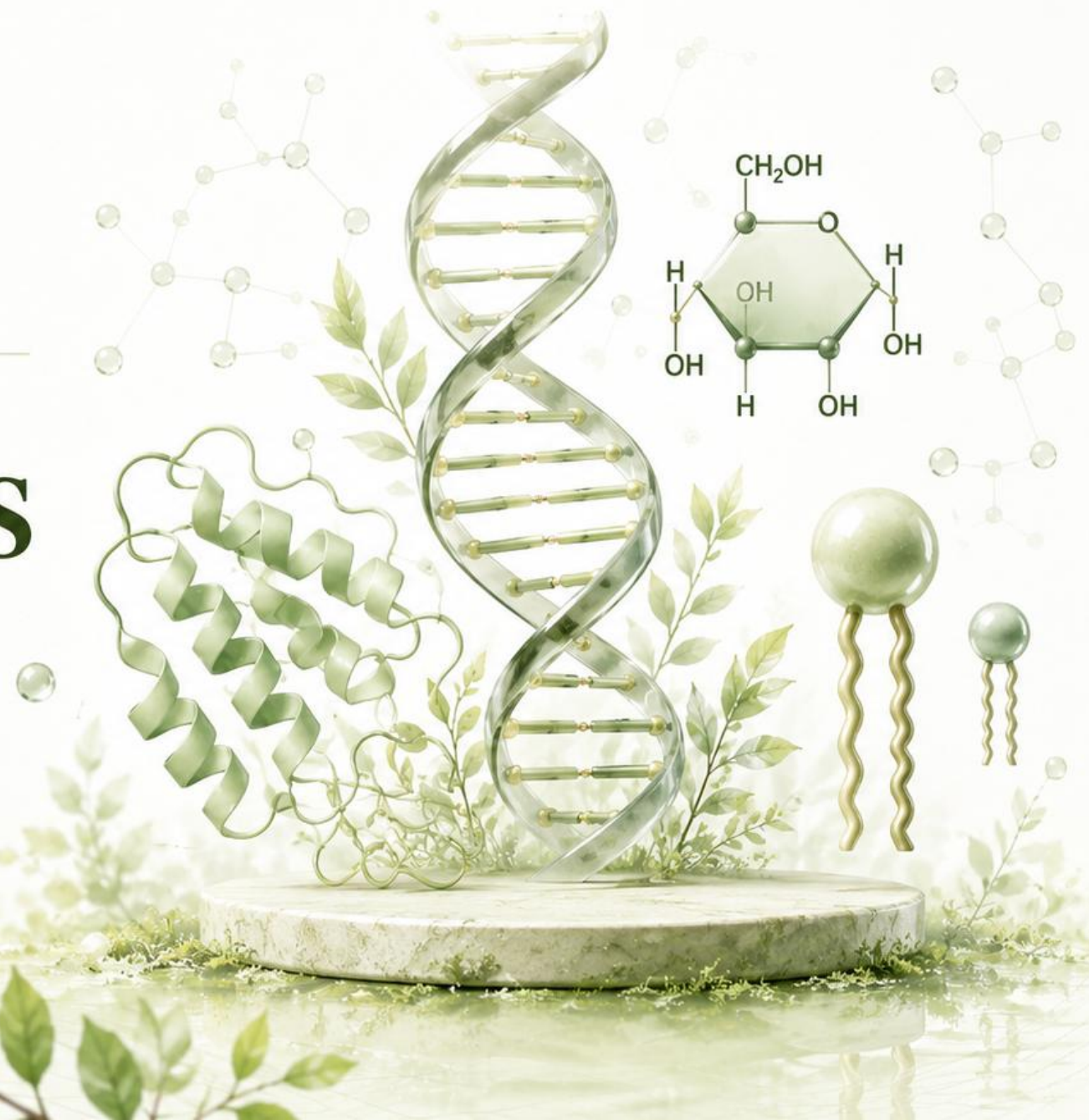


Chapter 9 : Biomolecules

Biology Notes | Class 11



CHEMICAL COMPOSITION OF LIVING TISSUE

1. LIVING & NON-LIVING MATTER

