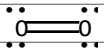
Structure, Polarity & Physical Properties

Supplemental packet handouts 92-96

I. Lewis structure, stability, and bond energies

A. Hydrogen, oxygen, and nitrogen are present in the atmosphere as diatomic molecular gases. All are covalent molecules. Molecules act as discrete units

Diatomic Compound	Nitrogen, N_2	Oxygen, O_2	Hydrogen, H_2
Atmospheric Abundance	~80%	~20%	trace
Lewis Structure			
Bonding	triple bond	double bond	single bond
Stability	inert	supports combustion	explosive

Why is there such a great difference in reactivity (stability) among these gases?

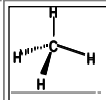
The order of stability often parallels the bond order; 3, 2, 1.
Stability is directly related to bond energy.
Bond energy is defined as the amount of energy required to break a bond holding two atom together.

	triple bond	> double bond	> single bond
Bond order	3	2	1
Strength	strongest		weakest

II. **Lewis structures and molecular geometry**

A. **In order to predict molecular shape, we must inspect a molecule's Lewis dot structure.**

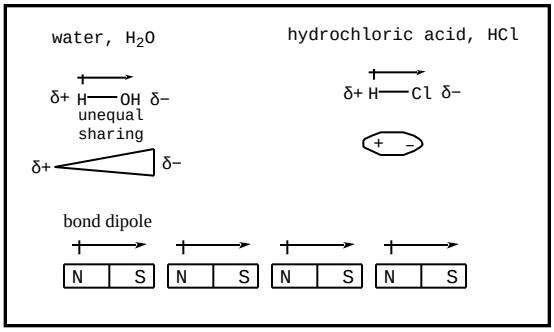
B. **The shape of a molecule plays a large part in determining its physical properties and chemical reactivity.**

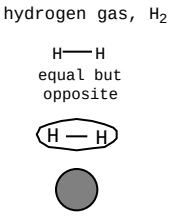
Molecular Compound	Methane, CH_4	hydrosulfuric acid, H_2S	Water, H_2O
Lewis Structure			
geometry	tetrahedral	bent	bent
polarity	nonpolar	polar	polar
intermolecular force of attraction	dispersion force	dipole-dipole force	hydrogen nonbonding force
physical state @ 25°C	gas	gas	liquid

III. Lewis Structure and Polarity

A. **Bond Polarity** - Shared electrons in a covalent bond show:

1. equal sharing between two bonding atoms
2. unequal sharing between two bonding atoms.
   a. For unequal sharing, the electrons are attracted to the more electronegative atom.
   b. A division is created in manner that the bond behaves as a **bond dipole**, like a bar magnet 
   (two "poles" or ends, one more negative and the other more positive.)
   c. the polar covalent bond division is represented by d+ and d- partial charges





B. **Molecular Polarity** - A molecule is polar if

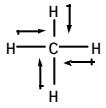
1. its centers of positive and negative charge do not coincide.

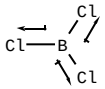
2. a molecule behaves as a dipole a

3. possesses a dipole moment.

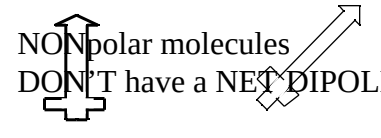
NonPolar Molecules

methane gas, CH_4 boron trifluoride, BF_3

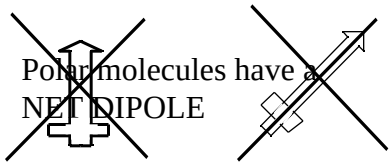




opposing bond dipoles



NONpolar molecules DON'T have a NET DIPOLE



Polar molecules have a NET DIPOLE

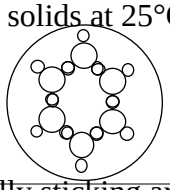
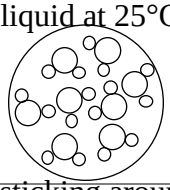
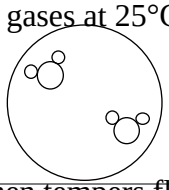
Balloon Bending Water Demostration

IV. Ramifications of Molecular Geometry on Physical State

A. Changes in Physical State and the Physical Appearance of Each State

Solid (s) ⟷ (melt / freeze) Liquid (l) ⟷ (boil / condense) Gas (g)

sublimes, sublimation occurs when a solid converts to gas without going throught the liquid state.

solids at 25°C	liquid at 25°C	gases at 25°C
		
really sticking around	sticking around	when tempers flare
strong physical attractions	moderate physical attractions	weak physical attractions

The strength of a physical attraction between molecules will determine how tolerant a molecule is of temperature

Changes in Physical State

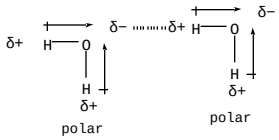
The addition of thermal energy (when tempers flare)

- causes changes in physical state
- physical attractions change NOT chemical bonds as (temperature) thermal energy is added to a substance

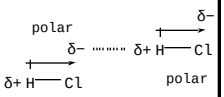
B. Boiling Point In a very general sense, the conversion of a liquid to a gaseous vapor at a given pressure. Normal boiling point is the conversion of a liquid to a gas at atmospheric pressure. When a liquid boils, the pressure of the gaseous vapor equals the external pressure (atmospheric).

polar molecules

hydrogen bonding

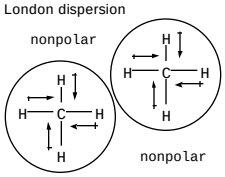


dipole-dipole



nonpolar molecules

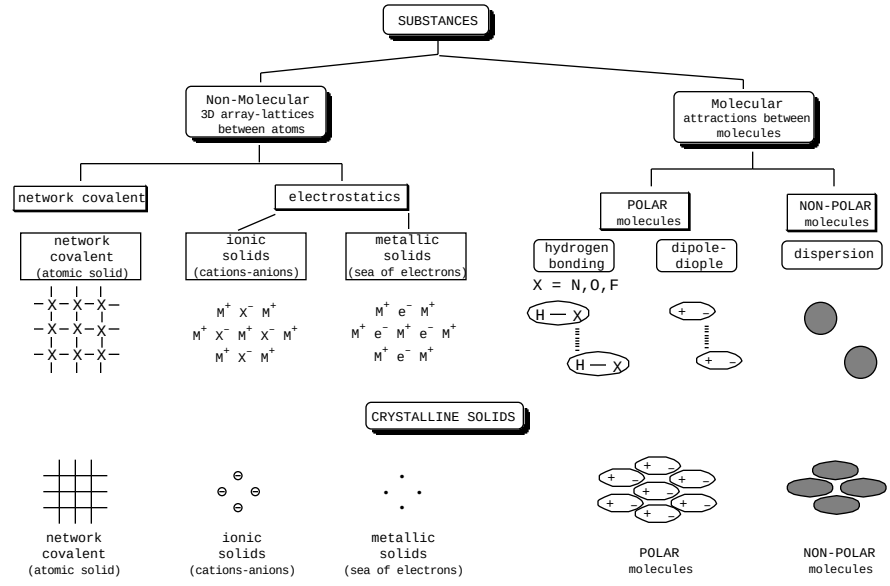
London dispersion



polar molecules are high boiling than nonpolar molecules

hydrogen bonding > dipole-dipole

Water (l) is higher boiling than HCl(g)



View the physical properties powerpoint