



## BIOLOGY

### BOOKS - MBD

# Photosynthesis in Higher Plants

#### Example

1. Name the specialised cells where photosynthesis occurs.

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2. Which part of chloroplast contains machinery for photochemical reaction of photosynthesis?

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3. Name the most important pigment capable of absorbing light.

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4. Which pigment provides green colour to leaves ?

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5. What is the reaction centre?

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6. What is photosystem?

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7. Who formulated the light driven reactions of photosynthesis?



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8. Which chlorophyll is termed as universal photosynthetic pigment?



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9. Name the photosynthetic pigment which can be converted to vitamin A.



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10. Name the central element present in chlorophyll.



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11. Which is the pigment present in reaction centre of photosystem-I and photosystem -II?

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12. Which pigment system is not directly involved in photooxidation of water and evolution of molecular oxygen?

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13. Expand RuBisCo.

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14. Name the enzyme which splits ribulose-1, 5-bisphosphate into 3-phosphoglyceric acid and 2-phosphoglycolic acid.

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15. Name any two  $C_4$  plants.



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16. Why is ATP essential for dark reaction?



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17. Which is the pigment present in reaction centre of photosystem-I and photosystem -II?



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18. Which colours of the visible light spectrum are most effective in photosynthesis?



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19. Which colour of light is least effective in photosynthesis?



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20. What is  $P_{700}$ ?



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21. Mention two conditions where light can become a limiting factor.



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22. Specify two conditions in which photorespiration may take place in green plants.



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23. Does photorespiration release energy?



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24. Define limiting factor.

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25. Who studied the effects of limiting factors?

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26. What is the effect of light intensity on rate of photosynthesis?

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27. Define light compensation point.

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28. What is  $C_2$  cycle?



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**29.** Fill in the blank

Photosynthesis is processed by which green plants trap .....energy and convert it into .....energy of carbohydrates.



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**30.** Fill in the blank

RuBP carboxylase, in the presence of high concentration of .....acts as oxygenase.



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**31.** Fill in the blank

In  $C_4$  pathway pyruvic acid is generated in the cells and is transferred back to .....



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**32.** Fill in the blank

All the pigments are located in..... membrans of chloroplast.



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**33.** Fill in the blank

The radioactive spots on chromatogram can be located by .....



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**34.** Fill in the blank

Biochemical mechanism for photo respiration is also called .....  
metabolism.



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**35. Fill in the blank**

Chemiosmosis requires a membrane, .....a proton gradient and ATPase.

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**36. Fill in the blank**

PGA is an abbreviation for .....

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**37. Fill in the blank**

Kranz menas '.....' and is reflection of arrangement of cells.

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**38. True or False**

Chloroplast is differentiated into two structural components i.e. grana

and stroma.



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**39.** True or False

$C_3$  plants are more efficient than  $C_4$  plants due to absence of photorespiration.



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**40.** True or False

Photo System II has the trap centre known as  $P_{680}$ .



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**41.** True or False

The large cells around vascular bundles of the  $C_4$  pathway plants are called bundle sheath cell.



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**42.** True or False

To make one molecule of glucose 6 turns of cycle are required.



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**43.** Give the technical terms used for the following:

A group of yellow, orange and red pigment found mostly in plastids.



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**44.** Give the technical terms used for the following:

The process of addition of a phosphate group to ADP to form ATP using light energy.



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**45.** Give the technical terms used for the following:

Emission of light, usually visible, of wavelength different from that absorbed from irradiated materials, or from impact of electrons.

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**46.** Give the technical terms used for the following:

The curve showing wavelength of light absorbed by photosynthetic pigments.

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**47.** By looking at a plant externally can you tell whether a plant is  $C_3$  or  $C_4$ ? Why and how?

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48. By looking at which internal structure of a plant can you tell whether a plant is  $C_3$  or  $C_4$ ? Explain.

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49. Even though a very few cells in a  $C_4$  plant carry out the biosynthetic - Calvin pathway, yet they are highly productive. Can you discuss why?

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50. RuBisCO is an enzyme that acts both as a carboxylase and oxygenase. Why do you think RuBisCo carries out more carboxylation in  $C_4$  plants?

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51. Suppose there were plants that had a high concentration of Chlorophyll b, but lacked chlorophyll a, would it carry out

photosynthesis? Then why do plants have chlorophyll b and other accessory pigments?

