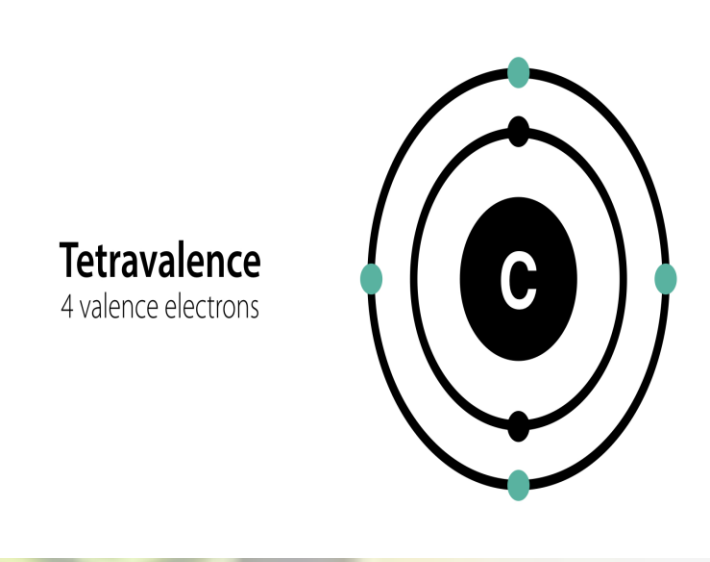
Carbon & its Compound

What is the Versatile Nature of Carbon?



Carbon:

- Carbon is a nonmetal has an atomic number 6.
- Versatile nature of Carbon:

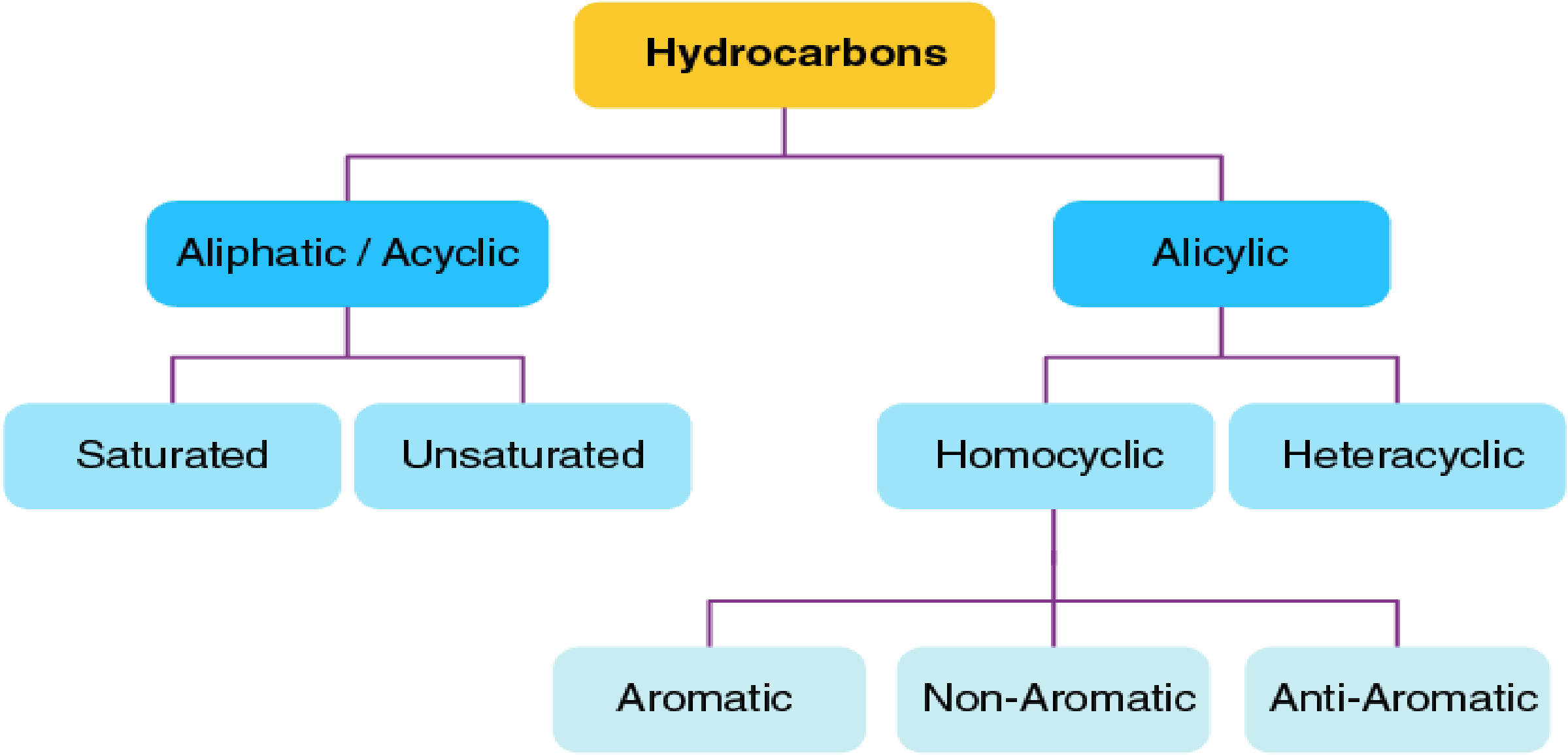
- Carbon has the ability to form bonds with the other carbon atoms due to which it can form large molecules. This is called catenation property.
- Carbon is tetravalent which means it has a valency of four. It can form bonds with four other atoms.
- It is known for its versatility due to which it is capable of forming a large number of organic compounds.

