

# MYP 4

# UNIT 2

# LESSON 4

PLANT NUTRITION AND PHOTOSYNTHESIS

# OBJECTIVES

- I can describe what plants need from their surroundings to stay alive and grow, and how they get food.
- I can identify the reactants and products of photosynthesis and write a word summary of the process.
- I can describe how plants are adapted to take in and release gases to support photosynthesis.
- I can describe how plants are adapted to take in and release gases to support photosynthesis.

# **PLANTS NUTRITION**



# **Lesson outline**

## **Plant nutrition**

What plants need to stay alive

How plants get food

What plant food is and how it's used

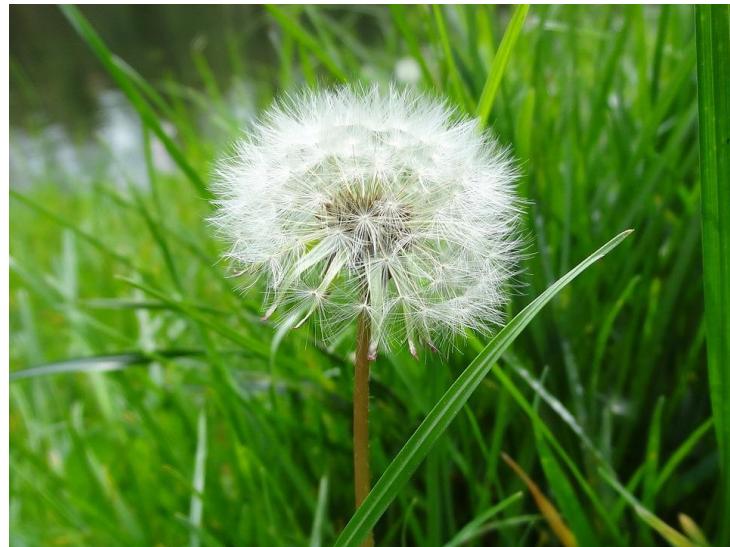


# What plants need to stay alive

Trees, flowers, weeds and vegetables are all examples of plants.

Plants are living organisms.

What do plants do that show they are living organisms?



# What plants need to stay alive



Plants need to take in things from their surroundings to stay alive, stay healthy and grow.

All plants need to take in **water**.



This plant has had plenty of water.



This plant needs more water!



# What plants need to stay alive

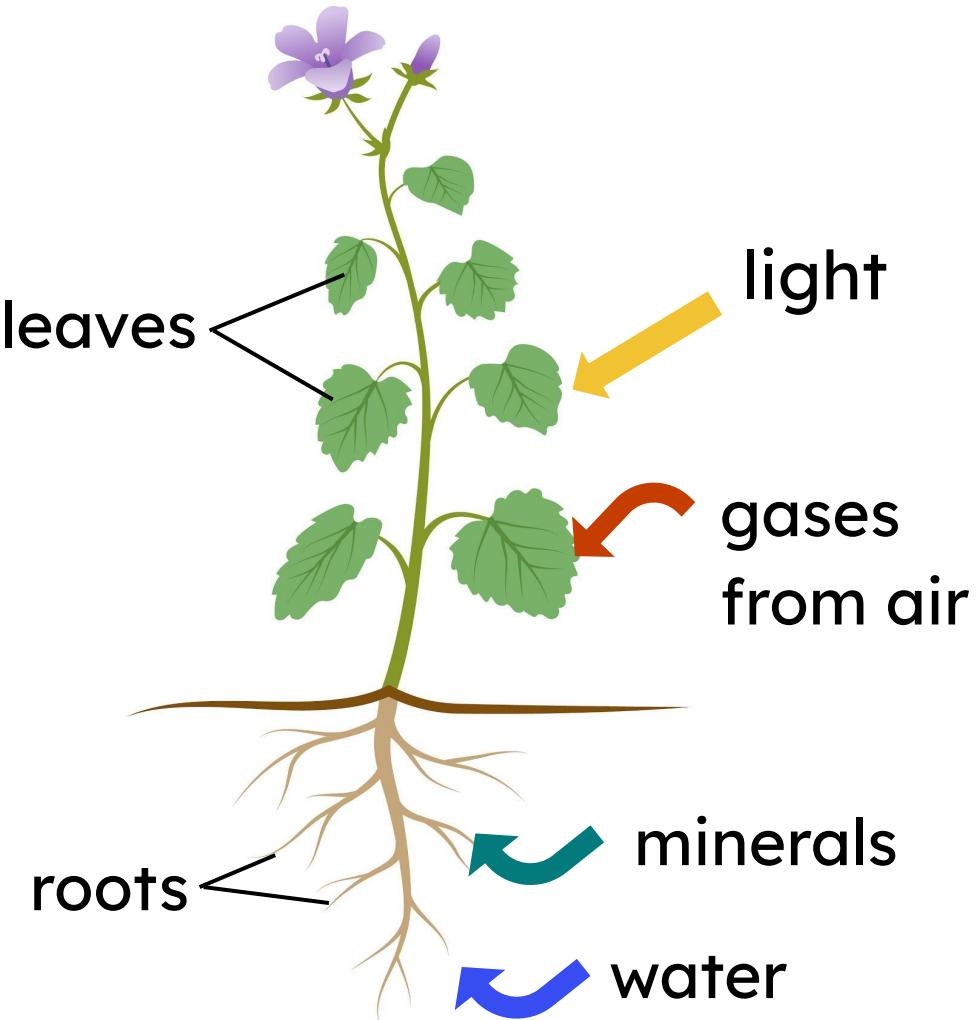
All plants need **light** to stay alive, stay healthy and grow.



