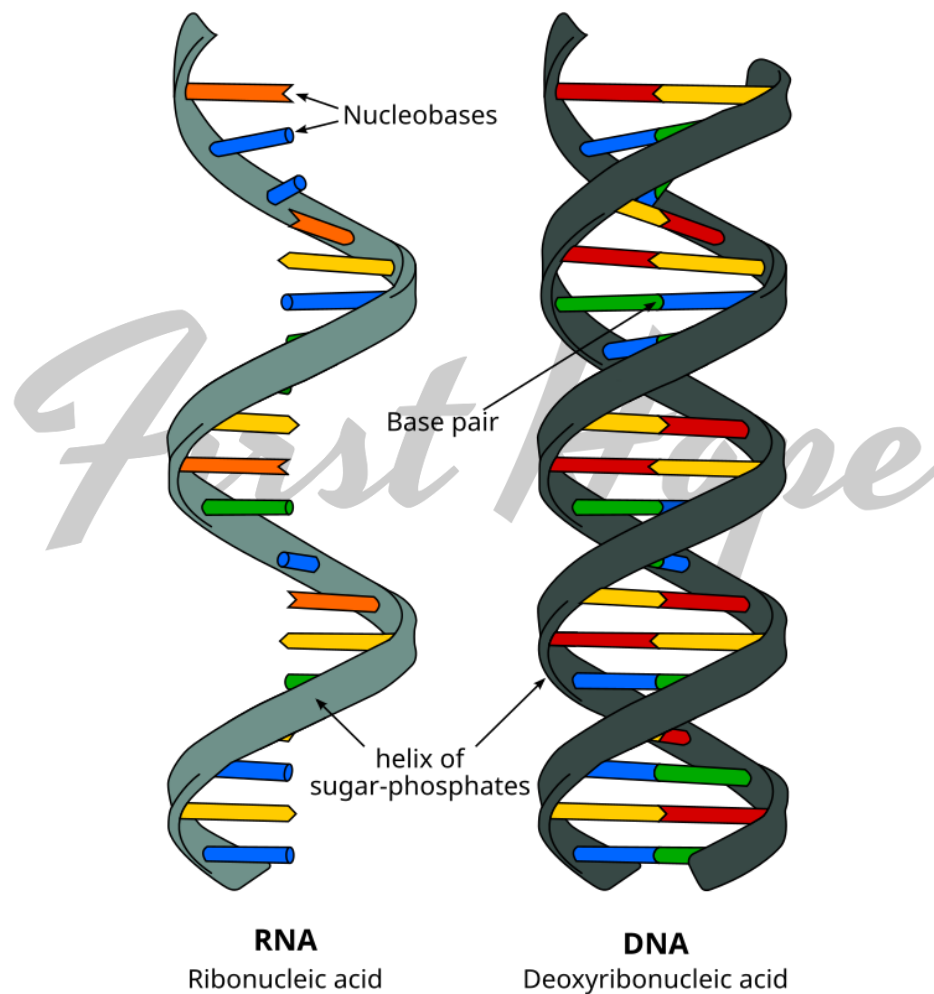


Nucleic acids

Nucleic Acids

Definition

- Nucleic acids are biological macromolecules that store and transmit genetic information in all living organisms and viruses.
- They are polymers of nucleotides, composed of carbon (C), hydrogen (H), oxygen (O), nitrogen (N), and phosphorus (P).



Types of Nucleic Acids

Type	Full Name	Function
DNA	Deoxyribonucleic Acid	Stores genetic information
RNA	Ribonucleic Acid	Involved in protein synthesis and gene regulation

Functions of Nucleic Acids

- Storage of genetic information (DNA).
- Transmission of genetic material during cell division.
- Protein synthesis (mRNA, tRNA, rRNA are forms of RNA).
- Regulation of gene expression.
- Some RNA molecules function as enzymes (ribozymes).

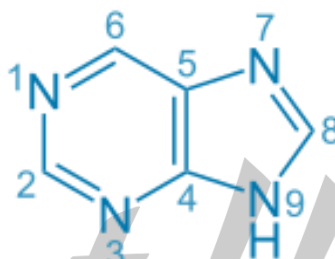
Nitrogenous Bases

- Nitrogenous bases are heterocyclic aromatic organic compounds containing nitrogen.

