Energy and Metabolism

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Outline

- Introduction to Energy
- Types of Energy in Living Organisms
- What is Adenosine Triphosphate
- Role of ATP
- Metabolism
- Metabolic Pathways

Objectives

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

1. Define energy and metabolism and explain their importance in living organisms.

2. Differentiate between anabolism and catabolism with suitable biological examples.

3. Identify the different forms of energy used by living organisms.

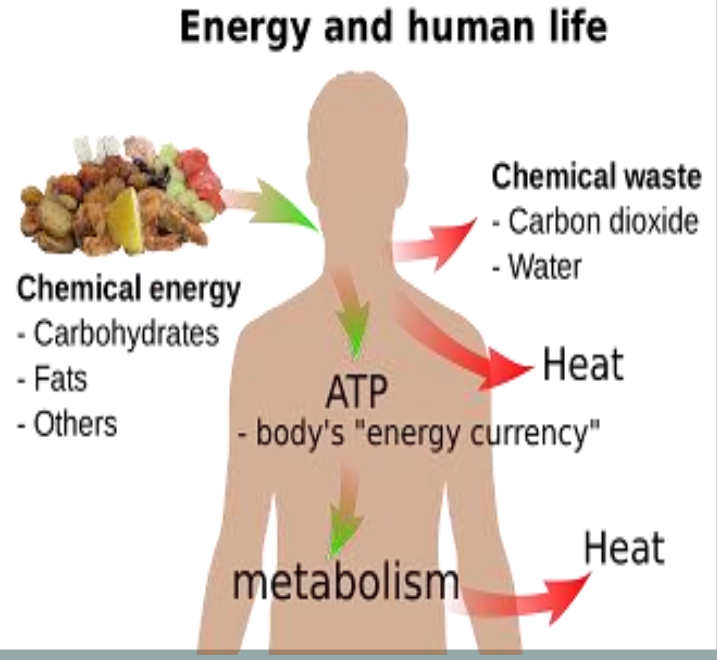
4. Explain the role of ATP.

❖ Introduction to Energy in Biological Systems

➢**Definition of Energy:** Is the **capacity to do work** and bring about change.

➢**Energy is required for:**

- Muscle contraction
- Active transport across membranes
- Synthesis of proteins, lipids, and nucleic acids
- Cell division and growth
- Maintenance of body temperature



❑ Types of Energy in Living Organisms:

1) Chemical energy:– Stored in glucose, fats, and ATP.

2) Mechanical energy:– Movement of muscle.

3) Electrical energy:– Neurons transmit signals.

4) Thermal energy:– Heat produced during metabolism.

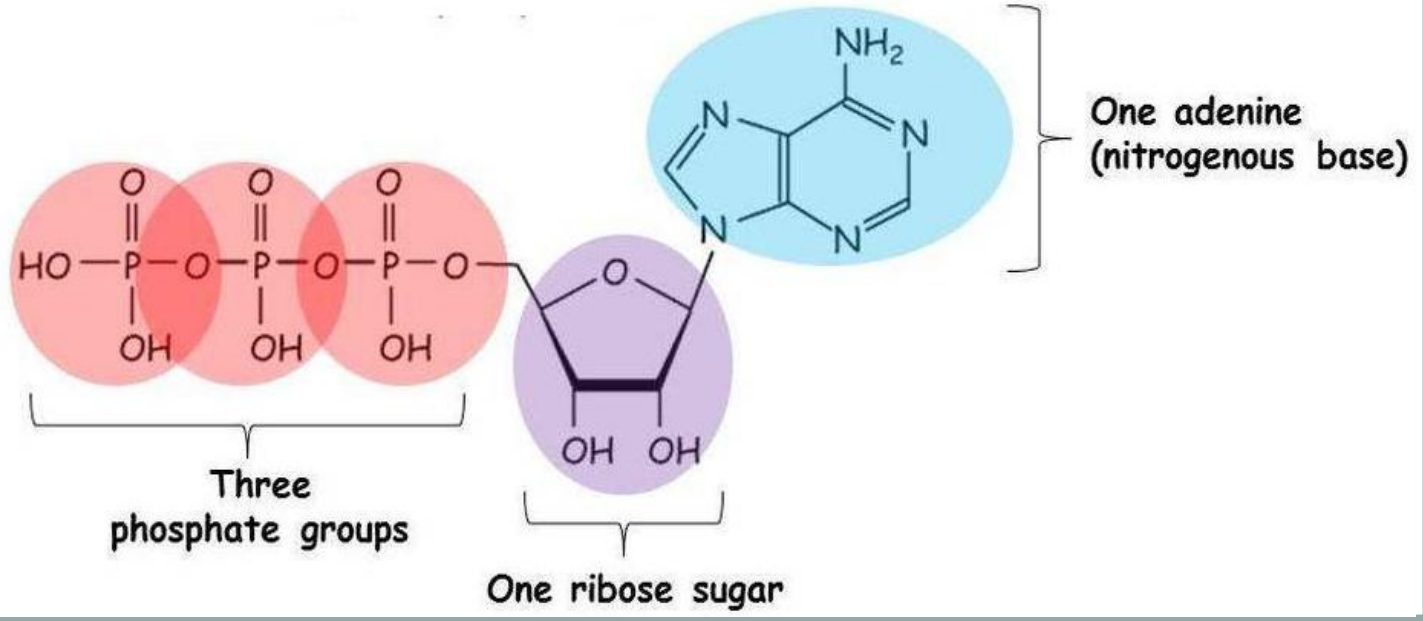
❖ Adenosine Triphosphate (ATP)?

