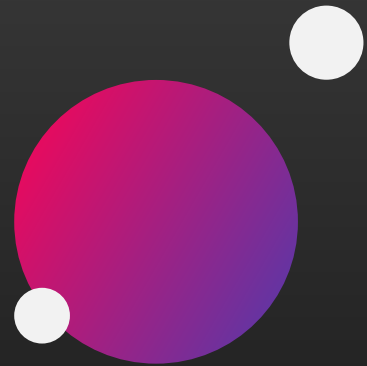
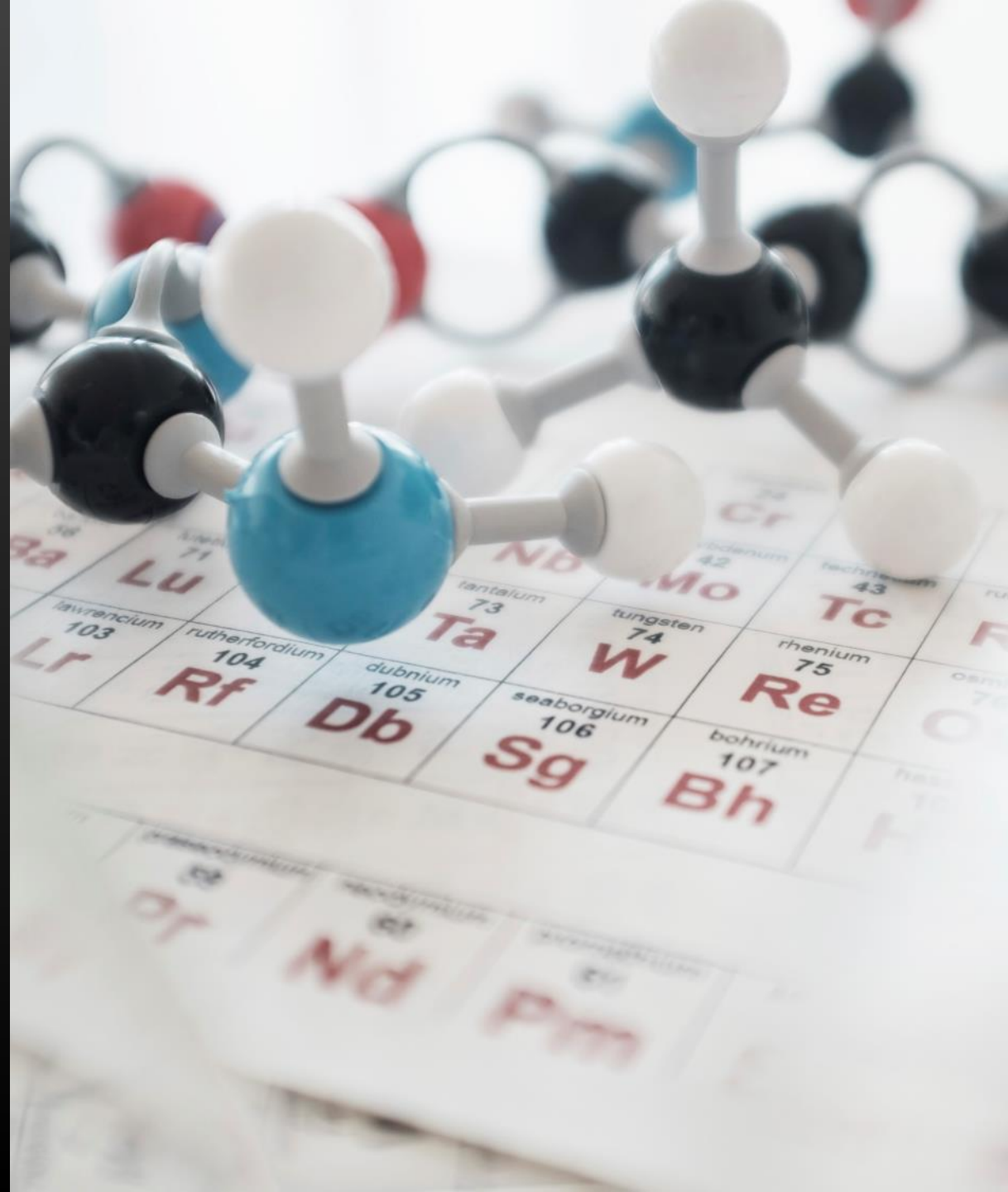


