Biomolecules (Biological molecules)

Course instructor: Jibril H. Yusuf PhD.

E-mail: jibril.habib@tiu.edu.iq

Course: **General Biology I** (MA 101)

Fall Semester (2025)

Week 2

Date 21-12-2025

Outline

- What is Biomolecules
- Composition of Biomolecules
- Major Classes of Biomolecules
- Additional Biomolecules

Objectives

❖By the end of this lecture, students should be able to:

1. Define biomolecules.

2. Identify and classify the major types of biomolecules.

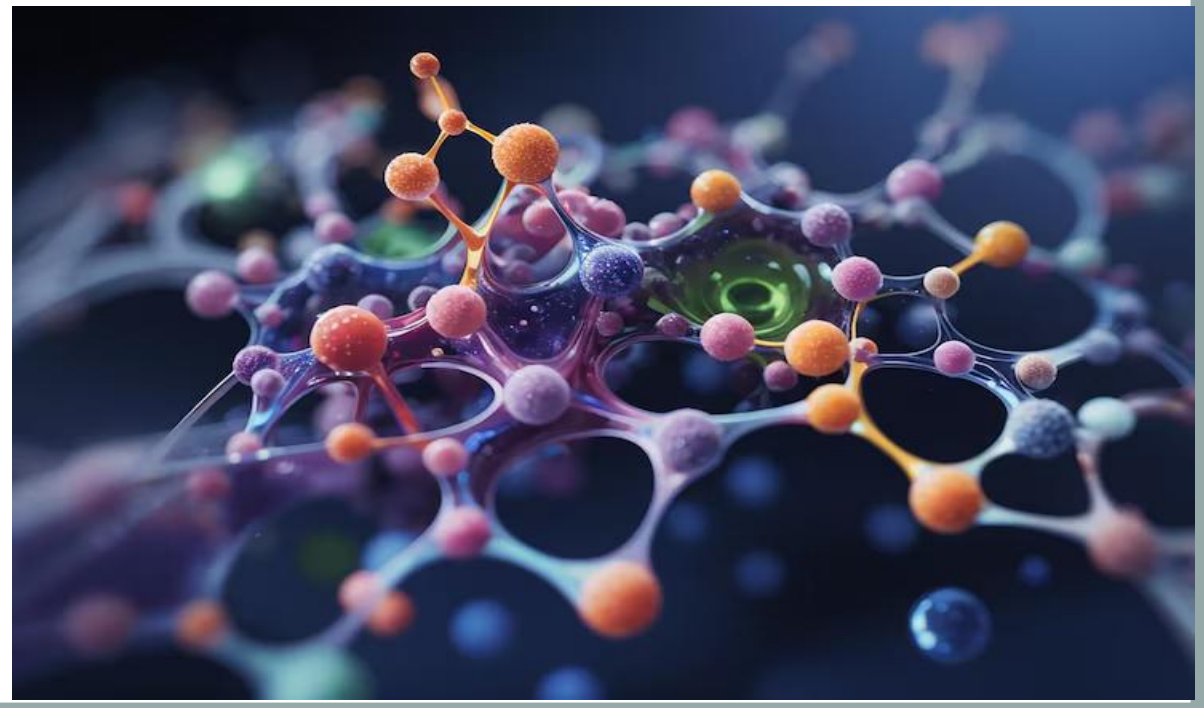
3. Explain the biological roles of biomolecules.

4. Describe the basic chemical composition and structural units of each class of biomolecules.

❑ What is Biomolecules (Biological molecules)?

➢ Are **organic molecules** that are essential for **life processes**.

- They are the building **blocks and machinery** of living organisms, involved in structure, function, regulation, metabolism, growth, and reproduction.



