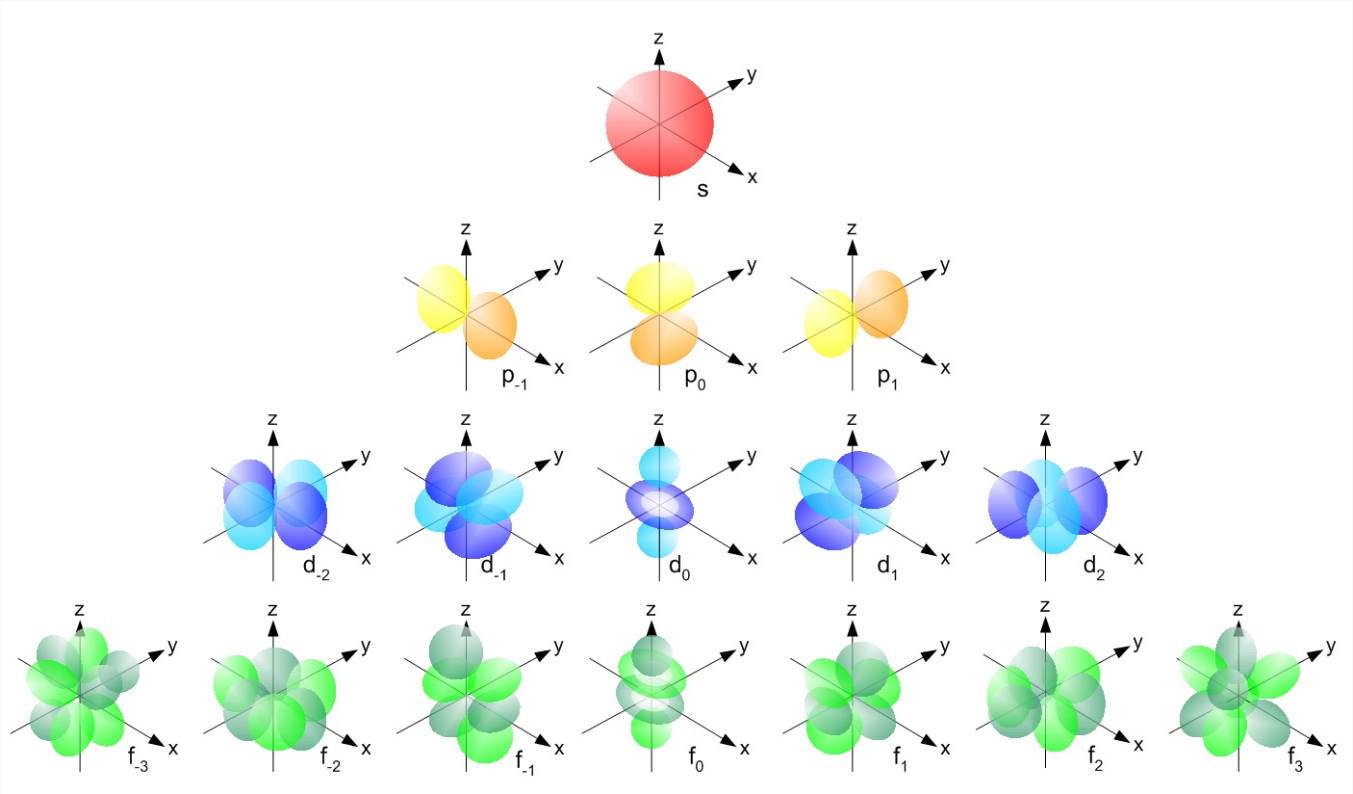
Outline

Water is Life



- Liquid water made up of moles upon moles of water molecules
- Molecules are made up of atoms connected by “chemical bonds”

