

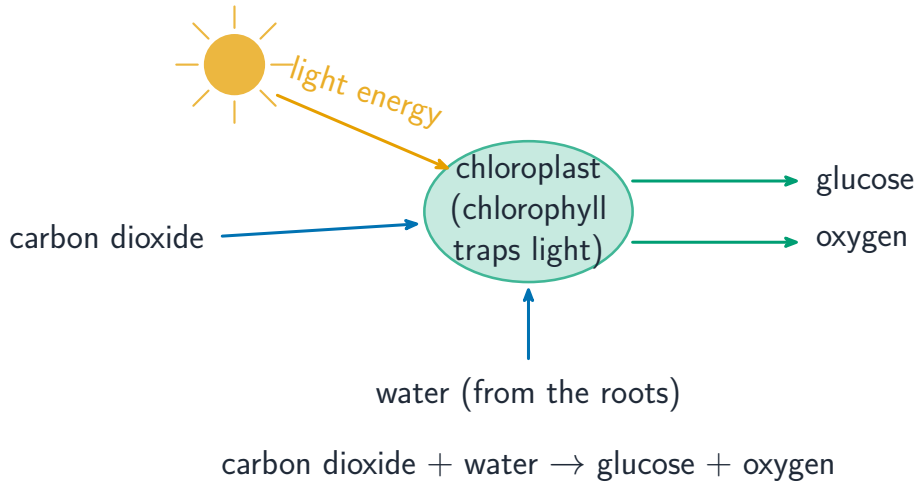
Exercise walk-through

6.1

Photosynthesis

IGCSE Biology

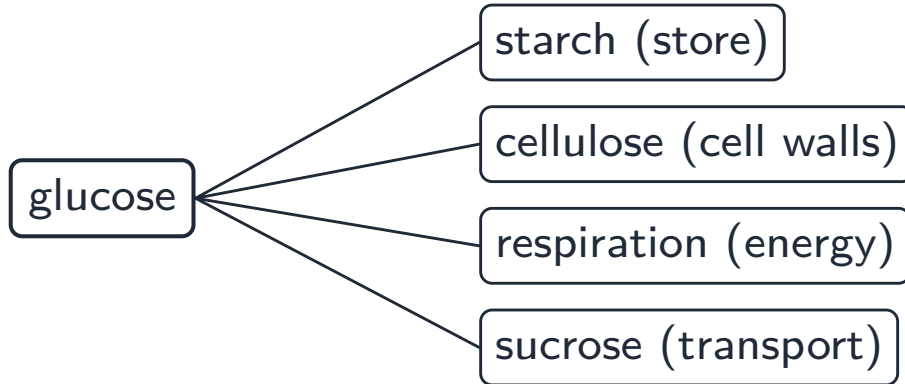
Photosynthesis



Green leaves capture sunlight for photosynthesis.

Photosynthesis takes in carbon dioxide and water and makes glucose and oxygen, using light

Uses of glucose



The glucose is used to:

- store as **starch**
- build **cellulose** cell walls
- release energy in **respiration**
- move as **sucrose** in the **phloem**

Minerals from the soil

nitrate ions

make **amino acids**
(proteins); shortage
→ poor, weak growth

magnesium ions

make chlorophyll; short-
age → **yellow** leaves

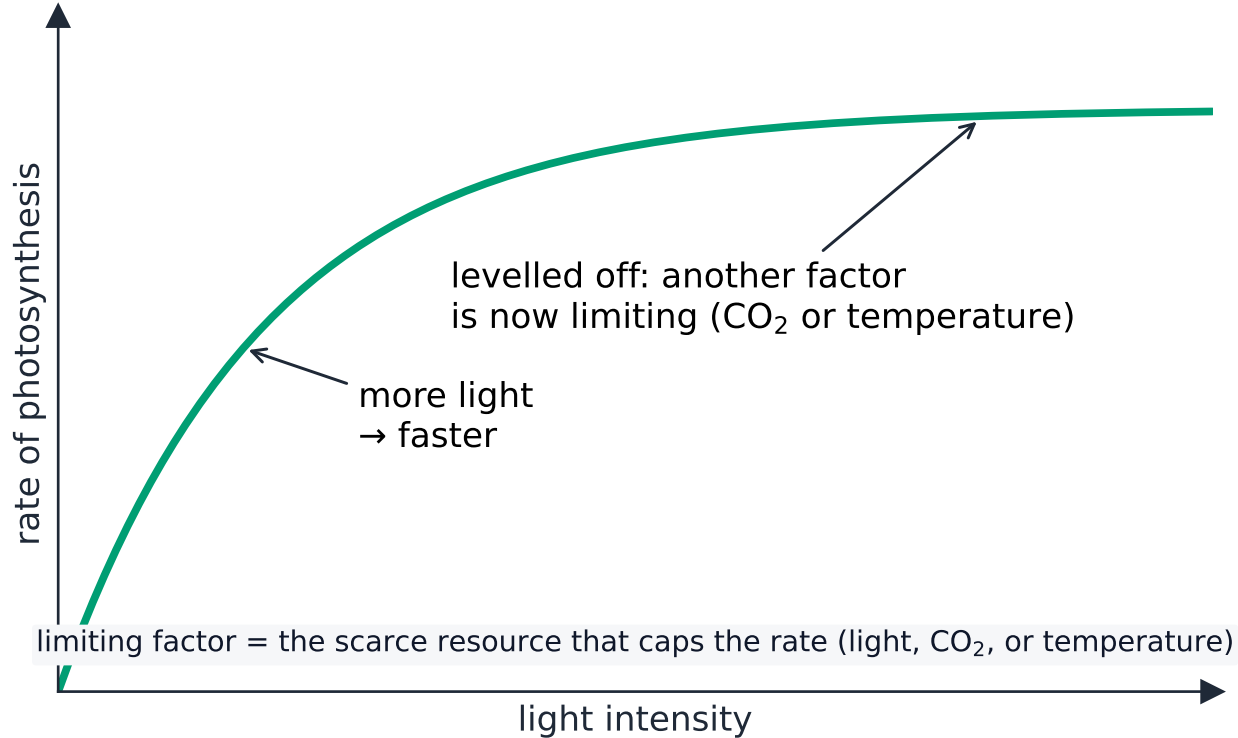
Rate and limiting factors

Three factors raise the rate:

- **light intensity**
- CO₂ concentration
- temperature (until enzymes denature)

The one in shortest supply is the **limiting factor** .