❑ Composition of Biomolecules

- Biomolecules are primarily composed of just **6 elements**, with carbon (C) as the central element:

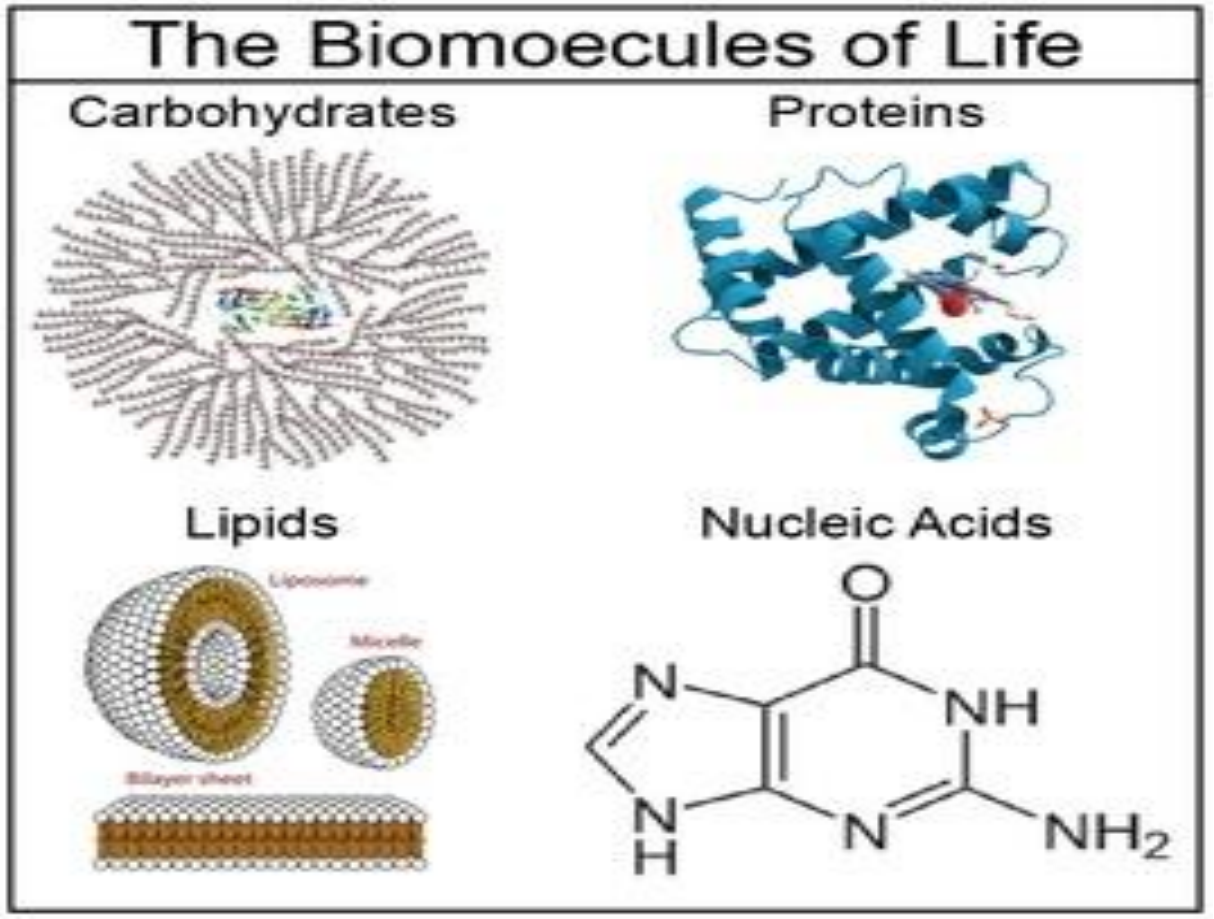
1) Carbon (C).
2) Hydrogen (H).
3) Oxygen (O).
4) Nitrogen (N).
5) Phosphorus (P).
6) Sulfur (S).