How to find out valency

The **valency** is the combining capacity of an atom to fulfill its **octet**

- Calculate valency by counting the number of electrons in the outer shell of an atom.
- If the number of electrons is four or fewer, then the valence in the outer shell is equal to the number of electrons.
- If the number of electrons is greater than four, then the valence in the outer shell is equal to eight minus the number of electrons.

Hydrocarbon & its classification

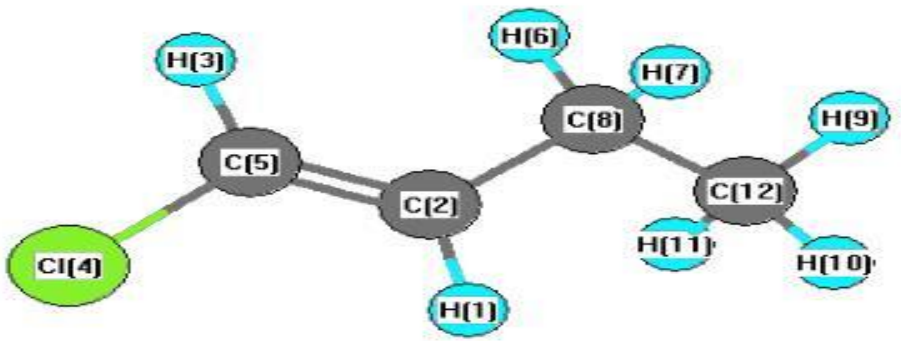


Saturated Hydrocarbons

- Saturated Hydrocarbons are hydrocarbons in which each carbon atom in the molecule forms four single covalent bonds with other atoms
- Hydrocarbons that contain only single bonds are alkanes

Unsaturated Hydrocarbons

- A hydrocarbon that contains one or more double or triple bonds is an ***unsaturated*** hydrocarbon.
- There are three types of unsaturated hydrocarbons ***alkenes***, ***alkynes***, and ***aromatic*** hydrocarbons.

