Respiration in Plants Class 11 Biology: Complete Summary, Notes, MCQs & Important Questions

Meta Description

Learn Respiration in Plants Class 11 Biology with clear notes, detailed summary, flowcharts, important questions, MCQs, and exam tips. Perfect for CBSE exams, NEET preparation, and quick revision.

Introduction of the Chapter

Respiration in Plants is a vital physiological process through which plants release energy stored in food molecules. This energy is required for growth, repair, transport of nutrients, and other metabolic activities.

Unlike photosynthesis, respiration occurs continuously, day and night. In this process, carbohydrates such as glucose are broken down in the presence or absence of oxygen to release energy in the form of ATP (Adenosine Triphosphate).

Understanding Respiration in Plants Class 11 helps students learn how cells generate energy and how plants maintain life processes.

Short Notes

Respiration is the process of breaking down food to release energy.

Energy released is stored in ATP molecules.

Occurs in all living cells.

Takes place both in presence (aerobic) and absence (anaerobic) of oxygen.

Major stages: Glycolysis, Krebs Cycle, Electron Transport System (ETS).

Glycolysis occurs in cytoplasm.

Krebs cycle occurs in mitochondrial matrix.

ETS occurs in inner mitochondrial membrane.

End products: CO_2, water, and ATP.

Anaerobic respiration produces ethanol (yeast) or lactic acid.

Detailed Summary (Respiration in Plants)

Respiration in Plants is a biochemical process through which cells oxidize food substances to release energy. This energy is used for various physiological activities including cell division, absorption of minerals, transport, and biosynthesis.

What is Respiration?

Respiration is the oxidation of food substances within cells to release energy. The energy released is stored in ATP and used by cells for metabolic activities.

General Equation:

Glucose + Oxygen → Carbon dioxide + Water + Energy (ATP)

Types of Respiration

1. Aerobic Respiration

Occurs in presence of oxygen.

Complete oxidation of glucose.

End products: CO_2, water, ATP.

Occurs in mitochondria.

Produces ~36–38 ATP molecules.

2. Anaerobic Respiration

Occurs without oxygen.

Partial breakdown of glucose.

End products:

Ethanol + CO_2 (yeast)

Lactic acid (muscle cells)

Produces only 2 ATP.

Respiratory Quotient (RQ)

RQ = CO_2 released / O_2 consumed

Carbohydrates → RQ = 1

Fats → RQ < 1

Organic acids → RQ > 1

RQ helps identify the type of respiratory substrate.

Steps of Respiration

1. Glycolysis (EMP Pathway)

Occurs in cytoplasm.

Glucose (6C) → 2 Pyruvate (3C).

Net gain: 2 ATP + 2 NADH.

Does not require oxygen

2. Oxidative Decarboxylation of Pyruvate

Pyruvate enters mitochondria.

Converted into Acetyl CoA.

CO_2 released and NADH formed.

3. Krebs Cycle (Citric Acid Cycle)

Occurs in mitochondrial matrix.

Acetyl CoA completely oxidized.

Produces CO_2, NADH, $FADH_2$, ATP.

4. Electron Transport System (ETS)

Occurs in inner mitochondrial membrane.

Electrons transferred through carriers.

Proton gradient formed

ATP produced via oxidative phosphorylation.

Oxygen acts as final electron acceptor.

Energy Yield in Respiration

Stage ATP Produced

Glycolysis 2

Krebs Cycle 2

ETS 32–34

Total 36–38 ATP

Amphibolic Pathway

Respiration acts as both catabolic and anabolic pathway.

Breakdown of carbohydrates → energy

Intermediates used for synthesis of amino acids & fats

Hence called amphibolic pathway

Respiratory Balance Sheet

Complete oxidation of 1 glucose molecule releases large energy

Efficient ATP production occurs in aerobic respiration.

Factors Affecting Respiration

Oxygen availability

Temperature

Water content

Substrate availablity

Significance of Respiration in Plants

Provides energy for growth.

Helps in active transport.

Supports biosynthesis.

Maintains cellular activities.

