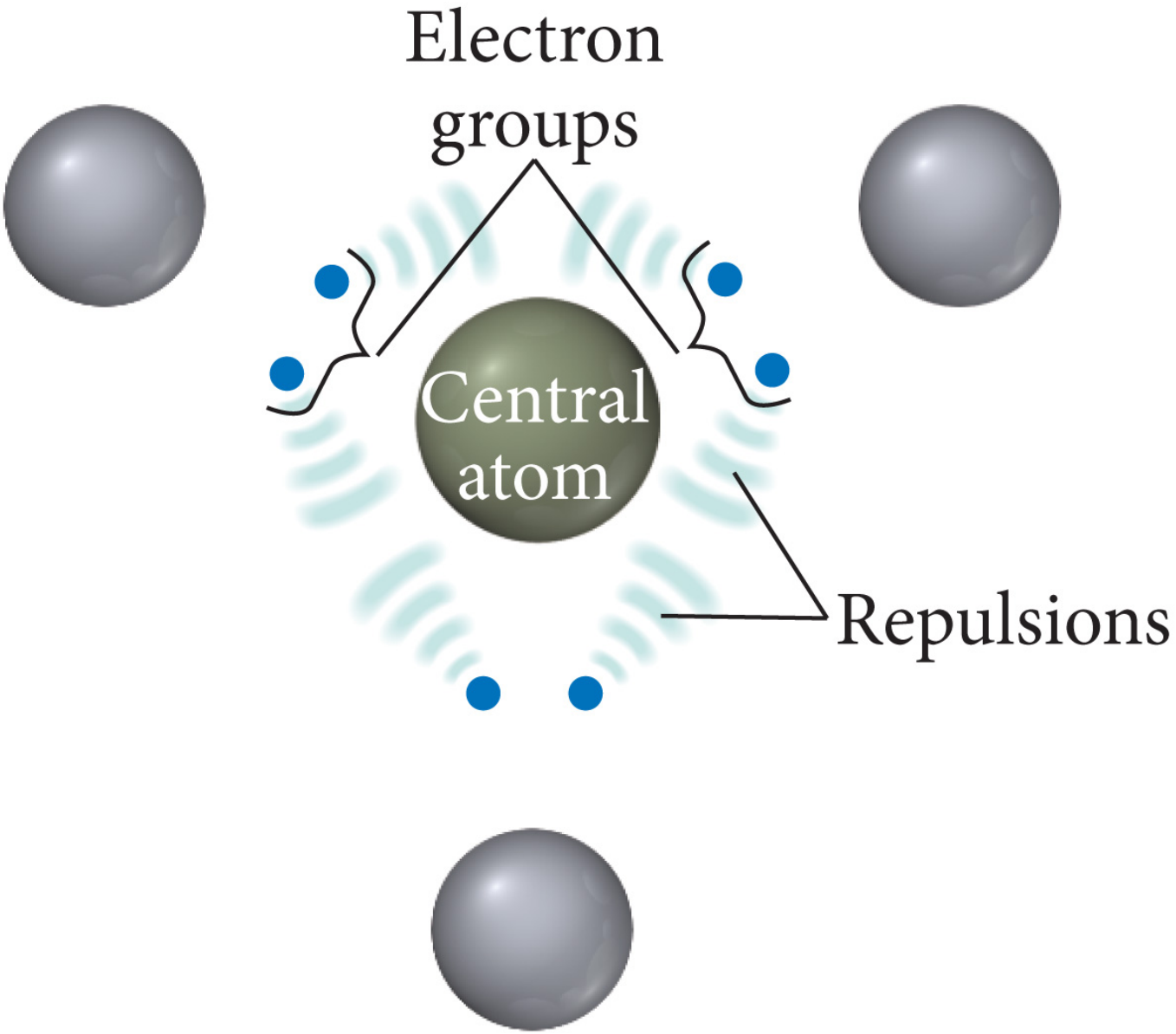
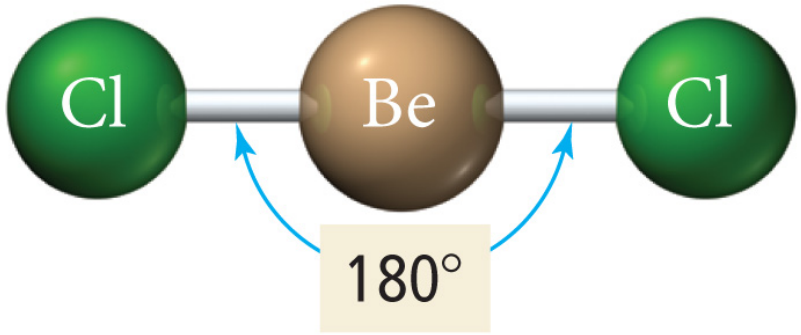
Covalent Bonding