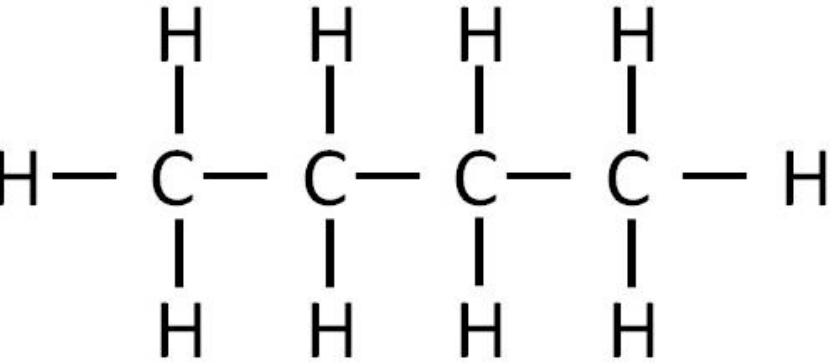


SATURATED HYDROCARBONS Vs UNSATURATED HYDROCARBONS

Saturated Hydrocarbons

C_nH_{2n+2}

Alkanes

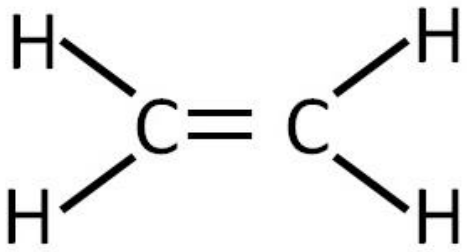


Butane

Unsaturated Hydrocarbons

C_nH_{2n}

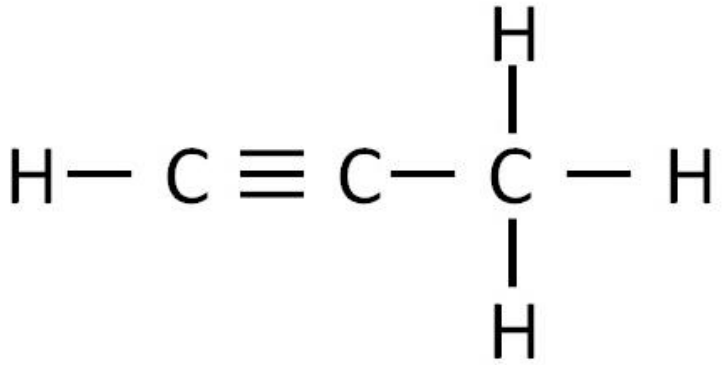
Alkenes



Ethene

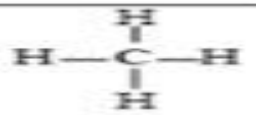
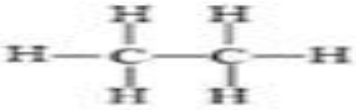
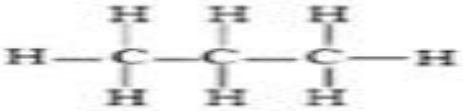
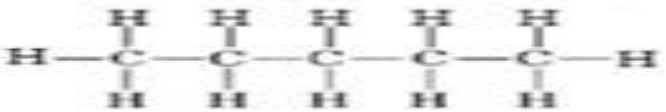
C_nH_{2n-2}

Alkynes

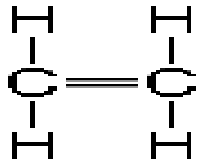
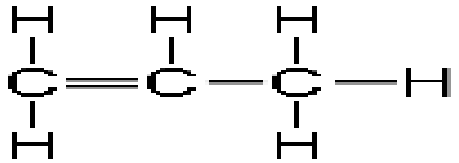
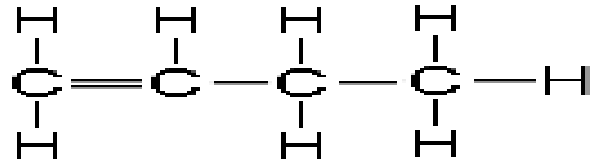
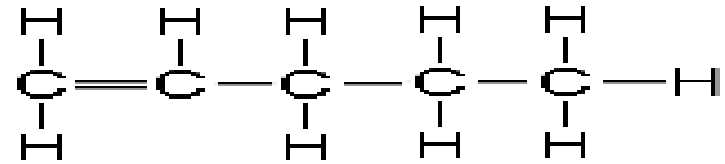
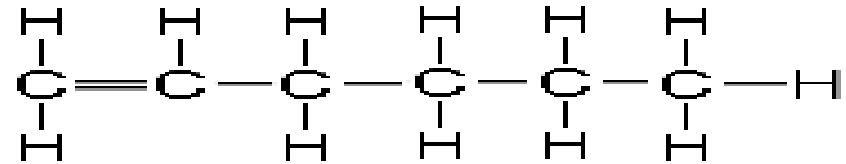