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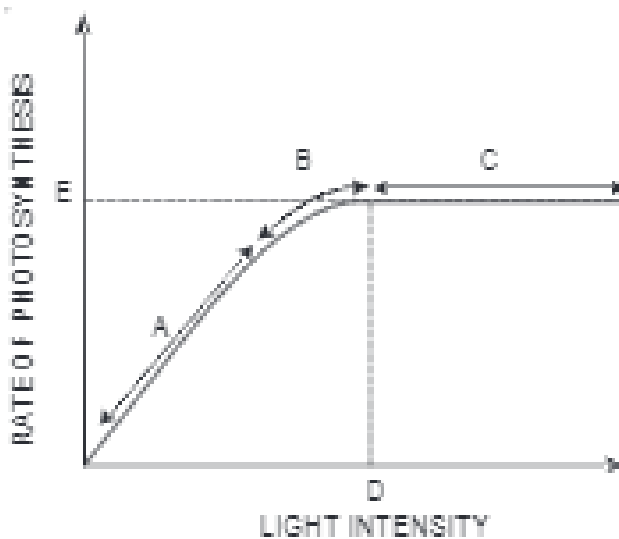
**52.** Why is the colour of a leaf kept in the dark frequently yellow, or pale green?

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**53.** Look at leaves of the same plant on the shady side and compare it with the leaves on the sunny side or compare the potted plants kept in the sunlight with those in the shade. Which of them has leaves that are darker green ? Why?

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54. Figure shows the effect of light on the rate of photosynthesis. Based on the graph, answer the following question:

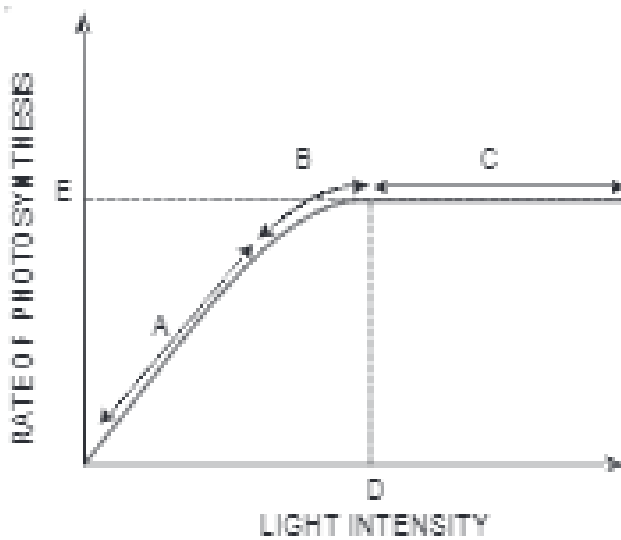


At which points (A,B,C) in the curve is light a limiting factor?

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55. Figure shows the effect of light on the rate of photosynthesis. Based on the graph, answer the following question:

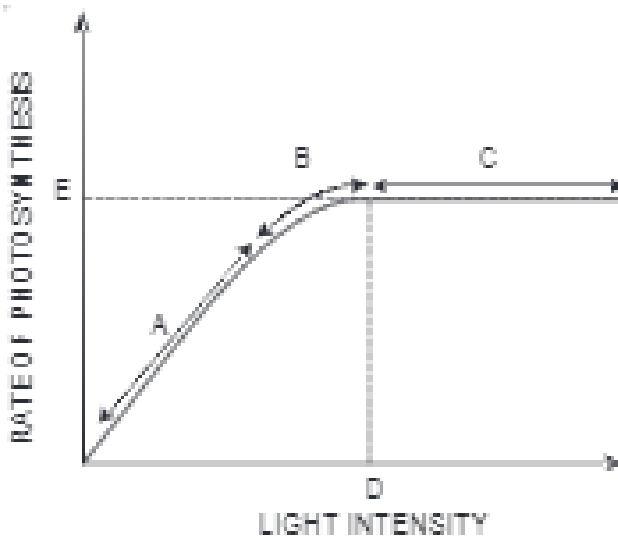




What could be the limiting factors in region A?

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56. Figure shows the effect of light on the rate of photosynthesis. Based on the graph, answer the following question:



What do C and D represent on the curve?

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57. Give comparison between the following:

$C_3$  and  $C_4$  pathways

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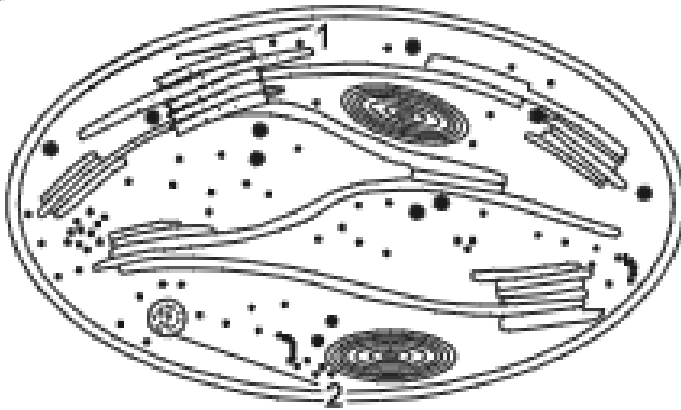
58. Give comparison between the following: Cyclic and non-cyclic photophosphorylation