❖ Major Classes of Biomolecules:

- All living organisms are built from and depend on four major classes of biomolecules:

✓ **The four Major Classes**:

1. Carbohydrates.
2. Lipids
3. Proteins
4. Nucleic Acids



Carbohydrates:

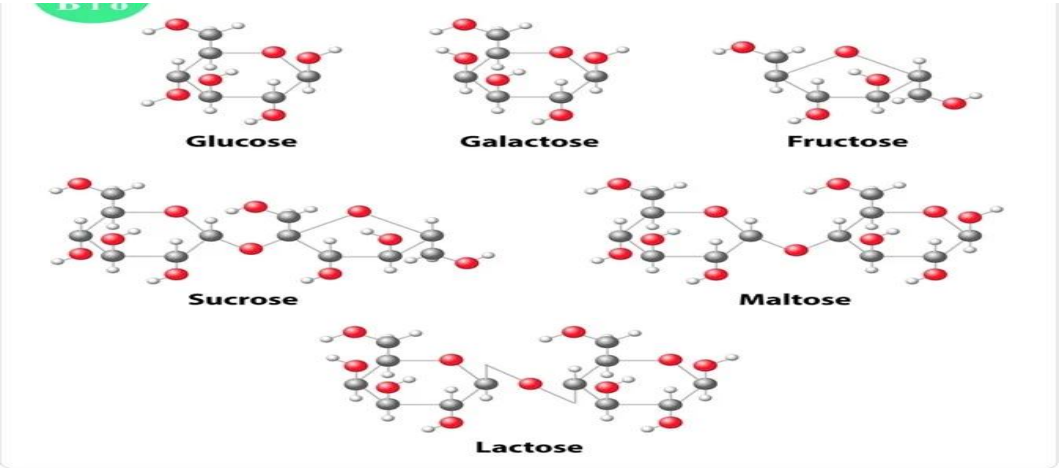
Definition: Organic compounds made up of carbon, hydrogen, and oxygen in a ratio of 1:2:1 (C:H:O).

Functions:

1. Primary source of energy
2. Provide strength & rigidity to cells.
3. Energy Storage

Type:

1. Monosaccharides
2. Disaccharides
3. Polysaccharides



➢ Lipids:

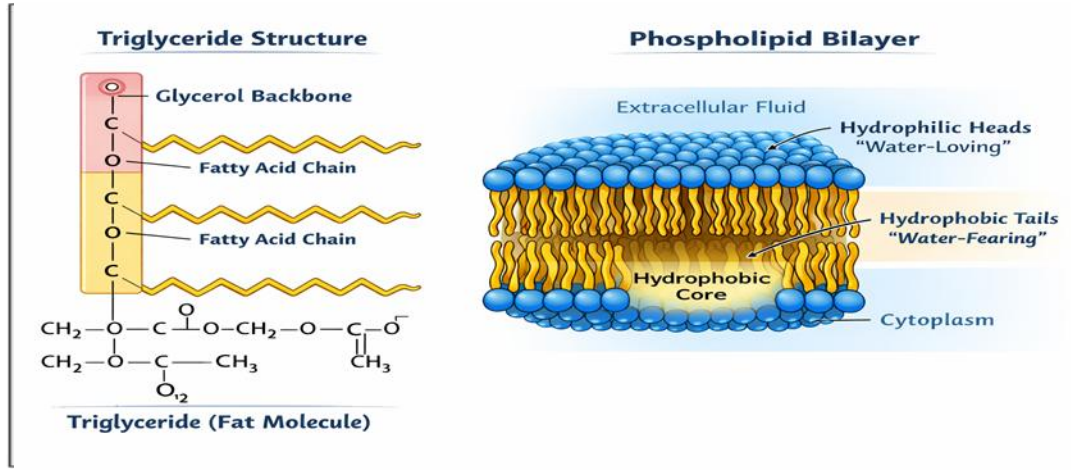
Definition: Are important class of biomolecules characterized by their hydrophobic nature, made mainly of C, H, and O (sometimes phosphorus and nitrogen).

Functions:

1. Energy storage.
2. Component of cell membrane
3. Insulation and protection

Type:

1. Fats & Oils.
2. Phospholipids.
3. Steroids (cholesterol)



Proteins:

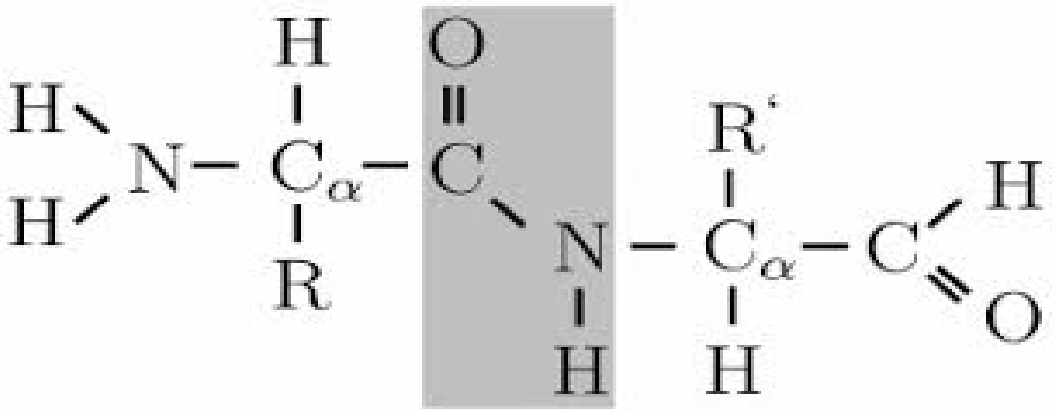
Definition: Large, complex molecules made of amino acids joined by peptide bonds. Contain C, H, O, N, and sometimes S.

Functions:

1. Enzymatic Function.
2. Structural Function.
3. Regulatory and Hormonal Function

Type:

1. Simple Proteins (Albumin).
2. Conjugated Proteins (Lipoprotein).
3. Fibrous & Globular Proteins



Nucleic Acids:

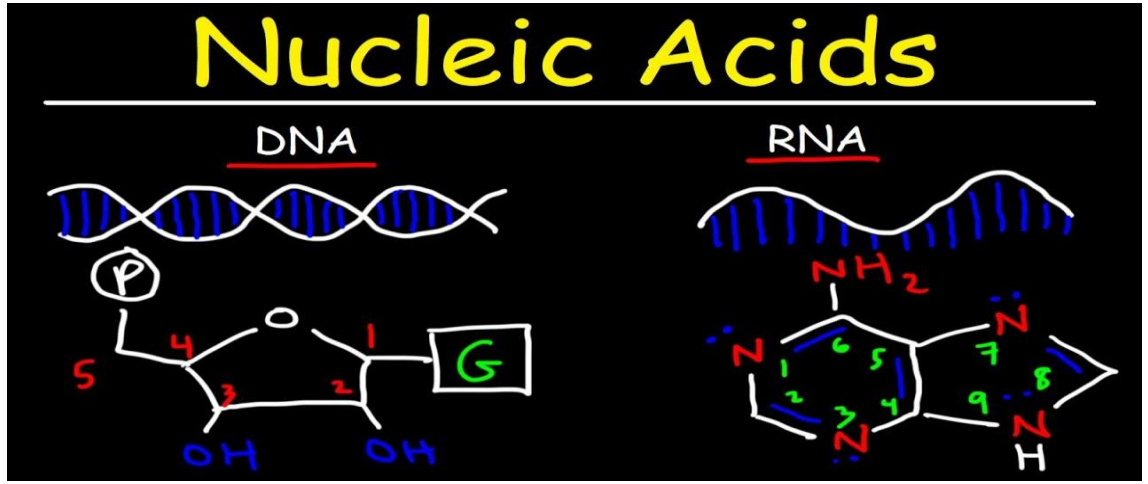
Definition: Macromolecules that store and transmit genetic information. Made of nucleotides. Pentose sugar, Phosphate group & Nitrogenous base.

Functions:

1. Stores hereditary information.
2. Controls cell activities.
3. Control of protein synthesis
4. Transmission of hereditary traits

Type:

1. DNA (Deoxyribonucleic acid).
2. RNA (Ribonucleic acid).



❖ Additional Biomolecules:

- In addition to the four major biomolecules (carbohydrates, lipids, proteins, and nucleic acids).

- Living organisms contain other essential biomolecules that play critical regulatory, metabolic, and supportive roles.

- These are often required in small amounts but are vital for normal biological function.

1. Vitamins:

- Organic compounds required in small quantities.
- Do not provide energy but are essential for metabolism
- Many act as coenzymes (Non-protein molecules NAD^+)

➢ **Types of Vitamins:**

✓ Fat-soluble: A, D, E, K

✓ Water-soluble: B-complex, C

2. Minerals:

- **Inorganic elements** required for **physiological processes**.

