By- Shailendra Shukla Sir

Nucleic Acids

The nucleus of a living cell is responsible for transmission of inherent characters from one generation to anther i.e. it is responsible for **heredity in living beings**. The particles in nucleus of the cell which are responsible for heredity are called chromosomes. These chromosomes are made up of proteins and an another type of biomolecules called **nucleic acids.**

Nucleic acids are long chain polymers of **nucleotides** and therefore, they are also called polynucleotides.

Nucleic acids are mainly of following two types-

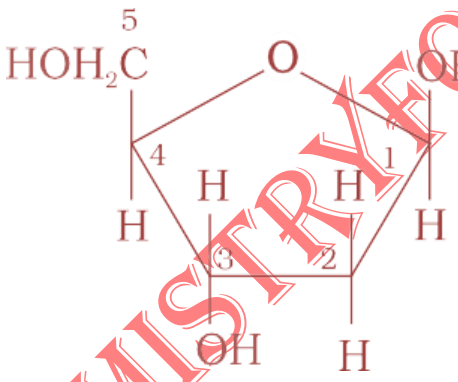
(1) D**eoxyribonucleic acid (DNA)**

(2) Ribonucleic acid (RNA)

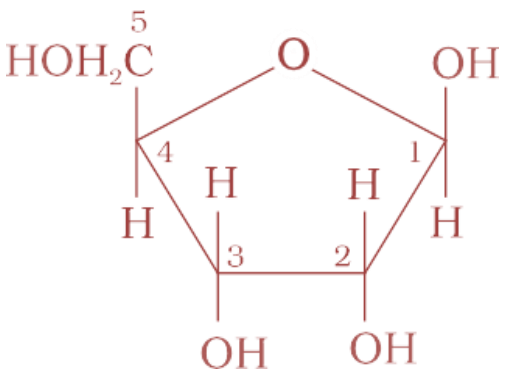
Chemical Composition of Nucleic Acids

Nucleic acids (DNA or RNA) on complete hydrolysis give a pentose sugar (ribose), phosphoric acid and nitrogen containing heterocyclic compounds called nitrogenous bases.

In DNA molecules, the sugar moiety is β-D-2-deoxyribose while, in RNA molecules, it is β-D-ribose.



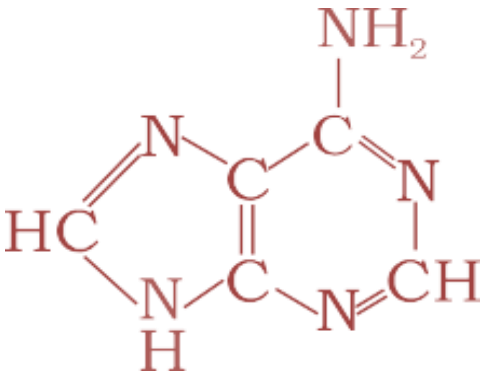
β-D-2-deoxyribose



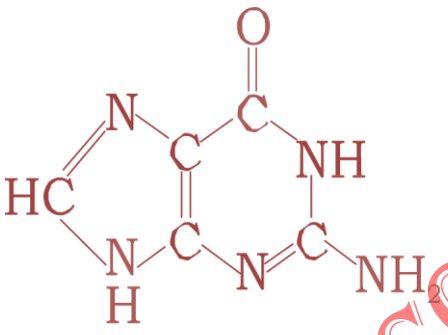
β-D-ribose

DNA contains four bases namely, adenine (A), guanine (G), cytosine (C) and thymine (T). RNA also contains four bases, where the first three bases are same as in DNA, but the fourth one is uracil (U) instead of thymine (T).

