CHAPTER-13

PHOTOSYNTHESIS IN HIGHER PLANTS

(Question carrying one Mark)

1. What is Photosynthesis?

   Ans: Physico-chemical process by which plants use light energy to drive the synthesis of organic compounds.

2. Which form of energy do plants use to synthesise organic Compounds?

   Ans: Light energy or solar energy.

3. The leaf which is partially covered with black paper does not show the presence of starch. Why?

   Ans: Photosynthesis does not occur in black paper covered part of leaf due to absence of sun-light.

   Or

   Photosynthesis occurs in the green parts of the leaves in presence of light.

4. Whose experiment showed that air is essential for green plants?

   Ans: Joseph Priestly.

5. Who described the action spectrum of Photosynthesis?

   Ans: T.W. Engelmann.

6. Give the correct equation that represents overall process of Photosynthesis?

   Ans: $6Co_2+12H_2O \xrightarrow{light} C_6H_{12}O_6+6H_2o+6O_2$

7. Who demonstrated that Photosynthesis is light dependent reaction?

   Ans: Cornelius van Niel.

8. Where does Photosynthesis occur?

   Ans: Chloroplast.

9. What is light reaction?

   Ans: The membrane system consisting of grana, and stroma lamella is responsible for the trapping the light energy and also for synthesis of ATP and NADPH. This directly light driven process is called light reaction.

Or

Light reaction include light absorption, water splitting, oxygen release and the formation of ATP and NADPH.

10. What is dark reaction?

Ans: In stroma, enzymatic reaction incorporate Co_2 into the plant leading to the synthesis of sugar.

11. What are Photosynthesis pigments?

Ans: Pigments are substances that have the ability to absorb light, at specific wave length.

12. Name the most abundant pigment is plants.

Ans: Chlorophyll 'a'

13. What is an electro transport system?

Ans: During light reaction electrons excited from chlorophyll 'a' are picked up by electron acceptor which passes them through a series of cytochromes. The movement of electron is down hill in terms of oxidation- reduction. This is called electron transport system.

14. Define Photophosphorylation .

Ans: Synthesis of ATP from ADP and inorganic phosphate in the presence of light.

15. Which is the site of non-cyclic photo phosphorylation?

Ans: Lamellae of grana.

16. Name the first product formed when Co_2 is fixed during dark reaction in C_3 cycle.

Ans: 3 phosphoglyceric acid or PGA .

17. Name the first product formed after carboxylation in C_4 cycle.

Ans: Oxaloactic Acid or OAA.

18. Name the primary acceptor of Co_2 in C_3 cycle.

Ans: RUBP or Rebulose bi phosphate.

19. Name the primary acceptor of Co_2 in C_4 cycle.

Ans: Phospho enol pyruvate or PEP.

20. Name the enzyme involved in carboxylation in C_3 cycle.

Ans: RUBP carboxylase – Oxygenase or Rubisco.

21. Name the enzyme involved in carboxylation in C_4 cycle.

Ans: PEPcarboxylase or PEPcase.

22. Name the enzyme that synthesize ATP.

Ans: ATP Synthase or ATP ase.

23. Mention the electron carries in photo system I.

Ans: Cytochromes.

24. Define photo respiration.

Ans: Process of conversion of rebulose bi phosphate into phospho glycerate and phosphoglycolate in presence of O_2 and enzyme Rubuis co is called photo respiration.

25. Name the most abundant enzyme in the world.

Ans: RUBis Co.

26. How many turns of C_3 cycle are required for the synthesis of one molecule of glucose?

Ans: 6 turns of the cycle are required to make one molecule of glucose

27. How many ATP are required for fixation of one molecule of Co_2 in Calvin Cycle?

Ans: 3 molecules of ATP.

28. How many NADPH is required For fixation of one molecule of Co_2 in Calvin's Cycle?

ANS: Two molecules of NADPH.

29. Which is the chief pigment associated with photosynthesis?

Ans: Chlorophyll a.

30. Who proposed the law of limiting factor?

Ans: Blackmann.

