

Plant nutrition

IGCSE Biology 0610 · Topic 6 revision notes

Everything from the 3 lessons of this topic on a few pages: the key idea of each lesson, the diagram to remember, the points to learn and the traps examiners set. Read it, cover it, test yourself.

1. Photosynthesis

2. Investigating photosynthesis

3. Leaf structure

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1 Photosynthesis

Syllabus 6.1

Photosynthesis is the process by which plants synthesise carbohydrates from raw materials using energy from light. Carbon dioxide + water → glucose + oxygen, in the presence of light and chlorophyll. Chlorophyll is a green pigment found in chloroplasts; it transfers energy from light into energy in chemicals, for the synthesis of carbohydrates.

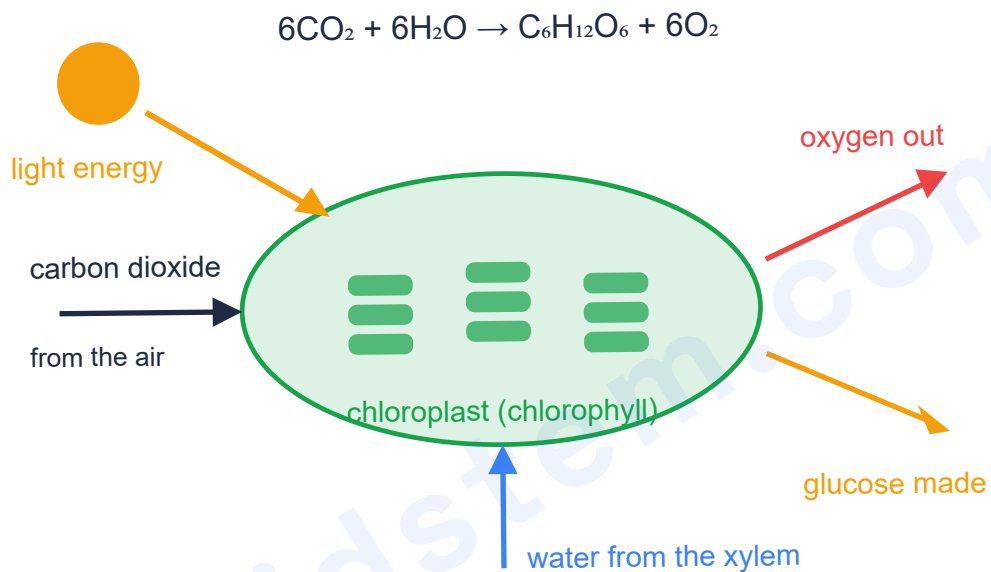


Fig. 1: chlorophyll in the chloroplast absorbs light energy and transfers it into chemical energy as carbon dioxide and water are built into glucose; oxygen is released

Light in, sugar out.

- ✓ **Word equation:** carbon dioxide + water → glucose + oxygen, in the presence of light and chlorophyll.
- ✓ **Extended:** $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$.
- ✓ **Glucose becomes:** starch (store), cellulose (walls), sucrose (phloem), nectar (insects), or is respired.
- ✓ **Nitrate** for amino acids; **magnesium** for chlorophyll.

Watch out!

Light and chlorophyll are written over the arrow, not as reactants. Chlorophyll is not used up and light is not a substance. Also, plants do not "make energy": chlorophyll transfers light energy into chemical energy.

Glucose is not transported in the phloem: it is converted to sucrose first. And it is starch, not glucose, that is stored, because starch is insoluble.

Nitrate is for amino acids (proteins), not for chlorophyll directly; magnesium is for chlorophyll. Do not swap them, and do not say minerals give the plant energy.

2 Investigating photosynthesis

Syllabus 6.1

A leaf that has photosynthesised stores starch, so **testing a destarched leaf for starch with iodine** shows where photosynthesis happened; experiments with controls show that chlorophyll, light and carbon dioxide are all needed. The rate of photosynthesis increases with light intensity, carbon dioxide concentration and temperature (up to an optimum). Extended: the factor in shortest supply is the **limiting factor**; only increasing that factor raises the rate.