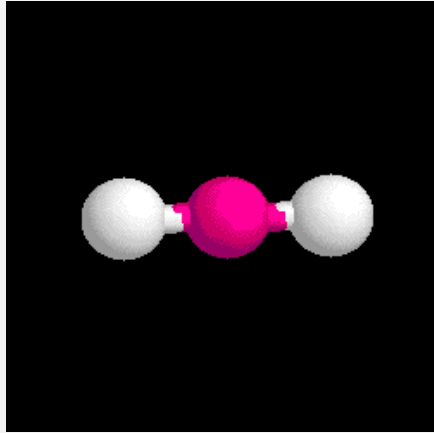


Unit 6 Intermolecular Forces & Polarity

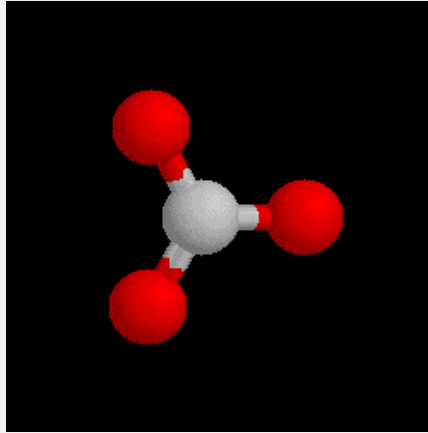
Krug 2020



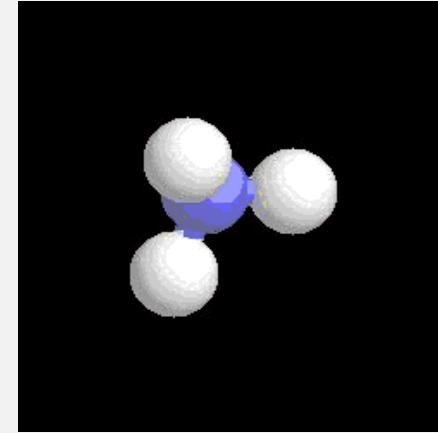
VSEPR Shapes



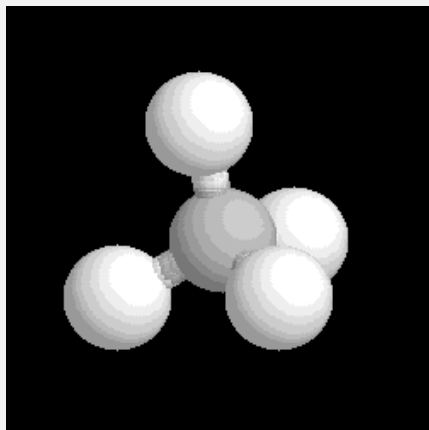
Linear



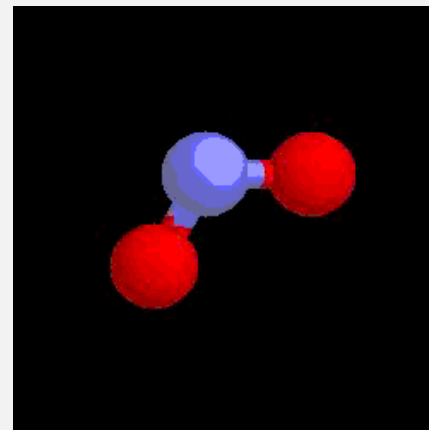
Planar



Pyramidal



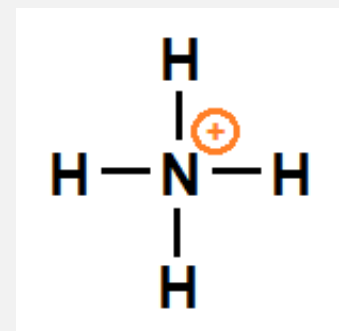
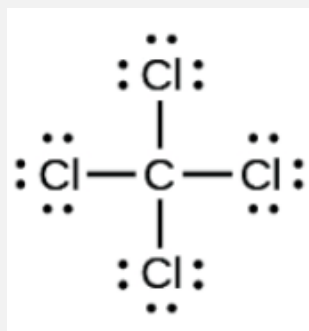
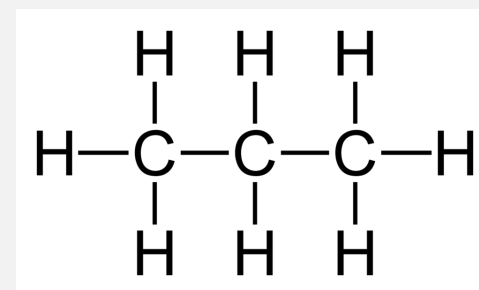
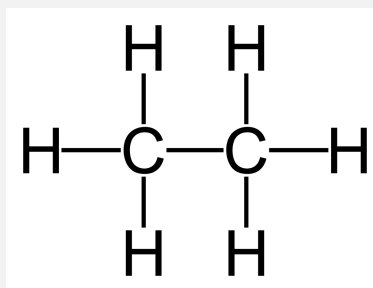
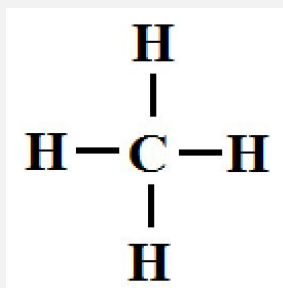
Tetrahedral



Bent

VSEPR Shapes

Tetrahedral **109.5°** **4 single bonds**
0 lone pair electrons



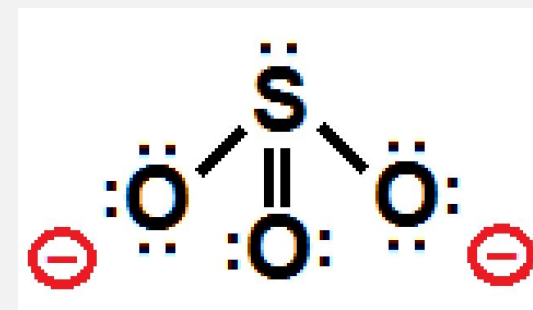
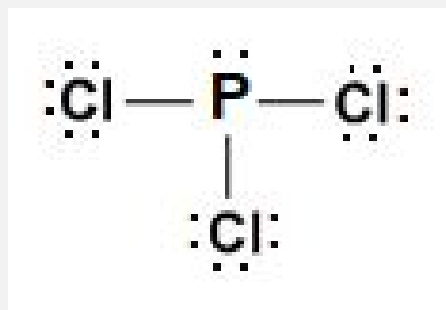
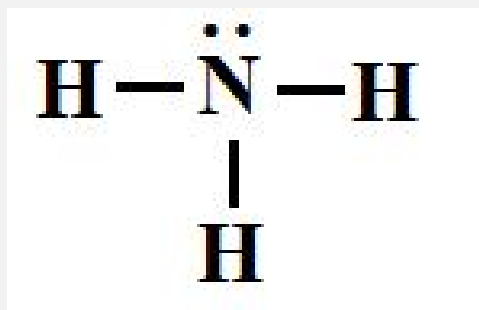
VSEPR Shapes