31. In which reaction, the fixation for carbon dioxide occurs?

Ans: Dark Reaction.

32. What is action spectrum?

Ans: a graph showing rate of photosynthesis at different Wavelength of light in plants.

33. What is absorption spectrum?

Ans: A graph showing absorption of light by pigments at different Wavelengths of light by plants during photosynthesis.

(Question carrying Two Marks)

1. Mention two significance of Photosynthesis.

   Ans: i Production of food.

   ii Release of O_2 into atmosphere.

2. Name the four factors required for Photosynthesis.

   Ans: Chlorophyll, light, CO_2 and Water.

3. List out the product of Light reaction.

   Ans: ATP, NADPH, O_2 and H_2O.

4. Name the Photosynthetic pigments.

   Ans: Chlorophyll a, Chlorophyll b, Xanthophylls, and carotenoids

6. Mention the functions or significance of accessory pigments?

   Ans: 1) Accessory pigments absorbs light and transfer the energy to Chlorophyll a.

   2) Protect Chlorophyll a from photo-oxidation.

9. Explain briefly Regeneration.

   Ans: 1) Regeneration of CO_2 acceptor molecule RUBP takes place.

   2) One molecule of ATP is required for Phosphorylation to form RUBP.

10. Mention the external factors that affect the rate of Photosynthesis.

    Ans: Light, carbon dioxide, Temperature, Water.

11. State the law of limiting factors.

    Ans: If a Chemical process is affected by more than one factor, then It's rate will be determined by the factor which is nearest to It's minimum value. It is the factor which directly affect the process if it's quantity is not changed.

12. Mention the internal factors that affect the rate of Photosynthesis.

    Ans: 1) Number, size, age and orientation of leaves.

    2) Mesophyll cells.

    3) Chloroplast and amount of Chlorophyll a.

    4) Internal CO_2 concentration.

13. How do C_3 plants respond to higher concentration of Co_2?

Ans: C_3 Plants respond to higher Co_2 Concentration by showing increased rates of photosynthesis this leads to higher productivity of food.

14. What is the effect of Temperature on rate of Photosynthesis in Temperate and Tropical plants?

Ans: Tropical plants have a higher Temperature optimum
Temperate plants have a lower Temperature optimum.

15. Who proposed C_4 Cycle?

Ans: M.D.Hatch and C.R.Slack.

16. What are C_3 Plants? Give Example.

Ans: The plants in which the first carbon dioxide fixation product is a 3 carbon compound i.e phospoglyceric acid.
Ex: Tomato, bellpepper.

17. What are C_4 Plants? Give Example.

Ans: The palnts in which the first carbon dioxide fixation product is a 4 carbon compound i.e Oxalo acetic acid .
Ex: Maize or Sorghum.

(Question carrying Four Marks)

