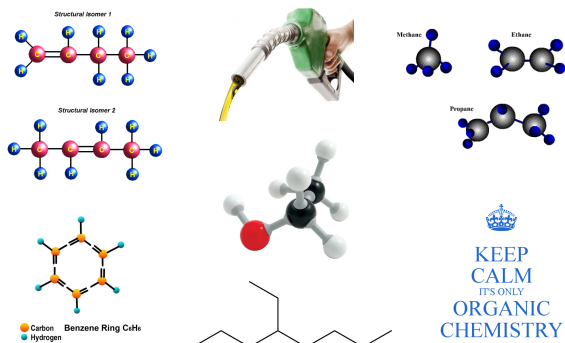


## ORGANIC CHEMISTRY



## Organic Chemistry

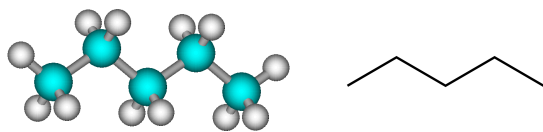
*Study of carbon containing compounds*

- Carbon is **UNIQUE**... has 4 e<sup>-</sup> in its outer shell with room for 4 bonds to 4 other atoms

- Many foods, gasoline products, vitamins, etc. are made of carbon compounds



## Geometry

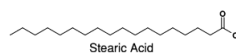
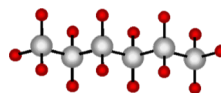


- When bonded to four atoms or groups, carbon has a tetrahedral geometry with 109.5° bond angle

- Carbon to carbon bonds are 109.5° so a chain of carbons form a **ZIGZAG** pattern... drawn this way instead of a straight line in organic chemistry

## Hydrocarbons

*Compound consisting of only carbon and hydrogen*



- Carbon to carbon bonds can be single, double, or triple bonds (changes the number of hydrogen attached because must satisfy the octet rule)

- Can be small molecules to really large chains

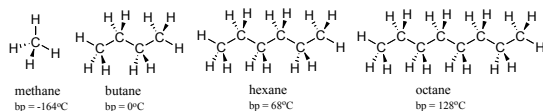
## Hydrocarbons

*Compound consisting of only carbon and hydrogen*

### CHARACTERISTICS

- Bonds are **NONPOLAR**

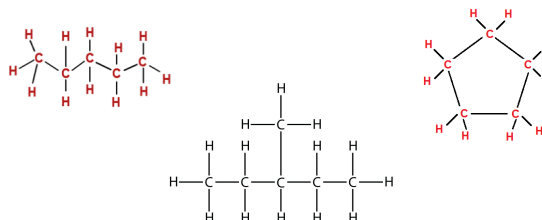
- As # of carbons increase... density increases, viscosity increases, boiling point increases, IMFs increase, decrease in volatility / VP



## Hydrocarbons

*Compound consisting of only carbon and hydrogen*

- Carbon to carbon chains can be straight, branched, or in a closed ring



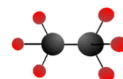
## Hydrocarbons

*Compound consisting of only carbon and hydrogen*

- Organic compounds... Three groups we will look at: **Alkanes**, **Alkenes**, and **Alkynes**
- Named with **PREFIXES** based on the number of carbon atoms present:

PREFIX	# OF C	PREFIX	# OF C
Meth	1	Hex	6
Eth	2	Hept	7
Prop	3	Oct	8
But	4	Non	9
Pent	5	Dec	10

## Alkanes



- Have the generic formula:  $C_nH_{2n+2}$
- Contains all single bonds... **SATURATED** (least reactive)
- Naming: Use the correct prefix with **-ane** ending
- Formula: Prefix determines how many carbons... Do the math to determine the number of hydrogens

### EXAMPLES:

Name the following compound:  $C_3H_8$

**Propane**

Write the formula for butane.

