25.2-hydrocarbons- are only composed of hydrogen and carbon. They are relatively non-polar thus they are almost completely insoluble in water. Hydrocarbons become less volatile with increasing molar mass.

Alkanes- contain only single bonds (ethane, C_2H_6)

Alkenes-contain double bonds (ethylene, C_2H_4)

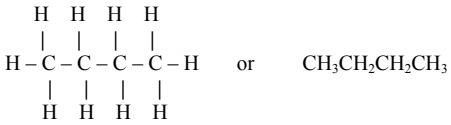
Alkynes-contain triple bonds (ethyne, C_2H_2)

Aromatic hydrocarbons-carbon atoms connected in a planar ring structure joined by both σ and π bonds between carbon atoms (Benzene, C_6H_6)

Unsaturated hydrocarbons- contain less hydrogen than an alkane having the same number of carbons

25.3-Alkanes- can be written in Lewis structure form or in the condensed structural formula

Butane, C_4H_{10}



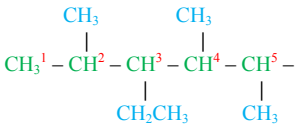
or $CH_3CH_2CH_2CH_3$

Structures of Alkanes-Each carbon in an Alkane is tetrahedral and can be represented by the sp^3 hybridization.

Structural Isomers-Compounds with the same molecular formula but with different bonding arrangements are called structural isomers.

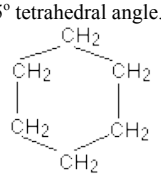
Nomenclature of Alkanes-named using the IUPAC names alkanes are named as follows…

1. Find the longest continuous chain of carbons and use the name of the base as the base name of the compound
2. Number the carbons in the longest chain, beginning with the end that is nearest to a substituent-(groups attached to the main chain)
3. Name and give the location of each substituent group. A substituent group formed by removing an H atom from an alkane is called an alkyl group. They are named by replacing the –ane ending with –yl
4. When two or more substituent groups are present, list them in alphabetical order. When there are multiple of the same substituents indicate using a prefix: di- (two), tri- (three), tetra- (four), etc.



3-Ethyl-2,4,5-trimethylheptane

Cycloalkanes-Alkanes formed in a ring or cycle formation. Carbon rings containing fewer than five carbons are strained because the bond angle in the smaller rings must be less than the 109.5° tetrahedral angle.



Cyclohexane

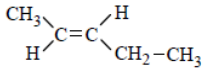
Reactions of Alkanes-They are relatively unreactive however their most commercially important reaction is combustion in air.

25.4-Unsaturated Hydrocarbons-the presence of one or more multiple bonds makes unsaturated hydrocarbons.

Alkenes-contain a double bond between two carbons. When there are multiple double bonds indicate with the suffixes of -diene, - treine, etc. Geometric isomers-compounds that have the same molecular formula and the same groups bonded to one another but differ in the spatial arrangement of these groups. Geometric isomers arise in alkenes because the C=C bond is resistant to twisting.

Cis- the substituent groups are on the same side of the double bond

Trans-the substituent groups are on opposite sides of the double bond

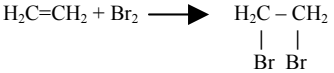


trans-2-pentene

Alkynes-unsaturated hydrocarbons containing one or more triple bonds

Addition reactions of Alkenes and Alkynes-the presence of double or triple bonds in hydrocarbons markedly increases their chemical reactivity

Addition reactions-A reactant is added to the two atoms that form the multiple bond.

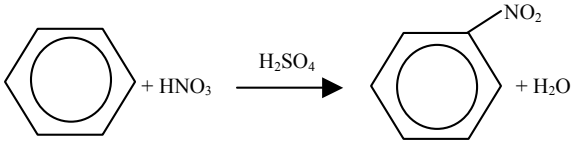


An addition of H_2 to an alkene converts it to an alkane – this is referred to as hydrogenation – A catalyst is necessary to promote this type of reaction

Aromatic Hydrocarbons-The simplest member of the series is Benzene.

Aromatic rings are represented by hexagons with a circle inscribed inside. Each corner of the hexagon represents a carbon atom. Each carbon is bound to three other atoms. Either three carbons or two carbons and a hydrogen (the hydrogen is not shown)

Although aromatic hydrocarbons are unsaturated, they do not readily undergo addition reactions. They undergo substitution reactions easily, where one atom of a molecule is removed and replaced by another atom or group of atoms.



25.5-Functional Groups; Alcohols and Ethers

Functional group - A site of reactivity in an organic molecule.

Alcohols (R–OH) - Alcohols are hydrocarbon derivatives in which one or more hydrogens of a parent hydrocarbon have been replaced by a hydroxyl or alcohol functional group, OH. The name for alcohols ends in –ol (ethane becomes ethanol) the boiling points of alcohols are much higher than those of their parent hydrocarbons.

Ethers(R – O – R) – Compounds in which tow hydrocarbon groups are bonded to one oxygen are called ethers. Ethers are formed by splitting water out from two substances in a reaction called a condensation reaction.