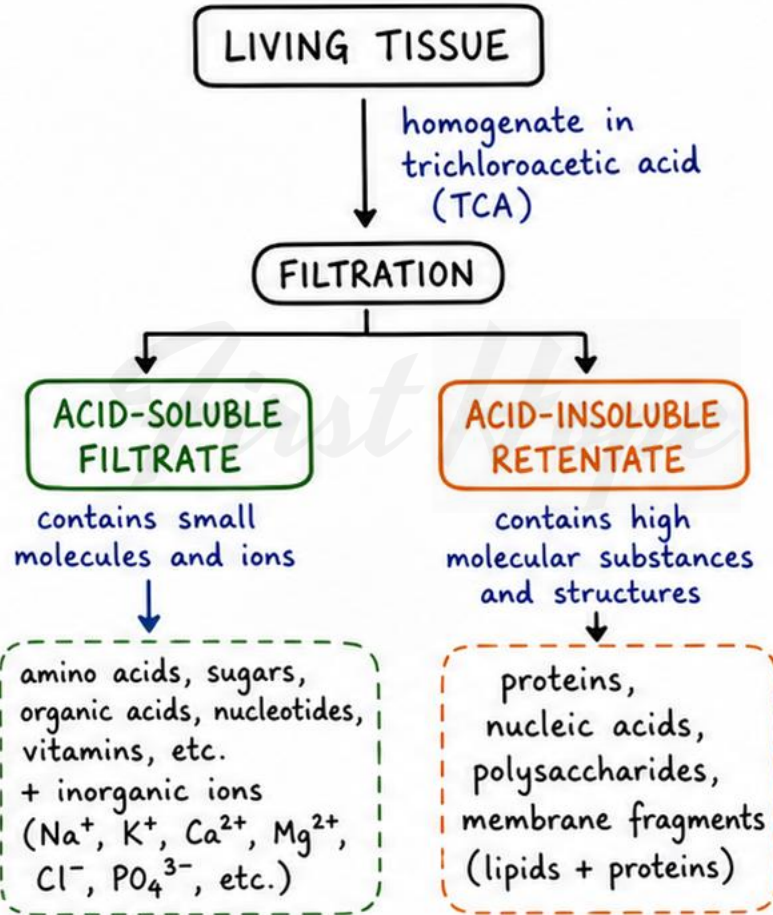
Living and non-living matter contain broadly the same elements, but the proportions in which these elements are present are different.