# What plants need to stay alive



To stay alive, stay healthy and grow, plants need:



# What plants need to stay alive



What do plants take in through their roots?

- A Light
- B Minerals ✓
- C Soil
- D Water ✓



# What plants need to stay alive



What do plants take in through their leaves?

- A Gases from air ✓
- B Light ✓
- C Minerals
- D Water



# **Lesson outline**

## **Plant nutrition**

What plants need to stay alive

How plants get food

What plant food is and how it's used

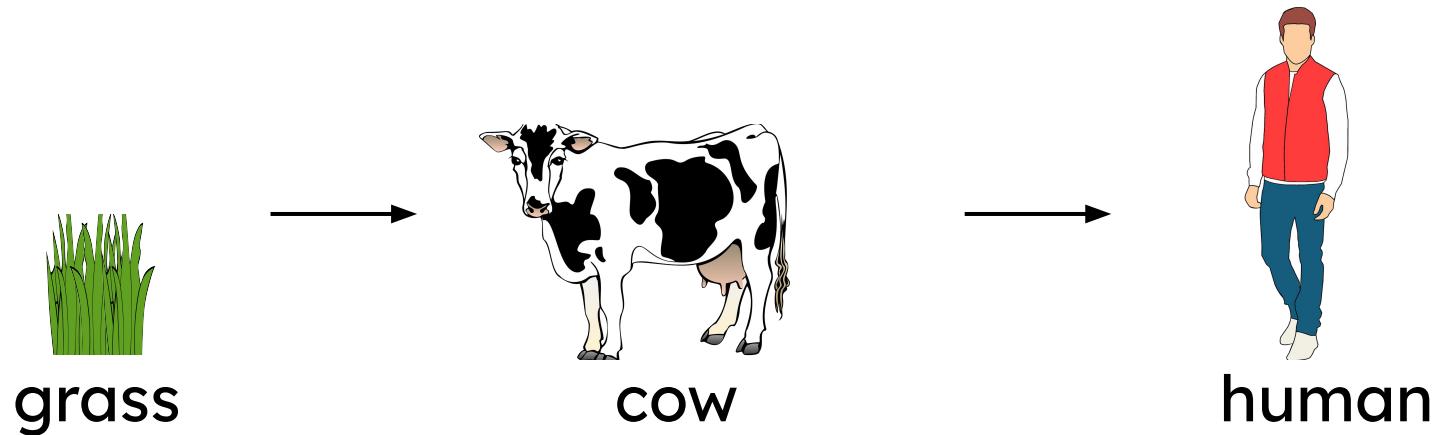


# How plants get food



Plants, animals and all other living organisms need **food** to stay alive, stay healthy and grow.

Animals, including humans, are **consumers**. They get their food by eating other organisms.