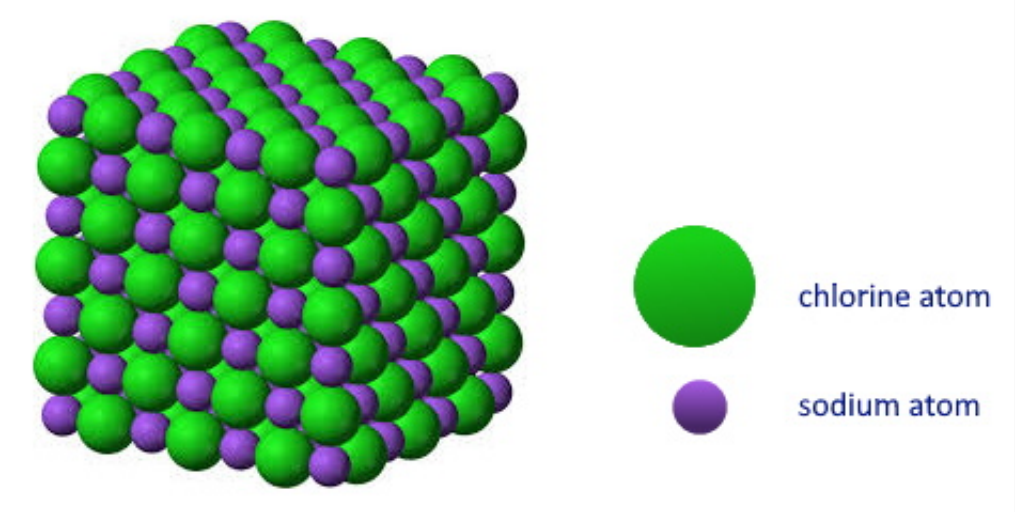
What are Chemical Bonds?



Bonds are made up of atomic orbitals

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

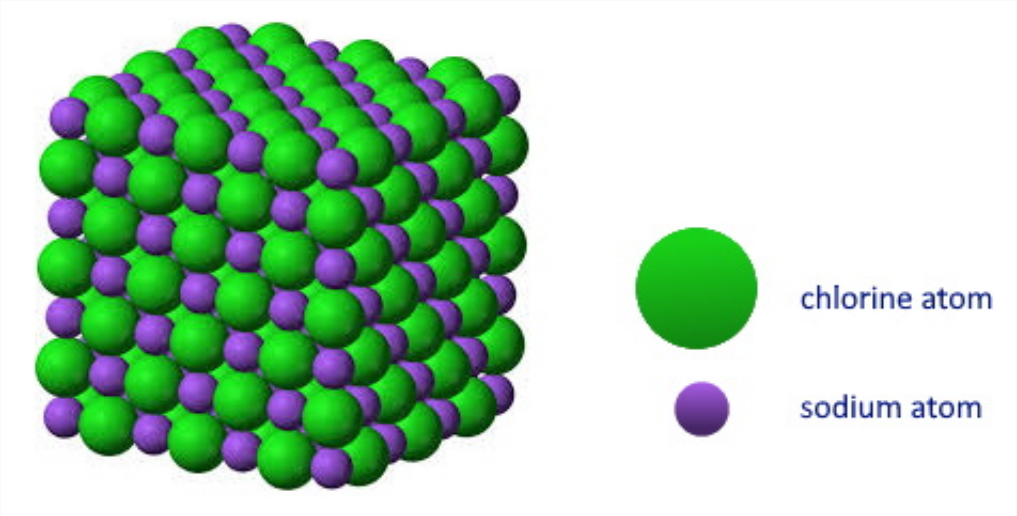
Ionic Bonds



Ionic Compounds - Made up of cation and anion

Ionic Bonds - Hold the cations and anions together; purely electrostatic interaction

