

Biomedical  
Science

Molecular  
Genetics



BMS 247 | Fall 2026-2027

**Basic Biochemistry**  
**Introduction**



Free Session

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## Cracking the Term 'Biochemistry'

**Bio****Life****Biology****Scientific study of life / study of living organisms****Chemistry**

a branch of science

Substances of which **matter** is composedInvestigation of their **properties**Use of such reactions to form **new substances**



## What Is Biochemistry?

The term biochemistry originated from combining the words **"bios"** meaning **life** and **"chemistry"**.

Biochemistry is defined as the **branch of science that deals with the study of chemical reactions** which take place inside the living organism.

### BIOCHEMISTRY INVOLVES THE STUDY OF

- 1 **Chemical constituents** of living matter.
- 2 Chemical changes which occur in the organism during **digestion, absorption and excretion**.
- 3 Chemical changes which occur during **growth and multiplication** of the organism.
- 4 **Transformation** of one form of chemical constituent to the other.
- 5 **Energy changes** involved in such transformation.



## Scope & Importance of Biochemistry

Biochemistry deals with the **chemical nature, structure and functions** of biomolecules.

Carbohydrates

Proteins

Lipids

Nucleic acids

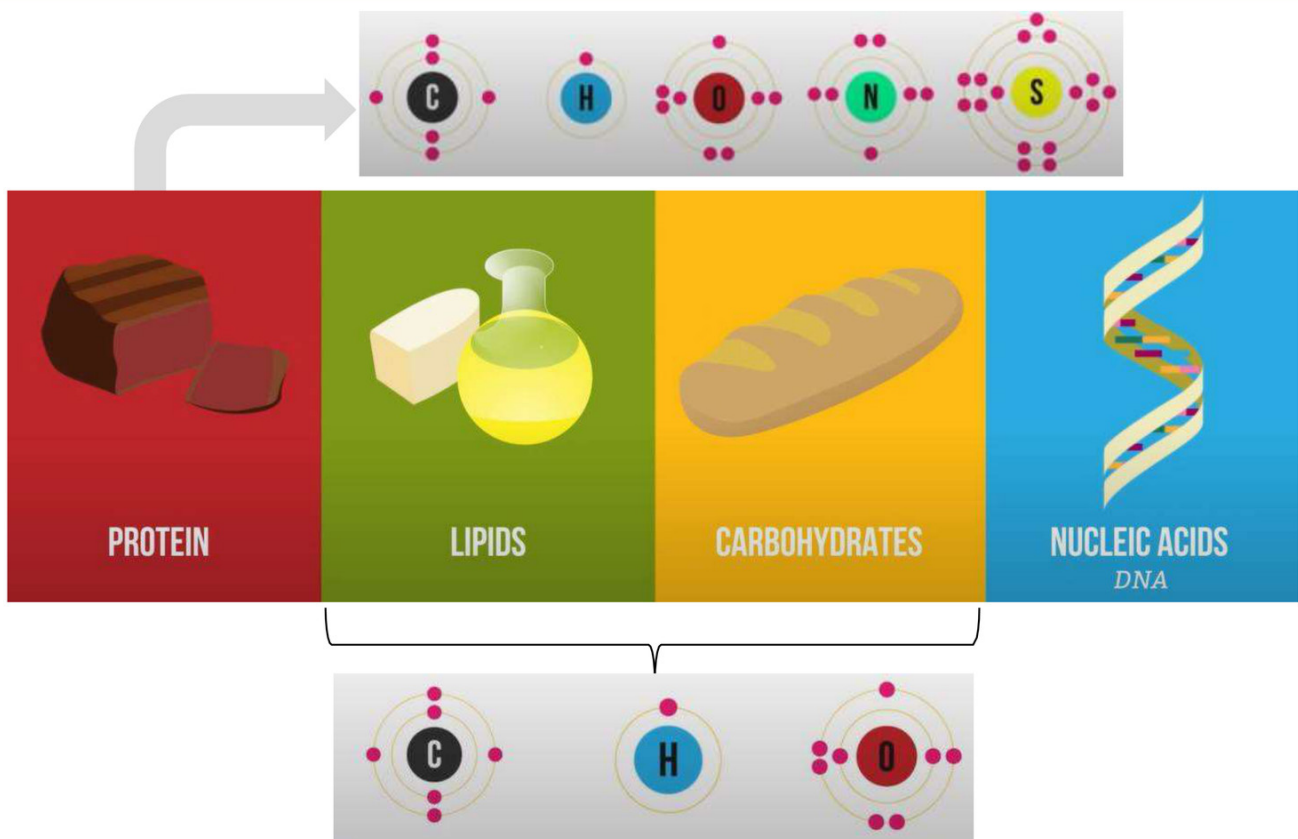
etc.

