Lecture 1

Introduction To Biochemistry

By

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Biochemistry is a hybrid science: Biology is the science of living organisms and chemistry is the science of atoms and molecules, so biochemistry is the science of the atoms and molecules in living organisms. Its domain encompasses all the living world with the unifying interest in the chemical structures and reactions that occur in living systems. Where can you find biochemistry? All through science, medicine, and agriculture.

What is Biochemistry ?

Significance: be essential to all life sciences as the common knowledge

–Genetics; Cell biology; Molecular biology

–Physiology and Immunology

–Pharmacology and Pharmacy

–Toxicology; Pathology; Microbiology

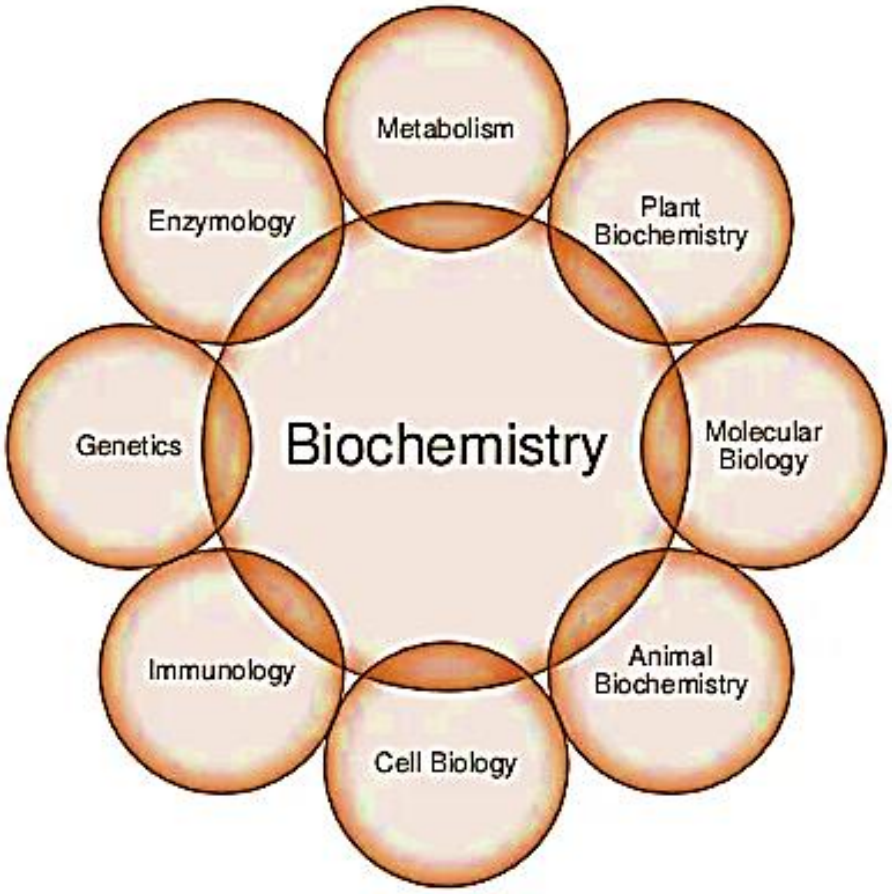
