The Octet Rule: Examples

- For ions we must adjust the number of electrons available, *A*:
  - Add one e^- to *A* for each negative charge
  - Subtract one e^- from *A* for each positive charge

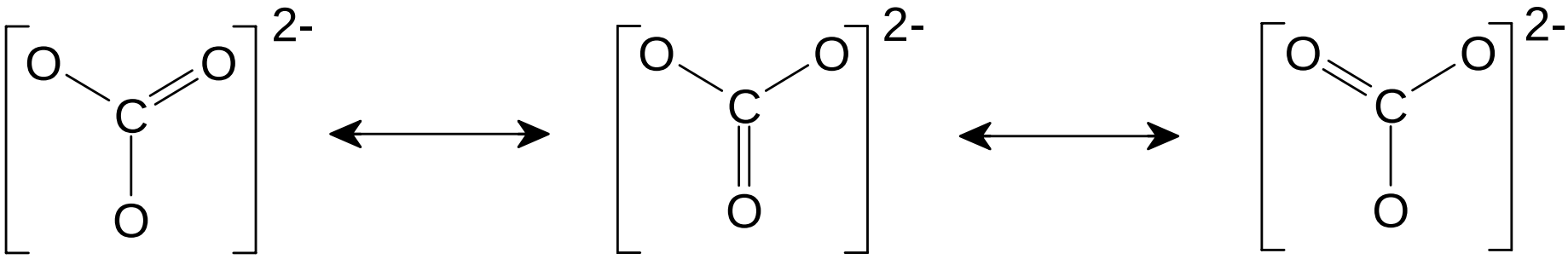
- NH_4^+

- BF_4^-

Example: CO_3^{2-}

Resonance

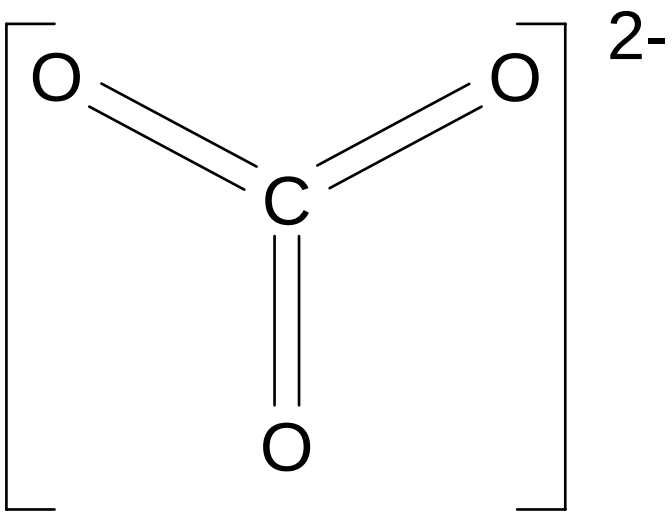
- There are three possible structures for CO_3^{2-}
  - The double bond can be placed in one of three places



- These are called equivalent <u>resonance structures</u>
- The real structure of the CO_3^{2-} anion is an average of these three resonance structures

Resonance

- There are no single or double bonds in CO_3^{2-}
- All three bonds are equivalent
- They are intermediate between the single and double bond



Resonance: Other Examples

- SO_3

Resonance: Other Examples

- NO_3^-

Resonance: Other Examples

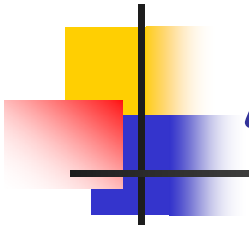
- SO_4^{2-}

Exceptions to the Octet Rule

- In those cases where the octet rule does not apply, the substituents attached to the central atom nearly always attain noble gas configurations
- The central atom does not have a noble gas configuration but may have fewer than 8 or more than 8 electrons

