

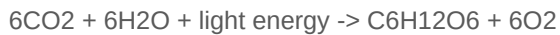
Grade 12 Life Sciences: Photosynthesis & Respiration Study Guide

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Free Study Resources for South African Matric Learners

1. Photosynthesis

Overall equation



Takes place in the chloroplast.

Two main stages: Light reactions (thylakoid membranes) and Dark reactions / Calvin cycle (stroma)

Light Reactions

- Light absorbed by chlorophyll (mainly in grana/thylakoids)
- Water molecules split (photolysis): $2\text{H}_2\text{O} \rightarrow 4\text{H}^+ + 4\text{e}^- + \text{O}_2$
- ATP and NADPH produced (used in Calvin cycle)
- Oxygen released as by-product

Calvin Cycle (Dark Reactions)

- CO_2 fixed by RuBisCO enzyme onto 5C acceptor (RuBP)
- Produces 3-carbon compounds (3-PGA)
- ATP and NADPH (from light reactions) used to reduce 3-PGA to G3P
- G3P used to make glucose and regenerate RuBP

2. Factors Affecting Photosynthesis

- Light intensity: increases rate up to saturation point; CO_2 or temperature then limits
- CO_2 concentration: increases rate; light or temperature may then limit
- Temperature: increases rate up to optimum ($\sim 30^\circ\text{C}$); enzymes denature above optimum
- Water: needed for light reactions; stomata close in drought $\rightarrow \text{CO}_2$ cannot enter
- Chlorophyll: more chlorophyll = more light absorbed

3. Cellular Respiration

Overall equation (aerobic)



Stages of Aerobic Respiration

- Glycolysis (cytoplasm): glucose (6C) $\rightarrow$ 2 pyruvate (3C); net 2 ATP, 2 NADH
- Pyruvate oxidation (mitochondrial matrix): 2 pyruvate $\rightarrow$ 2 acetyl-CoA; 2 NADH; 2 CO_2 released
- Krebs cycle (matrix): 2 acetyl-CoA $\rightarrow$ 4 CO_2 ; 6 NADH, 2 FADH_2 , 2 ATP
- Oxidative phosphorylation (inner membrane): NADH, FADH_2 pass electrons to ETC; ~ 32 -34 ATP produced; O_2 is final electron acceptor $\rightarrow \text{H}_2\text{O}$ formed

Anaerobic Respiration

- No oxygen present; glycolysis still occurs (2 ATP)
- Animals/fungi: pyruvate $\rightarrow$ lactate (or ethanol + CO_2 in yeast)
- Only 2 ATP per glucose (inefficient vs 36-38 ATP aerobic)

TIP Mitochondria = powerhouse of the cell. Outer membrane: permeable. Inner membrane (cristae): site of ETC and ATP synthase. Matrix: site of Krebs cycle.