Biomolecules

1. Introduction :

[a] All common activities of a living organism (bioactivity) involve reactions of certain organic compounds (mostly organic). Such compounds are called 'biomolecule'

[b] The synthesis of a biomolecules inside the body is known as anabolism while its degradation to simple products is known as 'catabolism' and two process collectively are called metabolism.

[c] Nowadays, carbohydrates are defined as the optically active polyhydroxy aldehydes or ketones or Substances which yield these on hydrolysis.

2. Carbohydrates :

[a] In these compounds H : O = 2 : 1 (same as water).

[b] Animal cell – Glucose, Glycogen. (forms of carbohydrates).

[c] Plant cell – cellulose, starch form (In plant cells carbohydrates are stored in form of starch).

[d] It's formula is : $C_n(H_2O)_m$.

[e] These are called hydrates of carbon.

[f] In some tissues amount of carbohydrates is equal to the 0.1% dryweight of cell.

[g] In liver cell 15 –16% glycogen is present.

[h] In Rammose H : O ≠ 2 : 1

Classification

Carbohyrates
↓Are of 3 types

Monosaccharides | **Oligosaccharides** | **Polysaccharides**

2.1 Monosoccharides :

[a] In it n = m

[b] There naming is of following type –

S.No.	Formula	Group	Aldolase	Ketose
1	$C_3H_6O_3$	Triosase	Gylceraldehyde	Dihydroxy acetone
2	$C_4H_8O_4$	T etrosase	Eryithrose	Erythrulose
3	$C_5H_{10}O_5$	Pentosase	Ribose	Ribulose
4	$C_6H_{12}O_6$	Hexosase	Glucose	Fructose.

Because in monosaccharides - CHO (Aldehyde) group is present so it keep reducing nature. They are reduced by Fehling (Cu_2O), Benedict solution.

[c] In aldolase aldehyde group is present and all central molecules are asymmetrical (chiral).

[d] In ketose ketone group is present and except 2nd carbon all molecules are asymmetrical.

[e] These are found in two isomeric forms L–form and D–form

[f] Simplest sugar → Glyceraldehyde

[g] Monosaccharides are of two types

Cyclic | **Non–cyclic**

[h] Cyclic compound are of 2 types :

Pyranosase	Furanosase
Ring made up of 6 members	Ring made up of 5 members

[i] Pyranosase and furanosase name was Coined by Howorth on basis of thermodynamics.

[j] Body sugar is called as glucose.

[k] 1 gm glucose yield 4.0 kcal energy on oxidation (Physiological fuel value)

[l] Fructose, Mannose and galactose are hexoses.

[m] Water hydrolysis of monosaccharides cannot take place.

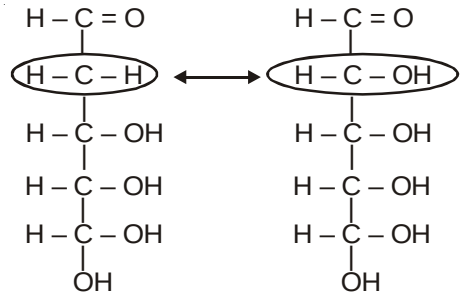
[n] Main isomeric form in it is α–isomers, α, β isomers $\rightarrow$ Anomeres.

[o] Arabinose and xylose which are pentose sugars are found in gum of cherry, Accacia (Babool) and Berry.

2.1.1 Derivatives of Monosaccharides :

Following are derivatives of monosaccharrides.

[a] Deoxy suger : If 1 hydrogen occupies the position of one – OH or one – OH is replaced by one -H than deoxy sugar is formed.



Deoxyribose **Ribose**

[b] Amino sugar : –OH group of Aldolase is replaced by $–NH_2$ group than it is called as amino sugar.

Eg. D–glucosamine, D–galactosamine

2.1.2 Special points :

[a] Glucose is simplest hexose

[b] Last product of digestion in human body is Glucose

[c] All hexose change into glucose in liver

[d] In body sugar of sugar cane is hydrolysed and forms fructose.

[e] Fructose is sweetest sugar

[f] Galactose is secreted in mammary glands.

[g] Lactose is formed by its water hydrolysis.

[h] Fructose is also called lactose.

[i] Mannose can be obtained from albumin of egg or from plants. It is not found in independent state.

[j] Monosaccharide does not react with schiffs reagent.

