Bonding

Ch 8 and 9

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Objectives

- Draw Lewis dot structures to satisfy octet rule
- Understand VSEPR as it applies to molecular shapes
- Identify a molec as polar or nonpolar
- Determine IMF for molecules

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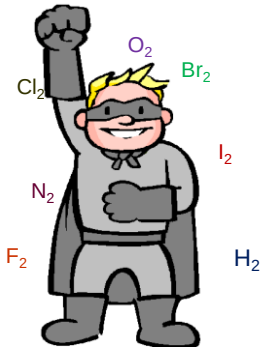
Mild-mannered
BrINClHOF



Diatomic Man

Covalent Bonding

- Molecular compounds
- Properties of molecules with covalent bonds:
  - Lower melting and boiling point than ionic compounds
    - Can be liquids or gases at room temperature
    - Sometimes can be solids
  - Molecules attracted to each other as strongly so it takes less heat to melt or boil

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- Atoms **share** electrons to satisfy octet rule
- Lewis dot structures:
  - Use only valence electrons
  - Share to get 8 electrons
  - Exceptions: B likes 6 e^-, H and He happy with 2 e^-

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Lewis structures for molecules

1. Count the number of total valence electrons in molecule
2. Determine # electron pairs
3. Write the atoms in the order they'll go
   a. Atom with lowest IE in center
   b. H never in center
4. Make a bond (2 e^-) between each atom
5. Complete octet with more bonds or lone pairs of e^-

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Practice

- Water
- Hydrofluoric acid (HF)
- Ammonia (NH_3)
- Methane (CH_4)
- Hydrosulfuric acid (H_2S)
- Chloroform ($CHCl_3$)
- Boron trifluoride

<u>Double/Triple</u>

- Oxygen (O_2)
- Hydrogen cyanide (HCN)
- Carbon dioxide

<u>Not double/triple, just a little more complicated</u>

- Methanol (CH_3OH)
- C_2H_6

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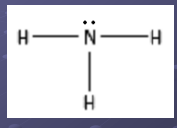
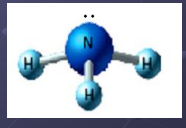
Molecular Shapes

- VSEPR—Valence Shell Electron Pair Repulsion
  - Electrons want to get as far away from each other as possible
  - Electron pairs (lone pairs) take up more room than a bond





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Molecule	# Atoms bonded to central atom	# Lone pairs (not bonded)	Molecular shape
CO_2	2	0	Linear
BF_3	3	0	Trigonal planar
CH_4	4	0	Tetrahedral
H_2O	2	2	Bent
O_3	2	1	Bent
NH_3	3	1	Pyramidal

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- What are the shapes of:
  - Oxygen difluoride
  - Hydrobromic acid (HBr)
  - Boron trichloride
  - Carbon tetrabromide

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- Use dot structures and model kits to determine the shapes of:
  1. Nitrogen
  2. Hydrophosphoric acid, H_3P
  3. Hydrogen cyanide
  4. Hydrobromic acid, HBr
  5. Boron trifluoride
  6. Silicon dioxide
  7. Ammonia (NH_3)
  8. Methane (CH_4)
  9. Hydrosulfuric acid, H_2S
  10. Carbon tetrachloride
  11. Chloroform ($CHCl_3$)
  12. H_2CO

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Polar vs Nonpolar

- Use electronegativities and shapes
- A molec is polar if one end is more negative (hogs e^-) and the other more positive
- H—F
  - F is more electronegative
  - You can divide the molec into positive and negative ends

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Dot structure, model, polarity

- Polar or nonpolar?
  - CH_2Cl_2
  - Hydrobromic acid (HBr)
  - Boron trichloride
  - Carbon tetrabromide
  - Water

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Intermolecular Forces

- Hold molecules together
- Strong IMF—high melting and boiling points
  - Solids or liquids at room temp
- Weak IMF—low MP and BP
  - Gases at room temp

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- Ionic bonds
- Hydrogen bonds
  - Polar molecules
  - must have H
  - Must have 1: Nerd On a Flagpole
- Dipole interactions*
  - Polar molecules
- Dispersion forces*
  - Also called London forces
  - Nonpolar molecules

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- What kind of forces hold these molecules together?
  - CH_2Cl_2
  - Hydrobromic acid (HBr)
  - Boron trichloride
  - Water
  - Calcium chloride

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- Which will have the highest melting/boiling point? Lowest? Put them in order
  - CH_2Cl_2
  - Boron trichloride
  - Water
  - Calcium chloride

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Determine IMF and high/low MP

1. Nitrogen
2. Hydrophosphoric acid, H_3P
3. Hydrogen cyanide
4. Hydrobromic acid, HBr
5. Boron trifluoride
6. Silicon dioxide
6. Ammonia (NH_3)
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9. Carbon tetrachloride
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