Flowchart / Mind Map (Text-Based)

Respiration in Plants

→ Glycolysis (Cytoplasm)

→ Pyruvate Formation

→ If Oxygen Present → Aerobic Respiration

- → Acetyl CoA Formation
- → Krebs Cycle
- → ETS → ATP (36–38)

→ If Oxygen Absent → Anaerobic Respiration

- → Ethanol + CO_2 / Lactic Acid
- → 2 ATP

Important Keywords with Meanings

Respiration – Breakdown of food to release energy

ATP – Energy currency of cell

Glycolysis – Breakdown of glucose into pyruvate

Krebs Cycle – Oxidation of acetyl CoA in mitochondria

ETS – Electron transport system producing ATP

Aerobic Respiration – Respiration using oxygen

Anaerobic Respiration – Respiration without oxygen

RQ – Respiratory quotient

Amphibolic Pathway – Pathway involved in both breakdown and synthesis

Oxidative Phosphorylation – ATP formation using electron transfer

Important Questions & Answers

Short Answer Questions

1. What is respiration?

Respiration is the oxidation of food to release energy in the form of ATP.

2. Where does glycolysis occur?

In the cytoplasm.

3. Define ATP.

ATP is the energy currency of the cell.

4. What is RQ?

It is the ratio of CO_2 evolved to O_2 consumed.

5. Name the end product of glycolysis.

Pyruvate.

6. Where does Krebs cycle occur?

In mitochondrial matrix.

7. What is anaerobic respiration?

Breakdown of glucose without oxygen.

8. What is ETS?

Electron transport system producing ATP.

9. Why is respiration called amphibolic?

Because it involves both catabolism and anabolism.

10. What is the final electron acceptor in aerobic respiration?

Oxygen.

Long Answer Questions

1. Explain the process of glycolysis.

Glycolysis is the first stage of respiration occurring in cytoplasm. One glucose molecule splits into two molecules of pyruvate. It produces 2 ATP and 2 NADH. It does not require oxygen and is common to both aerobic and anaerobic respiration.

2. Describe aerobic respiration.

Aerobic respiration occurs in presence of oxygen. Glucose is completely oxidized into CO_2 and water. It includes glycolysis, Krebs cycle, and ETS. It yields about 36–38 ATP molecules.

3. Explain Krebs cycle.

Krebs cycle occurs in mitochondrial matrix. Acetyl CoA combines with oxaloacetic acid to form citric acid. Through a series of reactions CO_2, NADH, $FADH_2$, and ATP are produced.

4. Write differences between aerobic and anaerobic respiration.

Aerobic uses oxygen and produces more ATP; anaerobic occurs without oxygen and produces only 2 ATP.

5. Explain the role of ETS.

ETS transfers electrons through carriers creating proton gradient which drives ATP synthesis.

6. What is respiratory quotient? Explain its significance.

RQ is ratio of CO_2 released to O_2 consumed. It indicates type of respiratory substrate.

7. Explain amphibolic pathway.

Respiration provides intermediates for synthesis and also breaks down substrates for energy.

8. Describe energy yield in respiration.

Total ATP from one glucose is about 36–38 ATP.

9. Explain factors affecting respiration.

Temperature, oxygen availability, substrate supply, and water affect respiration rate.

10. Write significance of respiration in plants.

Provides energy, supports growth, biosynthesis, and transport.