1. Write the Z scheme of the light reaction.

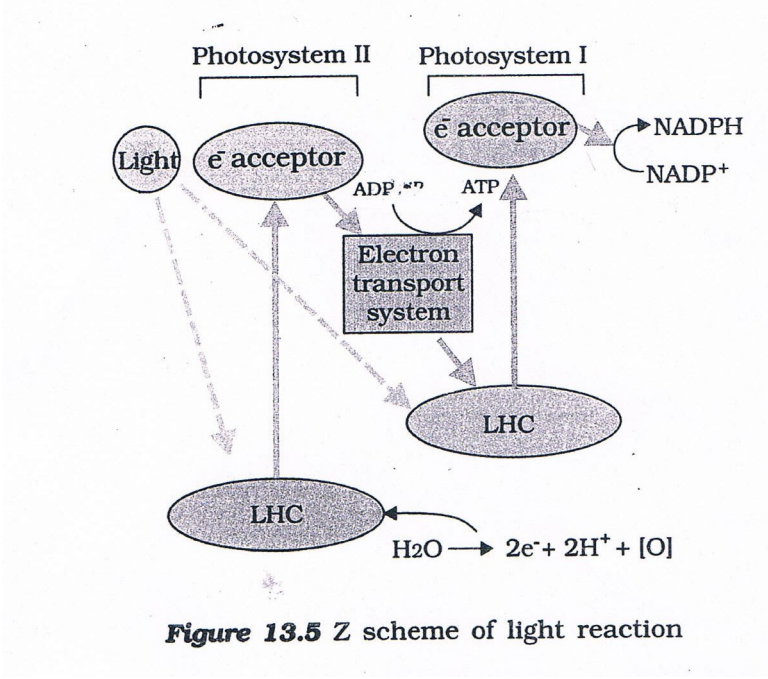
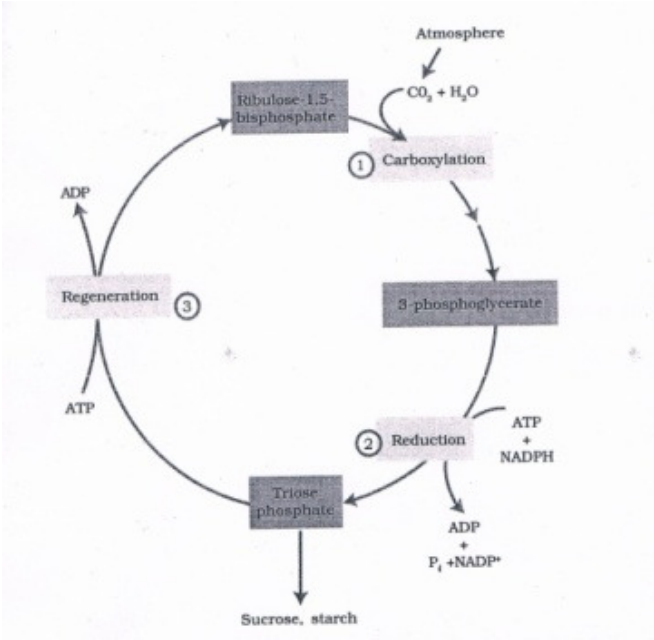


Figure 13.5 Z scheme of light reaction

2. Write the schematic representation of C_3 Cycle.



3. Differentiate between PS I and PS II.

Ans:

PS I	PSII
1) reaction center P700	Reaction center P680
2) Involved in both cyclic and Non-cyclic photophosphorylation	involved in only non-cyclic photophosphorylation
3) water Splitting complex is not	Water Splitting complex is not

associated with PS I	associated with PS II
4) Found in stroma lamellae and Grana lamellae	Found in grana lamellae

4. List out the differences between cyclic and non- cyclic photo phosphorylation.

Cyclic photophosphorylation	**Non-Cyclic photophosphorylation**
1) only Ps I is Involved	Both Ps I and PSII are involved
2) ATP is Synthesised	ATP and NADPH are Synthesised
3) Occur in Stroma lamella	Occur in grana lamella
4) Electrons return back to PS I	Electrons do not return PS I
5) splitting of water does not occur	splitting of water occur
6) 700 nm wave length of light is required.	680 nm wave length of light is required

5. Write the differences between C_3 cycles an dC_4 cycle.

C_3 Cycle	**C_4 Cycle**
1)Primary acceptor of CO_2 is RUBP	Primary acceptor of CO_2 is Phosphenol Pyruvate
2) first product after carboxylation is PGA with 3 carbon atoms	first product after carboxylation is Oxallo acetic acid with 4 carbon atoms
3)enzyme involved in Carboxylation is RUBisCo	enzyme involved in PEP carboxylase or PEPcase
4) Occurs in mesophyll cells	Occurs in bundle sheath cells

6. Describe the half leaf experiment to show that Co_2 is necessary for Photosynthesis.

Ans: 1) A part of leaf is enclosed in a test tube containing KOH Soaked cotton.

2) KOH absorbs CO_2.

3) The other part of the leaf is exposed to air.