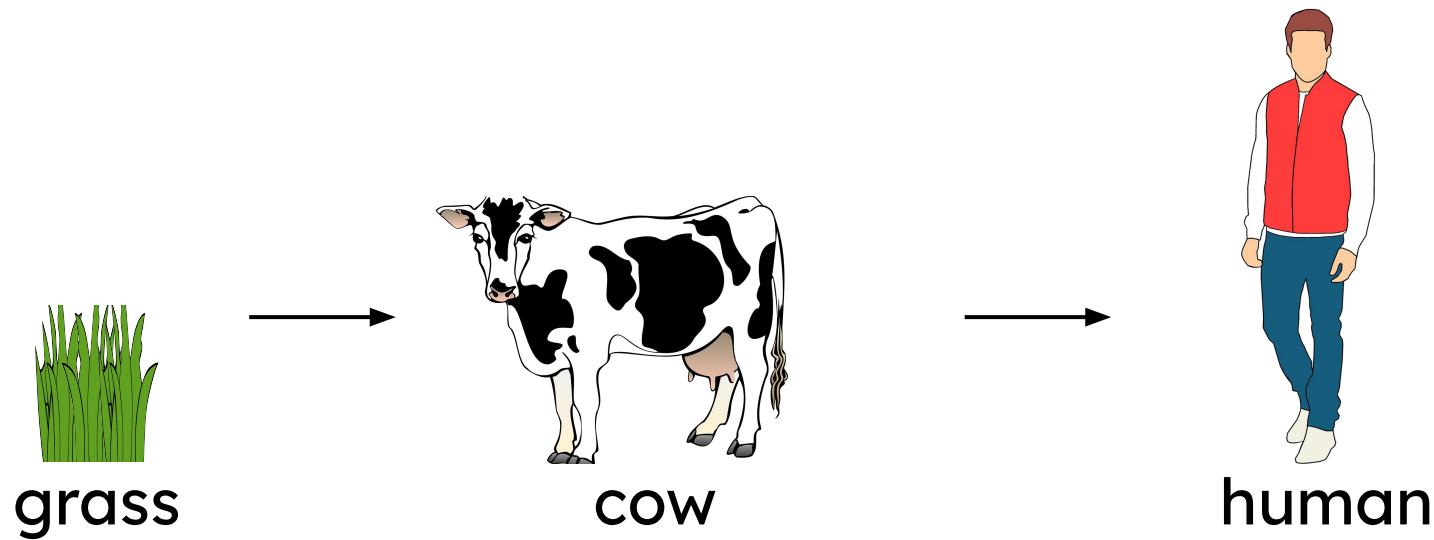
# How plants get food



**Plants are producers.**

They make their own food.

That's why producers are at the start of the food chain.

