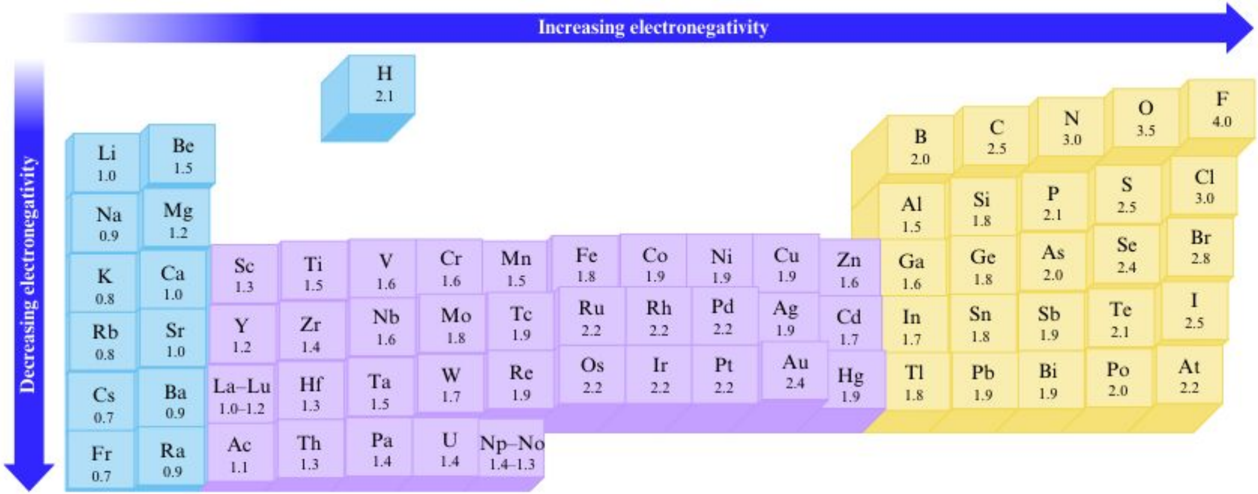
Lesson 11
Bonding

Electronegativity

The ability of an atom in a molecule to attract shared electrons to itself



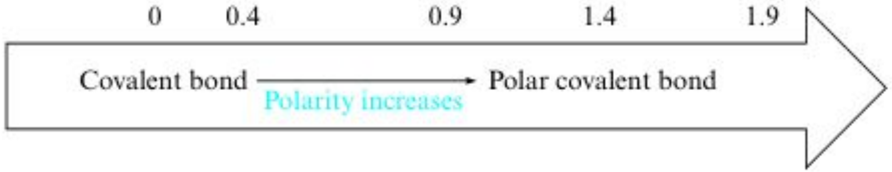
Difference in electronegativity affects the polarity and ionic character of a bond

Electronegativity

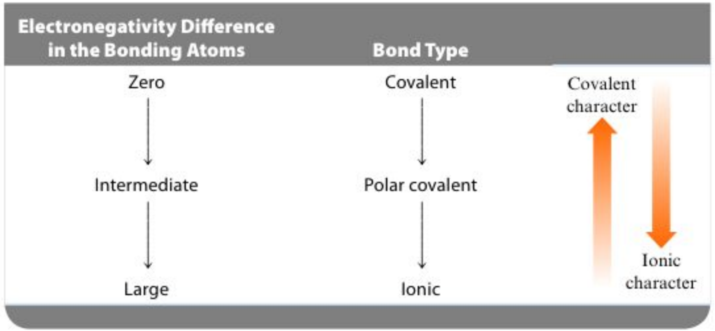
Small differences in EN - nonpolar covalent bond

Medium differences in EN - polar covalent bond

Large differences in EN - ionic bond



- Dipole moments are formed when there is a partial positive and negative charge in a molecule



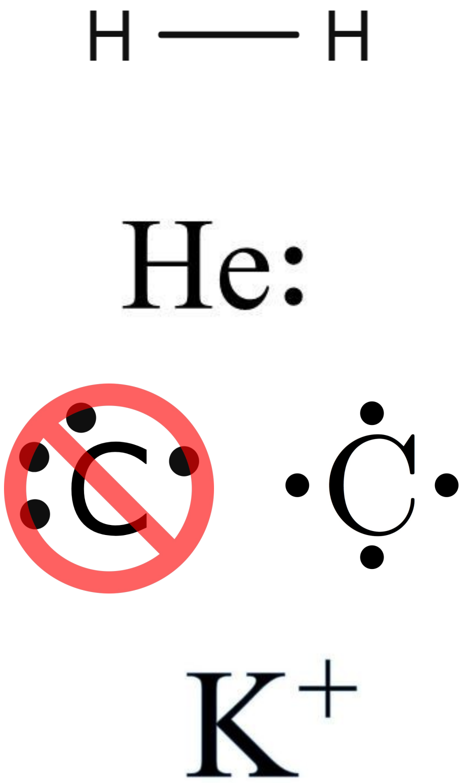
Electronegativity Difference in the Bonding Atoms	Bond Type
Zero	Covalent
Intermediate	Polar covalent
Large	Ionic

