Chapter 5: Photosynthesis

5.1 What photosynthesis does

Photosynthesis is the process by which plants, algae and some bacteria use light energy to turn carbon dioxide and water into glucose and oxygen. The overall equation is $6CO_2 + 6H_2O + \text{light energy} \rightarrow C_6H_{12}O_6 + 6O_2$.

It takes place in chloroplasts. Chlorophyll, the green pigment in the thylakoid membranes, absorbs mostly red and blue light and reflects green light, which is why leaves look green.

5.2 The light-dependent reactions

The light-dependent reactions happen in the thylakoid membranes. Light energy splits water molecules, releasing oxygen as a by-product, and the energy is stored in ATP and NADPH.

Because the oxygen comes from water, not from carbon dioxide, experiments with labelled oxygen isotopes showed that the oxygen plants release is the oxygen from water.

5.3 The Calvin cycle

The Calvin cycle happens in the stroma. It uses ATP and NADPH from the light-dependent reactions to fix carbon dioxide into sugar. The enzyme RuBisCO catalyses the first step, attaching CO_2 to a five-carbon molecule called RuBP.

The Calvin cycle does not need light directly, but it stops in the dark because it depends on the ATP and NADPH made in the light.

5.4 Limiting factors

The rate of photosynthesis is limited by whichever factor is in shortest supply: light intensity, carbon dioxide concentration or temperature. Above an optimum temperature the rate falls because enzymes such as RuBisCO stop working well.