

THE DNA Structure

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DNA is a long polymer of deoxyribonucleotides. Its length is usually defined as number of nucleotides (or a pair of nucleotide referred to as base pairs) present in it. This also is the characteristic of an organism.

For example,

φ 174 bacteriophage has 5386 nucleotides

Bacteriophage lambda has 48502 base pairs (bp)

Escherichia coli has 4.6×10^6 bp

Haploid content of human DNA is 3.3×10^9 bp

Structure of Polynucleotide Chain

A nucleotide has three components –

- 1) a nitrogenous base
- 2) a pentose sugar (ribose in case of RNA, and deoxyribose in case of DNA)
- 3) a phosphate group

There are two types of nitrogenous bases –

- 1) Purines (Adenine and Guanine)
- 2) Pyrimidines (Cytosine, Uracil and Thymine)

Cytosine is common for both DNA and RNA.

Thymine is present in DNA.

Uracil is present in RNA in place of Thymine.

A nitrogenous base is linked to the pentose sugar through a N-glycosidic linkage to form a nucleoside, such as –

adenosine or deoxyadenosine

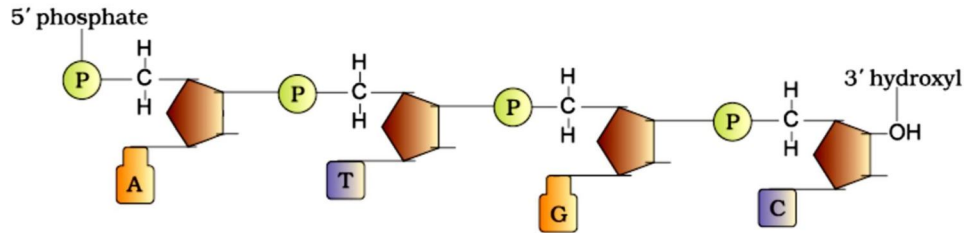
guanosine or deoxyguanosine

cytidine or deoxycytidine

uridine or deoxythymidine

When a phosphate group is linked to 5'-OH of a nucleoside through phosphoester linkage, a corresponding nucleotide (or deoxynucleotide depending upon the type of sugar present) is formed.

Two nucleotides are linked through 3'-5' phosphodiester linkage to form a dinucleotide.



More nucleotides can be joined in such a manner to form a polynucleotide chain. A polynucleotide chain formed has at one end a free phosphate moiety at 5'-end of ribose sugar, which is referred to as 5'-end of polynucleotide chain.

Similarly, at the other end of the polymer the ribose has a free 3'-OH group which is referred to as 3'-end of the polynucleotide chain.

The backbone in a polynucleotide chain is formed due to sugar and phosphates. The nitrogenous bases linked to sugar moiety project from the backbone.

In RNA, every nucleotide residue has an additional -OH group present at 2' - position in the ribose. Also, in RNA the uracil is found at the place of thymine (5-methyl uracil, another chemical name for thymine).

DNA is present as an acidic substance in nucleus was first identified by **Friedrich Meischer** in 1869. He named it as 'Nuclein'.

In 1953, James Watson and Francis Crick, based on the X-ray diffraction data produced by **Maurice Wilkins** and **Rosalind Franklin**, proposed the famous **Double Helix** model for the structure of DNA. This proposition was also based on the observation of **Erwin Chargaff** that for a double stranded DNA, the ratios between **Adenine** and **Thymine** and **Guanine** and **Cytosine** are constant and equals one.