–Zoology and Botany

–Agriculture

–Industrial applications

–Environmental implications

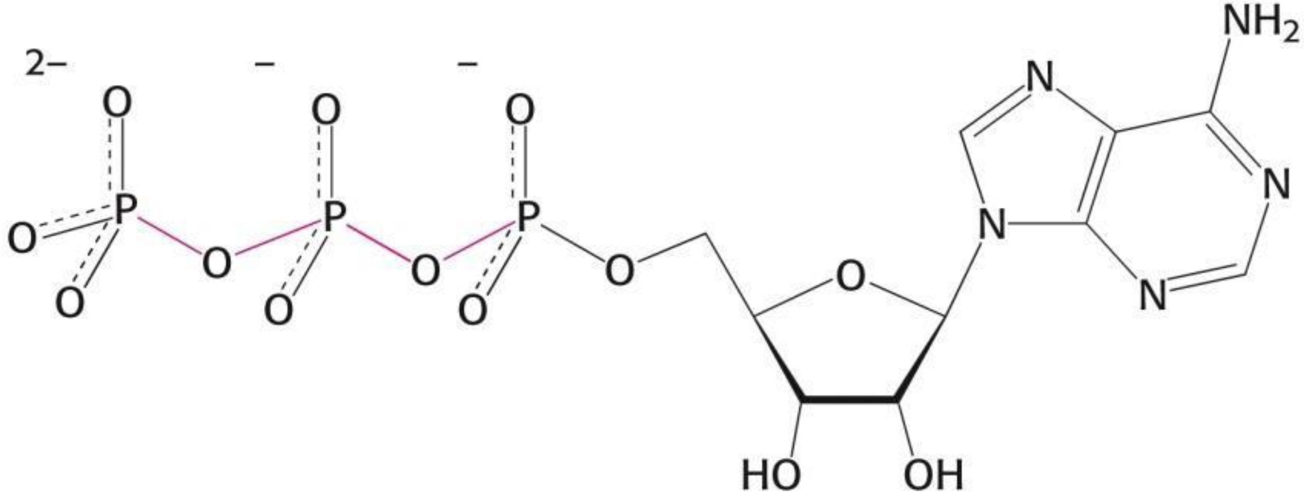
FIELDS OF BIOCHEMISTRY



Life has 3 requirements

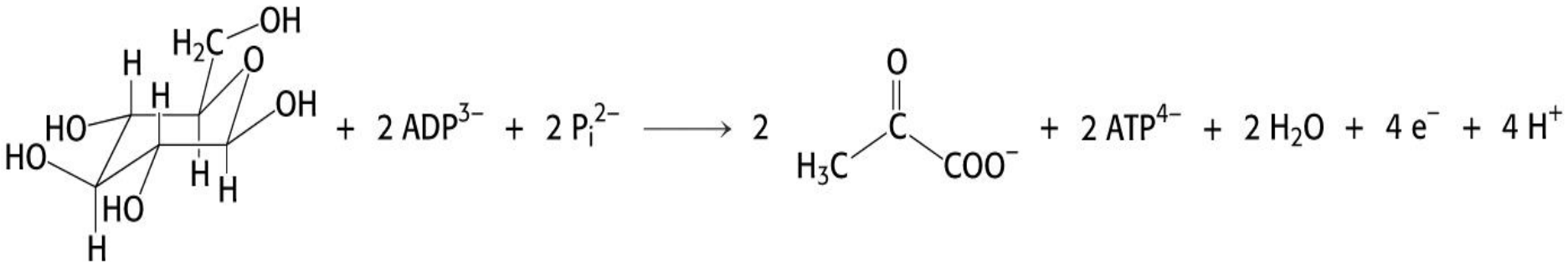
1)ENERGY: which it must know how to:

- Extract
- Transform
- Utilize



Adenosine triphosphate (ATP)

- Adenosine 5′-triphosphate, abbreviated ATP and usually expressed without the 5′-, is an important “energy molecule” found in all life forms. Specifically, it is a coenzyme that works with enzymes such as ATP triphosphatase to transfer energy to cells by releasing its phosphate groups. The molecule consists of three components: an adenine bicyclic system, a furanose ring, and a triphosphate chain.
- **Glycolysis** is the preferred pathway for the formation of **ATP**