2.2 Oligo saccharides :

It is formed by combination of 2 to 9 mono saccharide units.

2.2.1 Disaccharides :

[a] The disaccharides are sugars composed of two molecule of same or different monosaccharides.

[b] Generally one molecule of water is reduced in forming disaccharides.

[c] Reaction is called as dehydrogenation

[d] General Formula = $C_n(H_2O)_{n-1}$

[e] Monosaccharides attach called as monomers.

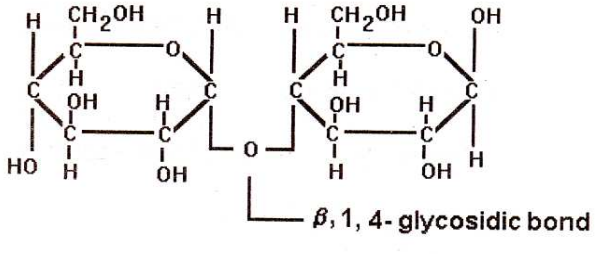
[f] Bond present in between them is called as **glycosidic bond**.

Some Important Disaccharides :

[i] Maltose → Glucose + Glucose = Maltose

[ii] Lactose → Galactose + Glucose = Lactose

- 5% in milk (only mammals)



Maltose

[iii] Sucrose → Glucose + Fructose = Sucrose

- It is a commercial or kitchen sugar.
- It is called invert sugar or (cane sugar)
- Hydrolysis *of* sugar is called as inversion *of* sucrose
- Reaction is catalysed by invertase.
- Equimolar mixture of glucose and fructose called as invert sugar.
- Saliva of Honey bee contain invertase enzyme.

[iv] Trehalose

- It is the major sugar *of* insect haemolymph. Among plants,.it is found in fungi and yeasts.

2.2.2 Trisaccharides : (Three monomers)

[a] Manotriose = 2 Galactose + 1 Glucose

[b] Raffinose = 1 Glucose + 1 Galactose + 1 Fructose

- It is found in cotton seed.

[c] Melanoxylose = 1 Fructose + 2 Glucose

2.2.3 Tetrasaccharides (Four monomers)

- Stachyose = 1 Glucose + 1 Fructose + 2 galactose

2.2.4 Pentasaccharides :

- Barbacose = 2 Galactose + 2 Glucose + 1 Fructose.

2.3 Polysaccharides

[a] Polysaccharides yield more than 9 molecules *of* monosaccharides on hydrolysis.

[b] General Formula = $(C_6H_{10}O_5)_n$.

[c] These are linear polymers and also highly branched

[d] These are not called as sugar. because are not sweet in taste.

Excep. - Inulin is sweet.

[e] Glycosidic bond is present between monomers

[f] Suffix - 'an' is present in last part of there names.

e.g. : Pentasan – Polymer of pentose

Hexosan – Polymer of hexose.

Polysaccharides

↓ two types

Homopolysaccharide | **Heteropolysaccharides**

2.3.1 Homopolysaccharides :

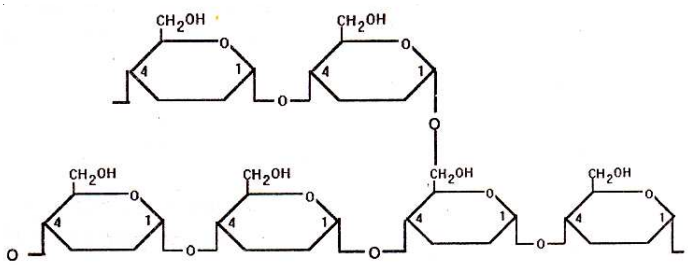
[a] There monomers are of one type of monosaccharides.

[b] These are simple type polysaccharides.

[c] Physiologically important homopolysaccharides.

[i] Starch

- **Stored food of plant**
- It is most improtant food source
- It is found in normal amount in all types of food source It is insoluble in water.
- It gives blue colour with iodine
- Its monomer is a α–D glucose.



Formula of Starch

- It is mixture of two compounds.

↓ **Amylose** ↓ **Amylopectin**

[a] Amylose :

- It has 250–300 monomers.
- These are combined with α 1, 4–linkage.
- It is unbranched helical structure.
- They give blue colour with I_2.
- It is 15% to 20% in starch.

