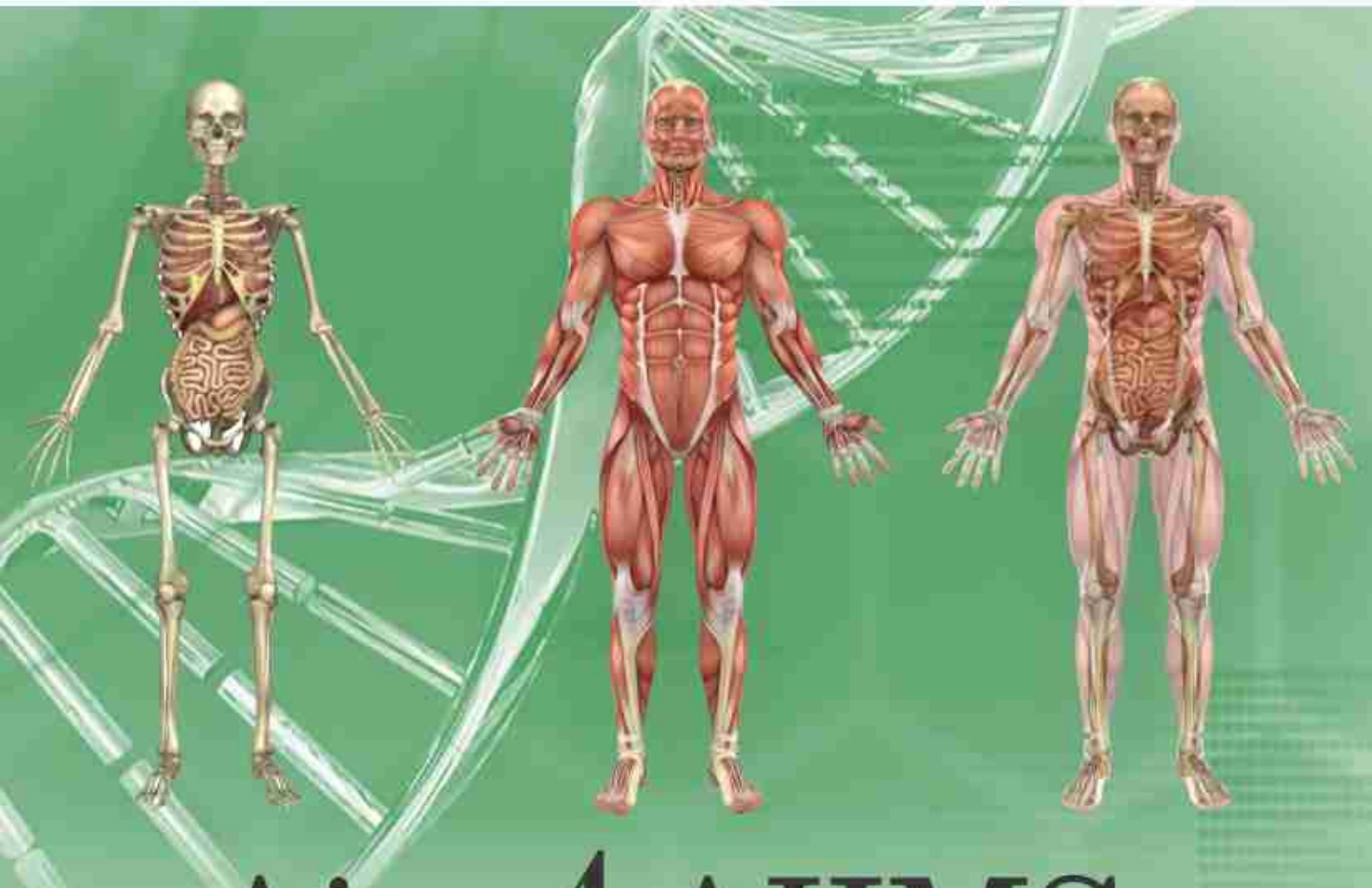
Series for AIIMS Selection Prepared By Toppers



Aim 4 AIIMS BIOLOGY

PREPGUIDE

Concise Synopsis Including Outside NCERT Topics
AIIMS High Yield Concepts - Chapterwise Section
Diagram or Visual Based Questions
600+ Self Assessment Questions for Practice
AIIMS Higher Order MCQs
Assertion & Reason Questions
NCERT Exemplar Problems

ALTIS VORTEX

13 Photosynthesis in Higher Plants

Importance of photosynthesis:

- Primary source of food
- Release O_2 to atmosphere

Early Discoveries

- **Joseph Priestly:** Candle with bell jar and mouse experiment – He concluded that air is necessary for the growth of a plant. He discovered the fact that plants restore oxygen in the air.
- **Jan Ingenhousz:** Experiment with aquatic plant in light and dark – He concluded that sunlight is essential for plant processes that purify the air.
- **Julius Von Sachs:** Green parts of plant make glucose and store as starch.
- **T.W. Engelmann:** Spilt light using prism into 7 colors (VIBGYOR) - Green algae *Cladophora* placed in a suspension of aerobic bacteria - Bacteria were used to detect the sites of O_2 evolutions.

