CHAPTER 06
PLANT NUTRITION

The stuff you need to know in this chapter:

6.1 Photosynthesis

Core:

- Define photosynthesis as the process by which plants manufacture carbohydrates from raw materials using energy from light
- State the word equation for photosynthesis
- Investigate the necessity for chlorophyll, light and carbon dioxide for photosynthesis, using appropriate controls
- Investigate and describe the effects of varying light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis e.g. in submerged aquatic plants

Extended:

- State the balanced chemical equation for photosynthesis
- Explain that chlorophyll transfers light energy into chemical energy in molecules, for the synthesis of carbohydrates
- Outline the subsequent use and storage of the carbohydrates made in photosynthesis
- Define the term limiting factor as something present in the environment in such short supply that it restricts life processes
- Identify and explain the limiting factors of photosynthesis in different environmental conditions
- Describe the use of carbon dioxide enrichment, optimum light and optimum temperatures in glasshouses in temperate and tropical countries
- Use hydrogencarbonate indicator solution to investigate the effect of gas exchange of an aquatic plant kept in the light and in the dark

6.2 Leaf structure

Core:

- Identify chloroplasts, cuticle, guard cells and stomata, upper and lower epidermis, palisade mesophyll, spongy mesophyll, vascular bundles, xylem and phloem in leaves of a dicotyledonous plant

Extended:

- Explain how the internal structure of a leaf is adapted for photosynthesis

6.3 Mineral requirements

Core:

- Describe the importance of nitrate ions for making amino acids, magnesium ions for making chlorophyll

Extended:

Explain the effects of nitrate ion and magnesium ion deficiency on plant growth

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Photosynthesis

1. A student is trying to find out where plants gain their mass from. She knows that you can't make something out of nothing, so it has to come from somewhere.

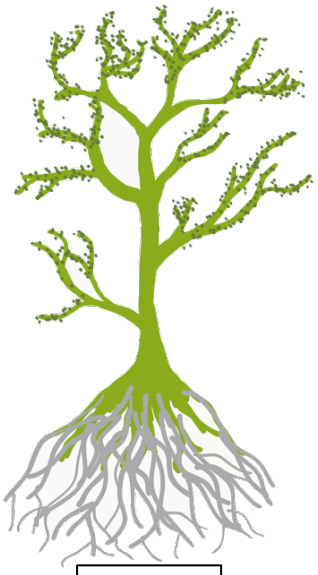
She comes up with a hypothesis:

"Plants gain their mass from the soil. Just like humans eat food to help us grow, plants consume soil through their roots."

She decides to test the idea. She weighs a plant pot, soil and a seed. It's mass is 5kg. She weights several months for the plant to grow, without adding any new soil then weighs the pot again. After this, she removes from the plant from soil and weighs it; its mass is 4kg.

5kg

?? kg



4kg

What do you think the mass of the plant plus the soil is?

_____ KG

2. Where did the plant gain its mass from?

_____

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3. Define "photosynthesis"

4. Write a word equation for photosynthesis

5. Write a **balanced** chemical equation for photosynthesis

6. Which type of cells is primarily responsible for photosynthesis in plants?

7. Name the main pigment in green plants that is responsible for photosynthesis.

8. What kind of energy conversion takes place during photosynthesis?
Choose from the following energy types and write the correct words in the blanks below:

light *sound* *heat* *chemical* *kinetic* *gravitational*

_____ energy → _____ energy

9. Which type of biological molecule is initially created in the process of photosynthesis? Choose from the following

Protein fats carbohydrates amino acids glycerol

10. Some of the glucose produced is used in plant respiration. Write a word equation for this.

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11. Before glucose is used, it is often transported as sucrose, and might be stored for a long time as starch. Explain why glucose cannot simply remain as glucose for transport and storage

12. Name the structural carbohydrate present in large amounts in cell walls that plants can make from glucose.

13. Humans (and other animals) eat the starch stores of plants as it is a good source of energy. Name one of these foods.