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59. Give comparison between the following: Anatomy of leaf in  $C_3$  and  $C_4$  plants

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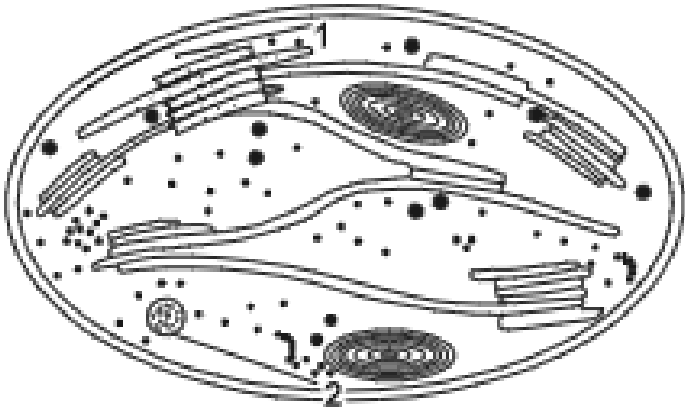
60. Examine the figure :



Is this structure present in animal cell or plant cell?

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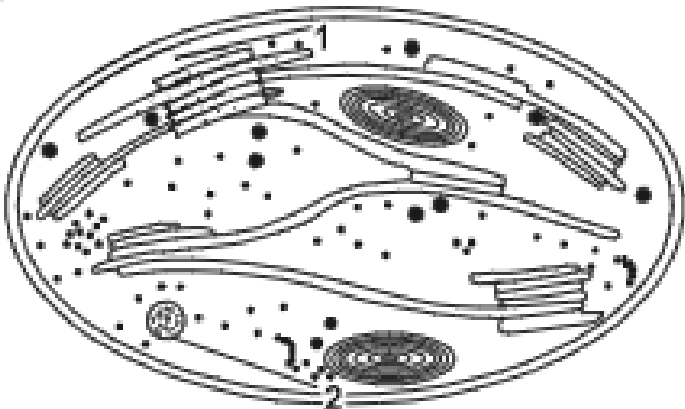
61. Examine the figure :



Can these be passed on to the progeny? How?

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62. Examine the figure :



Name the metabolic processes taking place in the places marked (1) and (2).

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based on the above equation, answer the following question:

Where does this reaction take place in plants?

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based on the above equation, answer the following question:

What is the significance of this reaction?

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65. Cyanobacteria and some other photosynthetic bacteria don't have chloroplasts. How do they conduct photosynthesis?

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66. NaDP reductase enzyme is located on .....

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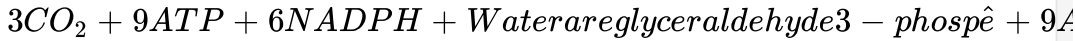
67. Breakdown of proton gradient leads to release of .....

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68. Can girdling experiments be done in monocots? If yes, how? If no, why not?

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69.

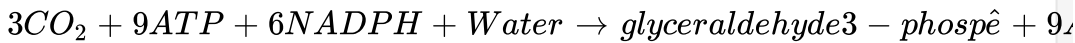


Analyze the above reaction and answer the following question:

How many molecules of ATP and NADPH are required to fix one molecule of  $CO_2$ ?

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70.



Analyze the above reaction and answer the following question:

Where in the chloroplast does this process occur?

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71. Does moonlight support photosynthesis? Find out.

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72. Some of these terms/ chemicals are associated with the  $C_4$  cycle, explain.

Hatch and Slack pathway



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73. Some of these terms/ chemicals are associated with the  $C_4$  cycle, explain.

Calvin cycle



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74. Some of these terms/ chemicals are associated with the  $C_4$  cycle, explain.

PEP carboxylase



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75. Some of these terms/ chemicals are associated with the  $C_4$  cycle, explain.

Bundle sheath cells.

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76. Where is NADP reductase enzyme located in the chloroplast? What is the role of this enzyme in proton gradient development?

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77. ATPase enzyme consists of two parts. What are those parts? How are they arranged in the thylakoid membrane? Conformational change occurs in which part of the enzyme?

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**78.** Which products formed during the light reaction of photosynthesis are used to drive the dark reaction?

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**79.** What is the basis for designating  $C_3$  and  $C_4$  pathways of photosynthesis?

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**80.** Succulents are known to keep their stomata closed during the day to check transpiration. How do they meet their photosynthetic  $CO_2$  requirements?

