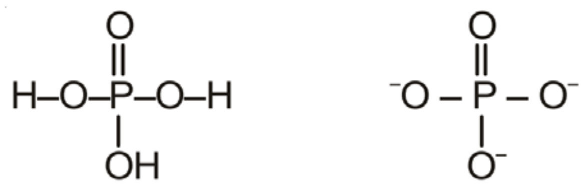
NUCLEIC ACIDS

Nucleic acids represent macromolecules composed of nucleotides and come in two distinct types: deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).

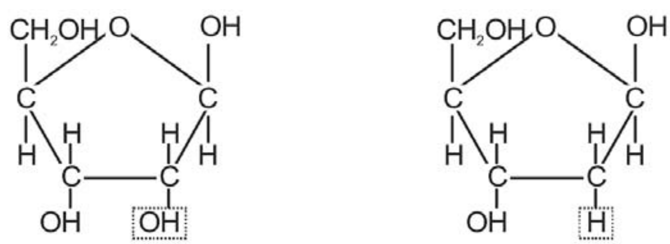
Nucleotide Structure: A nucleotide, the fundamental unit of nucleic acids, comprises three components:

- **Phosphate Group:**



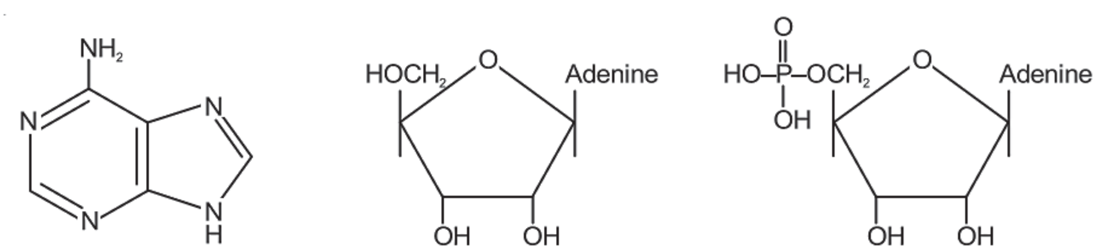
Phosphoric acid   Phosphate ion

- **Pentose Sugar (Monosaccharide):** In RNA, the sugar is ribose. In DNA, the sugar is deoxyribose.

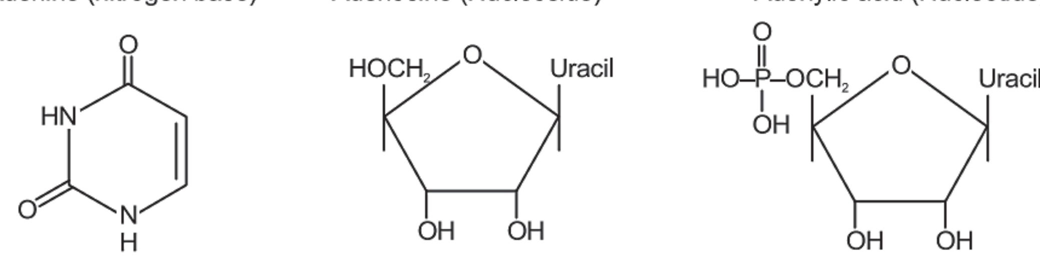


β-ribose   β-deoxyribose

- **Nitrogenous Base:** Adenine (A), Guanine (G), Thymine (T), and Cytosine (C) are common bases in DNA. RNA includes Adenine, Guanine, and Cytosine, with Uracil (U) instead of Thymine. Adenine and Guanine are purines, characterized by a double-ring structure, while Cytosine, Thymine, and Uracil are pyrimidines with a single-ring structure.



Adenine (nitrogen base)   Adenosine (Nucleoside)   Adenylic acid (Nucleotide)



Uracil (nitrogen base)   Uridine (Nucleoside)   Uridylic acid (Nucleotide)

- A glycosidic bond connects the nitrogenous base to the sugar, forming a nucleoside. The nucleoside, in turn, combines with a phosphate group through an ester bond, resulting in the formation of a nucleotide.
- In nucleic acids, phosphodiester bonds link the 3' carbon of one sugar to the 5' carbon of the succeeding sugar, creating a backbone. DNA serves as the genetic material for heredity, while RNA functions as the genetic material in certain viruses.