Ionic Bonds

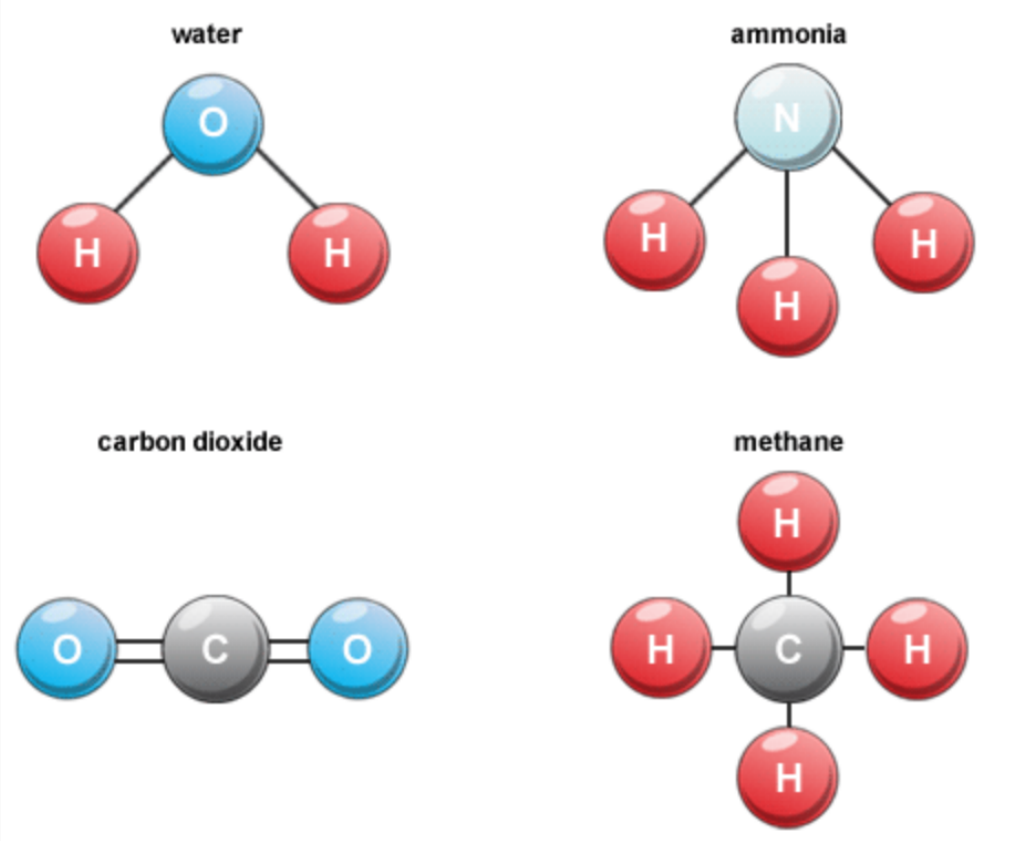


Ionic Compounds - Made up of cation and anion

Ionic Bonds - Hold the cations and anions together; purely electrostatic interaction

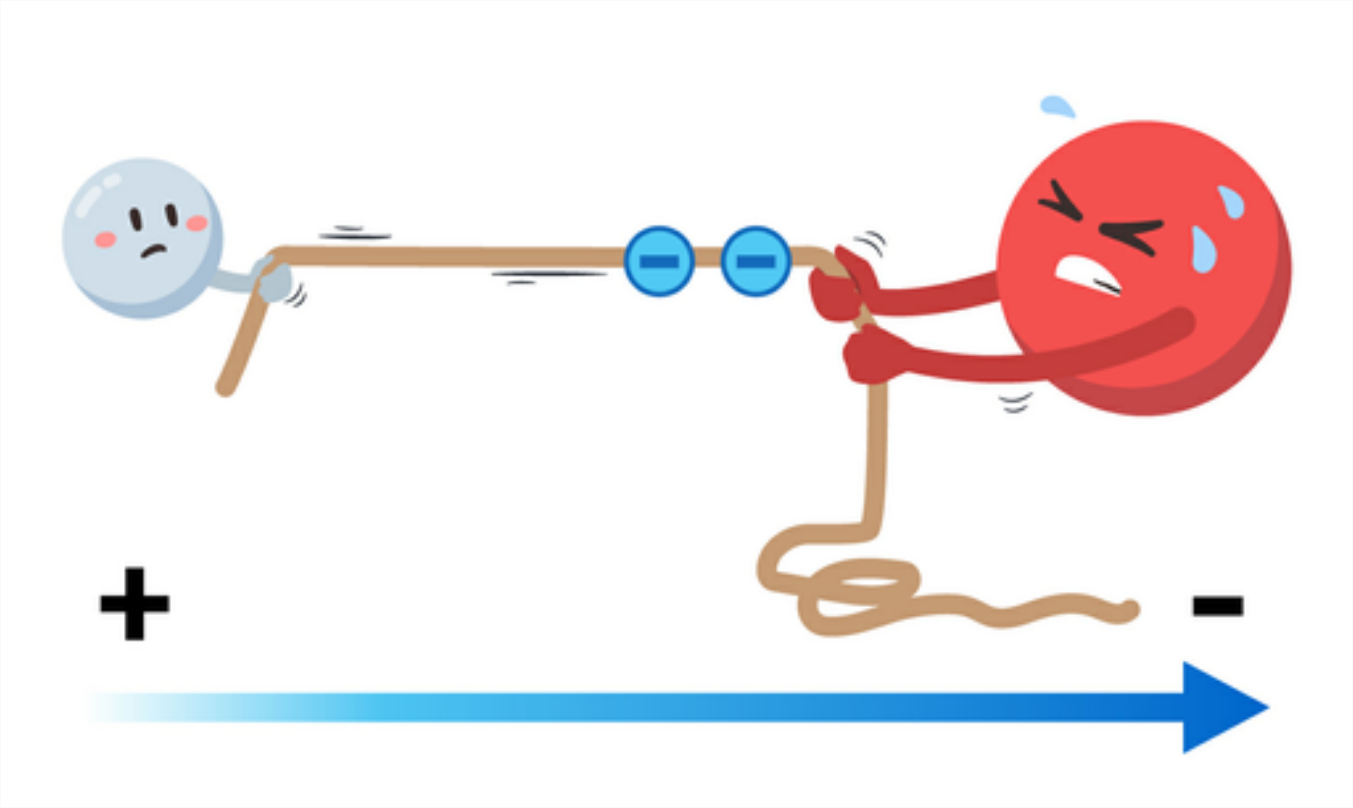
Q: For ionic bond, are the electrons shared between the cation and anion?

