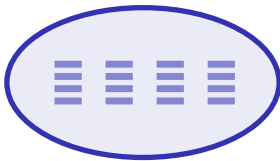


Photosynthesis

A-Level Biology ■ Topic 13

A-Level Biology



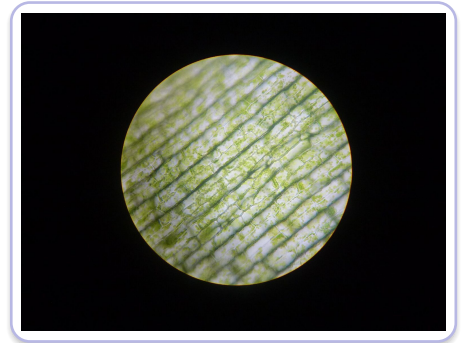
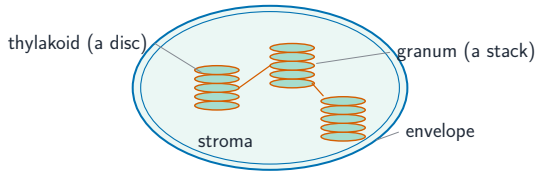
What we will cover

- 1 The chloroplast
- 2 The two stages
- 3 Pigments & spectra
- 4 The light-dependent stage
- 5 The Calvin cycle
- 6 Limiting factors



leaves are green with chlorophyll

The chloroplast

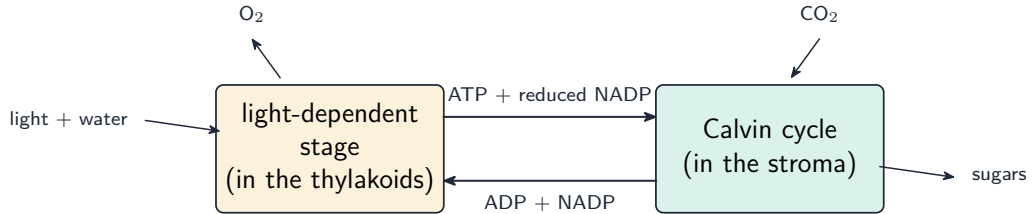


chloroplasts micrograph

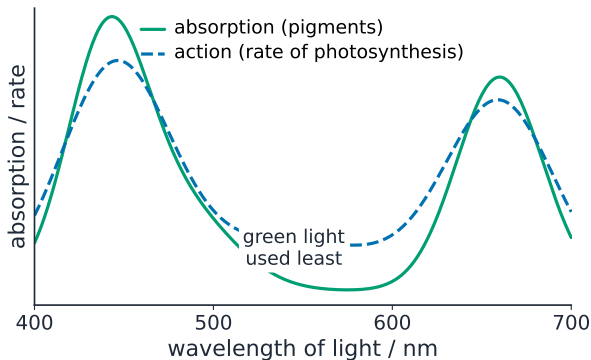
The two stages

- **light-dependent** 光反应阶段
(thylakoids) – makes ATP & reduced **NADP** NADP
- **Calvin cycle** 卡尔文循环
(stroma) – spends them to fix CO_2 into sugars

The two stages



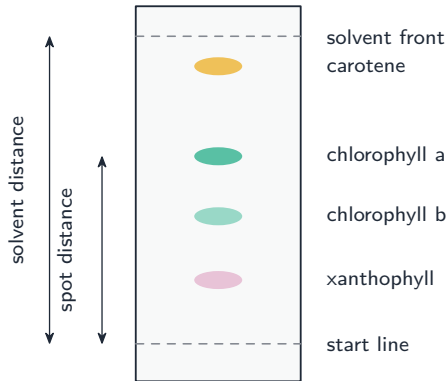
Pigments and spectra



Chlorophyll 叶绿素 absorbs mainly red & blue light.

The **absorption spectrum** 吸收光谱 matches the **action spectrum** 作用光谱 – showing the pigments drive photosynthesis.