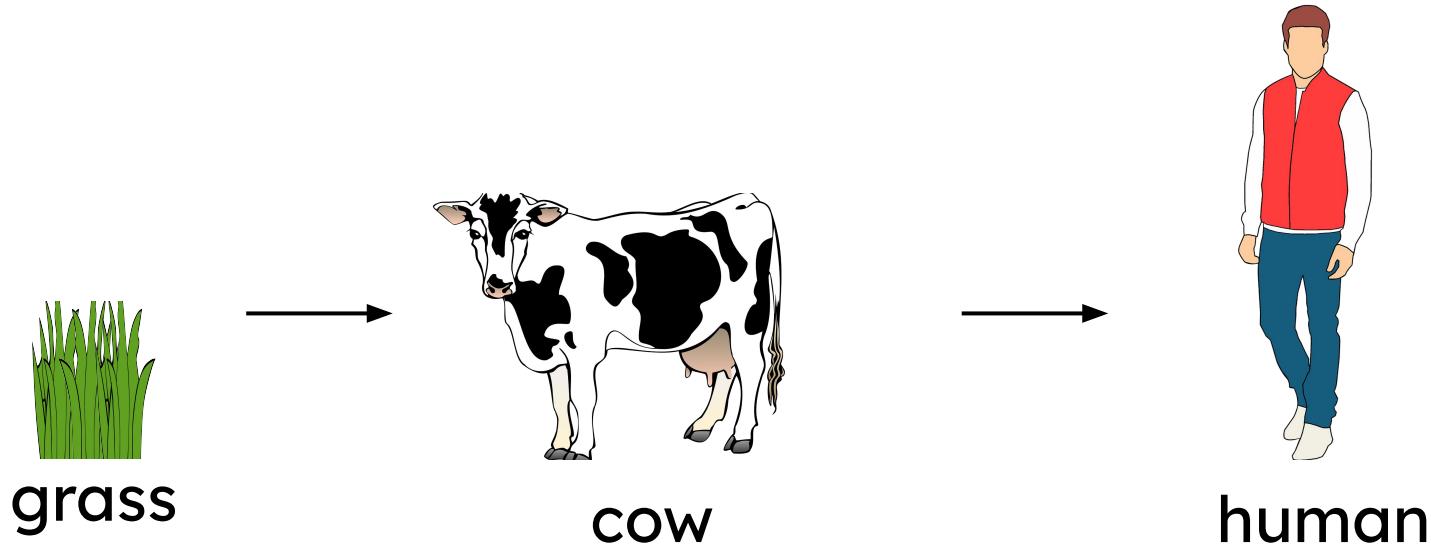


# How plants get food



Every food chain on Earth starts with a producer.

All the food in every food chain is made by plants and other producers.



Every animal, including every human, depends upon producers to make the food we consume to stay alive.



# How plants get food



## True or false?

Plants are consumers.

T

True

F

False ✓

## Justify your answer

A

Plants make their own food.



B

Plants take in food through their roots.



# How plants get food



## True or false?

Plants are producers.

T

True ✓

F

False

## Justify your answer

A

Plants make fruit and vegetables.

B

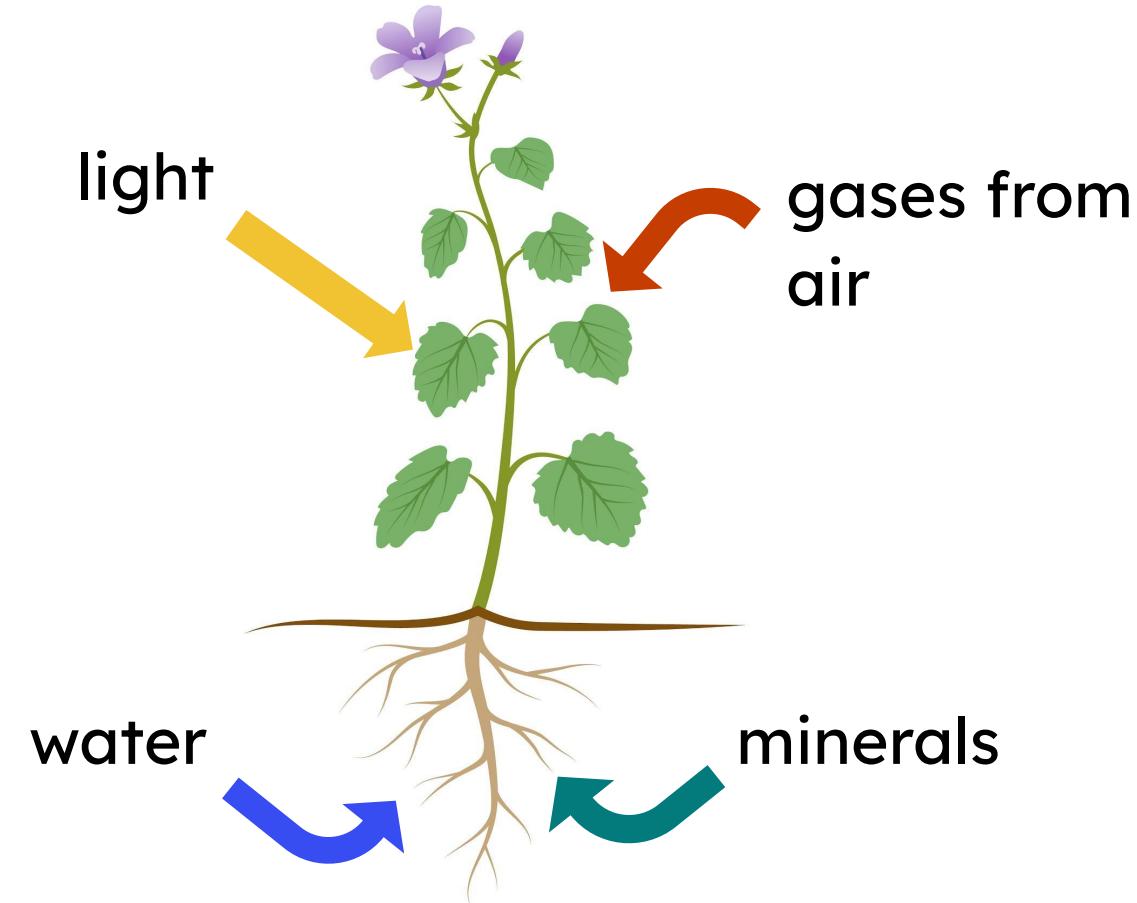
Plants make their own food.



