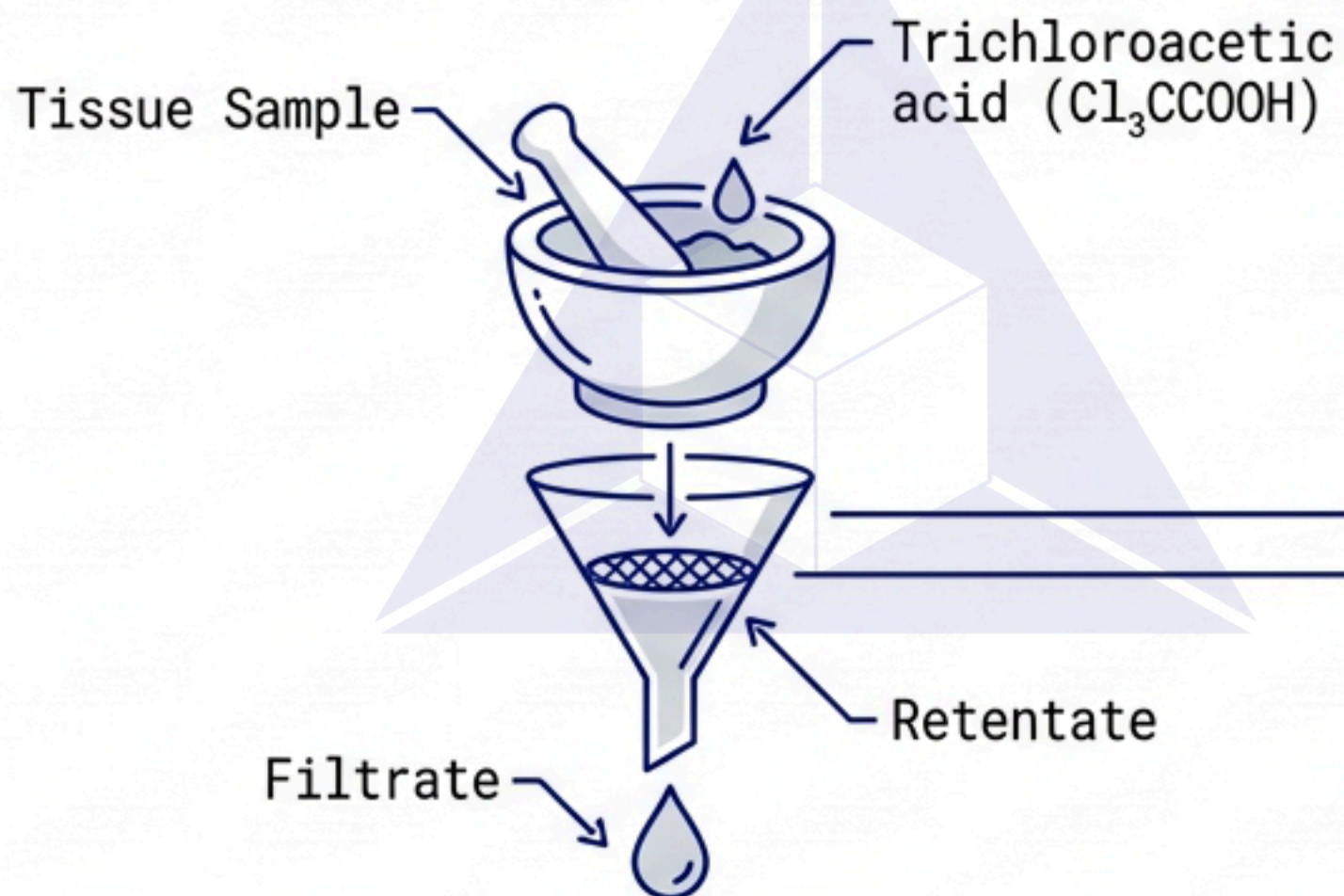


The Building Blocks of Life: Small Molecular Weight Organic Compounds



The Process



The Acid-Soluble Pool

Classification: Micromolecules

Molecular Weight: 18 to ~800 Daltons (Da)