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**81.** Chlorophyll 'a' is the primary pigment for light reaction. What are accessory pigments? What is their their role in photosynthesis?

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**82.** Do reactions of photosynthesis called as 'Dark Reaction' need light?

Explain.

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**83.** How are photosynthesis and respiration related to each other?

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**84.** If a green plant is kept in dark with proper ventilation, can this plant carry out photosynthesis ? Can anything be given as supplement to maintain its growth or survival?





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**85.** Photosynthetic organisms occur at different depths in the ocean. Do they receive qualitatively and quantitatively the same light? How do they adapt to carry out photosynthesis under these conditions?



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**86.** In tropical rain forests, the canopy is thick and shorter plants growing below it, receive filtered light. How are they able to carry out photosynthesis?



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**87.** What conditions enable RubisCO to function as an oxygenase? Explain the ensuing process.



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**88.** Why does the rate of photosynthesis decrease at higher temperatures?

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**89.** Explain how during light reaction of photosynthesis, ATP synthesis is a chemiosmotic phenomenon.

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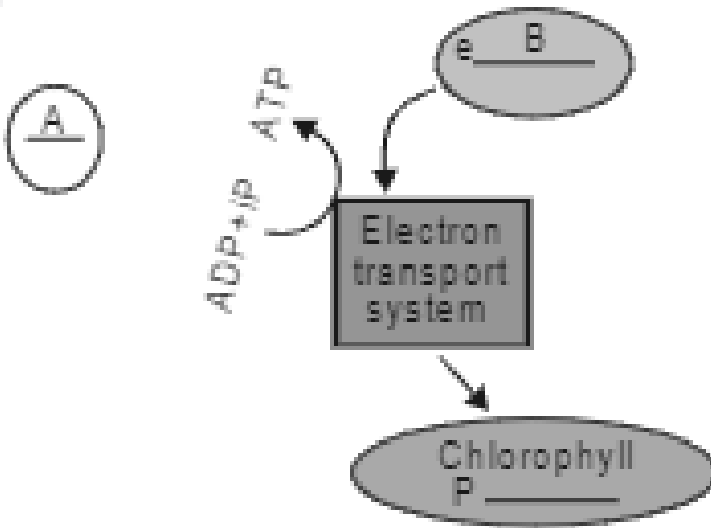
**90.** Find out how Melivn Calvin worked out the complete biosynthetic pathway for synthesis of sugar.

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**91.** Six turns of Calvin cycle are required to generate one mole of glucose. Explain.



92. Complete the flow chart for cyclic photophosphorylation of the photosystem-I.



93. A process is occurring throughout the day, in 'X' organism. Cells are participating in this process. During this process ATP,  $CO_2$  and water are evolved. It is not a light dependent process.

Name the process.



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**94.** A process is occurring throughout the day, in 'X' organism. Cells are participating in this process. During this process ATP,  $CO_2$  and water are evolved. It is not a light dependent process.

Is it a catabolic or an anabolic process?



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**95.** Tomatoes, carrots and chillies are red in colour due to the presence of one pigment. Name the pigment. Is it a photosynthetic pigment?



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**96.** Why do we believe chloroplast and mitochondria to be semi-autonomous organelle?



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**97.** In what kind of plants do you come across 'Kranz' anatomy ? To which conditions are those plants better adapted ? How are these plants better adapted than the plants, which lack this anatomy?

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**98.** Suppose Euphorbia and Maize are grown in the tropical area. Which one of them do you think will be able to survive under such conditions?

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**99.** Suppose Euphorbia and Maize are grown in the tropical area. Which one of them is more efficient in terms of photosynthetic activity?

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**100.** Suppose Euphorbia and Maize are grown in the tropical area.

What difference do you think are there in their leaf anatomy?

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**101.** Is it correct to say that photosynthesis occurs only in leaves of a plant? Besides leaves, what are the other parts that may be capable of carrying out photosynthesis? Justify.

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**102.** The entire process of photosynthesis consists of a number of reactions. Where in the cell do each of these take place?

Synthesis of ATP & NADPH .....

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**103.** The entire process of photosynthesis consists of a number of reactions. Where in the cell do each of these take place?

Photolysis of water.....

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**104.** The entire process of photosynthesis consists of a number of reactions. Where in the cell do each of these take place?

Fixation of  $CO_2$  .....

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**105.** The entire process of photosynthesis consists of a number of reactions. Where in the cell do each of these take place?

Synthesis of sugar molecules.....

