Topic 5: Nutrition in Plants

© Hee Xin Wei (Copyrighted)



Chapter Analysis

© Hee Xin Wei (Copyrighted)



FOCUS

- straightforward chapter
- link structure of leaf and photosynthesis knowledge from this chapter to the next



EXAM

• commonly tested in MCQ and structured questions



WEIGHTAGE

Constitute to around 6% in Paper 2 in the past 5 years





LeafStructure Gaseous exchange



© Hee Xin Wei (Copyrighted)

Key Concept



Structure of Leaf



	Structure & Functions	Chloroplast distribution
	 Waxy and transparent layer. Reduced water loss through evaporation from the leaf 	No
is	Single layer of closely packed cellsAllows light to pass through.	No
yll	 Long and cylindrical shape Main site of photosynthesis 	Contain the largest amount o chloroplasts among the tissue in leaves to increase absorption of sunlight for photosynthesis
yll	 Irregular shape with large intercellular air spaces among the cells to increase surface area for gaseous exchange. covered with a thin film of moisture so that carbon dioxide can dissolve in it. Contains vascular bundle. 	Contain less chloroplasts that palisade mesophyll





Structure of Leaf



sue	Structure & Functions	Chloroplast distribution
cular Idle	 containing xylem and phloem tissue Xylem: transport water and mineral salts from roots to other part of plants Phloem: transport sucrose from leaves to other parts of plants 	No
ercellular air ces	 The intercellular air spaces in the spongy mesophyll allow circulation of Carbon Dioxide and Oxygen inside leaf for photosynthesis and respiration rapid diffusion of gases into and out of the cells 	No
ver dermis	 Similar to upper epidermis, a single layer of closely-packed cells covered by cuticle 	No (but the layer of tissue consists of guard cells which contain chloroplast)
ard cells	 Guard cells are bean-shaped cells that surround stoma guard cells have a thicker cellulose cell wall on the side of stomata Control the opening and closing of the stoma that allow gaseous exchange of leaves 	Yes





Gaseous Exchange **Guard cells and stomata**



In the night

- Potassium ions move out of the guard cells via **diffusion**
- Water potential is increased in guard cells
- Water moves out of the guard cells to the neighbouring cells
- Guard cells become **flaccid** and the **stoma closes**.

- Plants open their stomata during the day for carbon dioxide intake and close their stomata during the night to minimise water loss through transpiration.

During the day

• Guard cells **photosynthesise** and **energy** is used to **pump potassium ions** by active transport into the guard cells from neighbouring epidermal cells.

• This lowers the water potential of guard cells

• Water from neighbouring cells enter guard cells via **osmosis** • Guard cells swell and become **turgid**. Due to uneven thickness of cell walls, guard cells become **curved** and lead to the **opening of stoma**





Photosynthesis Limiting Factors



© Hee Xin Wei (Copyrighted)

Key Concept



Photosynthesis Equation

Word equation

CarbonDioxide + Water $\xrightarrow{Chlorophyll}$ Glucose + Oxygen + Water LightEnergy

Chemical equation

 $6CO_2 + 12H_2O \xrightarrow[LightEnergy]{Chlorophyll} C_6H_{12}O_6 + 6O_2 + 6H_2O$

Simplified chemical equation

 $6CO_2 + 6H_2O \xrightarrow[LightEnergy]{Chlorophyll} C_6H_{12}O_6 + 6O_2$

Chlorophyll

- Pigment in chloroplast
- traps light energy and converts it into chemical energy for the formation of carbohydrates and their subsequent uses

Intake of Carbon Dioxide

- In daylight when photosynthesis occurs, the carbon dioxide in the leaf is rapidly used up.
- The carbon dioxide concentration in the leaf becomes lower than that in the atmospheric air, so carbon dioxide diffuses from the surrounding air through the stomatal openings into the intercellular air spaces
- The surfaces of the mesophyll cells are covered by a thin film of moisture so that carbon dioxide can dissolve in it and diffuses into the cells.

Intake of water

- The xylem transports water and dissolved mineral salts from roots to the leaves.
- Water moves out of xylem vessels and enters cells via osmosis







Limiting Factors **Effect of light intensity**



- Limiting factors are factors that **directly affect the process.** By increasing the amount of factors, it increases the rate of process
- Light intensity, carbon dioxide concentration and temperature are limiting factors on the rate of photosynthesis
- Rate of photosynthesis can be measured by
- 1) Measuring the uptake of CO_2
- 2) Measuring the production of O_2 (an example is shown)
- 3) Measuring the production of carbohydrates
- 4) Measuring the increase in dry mass



Limiting Factors **Effect of light intensity**



- At a **constant** temperature and carbon dioxide concentration, the rate of photosynthesis increases with increasing light intensity until it reaches a **plateau**.
- When the plateau is reached, light is **no longer the limiting factor** in the reaction but other factors such as temperature and concentration of carbon dioxide. This is also called the **light saturation point**
- Raising these factors can increase the plateau
- light compensation point is when rate of respiration = rate of **photosynthesis**, so while rate of photosynthesis is increasing, the net CO2 uptake or O2 release is zero





Limiting Factors **Effect of carbon dioxide concentration**



Carbon dioxide concentration

- An increase in the carbon dioxide concentration increases the rate of photosynthesis, until it reaches plateau
- Beyond this point, rate of photosynthesis is limited by another factor such as light intensity or temperature and carbon dioxide is no longer the limiting factor.
- Under normal circumstances, carbon dioxide is an important limiting factor since atmospheric carbon dioxide remains constant at about 0.03%



Limiting Factors **Effect of temperature**



• Photosynthesis is a process that is highly dependent on enzymes (thus a similar graph to enzyme activity against temperature)

• When temperature increases, **kinetic energy** increases which increases

the **frequency of effective collision** between enzymes and substrates,

increase the formation of enzyme substrate complex, thus increasing the rate of photosynthesis.

• Rate of photosynthesis is at the maximum at optimum temperature • When the temperature increases beyond the enzymes' optimum temperatures, the rate of photosynthesis begins to decrease until it stops as the enzymes are denatured.



Limiting factors an example



explain the graph:

- increasing light intensity increases the rate of photosynthesis as seen from increasing graph
- , light intensity is no longer a limiting factor but temperature At а because increasing temperature from 15°C to 25°C increases the rate of photosynthesis.
- At , light intensity and temperature is no longer the limiting b factor, but concentration of carbon dioxide. this is because increasing concentration of carbon dioxide to 0.4% greatly increases the rate of photosynthesis.





For more notes & learning materials, visit: www.overmugged.com

'O' levels crash course program

Professionally designed crash course to help you get a **condensed revision** before your 'O' Levels!

The 4 hour session focuses on going through key concepts and identifying commonly tested questions!

Our **specialist tutors** will also impart valuable **exam pointers and tips** to help you maximise your preparation and ace your upcoming national exam!

The crash courses will begin in June 2021 and last till Oct 2021.

Pre-register now on our <u>website</u> and secure your slots!





Join our telegram channel: <u>@overmuqqed</u>



Need help?

Hee Xin Wei (Private tutor with **5** years of experience)

90721842 (Whatsapp)

@xinweihee (telegram username)

FREE NOTES | CRASH COURSES | 'O' LEVELS | 'A' LEVELS WWW.OVERMUGGED.COM