25.6 – Compounds with a carbonyl group – a carbonyl group is a functional group containing a C=O double bond.

Aldehydes – In aldehydes the carbonyl group has at least one hydrogen atom attached.

Ketones – in ketones the carbonyl group occurs at the interior of a carbon chain and is therefore flanked by carbon atoms.

Carboxylic Acids - Carboxylic acids contain the carboxyl functional group, which is often written as COOH. Carboxylic acids can be produced by oxidation of alcohols in which the OH group is attached to a CH_2 Group.

$$CH_3\overset{O}{\overset{\|}{C}}H + (\text{oxidant that can provide oxygen atoms}) \longrightarrow CH_3\overset{O}{\overset{\|}{C}}OH$$

Esters - Carboxylic acids can undergo condensation reactions with alcohols to form esters. Esters are compounds in which the H atom of a carboxylic acid is replaced by a hydrocarbon group. Esters are named by using first the group from which the alcohol is derived and then the group from which the acid is derived. Also esters generally have pleasant odors.

Saponification - The hydrolysis of an ester in the presence of a base is called saponification.

Amines and Amides – Amines are organic bases. They have the general formula R_3N, where R may be H or a hydrocarbon group. $(CH_3)_3N$ – Trimethylamine

Amides – An Amine containing a hydrogen bonded to nitrogen that has undergone a condensation reaction with a carboxylic acid.

25.7 – Chirality in Organic Chemistry- A molecule possessing nonsuperimposable images is termed chiral. Nonsuperimposable mirror images care called enantiomers. Chirality is very common in organic substances.

25.8 – Introduction to Biochemistry – Biochemistry is the chemistry of living organisms. The part of earth in which living organisms are formed and exist is called the biosphere. The biosphere includes the influences on life of the atmosphere, natural waters, and the solid earth.

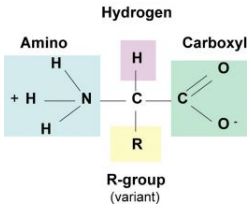
Biopolymers – classified into three broad categories: proteins, polysaccharides, and nucleic acids.

25.9 – Proteins – Proteins are macromolecular substances present in all living cells. Proteins serve as the major structural components in animal tissues. All proteins are chemically similar, being composed of the same basic blocks, called amino acids.

α - Amino acids - amino acids are the substances in which the amino group is located on the carbon atom immediately adjacent to the carboxylic acid group.

The ten amino acids that must be ingested are called the essential amino acids because they are necessary components of our diet.

Amino Acid Structure



Polypeptides and proteins- Peptide bonds are what the amide groups between two amino acids are called. Polypeptides are formed when large a number of amino acids are linked together by peptide bonds.

Protein structure - The arrangement, or sequence, of amino acids along a protein chain is called its primary structure. The secondary structure of a protein refers to how segments of the protein chain are oriented in a regular pattern. The most important and common secondary structure is the α–helix. The overall shape of a protein is called the tertiary structure. One of the most important classes of proteins are enzymes, large protein molecules that serve as catalysts.

25.10 – Carbohydrates – carbohydrates are not really hydrates of carbon; rather, they are polyhydroxy aldehydes and ketones.

Disaccharides – both glucose and fructose are examples of monosaccharides, simple sugars that can't be broken into smaller molecules. Tow monosaccharide units can be linked by a condensation reaction to form a disaccharide.

Polysaccharides - polysaccharides are made up of many monosaccharide units joined together. The term starch refers to a group of polysaccharides found in plants.

Glycogen – glycogen is a starchlike substance synthesized in the body that acts like an energy bank.

Cellulose – Cellulose forms the major structural unit of plants.

25.11 -Nucleic Acids – Nucleic acids are a class of biopolymers that are the chemical carriers of an organism's genetic information. Deoxyribonucleic acids (DNA) are huge molecules whose amu ranges from 6 to 16 million amu. Ribonucleic acids (RNA) are smaller molecules, with molecular weights in the range of 20,000 to 40,000 amu. DNA is found in the nucleus while RNA is found in the cytoplasm. The monomers of nucleic acids, called nucleotides, are formed from a phosphoric acid molecule (H_3PO_4), a five carbon sugar, and a nitrogen- containing organic base. DNA molecules consist of two deoxyribonucleic acid chains that are wound together in the form of a double helix.

Table 18.2 Common Functional Groups

FUNCTIONAL GROUP	COMPOUND TYPE	SUFFIX OR PREFIX OF NAME	EXAMPLE	SYSTEMATIC NAME (COMMON NAME)
	alkene	-ene		ethene (ethylene)
	alkyne	-yne		ethyne (acetylene)
	alcohol	-ol		methanol (methyl alcohol)
	haloalkane	halo-		chloromethane (methyl chloride)
	amine	-amine		ethylamine
	aldehyde	-al		ethanal (acetaldehyde)
	ketone	-one		propanone (acetone)
	carboxylic acid	-oic acid		ethanoic acid (acetic acid)
	ester	-oate		methyl ethanoate (methyl acetate)
	amide	-amide		ethanamide (acetamide)

Things to remember

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