NUCLEIC ACID

Sure, here's a detailed rephrasing of the provided text:

(a) These represent a unique category of acids that can be found both in the nucleus and the cytoplasm of cells.

(b) They play a pivotal role in regulating the various metabolic processes within the cell, exerting control over these essential activities.

(c) Furthermore, they are also detected within cellular structures like mitochondria, centrioles, and chloroplasts, where they contribute to the regulation and coordination of crucial cellular functions.

Types → These are of 2 types

→ DNA (Deoxy ribonucleic acid)

→ RNA (Ribonucleic acid)

(d) Fischer discovered Nitrogen bases in 1888

Nitrogen Base Type

→ Purine

→ Pyrimidine

(e) Levan found sugar

Two Type

→ Ribose (RNA)

→ Deoxyribose (DNA)

Deoxyribonucleic Acid (D.N.A.)

Structure of DNA (Deoxyribonucleic Acid)

J.D. Watson and F.H.C. Crick, in 1953, introduced the concept of the double helical structure of DNA, based on the findings of M.H.F. Wilkins and his colleagues. Their groundbreaking work was later recognized with the Nobel Prize in 1962.

Here are some distinctive characteristics of the double helical structure of DNA:

(i) Each nucleotide is composed of sugar, phosphate, and a nitrogenous base. Multiple such nucleotides are interconnected through phosphodiester bonds, forming a polynucleotide chain or strand.

(ii) Phosphodiester bonds are established between the 5' carbon of the sugar in one nucleotide and the 3' carbon of the sugar in the subsequent nucleotide.

(iii) The nitrogenous base is attached to the 1' carbon of the sugar molecule. In this position, purine bases are connected via their 5' position, while pyrimidines are linked through their 3' position.

(iv) The polynucleotide strand features a backbone consisting of sugar and phosphate, forming the long axis of the structure, with the bases positioned at right angles to this backbone.