- Maintain structure, enzyme function, and nerve activity.

- Examples:
- Calcium
- Iron
- Sodium
- Iodine

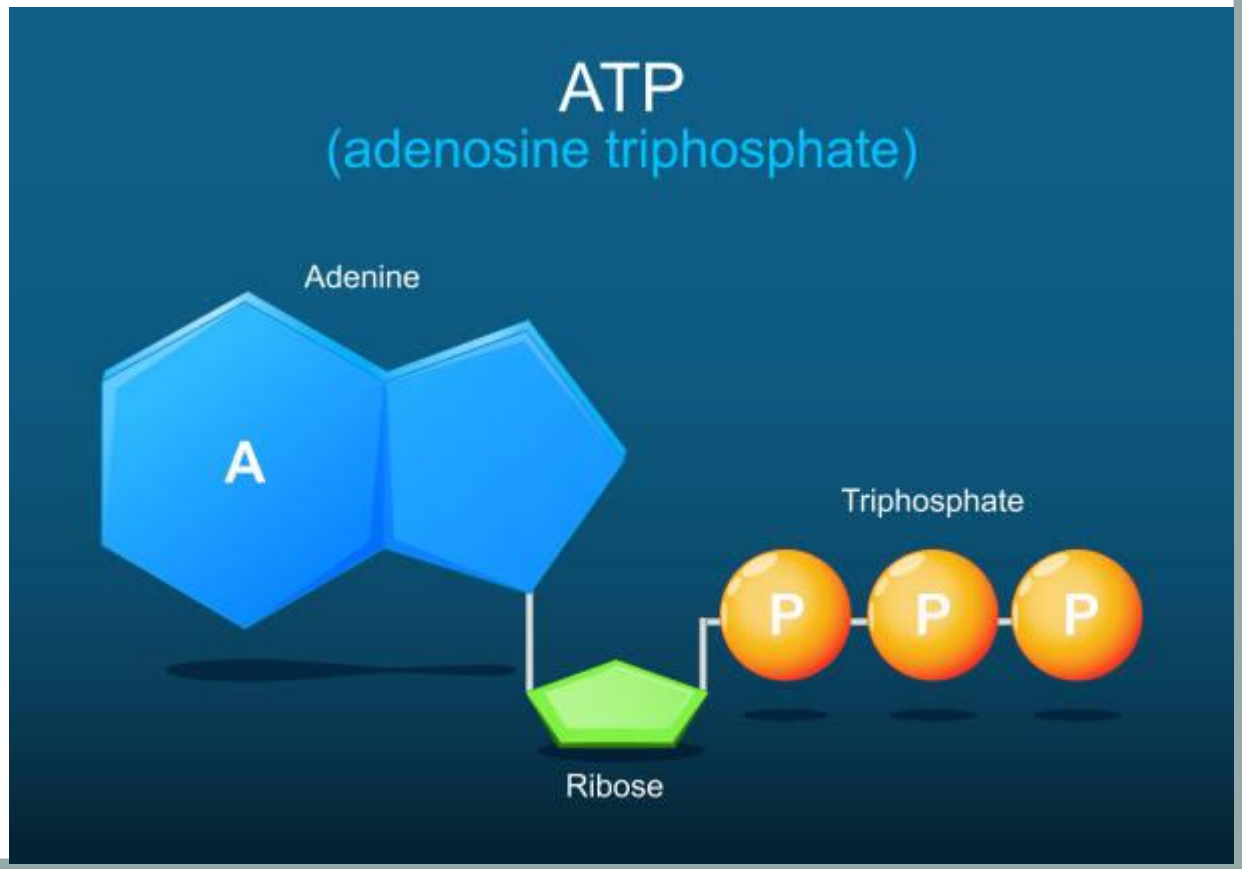
3. Adenosine Triphosphate (ATP):

- Known as the energy currency of the cell.
- Stores and releases energy for:

✓Muscle contraction

✓Active transport

✓Biosynthesis.