[b] Amylopectin :

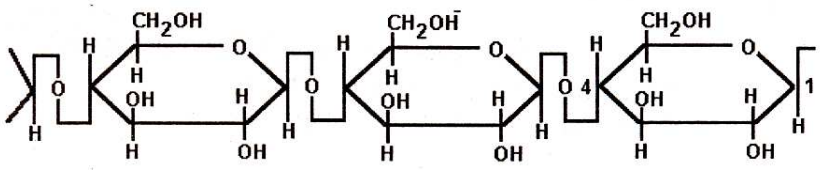
- Branch of 24–30 glucose monomers.
- Many branchess are present.
- In straight chain it is attached by α 1, 4 glycosidic. bond while in branched chain it is linked by α–1, 6 linkage.
- Give Purple colour with I_2.
- It is 80–85%.

[ii] Glycogen :

- Stored food of animals.
- Called as animal starch.
- It is found in more amount in Liver and muscles.
- It is a multibranched polysaccharide
- Its monomers are α D glucose
- In straight chain α 1, 4 linkage and in branched chain α 1, 6 linkage is present.
- Give red colour with I_2.

[iii] Cellulose ;

- It is mainly found in plant cells.
- It is main constituent of cell wall.
- 50% carbon of plant kingdom is in its form
- It is more in cotton (90%)
- It does not give colour with I_2.
- It is Polymer of B D–glucose.



Structure. of Cellulose

- Its no. is 2000–10,000.
- β–1, 4 glucosidic bond is present.
- It is insoluble in water.
- Water hydrolysis of it is by cellulase enzyme.

[iv] Chitin :

- It is nitrogenous carbohydrate. Important structural polysaccharide in invertebrates.
- Exoskeleton of insects and crustaceans are made up of it.
- Its monomers are N–acetyl glucosamine which are combined or linked in linear order by β 1, 4–glycosidic bond.

[v] Dextrin :

- It is found in form of central substance in between starch and glycogen digestion.
- Water hydrolysis of it forms glucose + Maltose
- It is non–crystalline.
- It is found in form of carbohydrates in yeast and bacteria.

[vi] Inuline :

- It is found in tubers and roots of compositee family. e.g. Dahlia
- It's monomers are fructose which are linked by β–1, 4 linkage.
- It is used for calculating the glomerular filteration rate.
- It is soluble.

Fatty acids are of two types -

Lipids are two types :

[i] Saturated [ii] Unsaturated

3. Proteins :

[a] Protein term is given by Berzelius in 1838.
[b] Terms is derived from greek word proteose which means first group or First division or First rank.
[c] Protein is 3/4 part of dry weight of tissues.
[d] They have first place in life
[e] They form the functional basis of metabolic activities of body
[f] Protein is the structural unit of body.
[g] Nerve cells, tissues, muscles etc. are made up of proteins.
[h] C, H, 0, N are necessary present in proteins.
[i] Proteins are qualitatively the main material of animal tissue.
[j] In some proteins P, S, Fe, Cu, I, also may be present. They are called trace elements.
[k] Percentage of protein in various sources are as follows

Milk of cow	→	3.5%
Wheat	→	10–17%
Rice	→	8–10%
Soya bean	→	30–40%
Kazu	→	21%
Barley	→	12%
Pulses	→	20%

Muscle of man	→	20%
Egg (white)	→	11–13%
Egg (yolk)	→	15–17%
Meat of cock	→	24%
Blood plasma	→	70%

[i] Amount of various compounds present in protein is

C	→	50 – 55%
O	→	20 – 24%
H	→	7 – 8%
N	→	14 – 18%
S	→	0.2 – 0 5%

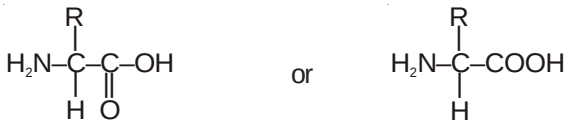
[m] Proteins are polymers of amino acids.

[n] 70 types of Amino acids are known. But in proteins about 20 types of amino acids are used. other amino acids are called non-proteinious amino acid for e.g. citrulin ornithino

3.1 Chemical Structure :

[a] Amino aCids can be given by the general formula.