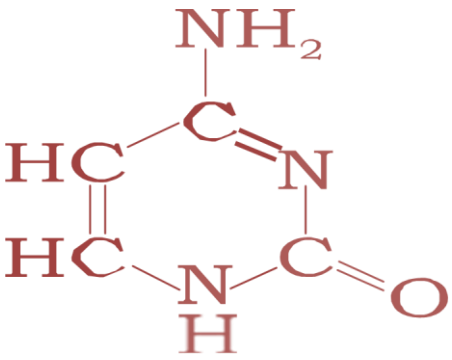
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Adenine (A)



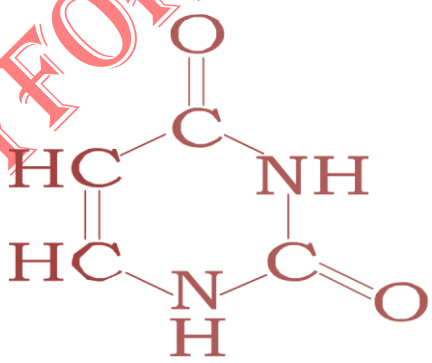
Guanine (G)



Cytosine (C)



Thymine (T)

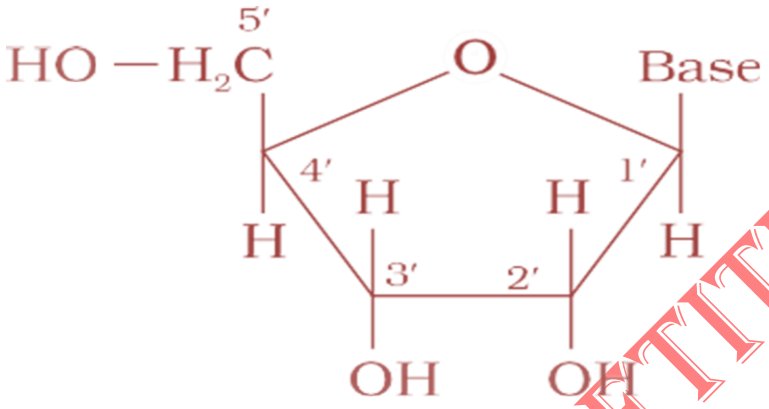


Uracyl (U)

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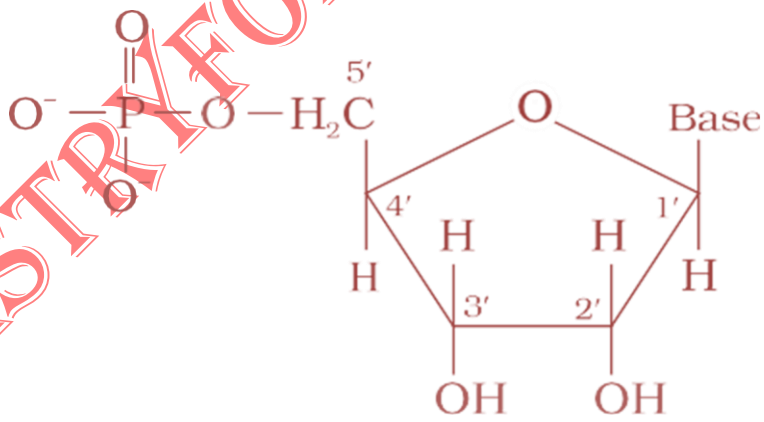
Structure of Nucleic Acids

In nucleic acids a nitrogenous base is attached to 1' position of sugar to form a unit called **nucleoside.** In nucleosides, the sugar carbon atoms are numbered as 1', 2', 3', etc. to distinguish them from the bases.