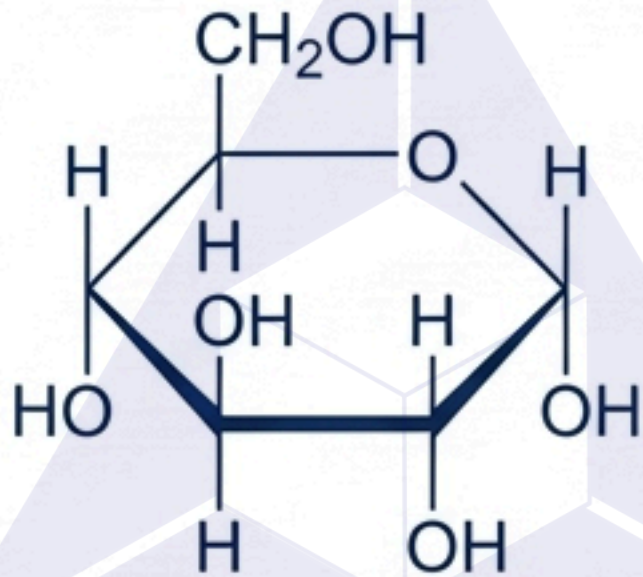
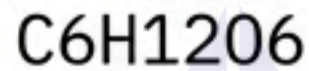
The Acid-Insoluble Pool

Contains macromolecules (weights > 10,000 Da) like proteins and polysaccharides.

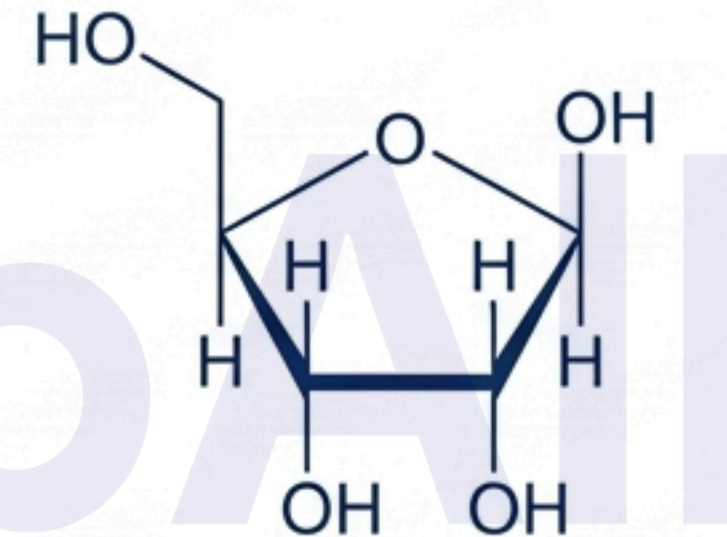
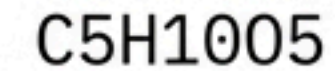
This acid-soluble fraction represents the vast majority of the cell's cytoplasmic composition—the essential primary metabolites like amino acids, sugars, and nucleotides that keep organisms alive.