- 1 Biochemical studies have revealed the **dynamic changes** which occur in these biomolecules.
- 2 The metabolism of these biomolecules is **remarkably the same** in almost all organisms.
- 3 Biochemistry has revealed the **abnormalities** in their metabolism and their relationship to various diseases.
- 4 It has helped to **correct these disorders** with dietary modifications or genetic manipulations.
- 5 Estimations of enzymes and other biomolecules help in the **diagnosis, prognosis, treatment and preventive measures** of various diseases.



## Biomolecules

The **four major classes** of biomolecules.



**Protein**

**Lipids**

**Carbohydrates**

**Nucleic acids**



## Nutritional Biochemistry

The field that studies the effects of certain **foods, minerals, proteins, carbohydrates, fats and vitamins** — when consumed in **excess or in deficient quantities** — on the human body.



## Metabolism

- The term **metabolism** describes the set of biochemical reactions occurring within a living organism.
- In humans these reactions allow **energy extraction from food** and **synthesis of molecules** required to sustain life.
- Metabolism itself is the **integration of anabolic and catabolic** processes.
- The balance between the two reflects the **energy status** of a cell or organism.

Building

+

Breaking

→

Metabolism

Life sustaining chemicals



## Catabolism & Anabolism

### Catabolism

The part of metabolism that involves the **break down of large, complex molecules** into smaller, more simplified products.

#### THIS OCCURS DURING

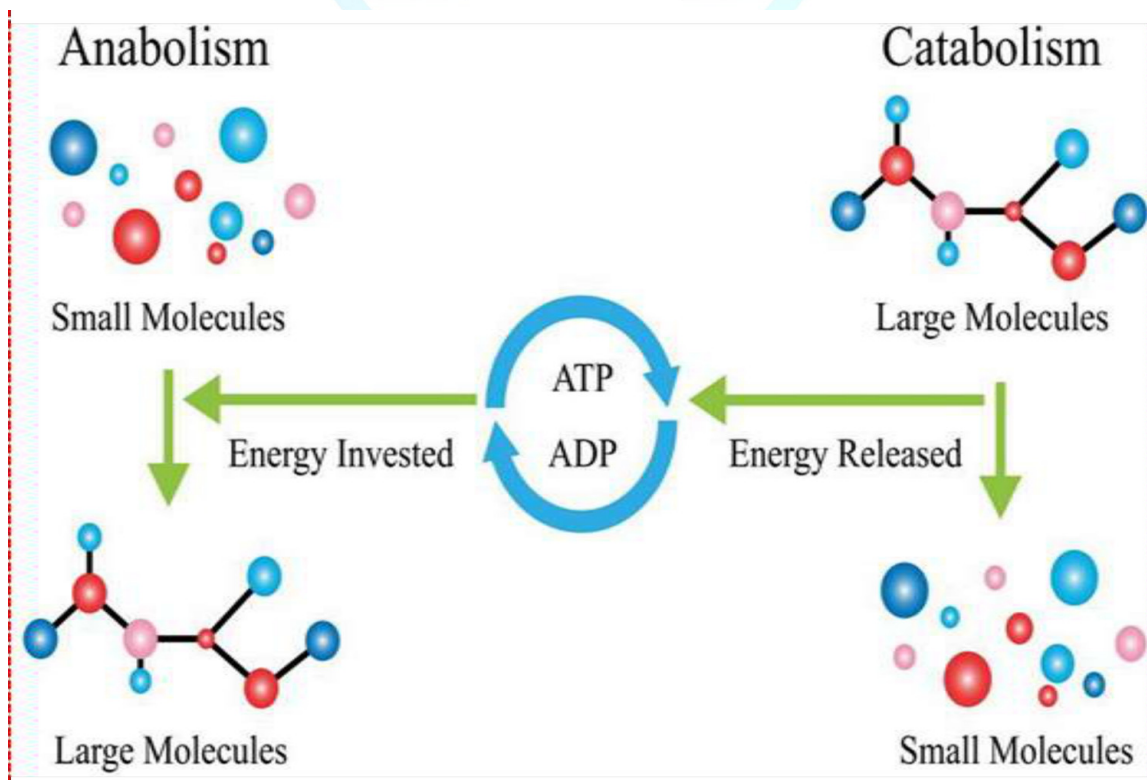
- Digestion
- Removal of hydrogen (dehydrogenation)
- Removal of carboxyl groups (decarboxylation)
- Removal of amino groups (deamination)
- Oxidation, etc.