Cornelius van Niel:

- He did experiment with purple and green bacteria and demonstrated photosynthesis is a light dependent process with hydrogen from H_2O reduces CO_2 to carbohydrates.
- He concluded that oxygen comes from H_2O, and not from CO_2. Finally, the correct equation for photosynthesis was discovered.
- $6CO_2 + 12H_2O\ C_6H_{12}O_6 + 6H_2O + 6O_2$

Site of Photosynthesis

- Green leaves, green stems and floral parts (sepal)
- Chloroplast - found in mesophyll cells of leaves
- In chloroplast – the membrane system is responsible for trapping the light energy and also for the synthesis of ATP and NADPH. Where stroma has enzymes for the reduction of CO_2 in to carbohydrates (sugars)

Pigments Involved in Photosynthesis

- 4 types of pigments may be present in leaves:
  - ◊ Chlorophyll *a*
  - ◊ Chlorophyll *b*
  - ◊ Xanthophylls
  - ◊ Carotenoids
- An **absorption spectrum** is the graph plotted against the fraction of light absorbed by the pigment.
- An **action spectrum** is the rate of a physiological activity plotted against the wavelength of light.
- Photosystems are pigments that are organized in the thylakoid membrane in to two different photosystems (PS 1 & PS 11)
- Each PS has one specific chlorophyll – a, and many other accessory pigments bound by proteins.
- Chlorophyll – a forms the reaction centre (actual reaction takes place) other pigments form the light harvesting complex (LHC) called antennae.
- PS 1 reaction centre is P_{700} (chlorophyll –a absorbs light at 700 nm)
- PS 11 reaction centre is P_{680} (chlorophyll –a absorbs light at 680 nm)

Light Reaction (Photochemical Phase)

- This phase directly depends on light. The pigments absorb light energy and produce ATP.
- Includes:
  - ◊ Light absorption
  - ◊ Water splitting
  - ◊ Oxygen release
- Formation of ATP and NADPH, which is then used in the biosynthetic phase(Dark Phase)
- Pigment molecules bound to the proteins form LHC (light harvesting complexes)
- LHC are located within two photosystems − PSI and PSII
- **Each photosystem has two parts:**

- ◊ Reaction centre − consisting of chlorophyll *a* molecule
- ◊ Antennae − consisting of accessory pigments, which increase the efficiency of photosynthesis by absorbing different wavelengths of light

- Reaction centre is different in both photosystems:
  - ◊ PSI − P_{700}; since chlorophyll *a* has absorption peak at 700 nm here
  - ◊ PSII − P_{680}; since chlorophyll *a* has absorption peak at 680 nm here.

Photo-Phosphorylation

- The process of formation of ATP in chloroplast in the presence of sunlight
- Photo-phosphorylation is of two types:
  - ◊ Non-cyclic photo-phosphorylation
  - ◊ Cyclic photo-phosphorylation

Non-Cyclic Photo-Phosphorylation

- PSII absorbs 680 nm wavelength of red light, causing electrons to become excited and these electrons are then accepted by an electron acceptor, which sends them to an electron transport system.
- Electron transport system transfers the electrons to PSI.
- Electrons in PSI are simultaneously excited on receiving a wavelength of 700 nm.
- From the electron acceptor, electrons are transferred to the molecule of $NADP^+$.
- Addition of these electrons reduces the $NADP^+$ to NADPH + H^+.
- Since the electrons lost by PSII do not come back to it, this process of formation of ATP is called non-cyclic photo-phosphorylation.

Cyclic Photo-Phosphorylation

- In this scheme, only PSI is functional. Hence, the electrons are circulated within the photosystem.
- This results in a cyclic flow of electrons.
- This scheme could possibly be occurring in *stroma lamellae* because it lacks both
- PSII and NADP reductase enzyme.
- This cyclic flow results only in the synthesis of ATP, and not of NADPH + H^+.

Splitting Of Water

- Water splitting complex is associated with PSII.
- Manganese, chlorine, etc., play an important role.
- The light-dependent splitting of water is called photolysis
- $2H_2O \rightarrow 4H^+ + O_2 + 4e^-$
- Electrons formed are used for replacing the electrons lost from P_{680}.
- P_{680} absorbs light and becomes as a strong oxidizing agent and splits a molecule of water to release oxygen. Oxygen is liberated as a by-product of photosynthesis.
- Protons are used for the formation of reducing power NADP to $NADPH^+$.

Differences between Non-cyclic and Cyclic Photophosphorylation:

Non- cyclic Photophosphorylation Cyclic Photophosphorylation

- Photolysis of water takes place. No photolysis of water occurs.
- Both PS I and PS II are involved. Only PS 1 is involved.
- Electrons are not cycled. The electrons released by PS I comeback to PS I itself.
- Both ATP and NADPH are produced.
- Only ATP is formed.
- Oxygen is liberated Oxygen is not liberated.

Chemiosmotic Hypothesis

- It is the mechanism of ATP synthesis in thylakoid of chloroplast.
- When electrons are transported through the electron transport system (ETS) and protons accumulate inside the thylakoid membrane due to photolysis of water.
- Now electrons are passed through PS and protons are transported across the membrane.

Chemiosmosis requires:

- A thylakoid membrane
- A protein pump
- A protein gradient
- ATP synthase enzyme.

Dark Reaction / Biosynthetic Phase:

- Next stage is the biosynthetic phase. In this, ATP and NADPH are used for synthesising the food / Glucose.
- This stage is also called the dark phase as it is independent of light.
- It takes place in the stroma of chloroplasts.
- In some plants, the first product of CO_2 fixation is a 3-carbon compound called 3-phosphoglyceric acid (PGA). These plants are said to adopt the C 3 pathway.
- In other plants, the first CO_2 fixation product is a 4-carbon compound called oxaloacetic acid. These plants are said to adopt the C 4 pathway.