Pyramidal

107°

3 single bonds

1 lone pair electrons



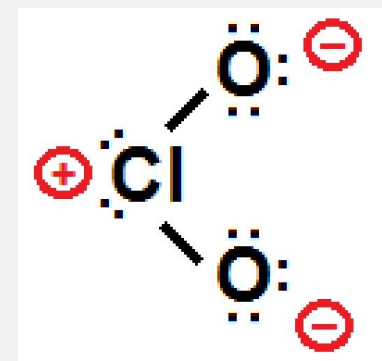
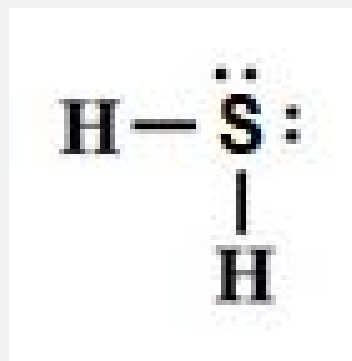
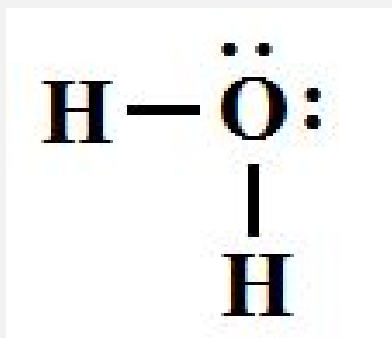
VSEPR Shapes

Bent

105°

2 single bonds

2 lone pair electrons



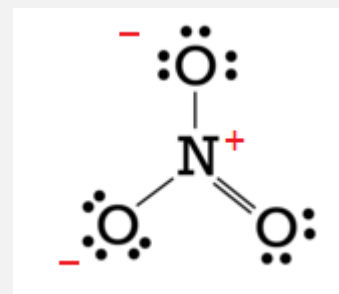
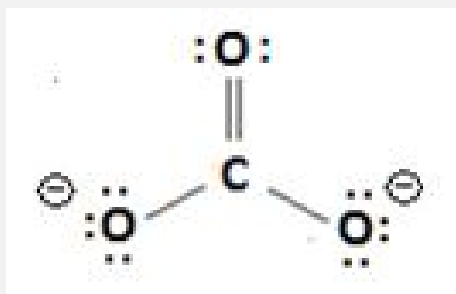
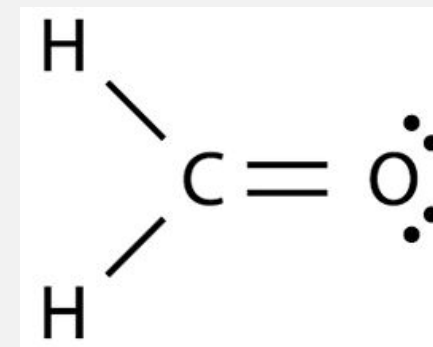
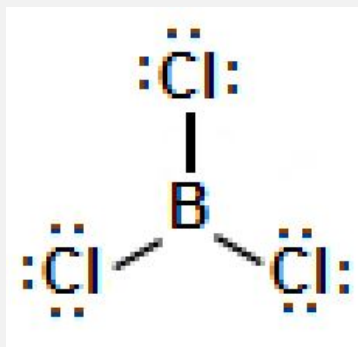
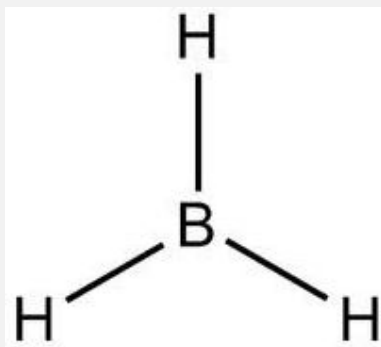
VSEPR Shapes

Planar

120°

3 single bonds

0 lone pair electrons



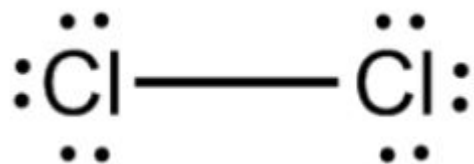
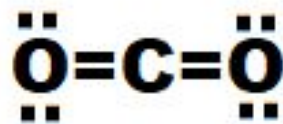
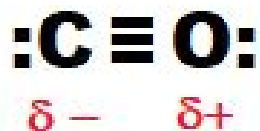
VSEPR Shapes