VSEPR Shapes, Effects of Lone Pairs, Polarity

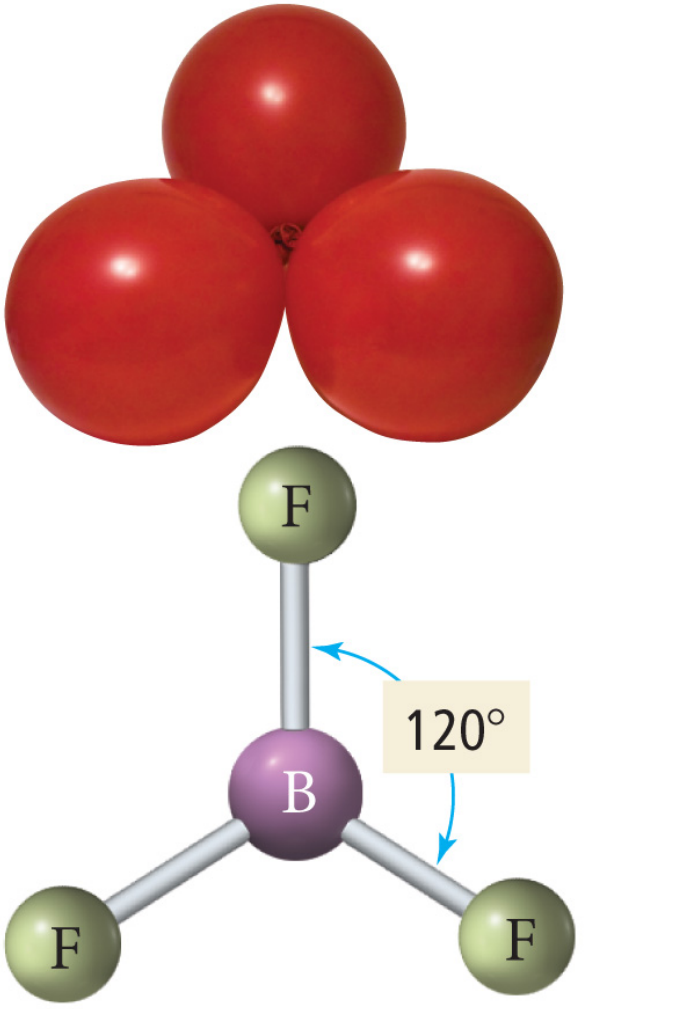

Electron groups
Central atom
Repulsions

Linear Geometry



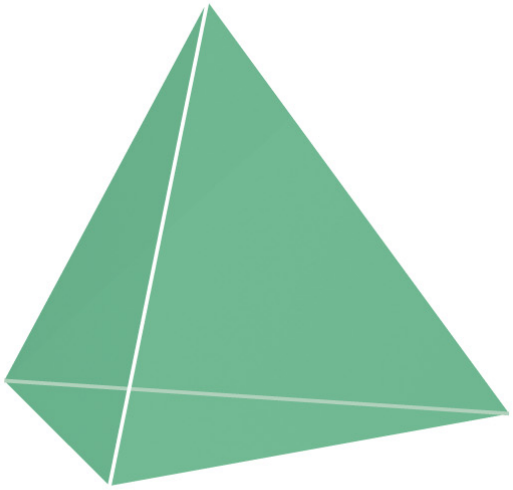
(a) Linear geometry

Trigonal Planar Geometry

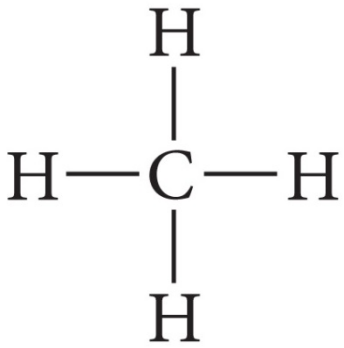