$C_4H_{10}$



## Alkenes



- Have the generic formula:  $C_nH_{2n}$
- Contains one double bond... **UNSATURATED**
- Naming: Use the correct prefix with **-ene** ending
- Formula: Prefix determines how many carbons... Do the math to determine the number of hydrogens

### EXAMPLES:

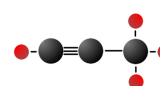
Name the following compound:  $C_6H_{12}$

**Hexene**

Write the formula for decene.

$C_{10}H_{20}$

## Alkynes



- Have the generic formula:  $C_nH_{2n-2}$
- Contains one triple bond... **UNSAT.** (most reactive)
- Naming: Use the correct prefix with **-yne** ending
- Formula: Prefix determines how many carbons... Do the math to determine the number of hydrogens

### EXAMPLES:

Name the following compound:  $C_5H_8$

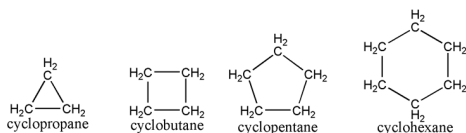
**Pentyne**

Write the formula for octyne.

$C_8H_{14}$

## Cycloalkanes

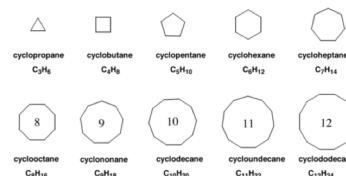
*Alkanes in which carbon atoms are arranged in a ring or cyclic structure*



Sometimes **SYMBOLS** are used to represent these structures...

## Cycloalkanes

*Alkanes in which carbon atoms are arranged in a ring or cyclic structure*



**Each carbon gets a number in the ring...  
Numbered in a way to give the substituents  
(things attached) the **SMALLEST** #s as possible!**

## Cycloalkanes

Alkanes in which carbon atoms are arranged in a ring or cyclic structure



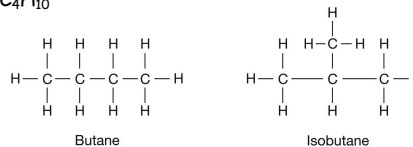
**AROMATIC** compounds are based on a benzene ( $C_6H_6$ ) ring structure!

## Structural Isomers

Compounds with the same molecular formula but the order in which atoms are connected is different

• Different structures result in the compounds having different **PROPERTIES**

• Ex:  $C_4H_{10}$

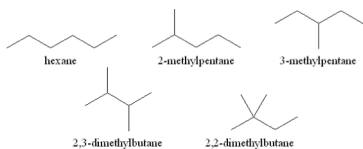


Used as a **fuel source**

Used as a **refrigerant**

## Structural Isomers

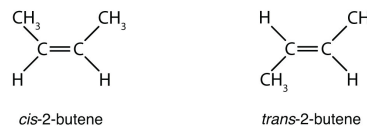
Compounds with the same molecular formula but the order in which atoms are connected is different



**FIVE structural isomers of hexane...**  
All with the formula  $C_6H_{14}$

## Geometric Isomers

Compounds with the same molecular formula but different spatial arrangement of atoms

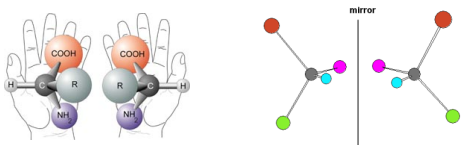


Usually occurs around a **RIGID** (restricted rotation) double bond structure!

## Enantiomers

Compounds with the same molecular formula that are mirror images of each other

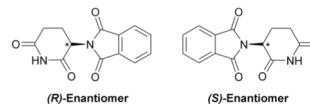
• Cannot be superimposed on one another



## Enantiomers

Compounds with the same molecular formula that are mirror images of each other

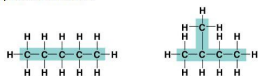
• Cannot be superimposed on one another



**THALIDOMIDE...** "R" form helps pregnant women with nausea while the "S" form is a teratogen (causes birth defects)... was given to women in the late 50s as a mixture of the two!