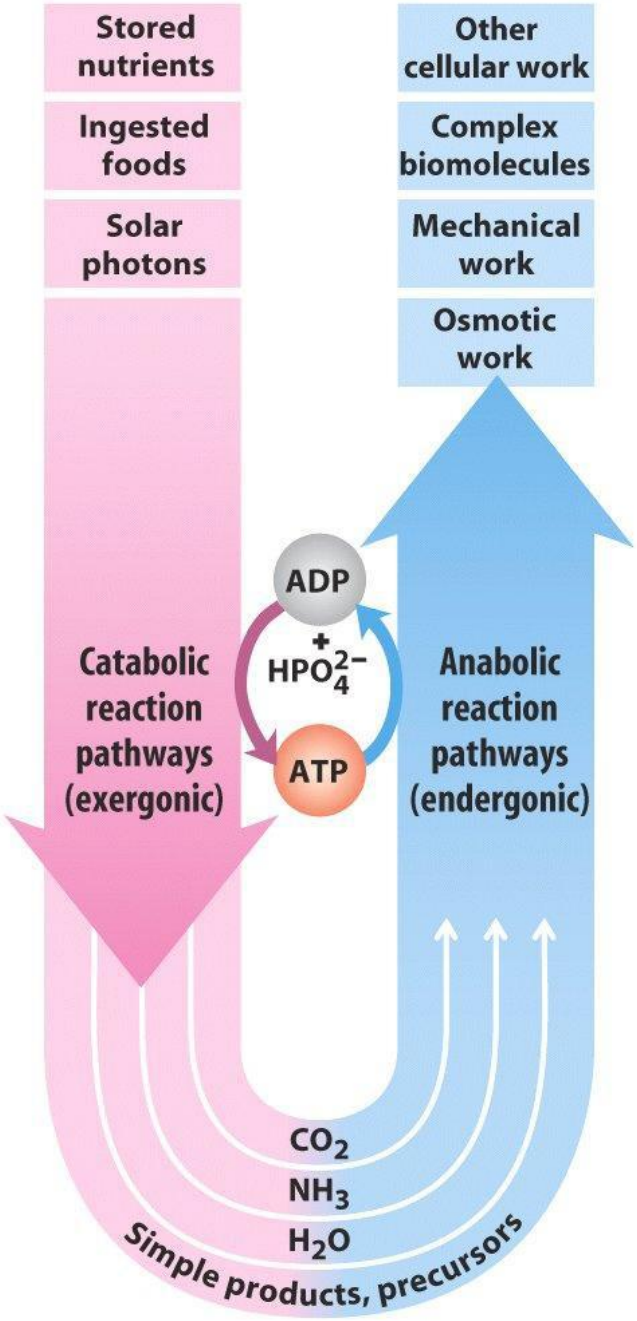


•Glycolysis is used by all cells in the body for energy generation. The final product of glycolysis is pyruvate in aerobic settings and lactate in anaerobic conditions. Pyruvate enters the Krebs cycle for further energy production. Anabolism and catabolism are the two broad classes of biochemical reactions that make up metabolism.

•Anabolism is the synthesis of complex molecules from simpler ones. These chemical reactions require energy.

•Catabolism is the breakdown of complex molecules into simpler ones. These reactions release energy.

•Anabolic and catabolic pathways typically work together, with the energy from catabolism providing the energy for anabolism.



(2) ***SIMPLE MOLECULES,*** which it must know how to:

•Convert •Polymerize •Degrade

- **(3)** ***CHEMICAL MECHANISMS,*** to:
- •Harness energy
- •Drive sequential chemical reactions
- •Synthesize & degrade macromolecules
- •Maintain a dynamic steady state
- •Self-assemble complex structures
- •Replicate accurately & efficiently
- •Maintain biochemical “order” vs outside

Organization of Life

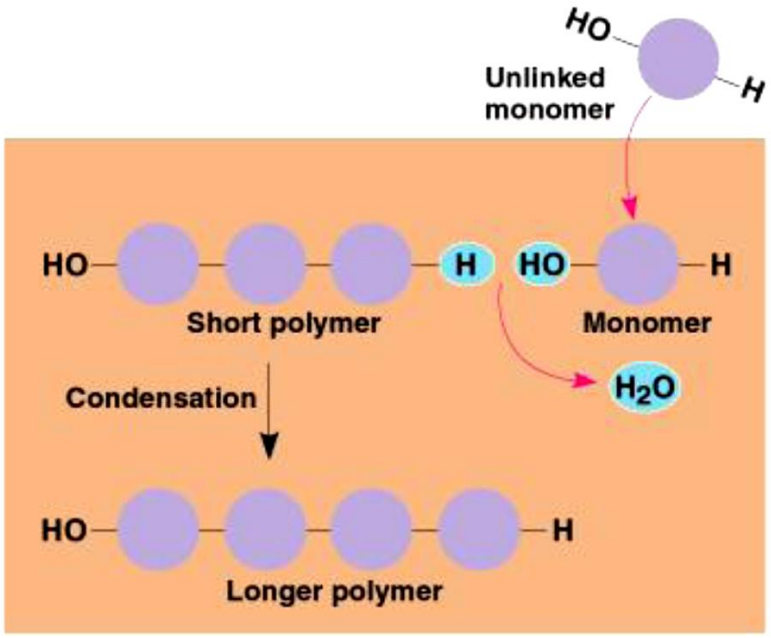
- elements
- simple organic compounds (monomers)
- macromolecules (polymers)
- supramolecular structures
- organelles
- cells
- tissues
- organisms