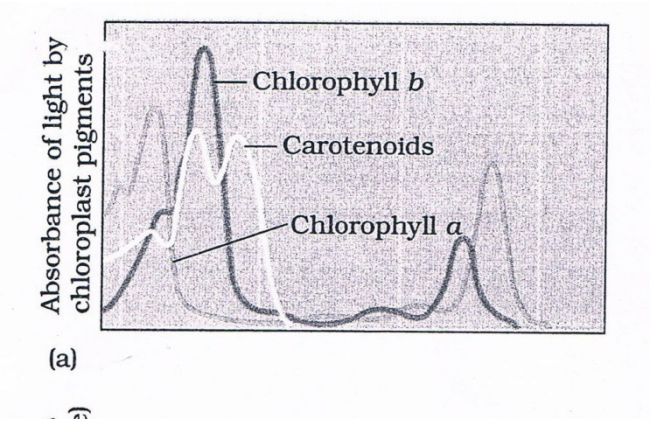
4) The set up is placed in sunlight for some time .

5) On testing for starch, the part of leaf exposed to air tested +ve.

6) the part of the leaf enclosed in the test tube containing KOH solution tested –ve for starch.

7. Draw a graph showing absorption spectrum of chlorophyll a, b and carotenoids , and explain.

Ans:



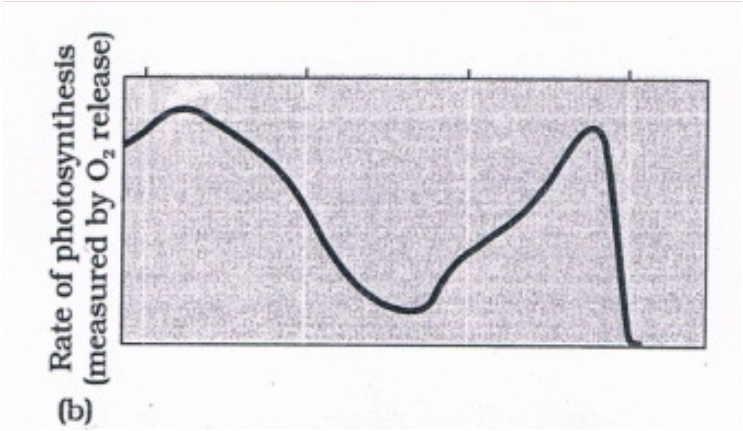
Ans:1) Chlorophyll a which shows maximum absorption in Blue and red wavelengths of light.

2) Chloropyll b shows absorption of 460 nm wave length of light.

3) Carotinoids absorbs between 450 to 500nm wavelength of light.

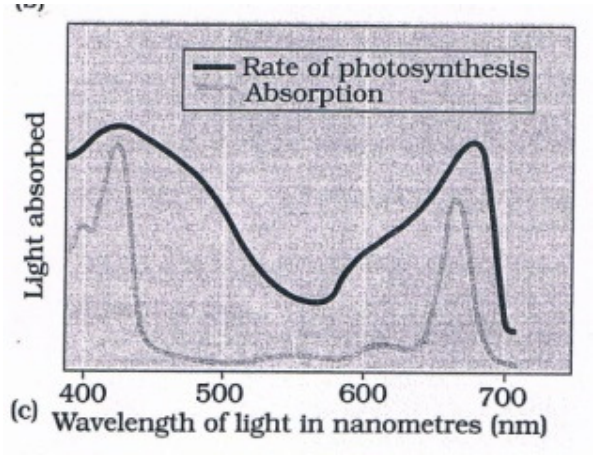
8. Draw a graph showing action Spectrum of Photosynthesis and discuss.

Ans:



The graph shows that the maximum rate of Photosynthesis occur in blue and red region of spectrum.

9. Draw a graph showing action spectrum of Photosynthesis. Super imposed on absorption spectrum of chlorophyll a, and comment.



Ans: 1) The graph shows that maximum rate of Photosynthesis takes place in Blue and Red region of spectrum .

2) chlorophyll a shows the maximum of absorption of light also In blue and red region of the spectrum.