Propyne

C_nH_{2n+2}

Name	Molecular Formula	Projection Formula	Condensed Structural Formula	Boiling Point (in °C)
Methane	CH_4		CH_4	−162
Ethane	C_2H_6		CH_3CH_3	−89
Propane	C_3H_8		$CH_3CH_2CH_3$	−42
n-Butane*	C_4H_{10}		$CH_3CH_2CH_2CH_3$ or $CH_3(CH_2)_2CH_3$	−0.5
n-Pentane*	C_5H_{12}		$CH_3CH_2CH_2CH_2CH_3$ or $CH_3(CH_2)_3CH_3$	36
n-Hexane*	C_6H_{14}		$CH_3CH_2CH_2CH_2CH_2CH_3$ or $CH_3(CH_2)_4CH_3$	69
n-Heptane*	C_7H_{16}		$CH_3(CH_2)_5CH_3$	98
n-Octane*	C_8H_{18}		$CH_3(CH_2)_6CH_3$	126
n-Nonane*	C_9H_{20}		$CH_3(CH_2)_7CH_3$	151
n-Decane*	$C_{10}H_{22}$		$CH_3(CH_2)_8CH_3$	174

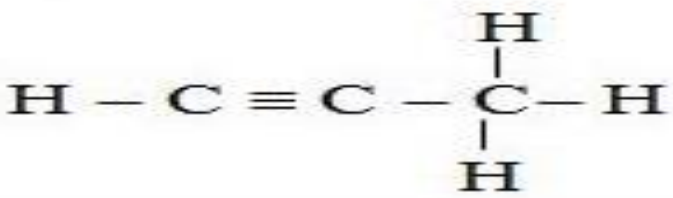
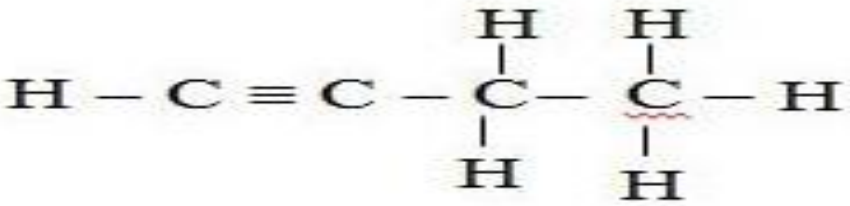
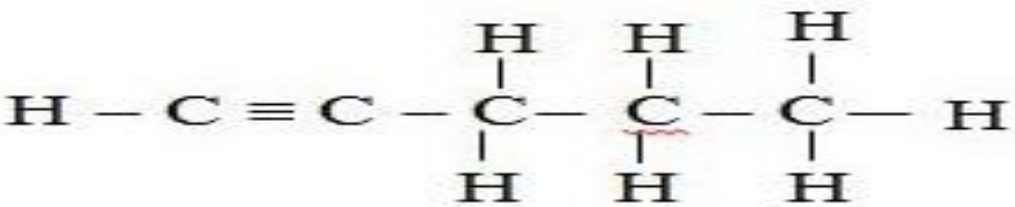
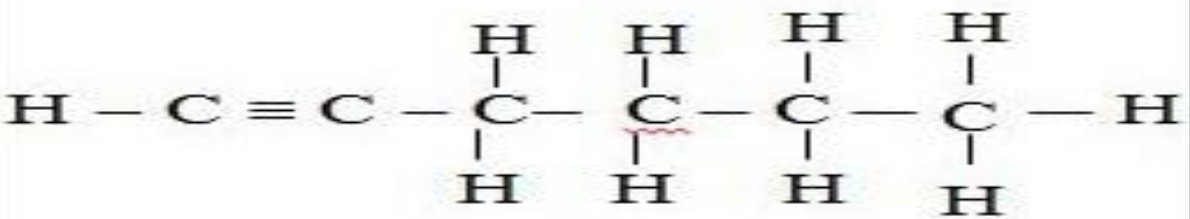
C_nH_{2n}

ALKENE	CARBON NUMBER	FORMULA	STRUCTURE
ETHENE	2	C_2H_4	
PROPENE	3	C_3H_6	
BUTENE	4	C_4H_8	
PENTENE	5	C_5H_{10}	
HEXENE	6	C_6H_{12}	