Linear

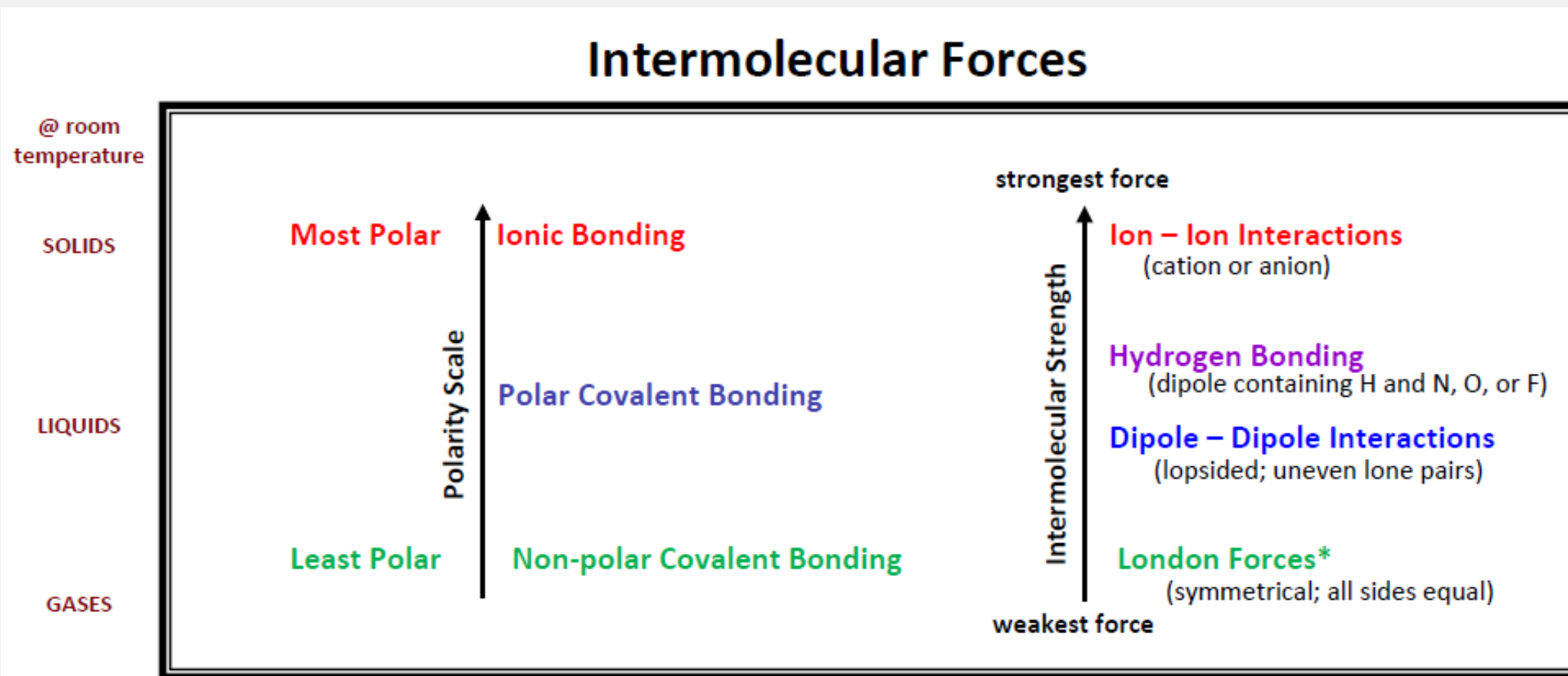
180°

1 or 2 single bonds

0 lone pair electrons



Intermolecular Forces



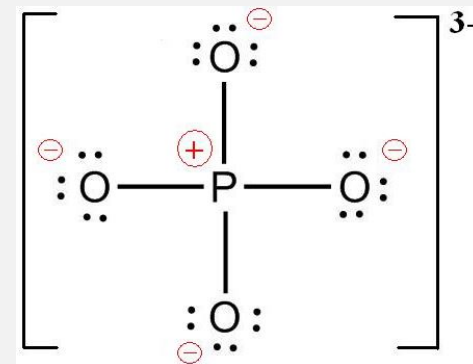
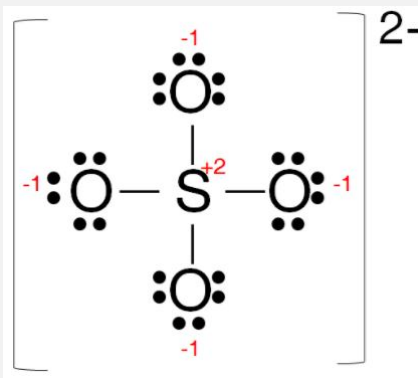
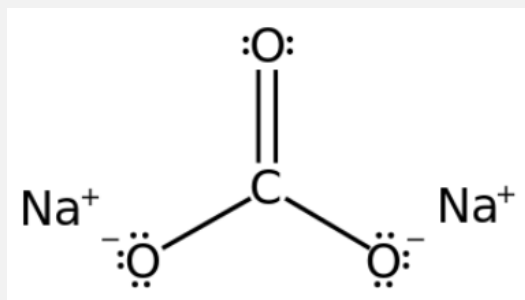
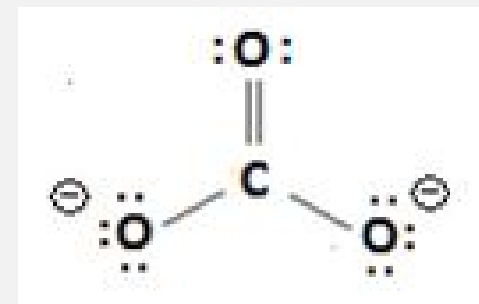
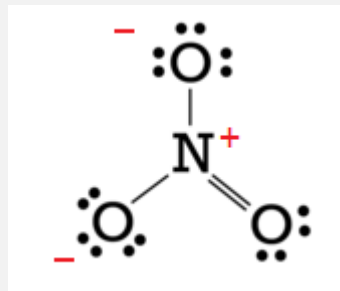
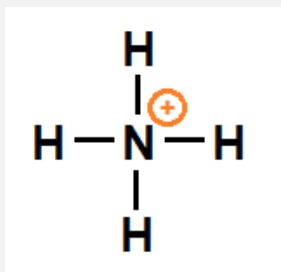
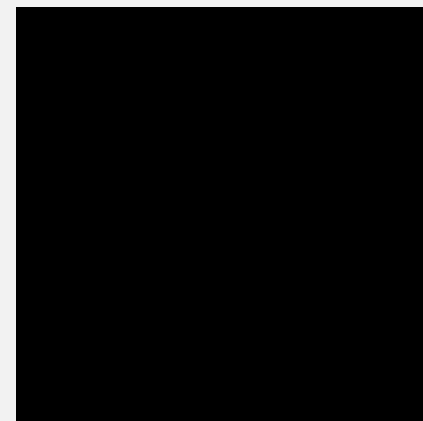
*London Forces are also called Dispersion Forces and Induced Dipole Interactions

Ion – Ion Forces

Metal Cations are Positive (+)

Nonmetal Anions are Negative (-)