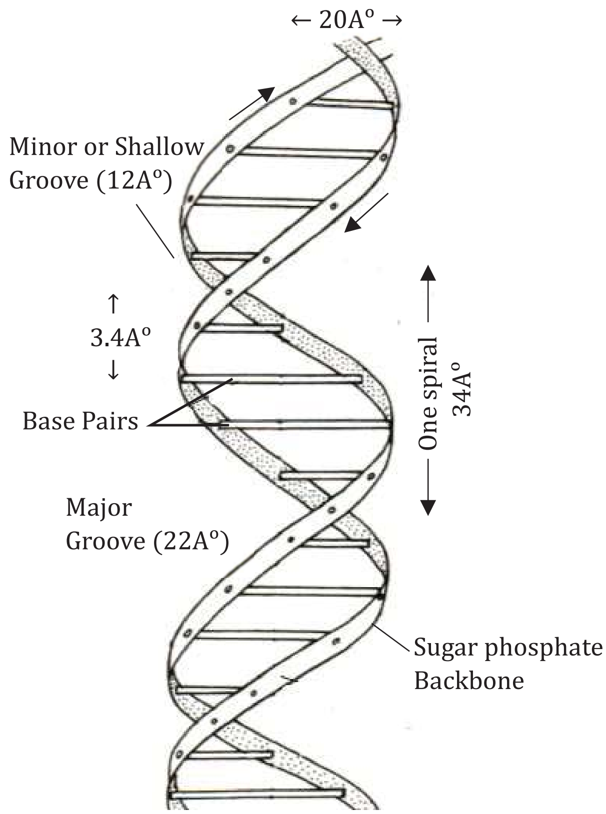


Fig. Structure of DNA- coiling in double helix of DNA

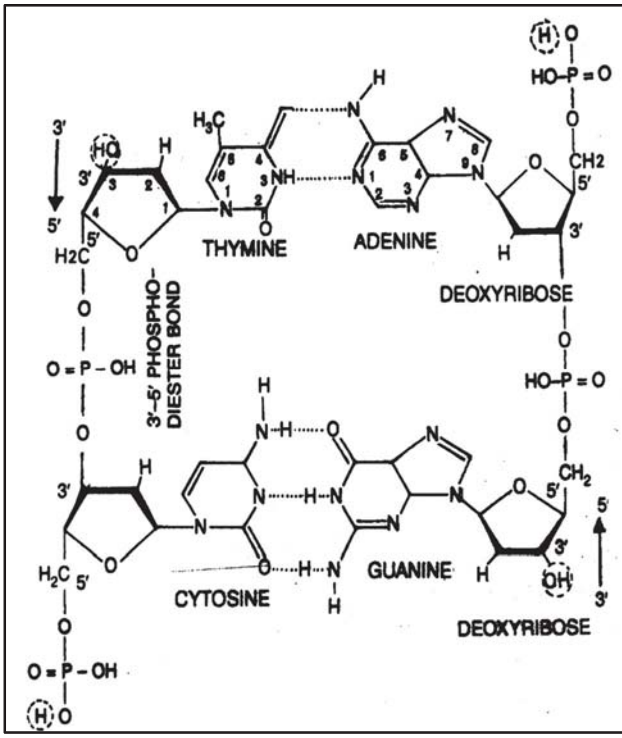


Fig. C. Chemical structure and bonding of different constituents of DNA. In the two chains.

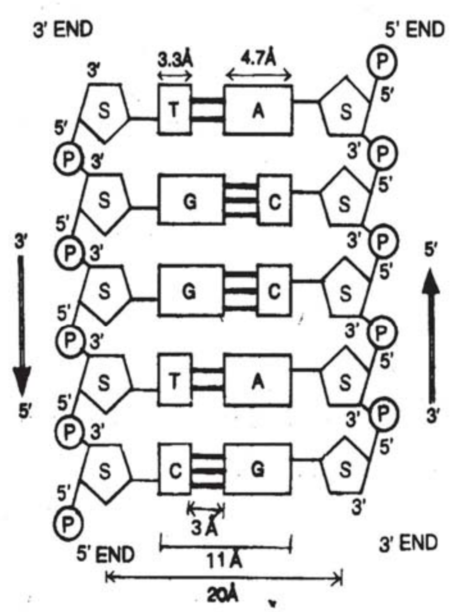
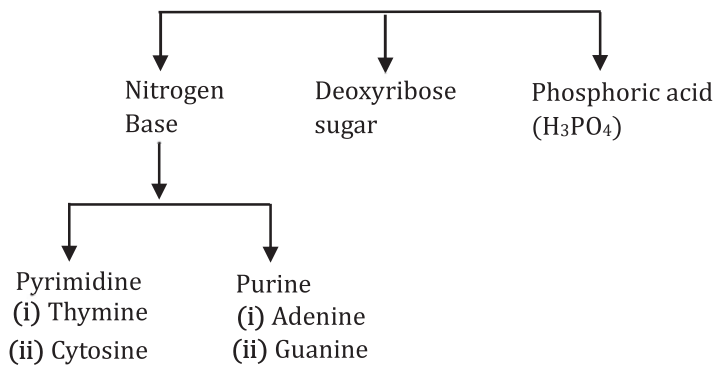


Fig. D. Arrangement of various constituents of DNA duplex. (S = Sugar, P = Phosphate)



Nucleoside

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

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

Nucleotide

(a) Nitrogen base + Sugar + Phosphate → Nucleotide

(b) Nucleotide is a unit of DNA.

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

Function of DNA

(i) Self - Replication or Self -Duplication

DNA possesses the ability to replicate itself, making it a molecule involved in reproduction. This distinctive feature of DNA underpins all forms of reproduction. DNA, through its replication process, plays a crucial role in heredity. During DNA replication, the two strands of the double helix unwind and separate, serving as a template for the creation of a new complementary strand.

(ii) Protein Synthesis

The precise arrangement of base pairs in DNA encodes information that guides the synthesis of distinct proteins. This coding information is initially transcribed into corresponding nitrogen-base sequences within mRNA. The instructions contained in this RNA are then further translated into specific sequences of amino acid units within polypeptide chains, ultimately forming proteins.

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

$$\text{DNA} \xrightarrow{\text{Replication}} \text{DNA} \xrightarrow{\text{Transcription}} \text{RNA} \xrightarrow{\text{Transcription}} \text{PROTINE}$$

Ribonucleic Acid (Ran)

➢ Found in cytoplasm as well as in nucleus.

