Chapter 10: Life Processes in Plants

Exercises — Let Us Enhance Our Learning

Q1 Complete the following table comparing Photosynthesis and Respiration across four features: Raw materials, Products, Word equation, and Importance.

SOLUTION

PHOTOSYNTHESIS

1. Raw materials: Carbon dioxide (from air) and Water (from soil)
2. Products: Glucose (carbohydrate) and Oxygen
3. Word equation: Carbon dioxide + Water → (Sunlight / Chlorophyll) → Glucose + Oxygen
4. Importance: Produces food (glucose) for the plant; releases oxygen into the atmosphere, which is essential for all aerobic living organisms

RESPIRATION

1. Raw materials: Glucose and Oxygen
2. Products: Carbon dioxide, Water, and Energy
3. Word equation: Glucose + Oxygen → Carbon dioxide + Water + Energy
4. Importance: Releases energy from food that is used by the plant for growth, development, and carrying out all life processes

Answer: Photosynthesis: raw materials = CO_2 + water; products = glucose + oxygen; equation: $CO_2 + H_2O \rightarrow$ glucose + O_2 (sunlight/chlorophyll). Respiration: raw materials = glucose + oxygen; products = CO_2 + water + energy; equation: glucose + $O_2 \rightarrow CO_2 + H_2O$ + energy.

Q2 Imagine a situation where all the organisms that carry out photosynthesis on the earth have disappeared. What would be the impact of this on living organisms?

SOLUTION

Photosynthesis is the process by which green plants (and other photosynthetic organisms) use carbon dioxide and water in the presence of sunlight and chlorophyll to produce glucose and oxygen.

If all photosynthetic organisms disappeared, the following impacts would occur:

1. No food production: Plants are the primary producers — they make food (glucose) from simple raw materials. Without them, no new food would be

synthesised. All animals, including herbivores and carnivores, depend on plants directly or indirectly for food. The entire food chain would collapse.

2. No oxygen release: Photosynthesis is the main source of oxygen in the atmosphere. Without it, atmospheric oxygen would gradually be consumed by respiration and other processes, eventually dropping to levels that cannot support aerobic life.

3. Build-up of carbon dioxide: Plants absorb carbon dioxide during photosynthesis. Without plants, CO_2 released by respiration and decomposition would accumulate, leading to an enhanced greenhouse effect and extreme climate change.

4. Extinction of most life forms: With no food and no oxygen, almost all living organisms — animals, fungi, and many microbes — would perish. Only some anaerobic microorganisms might survive.

In summary, the disappearance of photosynthetic organisms would cause a total breakdown of life-sustaining processes on Earth.

Answer: Without photosynthetic organisms: no food would be produced (entire food chain collapses), no oxygen would be released (aerobic life would die), and CO_2 would accumulate uncontrolled — nearly all life on Earth would cease to exist.

Q3 A potato slice shows the presence of starch with iodine solution. Where does the starch in potatoes come from? Where is the food synthesised in the plant, and how does it reach the potato?

SOLUTION

Leaves are the primary site for photosynthesis — they are the 'food factories' of a plant.

During photosynthesis, leaves use carbon dioxide from the air, water from the soil, sunlight, and chlorophyll to produce glucose. This glucose is the immediate food product.

Glucose is then converted into starch for storage.

Transport to the potato:
The food (glucose/starch) prepared in the leaves is transported to other parts of the plant — including stems, roots, and storage organs like potatoes — through thin tube-like structures called the phloem.

The potato is an underground stem (tuber) that acts as a storage organ. The food transported through the phloem is stored in the potato in the form of starch.

When we apply iodine solution to a potato slice, it turns blue-black, confirming the presence of this stored starch.

Answer: Food (glucose) is synthesised in the leaves by photosynthesis. It is converted to starch, then transported through the phloem to the potato (an underground storage stem/tuber), where it is stored as starch — hence the blue-black iodine test result.

Q4 Does the broad and flat structure of leaves make plants more efficient for photosynthesis? Justify your answer.

SOLUTION

Yes, the broad and flat structure of leaves does make plants more efficient for photosynthesis. The justification is as follows:

1. Maximum surface area for sunlight capture: Leaves are generally broad and flat, which gives them a large surface area. This allows them to capture as much sunlight as possible, which is essential for photosynthesis.

