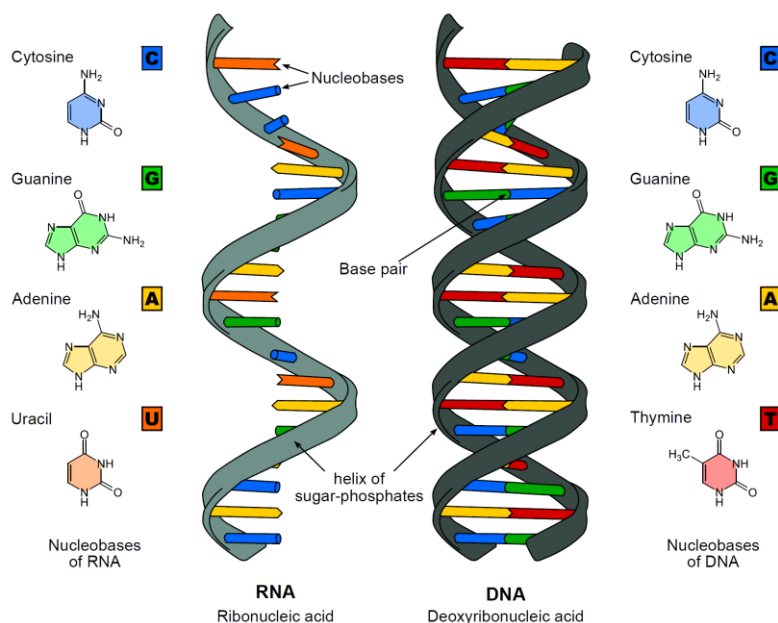


NUCLEIC ACID

❖ What are nucleic acids?

- Nucleic acids are **naturally occurring chemical compounds that serve as the primary information-carrying molecules in cells**. They play an especially important role in directing protein synthesis. The two main classes of nucleic acids are deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).
- Nucleic acids were discovered in 1869, when twenty-four-year-old Swiss physician **Friedrich Miescher** isolated a new compound from the nuclei of white blood cells

❖ Structure of polynucleotide chain-

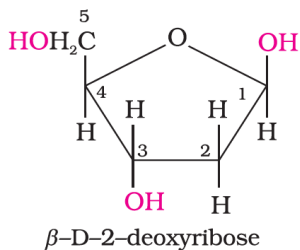
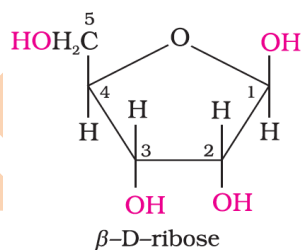


➤ Complete hydrolysis of DNA (or RNA) yields

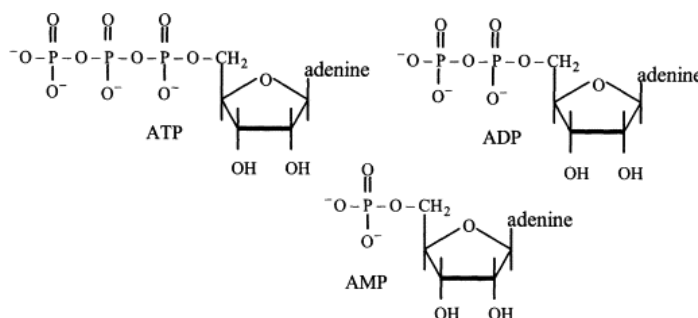
- Pentose sugar,
- Phosphoric acid and
- Nitrogen containing heterocyclic compounds (called bases or nitrogenbases).

1) Pentose sugar

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



2) Phosphoric acid (H_3PO_4)

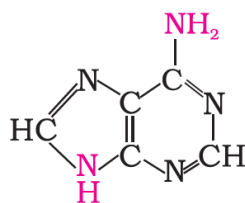


3) Nitrogen bases (Purines and Pyrimidines)

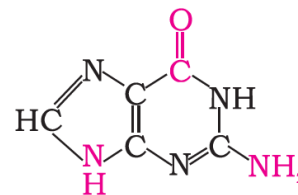
There are two types of nitrogenous base

- i) **Purines**-Adenine and Guanine
- ii) **Pyrimidines**- Cytosine, Uracil and Thymine.