10. Draw the neat labelled diagram of section of chloroplast.

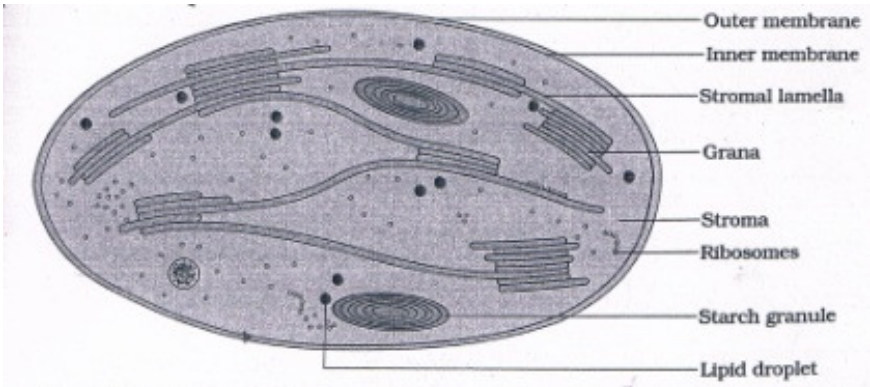


Figure 13.2 Diagrammatic representation of an electron micrograph of a section of chloroplast

11. Explain briefly carboxylation.

Ans: 1) Carboxylation is the fixation of CO_2 into a stable organic Intermediate.

2) CO_2 is utilized for corboxylation of RUBP.

3) This reaction is catalysed by enzyme RUBP carboxylase.

4) Results in formation of 2 molecules of
3 phosphoglyceric acid.

12. Explain briefly Reduction.

Ans: 1) It is series of reactions that lead to the formation of Glucose.
2) It involves utilisation of 2 molecule of ATP.
3) It involves utilisation of 2 molecules of NADPH for reduction Per CO_2 molecule fixed.
4) For synthesis of one molecule of Glucose, 6 Molecules of Co_2 and 6 terns of the cycle are required.

13. Explain briefly splitting of water during non cyclic photophorylation.

Ans: 1) the splitting of water is associated with PS II.
2) Water is split into H^+, [O] and electrons.
3) Water splitting complex is associated with PS II.
4) $2H_2O \longrightarrow 4H^+ + O_2 + 4e^-$

14. List out the differences between Anatomy of Leaf in C_3 and C_4 Plants

Anatomy of leaf in C_3 plants	**Anatomy of leaf in C_4 plants**
1)C_3 plants occur in all types of climates	C_4 plants occur in tropical region climates
2) They do not show Kranz anatomy	Leaves shows Kranz anatomy
3) Mesophyll is differentiated	Mesophyll cells are not Differentiated
4) Bundel sheath absent	Bundel sheath present

15. Write the Schematic representation of Cyclic Photophosphorylation

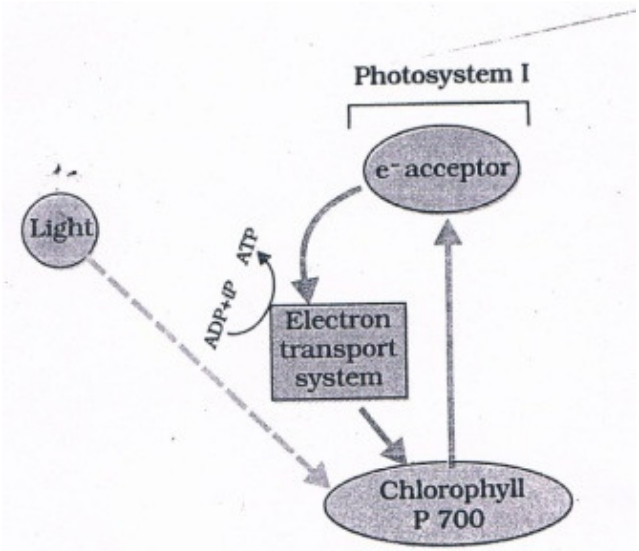


Figure 13.6 Cyclic photophosphorylation

(Question carrying Five Marks)

1. Describe Priestley's bell jar experiment to show that plants restore air that the animals breath and burning candles remove.