2. Efficient absorption of carbon dioxide: The large flat surface also maximises the area over which stomata (tiny pores on the leaf surface) are distributed. More stomata means more carbon dioxide can enter the leaf for photosynthesis.

3. Presence of chlorophyll: The broad flat structure ensures that chlorophyll — the green pigment responsible for capturing light energy — is spread over the maximum area, increasing the efficiency of light absorption.

4. Thin structure: Leaves are thin, which means light can penetrate to the cells containing chlorophyll, and gases (CO_2 in, O_2 out) can diffuse easily through the leaf tissue.

As stated in the chapter, leaves are mostly green because of the presence of chlorophyll, which helps in capturing sunlight efficiently, and their broad flat shape is described as being 'by design' to support this function.

Answer: Yes. The broad flat shape gives leaves a large surface area to capture sunlight and absorb CO_2 through stomata, while the thin cross-section allows light and gases to reach chlorophyll-containing cells easily — all of which increase photosynthetic efficiency.

Q5 X is broken down using Y to release carbon dioxide, Z, and energy. X + Y → Carbon dioxide + Z + Energy. X, Y, and Z are three different components of the process. What do X, Y, and Z stand for?

SOLUTION

The word equation given is the equation for respiration in plants (and all living organisms).

The word equation for respiration from the chapter is:
Glucose + Oxygen → Carbon dioxide + Water + Energy

Comparing with X + Y → Carbon dioxide + Z + Energy:

X = Glucose (the food substance that is broken down)
Y = Oxygen (used to break down glucose)
Z = Water (produced along with carbon dioxide and energy)

Answer: X = Glucose, Y = Oxygen, Z = Water. The equation describes respiration: Glucose + Oxygen → Carbon dioxide + Water + Energy.

Q6 Krishna set-up an experiment with two potted plants of same size and placed one of them in sunlight and the other in a dark room (Fig. 10.10). Answer: (i) What idea might she be testing through this experiment? (ii) What are the visible differences in plants in both the conditions? (iii) According to you, leaves of which plants confirm the iodine test for the presence of starch?

SOLUTION

Fig. 10.10 shows two potted plants of the same size: (a) one kept in sunlight and (b) one kept in complete dark.

(i) Idea being tested:
Krishna is likely testing whether sunlight is essential for the production of starch (food) in plants. Specifically, she wants to find out if photosynthesis — and therefore starch synthesis — occurs only in the presence of sunlight.

(ii) Visible differences in plants under both conditions:
The plant kept in sunlight will show healthy green leaves, normal growth, and overall vigour.
The plant kept in the dark room will show yellowing of leaves (loss of green colour/chlorophyll), drooping, and reduced growth over time. This is because without sunlight, photosynthesis cannot occur and the plant cannot produce new

food.

(iii) Leaves of which plant confirm the iodine test for starch:
The leaves of the plant kept in sunlight will confirm the iodine test — they will turn blue-black, indicating the presence of starch produced by photosynthesis.
The leaves of the plant kept in the dark will NOT turn blue-black with iodine, because without sunlight, photosynthesis does not occur and no starch is produced.

This is consistent with Bhaskar's experiment (Activity 10.3) described in the chapter, where the leaf from a plant kept in the dark did not show blue-black colour even on the green patches.

Answer: (i) She is testing whether sunlight is essential for starch production in plants. (ii) The sunlit plant has healthy green leaves; the dark-room plant shows yellowing and poor growth. (iii) Only the leaves of the plant in sunlight confirm the iodine test (turn blue-black) — the dark-room plant's leaves show no starch.

Q7 Vani believes that 'carbon dioxide is essential for photosynthesis'. She puts an experimental set-up (Fig. 10.11) with four conditions: (a) Sunlight with CO_2, (b) Sunlight without CO_2, (c) Dark with CO_2, (d) Dark without CO_2. All plants have sufficient water. Answer: (i) In which plant(s) will starch be formed? (ii) In which plant(s) will starch NOT be formed? (iii) In which plant(s) will oxygen be generated? (iv) In which plant(s) will oxygen NOT be generated?

SOLUTION

Photosynthesis requires four things: carbon dioxide, water, sunlight, and chlorophyll. Food (glucose → starch) is produced and oxygen is released ONLY when ALL these conditions are met.

