



Photosynthesis



trapping solar energy in chlorophyll: the light reaction, the Calvin cycle, and the C₄/CAM shortcuts

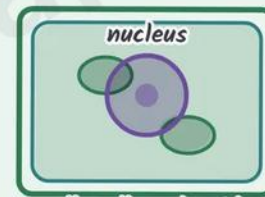


Photosynthesis, the Overall Process

- glucose is synthesised from CO₂ and H₂O, using solar energy trapped by chlorophyll
- $6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow{\text{light, chloroplast}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$
- characteristic of green plants and other photosynthetic organisms
- the final light-trapping step nearly all other life depends on
- atmosphere holds about 0.03% CO₂ by volume, 2200 billion tons
- oceans hold over 50 times that as dissolved gas or carbonate
- green plants fix about 70 billion tons of carbon a year from both

The Chloroplast

- mainly in leaf mesophyll cells
- CO₂ enters via stomata, water via the veins
- higher plant chloroplasts are discoid, lens shaped, double membrane bound
- inside is the ground substance, the stroma
- stroma holds stacks of chlorophyll-bearing double-membrane sacs, thylakoids, piled into a granum
- chlorophylls, carotenes, xanthophylls sit in the thylakoid membrane, fat soluble
- they absorb specific wavelengths, with enzymes convert solar energy to ATP and NADPH₂
- stromal enzymes then use that ATP and NADPH₂ to build carbohydrate



cell wall + plastids

a plant cell: wall and plastids outside, nucleus at the centre. The chloroplasts among those plastids are where every step below happens

Chlorophyll a vs b, and the carotenoids *

Chlorophyll a & b

- differ only in a side group: a carries -CH₃, b carries -CHO
- each has a head (porphyrin ring, tetrapyrrole) and a hydrocarbon tail (phytol)

Carotenoids

- lipid compounds, red, orange, yellow or brown: carotenes (C₄₀H₅₆, orange-red) and xanthophylls (oxygen-bearing)
- absorb light and pass it to chlorophyll a
- protect chlorophyll from photo-oxidation

