Photosynthesis and Respiration

Synopsis —

- The process of preparing or synthesising food using water from the soil and carbon dioxide from the air, together chlorophyll and sunlight is called **photosynthesis**.
- Photosynthesis occurs in the mesophyll cells of the leaf. These cells contain numerous plastids called chloroplasts.
- With in the plastids is present the green pigment called chlorophyll.
- On the lower surface of the leaf are numerous pores called **stomata**, which open into small air cavities inside the leaf.
- Stomata are tiny openings found mainly on the lower surface of leaves. These openings are surrounded by a pair of bean¬shaped cells called guard cells.
- All plants have a transport system called vascular system. It is composed of two types of tissues called xylem and phloem.
- **There are two end-products of photosynthesis :**
  - Glucose ($C_6H_{12}O_6$)
  - Oxygen
- The energy released during respiration is stored as chemical energy in the form of ATP — adenosine tri-phosphate.
- **Aerobic respiration —**
  $C_6H_{12}O_6+6O_2 \rightarrow 6CO_2+6H_2O+38ATP$
  Anaerobic respiration —
  $C_6H_{12}O_6 \rightarrow 2C_2H_5OH+2CO_2+2ATP$
- During vigorous exercise, the cells respire anaerobically and form lactic acid which accumulate in the muscle cells causing fatigue and pain.
- Cellular respiration is called internal respiration which takes place in the cells of living organisms.

Component	inspired air	expired air
O_2	21%	16%
CO_2	0.03%	4%
N_2	79%	79%
Water vapours	low	high

- **The frog respires through**
  1. skinmouth
  2. lining
  3. lungs.
- The respiratory organs of the fish are gills.
- Transpiration is the loss of water in the form of water vapour from the aerial parts of the plant.
- Transpiration occurs through stomata.

- **The factors which affect the rate of transpiration are**
  1. Sunlight
  2. Temperature
  3. Wind
  4. Humidity

- **The significance of transpiration**
  - Maintain the concentration of the sap inside the plant body.
  - Causes cooling effect

Review Questions

Multiple Choice Questions

1. Put a tick (✓) against the most appropriate alternative in the following statements.

(i) Carbohydrates are stored by plants in the form of:
(a) Vitamins
(b) Proteins
(c) Fats
(d) Glucose .

(ii) Stomata are present on the surface of:
(a) Leaves
(b) Roots
(c) Stem
(d) Flower petals

(iii) Which one of the following is an end-product of photosynthesis ?
(a) Fructose
(b) Glucose
(c) Cellulose
(d) Lactose

Short Answer Questions

1. Why do leaves generally look green ?
Ans.
The green colour of a leaf is due to the presence of chlorophyll.

2. Which four of the following are needed for photosyn-thesis in a leaf:
(i) Carbon dioxide:
(ii) Oxygen:
(iii) Nitrates :
(iv) Water:

(v) Chlorophyll:
(vi) Soil:
(vii) Light:
Ans.
(i) Carbon dioxide: from air
(iv) Water: from soil
(v) Chlorophyll: contained in leaf
(vii) Light: from sunlight

3. What is the source of energy for photosynthesis ?
Ans.
Light is the ultimate source of energy in photosynthesis because plants take in the sunlight CO_2 and H_2O and converts it into glucose.

4. Which gas is taken in and which one is given out by the leaf in bright sunlight ?
(i) Taken in :
(ii) Given out:
Ans.
(i) Carbon dioxide
(ii) Oxygen

5. Suppose we compare the leaf with a factory, match the items in Column A with those in Column B.
ColumnA Column B

	LEAF	FACTORY
(i)	Cells in the leaf	(a) Raw materials
(ii)	Chloroplast	(b) Power
(iii)	Sunlight	(c) Machinery
(iv)	Oxygen and water	(d) End product
(v)	Carbon dioxide and water	(e) By product
(vi)	Glucose	(f) Work room

Answer:

	Column A	Column B
	Leaf	**Factory**
(i)	Cells in the leaf	(c) Machinery
(ii)	Chloroplast	(f) Work room
(iii)	Sunlight	(b) Power
(iv)	Oxygen and water	(e) By product
(v)	Carbon dioxide and water	(a) Raw materials
(vi)	Glucose	(d) End product

6. State whether the following statements are True or False:

(i) Green plants prepare their food by using two raw materials, oxygen and water.
False. Green plants prepare their food by using raw materials, CO, chlorophyll and water.
(ii) The chlorophyll enables the plants to use light energy.
True
(iii) The free oxygen in the atmospheric air is the result of photosynthesis.
True
(iv) Photosynthesis occurs only in chlorophyll-containing parts of the plant.
True

7. Differentiate between aerobic and anaerobic respiration. Write the overall chemical equations of the two kinds of respiration in plants.
(i) Aerobic:
(ii) Anaerobic:
Answer:
Aerobic respiration

1. It occurs in the presence of oxygen.
2. Here there is complete breakdown of glucose releasing carbon-di-oxide, energy. water and energy.
3. More energy is released (38 ATP).

Anaerobic respiration

1. It occurs in the absence of oxygen.
2. There is partial breakdown of glucose into ethyl alohol, carbon-di-oxide and
3. Lesser energy is released (2 ATP).

(i) Aerobic respiration:

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 38ATP$$

(glucose)

(ii) Anaerobic respiration:

$$C_6H_{12}O_6 \xrightarrow{\text{enzymes}} 2C_2H_5OH + 2CO_2 + 2ATP$$

Question 8.

Explain how photosynthesis is different from respiration.

Answer:

Photosynthesis

1. Anabolic process
2. Food is produced here.
3. Oxygen is by-product.
4. Chlorophyll and sunlight are required.
5. Occur only during daytime.
6. Occurs in green plants only.

Respiration

1. Catabolic process
2. Food is broken down form here to release energy
3. Carbon-di-oxide is the by-product.
4. Chlorophyll and sunlight are notrequired.
5. Occurs all the time
6. Occurs in all living beings including plants.

Photosynthesis :

$$6CO_2 + 12H_2O \xrightarrow{\text{sunlight}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

Respiration:

$C_6H_{12}O_6+6O \rightarrow 6CO_2+6H_20+$energy

Question 9.

Do the plants respire all day and night or only during the night ?

Answer:

The plants respire only during the night. Plants take in oxygen and give out carbon dioxide. Hence, there is some truth in the belief that one should not sleep under the trees at night.

Question 10.
What happens to the energy liberated during respiration?
Answer:
The energy liberated during respiration is utilised for carrying out various life processes. Some of the energy liberated during the breakdown of 03 the glucose molecule, is in the form of heat, but a large part of it is converted into chemical energy called Adenosine Triphosphate (ATP). Any activity inside the cell is carried out by the energy released by these ATP molecules.

Long Answer Questions

Question 1.
In order to carry out photosynthesis, what are the substances that a plant must take in ? Also mention their sources.
Answer:
For preparing food, the plants require the following :

1. Water (from soil)
2. Carbon dioxide (from air)
3. Chlorophyll (contained in the leaf)
4. Energy (from sunlight)

The process of preparing or synthesising food using water from the soil and carbon dioxide from the air, together chlorophyll and sunlight is called photosynthesis. This entire process is a series of complex chemical reactions Photosynthesis is represented as follows:

$$\text{carbon dioxide} + \text{water} \xrightarrow[\text{sunlight}]{\text{chlorophyll}} \text{glucose} + \text{oxygen}$$

Question 2.
What is the role of chlorophyll in photosynthesis ?
Answer:
This pigment is of utmost importance as it absorbs the sunlight which provides energy for the process of photosynthesis occurs inside the chloroplast of the leaf.

Question 3.
Do plants need oxygen ? If so, what is its source ?
Answer:
Yes plants need oxygen, all the free oxygen in the atmospheric air is the result of photosynthesis. No animal can survive without oxygen as it is needed for respiration. Even the plants use the same oxygen in dark for their own respiration.