They are classified as:

A. Purines (*Double-ring structure*)

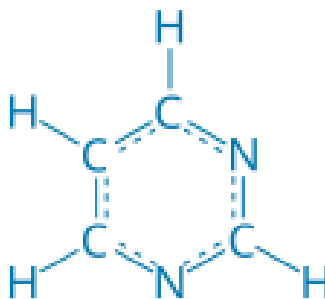
- Purines have a **two-ring structure**: a six-membered ring fused to a five-membered ring.



Base	Structure	Found in	Molecular Formula	Base Pairing	Notes
Adenine (A)	6-membered + 5-membered rings with nitrogen	DNA and RNA	$C_5H_5N_5$	Pairs with Thymine (T) in DNA and Uracil (U) in RNA	Larger than pyrimidines
Guanine (G)	Similar to adenine but contains a keto group	DNA and RNA	$C_5H_5N_5O$	Pairs with Cytosine (C)	Contains additional functional group

B. Pyrimidines (*Single-ring structure*)

- Pyrimidines have a **single six-membered ring** structure and are smaller than purines.



Base	Structure	Found in	Molecular Formula	Base Pairing	Notes
Cytosine (C)	Single ring with amine and keto groups	DNA and RNA	$C_4H_5N_3O$	Pairs with Guanine (G)	-
Thymine (T)	Two keto groups + methyl group	DNA only	$C_5H_6N_2O_2$	Pairs with Adenine (A)	Not found in RNA
Uracil (U)	Similar to thymine but lacks methyl group	RNA only	$C_4H_4N_2O_2$	Pairs with Adenine (A)	Replaces Thymine in RNA

Base Pairing Rules

Base in DNA/RNA	Pairs With	Type of Bond
Adenine (A)	Thymine (T) in DNA / Uracil (U) in RNA	2 Hydrogen Bonds
Guanine (G)	Cytosine (C)	3 Hydrogen Bonds

Components of Nucleosides and Nucleotides (with Examples)

Nucleosides

Definition:

- A nucleoside is composed of a nitrogenous base (purine or pyrimidine) linked to a pentose sugar (ribose in RNA or deoxyribose in DNA).
- It does not contain any phosphate group.

Bond Type:

- The base is linked to the sugar via a β -N-glycosidic bond between the nitrogen of the base and the 1' carbon of the sugar.

Examples of Nucleosides:

Nucleoside	Components	Sugar Type
Adenosine	Adenine + Ribose	RNA
Guanosine	Guanine + Ribose	RNA
Cytidine	Cytosine + Ribose	RNA
Uridine	Uracil + Ribose	RNA

Thymidine	Thymine + Deoxyribose	DNA
Deoxycytidine	Cytosine + Deoxyribose	DNA

Nucleotides

Definition:

- A nucleotide is formed when one or more phosphate groups are attached to the 5' carbon of the sugar in a nucleoside.

Bonding:

Step	Bond Type
Base + Sugar → Nucleoside	β-N-glycosidic bond
Nucleoside + Phosphate → Nucleotide	Phosphoester bond (between phosphate and 5' carbon of sugar)

Examples of Nucleotides (Monophosphates):

Nucleotide	Full Form	Nucleoside Base
AMP	Adenosine monophosphate	Adenosine
GMP	Guanosine monophosphate	Guanosine
CMP	Cytidine monophosphate	Cytidine
UMP	Uridine monophosphate	Uridine
TMP	Thymidine monophosphate	Thymidine

- Nucleotides may also exist in:
 - **Diphosphate form** (e.g., **ADP**, **GDP**)
 - **Triphosphate form** (e.g., **ATP**, **GTP**)

Functions of Nucleotides in the Body

Function	Examples / Role
Energy Currency	ATP – major energy carrier in cellular metabolism
Signal Transduction	cAMP, cGMP – act as second messengers in hormone signaling pathways
Coenzymes in Redox Reactions	NAD ⁺ , FAD – involved in metabolic pathways and electron transport

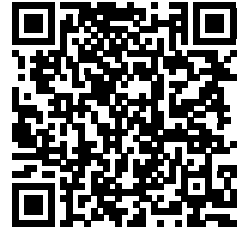


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