# How plants get food



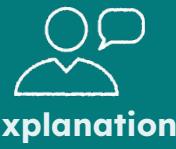
Plants take in things from their surroundings:



These things are **not** food!



# How plants get food



In everyday life, we call lots of things ‘food’.

In science, the word ‘food’ means something that an organism uses as...

**both**

- a source of materials for growth and repair

**and**

- a source of energy.



Examples of food



# How plants get food



The things that plants take in from their surroundings are **not** food.

This is because plants only use each thing as...

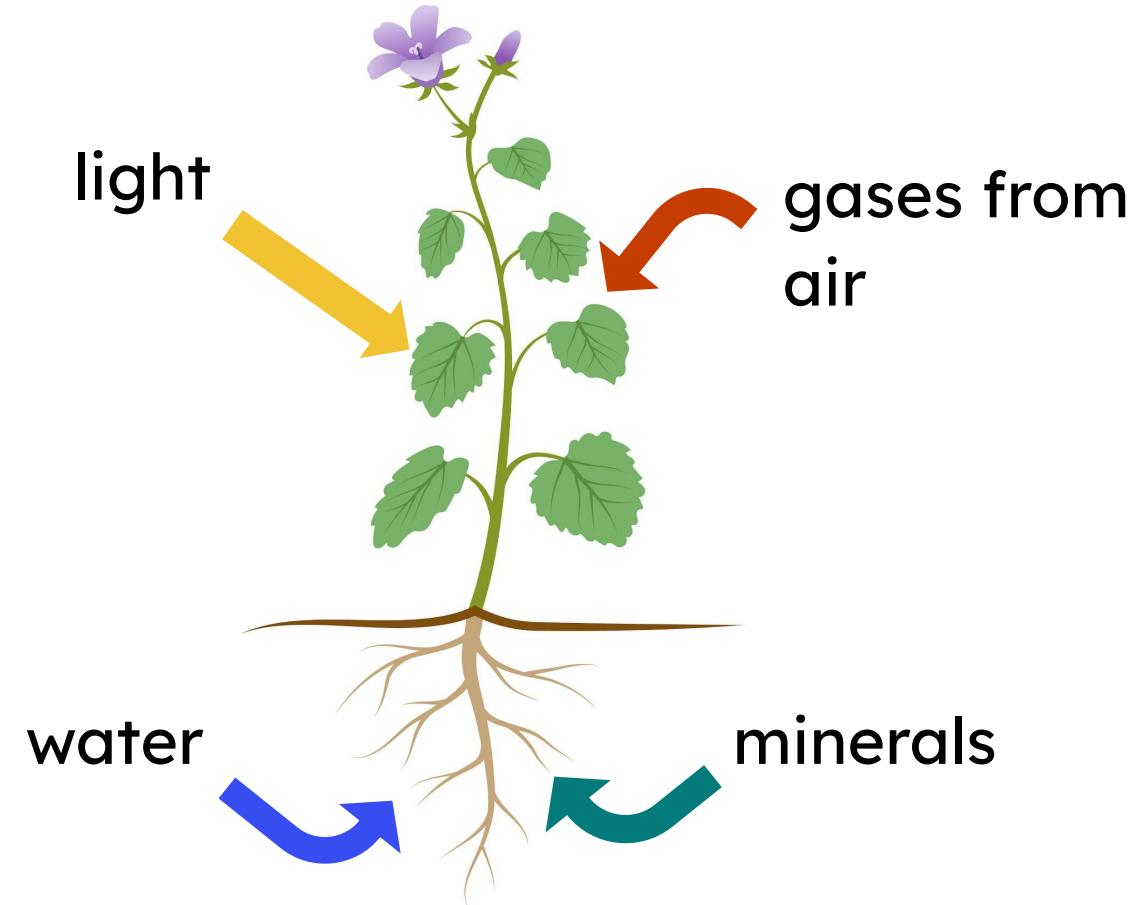
**either**

- a source of materials for growth and repair

**or**

- a source of energy

...but **not** both.