Sugars: The Monosaccharides

Glucose



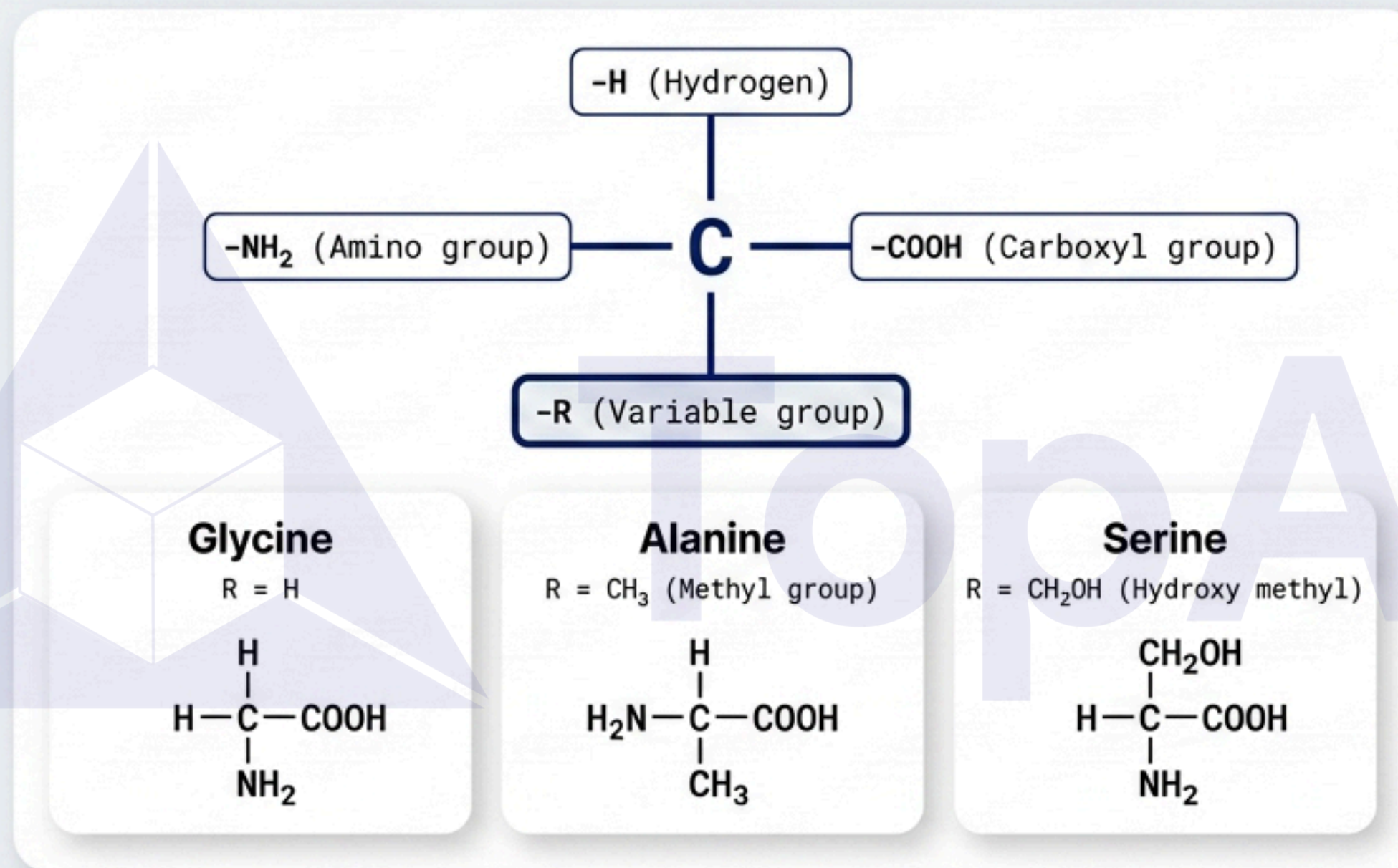
Ribose



Structural Backbones. Sugars function as individual energy metabolites but also serve as the essential structural backbone for complex biomolecules (like nucleic acids).

Do Not Confuse: These simple, small molecular weight sugars (monosaccharides) are distinct from polysaccharides (like starch, cellulose, or glycogen). Polysaccharides are massive polymeric threads found in the acid-insoluble macromolecular fraction.

Amino Acids: Substituted Methanes



The Zwitterionic Form.

Because the -NH₂ and -COOH groups are ionizable, the chemical structure of an amino acid dynamically changes depending on the pH of the surrounding solution.



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Key Highlights

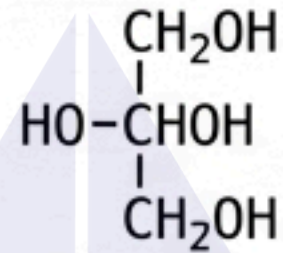
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Lipids: Fatty Acids and Glycerol

Glycerol

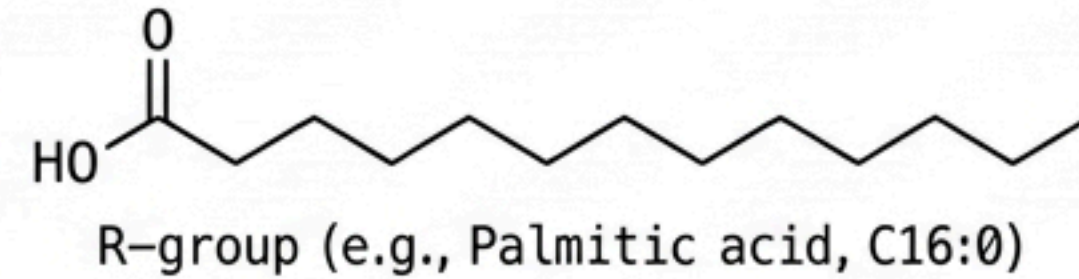
Trihydroxy propane



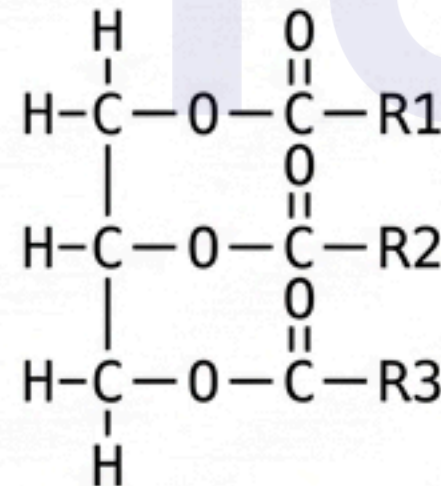
Esterification



Fatty Acid



Triglyceride (Fats/Oils)