Covalent Bonds



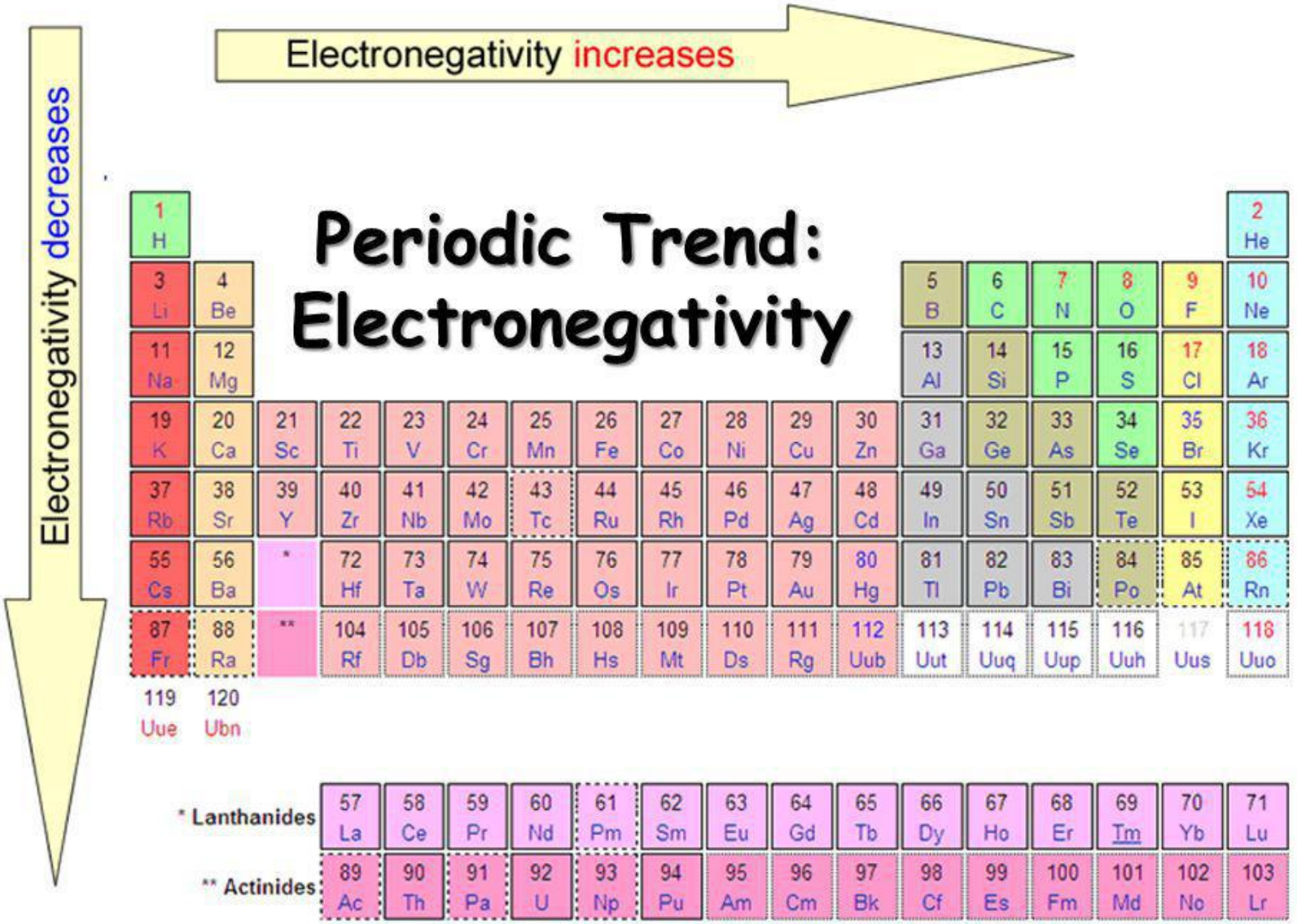
- Electrons are shared between atoms to achieve the octet rule
- *Note:* Octet rule can be broken for atoms after the 3rd row e.g. P, S, Cl, etc.