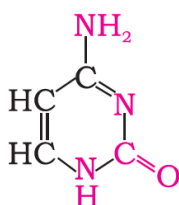
- Cytosine is common to both DNA and RNA but uracil is present in RNA at the place of thymine.
- DNA contains four bases viz. adenine (A), guanine (G), cytosine (C) and thymine (T). RNA also contains four bases, the first three bases are same as in DNA but the fourth one is uracil (U).



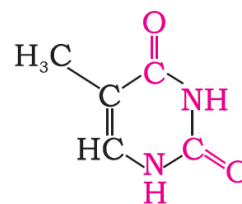
Adenine (A)



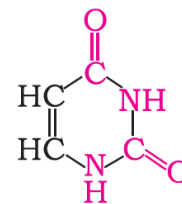
Guanine (G)



Cytosine (C)



Thymine (T)



Uracil (U)

❖ Formation of DNA (Nucleoside and Nucleotide)

Step-1 Nucleoside formation(component of nucleoside)

- Pentose sugar + Nitrogen base → Nucleoside
- A nitrogenous base is linked to the OH of 1' C pentose sugar through a N-glycosidic linkage to form a nucleoside, such as adenosine or deoxyadenosine, guanosine or deoxyguanosine, cytidine or deoxycytidine and uridine or deoxythymidine.

In DNA (Deoxyribonucleic acid)

deoxyadenosine = adenine + deoxyribose sugar

deoxyguanosine = guanine + deoxyribose sugar

deoxycytidine = cytosine + deoxyribose sugar

deoxythymidine = thymine + deoxyribose sugar

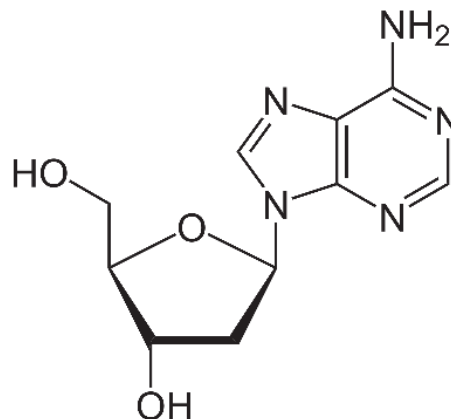
In RNA (Ribonucleic acid)

adenosine = adenine + ribose sugar

guanosine = guanine + ribose sugar

cytidine = cytosine + ribose sugar

uridine = uracil + ribose sugar



Step-2 Formation of nucleotide (component of nucleotide)

- A nucleotide has 3-component-`
 - i) Nitrogenous base
 - ii) Pentose sugar- Two types
 - a) Ribose in RNA
 - b) Deoxyribose in DNA
 - iii) Phosphate group

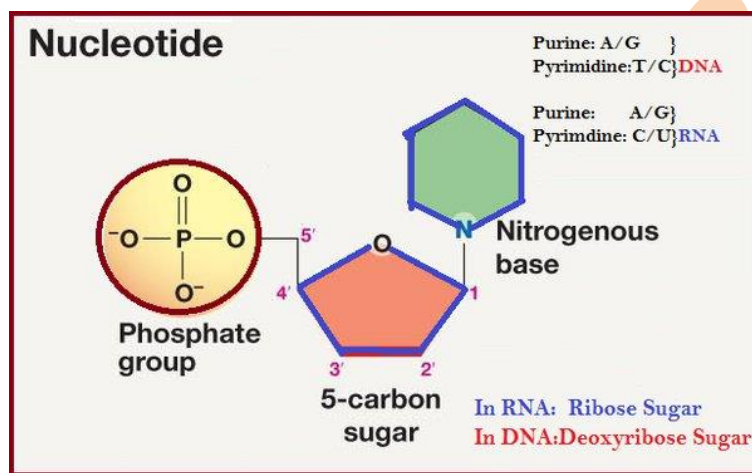
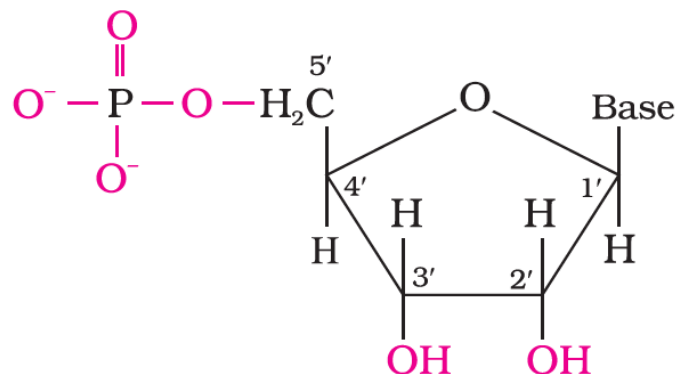
- Nucleoside + Phosphate group → Nucleotide
- When phosphate group is linked to 5'-OH of nucleoside through phosphoester linkage, a **nucleotide** is formed .