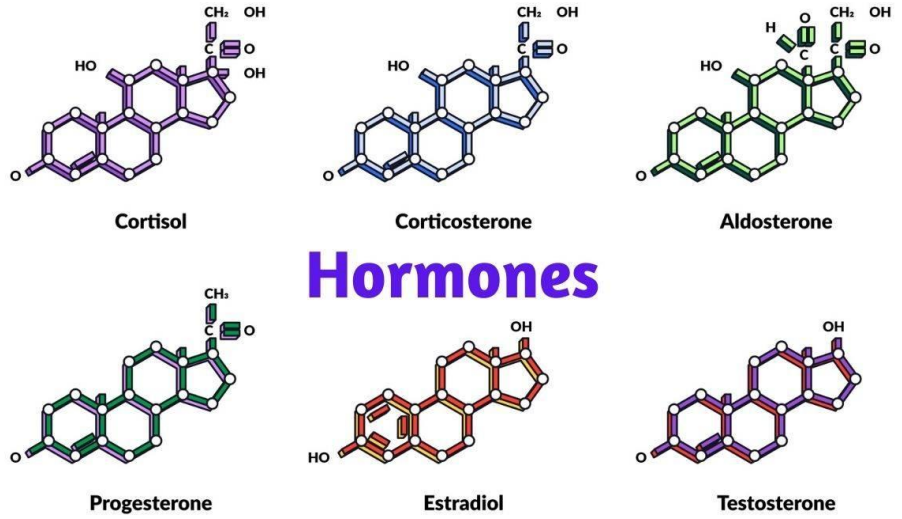


4. Hormones:

- Chemical messengers produced by endocrine glands.
- Regulate growth, metabolism, reproduction.

➢ **Examples:**

- Insulin → regulates blood glucose
- Thyroxine → regulates metabolism
- Adrenaline → stress response



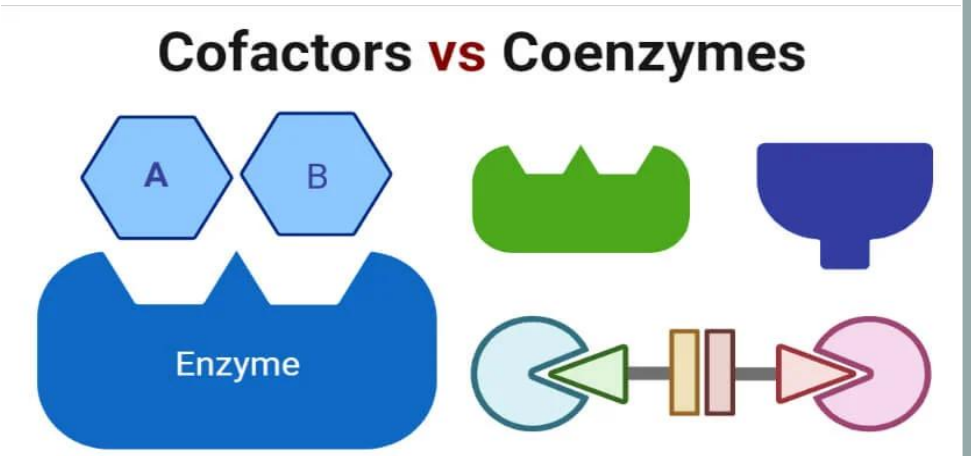
5. Enzyme Cofactors and Coenzymes:

- Assist enzymes in catalyzing reactions.

➢ Types:

✓ Cofactors: Inorganic ions (e.g., Mg^{2+}, Zn^{2+})

✓ Coenzymes: Organic molecules (often vitamins).



6. Secondary Metabolites:

- Not directly involved in growth.
- Important for defense and signaling.

➢ **Examples**

- Alkaloids (morphine, caffeine)
- Terpenoids (Menthol, Essential oils)
- Phenolic Compounds (Flavonoids, Lignin)

References

1. Campbell, N.A. et al. (2020). Biology (12th ed.). Pearson Education.
2. Mader, S.S. (2022). Biology (14th ed.). McGraw-Hill Education.
3. Raven, P.H., Johnson, G.B. et al. (2021). Biology (12th ed.). McGraw-Hill
4. Principles of Biology

Thanks