Lewis Structure

Method for showing how valence electrons are arranged around atoms in a molecule → most important goal is for atoms to achieve a full octet

- Hydrogen - duet rule, sharing 2 electrons
- Noble gases - do not form bonds
- Other nonmetals: octet rule

Cations and anions have different Lewis structures than their neutral forms



Lewis Structure

Steps to Draw Lewis Structures

1. Count total valence electrons (include positive/negative charges)
2. Write skeletal structure (central atom is usually least EN element)
3. Distribute electrons to outer atoms
4. Place remaining electrons on the central atom
5. Form double or triple bonds if necessary
6. Check formal charges (must be as close to 0 as possible)
7. Finalize the structure

Lewis Structure

Give the Lewis structure for each molecule:

a. HF

b. N_2

c. NH_3

d. CH_4

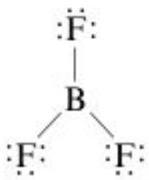
e. CF_4

f. NO^+

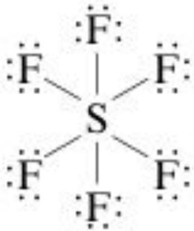
Lewis Structure

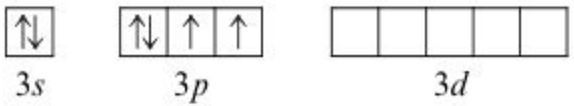
Exceptions to octet rule:

- Boron tends to form three bonds, ex. BF_3



- Some atoms exceed the octet rule (Period 3 elements and beyond), ex. SF_6
  - This is due to the empty 3d orbitals which can be used to place extra electrons for bonds





Lewis Structure

Give the Lewis structure for each molecule:

a. ClF_3

b. XeO_3

c. $RnCl_2$

d. $BeCl_2$

e. ICl_4^-

Resonance

Formal charge - difference between number of valence electrons of free atom and the number of valence electrons of atom in the molecule

$$FC = V - N - \frac{B}{2}$$

FC = formal charge
V = number of valence electrons
N = number of nonbonding valence electrons
B = total number of electrons shared in bonds

Use the equation to determine the formal charge of nitrogen in NO_3^-

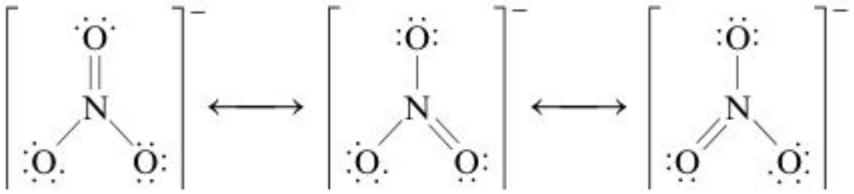
Other method to determine formal charge:

1. Count the number of things attached to an atom
2. FC = neutral VE - things attached

Resonance

Occurs when more than one valid Lewis structure can be written for a particular molecule

- Resonant structures form very stable molecules



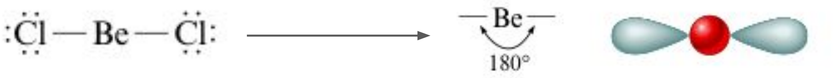
Double headed arrows represent resonant structures

Ex. Draw the resonance structures for O_3

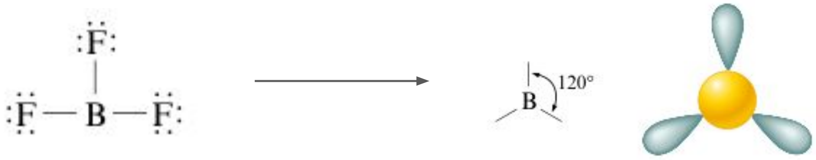
Molecular Structure

Valence Shell Electron Pair Repulsion (VSEPR) model -
geometry that limits the repulsion between atoms in a molecule

How can we make atoms as far away from each other?

