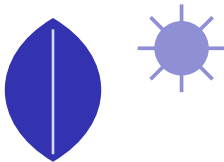


Plant Nutrition

IGCSE Biology ■ Topic 6

IGCSE Biology



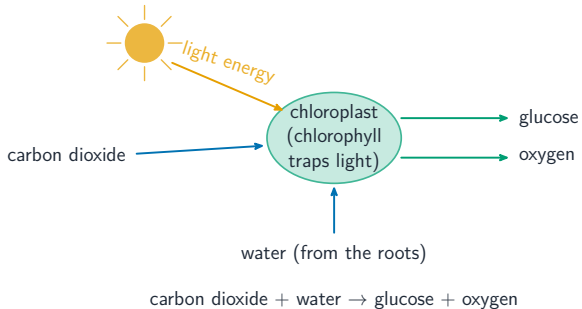
What we will cover

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

1

Photosynthesis

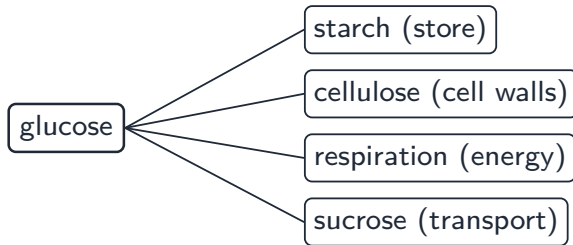
Photosynthesis



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** 淀粉
- build **cellulose** 纤维素 cell walls
- release energy in **respiration** 呼吸作用
- move as **sucrose** 蔗糖 in the **phloem** 韧皮部

Minerals from the soil

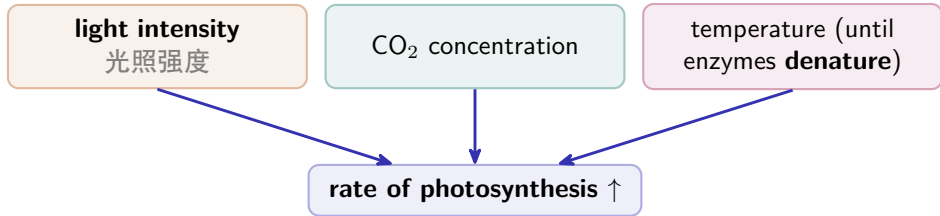
nitrate ions 硝酸根离子

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

magnesium ions 镁离子

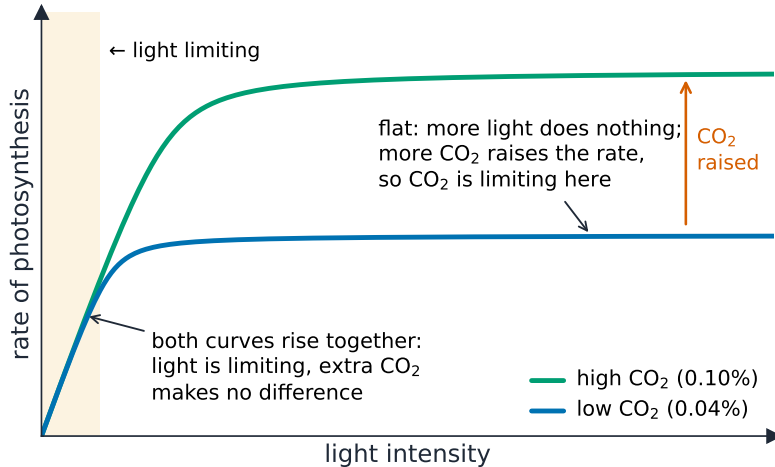
make chlorophyll; short-
age → **yellow** leaves

Rate and limiting factors



Limiting factor 限制因素 the factor in **shortest supply**: raising it raises the rate; raising the others does **not**.

Rate and limiting factors, in detail

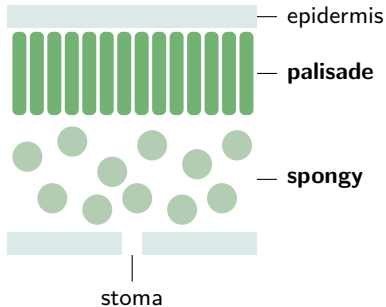


Same line at low light: light limits. Flat parts: more CO₂ raises the rate, so CO₂ limits