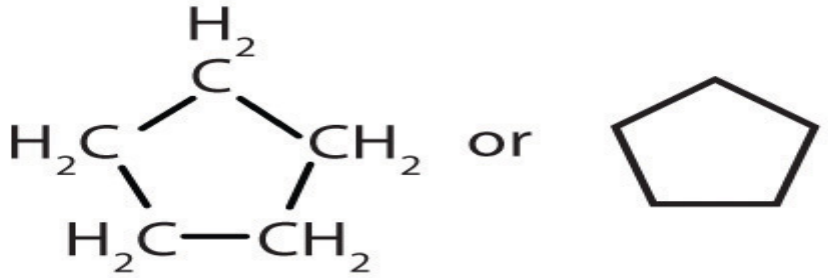
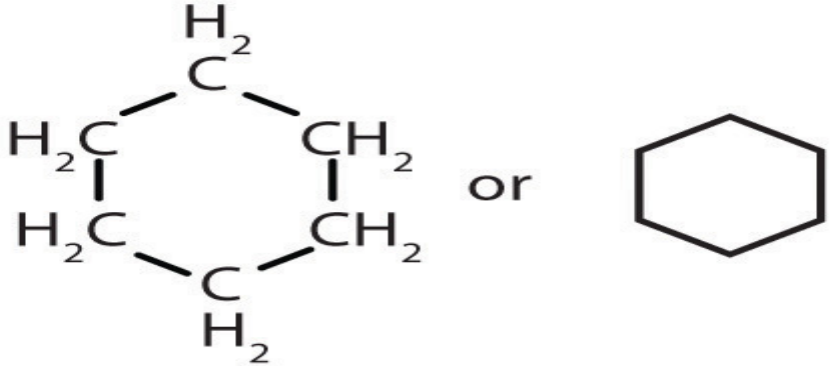
Alkyne

General Formula:

$$C_nH_{2n-2}$$

Name	*Open structure*	*Condensed structure*
Ethyne		$CH{\equiv}CH$
Propyne		$CH{\equiv}C{-}CH_3$
Butyne		$CH{\equiv}C{-}CH_2{-}CH_3$
Pentyne		$CH{\equiv}C{-}CH_2{-}CH_2{-}CH_3$
Hexyne		$CH{\equiv}C{-}CH_2{-}CH_2{-}CH_2{-}CH_3$

Cyclic Hydrocarbons

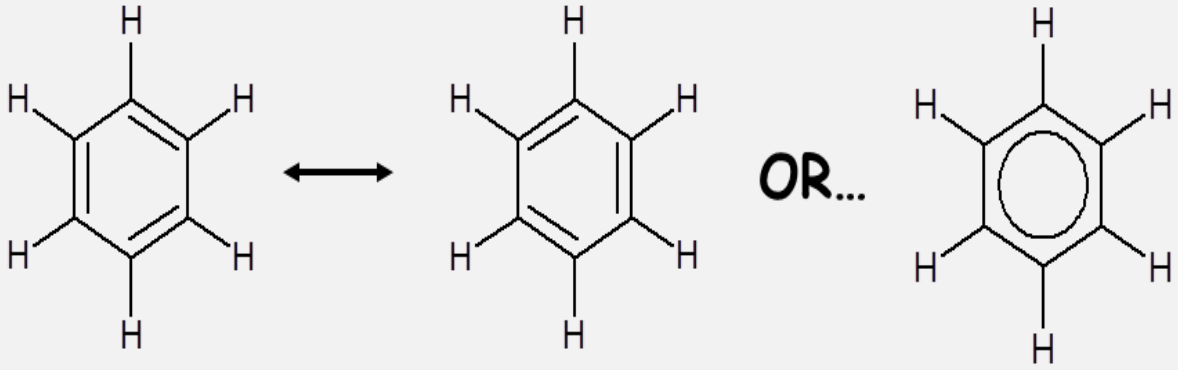
Name	Molecular Formula	Structural Formula
cyclopropane	C_3H_6	
cyclobutane	C_4H_8	
cyclopentane	C_5H_{10}	
cyclohexane	C_6H_{12}	