Biomolecules as polymers

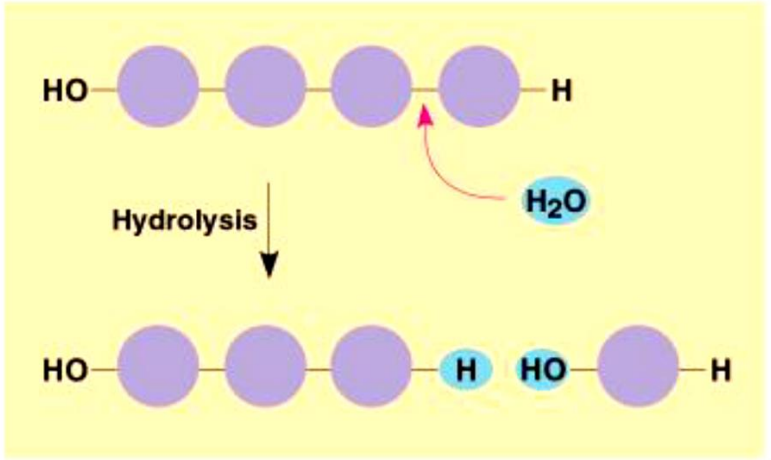
- Carbohydrates
- Proteins
- Lipids
- Nucleic acid
- Each of these types of molecules are **polymers** that are assembled from single units called **monomers**.

- Each type of macromolecule is an assemblage of a different type of monomer

- **Common theme: Monomers form polymers through condensations Polymers are broken down through hydrolysis.**