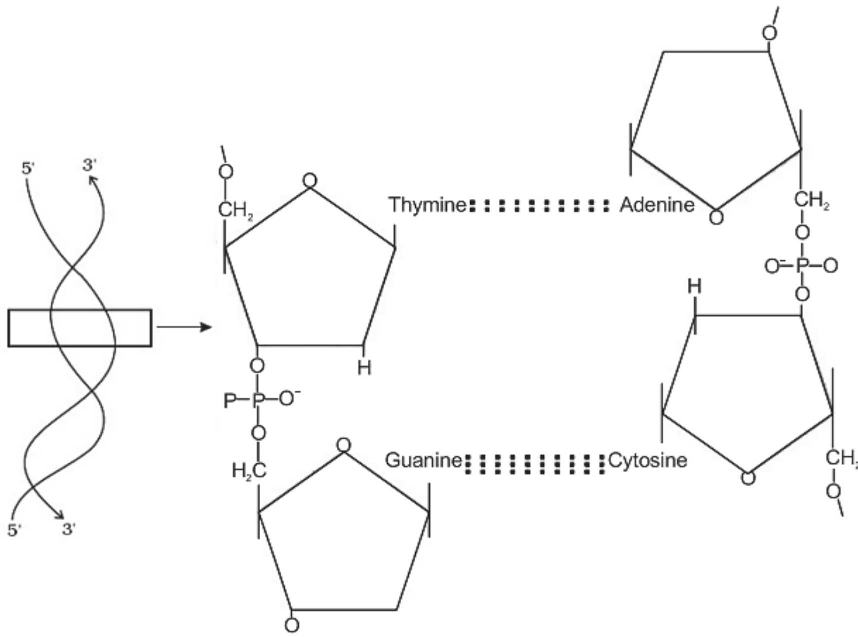


Fig. : Diagram indicating secondary structure of DNA

Watson-Crick Model of DNA

- The Watson - Crick Model posits that DNA assumes a double helix structure, consisting of two unbranched polynucleotide strands. These strands run antiparallel to each other, meaning they run in opposite directions. The backbone of the strands, formed by sugar and phosphate, coils around a common axis, resembling a spiral staircase with base pairs as steps.

Features of Watson-Crick Model:

- Specific base-pairing occurs: Adenine pairs with Thymine, and Guanine pairs with Cytosine.
- The base-pairs are complementary, showcasing specificity in DNA sequences.
- Hydrogen bonds between bases in opposing strands maintain the helical structure.

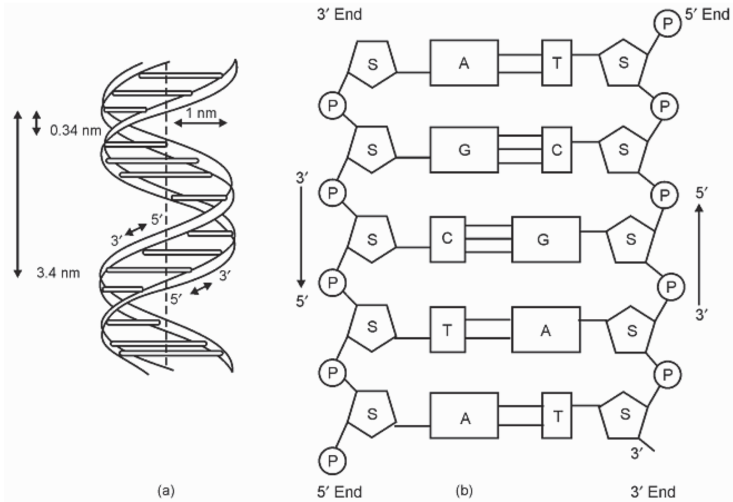


Fig. : DNA double helix

- Adenine and Thymine form two hydrogen bonds, while Guanine and Cytosine form three.
- The ends of the strands are termed 5' and 3', representing free carbons on the pentose sugar.

The helical structure turns 36° at each base pair, with one full turn comprising ten base pairs. The stacking of base pairs occurs 3.4 Å apart, resulting in a pitch of 34 Å. This particular form of DNA is known as B-DNA.

Chargaff's Rule:
Erwin Chargaff observed certain rules governing DNA composition:

- Equal amounts of purines (A + G) and pyrimidines (T + C).
- Adenine content equals Thymine, and Guanine content equals Cytosine (A = T and G = C).
- The base ratio (A + T)/ (G + C) may vary among species but remains constant for a given species.
- Deoxyribose sugar and phosphate components occur in equal proportions.

RNA (Ribonucleic Acid):

- RNA is generally single-stranded, although exceptions exist (e.g., Reovirus and Rice dwarf virus), showcasing less adherence to Chargaff's rules due to its single-stranded nature.

There are three main types of RNA:

- **Messenger RNA (m-RNA):** Carries information for protein synthesis, produced in the nucleus.
- **Ribosomal RNA (r-RNA):** Dominant RNA type, constituting about 80% of total cellular RNA, present in ribosomes.
- **Transfer RNA (s-RNA, t-RNA):** Represents the smallest RNA type, constituting about 10-15% of total cellular RNA, facilitating amino acid collection from the cytoplasm for protein synthesis.

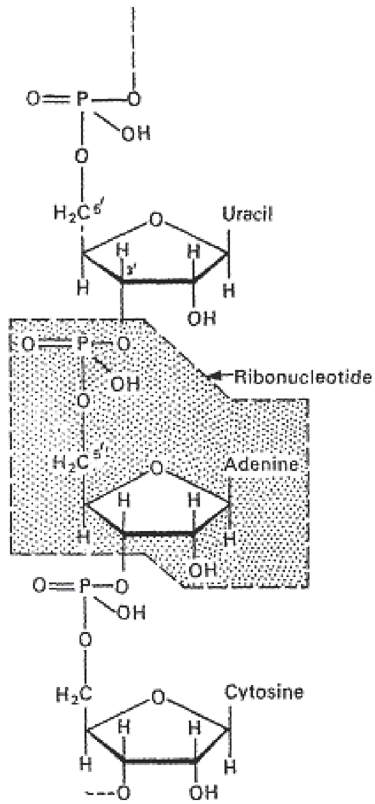


Fig. : A polynucleotide strand of RNA