Analysing each condition:

Set-up (a): Sunlight + CO_2 + water (sufficient) — all requirements for photosynthesis are present → photosynthesis OCCURS.
Set-up (b): Sunlight + NO CO_2 + water — CO_2 is absent, so photosynthesis CANNOT occur.
Set-up (c): Dark + CO_2 + water — sunlight is absent, so photosynthesis CANNOT occur.
Set-up (d): Dark + NO CO_2 + water — both sunlight and CO_2 are absent, so photosynthesis CANNOT occur.

(i) Starch WILL be formed in: Set-up (a) only — sunlight with carbon dioxide. This is the only condition where all requirements for photosynthesis are present.

(ii) Starch will NOT be formed in: Set-ups (b), (c), and (d) — because at least one essential requirement (CO_2 or sunlight) is missing in each.

(iii) Oxygen WILL be generated in: Set-up (a) only — photosynthesis occurs only there, and oxygen is a product of photosynthesis.

(iv) Oxygen will NOT be generated in: Set-ups (b), (c), and (d) — photosynthesis does not occur in these conditions, so no oxygen is produced through photosynthesis.

This experiment supports Vani's belief: carbon dioxide is indeed essential for photosynthesis. Set-up (b) is the key comparison — even with sunlight and water, the absence of CO_2 prevents starch formation.

Answer: (i) Starch formed only in (a) — sunlight + CO_2. (ii) Starch NOT formed in (b), (c), (d) — CO_2 or sunlight is missing. (iii) Oxygen generated only in (a). (iv) Oxygen NOT generated in (b), (c), (d).

Q8 Ananya took four test tubes (A, B, C, D) filled three-fourths with water. Test tube A: snail only; B: water plant only; C: snail + plant; D: water only. She added a carbon dioxide indicator to all and recorded initial colour, then observed colour changes after 2–3 hours. What does she want to find out? How will she know if she is correct?

SOLUTION

Fig. 10.12 shows four test tubes, each three-fourths filled with water: A = water + snail; B = water + water plant; C = water + snail + water plant; D = water only (control). A carbon dioxide indicator was added to all four.

What Ananya wants to find out:
Ananya wants to investigate how carbon dioxide (CO_2) levels change in different conditions — with an animal (snail) that respires, a plant that both photosynthesises and respires, a combination of both, and a control (water only). She likely wants to understand whether photosynthesis by the water plant can absorb the CO_2 released by the snail's respiration, and how the CO_2 level in each test tube changes.

Expected observations and how she will know:

A carbon dioxide indicator changes colour depending on the CO_2 concentration in the water. When CO_2 increases, the indicator typically changes to a different colour (e.g., yellow if using bromothymol blue); when CO_2 decreases, it changes back (e.g., blue/purple).

Test tube A (snail only): The snail respires, releasing CO_2. CO_2 level rises → indicator colour changes (indicates increased CO_2).

Test tube B (water plant only, in light): The plant performs photosynthesis, absorbing CO_2 and releasing O_2. CO_2 level decreases → indicator colour changes in the opposite direction (indicates decreased CO_2).

Test tube C (snail + plant, in light): The plant absorbs CO_2 released by the snail for photosynthesis. The CO_2 level may remain relatively stable or decrease, depending on the balance — indicator colour may remain same or shift slightly.

Test tube D (water only): No organism is present, so CO_2 level stays unchanged → indicator shows no colour change (serves as control).

She will know she is correct if:
The indicator in test tube A shows a colour change indicating higher CO_2 (respiration by the snail).
The indicator in test tube B shows a colour change indicating lower CO_2 (absorption by the plant during photosynthesis).
Test tube D (control) shows no change.
Test tube C shows little or no change if the plant absorbs the CO_2 produced by the snail.

Answer: Ananya wants to find out how CO_2 levels change due to respiration (snail) and photosynthesis (plant) in different combinations. She will know she is correct if the CO_2 indicator shows increased CO_2 in A (snail only), decreased CO_2 in B (plant only), little change in C (snail + plant balanced), and no change in D (control).

Q9 Design an experiment to observe if water transportation in plants is quicker in warm or cold conditions.