Representative % by mass comparison

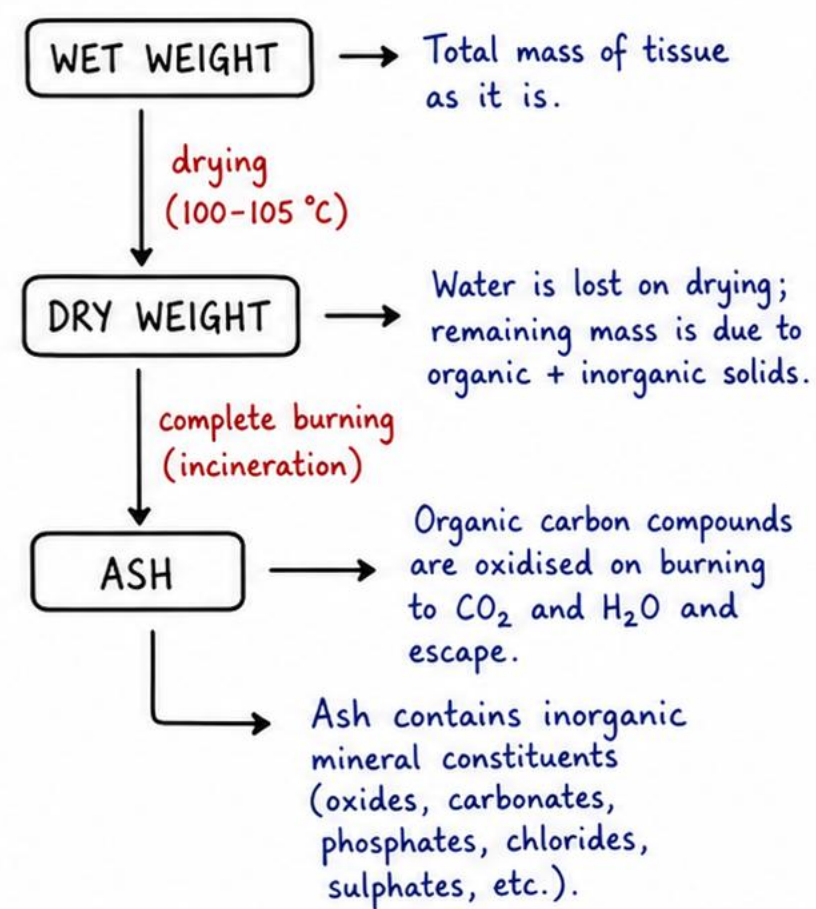
Element	Earth crust (% by mass)	Human body (% by mass)
C	0.03	18.5
H	0.14	9.5
O	46.6	65.0
N	very little	3.3

(Values are approximate)

2. CONCEPTUAL ANALYTICAL FLOW



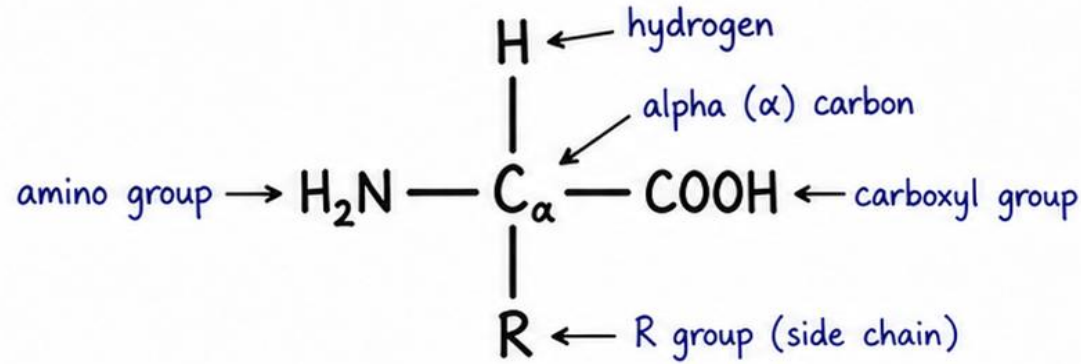
3. WEIGHT & ASH ANALYSIS CONCEPT



★ KEY TAKEAWAY: **ELEMENTAL ANALYSIS** tells which elements; **COMPOUND ANALYSIS** tells which molecules.

AMINO ACIDS: STRUCTURE & IONISATION

Proteins use 20 standard amino acids; the R group determines identity and many properties.



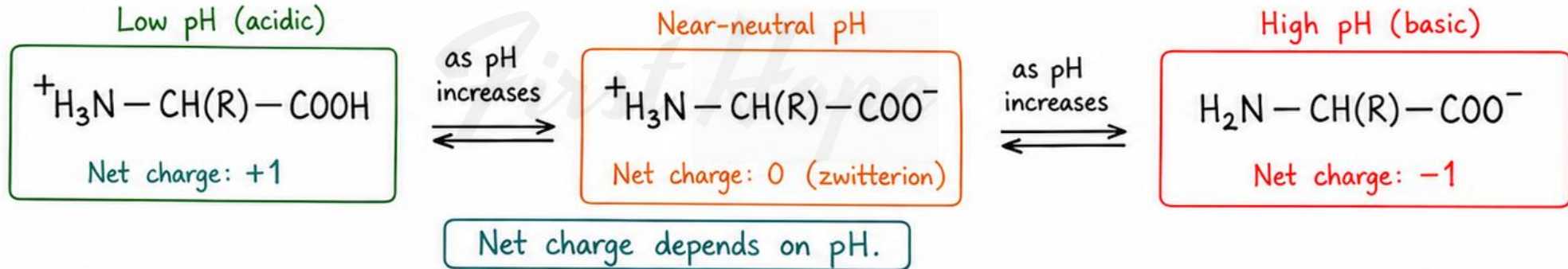
Examples (R group shown)

