

# Molecular Structure

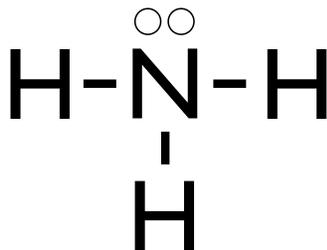
## VSEPR Theory

### Molecular Structure

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#### VSEPR Theory

- VSEPR Theory
  - Valence Shell Electron Pair Repulsion Theory
    - The three dimensional structure of molecules can be explained by the repulsion between the “electron domains” surrounding a central atom
  - Electron domains include...
    - Bonding pairs of electrons
      - Multiple bonds count as one domain
    - Non-bonded pairs of electrons
- We begin our discussion of molecular shape by looking at electron-domain geometries



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## VSEPR



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## VSEPR Theory

**T-76**  
Table 9.2

**Electron-Pair Geometries and Molecular Shapes for Molecules with Two, Three, and Four Electron Domains around Central Atom**

**TABLE 9.2** Electron-Pair Geometries and Molecular Shapes for Molecules with Two, Three, and Four Electron Domains About the Central Atom

Total Electron Domains	Electron-Domain Geometry	Bonding Domains	Nonbonding Domains	Molecular Geometry	Example
2 pairs	 Linear	2	0	 Linear	$\text{O}=\text{C}=\text{O}$
3 pairs	 Trigonal planar	3	0	 Trigonal planar	$\text{BF}_3$
		2	1	 Bent	$[\text{NO}_2]^-$
4 pairs	 Tetrahedral	4	0	 Tetrahedral	$\text{CH}_4$
		3	1	 Trigonal pyramidal	$\text{NH}_3$
		2	2	 Bent	$\text{H}_2\text{O}$

## Molecular Structure

### Atoms with more than an octet

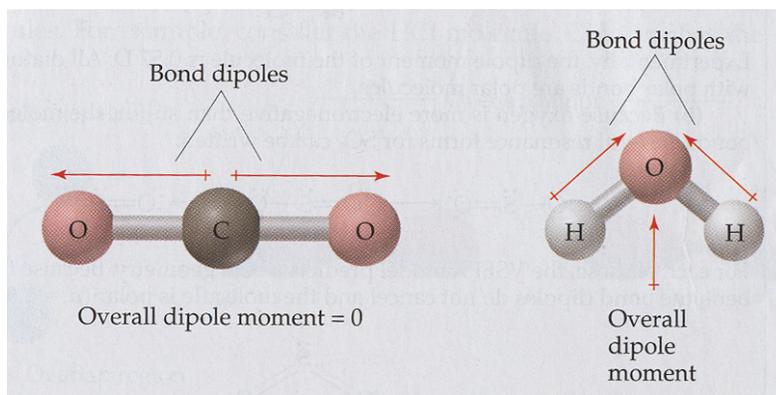
TABLE 9.3 Electron-Domain Geometries and Molecular Shapes for Molecules with Five and Six Electron Domains About the Central Atom

Total Electron Domains	Electron-Domain Geometry	Bonding Domains	Nonbonding Domains	Molecular Geometry	Example
5 domains		5	0	Trigonal bipyramidal	$\text{PCl}_5$
		4	1	See-saw	$\text{SF}_4$
		3	2	T-shaped	$\text{ClF}_3$
		2	3	Linear	$\text{XeF}_2$
6 domains		6	0	Octahedral	$\text{SF}_6$
		5	1	Square pyramidal	$\text{BrF}_5$
		4	2	Square planar	$\text{XeF}_4$

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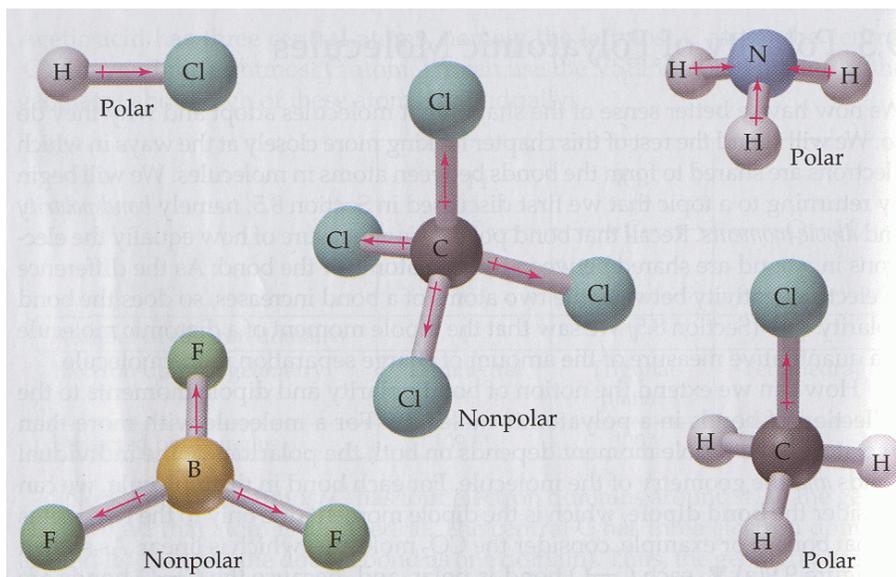
### Molecular Polarity

- Combining the concepts of polar covalent bonding and molecular geometries allows us to examine the polar nature of molecules
- Polar molecules must meet two criteria
  - Contain polar covalent bonds
    - Generally the case, except for the diatomics
  - Be non-symmetrical in such a way that there is a net imbalance in force (a moment)



## Molecular Structure

### Molecular Polarity



## Molecular Structure

### Homework

- 9.1 / 9.2 / 9.3 / 9.4 / 9.5 / 9.16 / 9.21 / 9.22 / 9.24 / 9.25 / 9.27 / 9.30 / 9.37 / 9.41 / 9.44