MCQs with Answers

1. Glycolysis occurs in:

A. Nucleus

B. Cytoplasm

C. Mitochondria

D. Ribosome

Answer: B

2. End product of glycolysis is:

A. Glucose

B. Pyruvate

C. Lactate

D. Ethanol

Answer: B

3. Krebs cycle occurs in:

A. Cytoplasm

B. Matrix

C. Ribosome

D. Nucleus

Answer: B

4. ATP stands for:

A. Adenosine Triphosphate

B. Adenine Triphosphate

C. Adenosine Diphosphate

D. None

Answer: A

5. Final electron acceptor is:

A. Hydrogen

B. Oxygen

C. Nitrogen

D. Carbon

Answer: B

6. Anaerobic respiration yields:

A. 38 ATP

B. 36 ATP

C. 2 ATP

D. 10 ATP

Answer: C

7. RQ for carbohydrates is:

A. 1

B. 0.7

C. 2

D. 0.5

Answer: A

8. ETS occurs in:

A. Outer membrane

B. Inner mitochondrial membrane

C. Cytoplasm

D. Matrix

Answer: B

9. Amphibolic pathway means:

A. Only synthesis

B. Only breakdown

C. Both synthesis and breakdown

D. None

Answer: C

10. Pyruvate oxidation occurs in:

A. Cytoplasm

B. Mitochondria

C. Ribosome

D. Chloroplast

Answer: B

11. Oxygen is required in:

A. Glycolysis

B. Krebs cycle

C. ETS

D. Fermentation

Answer: C

12. Lactic acid fermentation occurs in:

A. Plants

B. Yeast

C. Muscles

D. Bacteria

Answer: c

13. Ethanol is produced in:

A. Yeast

B. Humans

C. Plants

D. Animals

Answer: A

14. Energy currency of cell:

A. DNA

B. ATP

C. RNA

D. NAD

Answer: B

15. Complete oxidation occurs in:

A. Anaerobic respiration

B. Aeration

C. Aerobic respiration

D. Ferrous respiration

Answer: C

Exam Tips & Value-Based Questions

Exam Tips

Draw flowchart for steps of respiration.

Remember ATP yield numbers.

Learn differences between aerobic and anaerobic respiration.

Understand RQ values.

Practice diagrams of mitochondria & ETS.

Value-Based Questions

1. Why is respiration essential for plant growth?

Because energy released supports growth and development.

2. Why should farmers avoid waterlogging in soil?

Lack of oxygen reduces root respiration and damages plants.

3. How does temperature affect respiration?

High temperature increases respiration rate.

4. Why do stored grains need aeration?

To prevent anaerobic respiration and spoilage.

5. What happens if respiration stops in plants?

Energy supply stops and plant dies.

Conclusion (Respiration in Plants)

Respiration in Plants is one of the most fundamental biological processes that sustain life. Every living plant cell requires energy to perform essential activities such as growth, repair, nutrient absorption, and synthesis of biomolecules. This energy is derived from the breakdown of food molecules through respiration.

Unlike photosynthesis, which occurs only in green cells and requires sunlight, respiration occurs in all living cells of the plant continuously, both day and night. This ensures a constant supply of energy in the form of ATP, which powers metabolic activities.

The chapter Respiration in Plants Class 11 explains how glucose is oxidized through a series of enzyme-controlled reactions. The process begins with glycolysis in the cytoplasm, where glucose is converted into pyruvate. This stage does not require oxygen and is common to both aerobic and anaerobic respiration.

When oxygen is available, pyruvate enters the mitochondria and is converted into acetyl CoA. It then enters the Krebs cycle, where carbon dioxide is released and high-energy electron carriers such as NADH and $FADH_2$ are produced. These carriers transfer electrons to the Electron Transport System located in the inner mitochondrial membrane. This step generates a proton gradient that drives ATP synthesis through oxidative phosphorylation. Oxygen acts as the final electron acceptor, forming water.

Aerobic respiration produces a large amount of energy (about 36–38 ATP molecules per glucose molecule), making it highly efficient. In contrast, anaerobic respiration occurs in the absence of oxygen and produces only 2 ATP molecules. It results in the formation of ethanol and carbon dioxide in yeast or lactic acid in muscle cells.

The concept of Respiratory Quotient (RQ) helps determine which substrate is being respired. Carbohydrates have an RQ of 1, fats have less than 1, and organic acids have greater than 1. This concept is important for physiological studies and agricultural practices.

Another important concept discussed in Respiration in Plants is the amphibolic nature of respiration. While respiration breaks down complex molecules to release energy (catabolism), its intermediates are also used to synthesize essential compounds like amino acids and fatty acids (anabolism). Thus, respiration supports both energy production and biosynthesis.