Strongest Most Polar Forces of Attraction

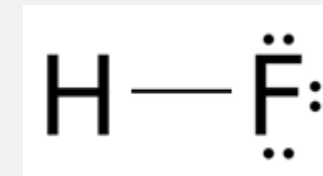
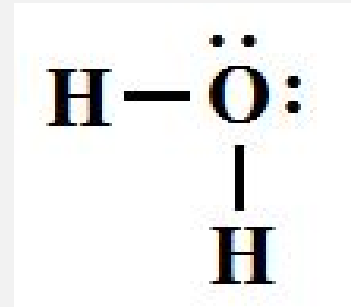
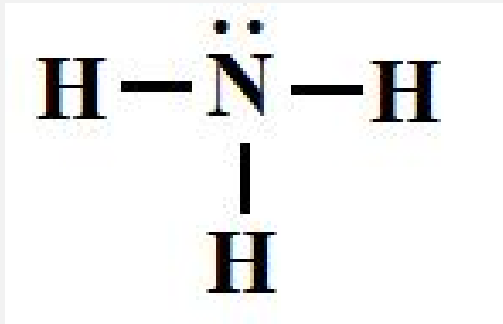
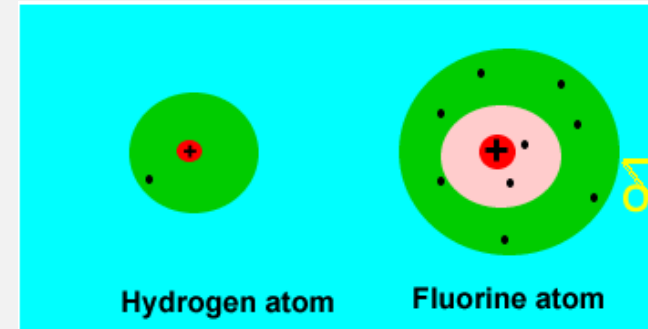


Hydrogen Bonding

Unshielded Nucleus

Hydrogen atom forms a Cation (H^+) when...

Nitrogen, Oxygen, or Fluorine steal electrons from bond



NOTE: Hydrogen Bonding is a special type of dipole. It is the strongest polar covalent bond, but it is still less polar than ionic bonding.

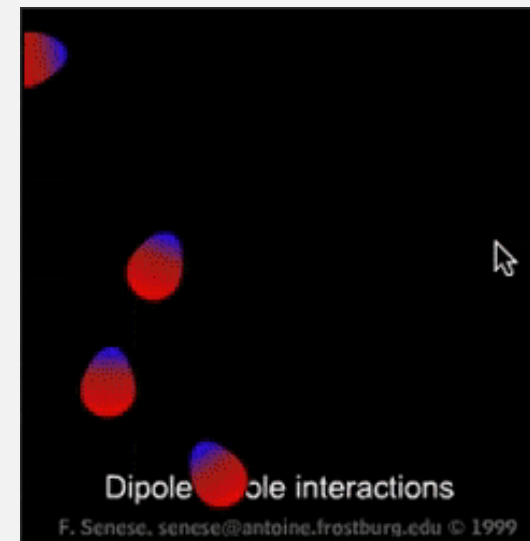
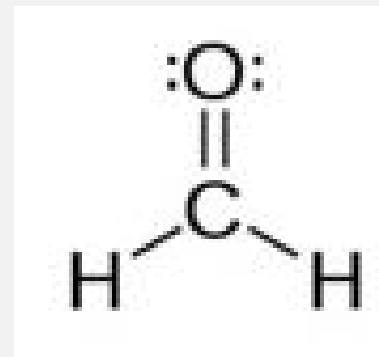
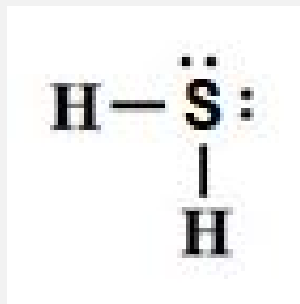
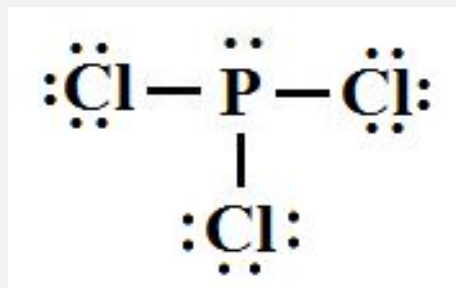
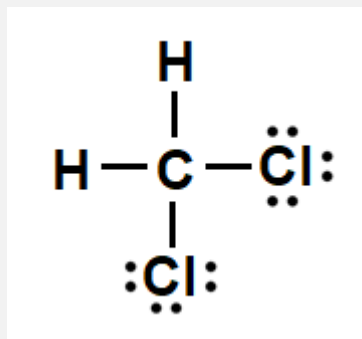


Dipole – Dipole Interactions

Must be **Asymmetrical**

Uneven (lopsided) lone pairs

Polar Covalent bond

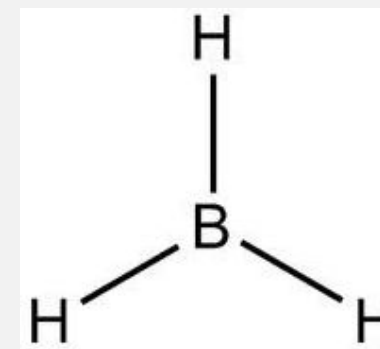
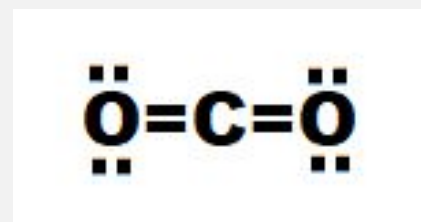
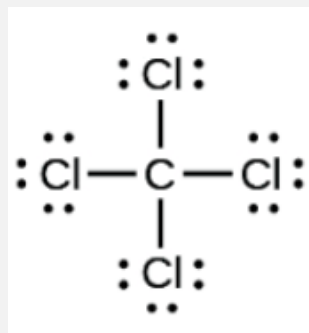
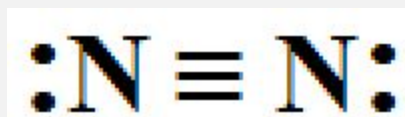
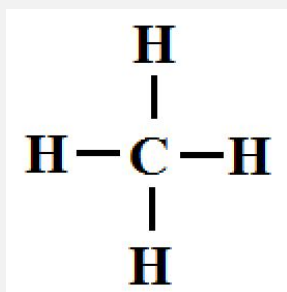
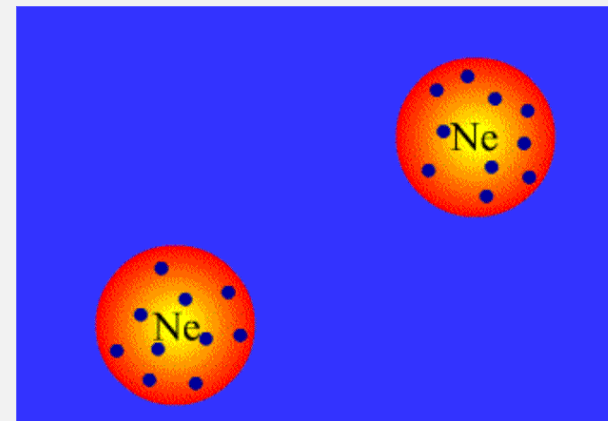