# How plants get food



In science, the word 'food' means something that an organism...

- A needs to stay alive
- B takes in from its surroundings
- C uses a source of materials for growth and repair ✓
- D uses a source of energy ✓



# How plants get food



## True or false?

Plants use water, gases from the air, minerals and light as food.

T

True

F

False ✓

## Justify your answer

A

Plants only use gases, minerals and water as a source of materials for growth and repair, and only use light as a source of energy.

B

Plants use all those things as a source of materials for growth and repair and as a source of energy.



# **Lesson outline**

## **Plant nutrition**

What plants need to stay alive

How plants get food

What plant food is and how it's used



# What plant food is and how it's used



Plants make their own food in their **leaves** and other parts of the plant that are above the ground.



Leaf of a maple tree

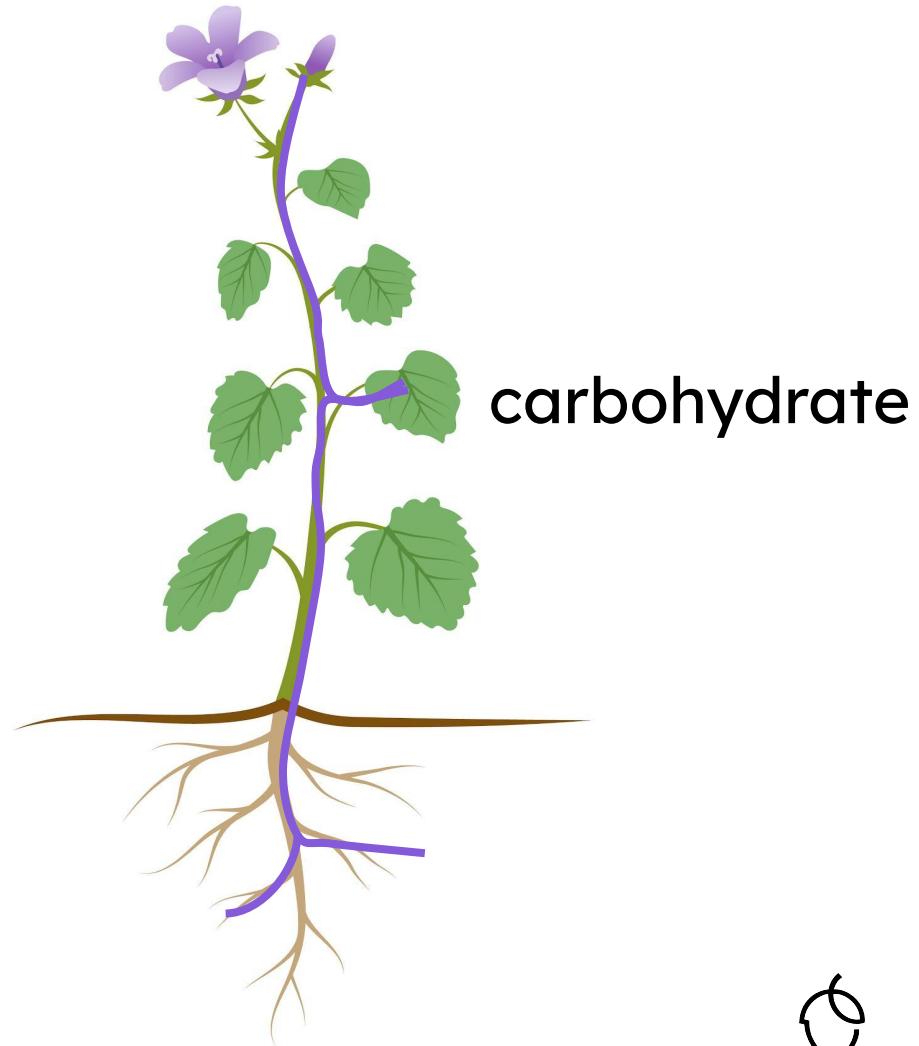


# What plant food is and how it's used



The food that plants make in their leaves is **carbohydrate**.

The carbohydrate food is transported to all parts of the plant to keep the plant alive.



# What plant food is and how it's used



The carbohydrate made in the leaves  
is all the food a plant needs.

This is because:

1) It's a source of energy.

