# DNA finger printing is used for

## BIOMOLECULES

**Continued from 6th March**

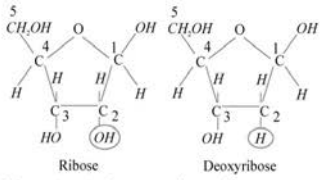
**Nucleic acids:** Nucleic acids are biologically significant polymers of nucleotides with polyphosphate Ester chain .

- These are present in all living cells .
- They direct the synthesis of proteins and are responsible for the transfer of genetic information i.e hereditary .
- Nucleoproteins are formed by combining proteins with nucleic acids .
  Nucleoproteins = protein + Nucleic acid
- Proteins have polyamide chains.
- The repeating units of nucleic acids are called nucleotides .
- Types of Nucleic acids are
  **a)** Ribonucleic acid ( RNA )
  **b)** Deoxyribonucleic acid ( DNA )

**Chemical Composition of Nucleic acids Hydrolysis**

- DNA $\xrightarrow{Hydrolysis}$ Deoxyribose sugar + phosphoric acid + purine / pyrimidine base
- RNA $\xrightarrow{Hydrolysis}$ ribose sugar + phosphoric acid + purine / pyrimidine base

The two sugars present in nucleic acids are ribose and deoxyribose. These are aldopentose sugars and present in furanose form. Ribose is present in RNA and deoxy ribose is present in DNA. Ribose and deoxyribose differ structurally in terms of one oxygen atom on carbon at position-2.

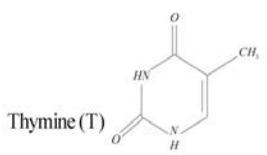


Ribose Deoxyribose

- Ribose ( or ) de – oxyribose is a pentose sugar
  a) $\alpha$ – D – ribose present in RNA
  b) $\alpha$ – D – deoxyribose present in DNA

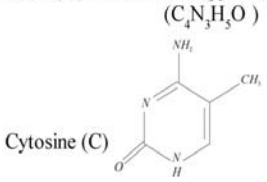
**Nitrogenous bases:** These are heterocyclic organic compound having two or more nitrogen atoms in ring skeleton. These are called bases because the lone pairs of electrons on the nitrogen atoms make them as Lewis bases. Their structures are given below

- Pyrimidines and purines are nitrogen containing hetrocyclic bases
- Pyrimidine bases are
  a) Thymine (T): 2,4-dioxo 5-aminopyrimidine $(C_5N_2H_6O_2)$



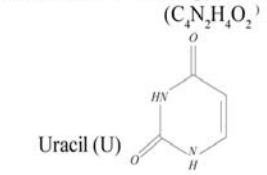
Thymine (T)

b) Cytosine ( C): 2-oxo 4-aminopyrimidine $(C_4N_3H_5O)$



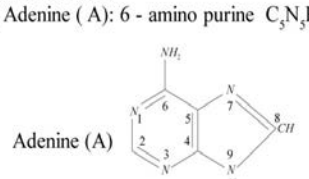
Cytosine (C)

c) Uracil ( U ): 2, 4 - di oxo pyrimidine $(C_4N_2H_4O_2)$



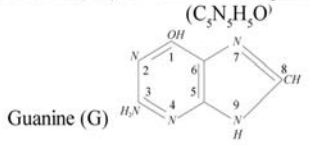
Uracil (U)

- Purine bases are
  a) Adenine ( A): 6 - amino purine $C_5N_5H_5$



Adenine (A)

b) Guanine ( G ): 2 - amino 6- oxo purine $(C_5N_5H_5O)$



Guanine (G)

- **a)** Thymine contains two oxo and one methyl groups
  **b)** cytosine contains one amino and one oxogroups
  **c)** Uracil contains two oxogroups
  **d)** Adinine contains one amino group
  **e)** Guanine contains one amino and one oxogroups.
- DNA contains A, G,T and C
- RNA contains A , G, U and C
- Thymine is not present in RNA.

***Phosphoric acid, $H_3PO_4$*** : Phosphoric acid forms esters to *–OH* groups of the sugars to bind nucleotide segments together.

**JEE MAIN Special**

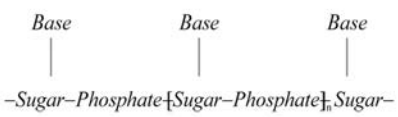
**Nucleosides:** N- Glycosides are called Nucleosides

- Nucleoside = Base + pentose sugar
- The bond present between sugar and base is called **N – Glycoside bond.**
- This bond is formed between first numbered nitrogen of pyrimidine and first carbon of sugar .
- This bond is formed between ninth numbered nitrogen of purine and first carbon of sugar.
- These are called as adenosine, guanosine , cytidine , thymidine and uridine, when they contain adenine, guanine, cytosine, thymine and uracil respectively.

**Nucleotides**

Nucleotide = Base + Sugar + phosphate

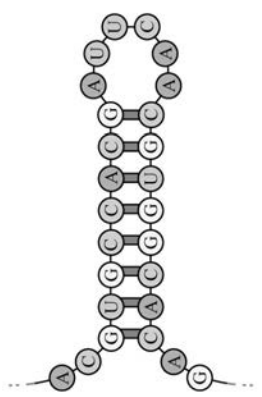
A simplified version of nucleic acid chain is as shown below