➢ What is ATP?

- Is the immediate and usable form of energy in cells.

➢ Structure of ATP:

- ✓ Adenine
- ✓ Ribose sugar
- ✓ Three phosphate groups



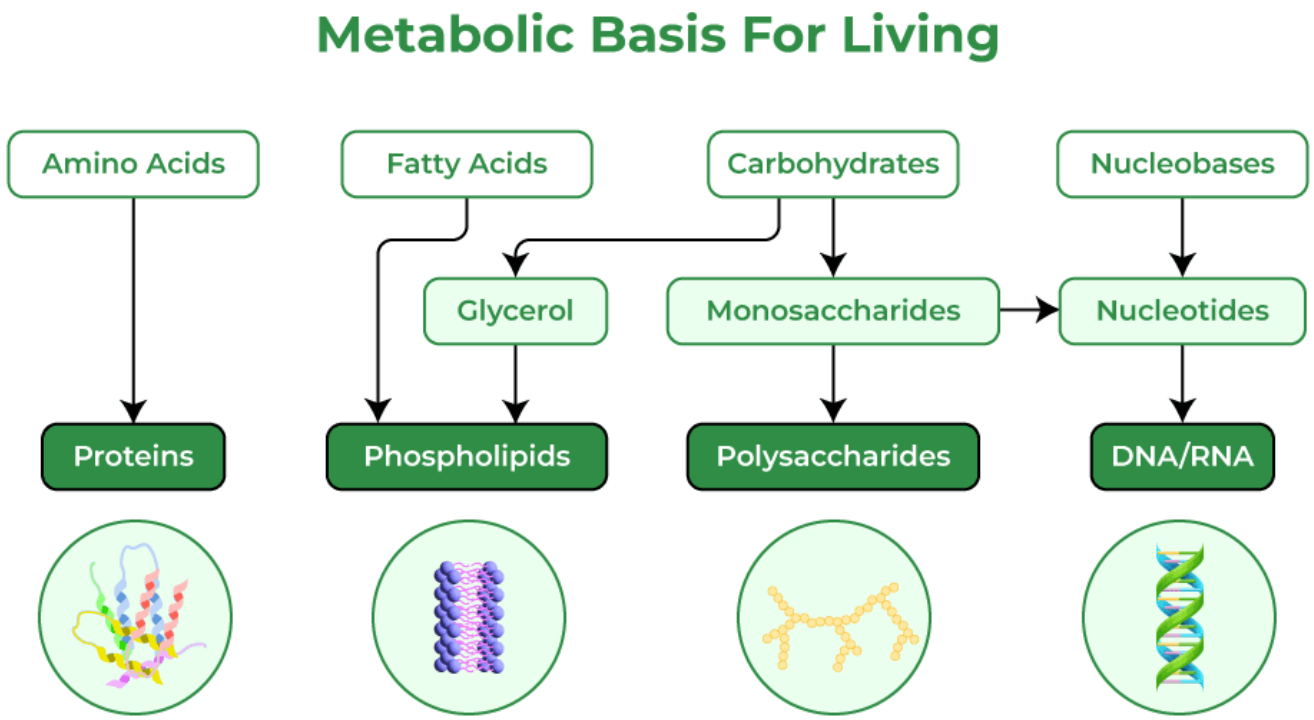
❖ Role of ATP:

1. Energy Supply for Cellular Work.
2. Active Transport of Substances.
3. Drives Biosynthetic (Anabolic) Reactions.

- Main Point: Without ATP, cells cannot function.

❖ Metabolism:

- **Definition:** Metabolism is the **sum of all chemical reactions** that occur in a **living cell** or organism to **maintain life**.