REMINDER: Name the food test and positive result you would observe to show this food type contained starch

14. With a little bit of nitrogen added, plants use carbohydrates to produce which essential biological molecule?

15. Which statement about biological production in plants is accurate? (Choose only one)

a) Plants make most of their own carbohydrates
b) Plants make all of their own carbohydrates, but must absorb some of their amino acids through their roots.
c) Plant make all of their own biological molecules, including carbohydrates, proteins, fats and oils
d) Plant make all of their own biological molecules, including carbohydrates and proteins, but they don't need any fats or oils

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Leaf structure

1. Draw a labeled diagram of a dicotyledonous leaf cross-section. Include the following parts:

chloroplasts, cuticle, guard cells and stomata, upper and lower epidermis, palisade mesophyll, spongy mesophyll, vascular bundles, xylem and phloem

2. Explain how a palisade cell is adapted for it's function (photosynthesis) in terms of:

Elongated shape:

Large number of chloroplasts

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3. Explain how leaf structure is adapted to its function in terms of the following

Feature	Explanation
Large surface area	
Thin	
Stomata present	
Gaps in mesophyll layer	
Palisade cells arranged end up ("upright")	
Close proximity of xylem vessels to the mesophyll cells	
Close proximity of phloem tubes to the mesophyll cells	

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Mineral Requirements

1. State the part of the plant responsible for taking in minerals

2. Complete the table to summarise the use of the following minerals in plants:

Mineral	Use
Nitrogen	
Magnesium	

3. Describe the consequences of a deficiency in these minerals

Nitrogen:

Magnesium

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Limiting Factors

1. Define "limiting factor"

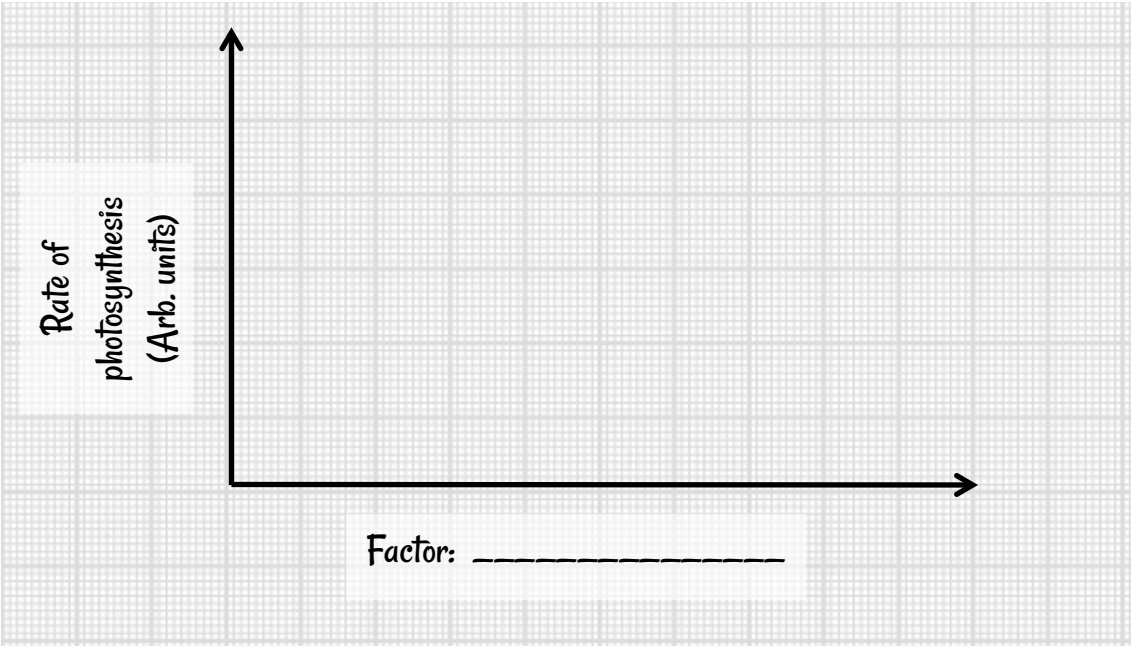
2. List three limiting factors on photosynthesis

a) _____

b) _____

c) _____

3. Draw a graph to show how the rate of photosynthesis would likely change with one of the factors mentioned in the previous question (other than temperature), assuming that this is the only variable. Remember to state which factor you are showing



4. Explain the trend you have drawn in the above graph.

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5. Explain how the rate of photosynthesis would change with temperature (Hint: think about enzymes).

6. Farmers may choose to control the environment that plants grow in to account for the limiting factors that restrict the rate of photosynthesis. Fill in the blanks describing the control of conditions in greenhouses

Controlling limiting factors in an _____ system is almost impossible. In greenhouses (which are closed systems), however, farmers can more easily control _____, _____ _____ _____ and _____ _____. The intensity of light is important, but so is the _____ of the light. Most plants grow best in _____ and _____-coloured light. Carbon dioxide levels in greenhouses are often _____ to higher than normal atmosphere levels. This is important because plants in greenhouses can use up the carbon dioxide _____ _____. Carbon dioxide is usually produced in a greenhouse by burning _____. This also helps _____ the temperature.

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