London Forces

Must be Symmetrical

No Lone Pairs on Central Atom

Weakest Force; Must be Induced



Organic Chemistry

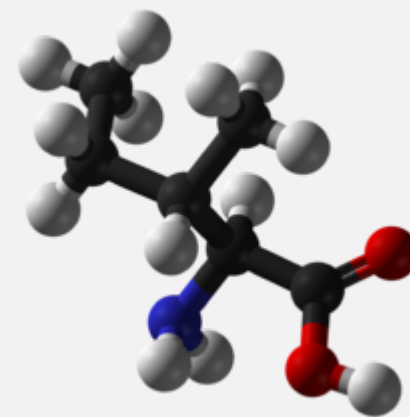
Must contain Carbon and Hydrogen

Natural Polymers – DNA, RNA, Proteins

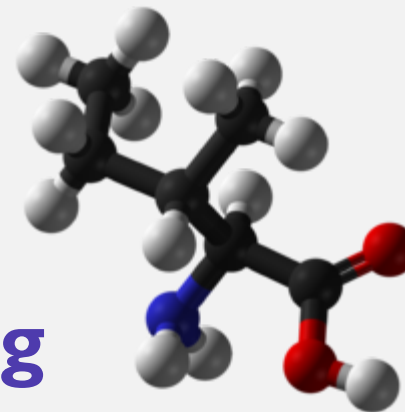
Synthetic Polymers – Teflon, Nylon, Kevlar, Plastic

Petrochemicals (Fuels) – Propane, Butane, Octane

Pharmaceuticals – Aspirin, Vitamins, Insulin



Organic Chemistry



DNA held together by Hydrogen Bonding

Distillation separates based on Boiling Point

Saturated hydrocarbons have Single Bonds

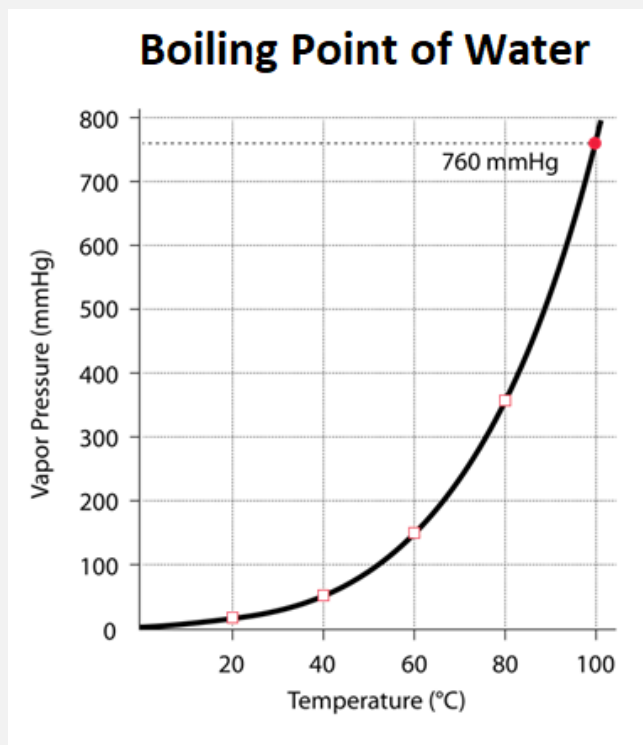
Stronger IMFs, Longer Chains, and/or More Mass

increase the following physical properties:

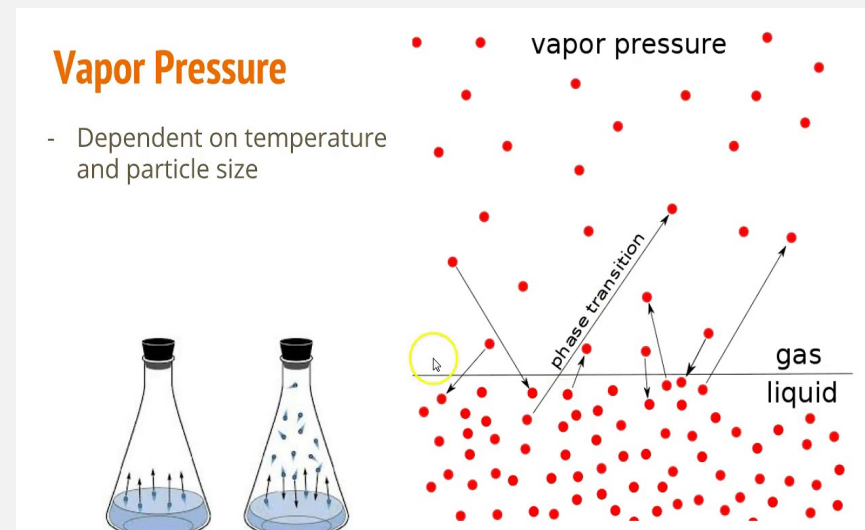
Boiling Point, Melting Point, Surface Tension, Viscosity