Calvin Cycle (C3 Cycle)

- The path of carbon in the dark reaction was traced by Melvin Calvin using radioactive carbon (14C).
- The primary acceptor of CO_2 was found to be a 5-carbon ketose sugar called
- Ribulose bisphosphate (RuBP). RuBP is used in a cyclic manner (regenerated) and a sugar is synthesized.
- 3 phases of Calvin cycle: Carboxylation, Reduction and Regeneration of RuBP.

1. **Carboxylation:**
   - ◊ Ribulose 1, 5-bisphosphate combines with CO_2, and fixes it to a stable
   - ◊ Organic intermediate 3C compound called

3-phosphoglycerate (2 molecules).

◊ 3 PGA is the first stable product of this cycle.

◊ Reaction catalyzed by the enzyme RuBisCO (RuBP Carboxylases - Oxygenase)

2. Reduction

◊ Here, two molecules each of ATP and NADPH are required for fixing one molecule of CO_2.

◊ This stage contains a series of reactions.

◊ Glucose is formed as a result of this series of reactions.

3. Regeneration

◊ RuBP regenerates to enable the cycle to continue uninterrupted. 1 ATP molecule is required.

Important Points

- For the formation of one molecule of glucose, six molecules of CO_2 need to be fixed; hence, six cycles are required.
- ATP required:
  - ◊ For fixing 1 molecule of CO_2 − 3 (2 for reduction and 1 for regeneration)
  - ◊ For fixing 6 molecules of CO_2 − $3 \times 6 = 18$ ATP
- NADPH required:
  - ◊ For fixing 1 molecule of CO_2 − 2 (for reduction)
  - ◊ For fixing 6 molecules of CO_2 − $2 \times 6 = 12$ NADPH
- Thus, the synthesis of 1 molecule of glucose requires 18 ATP and 12 NADPH.

C4 Pathway (Hatch and Slack Pathway)

- Occurs in plants like maize & sugarcane − plants adapted to dry tropical regions.
- The leaves of C4 plants have ***Kranz anatomy***. These plants show 2 types of photosynthetic cells, mesophyll cells and bundle sheath cells.
- Chloroplasts are dimorphic i.e., those is **the mesophyll cells are granal** and in **bundle sheath Cells are agranal.**
- C4 plants can tolerate high temperature and high light intensity, show greater productivity of biomass, and lack photorespiration.
- Primary CO_2 acceptor: Phosphoenol pyruvate (PEP) − a 3-carbon molecule.
- PEP Carboxylase fixes CO_2 in the mesophyll cells. It forms the 4-carbon compound oxaloacetic acid (OAA), and then other 4-carbon compounds Malic acid.
- These compounds are transported to the bundle sheath cells. There, C4 acid breakdown to form C3 acid and CO_2, and carbon dioxide enters the C3 cycle).
- C3 acid, so formed, is again transported to the mesophyll cells and regenerated back into PEP.
- C3 cycle cannot directly occur in the mesophyll cells of C4 plants because of the lack of the enzyme RuBisCO in these cells.
- RuBisCO is found in abundance in the bundle sheath cells of C4 plants.

Photorespiration

- It is a process in which there is no formation of ATP or NADPH, but there is utilization of ATP with release of CO_2. It is also considered a wasteful process.
- Photorespiration is responsible for the difference between C3 and C4 plants.
- At high temperature and high oxygen concentration, In C3 plants, RuBP carboxylases function as Oxygenase.
- RuBP oxidized into phosphoglycerate (3C) and phosphoglycolate (2C) 75% of carbon lost during oxygenation of RuBP
- There is loss of photosynthetically fixed carbon and no energy rich compounds are formed, so photorespiration is a wasteful process.

Differences between C3 and C4 Plants:

C3 plants	C4 plants
Photosynthesis occurs in mesophyll tissues.	Photosynthesis occurs both in mesophyll and bundle sheath cells.
The carbon dioxide acceptor is RuBisCO	The carbon dioxide accepter is PEP carboxylases.
Kranz anatomy is absent.	Kranz anatomy is present
The 1st stable compound formed is 3C compound called 3-PhosphoGlyceric Acid (PGA).	The 1st stable compound is 4-carbon Oxaloacetic acid (OAA).
The optimum temperature is 20-25 ^{0}C	The optimum temperature is 35 – 44 ^{0}C.
Photorespiratory loss is high.	Photorespiration does not take plac

Factors affecting rate of Photosynthesis:

- **Blackman's law of limiting factors**
  - ◊ When a physiological process is controlled by a number of factors, the rate of reaction depends on the lowest factor, so the factor which is the least/ limiting will determine the rate of Photosynthesis.
- Photosynthesis is influenced by internal (plant) factors and external factors.
- Light.
- Quality and intensity of light
- Wavelength of light between 400 nm 700 nm is called photosynthetically active radiation (PAR). High intensity of light destruct chlorophylls.

Temperature

- High temperature denatures enzymes of biosynthetic phase and low temperature inactivates.