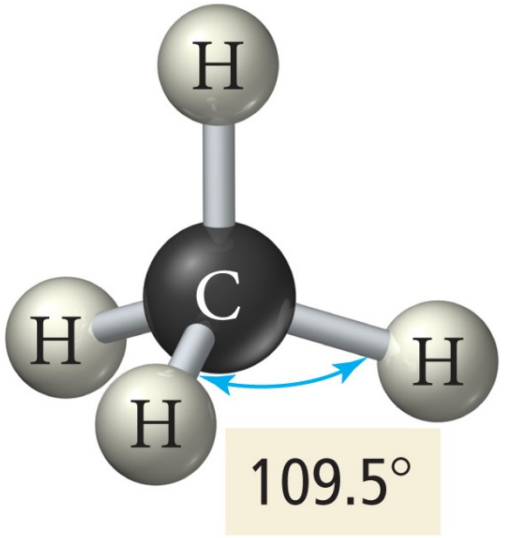
(b) Trigonal planar geometry

Tetrahedral Geometry



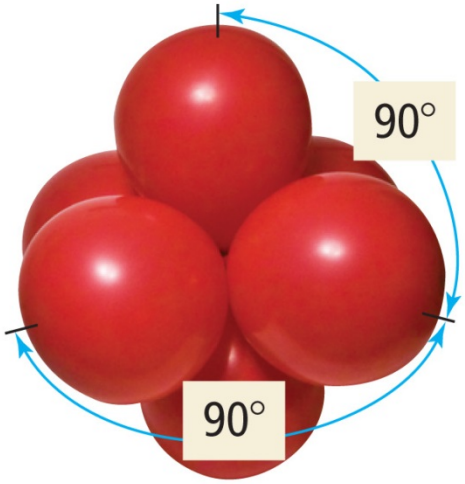
Tetrahedron





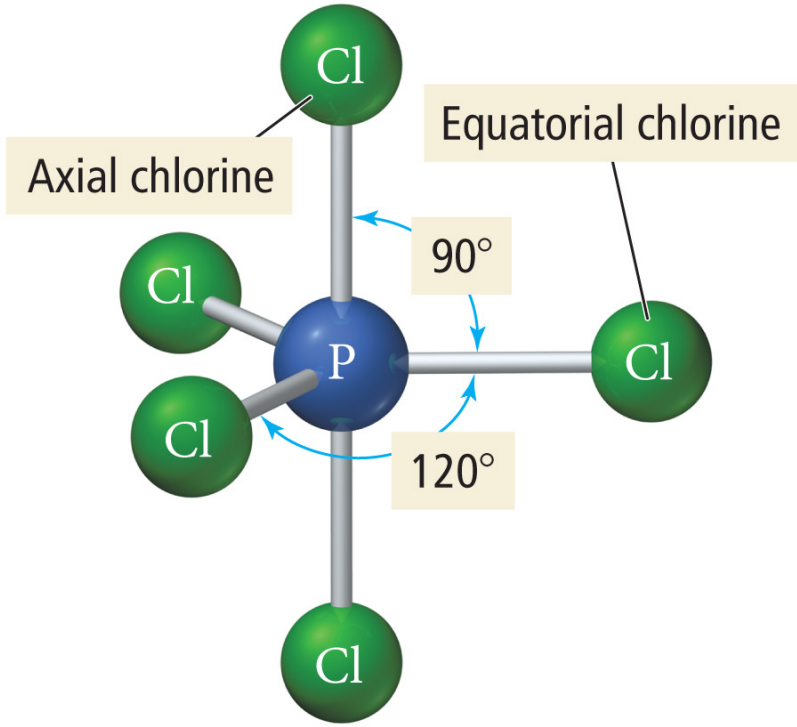
Tetrahedral geometry

Trigonal Bipyramid



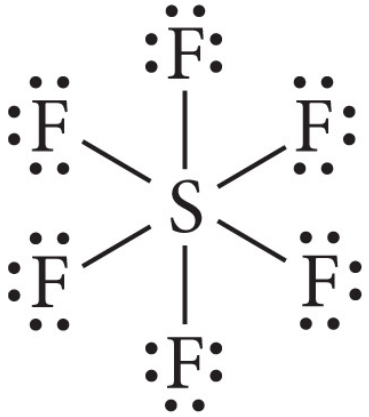