Several factors influence respiration rate, including oxygen availability, temperature, water content, and substrate concentration. For example, waterlogged soil reduces oxygen supply to roots, slowing respiration and harming plant growth. Similarly, temperature affects enzyme activity, thereby influencing respiration.

Respiration plays a crucial role in plant survival and productivity. It provides energy for active transport of minerals, cell division, synthesis of proteins, and maintenance of cellular structures. Without respiration, plants would be unable to grow, reproduce, or respond to environmental changes.

From an examination perspective, this chapter is extremely important for CBSE board exams and competitive exams like NEET. Students should focus on understanding the steps of respiration, ATP yield, respiratory quotient, differences between aerobic and anaerobic respiration, and the amphibolic pathway. Flowcharts and diagrams can improve answer presentation and help in scoring higher marks.

In daily life and agriculture, understanding respiration helps improve crop storage, soil aeration, and post-harvest management. Proper storage conditions prevent anaerobic respiration in stored grains, reducing spoilage. Good soil aeration ensures healthy root respiration and better crop yield.

To conclude, Respiration in Plants Class 11 Biology provides essential knowledge about how plants generate and utilize energy. It connects cellular metabolism with plant growth, environmental responses, and agricultural productivity. Mastering this chapter builds a strong foundation for advanced topics in plant physiology and helps students excel in both academic and competitive examinations.-

Assertion-Reason Questions

Instructions:

Read both the statements carefully.

Choose the correct option:

1. Both A and R are true, and R is the correct explanation of A

2. Both A and R are true, but R is not the correct explanation of A

3. A is true, but R is false

4. A is false, but R is true

1.

Assertion (A): Glycolysis occurs in the cytoplasm of the cell.

Reason (R): Glycolysis does not require oxygen and is the first step in both aerobic and anaerobic respiration.

Answer: 1 – Both A and R are true, and R is the correct explanation of A

2

Assertion (A): Aerobic respiration yields more ATP than anaerobic respiration.

Reason (R): Oxygen acts as the final electron acceptor in the Electron Transport System.

Answer: 1 – Both A and R are true, and R is the correct explanation of A

3.

Assertion (A): Anaerobic respiration occurs in mitochondria.

Reason (R): Anaerobic respiration does not require oxygen and occurs in the cytoplasm.

Answer: 4 – A is false, but R is true

4.

Assertion (A): The Krebs cycle occurs in the mitochondrial matrix.

Reason (R): Acetyl CoA combines with oxaloacetic acid to form citric acid in the Krebs cycle.

Answer: 1 – Both A and R are true, and R is the correct explanation of A

5.

Assertion (A): The respiratory quotient (RQ) helps to identify the type of respiratory substrate.

Reason (R): RQ is calculated as the ratio of CO_2 released to O_2 consumed.

Answer: 1 – Both A and R are true, and R is the correct explanation of A

6

Assertion (A): Lactic acid fermentation occurs in yeast cells.

Reason (R): Lactic acid is formed when glucose is broken down anaerobically in muscles.

Answer: 4 – A is false, but R is true

7.

Assertion (A): Electron Transport System (ETS) occurs in the inner mitochondrial membrane.

Reason (R): ETS creates a proton gradient that drives ATP synthesis via oxidative phosphorylation.

Answer: 1 – Both A and R are true, and R is the correct explanation of A

8.

Assertion (A): Respiration in plants is a catabolic process only.

Reason (R): Respiration produces intermediates used for biosynthesis of amino acids and fatty acids.

Answer: 4 – A is false, but R is true

9.

Assertion (A): Anaerobic respiration produces ethanol in plants.

Reason (R): Anaerobic respiration releases a small amount of energy (2 ATP per glucose).

Answer: 2 – Both A and R are true, but R is not the correct explanation of A

10.

Assertion (A): Glycolysis produces NADH along with ATP.

Reason (R): NADH carries electrons to the Electron Transport System to produce more ATP.

Answer: 1 – Both A and R are true, and R is the correct explanation of A