### Anabolism

The part of metabolism that involves the **synthesis of larger, more complex molecules** from small, simple reactants.

#### EXAMPLES

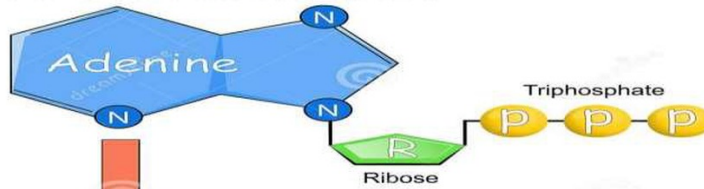
- Synthesis of **glycogen** from glucose
- **Protein** from amino acids
- **Fat** from glycerol and fatty acids



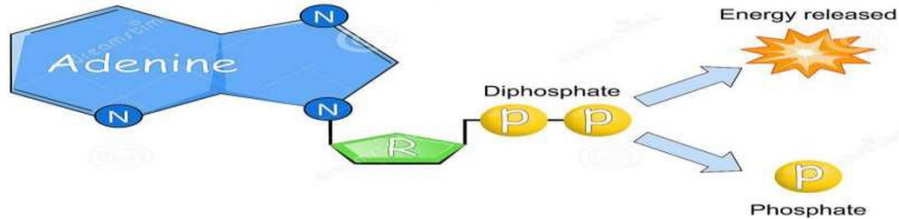


## ADP vs. ATP

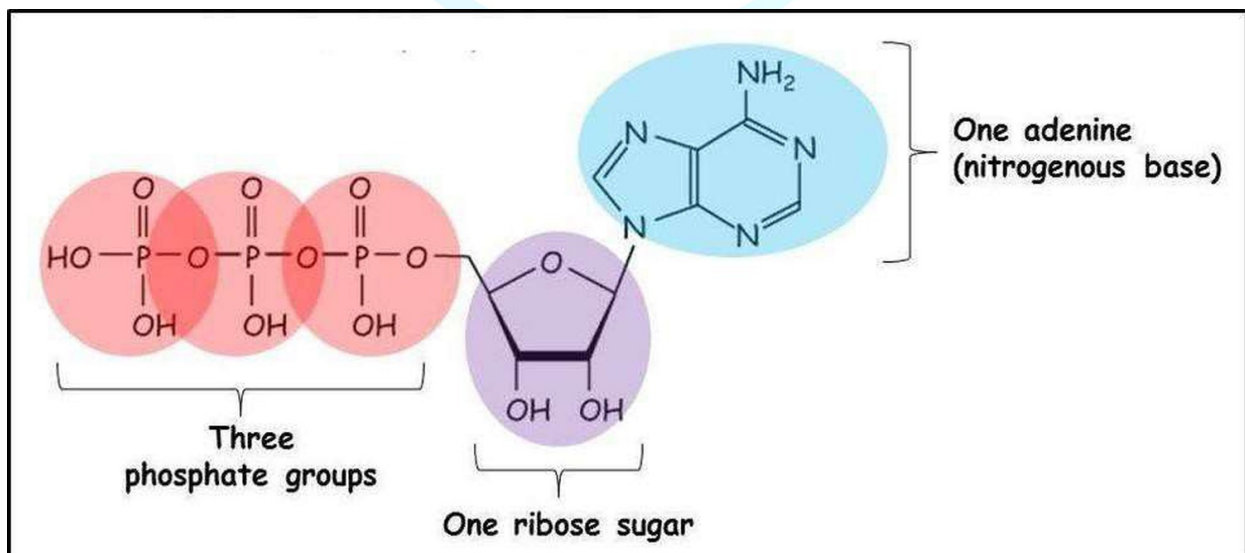
ATP (Adenosine triphosphate)



ADP (Adenosine diphosphate)



## ATP Structure



One adenine (nitrogenous base)

One ribose sugar

Three phosphate groups



## Metabolism and Body Heat Gain

Heat is one **form of energy**, measured in **calories**.

1 calorie (cal) = energy needed to raise 1 g of water 1°C

Heat is **produced (gained) from catabolism**.