Octahedral geometry

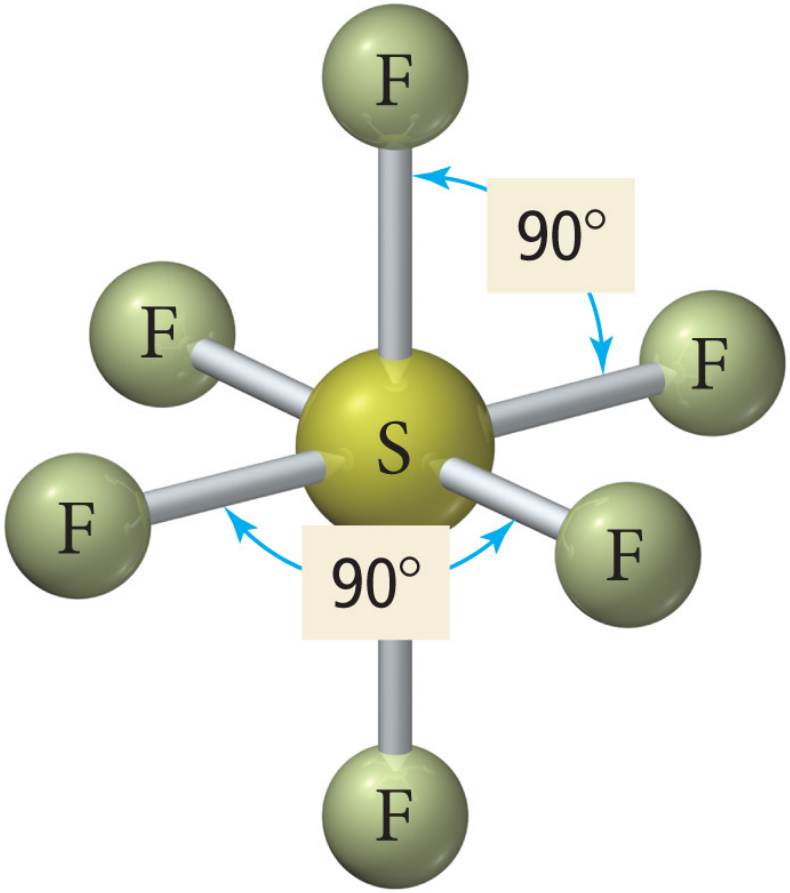
Octahedron



Trigonal bipyramidal geometry

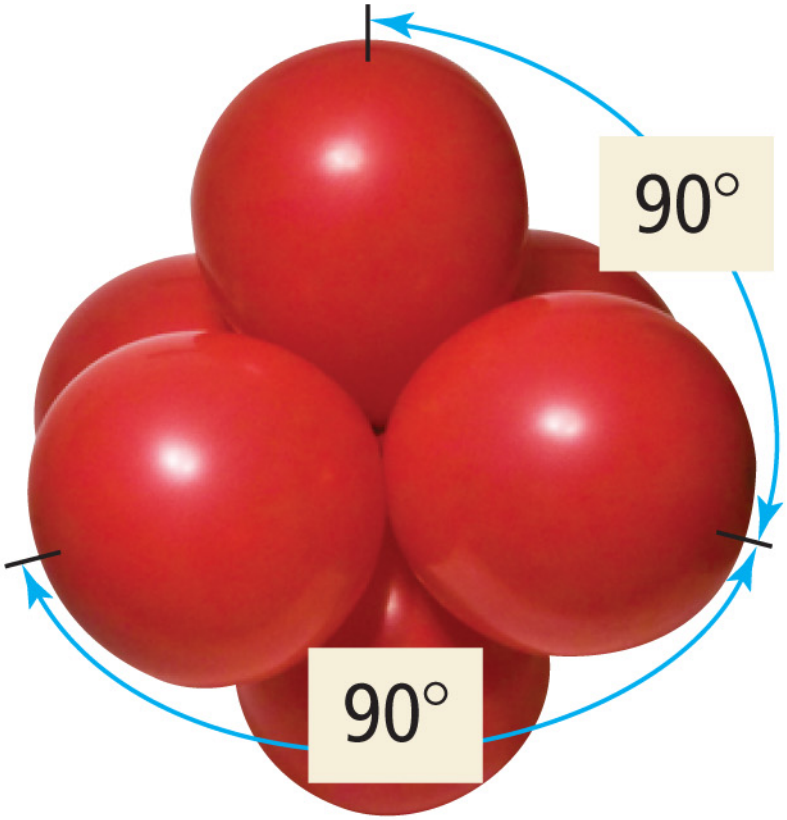
Octahedral Geometry

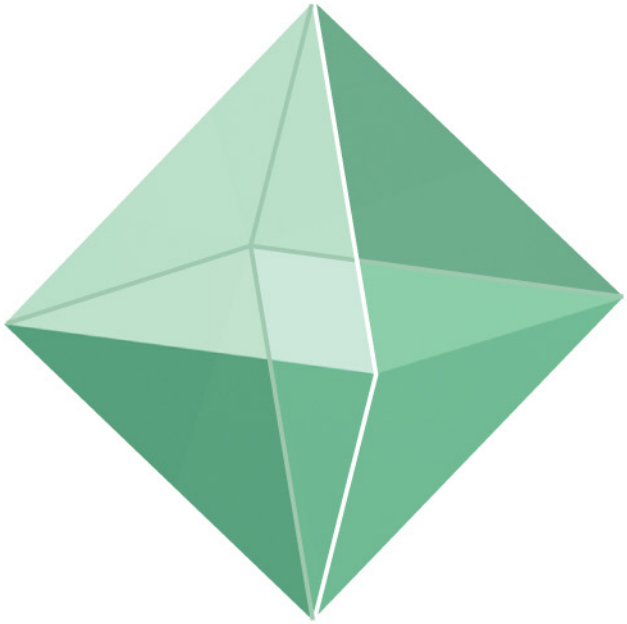




Octahedral geometry

Octahedral Geometry