- It is used as a fuel for **cellular respiration**.
- Cellular respiration provides the energy needed for all other life processes in the plant.



# What plant food is and how it's used



And...

2) It's also a source of materials for growth and repair.

- Carbohydrate is made of the elements carbon, hydrogen and oxygen.
- These elements are combined with others (such as nitrogen) from minerals to make **proteins and fats**.
- The carbohydrate, proteins and fats are used to make all the plant's cells and tissues.



# What plant food is and how it's used



What type of food do plants make for themselves?

A Carbohydrate ✓

B Fat

C Protein



# What plant food is and how it's used



How do plants use the carbohydrate food they make?

- A Only as a source of energy.
- B Only as a source of materials for growth and repair.
- C As a source of both energy and materials for growth and repair. ✓

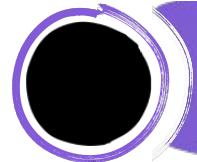


# **Photosynthesis**



## **Lesson outline**

# **Photosynthesis**



How producers make their own food



The reactants and products of photosynthesis



# How producers make their own food



Plants and other **producers** make their own food.

The food is made by a process called **photosynthesis**.

This process happens in the leaves and other parts of the plant that are above the ground.



leaf of a maple tree



# How producers make their own food



**Photosynthesis** can only happen when there is light.

photosynthesis  
light                  to make

What other words do you know that contain ‘photo’?



# How producers make their own food



## True or false?

Photosynthesis happens in plant roots.

T

True

F

False ✓

## Justify your answer

A

Photosynthesis happens in plant leaves when there is light ✓

B

Photosynthesis happens in all parts of a plant.



# How producers make their own food

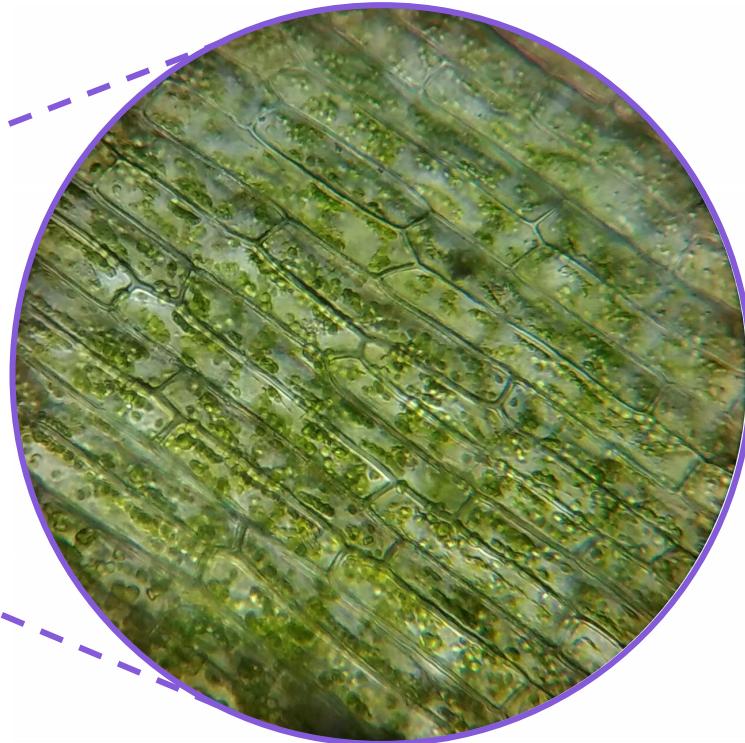


Leaves are made up of cells.

**Photosynthesis** takes place inside the cells.



leaf of a maple tree



leaf cells seen through a microscope

# How producers make their own food



Match the one correct start of the sentence... ...to the one correct end of the sentence to make one single sentence.

Plant food is made  
between plant cells...

...by the process of  
cellular respiration.

Plant food is made  
from plant cells...

...by the process of  
photosynthesis.

Plant food is made  
inside plant cells...

...by the process of  
digestion.