### Metabolic rate

The **rate of heat production**.

### Basal metabolic rate (BMR)

Heat produced from catabolism when **resting and fasting**.

**BMR for an adult: 1200–1800 Cal/day**



## Enzymes

Enzymes **are proteins** that catalyze metabolic reactions.

Catalysts

Proteins

'-ase'

# Enzymes

chemical reactions of metabolism



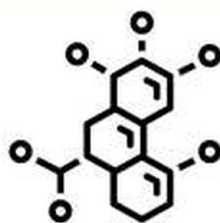
metabolic pathways



one chemical is transformed through a series of steps into another chemical



each step often being facilitated by a specific **enzyme**



### Enzymes:

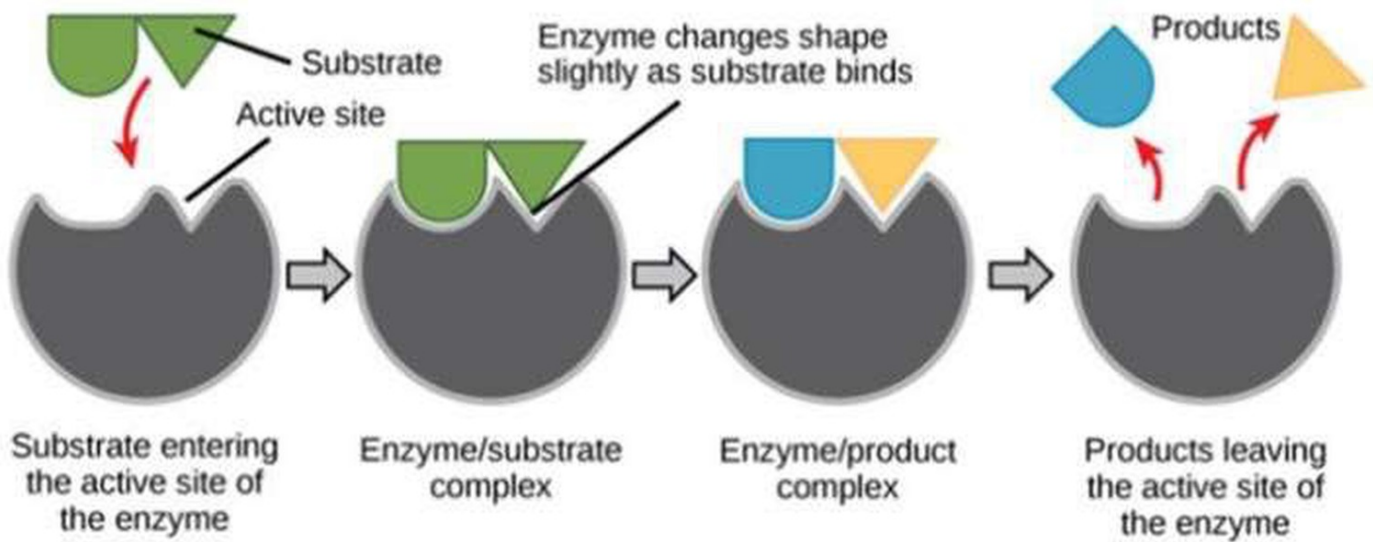
- Catalysts
- Proteins
- '-ase'