Additional Questions

CHECK YOUR PROGRESS

Answer these questions.

Question 1.
What is external respiration ?
Answer:
External respiration or breathing is a mechanical or physical process that involves inhaling (breathing in) air rich in oxygen and exhaling (breathing out) air rich in carbon dioxide.

Question 2.
Write the equation showing the process of respiration.
Answer:

$$\underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{oxygen}}{6O_2} \longrightarrow \underset{\text{carbon dioxide}}{6CO_2} + \underset{\text{water}}{6H_2O} + \underset{\text{(38 ATP)}}{\text{energy}}$$

Question 3. In what form is the energy released during respiration stored ?
Answer:
The energy released is stored in the form of an energy-rich chemical substance called ATP (Adenosine triphosphate).

Question 4 .
Name the two types of respiration.
Answer:
Aerobic respiration and anaerobic respiration.

Question 5.
Name the organ of respiration in fishes.
Answer:
Gills

Question 6.
What are the holes on the sides of the body of insects called ?
Answer:
Spiracles

CHECK YOUR PROGRESS

Answer the following in one word.
1. What is the muscular sheet below the lungs called ?
Ans. Diaphragm
2. Which organ is called the voice box ?
Ans. Larynx
3. Which membrane covers the lungs ?
Ans. Pleural membrane
4. Where does exchange of gases takes place ?
Ans. Lungs (alveoli)
5. What is formed when oxygen combines with haemoglobin ?
Ans. Oxyhaemoglobin
6. What is carbamino hemoglobin ?
Ans. Carbon-dioxide combines with haemoglobin to form carbomino haemoglobin.

EXERCISES

A. Tick the most appropriate answer.
1. The products of respiration are :
a. carbon dioxide and oxygen
b. oxygen and energy
c. carbon dioxide, water and energy
d. carbon dioxide, oxygen and energy.

2. Glucose is oxidized to produce ethyl alcohol during
a. excretion
b. aerobic respiration
c. anaerobic respiration
d. photosynthesis

3. In insects like grasshopper, there is a well-developed system of air tubes called
a. tracheae
b. gills
c. lungs
d. alveoli

4. Frogs breathe through the
a. moist skin
b. lungs
c. mouth cavity
d. all of these

5. Inside the chest, the trachea divides into two branches called
a. bronchi
b. bronchioles
c. bronchus
d. alveolus

6. In humans beings, during inhalation the diaphragm.
a. moves up
b. moves down
c. remains at its position
d. moves down moves up

7. Exhaled air contains
a. more carbon dioxide
b. more oxygen
c. more nitrogen
d. more hydrogen

8. Plants have these for exchange of gases.
a. spiracles and stomata
b. lenticels and spiracles
c. lenticels and stomata
d. buds and flowers

B. Fill in the blanks.

1. The two respiration of respiration are **aerobic** and **anaerobic.**
2. Muscles of human beings switch to anaerobic **respiration** in the absence of oxygen.
3. In **aerobic** respiration, food is completely oxidized into carbon dioxide, water and energy.
4. Below the lungs is a muscular sheet called **diaphragm.**
5. Bronchi divide into smaller tubes called **bronchioles.**
6. In human beings, exchange of gases takes place in **alveoli** (lungs).

C. State if the following statements are true or false. Correct the statement if it is false.

1. The oxidation pf food to release energy and water is called breathing.
False. The oxidation of food to release energy and water is called Respiration.
2. Anaerobic respiration takes place in our bones.
False. Anaerobic respiration takes place in our muscles.
3. The microscopic air sacs present in the lungs are called bronchi.
False. The microscopic air sacs present in the lungs are called alveolar sacs.