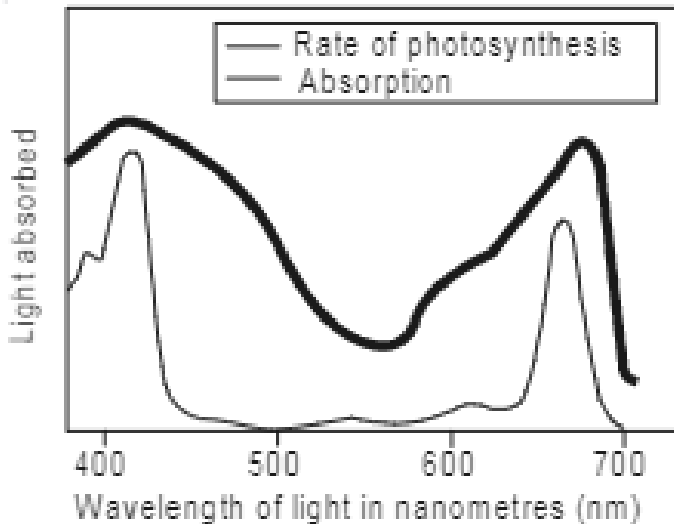
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106. The entire process of photosynthesis consists of a number of reactions. Where in the cell do each of these take place?

Synthesis of starch .....

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107. What can we conclude from the statement that the action and absorption spectrum of photosynthesis overlap? At which wavelength do they show peaks?



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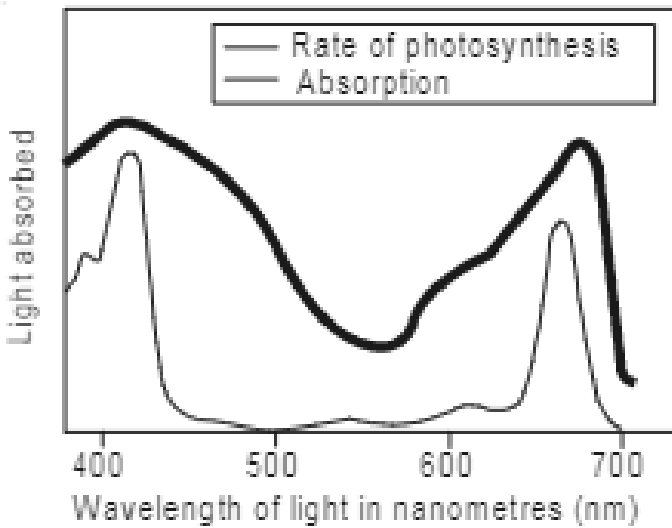
**108.** Which property of the pigment is responsible for its ability to initiate the process of photosynthesis? Why is the rate of photosynthesis higher in the red and blue regions of the spectrum of light?

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**109.** Under what conditions are  $C_4$  plants superior to  $C_3$ ?

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**110.** In the figure given below , the black line(upper) indicates action spectrum for photosynthesis and the lighter line (lower) indicates the absorption spectrum of chlorophyll 'a' , answer the followings:

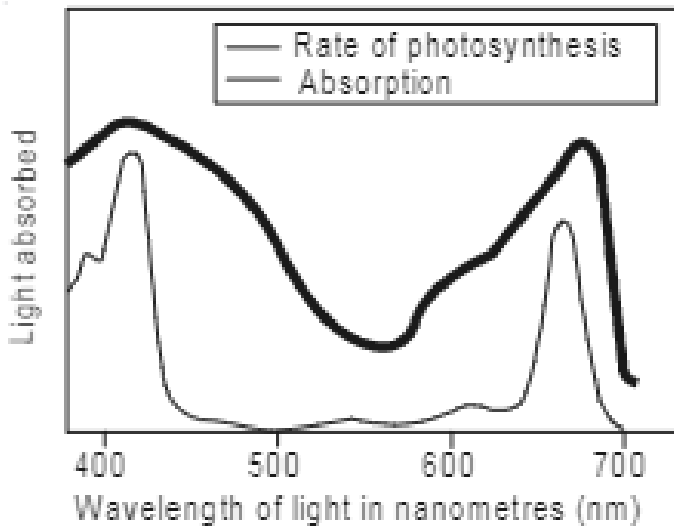


Wavelength of light nanometers(nm)

What does the action spectrum indicate? how can we plot an action spectrum? explain with an example.