## Lock & Key Model



## Induced Fit Model



Substrate entering the active site



Enzyme/substrate complex



Enzyme/product complex



Products leaving the active site

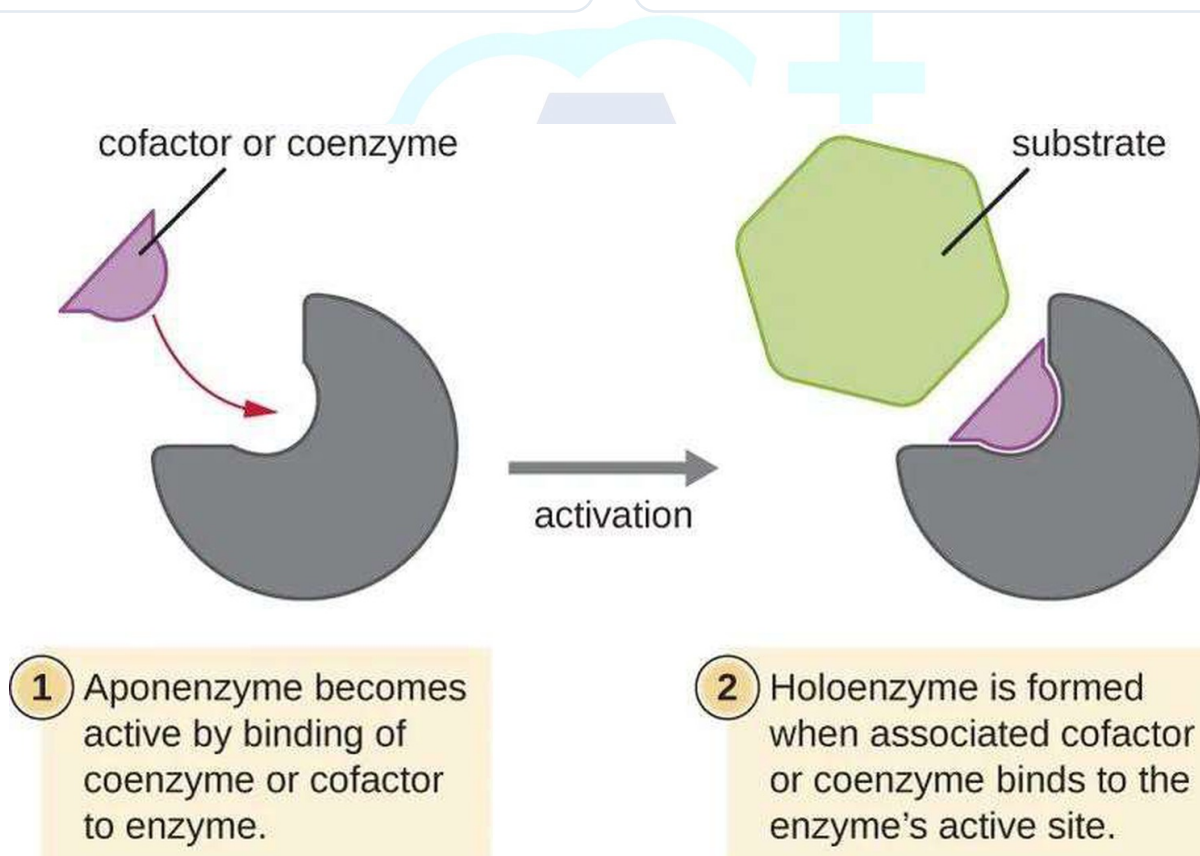


## Cofactors & Coenzymes

A substance that **enhances the action of an enzyme.**

Coenzymes are **small molecules.**

They **cannot by themselves** catalyze a reaction, but they help enzymes to do so.



### 1. Apoenzyme

Becomes active by binding of coenzyme or cofactor to enzyme

### 2. Holoenzyme

Is formed when the associated cofactor or coenzyme binds to the enzyme's active site



## The Major Coenzymes

### COENZYME

### SOURCE

**CoA**

Coenzyme A

**Pantothenic acid****FAD**

Flavin adenine dinucleotide

**Vit. B2****FMN**

Flavin mononucleotide

**Vit. B2****NAD**

Nicotinamide adenine dinucleotide

**Niacin****NADPH**

Nicotinamide adenine dinucleotide phosphate

**Niacin****PLP**

Pyridoxal phosphate

**Vit. B6**



## To Summarise...

## TERM

## bios

## Where the word comes from

- "Bios" meaning life, plus chemistry
- The study of chemical reactions in living organisms
- Biology = scientific study of living organisms

## CLASSES

4

## Major biomolecules

- Protein and lipids
- Carbohydrates and nucleic acids
- Built mainly from C, H and O

## METABOLISM

2

## Integrated processes

- Catabolism — breaks large into small
- Anabolism — builds small into large
- Their balance reflects the energy status

## ENERGY

ATP

## The energy carrier

- Catabolism releases energy; anabolism invests it
- ATP = adenine + ribose + three phosphates
- Losing a phosphate gives ADP and releases energy

## HEAT

1200–1800

## Adult BMR (Cal/day)

- Heat is produced from catabolism
- Rate of production = metabolic rate
- BMR is measured resting and fasting

## ENZYMES

2

## Models of enzyme action

- Lock & key — substrate fits the active site
- Induced fit — the enzyme changes shape
- Cofactors and coenzymes help them work

## THE THREAD THROUGH THE LECTURE

Biochemistry is the study of **chemical reactions inside living organisms** — and every one of those reactions is run by an **enzyme** and paid for in **ATP**.