Examples

- BBr_3
- AsF_5

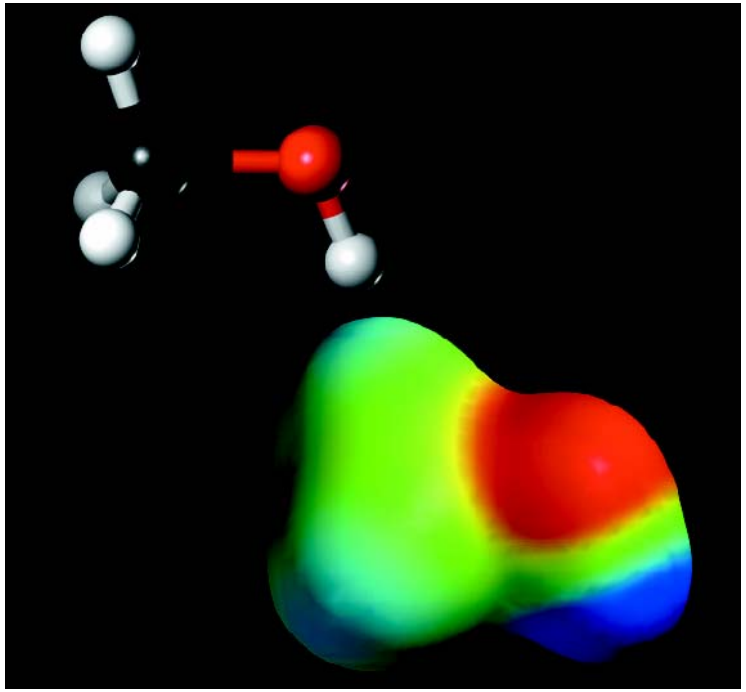


Assignments & Reminders

- Go through the recent lecture notes
- Read Chapter 7 completely,
  except for Sections 7-7 & 7-8
- Homework #4 due by Oct. 16 @ 3 p.m.
- Review Session @ 5:15 p.m. on Sunday

CHAPTER 8

- Molecular Structure & Covalent Bonding Theories



Stereochemistry

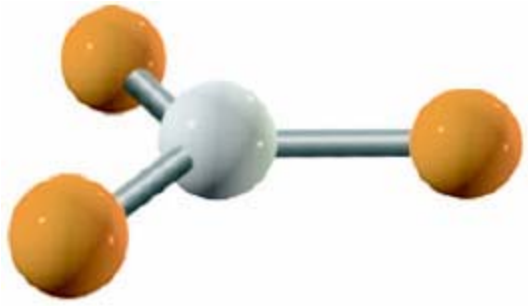
- The study of the three-dimensional shapes of molecules
- With the knowledge acquired so far we will be able to predict the shapes of molecules and ions
- Our instrument – Valence Shell Electron Pair Repulsion theory (VSEPR theory – R. J. Gillespie)

VSEPR Theory

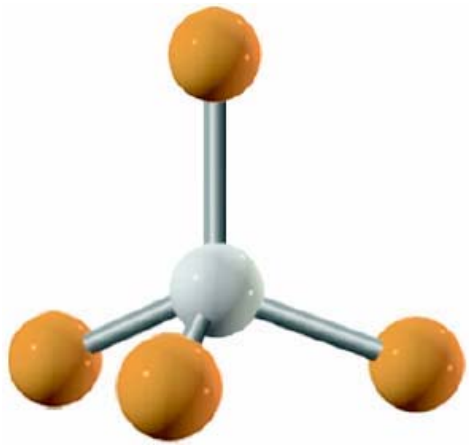
- In any molecule or ion there are regions of high electron density:
  - Bonds (shared electron pairs)
  - Lone pairs (unshared electrons)
- Due to electron-electron repulsion, these regions are arranged as far apart as possible
- Such arrangement results in the minimum energy for the system