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111. In the figure given below , the black line(upper) indicates action spectrum for photosynthesis and the lighter line (lower) indicates the absorption spectrum of chlorophyll 'a' , answer the followings:



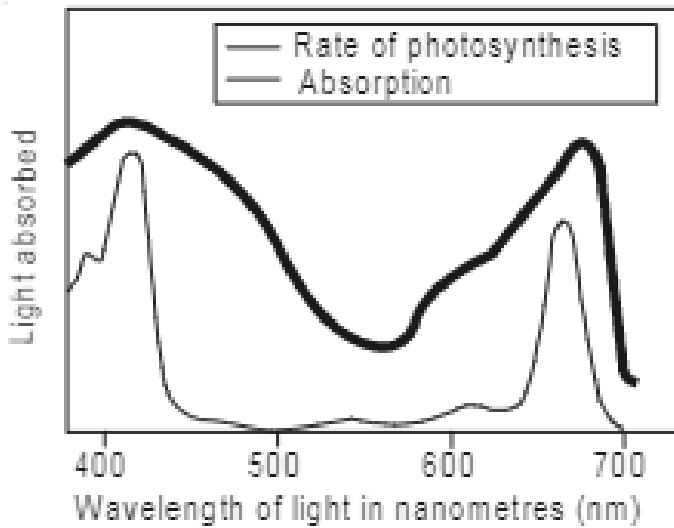
Wavelength of light nanometera(nm)

How can we derive an absorption spectrum for ny substance?



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**112.** In the figure given below , the black line(upper) indicates action spectrum for photosynthesis and the lighter line (lower) indicates the absorption spectrum of chlorophyll 'a' , answer the followings:

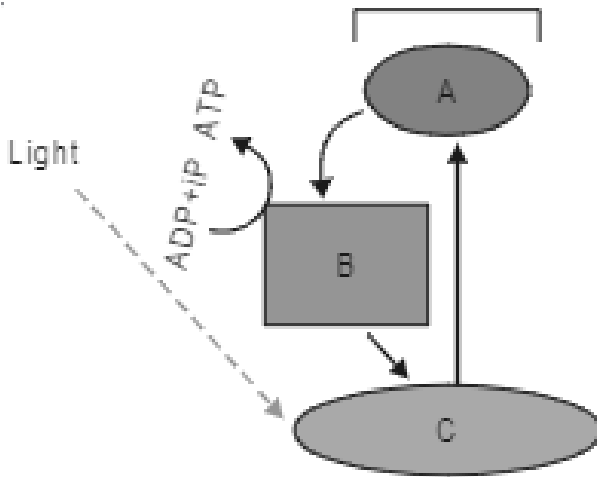


Wavelength of light nanometera(nm)

If chlorophll 'a' is responsible for light reaction of photosynthesis, why do the action spectrum and absorption spectrum not overlap?

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113. In the diagram shown below label A, B, C. What type of phosphorylation is possible in this?



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114. What are the important events and end products of the light reaction?

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115. Why is the RubisCo enzyme more appropriately called RUBP Carboxylase-Oxygenase and what important role does it play in photosynthesis?





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**116.** What special anatomical features are displayed by leaves of  $C_4$  plants? How do they provide advantage over the structure of  $C_3$  plants?



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**117.** Name the two important enzymes of  $C_3$  and  $C_4$  pathways, respectively? What important role do they play in fixing  $CO_2$ ?



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**118.** Why is RuBisCo enzyme the most abundant enzyme in the world?



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**119.** What is photolysis?

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**120.** Why chlorophyll is necessary for photosynthesis?

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**121.** In which form carbohydrates are translocated in plants?

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**122.** Write one difference between chl-a and chl-b.

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**123.** Name three end products of Hill reaction.

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124. What are quantosomes?

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125. What is quantum?

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126. What is quantum yield?

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127. Differentiate absorption spectrum and action spectrum.

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128. What is source of oxygen in photosynthesis?



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129. What is assimilatory power? When it is produced?



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130. What is Ferredoxin ? What is its function?



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131. Write one anatomical features of  $C_4$  plants.



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132. Who traced the path of  $CO_2$  in  $C_4$  plants?



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**133.** Who traced the path of carbon in photosynthesis?

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**134.** Which alga is used for studying photosynthesis?

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**135.** What is photorespiration?

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**136.** What is the other name of photorespiration?

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**137.** What is photosynthesis? List two major phases of photosynthesis



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**138.** Describe very briefly the contribution of following scientists:

Jan Ingenhousz



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**139.** Describe very briefly the contribution of following scientists:

C.B. Van Niel



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**140.** Describe very briefly the contribution of following scientists:

Joseph Priestely.



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**141.** Draw a diagram showing structure of chloroplast.

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**142.** What are the functions of chloroplast? List any three.

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**143.** Draw a structure of chlorophyll molecule.

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**144.** What is the difference between chlorophyll a and chlorophyll b?

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**145.** Why does chlorophyll appear green in reflected light and red in transmitted light?

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**146.** The photosynthetic lamellae taken out from a chloroplast and suspended in a nutrient medium in the presence of  $CO_2$  and light. Will they synthesise glucose or not?

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**147.** "Photosynthesis protects us from harmful ultraviolet radiation of sun". Comment on the statement.