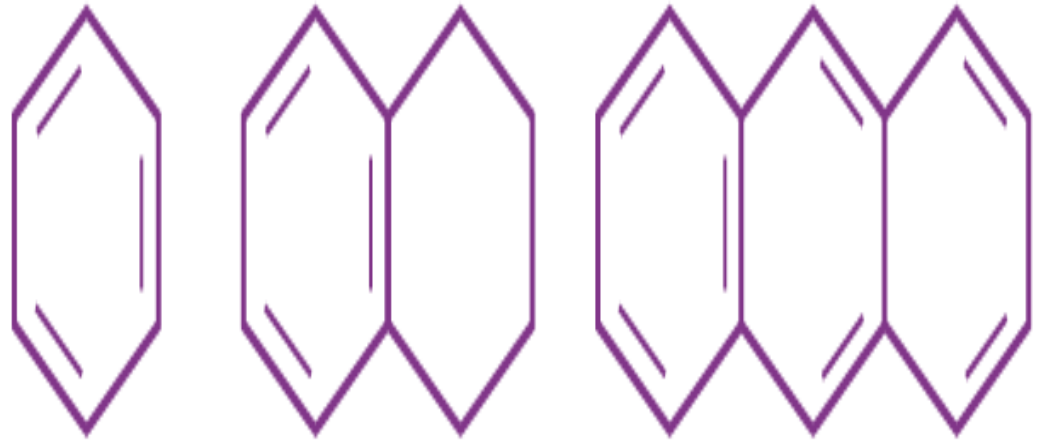
Aromatic Hydrocarbon

Aromatic Hydrocarbons

Cyclic unsaturated hydrocarbons with delocalized electrons

The simplest aromatic hydrocarbon is benzene (C_6H_6)





Benzene	Naphthalene	Anthracene
n = 1	n = 2	n =3
$(4 \times 1 + 2) = 6\pi$	$(4 \times 2 + 2) = 10\pi$	$(4 \times 3 + 2) = 14\pi$
Electrons	Electrons	Electrons

Homologous series

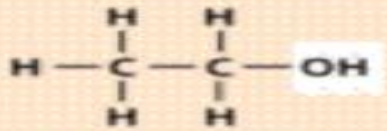
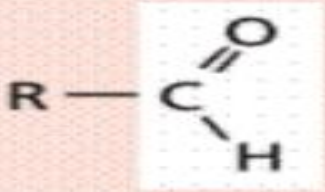
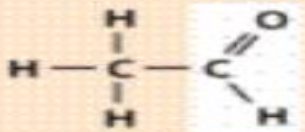
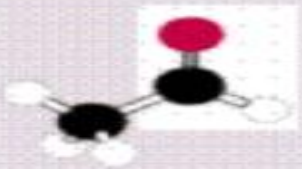
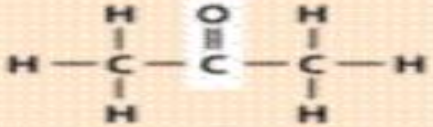
Homologous series is a series of compounds with similar chemical properties and some functional groups differing from the successive member by CH_2 and 14 unit by mass.

Eg.

FUNCTIONAL GROUP

Functional groups are specific groups of atoms in molecules that determine their chemical properties and reactions.

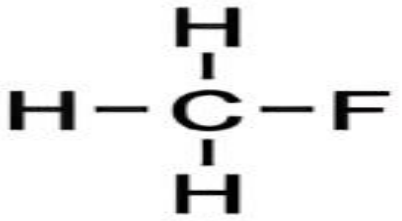
Functional Groups

Functional group	Class of compounds	Structural formula	Example	Ball-and-stick model
Hydroxyl —OH	Alcohols	R — OH	 Ethanol	
Carbonyl —CHO	Aldehydes		 Acetaldehyde	
Carbonyl >CO	Ketones		 Acetone	