[b] Their formula is

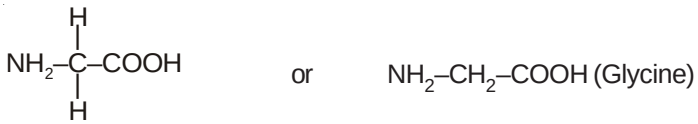


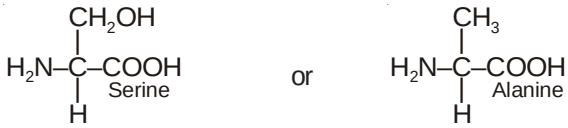
R = Alkyl group

[c] If 'R' Changes amino acids formed also changes.

e.g. If R = H → Glycine (Simplest A. Acid)
If R = CH_3 → Alanine
If R = CH_2OH → Serine

[d] 'R' group attach with the carbon than that carbon is called α – carbon.

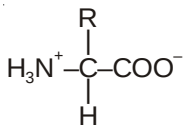




[e] Amino acids have also NH_2 group. Which is basic and also COOH group. Which is acidic. So Nature of Amino acid is Acidic + Basic

[f] Amino Acids are amphoteric in nature. So for it a special term is coined called Zwitter ion

[g] They have following structure in solution



[Zwitter Ion]

[Net charge on it is zero]

3.2 Classification of Amino Acids :

[A] According to structure of amino acids it is divided into 7 groups

[i] Aliphatic side chains :

Eg. Glycine : Alanine

Valine : Proline

Leucine : Isoleucine

[ii] Hydroxy aliphatic side chains :

Eg. Serine and Thrionine.

[iii] Aromatic side chains :

Eg. Phenyl alanine, Histidine, Tyrosine

[iv] Basic side chains :

Eg. Lysine, Arginine, (Aliphatic)

Histidine (Hetero cyclic)

Triptophan (Aromatic)

[v] Amide side chains :

Eg. Aspargine, Glutamine

[vi] Acidic side chain :

Eg. Aspartic acid, Glutamic acid.

[vii] Sulphur containing chain :

Eg. Cistine , Methionine

Aspartic and glutamic acid show acidic nature because they have 2- COOH groups.

Arginine, lysine has 2–NH_2 groups So are basic in nature.

Amino acid which are not present in protein are

[a] Ornithine [b] Citrulline

Both are mediatar of urea cycle

[B] According to synthesis amino acid is of two types :

[i] Essential amino Acids :

These are taken by food. Not synthesized in the body.

These are as follows

(1) Arginine (2) Histidine

(3) leucine (4) Isoleucine

(5) lysine (6) Methionine

(7) Phyenyl alanine (8) Threonine

(9) Tryptophan (10) Valine

Arginine and Histidine are semiessential ie. they are synthesized in tissues. But synthesis is so less that in the infant stage it is normal while in adult stage it is taken as in form of food according to some scientist tell that they are not formed in adult stage but it is a wrong concept.

[ii] Non - Essential Amino Acid :

[a] These are synthesized in body

[b] These are not taken by help of food.

[c] These are as follows

[1] Alanine [2] Aspargine [3] Aspartic acid [4] Cistine [5] Glutamic acid

[6] Glutamine [7] Hydroxy proline [8] Glycine [9] Proline [10] Serine

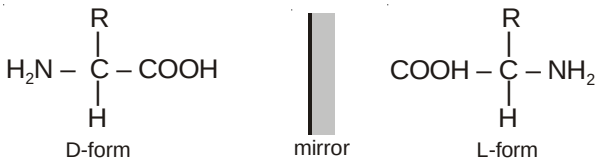
[11] Tyrosine

[d] Except glycine all Amino Acid has 2 optical image (1 and 2)

[e] Optical isomerism are those which has a simmilar common formula but there images opposes to each other.

[f] For it chiral carbon atom is necessary. Chiral carbon atom is that carbon atom whose four valency are not satisfied by same group or atoms.