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**148.** What is photocentre? Write the two kinds of photosystems.





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**149.** Explain the role of chlorophyll a molecule as reaction centre for harvesting light.



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**150.** Show with the help of sketch and briefly explain Z-scheme of light reaction.



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**151.** Differentiate

Photosystem-I and Photosystem-II



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**152.** Differentiate

Carboxylation and Oxygenation.

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**153.** How will you demonstrate that chlorophyll pigments are fluorescent?

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**154.** What is the advantage of having more than one type of pigment molecules in a photocentre?

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**155.** Differentiate absorption spectrum and action spectrum. Draw diagram also.

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**156.** Describe Hill reaction. What is its significance?



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**157.** What is photophosphorylation?



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**158.** Name the assimilation powers generated during light reaction.



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**159.** Write a note on photosynthetic unit.



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**160.** What is Blackman reaction?



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**161.** Write a short note on Dark reaction.



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**162.** Give a simple graphic representation of Calvin cycle.



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**163.** How was path of  $CO_2$  during carbon assimilation discovered by Melvin Calvin?



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**164.** With the help of graphic sketch explain chemiosmotic synthesis of ATP in thylakoid. What is the rate of ATP produced during this step.

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**165.** What type of chloroplast are present in bundle sheath of  $C_4$  plants? What is their advantage?

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**166.** What is  $C_4$  cycle?

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**167.** Write a note on photorespiration.

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168. Which organelle is responsible for the release of  $CO_2$  of photorespiration?

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169. " $CO_2$  in dark may have survival value to succulent plants." Explain.

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170. List the various external factors that influence photosynthetic rate.

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171. What are various internal factors which influence rate of photosynthesis?

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**172.** State and explain the law of limiting factors.



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**173.** How many ATP molecules are required by Calvin cycle?



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**174.** Give a brief summary of various reactions which take place during photosynthesis.



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**175.** What is photosystem? Which is the pigment that acts as a reaction centre? Describe the interaction of photosystem I and Photosystem II.



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176. Describe in detail how ATP and  $NADPH_2$  are formed during photochemical reactions.

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177. Describe carbon reactions in  $C_3$  pathway. Does this pathway also operate in  $C_4$  plants?

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178. Give a brief account of factors affecting the process of photosynthesis

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179. Briefly describe the Hatch and Slack pathway of  $CO_2$  fixation in  $C_4$  plants.

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**180.** Why are plants that consume more than usual 18 ATP to produce one molecule of glucose favoured in tropical region?

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**181.** Explain why photosynthesis is considered the most important process in the biosphere.

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**182.** What led to the evolution of  $C_4$  pathway of photosynthesis? Describe in detail.

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**183.** Explain why?

Calvin cycle occurs in  $C_4$  plants.



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**184.** Explain why?

Chloroplasts are generally located at the outer margins of mesophyll cells.



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**185.** Explain why?

Photorespiration is considered as a wasteful process.



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186. Explain why?

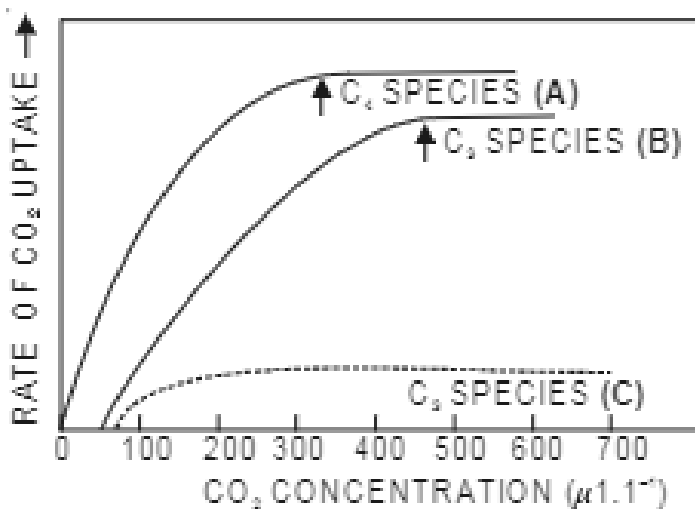
Chlorophyll 'a' occurs in different forms.

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187. How are the products of photosynthesis translocated in the plants?

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188. Study the figure and label A, B, C.