Fatty acids can be saturated (no double bonds) or unsaturated (one or more C=C double bonds). They esterify with glycerol to form monoglycerides, diglycerides, and triglycerides.

The Lipid Paradox

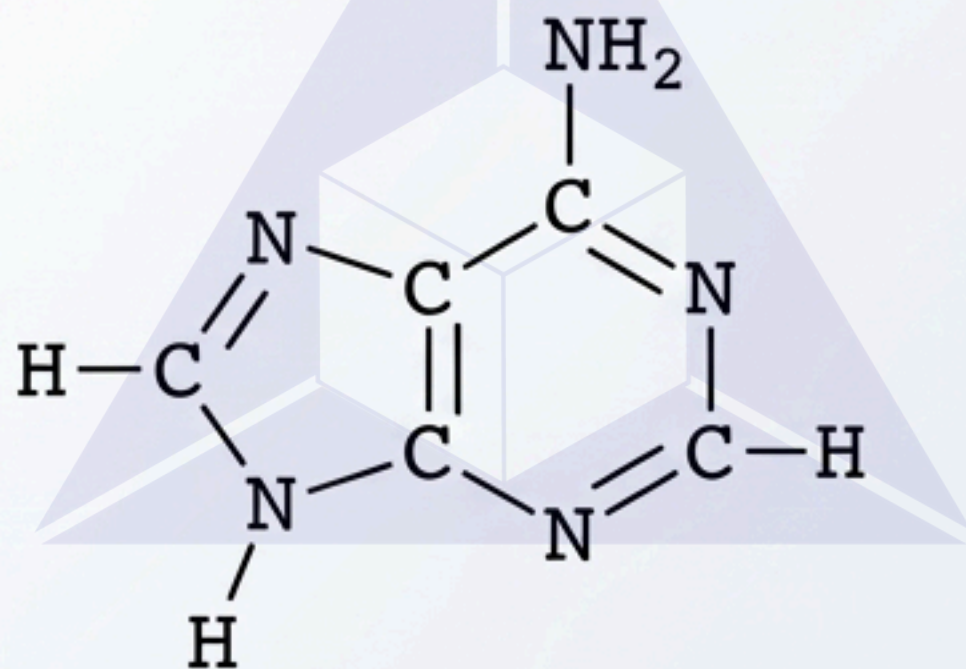
Lipids strictly weigh < 800 Da (micromolecules). Yet, they separate into the macromolecular (acid-insoluble) fraction! Why? Upon grinding tissue, cell membranes fragment and form water-insoluble vesicles that get physically trapped in the retentate. **Lipids are not strictly macromolecules.**

Nitrogen Bases: Heterocyclic Rings

Purines

Double-ring heterocyclic skeleton.

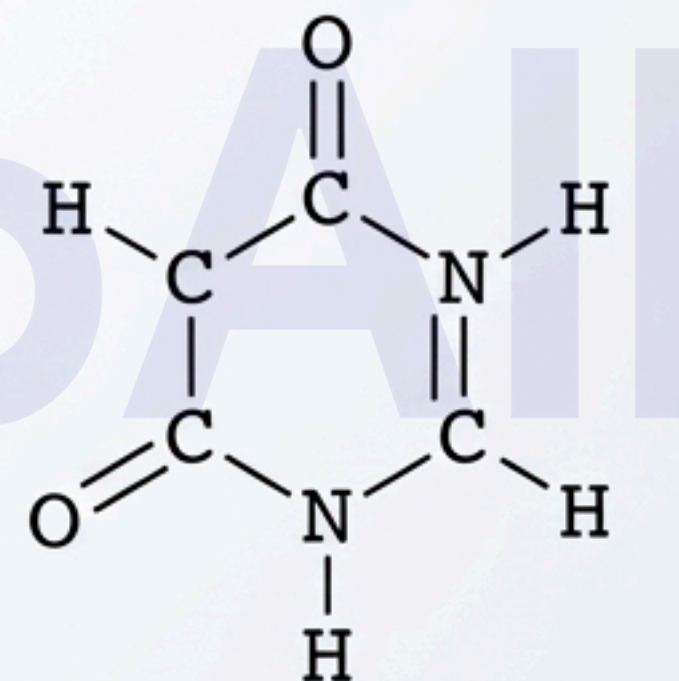
Adenine, Guanine.