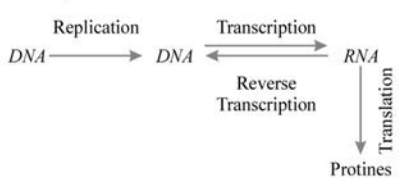

- Base is nothing but purine ( or ) pyrimidine
- Base bonded with sugar at $1^1$ carbon .
- Phosphate group bonded with sugar at $3^1$ or $5^1$ carbons .
- 1 to 3 phosphate groups may attach with sugar .
- If one phosphate group is present in adenine unit it is called adenosine mono phosphate **(AMP)**
- Similarly if 2 and 3 phosphate groups are present in adenine, then they are adenosine diphosphate (ADP) and adenosine triphosphate (ATP) respectively.
- If the phosphate group is at $5^1$ carbon, then it will be adenosine - $5^1$-monophosphate etc.
- These nucleotides connected by mono , di (or) tri phosphate groups at $5^1$ – **OH** of one nucleotide.
- a) Phosphate diester bonds which links two sugar rings present between $3^1$ and $5^1$ carbons.
  b) $\alpha$ - Glycoside bond which links Sugar and base
- a) A nucleotide contains two nucleotide sub-units called **"dinucleotide".**
  b) A nucleotide contains 3 – 10 subunits is called **"Oligonucleotide"**
  c) A nucleotide containing many subunits is called **"Polynucleotide"**
- DNA and RNA are Polynucleotides .
- A nucleic acid chain is abbreviated by one letter code with 5' end of the chain .

**Structure of DNA:** The double helix structure of DNA was proposed by Waston and Crick .

- They were based on X- ray diffraction studies.
- It explains base equivalance and duplication of DNA
- All species contains
  **a)** A = T **b)** $C \equiv G$
  **c)** no. of purines = no. of pyrimidines (A +G ) = ( C + T )
- The AT / GC ratio varies from species to species
  Ex . **a)** In human being AT / GC = 1.52 / 1
  **b)** In E. coli AT / GC = 0.93 / 1
- It is composed of two right handed helical polynucleotide strands .
- The two strands are anti parallel with each other.
- 5' – 3' phosphodiester linkages run in opposite direction .
- The base groups are present inside and perpendicular with the axis .
- The two strands are held together by hydrogen bonds due to A = T and G ≡ C
- Always A pairs with T and G pairs with C only.
- A forms two hydrogen bonds with T .
  G forms three hydrogen bonds with C
  A does not form Hydrogen bonds with C
  G forms only one hydrogen bond with T .
- Greater the number of GC pairs greater willbe the melting point of DNA.
- Melting point of E.Coli is less than that of human beings.
- The length of all hydrogen bonds are similar
- DNA strands are twisted but base pairs are planar and parallel with each other .
- Primary structure of nucleic acids explains order of bases .
- Secondary structure gives double helix .
- The stability of helix is due to
  1. Hydrogen bond between A = T and G ≡ C
  2. Hydrophobic interactions between bases.
- The diameter of double helix is 2 nm.
- The length of one complete turn ( $360^0$ ) is 3.4 nm.
- The DNA rotates at both sides i.e right hand side or left hand side.
- The right hand helices is more stable and is called $\alpha$ **– conformation .**
- At melting temperature, DNA separates into two strands, called as **melting**.
- When the melted DNA is cooled, the strands hybridise. This is called **Annealing**.
- In the secondary structure of RNA , helices are present but only single stranded.
- Some times they fold back on themselves like a hairpin thus acquiring double helix structure posessing double stranded characteristics.



Hairpin structure of RNA




Now in double stranded arrangmeent guanine pairs with cytosine and adenine with uracil. Since RNA molecule is a single strand complementary to only one of the two strands of a gene.

- Its guanine content does not necessarly equal to its cytocine contents, nor does its adenine contents to its uracil content.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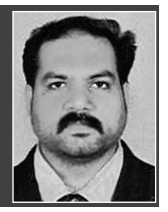
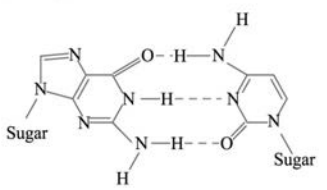


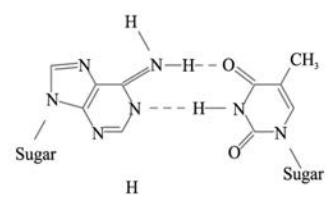
- Therefore, when RNA is hydrolysed there is no relationship among the quantities of different bases obtained.
- RNA molecules are of three types and they perform different functions. They are named as
  **(i) messenger RNA (m-RNA),** Linear in structure
  **(ii) ribosomal RNA (r-RNA),** Single Helix structure **and**
  **(iii) transfer RNA (t-RNA),** Clover leaf structure.
- The blue print of DNA is called m RNA .

**DNA Finger Printing:** Each human has unique finger prints at the tips of fingers, useful to identify that human.

- They may be altered due to some surgery
- Now a days a new technique known as DNA Printing is introduced to identify humans.
- DNA finger printing is based on the facts that a sequence of bases on DNA is unique for a person.
- It is the same in each and every cell and can not be altered by any known means
- DNA finger printing is used for
  a) Identify the criminals by forensic Labs.
  b) Determining the paternity of individual.
  c) Identifiying the dead bodies by comparing their DNA with their parents or children DNAs
  d) Identifying racial groups to rewrite biological evolution.

**Hydrogen Bonded Base Pairs**




A = = = T

**Biological Functions of Nucleic Acids**

- DNA is the chemical basis of heredity and may be regarded as the reverse of genetic informaiton.
- DNA is exclusively responsible for maintaining the identify of different species of organisms over millions of years.
- A DNA molecule is capable of self duplication during cell division and identical DNA strands are transferred to daughter cells.

**Hormones:** Hormones are molecules that act as inter cellar mesengers

- Hormones are produces by endocrine glands in the body and are released directly into blood stream which transports them to the site of action