4. Respiration that takes place through skin is called pulmonary respiration.
False. Respiration that takes place through skin is called cutaneous respiration.
5. Stomata are present on mature roots and woody stems.
False. Lenticels are present on mature roots and woody stems.
6. In photosynthesis oxygen is released as a by-product
True

D. Match the following.

Column A (Organism)	Column B (Organism of Respiration)
1. fish	a. lungs
2. human beings	b. tracheae
3. frog	c. gills
4. cockroach	d. moist skin, mouth cavity and lungs
5. bird	e. lungs

Answer:

Column A (Organism)	Column B (Organism of Respiration)
1. fish	c. gills
2. human beings	a. lungs
3. frog	d. moist skin, mouth cavity and lungs
4. cockroach	b. tracheae
5. bird	e. lungs

E.Differentiate between
(i) aerobic respiration and anaerobic respiration.
Answer:
Aerobic Respiration

1. It takes place in the presence of oxygen.
2. Complete oxidation of food takes place.
3. 38 molecules of ATP are produced by oxidation of one gram mole of glucose.

4. CO_2 and H_20 are the end products.

Anaerobic Respiration

1. It takes place in the absence of oxygen.
2. Incomplete oxidation of food takes place.
3. 2 molecules of ATP are produced by oxidation of gram mole of glucose.
4. Ethyl alcohol (C_6H5OH) and CO_6 are the end products.

(ii) External rcpiration and Internal respiration
Answer:
External rcpiration

1. It is the mechanical process of inhaling and exhaling air It does not involve any enzymes.
2. It involves taking in oxygen and giving out carbon dioxide.
3. No energy is released.
4. It takes place outside the cell.

Internal respiration

1. It is a complex biochemical process in which enzesare involved.
2. It involves the oxidation of glucose into carbon dioxide, water and energy.
3. Energy is released and stored in the form of ATP.
4. It takes place inside the cell.

(iii) Photosynthesis and Respiration
Answer:
Photosynthesis

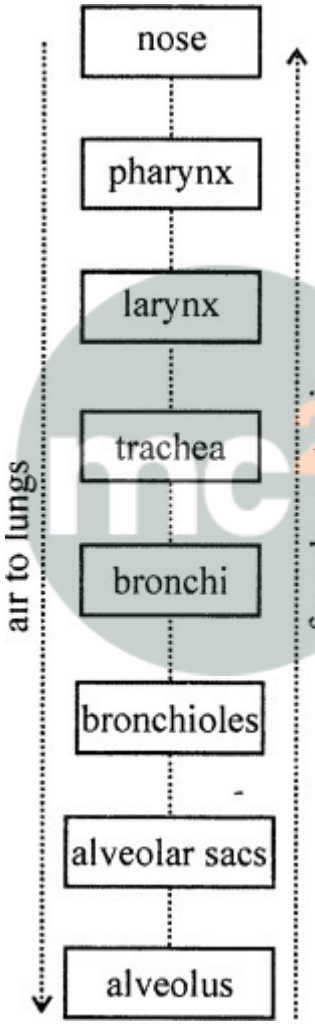
1. It is an anabolic process.
2. It takes place in the presence of sunlight
3. Oxygen is released as the by product.
4. It takes place in the green parts of the plant that is green leaves, young green stems.
5. Food is synthesised by plants using CO_2 and H_20

Respiration

1. It is a catabolic process Sunlight is not necessary for the respiration.
2. Carbondioxide is released as the by product.
3. It takes place in all the parts of a plant.
4. Food is oxidized using oxygen to release energy

F. Answer the following in short.

1. Define respiration.
Ans. The process of conversion of glucose molecules in food into energy rich molecules, carbondioxide and water with the help of oxygen is known as respiration.
2. What is the full form of ATP ?
Ans. ATP is the energy currency of cell. Its full form is Adenosine Triphosphate.
3. What is respiratory tract ?
Ans. The path through which the air travels to the lungs and back to the atmosphere in humans is called the respiratory tract



4. Define cutaneous respiration ?
Ans. The exchange of gases through moist skin and blood capillaries underneath is called cutaneous respiration.e.g. in frogs.
5. What is the function of pleural fluid ?
Ans. Pleural fluid keeps the surface of the lungs moist for easy diffusion of gases (oxygen and carbon dioxide).
6. What is the role of the diaphragm in breathing mechanism ?