[g] In Glycine chiral carbon atom is absent



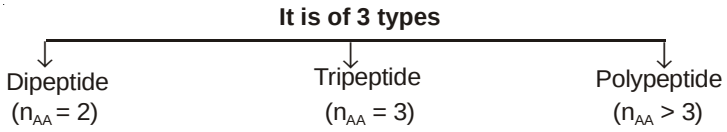
[h] In eukaryotes l-form synthesize protein

3.3 Peptide bond :

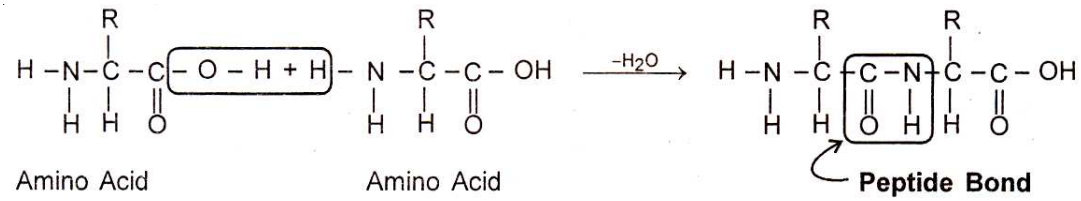
[a] Two or more than two amino acid linked and form a peptide.

[b] The bond present in between peptides is called peptide bond.

[c] Presence of peptide bond first of all given by Emil Fischer and Hofmeister in 1902.



[d] A peptide bond is bond between $–NH_3$ of one Amino acid and –COOH of another amino acid.



[e] Peptidyl transferase - Catalyse the synthesis of peptide bond.

3.4 Configuration of proteins :

[a] Biological nature or function of protein was confirmed by its conformation.

[b] This conformation is of 4 types

3.4.1 Primary Structure :

[a] This type of structure was given by Friedrich Sanger in 1953 in Insulin (of one chain)

[b] Primary str. is conformed by a single polypeptide chain in a linear manner.

[c] All amino acid are attached in a straight chain by peptide bond.

[d] No biological importance & soon changed to other forms.

3.4.2 Secondary Structure :

In it structure of straight chain from irregular changes to form coils.

H–bond + peptide bond present in sec. structure.

This H bond is present between hydrogen of Amino group and oxygen atom of carboxylic acid group.

This structure is of two types

[i] α – Coiling :

Chain is spiral

3.7 atoms in one coiling

Right handed circular.

Eg. → Myosin, Keratin, Tropomysin

[ii] β–Coiling :

Structure of protein is not arranged in a sequence.

Polypeptide chain are parallel to each other

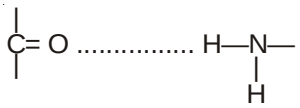
H - bond form by near chains **Eg.** Silk fibrin

3.4.3 Tertiary structure :

In this structure of protein atoms are highly coiled and form a spherical form

This structure is formed by 4 regular hydrogen bonds which makes a regularity in it

[i] Hydrogen bond :



Hydrogen bond

Create relation between the far distant parts

They form between oxygen of acidic amino acid and H of basic amino acid.

[ii] Hydrophobic bond :

Non–polar side chains of neutral amino acid tends to be closely associated with one another in proteins

Present in between the amino Acid

These are not true bonds

[iii] Ionic bond :

$–COO^{-}H_3^{+}N–$

Ionic bond

These are salt bonds formed between oppositely charged groups in side chains of Amino acids

Eg. Aspartic acid

Glutamic acid

[iv] Disulphide bonds :

I-------S – S -------I

Relatively stable bond and thus is not broken readily under usual conditions of denaturation.

Formed between the –SH group of Amino acid V_{12} – Cystine and Methionine.

3.4.4 Quaternary structure :

When 2 or more polypeptide chains united by forces other than covalent bonds (I.e. not peptide and disulphide bonds) are called Quaternary structure.

It is most stable structure.

3.5 Protein Test :

[a] On heating with Millon's reagent protein give red colour.

[b] With conc. HNO_3 on heating give yellow ppt. Which on more heating give solution On adding NH_4OH Red colour appears. It is Xanthoprotic test.

[c] (NH_4OH) + dil. $CuSO_4$ protein Blue violet colour. It is a biurate test.

[d] Indanone hydrate (Ninhydrine) + Protein → Blue colour called Ninhydrine test.

3.6 Biological Importance of protein :

[a] Component of plasma membrane

[b] All enzymes are protein

[c] Many harmones are protien

[d] Antigen and antibody are protein

[e] Actin and myosine protein are important in muscle contraction

[f] Proteins are important in growth, regeneration and repairing

4. Nucleic Acid :

[a] These are special type of acids which are present in nucleus & cytoplasm.