Cytoplasm → In the ribosome (higher amount)

Chemical Nature

- Ribonucleic acid (RNA) is a polymer made up of ribonucleotides, which include purine and pyrimidine bases, connected by 3' to 5' phosphodiester bonds. The number of nucleotides in RNA varies, ranging from as few as 75 to many thousands. Although it shares several similarities with DNA, RNA exhibits distinct characteristics.
- As implied by its name, the sugar in RNA to which phosphate and nitrogen bases are attached is ribose, in contrast to the deoxyribose found in DNA.
- While RNA contains the ribonucleotides adenine, guanine, and cytosine, it lacks thymine. Instead of thymine, RNA incorporates the ribonucleotide uracil. Consequently, the pyrimidine components in RNA differ from those in DNA.
- RNA primarily exists in a single-stranded form, unlike DNA, which forms a double-stranded helical structure. Nevertheless, the single RNA strand can exhibit a unique property: it can fold back upon itself, similar to a hairpin, resulting in the acquisition of double-stranded features. Within these regions, A pairs with U, and G pairs with C.
- where R stands for ribose; A, U, G, and C for Adenine, Uracil, Guanine and Cytosine respectively.

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)

- Messenger RNA, often abbreviated as mRNA, is a single-stranded RNA molecule of varying length. It plays a crucial role as a template in the process of protein synthesis by carrying the genetic code in the form of codons found on chromosomes.
- The primary function of mRNA is to create a complimentary copy of DNA, effectively transmitting chemical messages encoded in the nitrogen-base sequence from the nucleus to the ribosomes in the cytoplasm, where proteins are assembled. This function is why it is termed messenger RNA or mRNA.
- mRNA synthesis takes place within the nucleus, a process known as transcription.

(ii) Ribosomal RNA (rRNA)

- Ribosomal RNA, or rRNA, is an integral component of ribosomes, which are nucleoprotein structures located in the cytoplasm. These ribosomes serve as the cellular machinery responsible for protein synthesis, utilizing mRNA templates.
- Within the ribosome, mRNA and transfer RNA (tRNA) molecules collaborate, translating the information transcribed from DNA into a specific protein molecule.
- Notably, rRNA constitutes the most substantial portion of the total RNA content, accounting for about 80% of the total.

(iii) Transfer RNA (tRNA)

- Transfer RNA, also known as tRNA or Soluble RNA, consists of single-stranded RNA molecules.
- These molecules are relatively small, typically containing 75 to 80 nucleotides, and make up around 10-15% of the total RNA content.

- tRNA is synthesized within the nucleus from DNA and serves the crucial function of transporting amino acids from the cytoplasm to the site where protein synthesis occurs.

Differences Between DNA and RNA		
Sr.no.	DNA	RNA
1	It usually occurs inside nucleus and some cell organelles.	Very little RNA occurs inside nucleus. most of it is found in the cytoplasm.
2	DNA is the genetic material.	RNA is not the genetic material except in certain viruses, e.g. Reovirus.
3	It is double stranded with the exception of it some viruses (e.g. $\phi \times 174$).	RNA is single stranded except reovirus where is double stranded.
4	DNA contains over a million nucleotides.	Depending upon the type, RNA contains 70-1200 nucleotides.
5	DNA is of only two types; intra-nuclear and extra-nuclear.	There are at least three types of RNAs-mRNA, rRNA and tRNA
6	It contains deoxyribose sugar.	It contains ribose sugar.
7	Nitrogen base thymine occurs in DNA along with three others - adenine, cytosine and guanine.	Thymine is replaced by uracil in RNA The other three are similar - adenine, cytosine and guanine.
8	It replicates to form new DNA molecules.	It cannot normally replicate itself.
9	DNA transcribes genetic information to RNA.	RNA translates the transcribed message for forming polypeptides.
10	DNA controls metabolism and genetics Including variations.	It only controls metabolism under instruction from DNA.
11	Purine and pyrimidine bases are in equal number.	There is no proportionality between number of purines and pyrimidine bases.