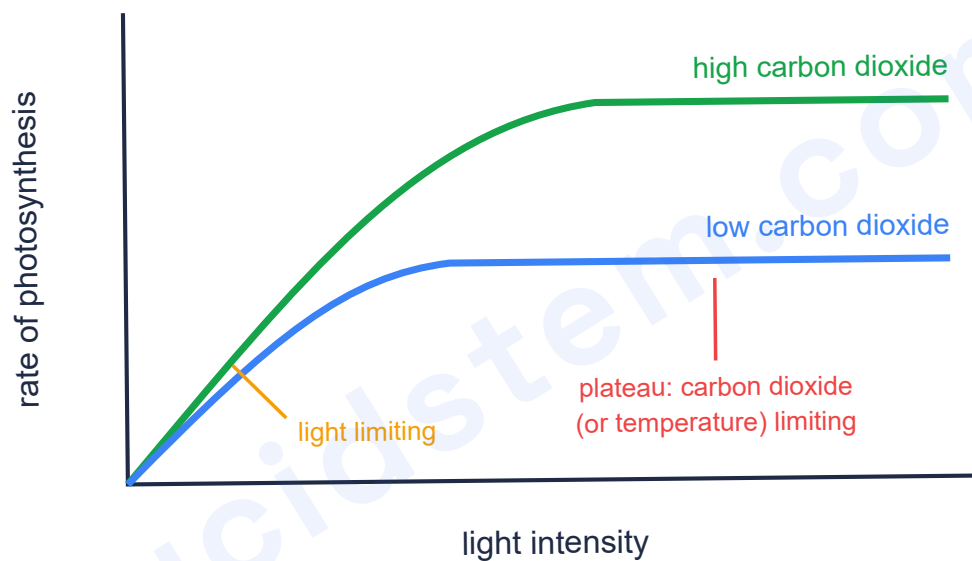


Fig. 1: at low light intensity, light limits the rate; on the plateau another factor is limiting, so raising carbon dioxide lifts the whole curve

Change one, control the rest.

- ✓ **Starch test:** destarch, expose, boil, hot ethanol (water bath), rinse, iodine: blue-black = starch.
- ✓ **Every experiment needs a control** that differs only in the factor being tested.
- ✓ **Indicator:** purple = less carbon dioxide, red = normal, yellow = more carbon dioxide.
- ✓ **Extended:** on a plateau, the x-axis factor is no longer limiting; name another factor.

Watch out!

Ethanol is flammable, so it is heated in a water bath, never over a flame. And the iodine test detects starch, not glucose: you are using stored starch as evidence that photosynthesis happened.

On the plateau of a light intensity graph, light is no longer the limiting factor. Something else (carbon dioxide or temperature) is limiting there. Students often name light because it is the variable on the x-axis.

Plants respire all the time, in the light as well as the dark. In the light the indicator turns purple because photosynthesis uses carbon dioxide faster than respiration produces it, not because respiration stops.

3 Leaf structure

Syllabus 6.2

Most leaves have a **large surface area**, to absorb as much light as possible, and are **thin**, so carbon dioxide has only a short distance to diffuse to the mesophyll cells and light can reach all of them. Inside, palisade cells packed with chloroplasts sit near the upper surface, air spaces in the spongy mesophyll connect to the stomata for gas exchange, and veins bring water in the xylem and carry sucrose away in the phloem.

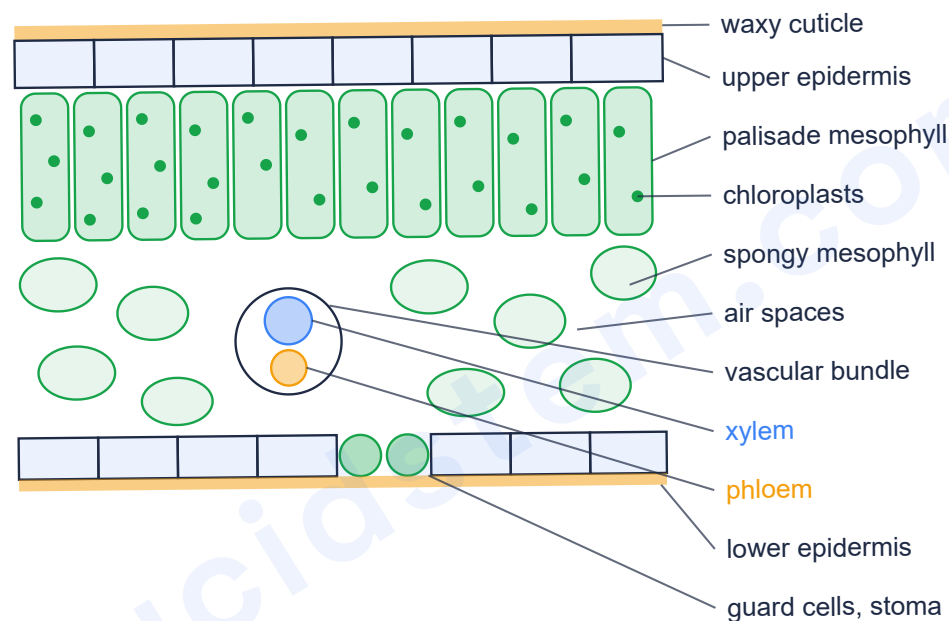


Fig. 1: transverse section through part of a dicotyledonous leaf (simplified, not to scale)

Structure, then function.

- ✓ **Large surface area:** absorbs more light.
Thin: short diffusion distance for carbon dioxide.
- ✓ **Top to bottom:** cuticle, upper epidermis, palisade, spongy mesophyll with air spaces, lower epidermis with stomata.
- ✓ **Vascular bundle:** xylem brings water and ions; phloem takes sucrose away.
- ✓ **Always link** each structure to light, carbon dioxide, water or the products.

Watch out!

Say what the feature does for photosynthesis: "large surface area to absorb more light", "thin, so a short diffusion distance for carbon dioxide". Just writing "large surface area" scores nothing.

The upper epidermis cells have no chloroplasts, but guard cells do.

And in a vascular bundle in a leaf, the xylem is on the upper side and the phloem on the lower side.