- Glycine R = H (simplest)

- Alanine R = CH₃ (methyl)

- Serine R = CH₂OH (hydroxyl)

pH-DEPENDENT IONISATION



CLASSIFICATION BY SIDE CHAIN (R GROUP) - SAME pH

ACIDIC (negatively charged) at physiological pH	BASIC (positively charged) at physiological pH	NEUTRAL POLAR (uncharged)	NEUTRAL NON-POLAR (hydrophobic)	AROMATIC (largely hydrophobic)
Example: Glutamate (Glu) $\text{R} = \text{CH}_2 - \text{CH}_2 - \text{COO}^-$ carboxylate side chain	Example: Lysine (Lys) $\text{R} = (\text{CH}_2)_4 - \text{NH}_3^+$ protonated amino side chain	Example: Serine (Ser) $\text{R} = \text{CH}_2\text{OH}$ hydroxyl side chain	Example: Valine (Val) $\text{R} = \begin{array}{c} \text{CH} \\ / \quad \backslash \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$ aliphatic side chain	Examples: Phenylalanine (Phe) Tyrosine (Tyr) Tryptophan (Trp) aromatic ring side chains

The ionisation state of the amino and carboxyl groups, and of the side chain (if ionisable), determines the net charge of each amino acid at a given pH.

LIPIDS: FATTY ACIDS, GLYCERIDES & PHOSPHOLIPIDS

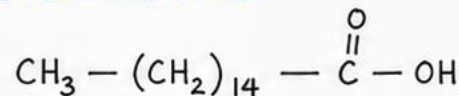
① FATTY ACIDS

Fatty acids are monocarboxylic acids with a long hydrocarbon chain.



(a) Saturated fatty acid

No C=C double bonds.

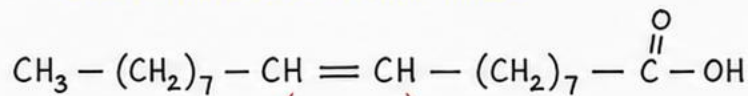


Palmitic acid (16:0)

Palmitic acid has 16 carbons.

(b) Unsaturated fatty acid (cis)

One or more C=C double bonds.



Oleic acid (18:1; one cis C=C shown)

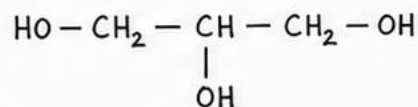
cis kink

Arachidonic acid: 20 carbons,

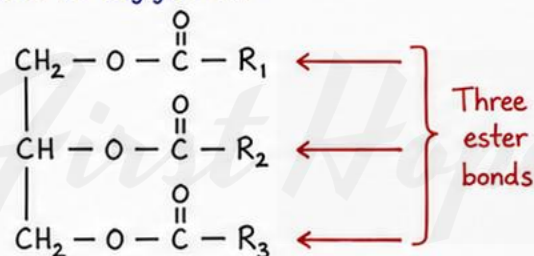
4 cis double bonds (20:4, omega-6).

② GLYCEROL & GLYCERIDES

Glycerol (propane-1,2,3-triol):



Triacylglycerol (a triglyceride):



R₁, R₂, R₃ = long hydrocarbon chains (fatty acyl groups)

Monoacylglycerols (1 fatty acid) • Diacylglycerols (2 fatty acids)

Triacylglycerols (3 fatty acids)

Fats (more saturated; longer chains) generally have higher melting points and are solid at room temperature.