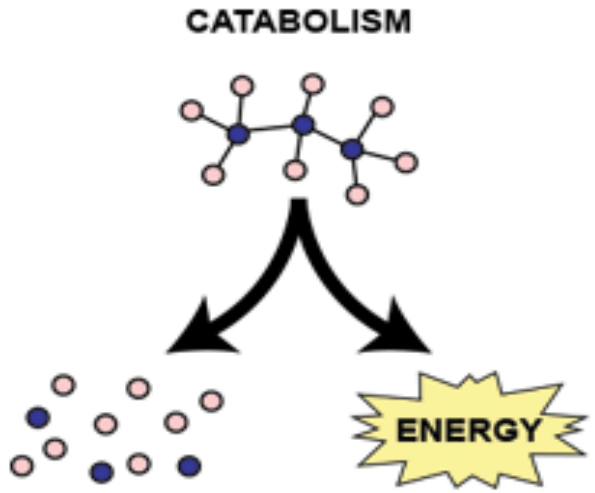


❖ Types of Metabolism:

1. Catabolism: Breakdown of complex molecules into simpler ones, to releases energy.

- Examples:

1. Breakdown of glucose during cellular respiration
2. Digestion of proteins into amino acids
3. Breakdown of fats into fatty acids and glycerol

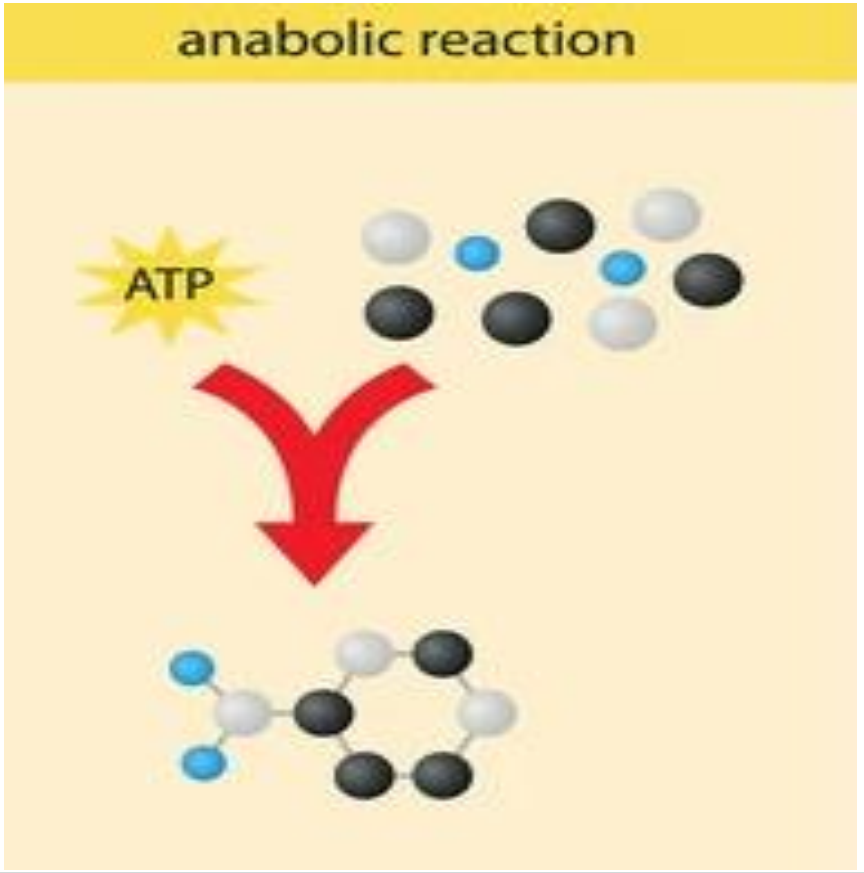


2. Anabolism:

- Building of complex molecules from simpler ones which requires energy (ATP).

➢ Examples:

- Protein synthesis from amino acids
- Glycogen formation from glucose
- DNA synthesis during cell division.



Difference Between Catabolism and Anabolism:

Feature	Catabolism	Anabolism
Process	Breakdown	Synthesis
Energy	Releases energy	Uses energy
Example	Respiration	Protein synthesis

➢ Metabolic Pathways:

- A metabolic pathway is a series of enzyme-controlled reactions where each step is regulated.

➢ Examples of Metabolic Pathways:

- **Glycolysis:** Glucose → Pyruvate
- **Krebs cycle:** Further breakdown of pyruvate
- **Electron transport chain:** ATP production

❖ Role of Enzymes in Metabolism

➢Enzymes are biological catalysts that:

I. Lower activation energy.

II. Speed up metabolic reactions.

III. Highly specific to substrates.

- Without enzymes, metabolic reactions would be too slow to sustain life.

➢Energy Production in Cells:

- Cellular Respiration: The process by which cells convert chemical energy stored in glucose into usable energy (ATP).

➢ Occurs mainly in the mitochondria

➢ Converts glucose into ATP

➢Glucose + Oxygen ⟶ Carbon dioxide + Water + Energy (ATP)

- **Includes:**

1. Glycolysis 2. Krebs cycle 3. Oxidative phosphorylation

❖Importance of Energy and Metabolism

➢Understanding energy and metabolism helps medical analysis students to:

I. Interpret blood glucose tests.

II. Understand enzyme-based diagnostic assays.

III. Analyze metabolic diseases.

IV. Correlate lab findings with physiological conditions

References

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Thanks