Octahedral geometry

Octahedron

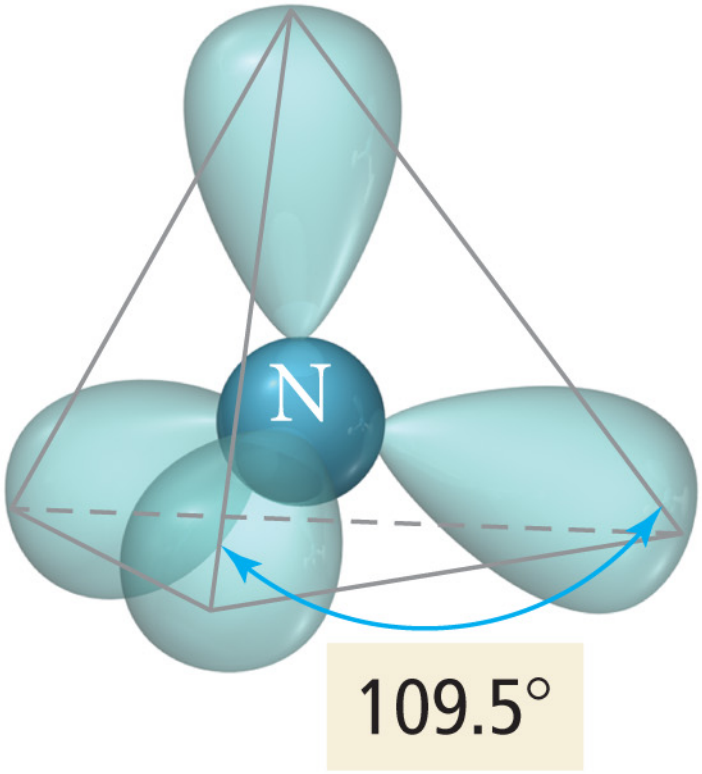
The Effect of Lone Pairs

- Lone pair groups “occupy more space” on the central atom because their electron density is exclusively on the central atom, rather than shared like bonding electron groups.