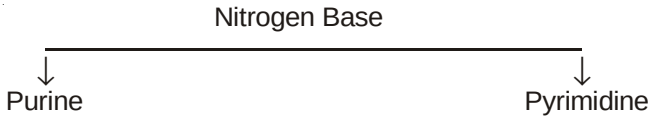
[b] Control help in metabolic activity of cell

[c] They are also found in Mitochondria, centriole and chloroplast.

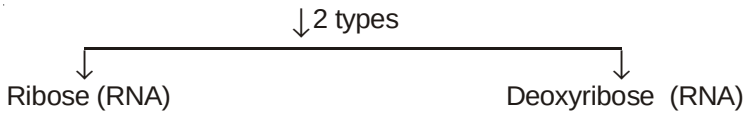
Types → These are of 2 types → DNA (Deoxy Ribo Nucleic acid)
→ RNA (Ribo Nucleic acid)

[d] It is discovery by First of all in pus cells of WBC iri 1869 by Friedrich Meischer.

[e] Fischer discovered Nitrogen bases in 1888



[f] Levan found sugar



[g] Altman coined the term "nucleic acid"

4.1 DEOXY RIBONUCLIC ACID (D.N.A.) :

[a] It is found in Nucleus

[b] Avery, Mcleoid and Mccarty told that hereditory charactersare stored inDNA

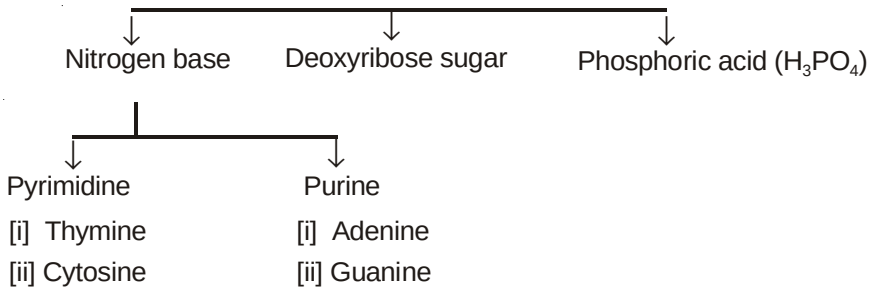
[c] They performed their experiment on pneumococcus bacteria.

[d] Double helical structure of DNA was given by Watson Crick. (a)

[e] Synthesis of DNA was done by Rich.

[f] Chargaff told that ratio of A or T and G or C = 1

[g] DNA made up of 3 units

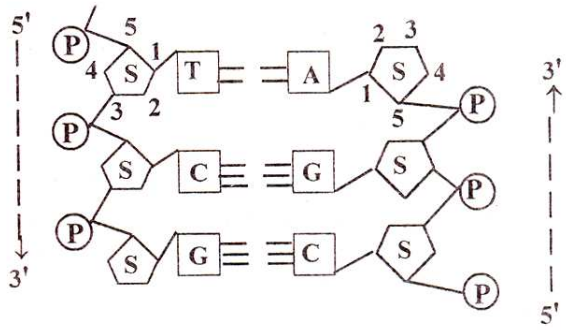


[h] Nucleoside

When nitrogen base combined with deoxyribose sugar it constitute a nucleoside.

S.No.	Deoxyribonucleotide		
1	Adenine + Deoxyribose	→	Deoxyadenosine
2	Guanine + Deoxyribose	→	Deoxyguanosine
3	Cytosine + Deoxyribose	→	Deoxycytidine
4	Thymine + Deoxyribose	→	Deoxythymidine

Deoxyadenosine → It is a part of Nucleotide.



[i] Nucleotide

[a] Nitrogen base + Sugar + Phosphate → Nucleotide

S.No.	Deoxyribonucleoside phosphate.		
1.	Deoxyadenosine mono, di, tri, phosphate	→	dAMP, dADP, dATP
2.	Deoxyguanosine mono, di, tri, phosphate	→	dGMP, dGDP, dGTP.
3.	Deoxycytidine mono, di, tri, phosphate	→	dCMP, dCDP, dCTP
4.	Deoxy thymidine mono, di, tri, phosphate	→	dTMP, dTDP, dTTP.

[b] It is a unit of DNA

[c] All nucleotides combined and form a chain called polynucleotides by which RNA and DNA formed.

4.1.1 Structure of DNA :

[a] Double Helical model of DNA was proposed by biochemist J.D. watson, Brittsh chemist FHC crick in 1953.