Ans:

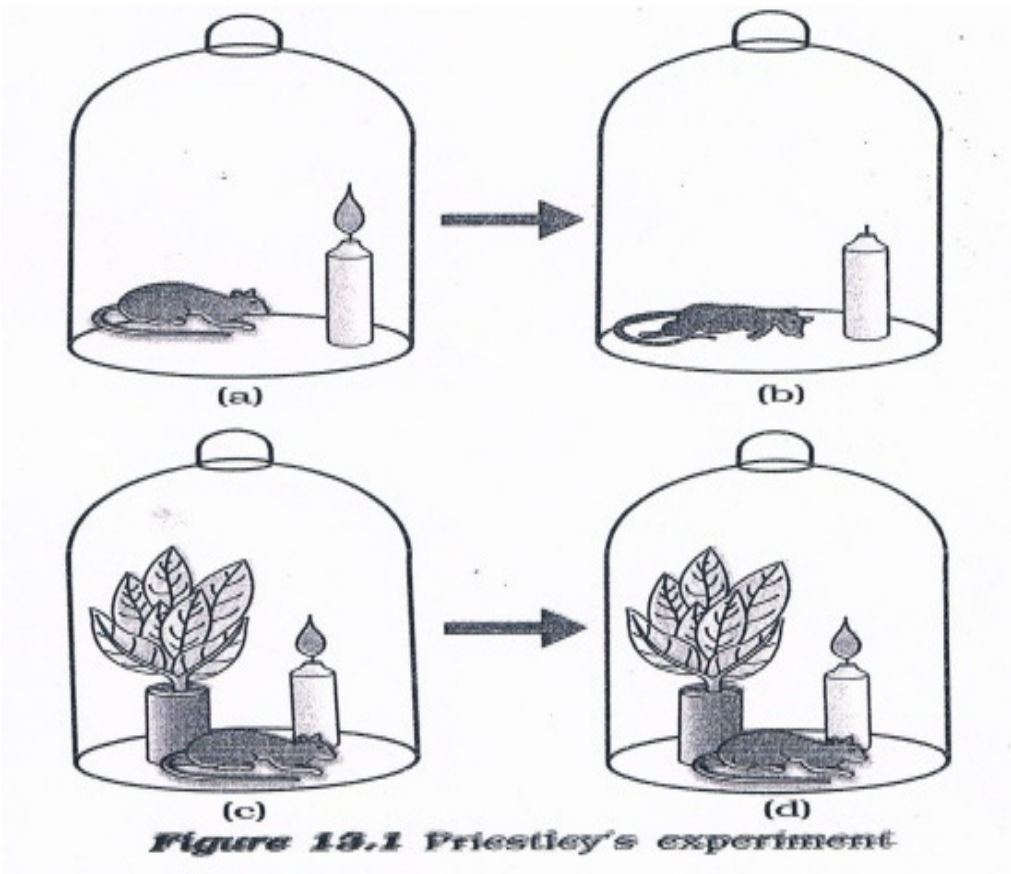


Figure 13.1 Priestley's experiment

Ans: 1) Joseph Priestley performed a series of experiments that

Revealed the essential role of air in the growth of Green plants.

2) A candle burning in a closed bell jar soon gets extinguished.

3) A mouse place in a closed bell jar gets suffocated.

4) Priestley concluded that burning candle and breathing mouse Both damage the air.

5) When a mint plant was placed in the bell jar, a mouse stayed Alive, and the candle continued to burn.

6) Thus plants restore air that the animals breathe and burning candles remove.

2. Explain Z scheme of light reaction.

Ans: 1) Both PS I and PS II are involved in non cyclic photo Phosphorylation.

2) In PS II, chlorophyll a in reaction center P 680 absorb 680nm wave length of red light.

3) Electrons become excited and jump into an orbit farther from the atomic nucleus.

4) These Electrons are picked by an electron acceptor which passes them to an electron transport system.