Nucleoside

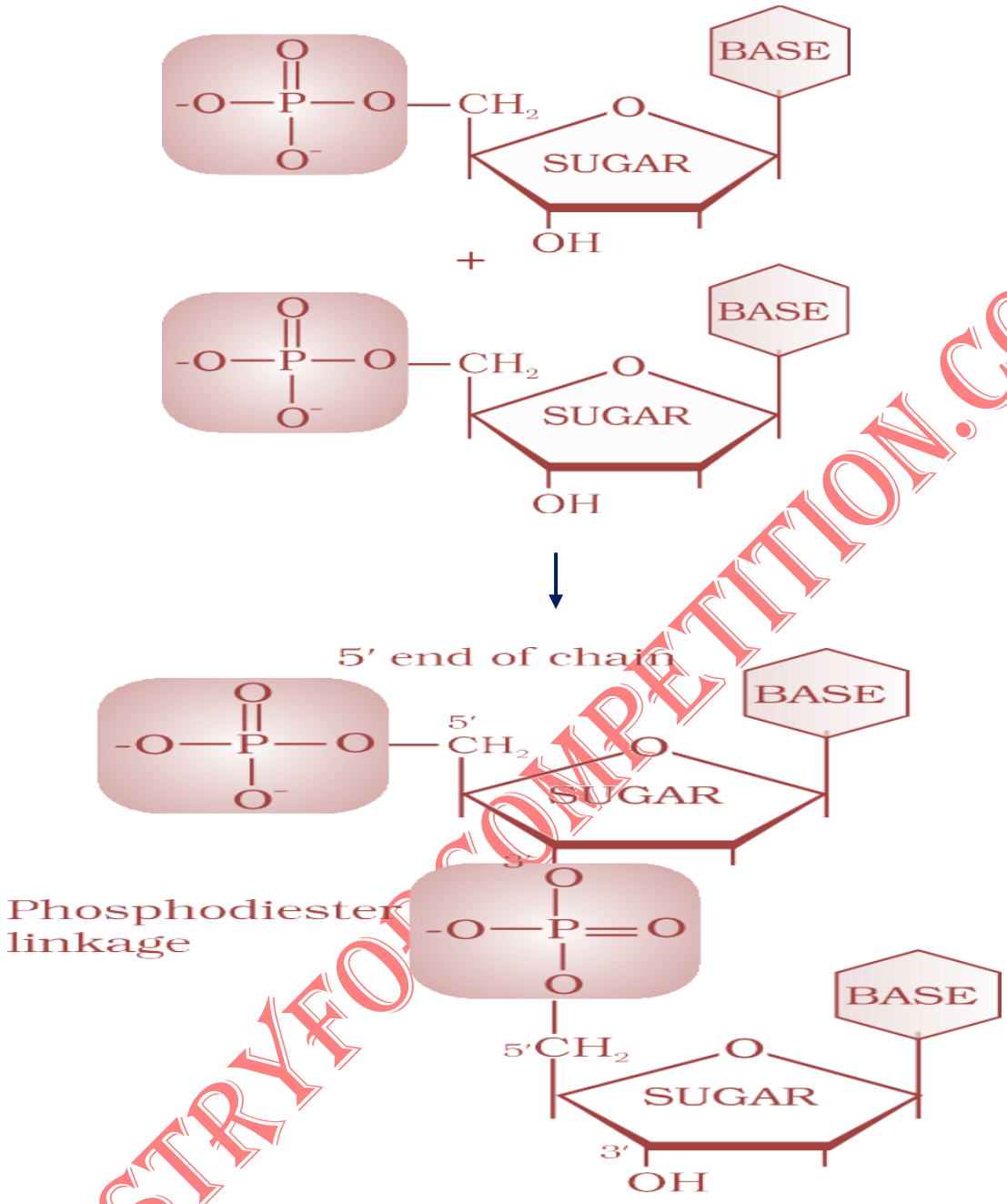
When a phosphate group is linked to a nucleoside at 5'-position of its sugar moiety a nucleotide is obtained.



Nucleotide

Nucleotides are joined together by phosphodiester linkage between 5' and 3' carbon atoms of the pentose sugar to form polynucleotides called nucleic acids. The formation of a typical dinucleotide can be represented as follows-