Organic Chemistry

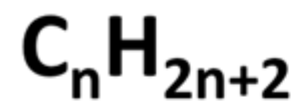
Vapor Pressure – collisions of molecules that have changed from the liquid to gas phase



Boiling Point occurs when vapor pressure equals the atmospheric pressure



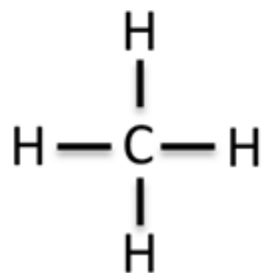
Alkanes



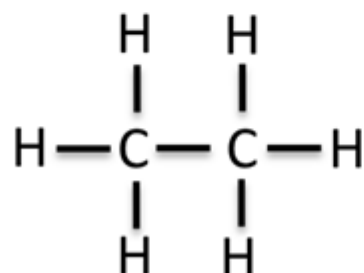
Tetrahedral **109°**

London Forces

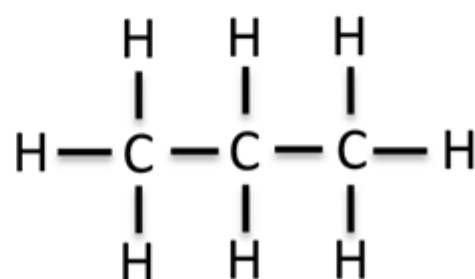
methane
 CH_4



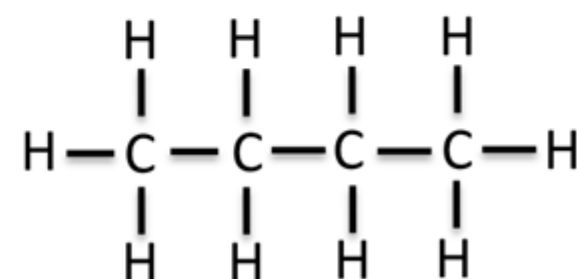
ethane
 C_2H_6



propane
 C_3H_8



butane
 C_4H_{10}



Alkenes

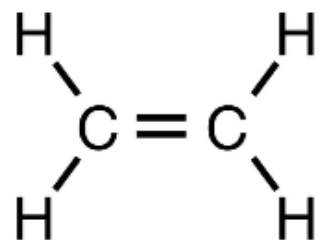
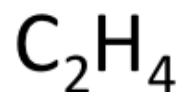


Trigonal Planar
@ double bond

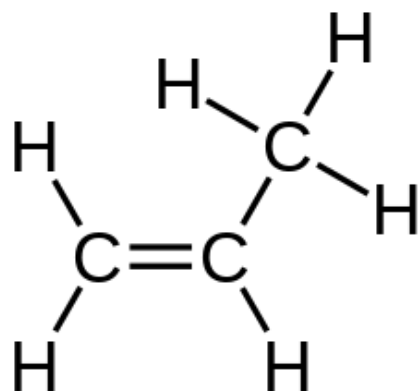
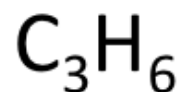
120°

London Forces

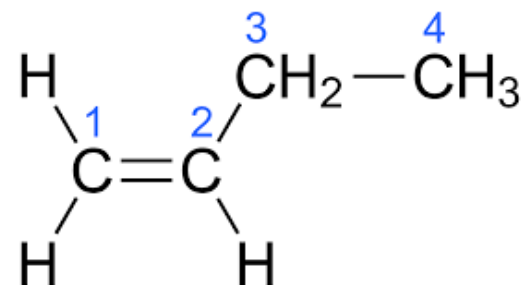
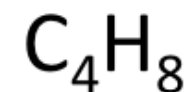
ethene



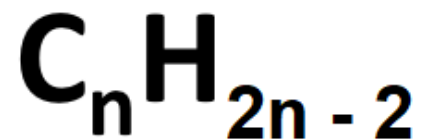
propene



butene



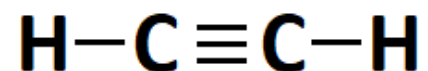
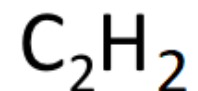
Alkynes



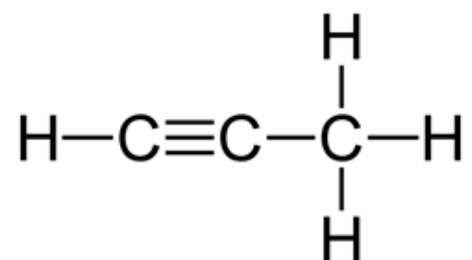
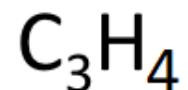
Linear 180°

London Forces

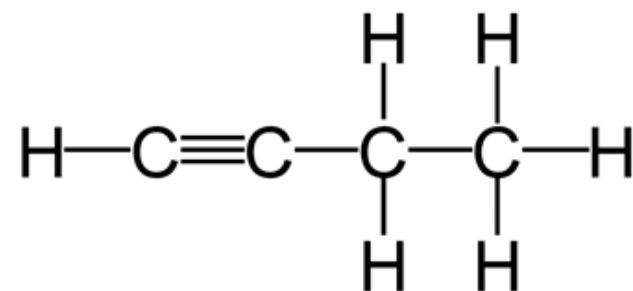
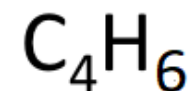
ethyne