## Isomers

(a) Structural isomers



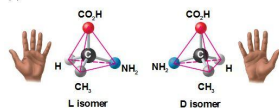
(b) Cis-trans isomers



cis isomer: The two Xs are on the same side.

trans isomer: The two Xs are on opposite sides.

(c) Enantiomers



L isomer

D isomer

## Functional Groups

Atoms or group of atoms that are added to the hydrocarbon



**ALCOHOL**  
Naming: -ol  
e.g. ethanol



**ETHER**  
Naming: -oxy-ane  
e.g. methoxyethane



**ALDEHYDE**  
Naming: -al  
e.g. ethanal



**KETONE**  
Naming: -one  
e.g. propanone



**CARBOXYLIC ACID**  
Naming: -oic acid  
e.g. ethanoic acid



**ESTER**  
Naming: -yl -oate  
e.g. ethyl ethanoate



**AMIDE**  
Naming: -amide  
e.g. ethanamide

## FUNCTIONAL GROUPS IN ORGANIC CHEMISTRY

FUNCTIONAL GROUPS ARE GROUPS OF ATOMS IN ORGANIC MOLECULES THAT ARE RESPONSIBLE FOR THE CHARACTERISTIC CHEMICAL REACTIONS OF THOSE MOLECULES. IN THE GENERAL FORMULAE BELOW, 'R' REPRESENTS A HYDROCARBON GROUP OR HYDROGEN, AND 'X' REPRESENTS ANY HALOGEN ATOM.

● HYDROCARBONS ● SIMPLE OXYGEN HETERODATOMICS ● HALOGEN HETERODATOMICS ● CARBOXYL COMPOUNDS ● NITROGEN BASED ● SULFUR BASED ● AROMATIC



**ALKANE**  
Naming: -ane  
e.g. ethane



**ALKENE**  
Naming: -ene  
e.g. ethene



**ALKYNE**  
Naming: -yne  
e.g. ethyne



**ALCOHOL**  
Naming: -ol  
e.g. ethanol



**ETHER**  
Naming: -oxy-ane  
e.g. methoxyethane



**EPOXIDE**  
Naming: -ene oxide  
e.g. ethene oxide



**HALOALKANE**  
Naming: halo-  
e.g. chloroethane



**ALDEHYDE**  
Naming: -al  
e.g. ethanal



**KETONE**  
Naming: -one  
e.g. propanone



**CARBOXYLIC ACID**  
Naming: -oic acid  
e.g. ethanoic acid



**ACID ANHYDRIDE**  
Naming: -oic anhydride  
e.g. ethanoic anhydride



**ESTER**  
Naming: -yl -oate  
e.g. ethyl ethanoate



**AMIDE**  
Naming: -amide  
e.g. ethanamide



**ACYL HALIDE**  
Naming: -oyl halide  
e.g. ethanoyl chloride



**AMINE**  
Naming: -amine  
e.g. ethanamine



**NITRILE**  
Naming: -nitrile  
e.g. ethanenitrile



**IMINE**  
Naming: -imine  
e.g. ethanimine



**ISOCYANATE**  
Naming: -yl isocyanate  
e.g. ethyl isocyanate



**AZO COMPOUND**  
Naming: -azo-  
e.g. azoethane



**THIOL**  
Naming: -thiol  
e.g. methanethiol



**ARENE**  
Naming: -yl benzene  
e.g. ethylbenzene

## Functional Groups Mini-Project

Work in groups to create about a **10 minute** presentation about a particular functional group...

- Be sure to explain the following in your presentation: properties, naming, formation (brief), and real world importance
- Pose questions to the class or keep them engaged in some way
- All group members should participate
- Pictures or visual aides should be used
- Good presentation skills (speak loud and clear, serious, eye contact, know your material, etc.)

