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REMEDIAL BIOLOGY

UNIT 5

TOPIC :

- **Plant respiration :** Respiration, glycolysis, fermentation (anaerobic).

RESPIRATION

- Respiration is a biochemical process in which energy is released by the oxidation of organic molecules, primarily glucose, within cells. This energy is then stored in the form of ATP (Adenosine Triphosphate), which is used to power various cellular functions.
- Respiration is an oxidation-reduction (redox) process. It is different from simple combustion and distinct from breathing, although often confused with them. It occurs in living cells in a controlled manner without generating harmful heat or flames.

Respiration is of two types

→ Respiration in which free oxygen is utilized is known as aerobic respiration.

→ While the respiration in absence of free oxygen is called anaerobic respiration.

- Amount of energy released in case of aerobic respiration is much more as compared to anaerobic respiration.
- Respiration is a vital process that enables living cells to extract energy from food. Aerobic respiration is more efficient and preferred when oxygen is available, while anaerobic respiration helps organisms survive in oxygen-deficient environments but yields less energy.

AEROBIC RESPIRATION

- Aerobic respiration is a biological process by which glucose is completely oxidized in the presence of oxygen, releasing carbon dioxide, water, and large amounts of energy (ATP). It occurs in most plants, animals, and aerobic microorganisms.

This consists of three steps namely:

- Glycolysis or EMP pathway
- Kreb's cycle or TCA cycle and
- Electron transfer and terminal oxidation.

(a) Glycolysis : It is the first step in the respiration process taking place in the cytoplasm in presence or absence of oxygen, wherein glucose molecule breaks down into two molecules of pyruvic acid. The breakdown takes at body temperature and is aided by number of enzymes and co-enzymes.

(b) Kreb's cycle : This takes place in presence of oxygen in mitochondria of cells wherein pyruvic acid is degraded further to form carbon-dioxide, water and energy. The complete oxidation of glucose is represented as follows:

Glucose oxygen CHO+ 602 Carbon-dioxide + Water 6 CO_2 + 6 H_2O Energy 673 k cal

In this process, hydrogen is removed from the substrate and electrons released are transferred to generate ATP. The formation of ATP in mitochondria due to oxidation is called oxidative phosphorylation. The energy produced during respiration is incorporated in the form of ATP. In ATP it is stored in high energy phosphate bond which after breaking releases large amount of energy.

Kreb's cycle Diagram

(c) Electron transfer and terminal oxidation.

- Electron transfer and terminal oxidation refer to the final stage of aerobic respiration, where high-energy electrons carried by NADH and $FADH_2$ (produced during glycolysis and Krebs cycle) are transferred through a chain of proteins located in the inner mitochondrial membrane. This transfer leads to the production of ATP and water.

ANAEROBIC RESPIRATION (FERMENTATION)

→ Anaerobic respiration is a type of cellular respiration that occurs in the absence of oxygen. It is mainly observed in microorganisms like yeast, certain bacteria, and some plant tissues, as well as animal muscle cells under oxygen-deficient conditions.

→ It results in the incomplete breakdown of glucose and produces much less energy than aerobic respiration.

Types of Anaerobic Respiration

Type	End Products	Occurs In
Alcoholic Fermentation	Ethanol + CO_2 + ATP	Yeast, some plant tissues
Lactic Acid Fermentation	Lactic Acid + ATP	Animal muscle cells, some bacteria

Steps of Anaerobic Respiration

1. **Glycolysis**
   - Occurs in cytoplasm
   - Glucose is broken into **2 molecules of pyruvic acid**
   - Generates **2 ATP** and **2 NADH**
2. **Fermentation Step**
   - **In absence of O_2**, pyruvic acid is **not sent to mitochondria**.
   - Instead, it's **converted into either ethanol + CO_2 (in yeast)** or **lactic acid (in muscles)**.
   - NADH is oxidized back to NAD^+ so glycolysis can continue.