Electronegativity: Tug-of-War



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

Electronegativity Trends



Practice: Polarity

Which of the following is the most polar bond?

C–C; C–H; N–H; O–H; F–H; Se–H

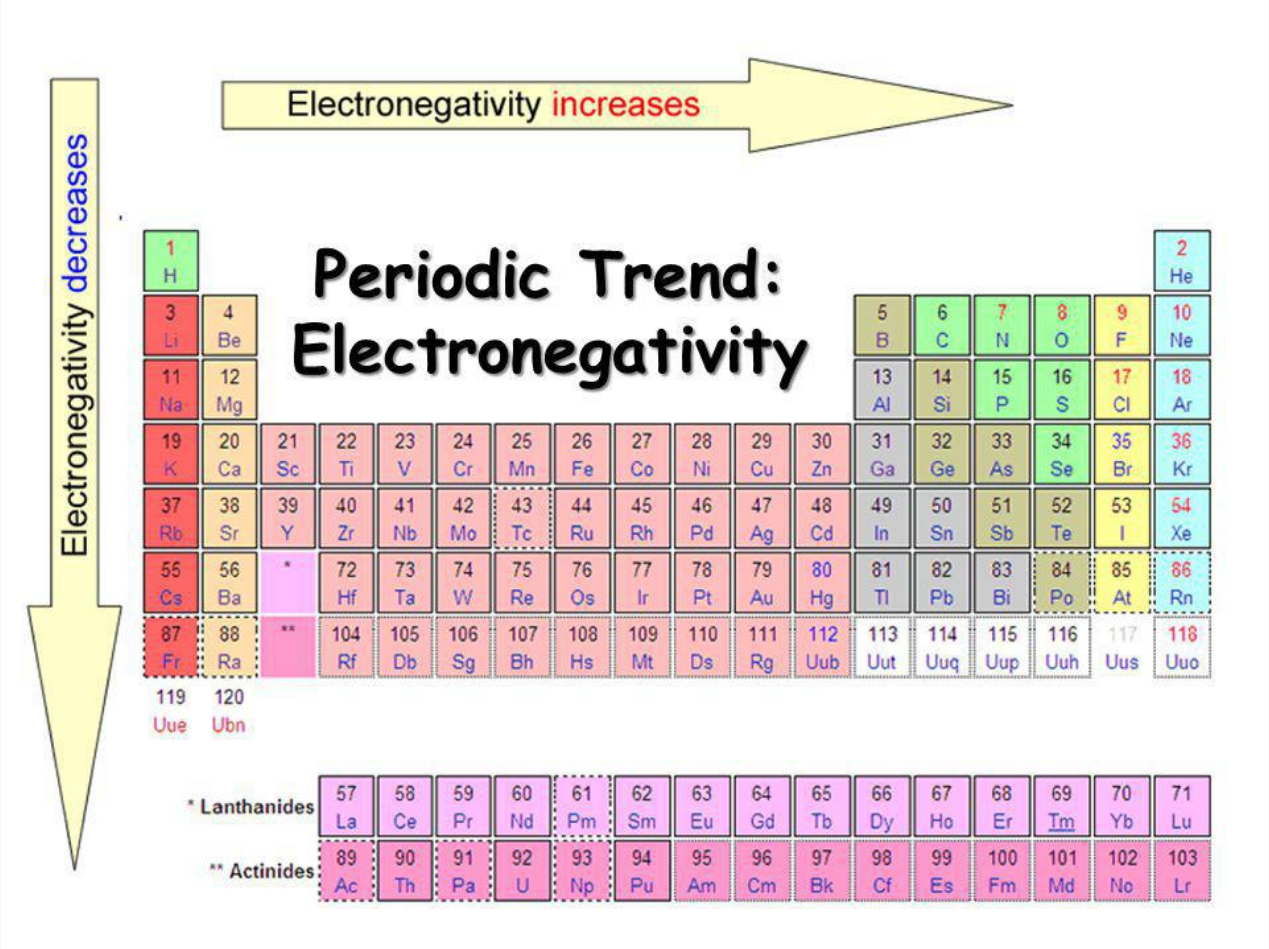