Pyrimidines

Single-ring heterocyclic skeleton.

Cytosine, Uracil, Thymine

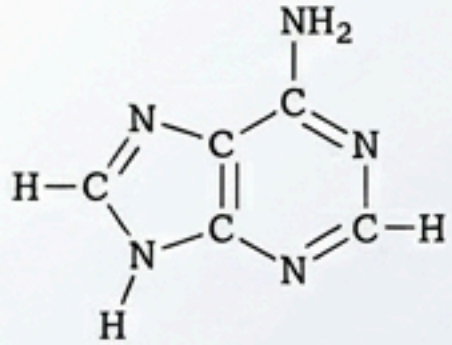


Key Takeaway Panel

These unique carbon-nitrogen heterocyclic ring structures are essential primary metabolites. When combined with other molecules, they form the alphabet that encodes all biological and genetic information.

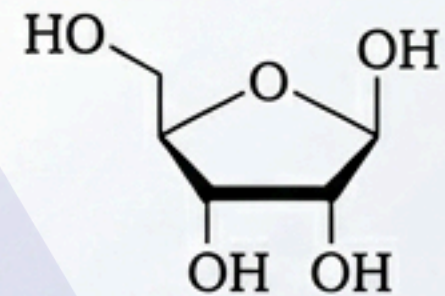
Nucleosides: Base + Sugar

Adenine
(Nitrogen Base)

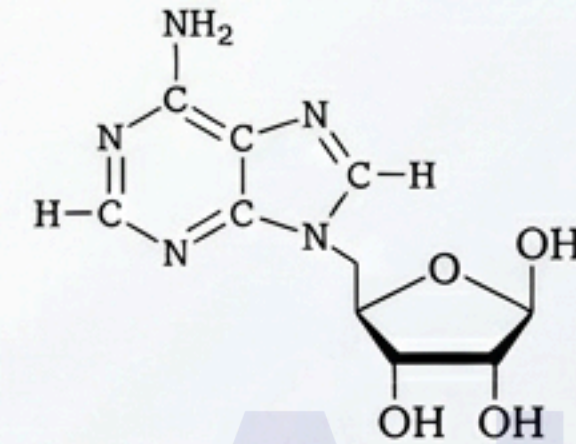


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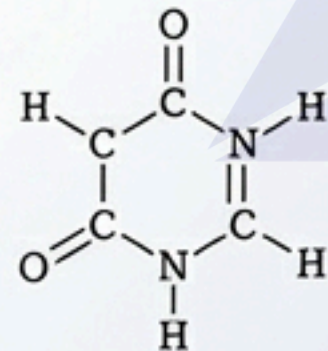
Ribose
(Pentose Sugar)



Adenosine

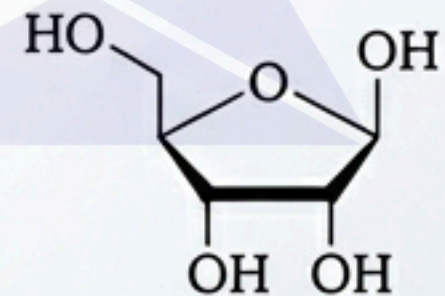


Uracil
(Nitrogen Base)

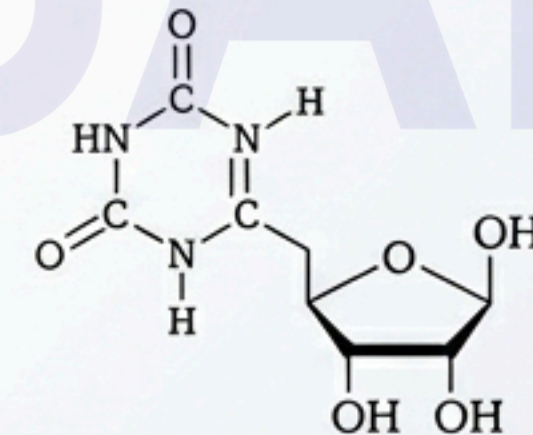


+

Ribose
(Pentose Sugar)



