Topic: Functions of the Cell II

Subtopics:

1. **Cellular Respiration – Aerobic, Anaerobic, and Energy Release**
2. **Anabolism and Usefulness of Food**

Class: SS1

Term: First Term

Duration: 40 Minutes

Lesson Objectives:

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

1. Define **cellular respiration** and explain how **energy is released**.
2. Differentiate between **aerobic and anaerobic respiration**.
3. Define **anabolism** and explain how the body uses food for **growth and repair**.
4. Relate **cellular respiration** to daily life activities.

Introduction:

All living things need **energy** to survive.
Cells require energy for:

- Movement
- Growth
- Repair of damaged parts
- Reproduction
- Active transport (moving substances across membranes)

The process by which cells **release energy from food** is called **cellular respiration**.
Cells also use the nutrients from food to **build and repair** body tissues, which is called **anabolism**.

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1. Cellular Respiration

Definition:

Cellular respiration is the **process by which food substances (mainly glucose)** are **broken down** to release **energy** in the form of **ATP (Adenosine Triphosphate)**, which the cell uses to carry out life processes.

Purpose of Cellular Respiration:

- To provide **energy for cellular activities**
- To help organisms maintain life by supporting **metabolism**

The Food Used in Respiration:

- The main food used is **glucose ($C_6H_{12}O_6$)**, a simple sugar.
- Glucose is obtained from **digested food** in animals and **photosynthesis** in plants.

Types of Respiration:

A. Aerobic Respiration

Definition:

Aerobic respiration is the **breakdown of glucose in the presence of oxygen** to release energy.

Process:

- Oxygen is **inhaled** and transported to the cells.
- In the mitochondria of the cell, glucose is combined with oxygen.
- The glucose is **completely broken down** into **carbon dioxide and water**.
- **A large amount of energy (38 ATP molecules)** is produced.

Word Equation:

Glucose+Oxygen→Carbon dioxide+Water+Energy (ATP)\text{Glucose} + \text{Oxygen} \rightarrow \text{Carbon dioxide} + \text{Water} + \text{Energy (ATP)}Glucose+Oxygen→Carbon dioxide+Water+Energy (ATP)

Chemical Equation:

C6H12O6+6O2→6CO2+6H2O+Energy (ATP)C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy (ATP)}C6H12O6+6O2→6CO2+6H2O+Energy (ATP)

Examples of Aerobic Respiration:

- Humans breathing and using oxygen for energy
- Plants using oxygen at night for respiration
- All vertebrates and most invertebrates

B. Anaerobic Respiration

Definition:

Anaerobic respiration is the **breakdown of glucose without oxygen** to release energy.

Process:

- Oxygen is **not available**
- Glucose is **partially broken down**
- Produces **little energy (2 ATP molecules)**
- Produces **by-products like alcohol, carbon dioxide, or lactic acid**

Word Equations:

In yeast (Alcoholic fermentation):

Glucose→Alcohol (Ethanol)+Carbon dioxide+Energy\text{Glucose} \rightarrow \text{Alcohol (Ethanol)} + \text{Carbon dioxide} + \text{Energy}Glucose→Alcohol (Ethanol)+Carbon dioxide+Energy

In human muscle cells (Lactic acid fermentation):

Glucose→Lactic acid+Energy\text{Glucose} \rightarrow \text{Lactic acid} + \text{Energy}Glucose→Lactic acid+Energy

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Examples of Anaerobic Respiration:

Organism/Process	**By-product**
Yeast	Alcohol (Ethanol) + Carbon dioxide
Muscle cells during heavy exercise	Lactic acid

Why Do Muscles Use Anaerobic Respiration?

- During **intense exercise** (e.g., running), muscles may not get enough oxygen.
- They temporarily switch to **anaerobic respiration** to continue producing energy.
- **Lactic acid builds up**, causing **muscle cramps and fatigue**.

Comparison of Aerobic and Anaerobic Respiration:

Feature	**Aerobic Respiration**	**Anaerobic Respiration**
Oxygen needed?	Yes	No
Energy produced	High (38 ATP)	Low (2 ATP)
By-products	CO_2 and Water	Alcohol, CO_2 (yeast) / Lactic acid (humans)
Efficiency	More efficient	Less efficient
Occurs in	Most plants and animals	Yeast, muscle cells (during exercise), some bacteria

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Importance of Respiration:

- Provides **energy** for life activities
- Helps in **growth and repair**

- Supports **movement, reproduction, and active transport**
- Maintains **body temperature** (in warm-blooded animals)

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2. Anabolism and Usefulness of Food

Definition of Anabolism:

Anabolism is the **building up of complex molecules from simpler ones** using energy from respiration.
It is the **constructive phase of metabolism**.

Examples of Anabolic Processes:

Process	Description
Protein synthesis	Amino acids are joined to form proteins needed for growth and repair
Fat synthesis	Extra glucose is converted to fat for storage
Formation of glycogen	Glucose is stored in the liver and muscles as glycogen
Photosynthesis	Plants build glucose from carbon dioxide and water

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Usefulness of Food to the Body:

Food is used for:

Purpose	Explanation
Energy	For work, movement, and body activities
Growth	Building new cells and tissues
Repair	Replacing worn-out or damaged parts
Maintenance	Keeping the body systems functioning properly
Storage	Storing energy as fats or glycogen for future use

Summary of Metabolism:

Process	Meaning
Anabolism	Building complex substances from simple ones
Catabolism	Breaking down complex substances to release energy (e.g., respiration)

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3. Importance of Anabolism:

- **Growth and development** of the body
- **Repair of tissues and cells**
- **Storage of excess food** for future energy needs
- Helps plants and animals to **build vital structures**

Conclusion:

The **cell performs respiration** to release **energy from food**, which is used for:

- **Work and movement**
- **Growth and repair (anabolism)**
- **Storage of extra nutrients**

Both **aerobic and anaerobic respiration** are essential for life, but **aerobic respiration is more efficient** because it produces more energy.