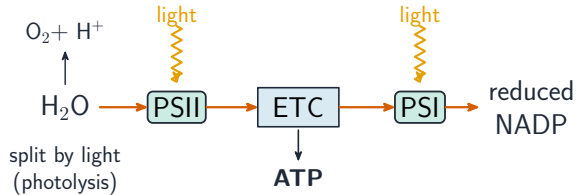
Chromatography



Chromatography 色谱法 separates the pigments – each travels its own distance up the paper.

$$R_f = \frac{\text{spot distance}}{\text{solvent distance}}$$

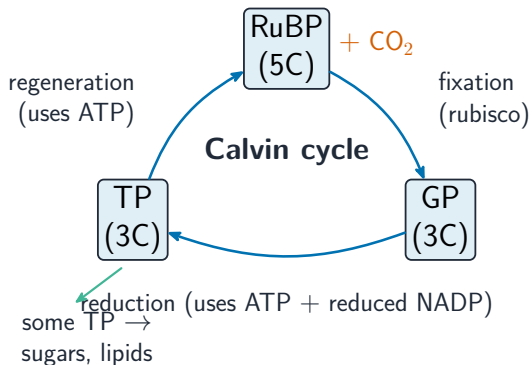
The light-dependent stage



Photophosphorylation 光合磷酸化 makes ATP. In the **non-cyclic** form:

- **photolysis** 光解 of water releases **oxygen** 氧气
- electrons flow $\text{PSII} \rightarrow \text{PSI}$
- ATP *and* reduced NADP are made

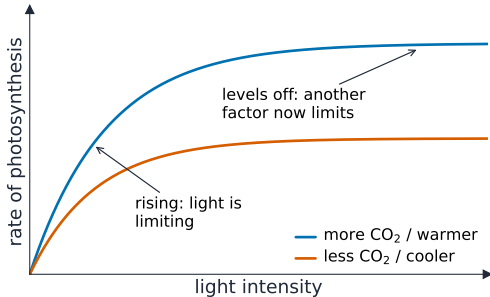
The Calvin cycle



- **fixation** 固定 –
rubisco 核酮糖二磷酸羧化酶
joins CO₂ to RuBP → GP
- **reduction** 还原 – GP → TP
using ATP & reduced NADP
- **regeneration** 再生 – TP
remakes RuBP

Some TP leaves to make sugars.

Limiting factors



A **limiting factor** 限制因素 is the one in shortest supply.

While the rate rises, **light** 光照强度 limits it; where it levels off, CO₂ or temperature limits it. (Too hot → enzymes denature.)

Worked example – the Calvin cycle disturbed

A plant photosynthesising steadily is suddenly given no CO_2 . What happens to GP and RuBP?

- CO_2 joins RuBP (via rubisco) to make GP; no $\text{CO}_2 \Rightarrow$ that step stops.
- GP is still being **used up**, reduced to triose phosphate $\Rightarrow$ **GP falls**.
- RuBP is still being **regenerated** from triose phosphate but no longer consumed $\Rightarrow$ **RuBP rises**.
- Remove the **light** instead: the opposite – GP rises, RuBP falls.

Track **what is made** and **what is used** for each molecule. Cutting CO_2 and cutting light give **opposite** answers – read which one the question removed.

Topic 13 – key takeaways

1

Chloroplast

grana for stage 1; stroma for stage 2

2

Light stage

photolysis releases O_2 ; makes ATP & NADPH

3

Calvin cycle

fixation, reduction, regeneration

4

Limiting factors

light, CO_2 , temperature

Check yourself

- 1 Where does the Calvin cycle happen?
- 2 What gas is released by photolysis of water?
- 3 Which enzyme fixes carbon dioxide?
- 4 Name a limiting factor of photosynthesis.



Answers 1. the stroma 2. oxygen 3. rubisco 4. light / CO₂ / temperature