Uridine

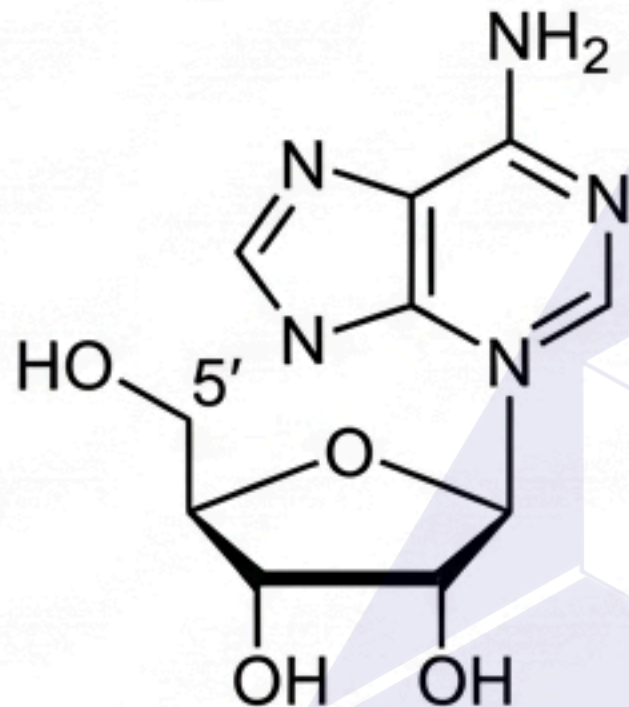


Nomenclature Rule

When a nitrogen base covalently attaches to a sugar (ribose or 2' deoxyribose), the resulting small molecule is termed a **nucleoside**. Common nucleosides include Adenosine, Guanosine, Thymidine, Uridine, and Cytidine.