Ans. Diaphragm moves up and down and helps in the exchange of air between the atmosphere and lungs.

G Answer the following in detail.

Question 1.

How is the process of cellular respiration different from breathing ?

Answer:

Respiration

1. It is a complex bio- chemical process which involves enzymes.
2. It involves oxidation of glucose in to CO_2, water and energy.
3. Energy is released and stored in the form of ATP.
4. It takes place inside the ceil

Breathing

1. It is a mechanical process without the involvement of enzymes.
2. It involves only the exchange of oxygen and CO_2.
3. No energy is released.
4. It takes place outside the cell.

Question 2.

Explain the process of Cellular Respiration.

Answer:

Cellular Respiration is a biochemical process which involves the oxidation of glucose to release energy, carbondioxide and water are released as by – products.

$$C_6H_{12}O_6 + 6O_2 \xrightarrow{\text{enzymes}} 6CO_2 + 6H_2O + \text{energy}$$

glucose oxygen carbon dioxide water

It involves a series of chemical reactions controlled by different enzymes. The energy released in the process is stored in the form of energy rich substance called ATP (Adenosine triphosphate). The ATP molecules are stored in the cells and later on can be broken down to release energy for various metabolic activities. The entire process takes place partially in the cytoplasm and partially in the mitochondria of our body cells. The process of conversion of glucose molecules in food in to energy rich molecules, CO_2 and water with the help of oxygen is known as respiration.

Question 3.

In human beings, what happens to oxygen after it is inhaled through the nose ?

Answer:

Air rich in oxygen, enters the body through the nostrils (nose). From the nose, air enters the phaiynx which leads to larynx and then trachea (windpipe). From trachea, it enters the bronchi and enters the lungs. From bronchi, it enters bronchioles and finally the

alveoli. The oxygen diffuses through the thin walls of blood capillaries (surrounding) into the blood and combines with hemoglobin to form oxy haemoglobin. The oxygen in blood is carried to all body cells where internal respiration takes place in a series of chemical reactions and food (in the form of glucose) is converted into carbon-dioxide water and energy in the form of ATP, using the oxygen.

Question 4.
Show the mechanism of breathing in human beings.
Answer:
The process of taking in oxygen and giving out carbondioxide is called breathing. It is a physical process and carried out by the movement of the various body parts.

1. **Inhalation :** When we inhale air our ribs move upwards and outwards and the diaphragm moves downwards. The volume of chest cavity increases and the air pressure is reduced, as a result of which air flows in to the lungs.
2. **Exhalation :** When we exhale air, that is breathe out air,the diaphragm moves upwards and the ribs move downwards and inwards. The space inside the chest cavity decreases and the air pressure is increased as, a result the air rushes out.

Question 5.
Explain the process of exchange of gases in plants.
Answer:
In plants, exchange of gases takes place through stomata and lenticels.

1. **Stomata –** They are tiny pores present on the lower surface of leaves and young green stems. The gaseous exchange takes place in plants mostly through stomata. They remain open during the day and close at night.
2. **Lenticels –** In certain trees, the mature roots and woody stems have tiny openings called lenticels which enable the oxygen to reach the intercellular spaces of interior tissues and carbon dioxide to be released into the atmosphere. The exchange of gases (oxygen and carbon dioxide) in plants takes place by two processes – photosynthesis and respiration
    - **Photosynthesis occurs during the day.** It takes in carbon dioxide and gives out oxygen. A part of oxygen formed is used by plants for respiration and rest is given out through stomata
    - **Respiration occurs throughout day and night.** Oxygen is used and carbon dioxide is given out. This carbon dioxide is used by the plant for photosynthesis during the day. At night, in the absence of photosynthesis, carbon dioxide is released into the air through stomata.

H. Number the following organs in the correct order to show the path taken by fresh air at the time of inhalation.
trachea, nose, bronchioles, bronchi, larynx, alveoli, pharynx, lungs
Answer
nose →pharynx → larynx →trachea→bronchi → lungs →bronchioles →alveoli.