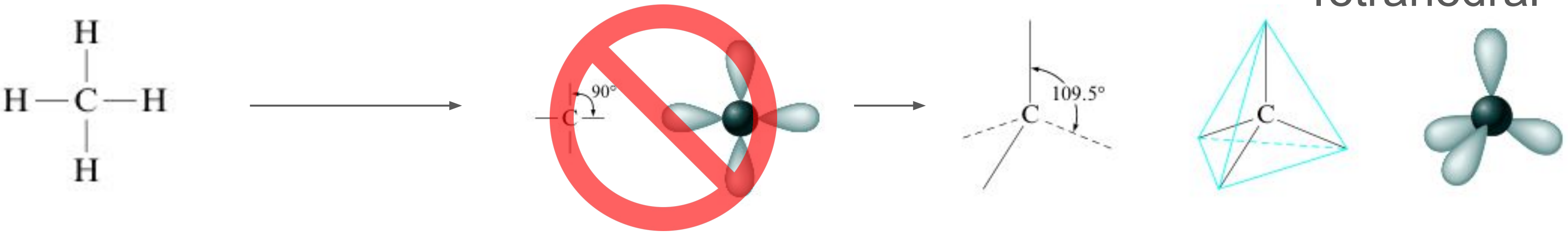


Linear



Trigonal Planar

Tetrahedral

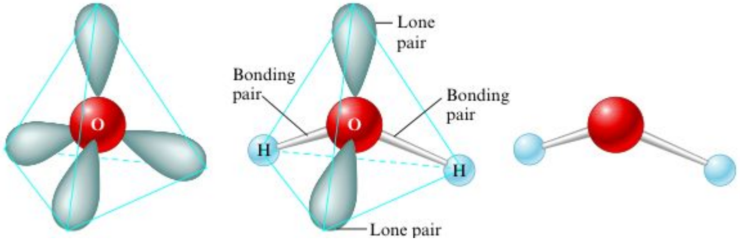


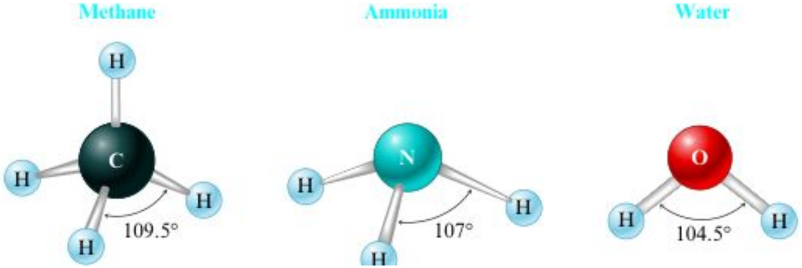
Molecular Structure

Lone pairs also affect the structure of atoms in VSEPR

- Electrons have lots of repulsion so they will repel other atoms and change the bond angles

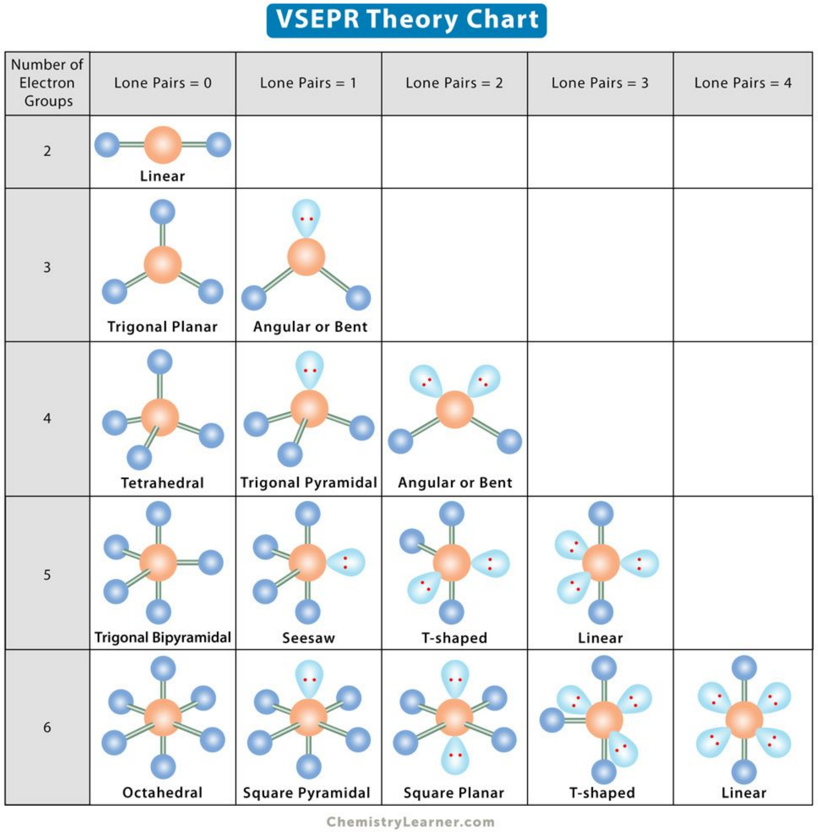
Ex. H_2O - tetrahedral form with 2 lone pairs → Bent





Compare bond angles of tetrahedral structures with different numbers of lone pairs

Molecular Structure



Give the name for the following molecules and predict their VSEPR structures:

a. XeF_4

b. ClF_3

c. PCl_5

d. BrF_5

e. IF_7