(a) Condensation (dehydration) synthesis of a polymer



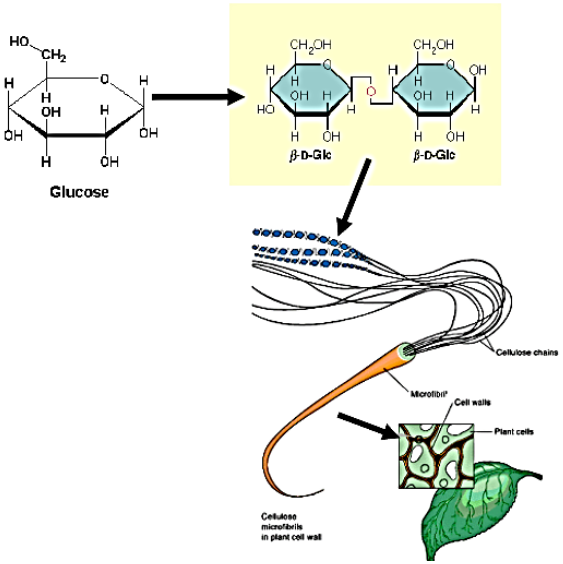
(b) Hydrolysis of a polymer

Carbohydrates

monomer: glucose

polymer: cellulose

supramolecular structure: cell wall

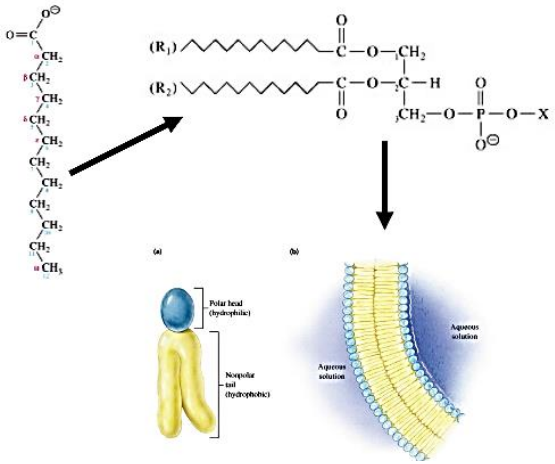


Lipids

monomer: fatty acid

polymer: phospholipid

supramolecular structure: membrane

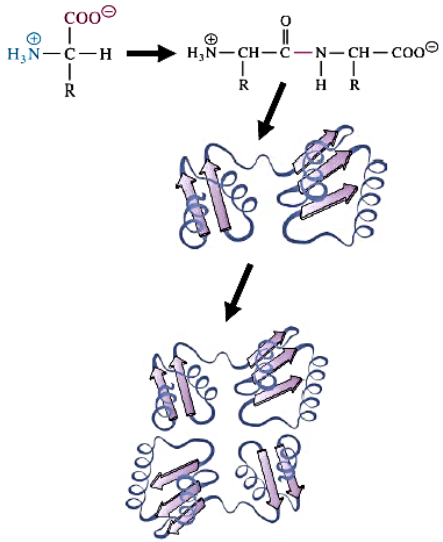


Proteins

monomer: amino acid

polymer: protein subunit

supramolecular structure: Enzyme complex

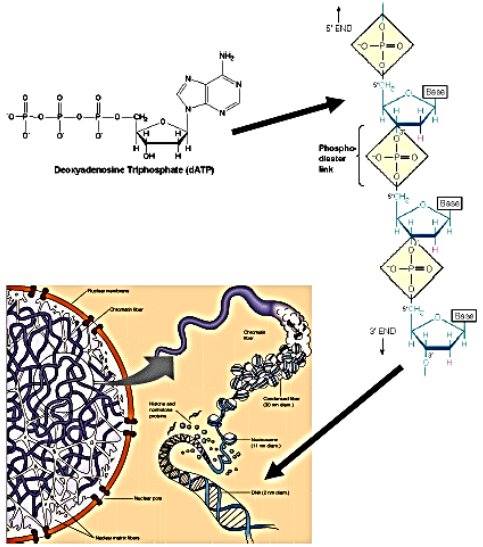


Nucleic Acids

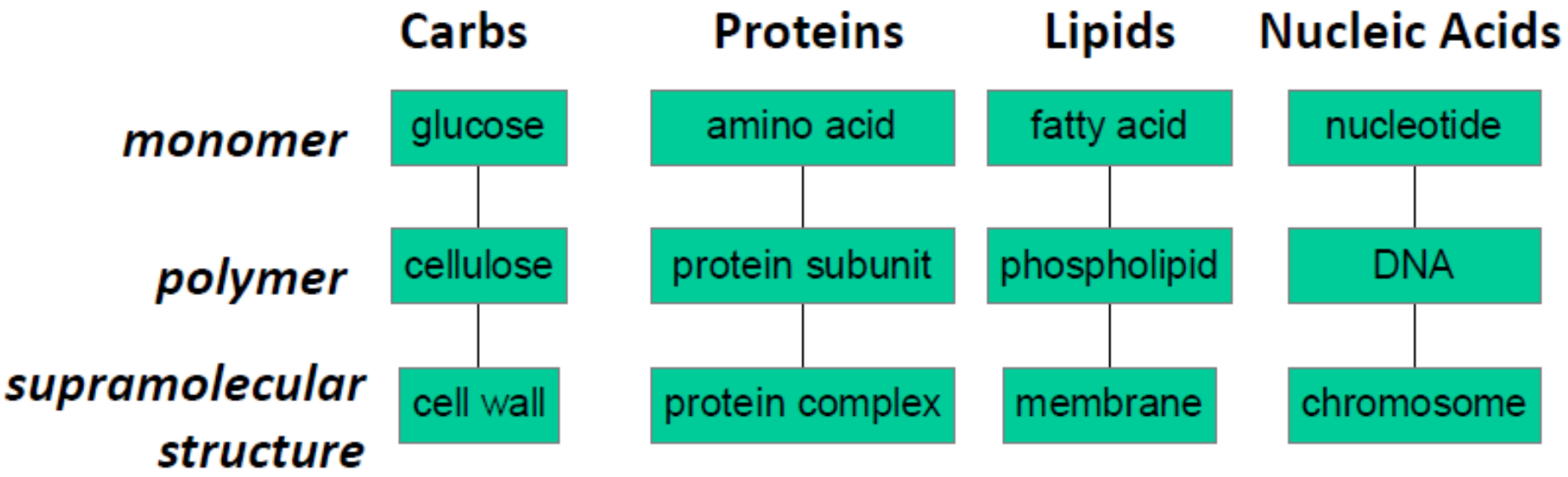
monomer: nucleotide

polymer: DNA

supramolecular structure: chromatin



Many Important Biomolecules are Polymers



Principle areas of Biochemistry

•Structure and function of cellular components

(i.e.) proteins, carbohydrates, lipids, nucleic acids and other biomolecules

•Metabolism (catabolic and anabolic processes) and its regulation

•Molecular Genetics:

-Gene expression and modulation

-Regulation of protein synthesis

-How life is replicated

DNA → **RNA** → **Protein**