Diagram Based Questions

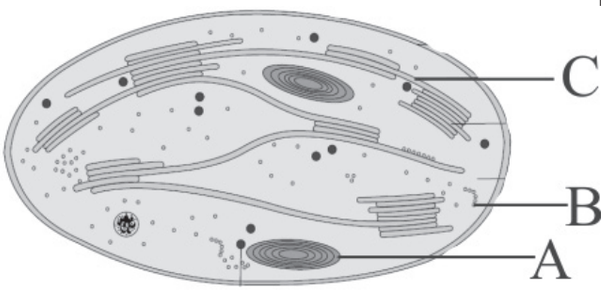


Figure 1

Name the part Labeled (A) _____

Name the part Labeled (B) _____

Name the part Labeled (C) _____

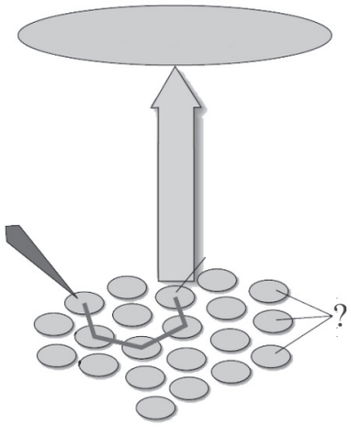


Figure 2

Name the part Labeled _____

What does they help in _____

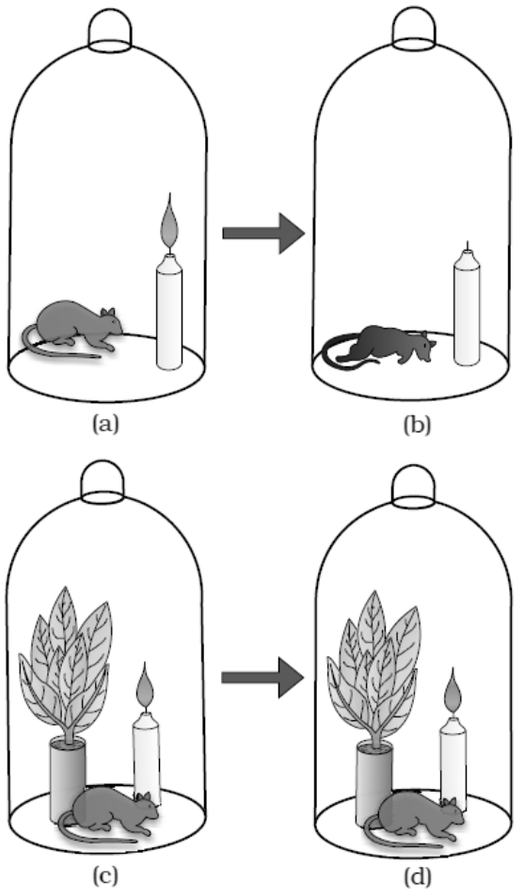


Figure 3

Who performed this experiment and what was the aim _____

Self Assessment Questions

1. **Which of the following conclusions regarding photosynthesis was proved by using radiosotopic techniques?**
   a. Light is essential
   b. O_2 comes from H_2O not from CO_2
   c. Glucose is stored as starch
   d. Exchange of gases with environment

2. **Which of the following statements are correct regarding synthesis of ATP in chloroplast during photosynthesis?**
   (A) Splitting of water in stroma helps in creation of proton gradient
   (B) Cytochrome complex helps in the release of protons in the lumen of thylakoid by accepting electrons from hydrogen carrier
   (C) Movement of protons across the membrane to the stroma through the F0 of the ATPase coupled with ATP synthesis
   (D) Reduction of $NADP^+$ to $NADPH + H^+$ is also a cause for creation of proton gradient
   a. All statements are correct
   b. (c) and (d)
   c. (a) and (b)
   d. (b), (c) and (d)

3. **What is the correct ratio of ATP utilisation in steps of Calvin cycle?**
   a. Reduction: Regeneration:: 1 : 1
   b. Reduction: Regeneration:: 2 : 1
   c. Reduction: Regeneration:: 2 : 2
   d. Reduction: Regeneration:: 1 : 2

4. **The productivity is better in C_4 plants because:**
   a. They increase the intracellular concentration of CO_2 in mesophyll cells
   b. In these plants RuBisCO has much greater affinity for O_2 than for CO_2
   c. These plants can prevent an competitive binding phenomena related to RuBisCO
   d. These plants minimise the carboxylase activity of RuBisCO

5. **Which of the following is not special about C_4 plants?**
   a. Responsiveness to high light intensities
   b. Lack of photorespiration
   c. Greater productivity
   d. Scotoactive stomata

6. **The correct sequence of cell organelles during photorespiration is:**
   a. Chloroplast, Golgi-bodies, mito-chondria
   b. Chloroplast, rough endoplasmic reticulum, dictyosomes
   c. Chloroplast, mitochondria, peroxisome
   d. Chloroplast, vacuole, peroxisome

7. **Read the following four statements (A- D):**
   a. Both photophosphorylation and oxidative phosphorylation involve uphill transport of protons across the membrane
   b. In dicot stems, a new cambium originates from cells of pericycle at the time of secondary growth
   c. Stamens in flowers of *Gloriosa* and *Petunia* are polyandrous
   d. Symbiotic nitrogen fixers occur in free-living state also in soil

8. **C_4 plants are more efficient in photosynthesis than C_3 plants due to:**
   a. Higher leaf area
   b. Presence of larger number of chloroplasts in the leaf cells
   c. Presence of thin cuticle
   d. Lower rate of photorespiration

9. **The first acceptor of electrons from an excited chlorophyll molecule of photosystem II is:**
   a. Iron-sulphor protein
   b. Ferredoxin
   c. Quinone
   d. Cytochrome

10. **Photosynthesis in C_4 plants is relatively less limited by atmospheric CO_2 levels because:**
    a. Effective pumping of CO_2 into bundle sheath cells
    b. Rubisco in C_4 plants has higher affinity for CO_2
    c. Four carbon acids are the primary initial CO_2
    d. The primary fixation of CO_2 is mediated via PEP carboxylase

11. **Plants adapted to low light intensity have:**
    a. Larger photosynthetic unit size than the sun plants
    b. Higher rate of CO_2 fixation than the sun plants
    c. More extended root system
    d. Leaves modified to spines

12. **Which pigment system is inactivated in red drop?**
    a. PS-I and PS-II
    b. PS-I
    c. PS-II
    d. None of the above

13. **For the synthesis of one glucose molecule the Calvin cycle operates for:**
    a. 2 times
    b. 4 times
    c. 6 times
    d. 8 times

14. Chlorophyll-a molecule at its carbon atom 3 of the pyrrole ring II has one of the following:
a. Carboxylic group b. Magnesium
c. Aldehyde group d. Methyl

15. Photorespiration is favoured by:
a. High temperature and low O_2
b. High humidity and temperature
c. High O_2 and low CO_2
d. High CO_2 and low O_2.

