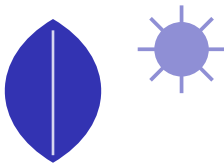


Plant Nutrition

IGCSE Biology ■ Topic 6

IGCSE Biology

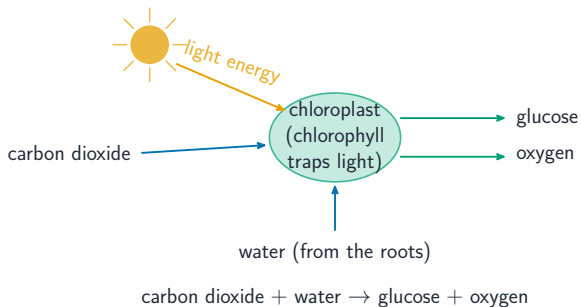


What we will cover

- 1 Photosynthesis
- 2 Uses of glucose
- 3 Minerals from the soil
- 4 Rate & limiting factors
- 5 Leaf structure



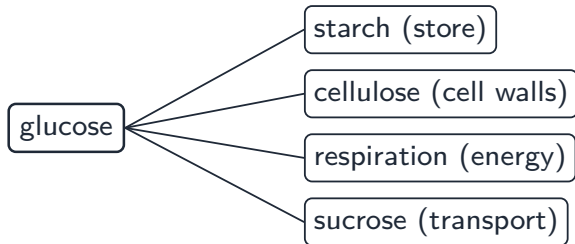
Photosynthesis



Green leaves capture sunlight for photosynthesis.

Photosynthesis takes in carbon dioxide and water and makes glucose and oxygen, using light

Uses of glucose



The glucose is used to:

- store as **starch**
- build **cellulose** cell walls
- release energy in **respiration**
- move as **sucrose** in the **phloem**

Minerals from the soil

nitrate ions

make **amino acids** (proteins);
shortage → poor, weak growth

magnesium ions

make chlorophyll; short-
age → **yellow** leaves

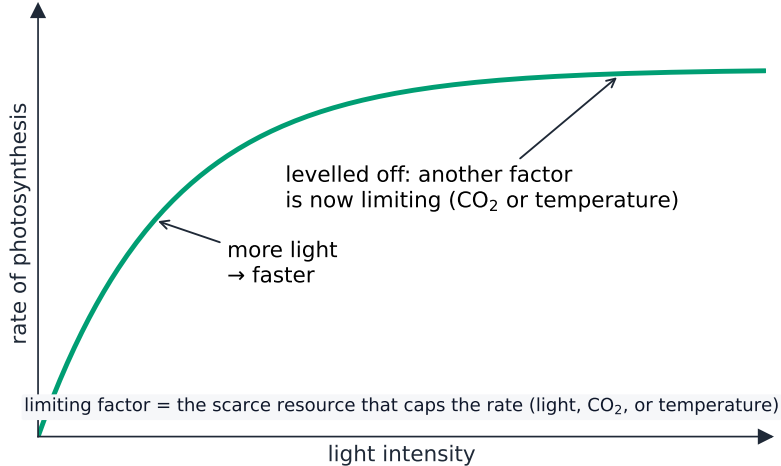
Rate and limiting factors

Three factors raise the rate:

- **light intensity**
- CO₂ concentration
- temperature (until enzymes denature)

The one in shortest supply is the **limiting factor** .

Rate and limiting factors, in detail



More light speeds up photosynthesis until another factor becomes limiting

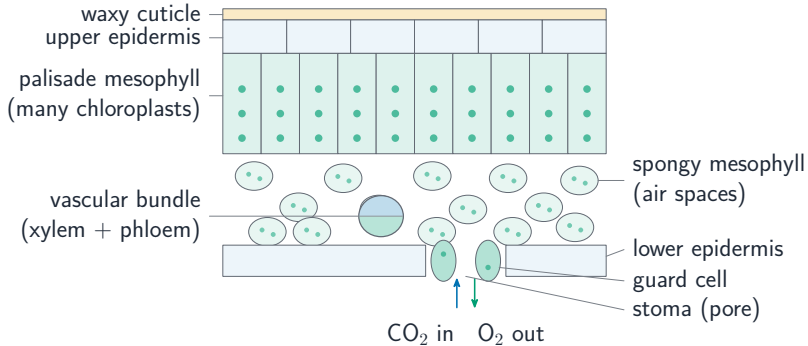


Leaf structure

A leaf is **adapted** – broad & thin to catch light.

- **palisade** cells: packed with chloroplasts
- **spongy** layer: air spaces for gas
- **xylem** brings water; phloem takes sugar

Leaf structure, in detail



A leaf is **adapted** – broad & thin to catch light.