- Relative sizes of repulsive force interactions is as follows:

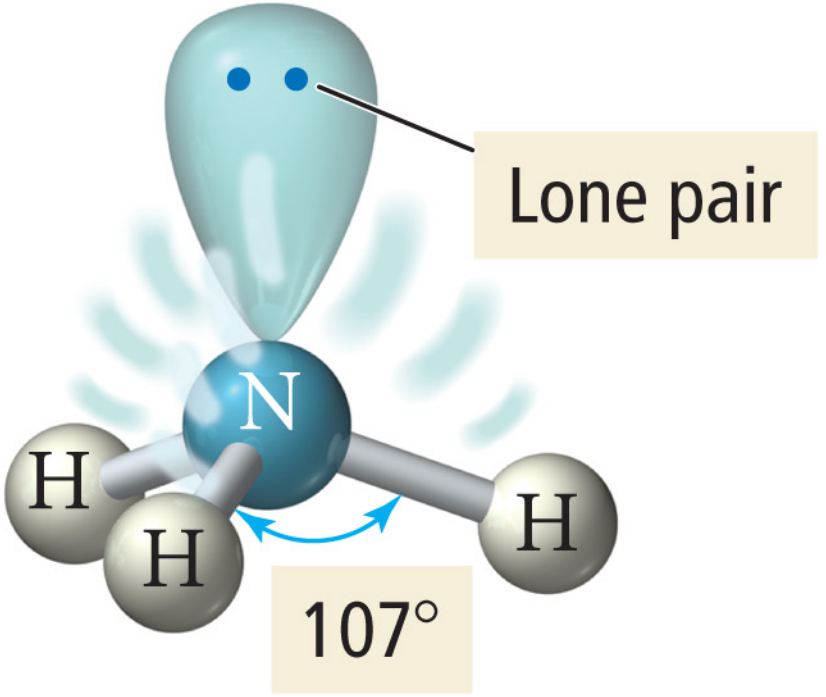
Lone Pair – Lone Pair > Lone Pair – Bonding Pair > Bonding Pair – Bonding Pair

- This affects the bond angles, making the bonding pair angles smaller than expected.