16. In C4 plants, CO_2 combines with:
a. Phosphoenol pyruvate
b. Phosphoglyceraldehyde
c. Phosphoglyceric acid
d. Ribulose diphosphate

17. During light reaction of photosynthesis, which of the following phenomenon is observed during cyclic phosphorylation as well as non-cyclic phosphorylation?
a. Release of O_2
b. Formation of ATP
c. Formation of NADPH
d. Involvement of PS I and PS II pigment systems

18. Maximum solar energy is trapped by:
a. Planting trees
b. Cultivating crops
c. Growing algae in tanks
d. Growing grasses

19. Choose the wrong statement:
a. Fixation of CO_2 means oxidation of carbon dioxide
b. Splitting of water molecules in the presence of light is called photolysis
c. O_2 released during photosynthesis comes from H_2O.
d. Photosynthesis occurs particularly in specialized cells called mesophylls

20. Choose the correct statement:
a. Non cyclic photphosphorylation includes P 680 and P 700
b. Photolysis of water takes place in photo system Ii
c. Light depended formulation of ATP is known as photophosphorylation
d. Photophosphorylation can occur non cyclically or cyclically

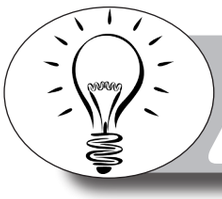
21. Which is the wrong statement:
a. Rubulosebisphosphate has the ability to combine with oxygen
b. RUBP can combine with CO_2
c. Photorespiration can take place in every cell
d. The oxygenation of photo respiration

22. Which is the wrong statement:
a. Rubulosebisphosphate has the ability to combine with oxygen
b. RUBP can combine with CO_2
c. Photorespiration can take place in every cell
d. The oxygenation of photo respiration

23. C_4photsynthetic pathway is more efficient than the C_3 path way due to:
a. Presence of Kranz anatomy
b. Presence of two types of photosynthetic cells
c. Presence of dimorphic chloroplasts
d. Poor supply of CO_2

24. C_4 plants avoid photorespiration because:
a. Of granal chloroplast
b. Agranal chloroplast
c. Light reaction occurs in mesophyll
d. Of two types of photosynthetic cells
d. Rubisco is present only in bundle sheath cells

25. In CAM-plants carbon dioxide required for photosynthesis enters the plant body during:
a. Day time through the lenticels
b. Night through the stomata, which are kept open
c. Day time when the hydathodes are open
d. Night when the hydathodes are open



Higher Order Questions

1. **What is true for photolithotrophs?**
   a. Obtain energy from radiations and hydrogen from organic compounds
   b. Obtain energy from radiations and hydrogen from inorganic compounds
   c. Obtain energy from organic compounds
   d. Obtain energy from inorganic compounds
2. **The rate of photosynthesis is higher in:**
   a. Very high light
   b. Continuous light
   c. Red light
   d. Green light
3. **Primary acceptor of CO_2 in C_3 plant is:**
   a. PEP Carboxylase
   b. RuBisCO
   c. Urease
   d. Hexose
4. **First stable product of C3 cycle:**
   a. 3-PGA
   b. Oxalic acid
   c. Citric acid
   d. Acetic acid
5. **What is not true about C4 plants?**
   a. They show a response to high light intensities
   b. They show kranz anatomy
   c. Calvin pathway takes place in mesophyll cells
   d. Show greater productivity of biomass
6. **C_4 plants have better productivity because:**
   a. C_4 plants absorb more light
   b. C_4 plants absorb more CO_2
   c. C_4 plants does not carry photorespiration
   d. C_4 plants have more amount of RuBisCO
7. **Consider the following statements regarding starch and sucrose synthesis during day time and select the correct ones.**

   (i) Triose phosphate is confined to choloroplast and is utilized for the synthesis of starch only.

   (ii) Triose phosphate is translocated to cytosol from chloroplast

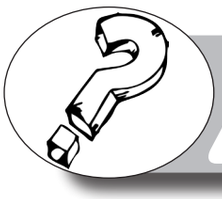
   (iii) Triose phosphate is utilized for the synthesis of both starch and sucrose

   (iv) Triose phosphate is translocated from cytosol to chloroplast

   a. (i) and (iii) b. (ii) and (iii)
   c. (ii) and (iv) d. (iii) and (iv)
8. **When wheat and sugarcane leaves are fed with radiactive $^{14}CO_2$, in which molecule would the radioactivity appear first in these plants?**

	Wheat	Sugarcane
(a)	3-Phosphoglycerate	Oxaloacetate
(b)	3-Phosphoglycerate	3-Phosphoglycerate
(c)	Oxaloacetate	Oxaloacetate
(d)	Malate	3-Phosphoglycerate