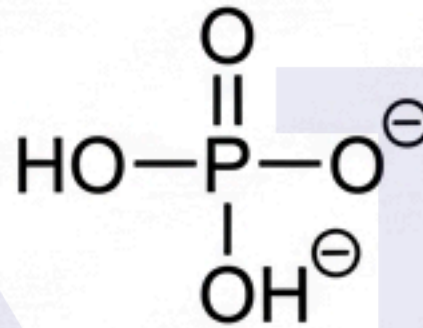
Nucleotides: Nucleoside + Phosphate

**Adenosine
(Nucleoside)**

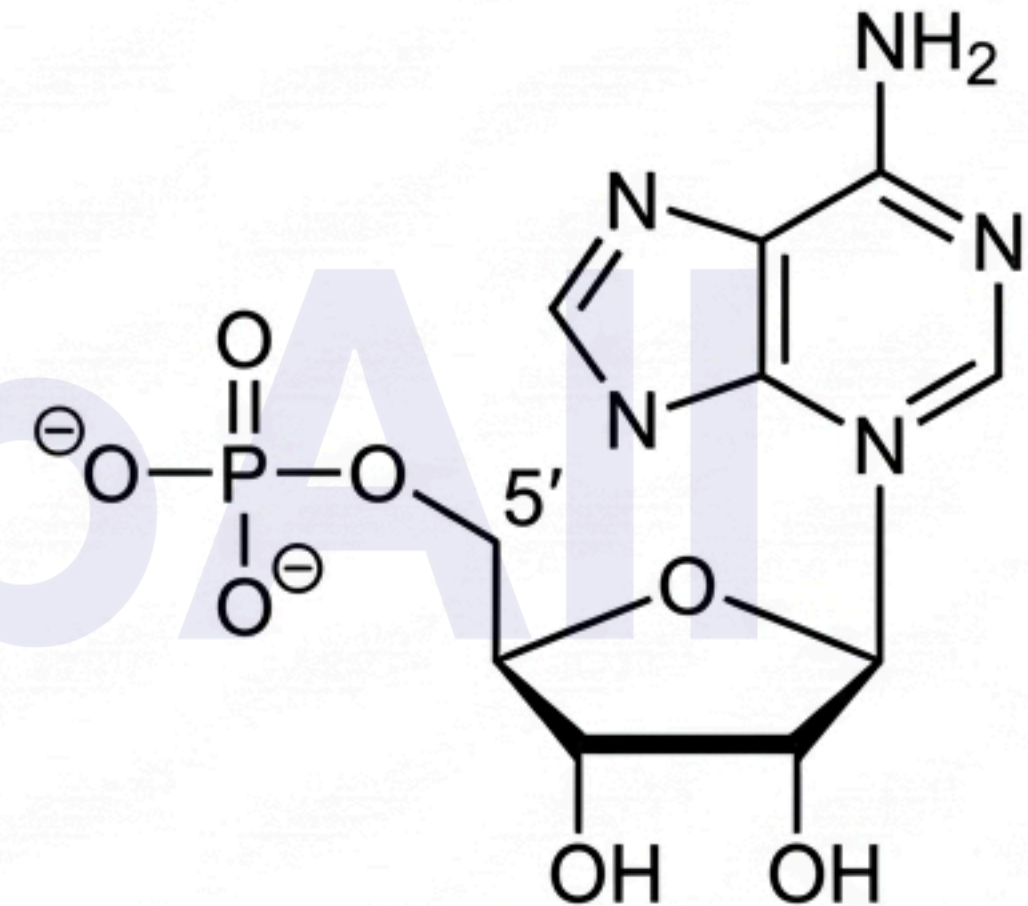


+

**Phosphate Group
(H_3PO_4)**



**Adenylic Acid
(Nucleotide)**



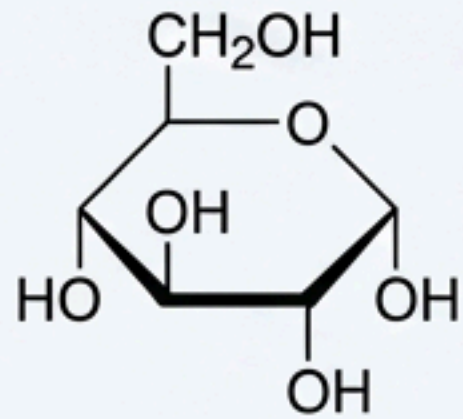
Esterification. The phosphate group is chemically esterified to the sugar molecule of the nucleoside nucleoside to form the nucleotide.

Other examples include thymidylic acid, guanylic acid, uridylic acid, and cytidylic acid.

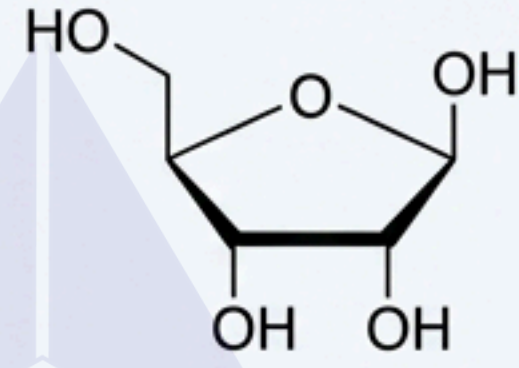
Key Takeaway Panel: Nucleotides are the sole monomeric building blocks for DNA and RNA. As individual molecules, they exist in the acid-soluble pool. Only when polymerized into long chains do they become nucleic acids (macromolecules).

Synthesis: Small Molecular Weight Organic Compounds

Sugars (Carbohydrates)

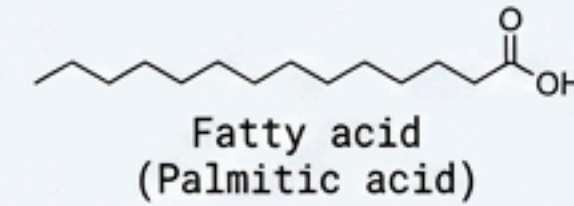


Glucose
($C_6H_{12}O_6$)

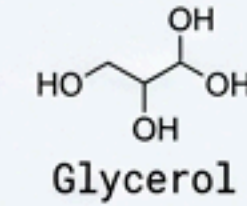


Ribose
($C_5H_{10}O_5$)

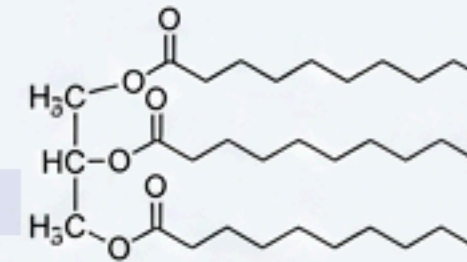
Fats and Oils (Lipids)