Outline

Octet Rule

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

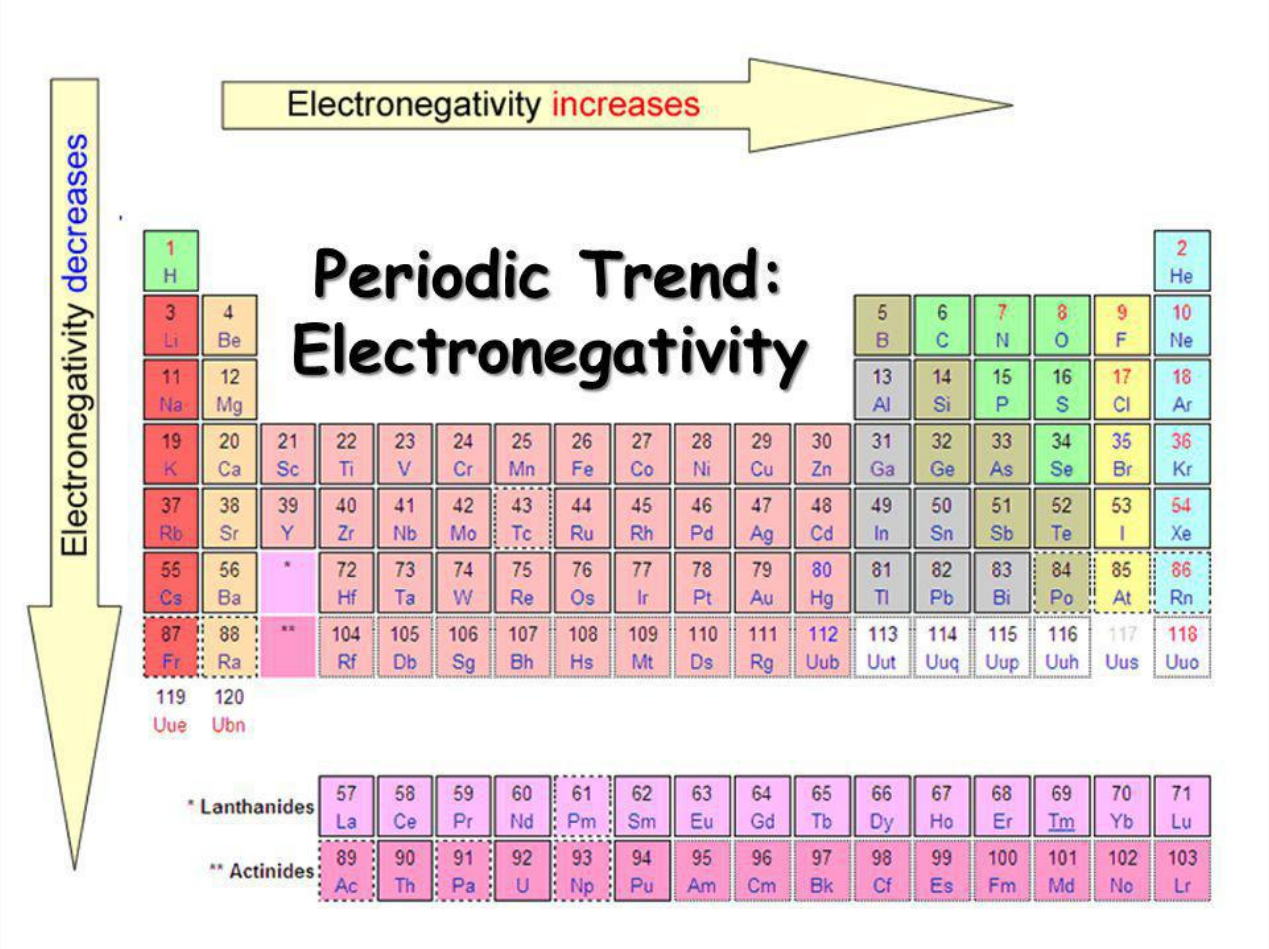
Q: How many electrons are needed for the following atoms to achieve the octet rule: C, N, O, F, Xe, and Ne