9. **A plant is kept in 300 ppm CO_2 concentration. What will happen to it:**
   a. Plant will die soon
   b. Plant will grow but will not die
   c. Plant will show normal photosynthesis
   d. Respiration will be greatly decreased
10. **Bundle sheath chloroplast of C4 plants are:**
    a. Large and agranal
    b. Large and granal
    c. Small and granal
    d. Small and agranal
11. **Donor and acceptor of electrons is the same chlorophyll molecule in:**
    a. Cyclic photophosphorylation
    b. Photorespiration
    c. Substrate level phosphorylation
    d. Non-cyclic photophosphorylation
12. **Action spectrum is:**
    a. A graph showing amount of light absorbed
    b. A graph showing rate of photosynthesis
    c. A graph showing absorption of light
    d. A graph showing amount of CO_2 released
13. **In Hill's experiment, Hill used _____ as oxygen acceptor:**
    a. Hydrogen b. FAD
    c. NADP d. Haemoglobin



NCERT Exemplar Problems

1. Which metal ion is a constituent of chlorophyll?
a. Iron
b. Copper
c. Magnesium
d. Zinc

2. Which pigment acts directly to convert light energy to chemical energy?
a. Chlorophyll-a
b. Chlorophyll-b
c. Xanthophyll
d. Carotenoid

3. Which range of wavelength (in nm) is called Photosynthetically Active Radiation (PAR)?
a. 100-390
b. 390-430
c. 400-700
d. 760-100,00

4. Which light range is most effective in photosynthesis?
a. Blue
b. Green
c. Red
d. Violet

5. Chemosynthetic bacteria obtain energy from:
a. Sun
b. Infrared rays
c. Organic substances
d. Inorganic chemicals

6. Energy required for ATP synthesis in PS II comes from:
a. Proton gradient
b. Electron gradient
c. Reduction of glucose
d. Oxidation of glucose

7. During light reaction in photosynthesis the following are formed:
a. ATP and sugar
b. Hydrogen, O_2 and sugar
c. ATP, hydrogen donor and O_2
d. ATP, hydrogen and O_2 donor

8. Dark reaction in photosynthesis is called so because:
a. It can occur in dark also
b. It does not depend on light energy
c. It cannot occur during day light
d. It occurs more rapidly at night

9. PEP is primary CO_2 acceptor in:
a. C_4 plants
b. C_3 plants
c. C_2 plants
d. Both C_3 and C_4 plants

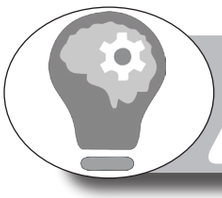
10. Splitting of water is associated with:
a. Photosystem I
b. Lumen of thylakoid
c. Both photosystem I and II
d. Inner surface of thylakoid membrane

11. The correct sequence of flow of electrons in the light reaction is:
a. PS II, plastoquinone, cytochromes, PS I, ferredoxin
b. PS I, plastoquinone, cytochromes, PS II, ferredoxin
c. PS I, ferredoxin, PS II
d. PS I, plastoquinone, cytochromes, PS II, ferredoxin

12. The enzyme that is not found in a C_3 plant is:
a. RuBP carboxylase
b. PEP carboxylase
c. NADP reductase
d. ATP synthase

13. The reaction that is responsible for the primary fixation of CO_2 is catalysed by:
a. RuBP carboxylase
b. PEP carboxylase
c. RuBP carboxylase and PEP carboxylase
d. PGA synthase

14. When CO_2 is added to PEP, the first stable product synthesised is:
a. Pyruvate
b. Glyceraldehyde-3-phosphate
c. Phosphoglycerate
d. Oxaloacetate



Assertion & Reason

1. **Assertion:** All prokaryotes show the presence of only one photosystem, i.e. PS I.

   Reason: No photolysis of water takes place in the prokaryotes lacking PS II.

2. **Assertion:** In oxidative phosphorylation, the electron flow from NADH to O_2.

   Reason: In photosynthesis, the electrons flow from H_2O to NADPH.

3. **Assertion:** Chloroplasts synthesize all protein which they require for photosynthesis.

   Reason: Chloroplast are tetrapyrrole structure and they contain Mg.

4. **Assertion:** Cycling photophosphorylation synthesizes ATP.

   Reason: ATP synthesise in cyclic photophosphorylation in associated with NADPH formation.

5. **Assertion:** CO_2 is transported from mesophyll cells to bundle sheath of chloroplasts in C_4 plans.

   Reason: RuBP is called final acceptor of CO_2 in C_4 plans.

6. **Assertion:** RuBisCO is located on the inner surface of thylakoid membrane.

   Reason: RuBisCO is also called carboxydismutase.

7. **Assertion:** 8 light quanta are required in photosynthesis.

   Reason: One light quantum is required to eject one electron and total 8 electrons are needed to be ejected.

8. **Assertion:** Photorespiration is a type of mitochondrial respiration.

   Reason: Photorespiration reduces photo-synthesis.

9. **Assertion:** Blue-violet and red light are most absorbed light by chlorophylls.

   Reason: In case of both light, photosynthetic products are always carbohydrates.

10. **Assertion:** Cyanide inhibit phloem translocation.

    Reason: Cyanide block the conducting elements.

11. **Assertion:** CAM plants show low transpiration.

    Reason: CAM plants lack efficient gas exchange.

12. **Assertion:** The efficiency of C4 plant is more than those of C3 plant.

    Reason: C4 plants are more efficient in picking CO_2.

13. **Assertion:** Excess Mn in soil, can adversely decrease Mg, Fe and Cu concentrations in the soil.