[b] DNA in double stranded structure is made up of two chains of polynucleotides.

[c] Both chains are called as Right handed helicaly.

[d] DNA is a polymer of Nucleotide.

[e] Single unit 3', 5' is a pair of phosphodiester bonds.

3'end -------- 5'end

5' end -------- 3'end

[f] Sugar and phosphorous are alternately arranged.

[g] In both chains, in between A and T, 2 Hydrogen bonds are present while in C and G 3H bonds are present.

(A = T) (C ≡ G)

[h] A always attach with T while C always attach with G.

[i] Purine and pyrimidine are found in ratio 1 : 1

[j] 98% part of DNA is found in nucleus of eukaryotic cells

[k] DNA is attached with histone protein

[l] Mol. weight of DNA is 10^6 to 10^9 Dalton.

[m] In between DNA and histone bond of Mg^{+2} salt is present.

[n] In prokaryotic cell and mitochondria circular DNA is present.

[o] Major groove is present in DNA Different types of DNA have different types of arrangement of bases. So two DNA molecule are not similar.

4.1.2 Function of DNA :

[i] Self–Replication or self–Duplication

DNA has the property of self - replication. It is therefore a reproducing molecule. This unique property of DNA is at the root of all reproduction. Through its replication, DNA acts as the key to heredity. In the replication of DNA, the two strands of a double helix unwind and separate as a template forthe formation of a new complementary strand.

[ii] Protein Synthesis

The specific sequence of pyrimidine, purine base pair in DNA represents coded information for the manufacture of specific proteins. These code instructions first are transcribed into the matching nitrogen- base sequences within mRNA and the instructions in such RNA subsequently are translated into particular sequence of amino acid units within the polypeptide chains and proteins.

The major steps in the utilization of the genetic information can be represented as :

$$\text{DNA} \xrightarrow{\text{Replication}} \text{DNA} \xrightarrow{\text{Transcription}} \text{RNA} \xrightarrow{\text{Translation}} \text{Protein}$$

[iii] Mutation →

Under ceratin conditions. the nitrogen base sequence of a particular amino acid gets altered. Such alterations then are stable and persist into succeeding molecular generations of DNA.

When such changes occur, the structural and functional traits of a cell also change correspondingly. Through changes in its cells, a whole animal and its progency may thus become changed in the coures of successive generation; this is equivalent to evolution.

4.1.3 Replication of DNA :

[a] The synthesis of new DNA molecules from preexisting DNA is called replication.

[b] It occurs in mitosis and meiosis I in S phase of interphase.

[c] DNA replication is semiconservative proposed by Watson and Crick.

4.1.4 Significance of DNA :

Chromosomes are mainly composed of DNA, RNA and histone protein.

Among these molecules, DNA is the main hereditary material.

4.2 Ribonuclic Acid (RNA) :

Found in cytoplasm as well as in nucleus.

Cytoplasm → In the ribosome (heigher amount)

Occourence

Nucelus → Nucleus

4.2.1 Chemical Nature :

Ribonucleic acid is a polymer of purine and pyrimidine ribonucleotides linked by 3' →5' phosphodiester bridges. The number of nucleotides in RNA ranges from as few as 75 to many thousands. Although sharing many features with DNA, RNA possesses several specific difference.

As indicated by its name, sugar in RNA to which the phosphate and nitrogen- bases are attached, is ribose rather than the deoxyribose of DNA.

Although RNA contains the ribonucleotides of adenine, guanine, and cytosine, it does not posses thymine. Instead of thymine, RNA contains the ribonucleotides of uracil. Thus the pyrimidine components of RNA differs from those of DNA.

RNA exists basically as a single-stranded moiecule rather than as a double -stranded helical molecule, as does DNA. However the single strand of RNA is capable of folding back on itself like a hirpin and thus acquiring double-stranded characteristics. In these regions. A pairs with U and G pairs with C.

Thus a given segment of a long RNA molecule might, for example, be represented as follows.

```
P – R – P – R – P – R – P – R – P – R
    |       |       |   |       |
    A       U       G   G       C
```

where R stands for ribose; A, U, G, and C for Adenine, Uracil, Guanine and Cytosine respectively.

