Chapter 6: Respiration in Plants

Introduction:

Respiration in plants is a process by which plants break down organic molecules (like glucose) to release energy. It occurs in all living plant cells and is essential for growth and metabolic activities.

Outline of the Process:

Respiration can be classified into two types:

1. **Aerobic Respiration:** Occurs in the presence of oxygen.
2. **Anaerobic Respiration:** Occurs in the absence of oxygen.

Aerobic Respiration:

- Takes place in the **mitochondria**.
- **Steps:**
    1. **Glycolysis:**
        - Occurs in the cytoplasm.
        - Glucose (6C) breaks into two molecules of pyruvate (3C).
        - Produces 2 ATP and NADH.
    2. **Krebs Cycle (Citric Acid Cycle):**
        - Occurs in the mitochondrial matrix.
        - Pyruvate is converted into Acetyl CoA, which enters the cycle.
        - Produces CO_2, NADH, $FADH_2$, and ATP.
    3. **Electron Transport Chain (ETC):**
        - Occurs on the inner mitochondrial membrane.
        - Uses NADH and $FADH_2$ to produce ATP.
        - **End Products:** CO_2, water, and 36-38 ATP per glucose molecule.

Chemical Equation:

$C_6H_{12}O_6+6O_2 \rightarrow 6CO_2+6H_2O+36-38ATP$

Significance:

- Produces a large amount of energy.
- Helps in various physiological processes.

Anaerobic Respiration:

- Occurs in the **cytoplasm**.
- In the absence of oxygen, pyruvate is converted into ethanol (in yeast) or lactic acid (in muscles).
- Produces only **2 ATP** per glucose molecule.

Chemical Equations:

1. **Lactic Acid Fermentation (in muscles):**

$$C_6H_{12}O_6 \rightarrow 2C_3H_6O_3 + 2ATP$$

2. **Alcoholic Fermentation (in yeast):**

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 + 2ATP$$

Significance:

- Quick energy release.
- Used in industries (brewing, baking).

Gaseous Exchange in Plants:

- Occurs mainly through **stomata (leaves)**, **lenticels (stems)**, and **root hairs (roots)**.
- Plants take in oxygen and release carbon dioxide during respiration.
- During the day, photosynthesis masks respiration, but at night, only respiration occurs.

Experiments:

1. **Demonstrating Oxygen Uptake:**
    - Use germinating seeds in a closed container with KOH to absorb CO_2.
    - Observe the reduction in air volume, indicating oxygen uptake.
2. **Heat Production during Respiration:**
    - Place germinating seeds in a thermos flask.
    - Observe a rise in temperature due to metabolic activity.

Key Differences: Aerobic vs. Anaerobic Respiration

Feature	Aerobic Respiration	Anaerobic Respiration
Oxygen Requirement	Present	Absent
Location	Mitochondria	Cytoplasm
End Products	CO_2, H_2O, and ATP	Ethanol/CO_2 (yeast) or Lactic Acid (muscle)
Energy Yield	36-38 ATP per glucose	2 ATP per glucose

Conclusion:

Respiration in plants is a crucial process for energy production. While aerobic respiration is more energy-efficient, anaerobic respiration provides a quick energy supply under anaerobic conditions. Understanding these processes helps explain how plants maintain their metabolic activities.