Nucleotide of RNA

- Adenylic acid or Adenosine monophosphate
- Uridylic acid or Uridine monophosphate
- Guanylic acid or Guanosine monophosphate
- Cytidylic acid or cytidine monophosphate

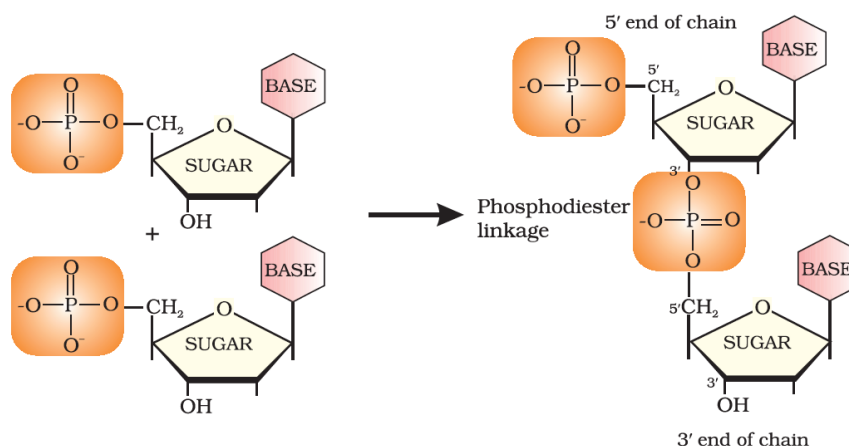
Nucleotide of DNA

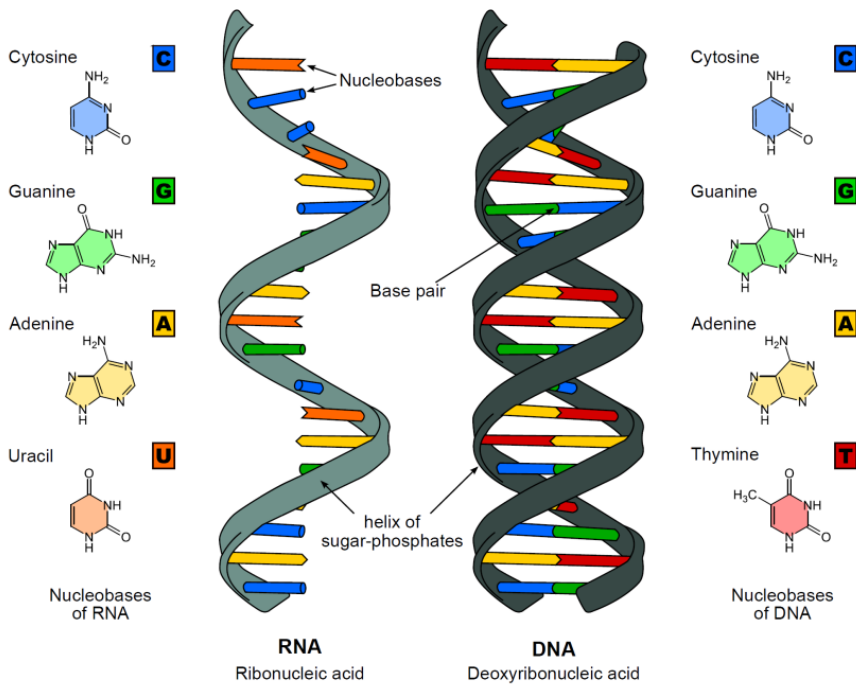