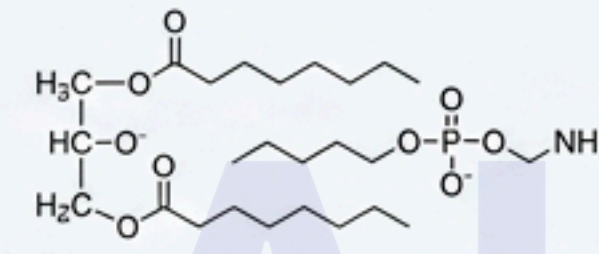
Fatty acid
(Palmitic acid)



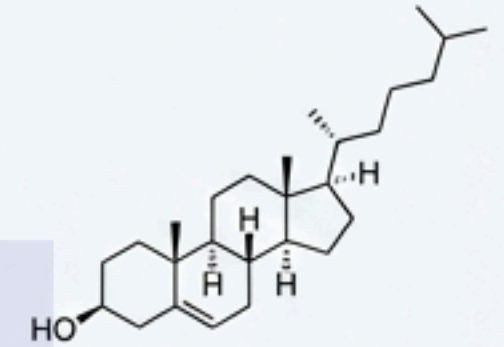
Glycerol



Triglyceride

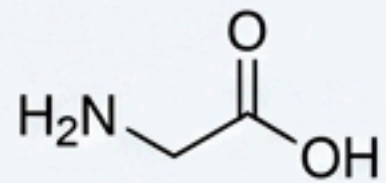


Phospholipid
(Lecithin)

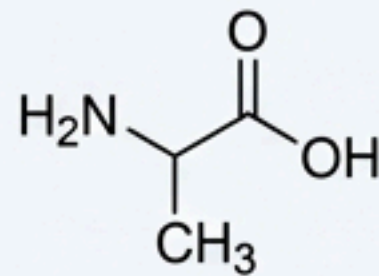


Cholesterol

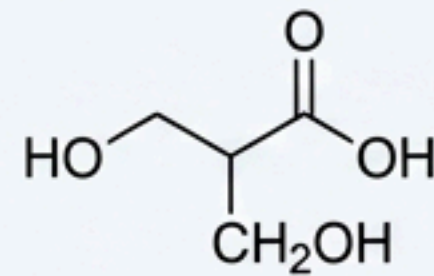
Amino Acids



Glycine

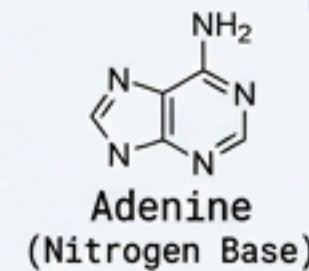


Alanine

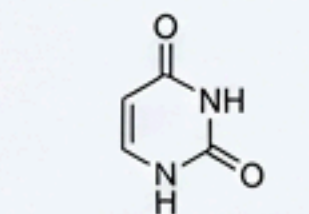


Serine

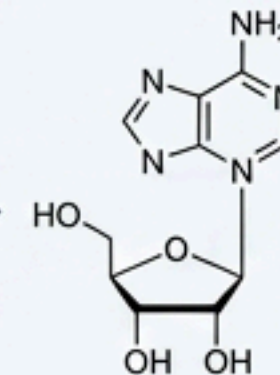
Nitrogen Bases, Nucleosides, Nucleotides



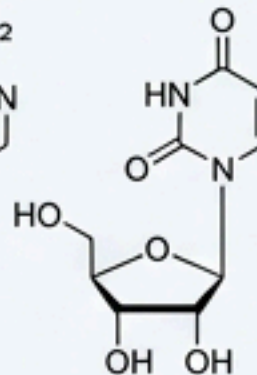
Adenine
(Nitrogen Base)



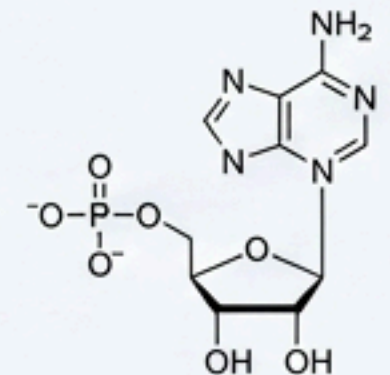
Uracil
(Nitrogen Base)



Adenosine
(Nucleoside)



Uridine
(Nucleoside)



Adenylic acid
(Nucleotide)



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