

## Exercise walk-through

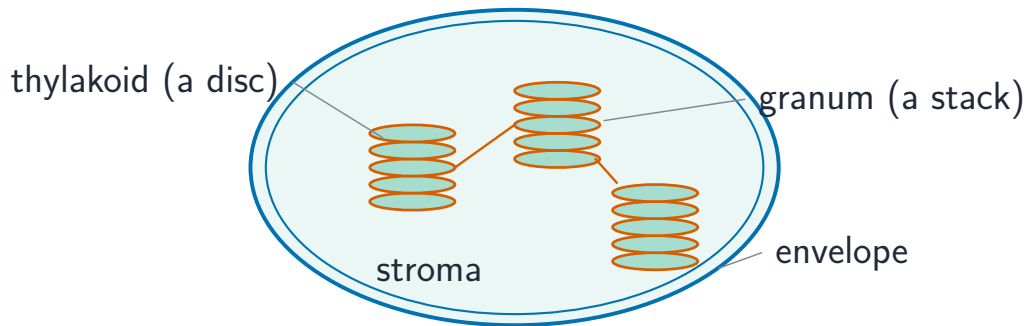
Photosynthesis as an energy transfer process ■ 13.1

eXercise

## You must be able to

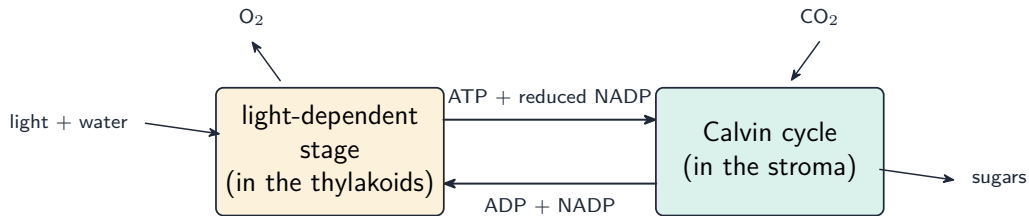
- relate chloroplast structure to function and explain the two linked stages
- describe the roles of pigments, interpret spectra, and use **Rf values** 比移值
- explain cyclic and non-cyclic photophosphorylation and the Calvin cycle

## Method — Chloroplast and the two stages

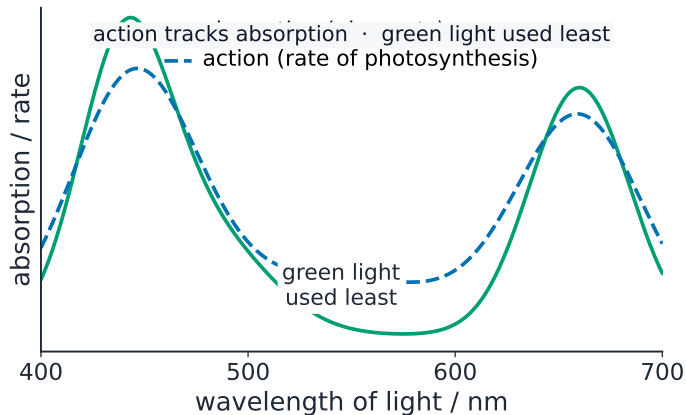


*A chloroplast with thylakoid stacks (grana) bathed in the stroma*

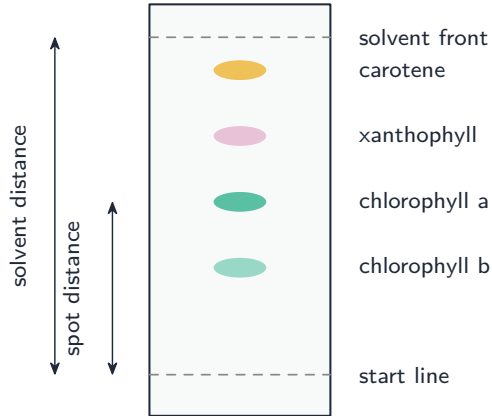
## Method — Chloroplast and the two stages