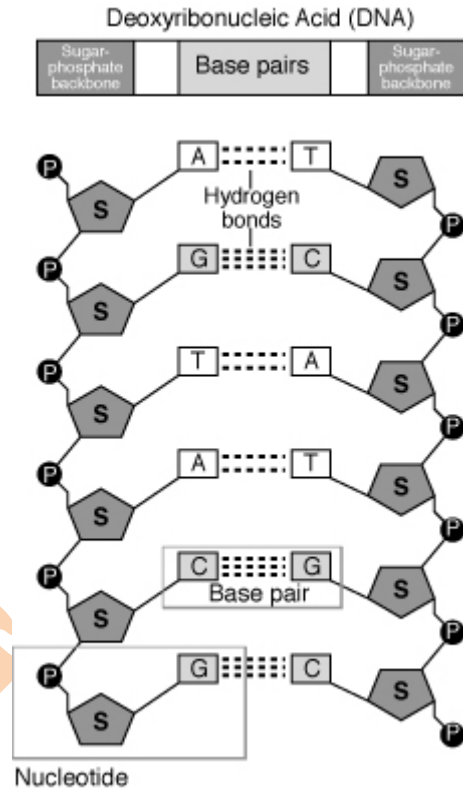
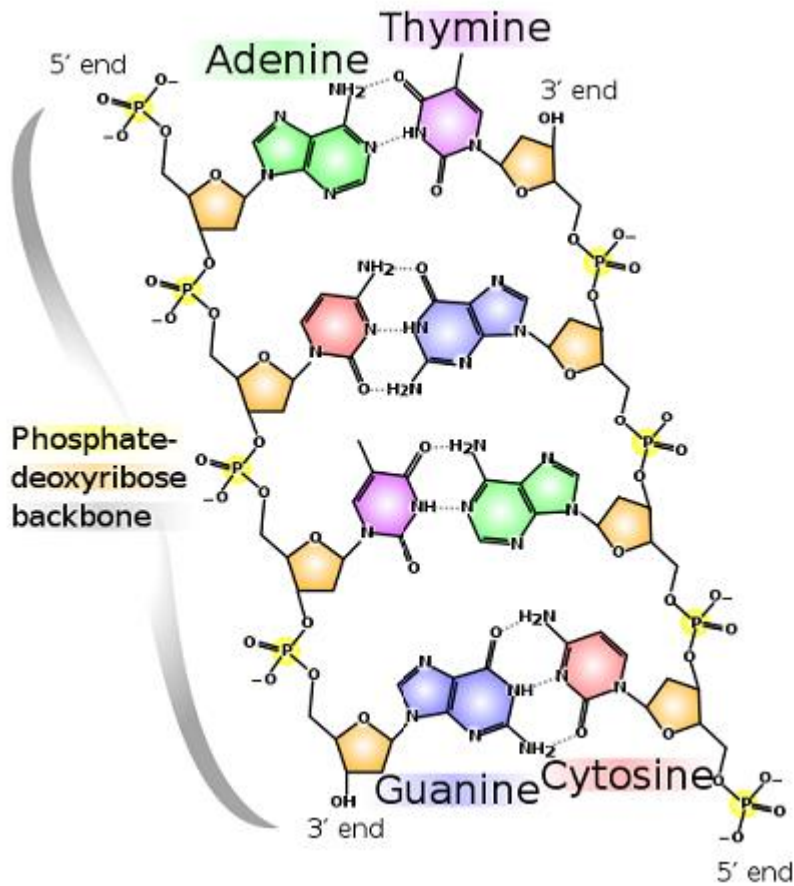
- Deoxyadenylic acid Deoxyadenosine monophosphate
- Deoxyguanylic acid Deoxyguanosine monophosphate
- Deoxycytidylic acid Deoxycytidine monophosphate
- Deoxythymidylic acid Deoxythymidine monophosphate