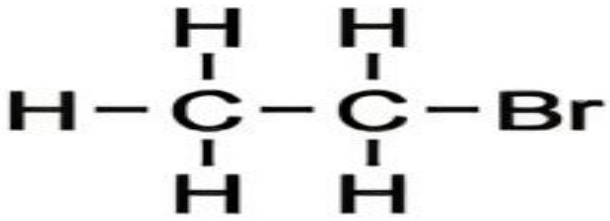
Carbon compounds containing Halogen

Example of Haloalkane

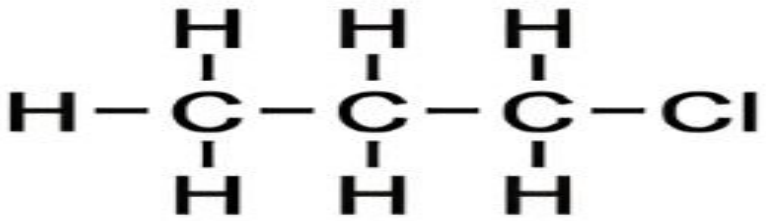
1 **Fluoromethane**
(also known as *methylfluoride* and as *methyl fluoride*)



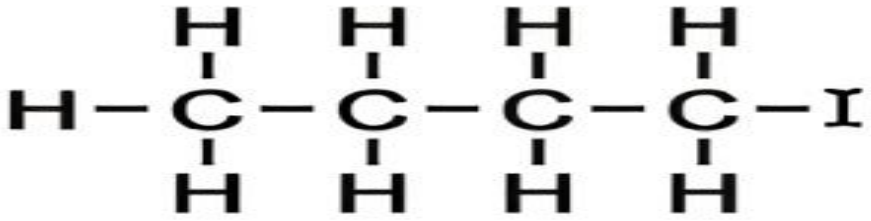
2 **Bromoethane**
(also known as *ethyl bromide*)



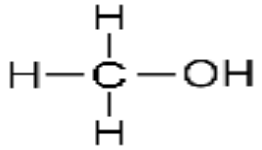
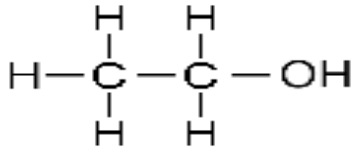
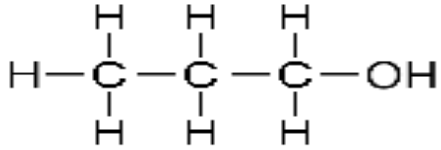
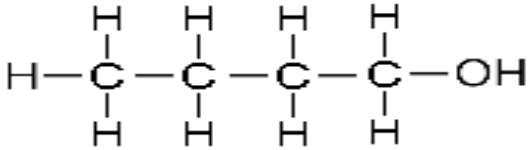
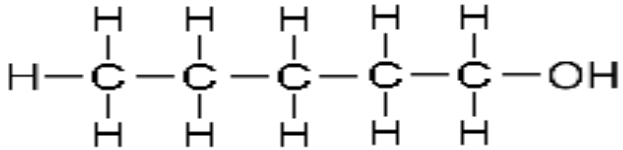
3 **Chloropropane**
(also known as *1-chloropropane*)



4 **Iodobutane**
(also known as *1-iodobutane* and as *n-butyl iodide*)