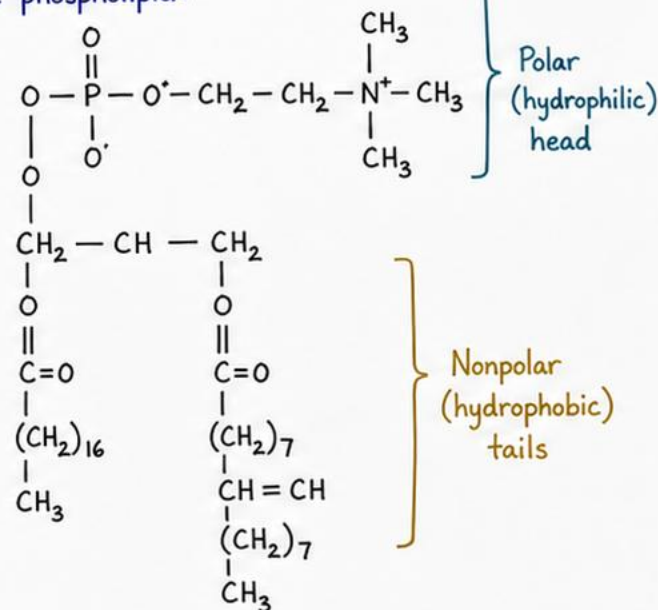
Oils (more unsaturated; shorter chains) have lower melting points and are liquid at room temperature.

In general: $\uparrow$ chain length $\rightarrow \uparrow$ melting point

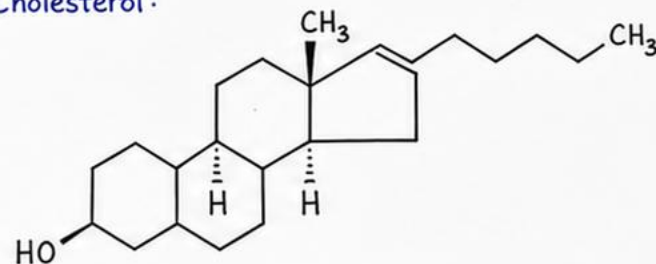
$\uparrow$ unsaturation (more C=C) $\rightarrow \downarrow$ melting point

③ MEMBRANE LIPIDS

Example phospholipid:



Cholesterol:



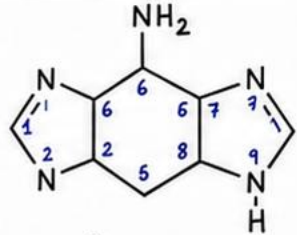
cholesterol

Lipids are generally water-insoluble and are not true macromolecular polymers.

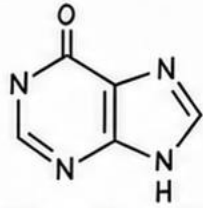
BASES, NUCLEOSIDES & NUCLEOTIDES

NITROGENOUS BASES

PURINES (two fused rings)

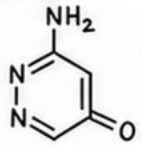


Adenine (A)

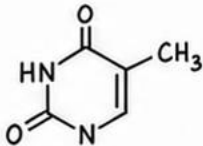


Guanine (G)

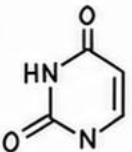
PYRIMIDINES (one ring)



Cytosine (C)



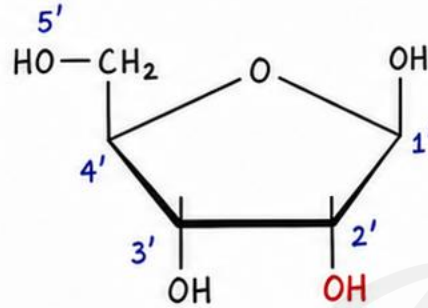
Thymine (T)