5) Movement of the electron is down hill in terms of oxidation------reduction potential scale. One ATP is produced.

6) Electrons then pass to PS I.

7) A molecule of energy reach NADP is reduced to $NADPH+H^+$

8) Water is split into H^+, (O), and Electrons.

9) Electrons removed from PS I are replaced by PS II by splitting of water.

3. Explain the process of synthesis of ATP through chemiosmosis.

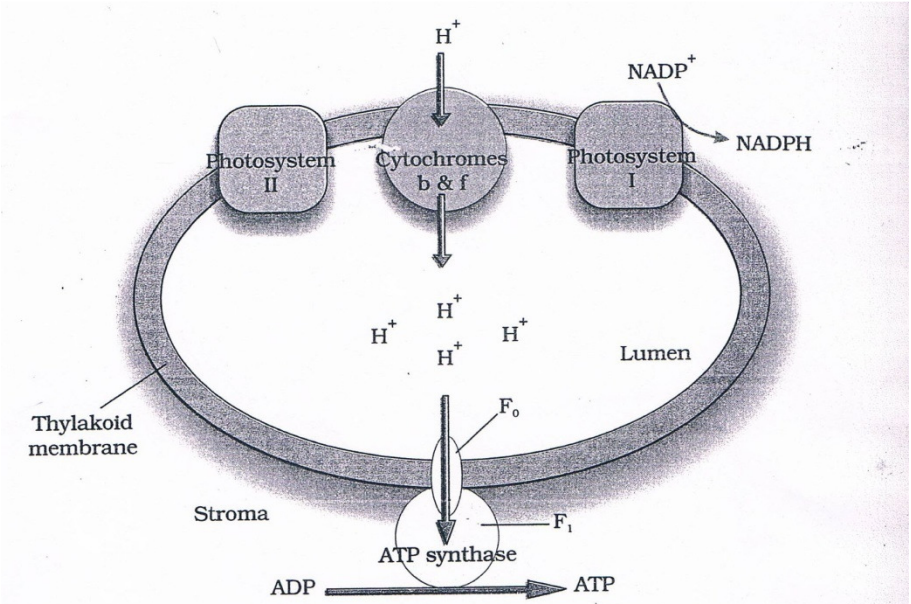


Figure 13.7 ATP synthesis through chemiosmosis

Ans: 1) ATP synthesis linked to development of a proton gradient across thylakoid membrane

2) Protons or hydrogen Ions are produced by splitting of Water during non cyclic photophosphorylation and during electron transfer in electro transport system .

3) The proton or hydrogen accumulate towards inside of membrane i.e in the lumen.

4) This results in development of proton Gradient across the thylakoid membrane.

5) The ATP ase enzyme consists of two parts: one Called Fo is embedded in the membrane it forms the trans membrane channel . the other called F1 which protrude on the outer surface of thylakoid membarane.

6) ATP ase has a channel that allows diffusion of protons back across the membrane.

7) This releases enough energy to activate ATP ase that catalyses the formation of ATP.

4. Explain C_3 Cycle.

Ans: I) Carboxylation

1) Corboxylation is the fixation of CO_2 into a stable organic Intermediate.
2) CO_2 utilized for corboxylation of RUBP.
3) This reaction is catalysed by enzyme RUBP corboxylase.
4) Results in formation of 2 molecules of 3 phosphoglyceric acid

II) Reduction.

1) It is series of reactions that lead to the formation of Glucose.
2) It involves utilisation of 2 molecule of ATP.
3) It involves utilisation of 2 molecules of NADPH for reduction per CO_2 molecule fixed.
4) For synthesis of one molecule of Glucose, 6 Molecules of Co_2 and 6 terns of the cycle are required.

III) Regeneration.

1) Regenration of CO_2 acceptor molecule RUBP takes place.
2) One molecule of ATP is required for Phosphorylation to form RUBP.