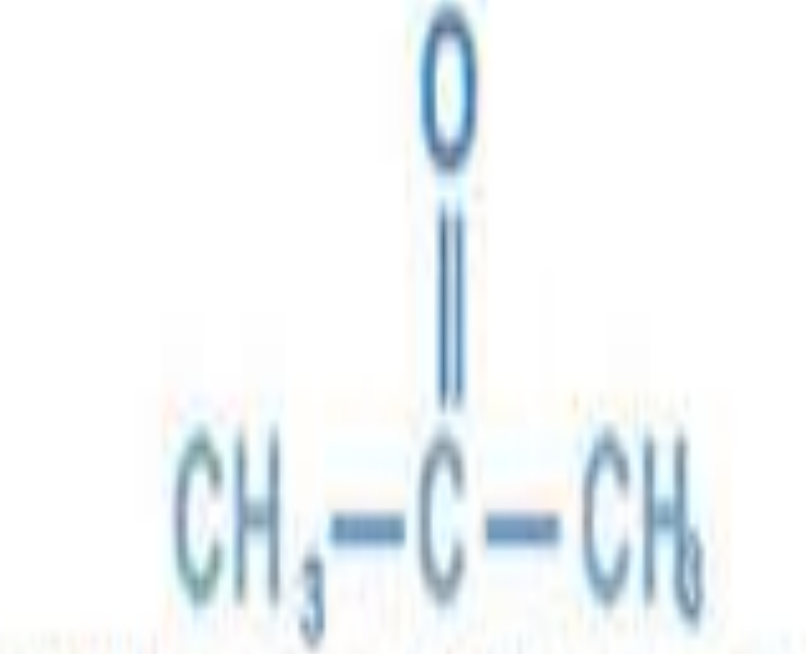
Carbon compounds containing Alcohol

ALCOHOL	CARBON NUMBER	FORMULA	STRUCTURE
METHANOL	1	CH_3OH	
ETHANOL	2	CH_3CH_2OH	
PROPANOL	3	$CH_3CH_2CH_2OH$	
BUTANOL	4	$CH_3CH_2CH_2CH_2OH$	
PENTANOL	5	$CH_3CH_2CH_2CH_2CH_2OH$	

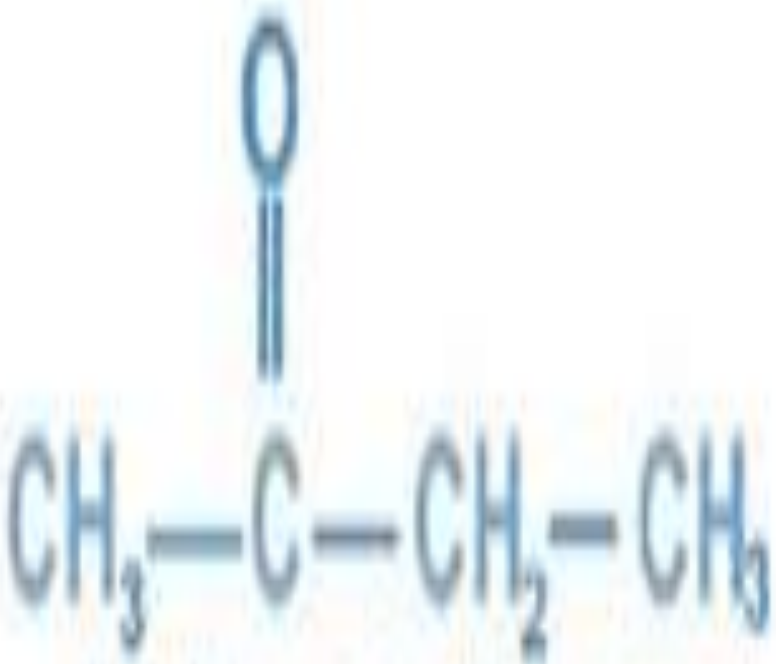
Carbon compounds containing aldehyde

Formula	Common Name	IUPAC Name
H - CHO	Formaldehyde	Methanal
CH3 - CHO	Acetaldehyde	Ethanal
CH3 - CH2 - CHO	Propionaldehyde	Propanal
CH3 - CH2 - CH2 - CHO	Butyraldehyde	Butanal

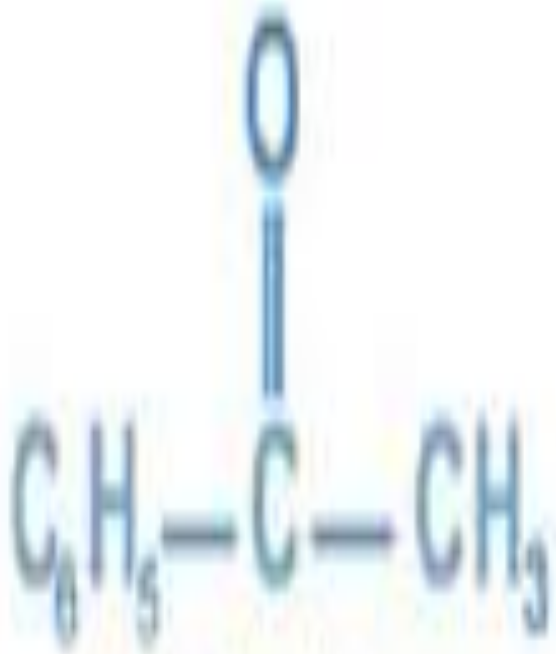
Carbon compounds containing KETONE



2-Propanone (Propanone)



2-Butanone (Butanone)



Acetophenone