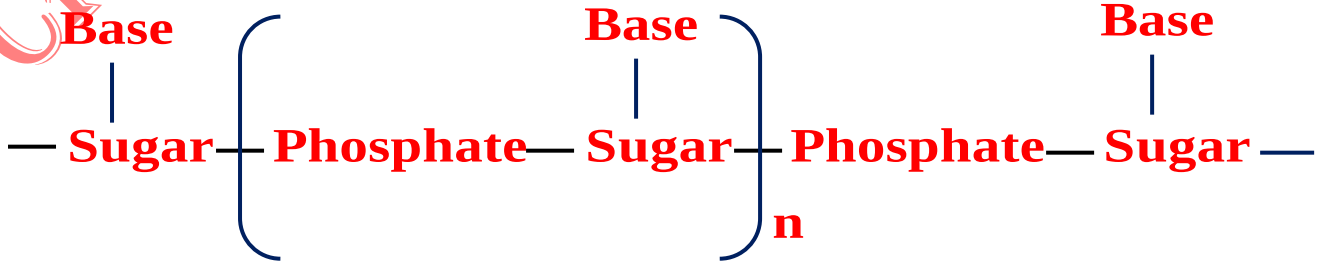
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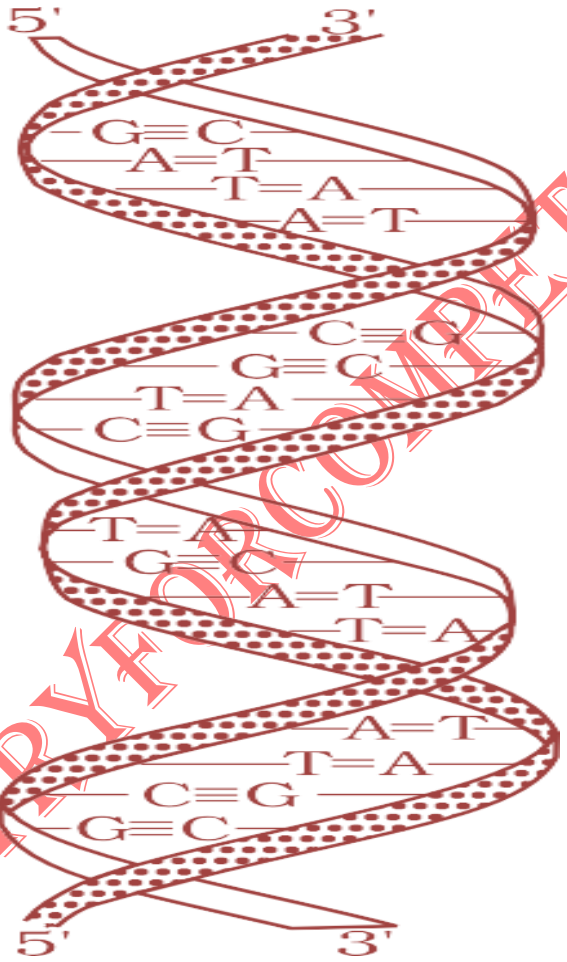
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Formation of Dinucleotide

Thus, a simplified nucleic acid chain can be represented as under-



The sequence of nucleotides in the chain of a nucleic acid is called the primary structure of nucleic acid. Nucleic acids also have a secondary structure. **James Watson and Francis Crick** gave a double stranded helix structure for DNA where, two nucleic acid chains are wound about each other and are held together by hydrogen bonds between pairs of bases. These two strands are complementary to each other because the hydrogen bonds are formed between specific pairs of bases. Adenine forms hydrogen bonds with thymine while, cytosine forms hydrogen bonds with guanine.



Double stranded Helix structure of DNA

Secondary structure of RNA contains single stranded helices which sometimes folds back on itself.

RNA molecules are of three types namely **messenger RNA (m-RNA), ribosomal RNA (r-RNA) and transfer RNA (t-RNA)**. They perform different functions in the cell.

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Biological Functions of Nucleic Acids

DNA is the chemical basis of heredity and is regarded as the reserve of genetic information. It is exclusively responsible for maintaining the identity 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.

Another important function of nucleic acids is the protein synthesis in the cell. Actually, the proteins are synthesised by various RNA molecules in the cell, but the message for the synthesis of a particular protein is present in DNA.

DNA Fingerprinting

It is well known that, every individual has unique fingerprints. These occur at the tips of the fingers and have been used for identification of a person for a long time, but these can be altered by surgery.

The sequence of bases in DNA is also unique for a person. It is same for every cell and cannot be altered by any known treatment. To gain valuable information from the sequence of bases in DNA is called DNA fingerprinting. DNA fingerprinting is used-

(1) In forensic laboratories for identification of criminals.

(2) To determine paternity of an individual.

(3) To identify the dead bodies in any accident by comparing the DNA's of parents or children.

(4) To identify racial groups to rewrite biological evolution.

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