5. Explain C_4 Cycle.

Ans: 1) The first product of carboxylation is 4 carbon compound oxaloacetic acid .
2) Plants adapted to dry tropical region have C_4 pathway.
3) The primary CO_2 acceptor is a 3 carbon molecule phosphoenol pyruvate.
4) A 4 Carbon molecule oxalo acetic acid is formed.
5) This reaction is catalysed by enzyme PEP carboxylase or PEP case in mesophyll cells .
6) Oxalo acetic acid is converted into malic acid or aspartic acid which are transported to bundle sheath cells.

7) Malic acid or aspartic acid is broken down to release CO_2 and a 3 corbon molecule.

8) Co_2 relesed in a bundle sheath cells enter the Calvin's Pathway.

9) Bundle sheath cells are rich in enzyme Ribulose bi phosphate Carboxylase------- oxigenase (RuBis CO).

10) The basic pathway result in formation of sugars .

7. Write the schematic representation of the Hatch and Slack pathway.

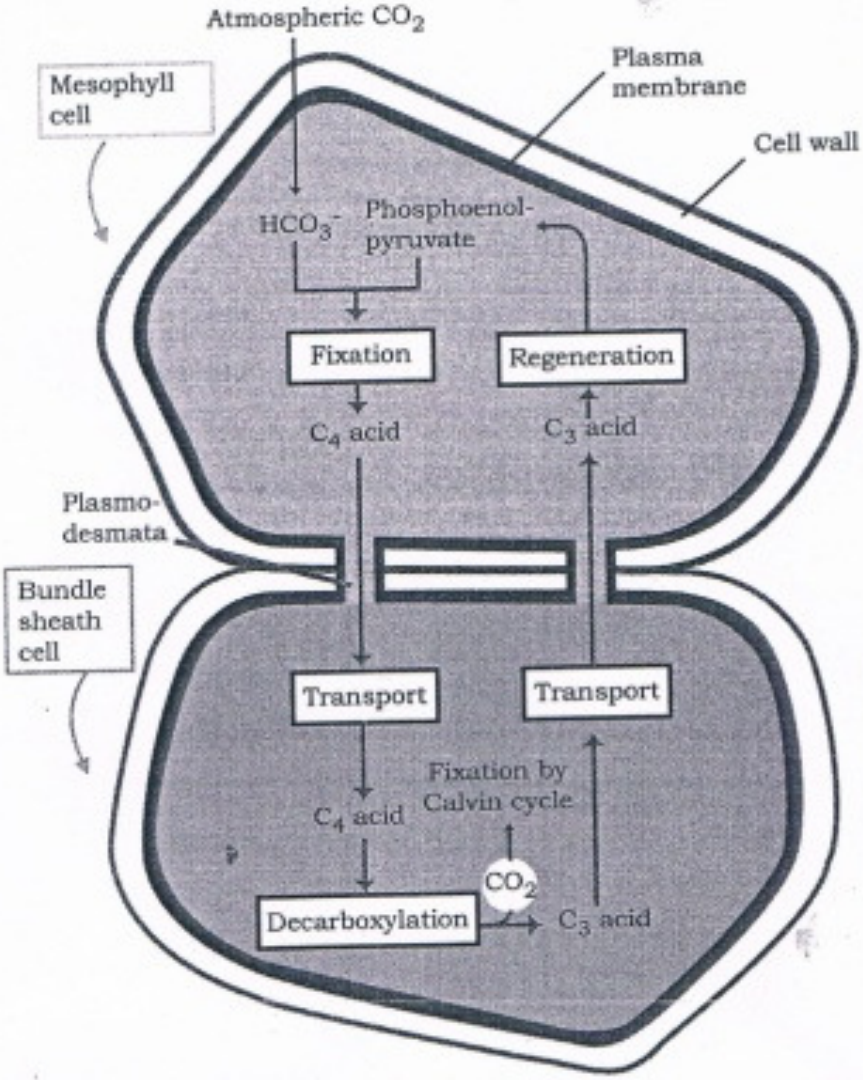


Figure 13.9 Diagrammatic representation of the Hatch and Slack Pathway

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