SOLUTION

Experiment Design: Effect of temperature on water transportation in plants

Objective: To observe whether water transportation in plants is quicker in warm or cold conditions.

Materials required:
Two similar fresh plant twigs (preferably with white flowers, e.g., white balsam or sadabahar)
Two glass tumblers (labelled A and B)
Water
Red ink (or food colouring)
A source of warmth (e.g., warm water at about 35–40°C) and cold conditions (cold water with ice)
A ruler and a clock/timer
A magnifying glass

Procedure:
1. Fill tumbler A with warm water (around 35–40°C) and tumbler B with cold water (around 4–8°C with ice). Add the same amount of red ink to each.
2. Obliquely cut the stems of both plant twigs at their base while keeping them submerged in water (to prevent air bubbles entering the xylem), and immediately place one twig in each tumbler.
3. Leave both tumblers undisturbed for the same duration (e.g., 30 minutes, 1 hour, and 2 hours — observe at regular intervals).
4. At each time interval, carefully cut a section from the upper part of each stem (above the water level) and observe the cut end with a magnifying glass.
5. Record how far the red colour has moved up the stem in each twig.

Observation:
Record the height (in cm) up to which the red colour is visible in the stem of the plant in warm water and the plant in cold water at each time interval.

Expected result:
The red colour is expected to travel higher (further up the stem) in the plant placed in warm water, suggesting that water transportation through the xylem is quicker in warm conditions.

Inference:
Warmth increases the rate of transpiration (loss of water through stomata), which drives water up the xylem more quickly. Therefore, water transportation in plants is quicker in warm conditions.

Note: This experiment is modelled on Activity 10.7 described in the chapter (water transport using red ink), extended to compare warm and cold temperatures.

Answer: Set up two identical plant twigs in tumblers with red-inked water — one tumbler warm (~35–40°C), one cold (~4–8°C). After equal time intervals, cut the upper stem of each twig and check how far the red colour has travelled. Greater upward movement in the warm-water twig indicates faster water transport in warm conditions.

Q10 Photosynthesis and respiration are essential to maintain balance in nature. Discuss.

SOLUTION

Photosynthesis and respiration are complementary processes that together maintain the balance of oxygen and carbon dioxide in nature.

Photosynthesis (by green plants and other photosynthetic organisms):
Absorbs carbon dioxide from the atmosphere.
Uses water and sunlight to produce glucose (food) and oxygen.
Word equation: Carbon dioxide + Water → (Sunlight/Chlorophyll) → Glucose + Oxygen
Releases oxygen into the atmosphere.

Respiration (by all living organisms — plants, animals, microbes):
Absorbs oxygen from the atmosphere.
Breaks down glucose to release carbon dioxide, water, and energy.
Word equation: Glucose + Oxygen → Carbon dioxide + Water + Energy
Releases carbon dioxide into the atmosphere.

How they maintain balance in nature:

1. Oxygen-carbon dioxide balance: Photosynthesis consumes CO_2 and produces O_2; respiration consumes O_2 and produces CO_2. These two processes cycle oxygen and carbon dioxide between living organisms and the atmosphere, keeping both gases at levels that can support life.

2. Food and energy flow: Photosynthesis produces food (glucose) that provides energy to plants. Animals eat plants (directly or indirectly), and respiration in animals releases this energy. The food energy fixed by photosynthesis flows through the entire food chain.

3. Carbon cycle: The carbon in CO_2 absorbed during photosynthesis is incorporated into organic molecules (carbohydrates). When living organisms respire or decompose, this carbon is returned to the atmosphere as CO_2,

maintaining the carbon cycle.

4. Ecosystem sustainability: Without photosynthesis, there would be no oxygen and no food. Without respiration, energy locked in food could not be released for life processes. Together, they ensure that all living organisms can obtain energy and that the atmosphere remains suitable for life.

In summary, photosynthesis and respiration are two sides of the same cycle — one builds up organic matter and releases oxygen, the other breaks it down and releases CO_2 — and together they keep the living world in dynamic balance.

Answer: Photosynthesis absorbs CO_2 and releases O_2 (producing food); respiration absorbs O_2 and releases CO_2 (releasing energy). Together they cycle oxygen, carbon dioxide, and energy through all living organisms, maintaining atmospheric balance and sustaining the food chain in nature.