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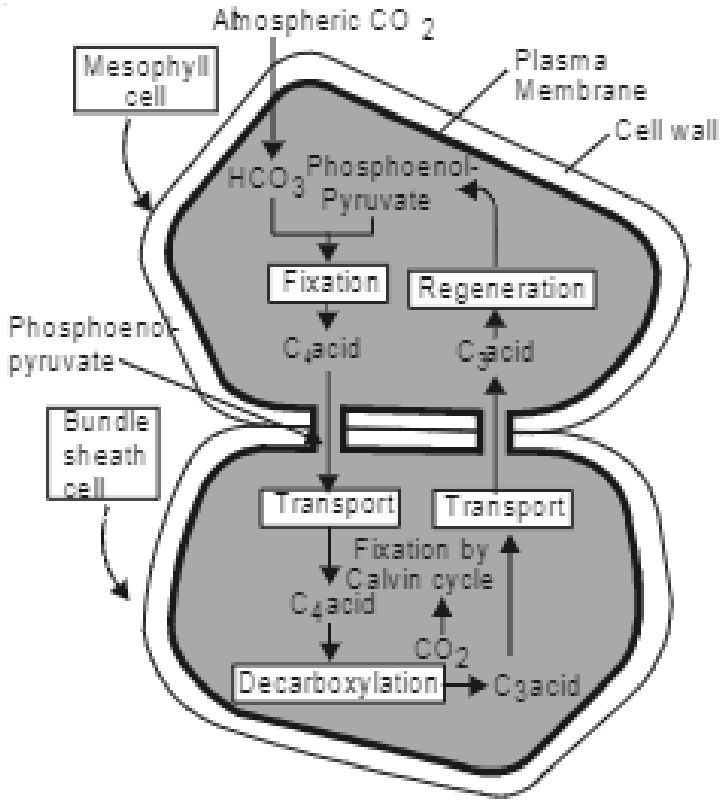
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**189.** Why does chlorophyll appear red in reflected light and green in transmitted light? Explain the significance of these phenomena in terms of photosynthesis.



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190. Observe the diagram and answer the following:

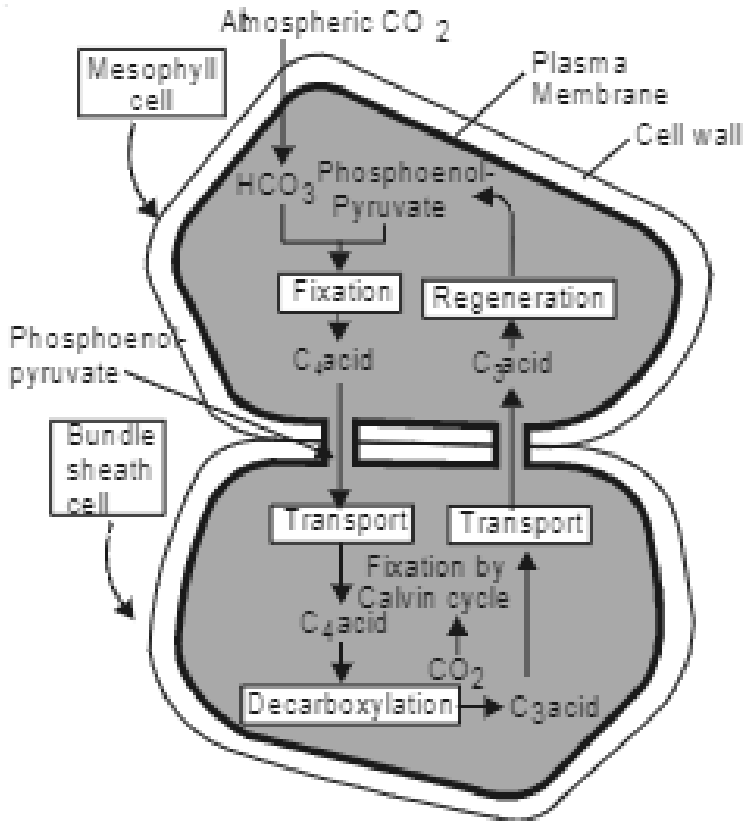


Which group of plants exhibits these two types of cells?



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191. Observe the diagram and answer the following:



What is the first product of C<sub>4</sub> cycle ?

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Exercise

1. NaDP reductase enzyme is located on .....

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2. Can girdling experiments be done in monocots? If yes, how? If no, why not?

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3. Does moonlight support photosynthesis? Find out.

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4. Name the specialised cells where photosynthesis occurs.

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5. What is assimilatory power? When it is produced?

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6. Why is ATP essential for photosynthesis?

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7. Chlorophyll 'a' is the primary pigment for light reaction?

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8. What conditions enable RubisCO to function as an oxygenase? Explain the ensuing process.

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9. Differentiate absorption spectrum and action spectrum.

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11. Differentiate

Photosystem-I and Photosystem-II

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12. Describe Hill reaction. What is its significance?

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13. Write graphic representation of  $C_4$  cycle.



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14. Describe Calvin cycle.



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