

Photosynthesis

What energy transformation happens in photosynthesis?

Photosynthesis

Word equation for photosynthesis

Photosynthesis

Where does the hydrogen in glucose come from?

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Oxygen in photosynthesis

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Rf value

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Colours of photosynthetic pigments on a chromatogram

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What happens when a pigment absorbs light?

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Absorption spectrum vs action spectrum

carbon dioxide + water → glucose + oxygen

Light energy is transformed to chemical energy in carbon compounds, supplying most energy for ecosystems.

A by-product from the splitting of water, released by plants, algae and cyanobacteria.

From splitting water molecules, using light energy.

Carotene orange-yellow, xanthophyll yellow, chlorophyll a blue-green, chlorophyll b yellow-green.

Distance moved by pigment ÷ distance moved by solvent front. No units; between 0 and 1.

Absorption: % light absorbed at each wavelength. Action: rate of photosynthesis at each wavelength. Both peak in blue and red.

An electron in the pigment molecule is excited to a higher energy level; only wavelengths matching the energy gap are absorbed.

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How can light intensity, CO₂ and temperature be varied?

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Limiting factor

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FACE vs greenhouse CO₂ enrichment

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Advantages of a pigment array in a photosystem

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Photolysis of water

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Cyclic vs non-cyclic photophosphorylation

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How is NADP reduced?

The factor furthest from its optimum, which limits the rate of photosynthesis.

Light: lamp distance or filters. CO₂: sodium hydrogencarbonate concentrations.
Temperature: water baths.

Molecular array of chlorophyll and accessory pigments in a membrane, with a special chlorophyll reaction centre that emits excited electrons.

FACE: CO₂ released over field plots, realistic but less controlled. Greenhouse: enclosed, controlled but less natural.

In photosystem II: $2\text{H}_2\text{O} \rightarrow 4\text{H}^+ + 4\text{e}^- + \text{O}_2$.
Electrons and protons are used; oxygen is waste.

Wider range of wavelengths absorbed, more light captured, energy funnelled to one reaction centre beside an electron acceptor.

It accepts two electrons from photosystem I and a hydrogen ion from the stroma.

Non-cyclic: electrons from PSII; ATP, reduced NADP, O₂. Cyclic: electrons from PSI return to carriers; ATP only.

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Where in a thylakoid do photolysis, ATP synthesis and NADP reduction happen?

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Carbon fixation by Rubisco

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Synthesis of triose phosphate

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Regeneration of RuBP

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How are amino acids made in plants?

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Why does lack of CO₂ stop photosystem II?

$\text{RuBP} + \text{CO}_2 \rightarrow 2 \text{ glycerate 3-phosphate.}$
Rubisco is slow and ineffective at low CO_2 ,
so it is very abundant.

Photolysis: lumen side of PSII. ATP: ATP
synthase, released to stroma. NADP
reduced: stroma side of PSI.

Five triose phosphate $\rightarrow$ three RuBP, using
ATP. Five-sixths of TP is recycled if glucose
is the product.

Glycerate 3-phosphate (GP) is converted to
triose phosphate (TP) using reduced NADP
and ATP.

No carbon fixation, so NADP is not
regenerated; carriers stay reduced and PSII
cannot pass electrons on.

From Calvin cycle intermediates plus
mineral nutrients: nitrogen (nitrate or
ammonium), and sulfur for some.