Exception to Octet Rule



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

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

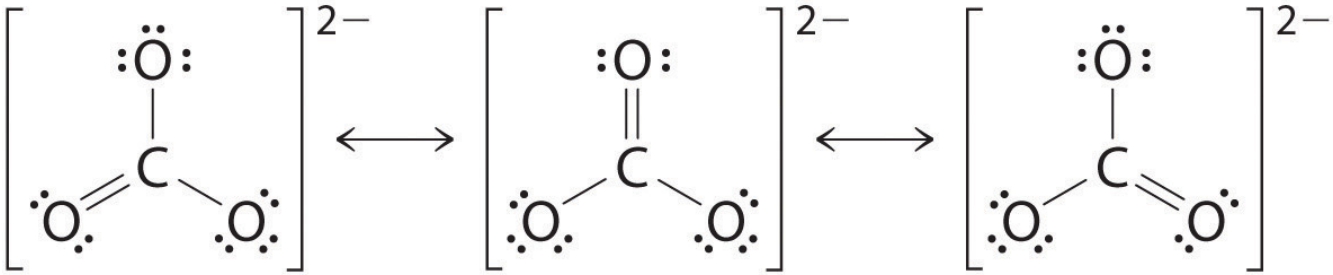
Practice: Draw Lewis Structures

Draw the Lewis structures and compute the formal charges for the following: CO_2, CN, HCl, O_3, CO_3^{2-}

Resonance Structures

As seen in the previous slide, O_3 and CO_3^{-2} have multiple structures that are valid