Bond Angle Distortion from Lone Pairs

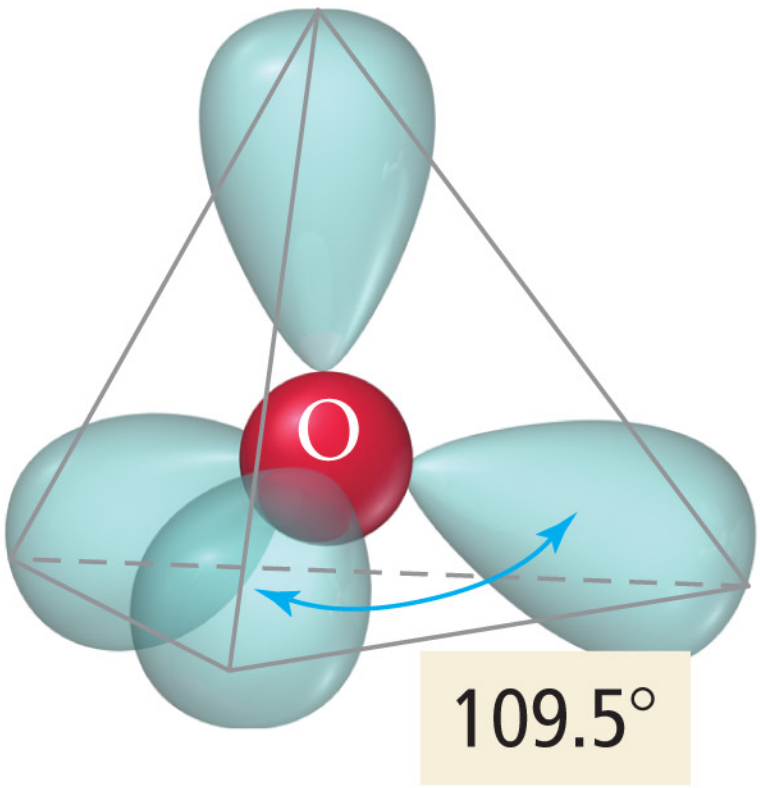


Ideal tetrahedral geometry

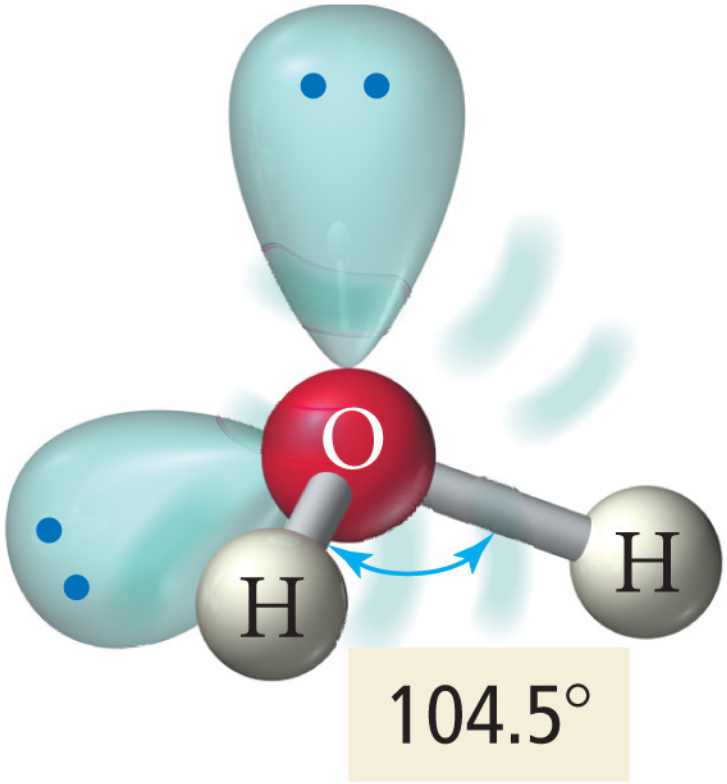


Actual molecular geometry

Bond Angle Distortion from Lone Pairs



Ideal tetrahedral geometry



Actual molecular geometry

Polarity of Molecules

- **For a molecule to be polar it must**
  1. **have polar bonds.**
     - **Electronegativity difference – theory**
     - **Bond dipole moments – measured**
  2. **have an asymmetrical shape.**
     - **Vector addition**
- **Polarity affects the intermolecular forces of attraction.**
  - ✓ **Therefore, boiling points and solubility's**
    - **Like dissolves like**
- **Non-bonding pairs affect molecular polarity, strong pull in its direction.**