4.2.2 Types of RNA and their Functions :

There are 3 main types of RNA molecules

[i] Messenger RNA (mRNA)

[ii] Transfer RNA (tRNA)

[iii] Ribosomal RNA (rRNA)

[i] Messenger RNA (mRNA)

Discovered by Astrachan, Huxley.

This type of RNA consists of single strand of variable length and serves as a template for protein synthesis.Codon in the chromosomes,

mRNA complementary copy of DNA as it carries chemical messages in the form of nitorgen-base sequence from the nucleus to the ribosomes, i.e. from DNA to cytoplasm where proteins are synthesized. Therefore, it is called messenger RNA or mRNA

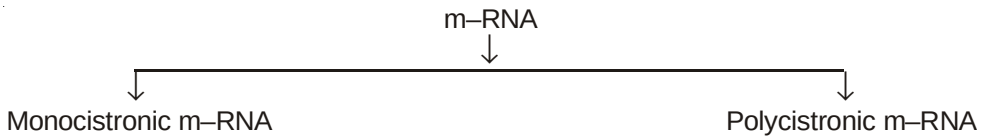
As chain-like polymer of nucleotides, mRNA is shaped like a filament which is believed to become draped over the surface of one or more ribosomes during protein synthesis.

INFOROMOSOMES

[a] Inforomosomes = mRNA + protein (discovered by Spirin) produced in previtellogenesis.

[b] Heterogenous RNA (Hn RNA) is processed as mRNA.

[c] Two types of m-RNA on the basis of no. of cistrones



Among RNAs, Messenger RNA is the longest one (900 – 1500 nucleotides).

Synthesis of mRNA :

mRNA is sythesised from DNA in the nucleus.

It is cal!ed transcription.

Sythesis is catalysed by an enzyme called RNA polymerase.

5-10% of cellular RNA.

Lowest in quantity.

[ii] Ribosomal RNA

A ribosome is a cytoplasmic nucleoprotein structure which serves as the organellar machinery for protein synthesis from mRNA templates.

On the ribosome, the mRNA and tRNA molecules interact to translate into a specific protein molecule the information transcribed from the DNA.

rRNA constitutes the largest part of total RNA (Highest) - 80%

Synthesis $\rightarrow$ Nucleolus

[iii] Transfer RNA (tRNA) :

These are also called **Soluble RNA.**

Single stranded.

10-15% of the total RNA.

Size - Smallest $\rightarrow$ 75 - 80 nucleotides only.

Synthesis - Within **nucleus** from **DNA.**

Function – It transport amino acid from cytoplasm to the site of protein synthesis.

Clover leaf model (2 dimensional) :

This model regarding structure of RNA is proposed by **Holley.**

tRNA folded on itself to form a clover leaf like structure.

It has two **terminal ends, three main loops** and **one miniloops.**

A tRNA has **four** main regions, namely.

Enzyme site

Carrier site

Anticodon site

Ribosome site

5. Enzymes :

Proteins which are used as a catalyst in biochemical reaction is known as biocatalysts.

5.1 Structure of enzyme

[a] They are globular proteins.

[b] With having tertiary structure it can be collected as crystals.

[c] In the presence of enzymes biochemical reactions is completed with body temperature, normal pressure and normal pH 7 in the body.

5.2 Specific characteristics :

Enzymes have following two specific character as :

[i] Specificity [ii] Efficiency

5.2.1 Specificity of enzymes

[a] Generaly one enzyme can catalyze only one biochemical reaction.

[b] It can increases rate of reaction upto 10^{20} times.

[c] In some cases one enzyme can catalyzes more than one reaction and one reaction can be catalyzes more than one enzyme also.

eg. Enzyme present in Yeast (Zymase) can fermant both glucose and fructose into .alcohol and also cane-sugar can be hydrolyses by invertase and sucrase enzymes.

5.2.2 Efficiency of enzymes

[a] One molecule of enzyme can convert millions of substrate molecules into product per second.

eg. Carbonic anhydrase enzyme present in red blood carpcells can convert 6 lac molecules of carbonic acid into carbondioxide and water per second.

[b] With having tertiary structure it can be collected as crystals.

[c] Enzyme can be stored at low temperature.

5.3 Importance of enzymes

In the thousands of enzymes presents in body if even a single enzyme would be absent or damaged than complex disease in results.

eg. Scacity of Phenylalaine hydroxylase enzyme in human body is result in phenylketonuria disease.