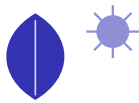


Plant Nutrition

IGCSE Biology ■ Topic 6

IGCSE Biology



Plant Nutrition

What we will cover

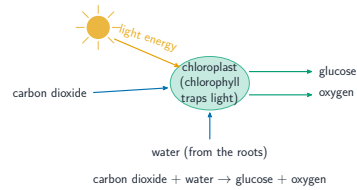
- 1 Photosynthesis
- 2 Uses of glucose
- 3 Minerals from the soil
- 4 Rate & limiting factors
- 5 Leaf structure

1 Photosynthesis

Plant Nutrition

↳ Photosynthesis

Photosynthesis



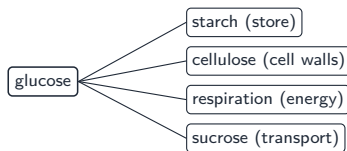
Green leaves capture sunlight for photosynthesis.

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

Plant Nutrition

↳ Photosynthesis

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

Plant Nutrition

↳ Photosynthesis

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

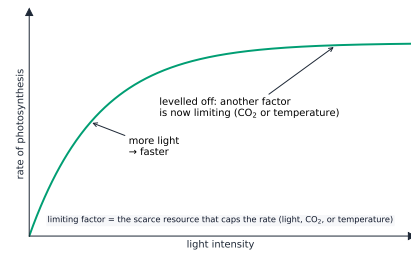
Rate and limiting factors

Three factors raise the rate:

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

The one in shortest supply is the **limiting factor** 限制因素.

Rate and limiting factors, in detail



More light speeds up photosynthesis until another factor becomes limiting

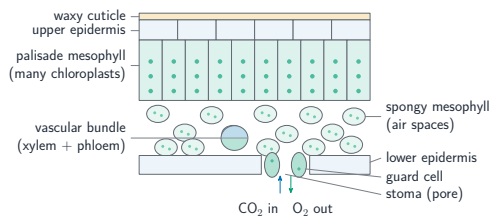
2 The leaf

Leaf structure

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

- **palisade** 栅栏叶肉 cells: packed with chloroplasts
- **spongy** 海绵叶肉 layer: air spaces for gas
- **xylem** 木质部 brings water; phloem takes sugar

Leaf structure, in detail



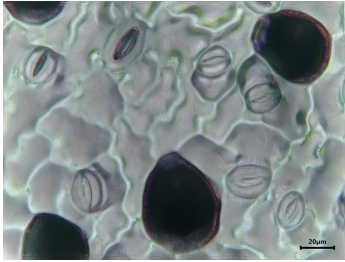
A leaf is **adapted** 适应 – broad & thin to catch light.

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
the vein	xylem brings water, 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 and test the leaf for starch. The **indicator** 指示剂 is iodine, and it goes blue-black.

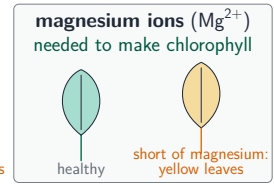
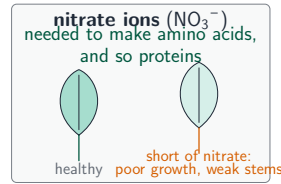
Stomata and guard cells



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.

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.

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 word equation	carbon dioxide + water → glucose + oxygen
(Supplement)	$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
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 → 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.

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