Classification and the nomenclature of organic compounds.

Organic chemistry is the chemistry of compounds of carbon.

Bioorganic chemistry is the part of organic chemistry that studies the carbon compounds, which are present in the living organism – the so-called **biomolecules**. The major biomolecules are carbohydrates, proteins, lipids, and nucleic acids.

Bioorganic chemistry also studies organic chemicals that are applied in medicine as pharmaceutical drugs.

Organic compounds

Open chain or Acyclic (Aliphatic)

Saturated hydrocarbons

Alkanes

C_nH_{2n+2}

$CH_3 - CH_2 - CH_3$

Unsaturated hydrocarbons

Alkenes

C_nH_{2n}

$CH_2 = CH_2$

Alkynes

C_nH_{2n+2}

Alkadiens

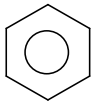
C_nH_{2n-2}

$CH_2 = CH - CH = CH_2$

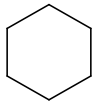
Closed chain or Cyclic

Carbocyclic or Homocyclic

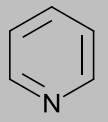
Aromatic
(arenes)



Alicyclic



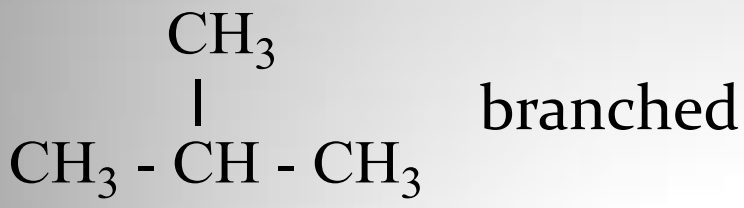
Heterocyclic



Pyridine

Acyclic compounds (or aliphatic) are organic chemicals having open chains of carbon atoms, branched or unbranched. For example:

$CH_3 – CH_2 – CH_3$ unbranched
propane



branched

2 – methylpropane

Hydrocarbons are organic chemicals that contains only carbon and hydrogen.

Saturated hydrocarbons are compounds that contains only single bonds between carbon atoms.

Alkanes contain only single covalent bonds between carbon atoms and have the general formula C_nH_{2n+2}

Unsaturated hydrocarbons are hydrocarbons that contains one or more double or triple bonds.

Alkenes are hydrocarbons that contains a double bond. The general formula is C_nH_{2n}.

Alkynes are hydrocarbons that contains a triple bond. The general formula is C_nH_{2n-2}.

Cyclic compounds are compounds that contains a ring (cycle).

Carbocyclic compounds are compounds that include chains of carbon atoms closed in a ring.

Alicyclic (aliphatic cycle) are nonaromatic cycle organic compounds.

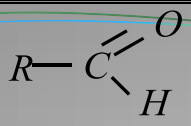
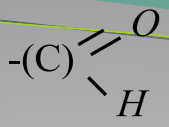
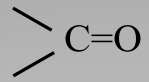
Aromatic hydrocarbons have carbon atoms arranged in hexagonal rings, based on benzene C_6H_6.

Heterocyclic compounds are compounds that have certain heteroatoms (predominantly N, O or S) included in the structure of their cycles.

Functional groups. Classes of organic compounds.

A **functional group** is an atom or group of atoms attached to a hydrocarbon residue, R. The functional group often confers specific properties to an organic molecule.

NAME OF CLASS	GENERAL FORMULA	FUNCTIONAL GROUP		IUPAC	
		FORMULA	NAME	PREFIX	SUFFIX
Carboxylic acids	RCOOH	-(C)OOH*	Carboxyl	---------	-oic acid
		-COOH		Carboxy-	
Sulfonic acids	R-SO_3H	-SO_3H	Sulfonate	Sulfo-	- sulfo acid
Esters	R-COO-R	-(C)OOR*	Carbalkoxy	--------	-oate
Amides	R-$CONH_2$	-$CONH_2$	Amide	Carbamyl-	-amide
Nitriles	R-C≡N	-(C)≡N*	Nitrile	--------	-nitrile
		-CN		Cyano-	-------

Aldehydes			*Carbonyl*	*Formyl-*	*-al*
Ketones	*R-CO-R*			*Oxo or keto-*	*-one*
Alcohols	*R-OH*	*-OH*	*Hydroxyl*	*Hydroxy-*	*-ol*
Thioalcohols	*R-SH*	*-SH*	*Thiol*	*Mercapto-*	*-thiol*
Amines	*R-NH_2*	*-NH_2*	*Amino*	*Amino-*	*-amine*
Nitro compound	*R-NO_2*	*-NO_2*	*Nitro*	*Nitro-*	-----
Ethers	*R-O-R*	*-OR*	*Alkoxy*	*Alkoxy-*	-----
Halogen derivatives	*R-Hal*	*-Hal(-F,-Cl, -Br, -I)*	*Halogens*	*Fluoro-, chloro-, bromo-, iodo-*	-----

Nomenclature of organic compounds.

The present-day system used to name the organic compounds is recommended by the International Union of Pure and Applied Chemistry (IUPAC). This system is accepted by the chemists throughout the world.

Nomenclature according to IUPAC system involves the use of following terms.

(I) Word Root

(II) Primary suffix

(III) Secondary suffix

(IV) Prefix

(I) Word root. The word root represents the number of carbon atoms in the parent chain.

Some straight chains and their names

CH_4 metane	C_6H_{14} hexane
C_2H_6 ethane	C_7H_{16} heptane
C_3H_8 propane	C_8H_{18} octane
C_4H_{10} butane	C_9H_{20} nonane
C_5H_{12} pentane	$C_{10}H_{22}$ decane

The root word of one carbon chain is obtained by leaving –ane from methane, i.e., meth

c1 Methane Meth

c2 Ethane Eth

(II) Primary Suffix is used to indicate saturation or unsaturation in the carbon chain. Primary suffix is added to the word root.

Saturated carbon Chain	C – C : ane	ethane (alkane)
Unsaturated carbon Chain	C = C : ene	ethene (alkene)
	C = C – C = C : adiene	butadiene (alkadiene)
	C≡C : yne	ethyne (alkyne)

(III) Secondary suffix is used to indicate the functional group in the organic compound.

Secondary suffix for various functional groups are given in Table 1.

(IV) Prefixes are used for different categories of groups present in molecule.

(a) Alkyl group (C_nH_{2n-1} or R-):

Alkane	Alkyl group	Abbreviation	Prefix
CH_4	CH_3 –	Me-	Methyl
C_2H_6	$CH_3 – CH_2$ –	Et-	Ethyl
C_3H_8	$CH_3 – CH_2 – CH_2$ –	n-Pr-	n-Propyl
C_3H_8	$CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle \vert}{CH}} -$	Iso-Pr-	Isopropyl or 1-methyl ethyl-

In polyfunctional compounds (compounds with more than one functional groups), one of the functional groups is treated as **principal** functional group and is indicated by the secondary suffix whereas other functional groups are treated as substituents and are indicated by the prefixes. The prefixes and suffixes are given in Table 1.

Arrangement of Prefixes, word root and suffixes.

The prefixes, word root and suffixes are arranged as follows while writing the name.

Prefix(es) + Word root + p. suffix + sec. suffix

The above arrangement is illustrated by the following examples.