propyne



butyne



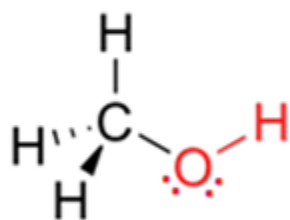
Alcohol_s

C - H side: Tetrahedral 109°

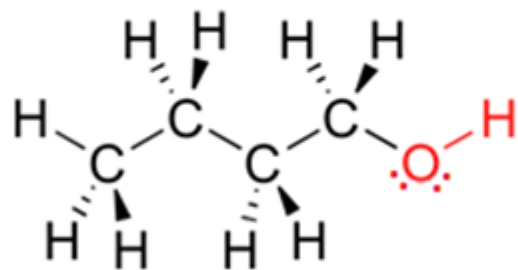
O - H side: Bent 105°

London Forces

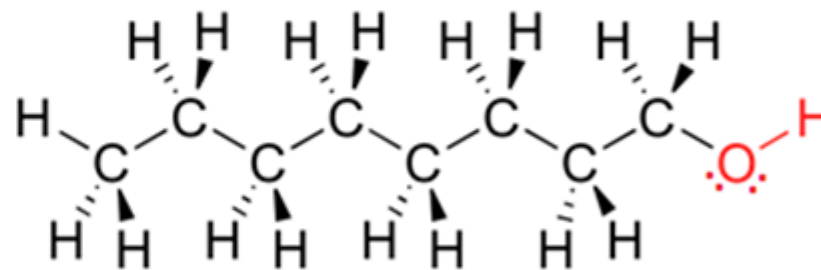
Hydrogen Bonding



methanol
very soluble in water



butanol
slightly soluble in water

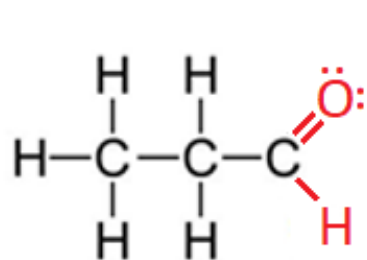


octanol
very insoluble in water

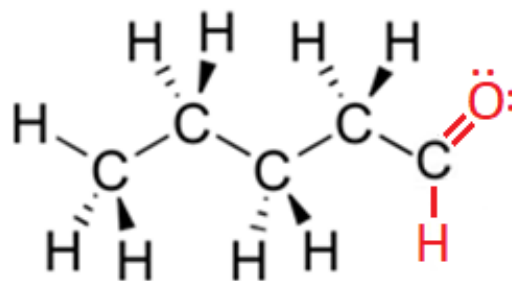
Aldehydes

C - H side: Tetrahedral 109° London Forces

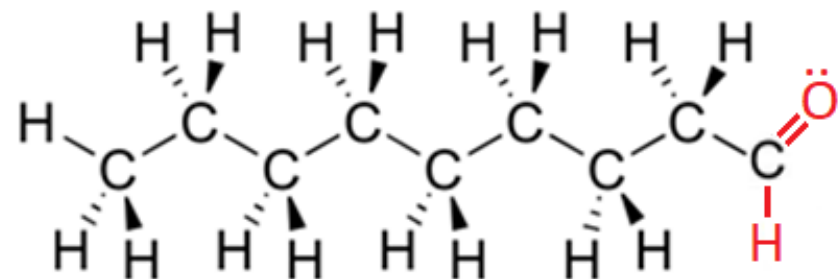
C = O side: Trigonal Planar 120° Dipole-Dipole



ethanal
soluble in water



butanal
slightly soluble in water



octanal
very insoluble in water

Carboxylic Acids

➤ Hydrocarbon side:

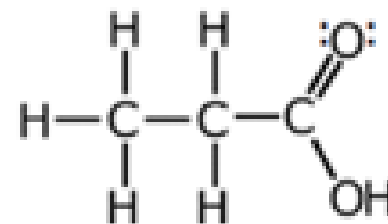
- Nonpolar / London Forces
- 109.5° / Tetrahedral

➤ Aldehyde part:

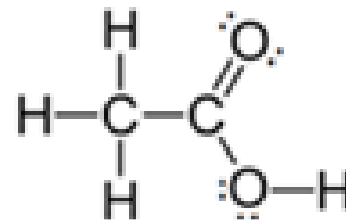
- Polar / Dipole-dipole
- 120° / Trigonal planar

➤ Alcohol part:

- Polar / Hydrogen Bonding
- 105° / Bent



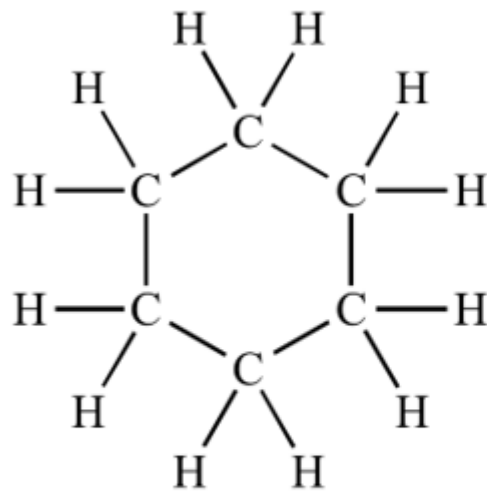
$\text{CH}_3\text{CH}_2\text{COOH}$
Propanoic Acid



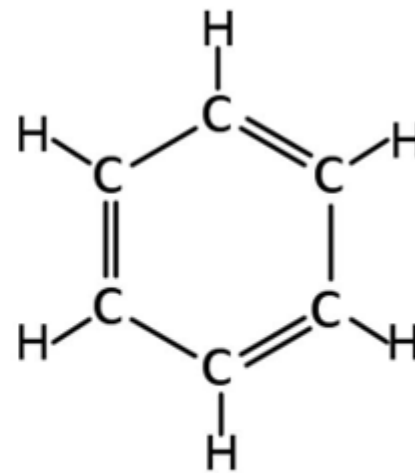
CH_3COOH

Ethanoic Acid
"Acetic Acid"

Ring Structures



Cyclohexane



Cyclohexene