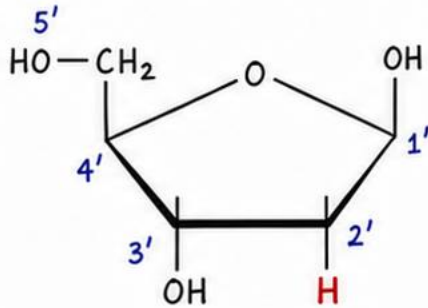
Uracil (U)

PENTOSE SUGARS

RIBOSE (in RNA)



2'-DEOXYRIBOSE (in DNA)



BASE + PENTOSE SUGAR
= NUCLEOSIDE

NUCLEOSIDE + PHOSPHATE
= NUCLEOTIDE

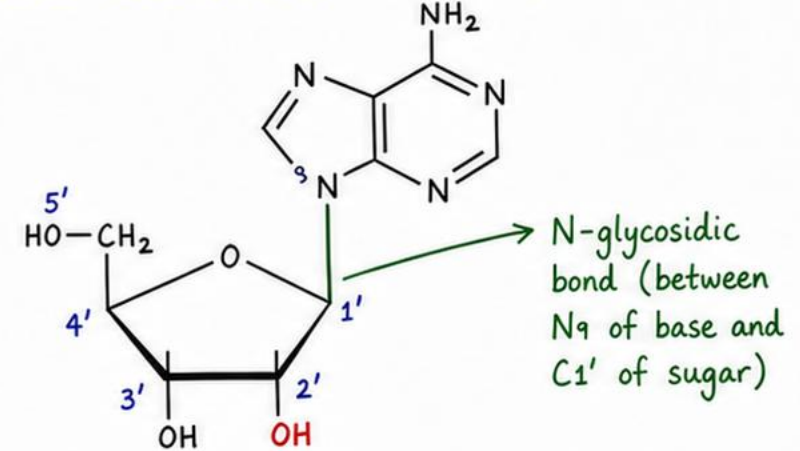
DNA NUCLEOTIDE

- Sugar: 2'-deoxyribose (2'-H)
- Bases: Adenine (A), Guanine (G), Cytosine (C), Thymine (T)

RNA NUCLEOTIDE

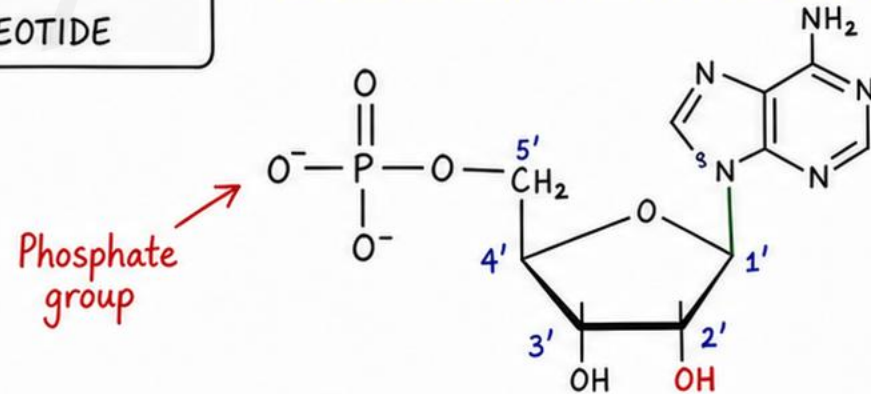
- Sugar: Ribose (2'-OH)
- Bases: Adenine (A), Guanine (G), Cytosine (C), Uracil (U)

EXAMPLE: ADENOSINE (a nucleoside)



N-glycosidic bond (between N9 of base and C1' of sugar)

EXAMPLE: ADENOSINE MONOPHOSPHATE (AMP)



Phosphate group

Nucleotides are monomers of nucleic acids; some also function in energy transfer and signalling.



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