❖ **Formation of polynucleotide (Structure of DNA)**

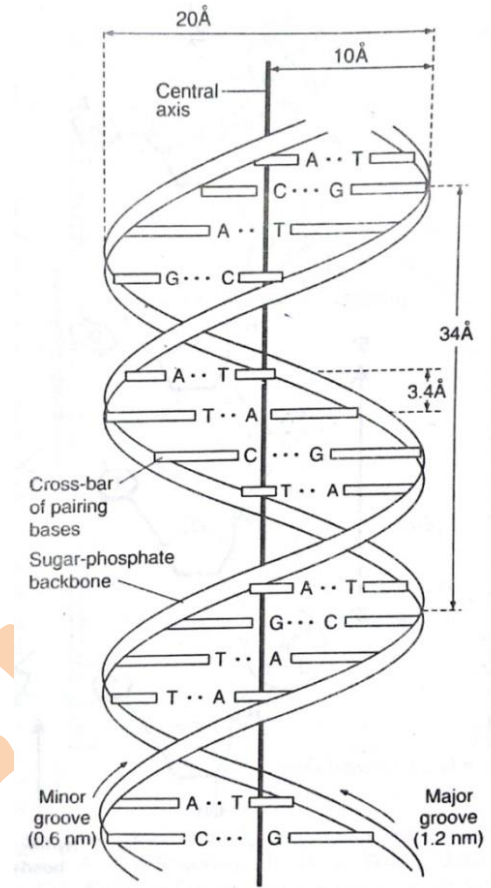
Two nucleotide are linked through 3' – 5' phosphodiester linkage to form a dinucleotide. Similarly more nucleotide joined and a polynucleotide is formed.





❖ **WATSON AND CRICK MODEL OF DNA (double helix model)****Salient feature-**

- Two helical polynucleotide chain or strand are spirally coiled clock wise around a common central axis, forming a right handed double helix of 20 Å thickness.
- The two chains have anti parallel polarity. It means, if one chain has the polarity 5'–3' the other has 3'–5'
- The nitrogenous base in two strand are paired through hydrogen bond forming base pairs (bp).
 - Adenine form two H-bond with Thymine.
 - Guanine bonded with three hydrogen bond with cytosine.
- Each complete turn of double helix is 3.4 nm (34 Å) long and comprise 10 base pairs. This means that the base pair (cross bar) are stacked upon one another 0.34 nm apart i.e each base pair occupies 0.34 nm length of the helix.
- The plane of one base pair stacks over the other in double helix. This in addition to hydrogen bond confers stability of the helical structure.

❖ **RNA(Ribonucleic acid)****i) Definition**

- Ribonucleic acid (abbreviated RNA) is a nucleic acid present in all living cells that has structural similarities to DNA. Unlike DNA, however, RNA is most often single-stranded. An RNA molecule has a backbone made of alternating phosphate groups and the sugar ribose, rather than the deoxyribose found in DNA. Attached to each sugar is one of four bases: adenine (A), uracil (U), cytosine (C) or guanine (G). Different types of RNA exist in cells: messenger RNA (mRNA), ribosomal RNA (rRNA) and transfer RNA (tRNA). In addition, some RNAs are involved in regulating gene expression. Certain viruses use RNA as their genomic material.

ii) Structure as discussed above

iii) Types of RNA and their function

Type	Abbreviation	Function(s)
Messenger RNA	mRNA	Transfers genetic information from genes to ribosomes to synthesize proteins.
Heterogeneous nuclear RNA	hnRNA	Serves as precursor for mRNA and other RNAs
Transfer RNA	tRNA	Transfers amino acid to mRNA for protein synthesis.
Ribosomal RNA	rRNA	Provides structural framework for ribosomes
Small nuclear RNA	snRNA	Involved in mRNA processing
Small nucleolar RNA	snoRNA	Plays a key role in processing of rRNA molecules
Small cytoplasmic RNA	scRNA	Involved in selection of proteins for export.
Transfer messenger RNA	tmRNA	Mostly present in Bacteria. Adds short peptide tags to proteins to facilitate the degradation of incorrectly synthesized proteins.

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