2

The leaf

Leaf structure



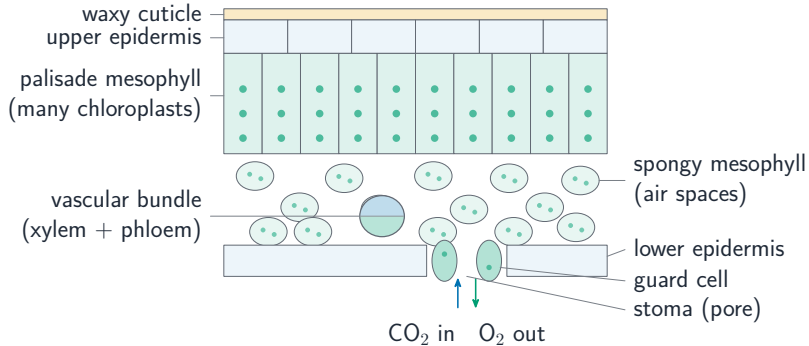
A leaf is **adapted** 适应: **broad and thin** to catch light.

Palisade 栅栏叶肉: packed with chloroplasts

Spongy 海绵叶肉: air spaces for gas exchange

Veins: **xylem** 木质部 brings water; **phloem** takes sugar

Leaf structure, in detail



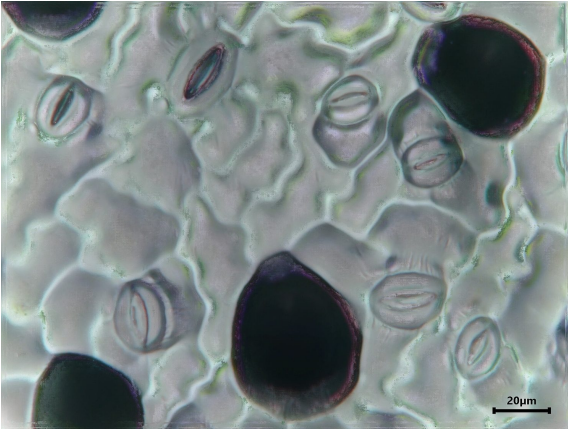
A leaf is **adapted** 适应 – broad & thin to catch light.

The leaf, layer by layer

the cuticle 角质层	a waxy waterproof layer on top – reduces water loss, and lets light through
the epidermis 表皮	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 海绵叶肉	loosely packed with air spaces – a large surface area 表面积 for gas exchange
vascular bundles 维管束	the leaf's veins: xylem 木质部 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** 对照, and test the leaf for starch with iodine – blue-black means starch. Hydrogencarbonate **indicator** 指示剂 is the separate test, for carbon dioxide.

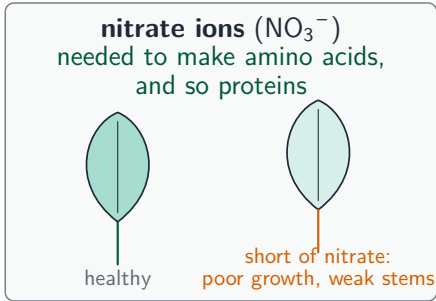
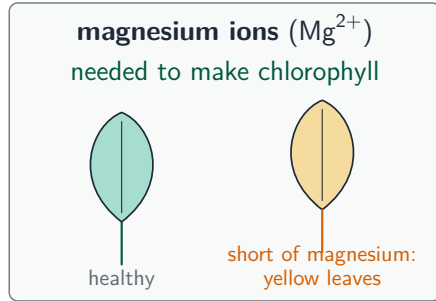
Stomata and guard cells



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

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

Nitrate and magnesium deficiency



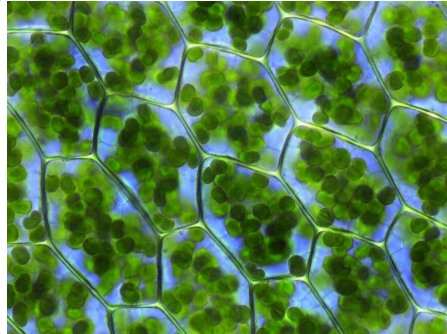
A plant short of nitrate grows poorly; a plant short of magnesium has yellow leaves

Leaves capture light



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

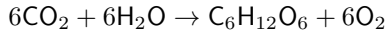
photosynthesis
光合作用

plants make **carbohydrates** 碳水化合物 from simple **raw materials** 原料, using light energy trapped by chlorophyll – the green **pigment** 色素 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** 花蜜, which draws **insects** 昆虫 for **pollination** 传粉

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

Exam tips

- Learn the word equation exactly: carbon dioxide + water $\rightarrow$ 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) $\rightarrow$ 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 $\rightarrow$ amino acids; magnesium ions $\rightarrow$ chlorophyll.

3

Recap

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** 限制因素 – 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