    Reason: Mn increases rate of photosynthesis, thereby increasing absorption of Mg, Fe and Ca from soil.

14. **Assertion:** Proton and hydrogen ion produced by photolysis of water are accumulated in the lumen of thylakoids.

    Reason: Splitting of water takes place on inner thylakoids membranes.

15. **Assertion:** Water stress in plant leads to reduction of CO_2 availability.

    Reason: Water strees causes stomata to open maximally.

16. **Assertion:** RuBisCO is an enzyme which can act both as oxygenase and carboxylase.

    Reason: Calvin cycle is common to both C3 and C4 plants.

17. **Assertion:** Chloroplasts are protected by carotenoids during light reaction.

    Reason: Carotenoids pick the nascent oxygen which is highly reactive and may damage chloroplast. It is produced during proteolysis of water molecules.

18. **Assertion:** The atmospheric concentration of carbon dioxide at which photosynthesis just compensates for respiration is referred to as carbon dioxide compensation point.

    Reason: The carbon dioxide compensation point is reached when the amount of carbon dioxide uptake is less that generated through respirations because the level of carbon dioxide in the atmosphere is more than that required for achieving carbon dioxide compensation point.

19. **Assertion:** Higher yields in case of bell pepper can be achieved by growing them in carbon dioxide enriched green houses.

    Reason: Due to higher intracellular CO_2 concentration in bundle sheath cells RuBisCO mainly acts as carboxylating enzyme.

20. **Assertion:** Under conditions of high light intensity and limited carbon dioxide supply, photorespirations has a useful role in protecting the plants from photooxidative damage.

    Reason: If enough carbon dioxide is not available to utilise light energy for carboxylation to processed, the excess energy may not cause damage to plants.

ANSWER KEY

Self Assessment Questions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b	d	b	c	d	c	a	d	c	d	a	c	c	d	c	a	b
18	19	20	21	22	23	24	25									
c	a	d	c	d	d	b	b									

Higher Order Questions

1	2	3	4	5	6	7	8	9	10	11	12	13
b	c	b	a	c	c	b	a	c	b	a	d	d

NCERT Exemplar Problems

1	2	3	4	5	6	7	8	9	10	11	12	13	14
c	a	c	c	d	a	c	b	a	d	a	b	c	d

Assertion & Reason

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
c	b	e	b	e	e	a	e	c	c	b	a	d	b	c	b	a
18	19	20														
e	a	a														

EXPLANATIONS

Assertion & Reason

1. (c) *Assertion is false but reason is true.*

Purple bacteria and green bacteria lack photosystem II, while blue-green bacteria show the presence of both photosystems. Photosystem II (P_{700}) is directly involve in photo oxidation of water and release of molecular oxygen. Lacking photosystem II, purple bacteria and green bacteria cannot use H_2O as a reductant for CO_2 assimilation; this function is assumed by other reduced inorganic compound like sulphur etc.

2. (b) *Both assertion and reason are true but the reason is not the correct explanation of assertion.*

In the process of oxidative phosphorylation is mitochondria, the flow of electrons from NADH to O_2 takes place following the oxidation-reduction potential, i.e. from — 0.6 + 0.82 volts. In photosynthesis the opposite phenomenon occurs and the electron flow from H_2O to NADPH to reduce $NADP^+$ to NADPH.

3. (e) *Assertion is true but reason is false.*

Chloroplasts are semiautonomous organelles as they possess their own DNA. They contain 70s ribosomes, which account for upto 50% of the total ribosomes in photosynthetic cells. The presence of such ribosomes provide evidence that these organelles contain a specific protein synthesizing system. Although some protein synthesis (about 10%) occurs within the chloroplast, most protein are made in the cytosol and are translocated into this organelle.

4. (b) *Both assertion and reason are true but the reason is not the correct explanation of assertion.*

In case of cyclic photophosphorylation, the electron, while passing between ferredoxin and/or over the eytochrome complex, the electron loses sufficient energy to form ATP from ADP and inorganic phosphate.

5. (e) *Assertion is true but reason is false.*

Malic acid or aspartic acid is translocated to bundle sheath cells throughplasmodesmata. Inside the bundle sheath cells they are decarboxylase (and delaminated in case of aspartic acid) to form pyruvate and CO_2. CO_2 is again fixed inside the bundle sheath cells through Calvin cycle. RuBP of Calvin cycle is called secondary or final acceptor of CO_2 in C_4 plants.

6. (c) *Assertion is false but reason is true.*

RuBP carboxylase or rubisco was previously called carboxydismutase. It is located on the outer surface of thylakoid membrane.

7. (a) *Both assertion and reason are true and the reason is the correct explanation of assertion.*

8. (c) *Assertion is false but reason is true.*

The types of respiration that occurs in illuminated green plants is not a type of mitochondrial respiration since it is not sensitive to characteristic inhibitors like of mitochondrial respiration. Such "light" respiration, which is called photorespiration, consumes reducing power generated by photosynthesis and uses it to reduce molecular oxygen. Photosynthesis thus reduces photosynthesis a since it diverts the normal flow of light induced reducing power from the reduction of carbon dioxide into the reduction of oxygen.

9. (c) *Assertion is true but reason is false.*

Maximum photosynthesis occurs is blue violet and red regions of the light spectrum where most of the absorption is carried out by chlorophylls. Red light favours carbohydrate accumulation while blue light stimulates protein synthesis.