$BeCl_2$

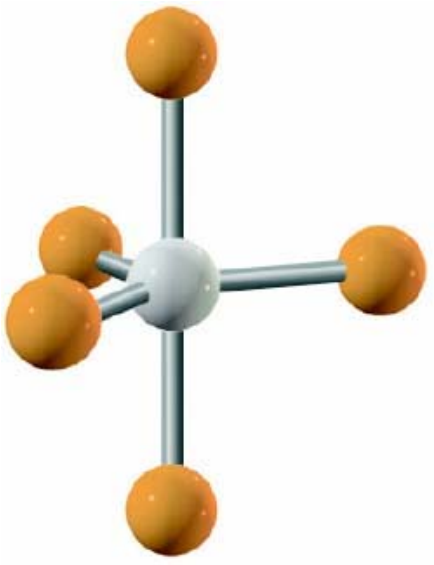
BBr_3



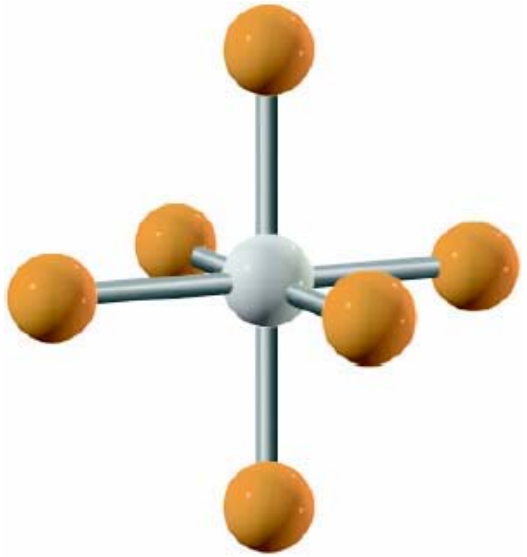
CH_4



PCl_5

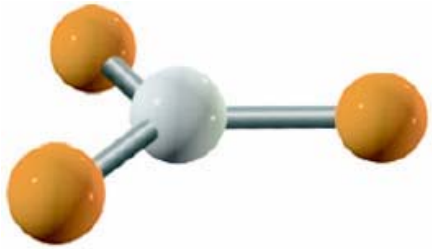


SF_6

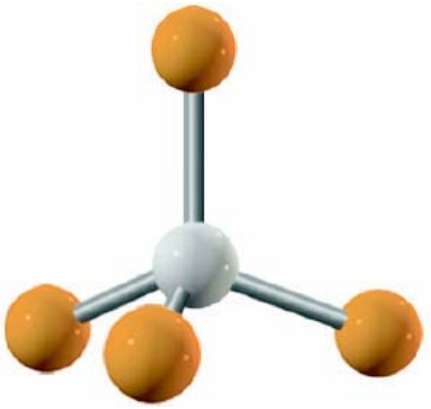


Five Basic Geometries

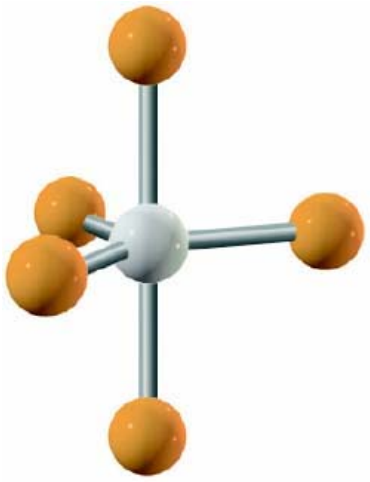
Linear



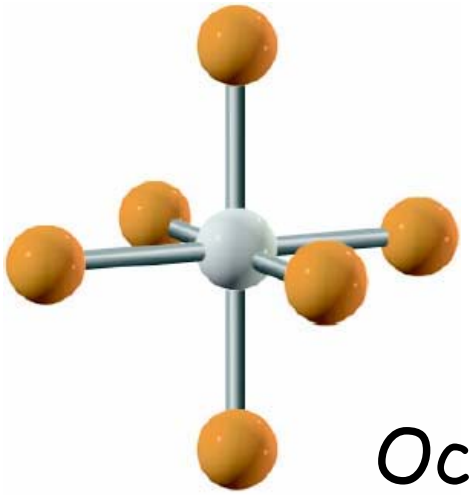
Trigonal



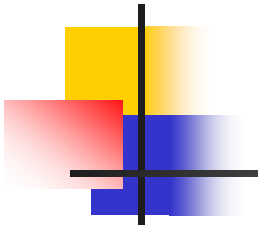
Tetrahedral



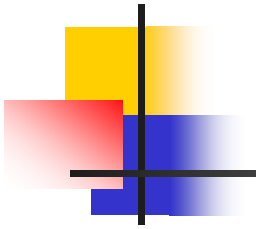
Trigonal bipyramidal



Octahedral



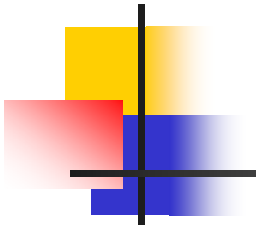
SiF_4



NH_3

Electronic Geometry and Molecular Geometry

- **Electronic geometry**
  - Distribution of regions of high electron density around the central atom
- **Molecular geometry**
  - Arrangement of atoms around the central atom



H_2O