## Method — Pigments, spectra and chromatography

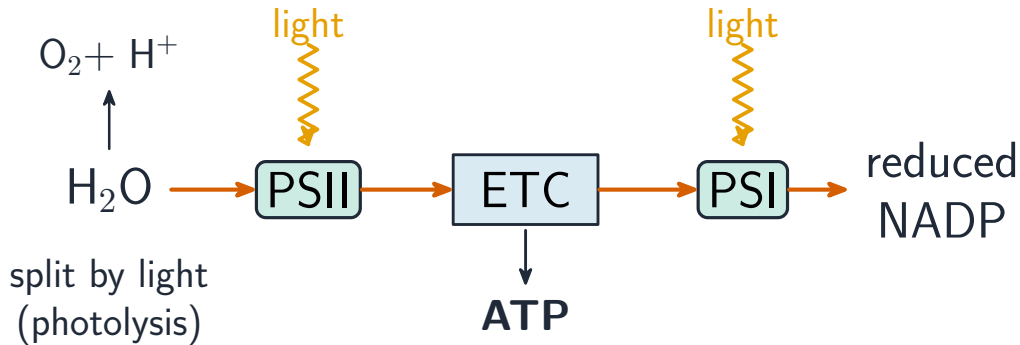


## Method — Pigments, spectra and chromatography

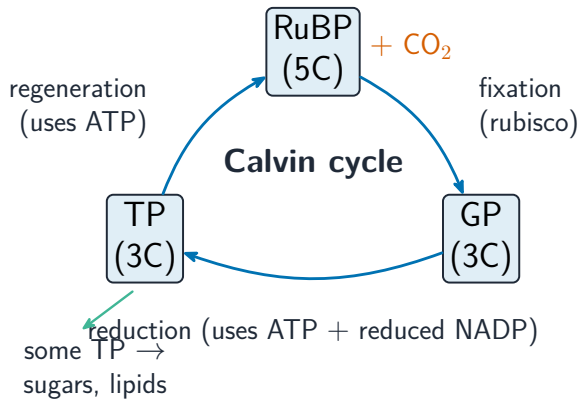


*Chromatography paper with pigments separated; spot distance and solvent distance marked*

## Method — Photophosphorylation



## Method — The Calvin cycle



## Practice 2.1 ■ 2 marks

State what is made in the light-dependent stage and passed to the Calvin cycle.

## Solution 2.1

Method: Chloroplast and the two stages

### Worked steps

ATP and reduced NADP **B1** *each*.

## Practice 2.2 ■ 1 mark

Name the enzyme that fixes carbon dioxide onto RuBP in the Calvin cycle.

## Solution 2.2

Method: The Calvin cycle

### Worked steps

rubisco **B1**.

## Exam-style 3.1 ■ 1 mark

In which part of the chloroplast does the Calvin cycle take place?

**A** the thylakoid membrane

**B** the stroma

**C** the grana

**D** the outer envelope

## Solution 3.1

Method: Chloroplast and the two stages

**A** the thylakoid membrane

**B** the stroma



**C** the grana

**D** the outer envelope

### Worked steps

**B.** The Calvin cycle takes place in the stroma.

## Exam-style 3.2 ■ 1 mark

Which is produced **only** in non-cyclic (not cyclic) photophosphorylation?

**A** ATP

**B** reduced NADP and oxygen

**C** carbon dioxide

**D** RuBP

## Solution 3.2

Method: Photophosphorylation

**A** ATP

**B** reduced NADP and oxygen



**C** carbon dioxide

**D** RuBP

### Worked steps

**B.** Only non-cyclic photophosphorylation makes reduced NADP and releases oxygen (from photolysis).

## Exam-style 3.3 ■ 2 marks

In a chromatography experiment a pigment moved 4.8 cm while the solvent moved 12.0 cm.

- (a) Calculate the  $R_f$  value of the pigment.
- (b) State **one** reason the chloroplast contains several different pigments.

## Solution 3.3

Method: Pigments, spectra and chromatography

### Worked steps

(a)  $R_f = \frac{4.8}{12.0} = 0.40$  **M1** **A1**.

(b) different pigments absorb different wavelengths, so more of the light energy is trapped **B1**.

## Exam-style 3.4 ■ 4 marks

Describe the three main steps of the Calvin cycle.

## Solution 3.4

### Worked steps

fixation — rubisco joins CO<sub>2</sub> to RuBP (5C) to make two GP (3C) **B1**; reduction — GP is reduced to TP using ATP and reduced NADP **B1** **B1**; regeneration — most TP is used (with ATP) to remake RuBP **B1**.