10. (c) *Assertion is true but reason is false.*

Metabolic inhibitors such as cyanide to do not inhibit phloem translocation by affecting the metabolism of the conducting elements, but do so by being translocated to the sources or sink regions, where they inhibit photosynthesis and loading and unloading processes.

11. (b) *Both assertion and reason are true but the reason is not the correct explanation of assertion.*

The stomata of CAM plants are closed during the day and open at night. Thus stomatal behaviour and the reduced rate of stomatal transpiration due to night time environmental factors account for the low transpiration rates of CAM plants. CAM plants have a low ratio of surface areas to volume, which is an important structural character for water retention but not necessarily for efficient gas exchange.

12. (a) *Both assertion and reason are true and the reason is the correct explanation of assertion.*

The efficiency of C4 plants is more than those of C3 plants because C4 plants are more efficient in picking up CO_2 even where it is found in low concentration because of high affinity of PEP.

13. (d) Manganese is a micrountrient. Its excess may cause toxicity. Manganese competes with iron and magnesium for uptake and for binding with enzymes. Therefore, its excess induce deficiencies of iron, magnesium and calcium.

14. (b) *Both assertion and reason are true but the reason is not the correct explanation of assertion.*

The first step in photosynthesis is light driven oxidation (splitting or photolysis) of water. It provides the electrons for the photosynthetic electron transport chains as well as protons for establishment of a proton gradient. It occurs on luminal side of thylakoid membrane.

15. (c) *Assertion is true but reason is false.*

Water stress causes the stomata to close hence reducing the CO_2 availability. Opening of stomata leads to transpiration i.e. loss of water through stomata.

T: In stomata — Opening — Out

(Outside Movement of water)

16. (b) *Both assertion and reason are true but the reason is not the correct explanation of assertion.*

Bundle sheath cells are rich in an enzyme Rubisco (Ribulose bisphosphate carboxylage oxygenase). It is characterized by a fact that its active site can bind to both CO_2 and O_2.

17. (a) *Both assertion and reason are true and the reason is the correct explanation of assertion.*

Carotenoids protect chloroplast from photo oxidation during high light intensity.

It picks up the nascent oxygen produced during photolysis of water which is highly reactive and may damage chloroplast.

18. (e) *Assertion is true but reason is false.*

The point at which CO_2 released in respiration is exactly compensated by CO_2 fixed in photosynthesis is called compensation point.

Since the rate of fixation of CO_2 in photosynthesis just, balances the rate of CO_2 released in respiration, the net gas exchange is zero at compensation point.

19. (a) *Both assertion and reason are true and the reason is the correct explanation of assertion.*

It is true that higher yields in case of bell pepper can be achieved by growing them is CO_2 rich greenhouse. RuBisCO is located only in bundle sheath cells in C_4-plants where photosynthetic release of O_2 does not occur.

Bundle sheath cells have a high inter cellular concentration of CO_2 due to flow of C_4-acids and their carboxylation to release CO_2. Therefore, RuBisCO function purely as carboxylase in C_4-plants.

20. (a) *Both assertion and reason are true and the reason is the correct explanation of assertion.*

The photorespiration is light induced oxidation of photo-synthetic intermediate with the half of O_2 for this RuBP enzyme function as RuBP orxygenase and no ATP, NADPH formation takes place.

Instead, oxygen is used and CO_2 is realesed. The photorespiration is stimulated by

(i) High O_2 concentration.

(ii) Low CO_2 concentration.

(iii) High light intensity

(iv) High temperature

(v) Ageing of leaf

DBQ Answers

Figure 1

Name the part Labeled (A) : Starch granule

Name the part Labeled (B) : Ribosomes

Name the part Labeled (C) : Stromal lamella

Figure 2

Name the part Labeled : Pigment molecules

Absorb sunlight and give it to chlorophyll molecule

Figure 3

Joseph Priestley (1733-1804) in 1770 performed a series of experiments that revealed the essential role of air in the growth of green plants.

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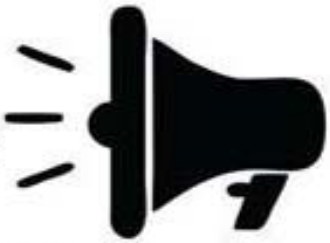

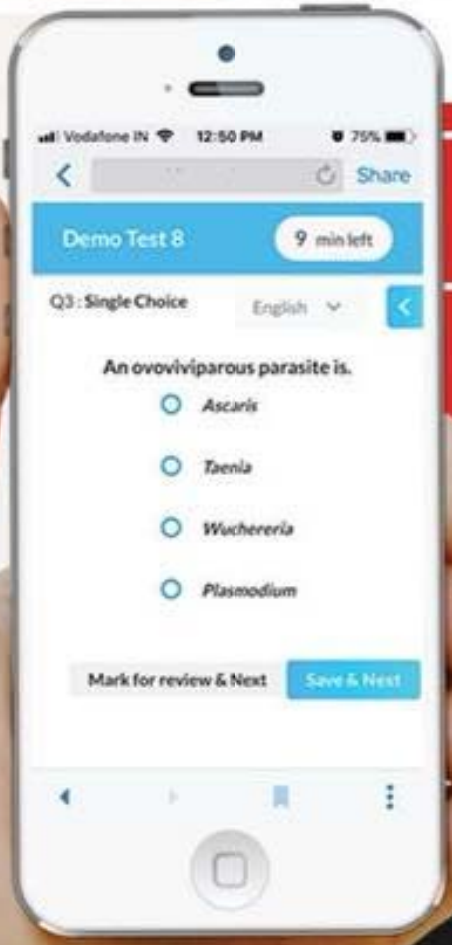

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