CLUECUB · REVISION NOTES

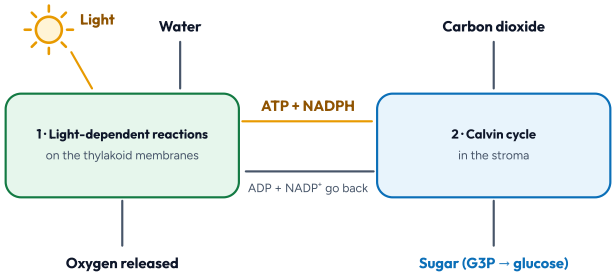
Photosynthesis notes

WORD EQUATION

carbon dioxide + water → glucose + oxygen (using light energy, absorbed by chlorophyll)

SYMBOL EQUATION

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$



What it is

- Plants, algae and some bacteria make **glucose** from carbon dioxide and water, using **light energy**.
- It is **endothermic**: energy from light is taken in and stored in glucose.
- In plants and algae it happens in **chloroplasts**, mostly in the **palisade cells** of leaves.
- **Chlorophyll** absorbs mostly red and blue light and reflects green.

The two stages

- **Light-dependent reactions** (thylakoid membranes): light splits water, **oxygen** is released, and **ATP** and **NADPH** are made.
- **Calvin cycle** (stroma): uses ATP and NADPH to turn CO_2 into sugar. The enzyme is **RuBisCO**.
- The oxygen released comes from **water**, not from carbon dioxide.

In and out of the leaf

- CO_2 diffuses in through the **stomata**; O_2 diffuses out.
- **Water** comes from the roots through the **xylem**.
- **Guard cells** open and close the stomata.
- Glucose is used for respiration, or turned into **starch** (storage), **cellulose** (cell walls), **sucrose** (transport) and proteins and fats.

Limiting factors

- **Light intensity**, **CO_2 concentration** and **temperature** limit the rate. Whichever is in shortest supply is the limiting factor.
- Light intensity falls with distance: intensity $\propto 1 \div \text{distance}^2$ (the inverse square law).
- Too hot and the enzymes are **damaged**, so the rate falls.

How a leaf is adapted

- **Broad and thin**: a big surface for light, and a short path for gases.
- **Palisade cells** packed with chloroplasts near the top surface.
- **Air spaces** in the spongy layer let gases move between cells.
- **Veins** bring water (xylem) and carry sugar away (phloem).

Mistakes that lose marks

- Plants **respire all the time**, day and night, not just in the dark.
- Most of a plant's mass comes from **CO_2 in the air**, not from the soil.
- The Calvin cycle **doesn't need darkness**. "Dark reactions" is a misleading old name.
- Glucose is the product. **Starch** is only how it is stored.

Quick check

1. Where in the chloroplast do the light-dependent reactions happen?
2. Which gas is released as a by-product?
3. Name the three main limiting factors.
4. Why does the rate fall when it gets too hot?
5. What is glucose turned into for storage?

Answers: 1. On the thylakoid membranes. 2. Oxygen. 3. Light intensity, carbon dioxide concentration, temperature. 4. The enzymes are damaged (denatured). 5. Starch.