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



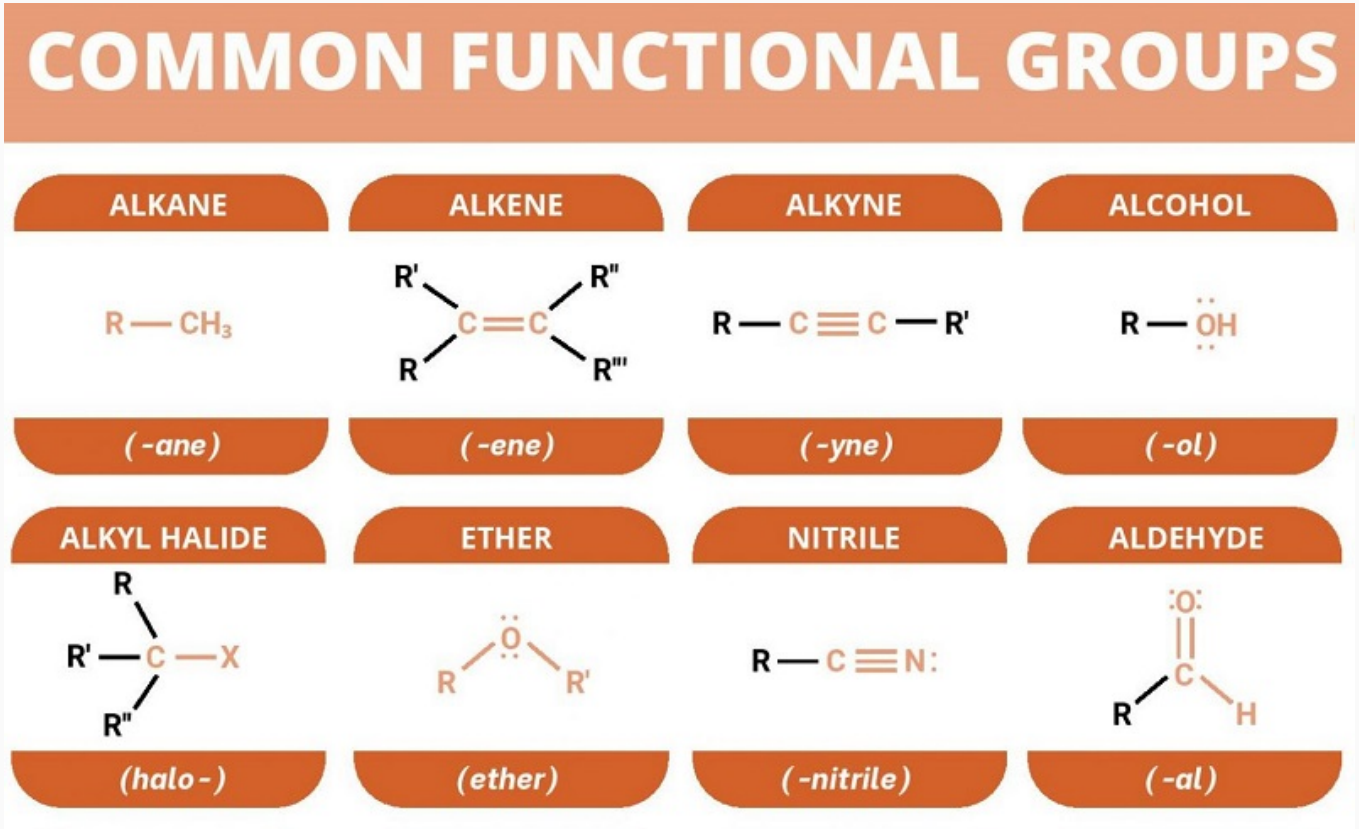
Practice: Drawing Resonance Structures

Draw the resonance structures and resonance hybrid for the following:

HCO_2^-, NO_2^-, SO_2, CNS^-, and N_2O

Functional Groups in Hydrocarbons

Functional Groups - derivatives of a hydrocarbon



where R represents hydrocarbon component

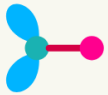
Practice: Drawing Hydrocarbons

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

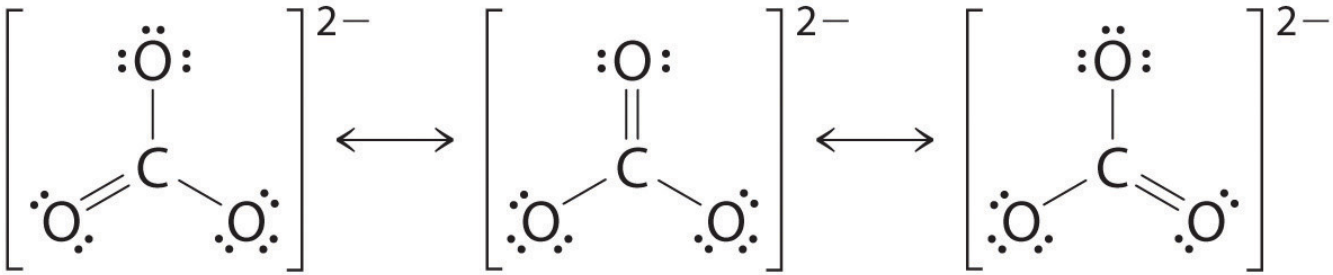
Outline

VSEPR Theory

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

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

Bond Polarity and Molecular Polarity



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

Practice: Determine the Geometry

CO_2, CN, HCl, O_3, CO_3^{2-}, CH_4, C_3H_8, CH_8, C_2H_2