The leaf, layer by layer

the cuticle

a waxy waterproof layer on top – reduces water loss, and lets light through

the epidermis

a single transparent layer, with no chloroplasts, protecting the tissue beneath

palisade mesophyll

tall cells packed with chloroplasts, near the top where the light is strongest

spongy mesophyll

loosely packed with air spaces – a large **surface area** for gas exchange

vascular bundles

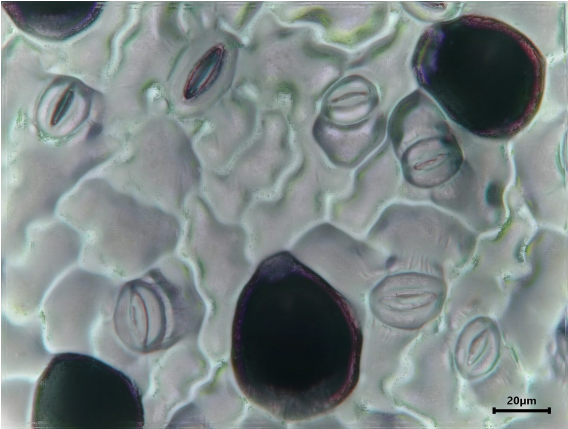
the leaf's veins: **xylem** brings water in, phloem takes sugar away

stomata

pores in the lower epidermis, opened and closed by guard cells

To test what photosynthesis needs, remove **one** of light, chlorophyll or carbon dioxide, keep every other condition the same as the **control**, and test the leaf for starch with iodine – blue-black means starch. Hydrogencarbonate **indicator** is the separate test, for carbon dioxide.

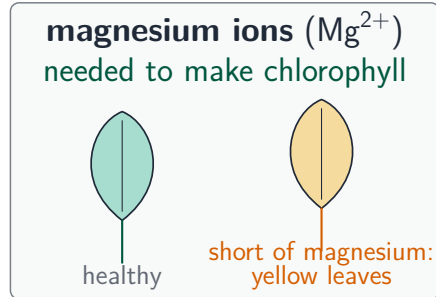
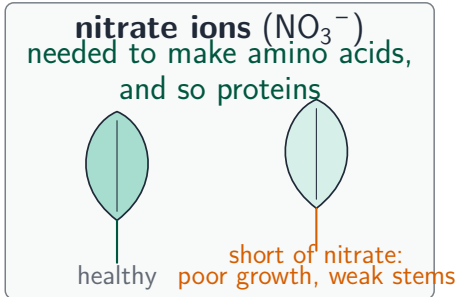
Stomata and guard cells



Stomata are tiny pores (mostly on the lower surface) that let CO_2 in & O_2 out.

A pair of **guard cells** opens & closes each stoma.

Minerals from the soil, continued



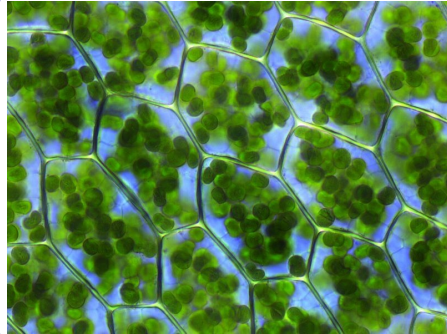
A plant short of nitrate grows poorly; a plant short of magnesium has yellow leaves

Photosynthesis, continued



Green leaves capture sunlight for photosynthesis.

Chloroplasts, where photosynthesis happens



Chloroplasts packed inside moss leaf cells, under a microscope – the green is the chlorophyll

Photosynthesis: the equation and what the glucose becomes

photosynthesis

plants make **carbohydrates** from simple **raw materials** , using light energy trapped by chlorophyll – the green **pigment** held in the chloroplasts

the word equation

carbon dioxide + water → glucose + oxygen

(Supplement)



stored

converted to **starch** for storage, and to cellulose for cell walls

respired

broken down to release energy

to attract animals

made into **nectar** , which draws **insects** for **pollination**

Plants also take up mineral **ions** through their roots: **nitrate** for amino acids and proteins, **magnesium** for chlorophyll.

Exam tips

- Learn the word equation exactly: carbon dioxide + water → glucose + oxygen (in light, with chlorophyll).
- Chlorophyll is in the chloroplasts; it does not get used up – it transfers light energy.
- Link each factor to the rate: more light, more carbon dioxide, warmer (but not too hot) → faster, until a **limiting factor** stops further increase.
- For leaf structure, always link the part to its job: broad and thin to catch light; palisade cells full of chloroplasts; stomata and air spaces for gas exchange.
- Nitrate ions → amino acids; magnesium ions → chlorophyll.



Worked example – limiting factors

A graph of photosynthesis against light intensity rises then levels off. Explain both parts.

- Rising part: light is the **limiting factor** – more light, more photosynthesis.
- Levelling off: adding light changes nothing, so **something else** now limits it.
- That will be **carbon dioxide concentration** or **temperature**.
- To prove it, raise one of them: if the plateau **rises**, that was the limiting factor.

The limiting factor is whichever is **in shortest supply**. On a graph: the **slope** shows the factor is limiting; the **plateau** shows it no longer is.

Topic 6 – key takeaways

1

Equation

$\text{CO}_2 + \text{water} \rightarrow \text{glucose} + \text{O}_2$
(light)

2

Glucose

starch, cellulose, respiration,
transport

3

Minerals

nitrate $\rightarrow$ proteins; magnesium $\rightarrow$
chlorophyll

4

Leaf

palisade for light; stomata for gas
exchange

Check yourself

- 1 What two raw materials does photosynthesis use?
- 2 What ion does a plant need to make chlorophyll?
- 3 Which leaf cells do most photosynthesis?
- 4 What opens and closes a stoma?



Answers 1. carbon dioxide & water 2. magnesium 3. palisade mesophyll 4. the guard cells