Rate and limiting factors, in detail



More light speeds up photosynthesis until another factor becomes limiting

Exercises 2.1-2.3

2.1 Write the word equation for photosynthesis.

[2]

2.2 State the role of magnesium ions in a plant.

[1]

2.3 Explain why a plant lacking nitrate ions grows poorly.

[2]

Exercises 2.1-2.3

2.1 Write the word equation for photosynthesis.

[2]

2.1

- carbon dioxide + water $\rightarrow$ glucose + oxygen

2.2 State the role of magnesium ions in a plant.

[1]

2.2

- magnesium ions are needed to make **chlorophyll**

2.3 Explain why a plant lacking nitrate ions grows poorly.

[2]

2.3

- nitrate is needed to make **amino acids and proteins**
- without proteins the plant cannot build new cells, so **growth is stunted**

Exercises 2.4·2.5

2.4 State what is meant by a limiting factor.

[1]

2.5 Give the balanced symbol equation for photosynthesis.

[2]

Exercises 2.4·2.5

2.4 State what is meant by a limiting factor. [1]

2.4

- a limiting factor is the factor in **shortest supply**, which holds back the rate
-

2.5 Give the balanced symbol equation for photosynthesis. [2]

2.5

- $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

Exercise 3.1

3.1 Photosynthesis can only take place where there is light and:

[1]

☐

A nitrate

B chlorophyll

C oxygen

D protein

Exercise 3.1

3.1 Photosynthesis can only take place where there is light and:

[1]

☐

A nitrate

B chlorophyll

C oxygen

D protein

3.1 B

- photosynthesis needs **chlorophyll** (and light)
- A is a mineral; C is a product; D is not required for the reaction itself

Exercise 3.2 (a)

3.2 A graph shows photosynthesis rate rising with light intensity, then levelling off.

(a) Explain why the rate levels off at high light intensity.

[2]

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3.2 A graph shows photosynthesis rate rising with light intensity, then levelling off.

(a) Explain why the rate levels off at high light intensity.

[2]

(a)

- another factor is now **limiting**
- e.g. CO₂ concentration or temperature

Exercise 3.2 (b)

3.2 A graph shows photosynthesis rate rising with light intensity, then levelling off.

(b) Name one other factor that could then be limiting.

[1]

Exercise 3.2 (b)

3.2 A graph shows photosynthesis rate rising with light intensity, then levelling off.

(b) Name one other factor that could then be limiting. [1]

(b)

- **carbon dioxide concentration** (or temperature)

Exercise 3.3

3.3 State two uses a plant makes of the glucose produced in photosynthesis. [2]

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3.3

- any **two** of: stored as starch / made into cellulose / used in respiration / converted to sucrose

Exercise 3.4 (a)

3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

(a) Name the gas being collected, and explain why counting its bubbles measures the rate of photosynthesis. [2]

Exercise 3.4 (a)

3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

(a) Name the gas being collected, and explain why counting its bubbles measures the rate of photosynthesis. [2]

(a)

- the gas is **oxygen**
- it is a product, so more bubbles mean a **faster rate**

Exercise 3.4 (b)

3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

(b) At low light intensity both lines rise steeply and lie on top of each other. Explain what this shows. [2]

Exercise 3.4 (b)

3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

(b) At low light intensity both lines rise steeply and lie on top of each other. Explain what this shows. [2]

(b)

- **light intensity** is limiting
- temperature makes no difference because it is **not limiting** here

Exercise 3.4 (c)

3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

(c) At high light intensity the 25 °C line levels off higher than the 15 °C line. Explain why. [3]

Exercise 3.4 (c)

3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

(c) At high light intensity the 25 °C line levels off higher than the 15 °C line. Explain why. [3]

(c)

- light is no longer limiting, so both lines **level off**
- at 25 °C the enzymes work **faster** than at 15 °C
- **temperature** was limiting the 15 °C line

Exercise 3.4 (d)

3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

(d) The student repeats the experiment at 45 °C and the rate is very low. Explain this result.

[2]

Exercise 3.4 (d)

3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

(d) The student repeats the experiment at 45 °C and the rate is very low. Explain this result. [2]

(d)

- enzymes are **denatured** at 45 °C
- active sites change shape, so the reaction **almost stops**

Exercise 3.4 (e)

3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

(e) Suggest two variables the student must keep constant for the comparison to be valid.[2]

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3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

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(e)

- any **two** of: lamp distance / CO₂ concentration / pondweed mass / volume of water / time counted

Exercise 3.4 (f)

3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

(f) Estimate what would happen to the rate if the student added sodium hydrogencarbonate solution, which releases carbon dioxide, at high light intensity. Explain your answer.

[2]

Exercise 3.4 (f)

3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

(f) Estimate what would happen to the rate if the student added sodium hydrogencarbonate solution, which releases carbon dioxide, at high light intensity. Explain your answer. [2]

(f)

- the rate would **increase**
- at high light, CO_2 is limiting, so supplying more **removes that limit**