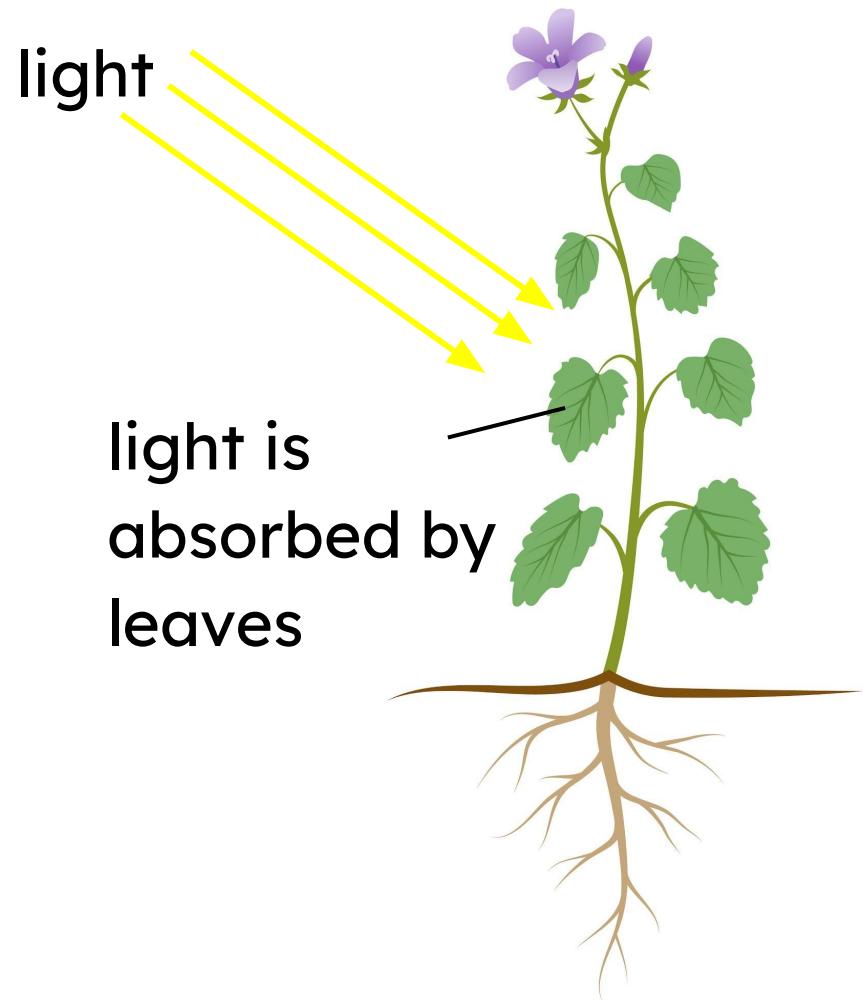
# How producers make their own food



## Photosynthesis needs light.

Light transfers energy from the light source to the leaf cells.

This provides the energy needed for photosynthesis to take place.



# How producers make their own food



Which statement about light and photosynthesis is true?

- A Light creates cells for photosynthesis.
- B Light is made by photosynthesis.
- C Light provides the energy for photosynthesis. ✓



## **Lesson outline**

# **Photosynthesis**



**How producers make their own food**



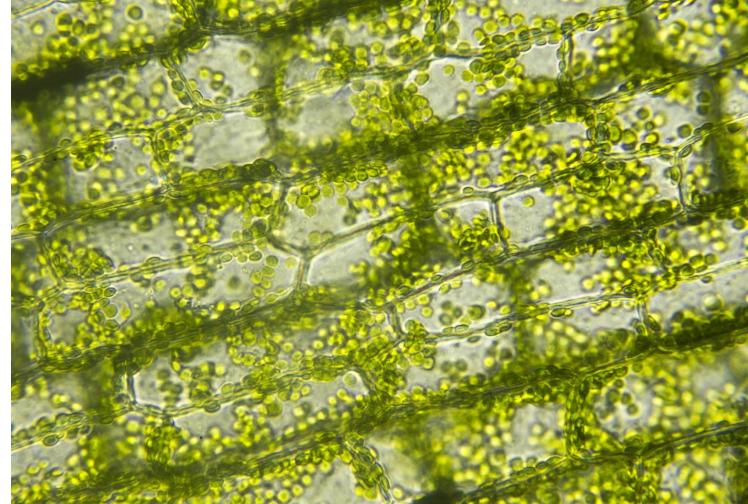
**The reactants and products of photosynthesis**



# The reactants and products of photosynthesis



**Photosynthesis** is a series of **chemical reactions** that happen inside leaf cells.



leaf cells seen through a microscope

During chemical reactions:

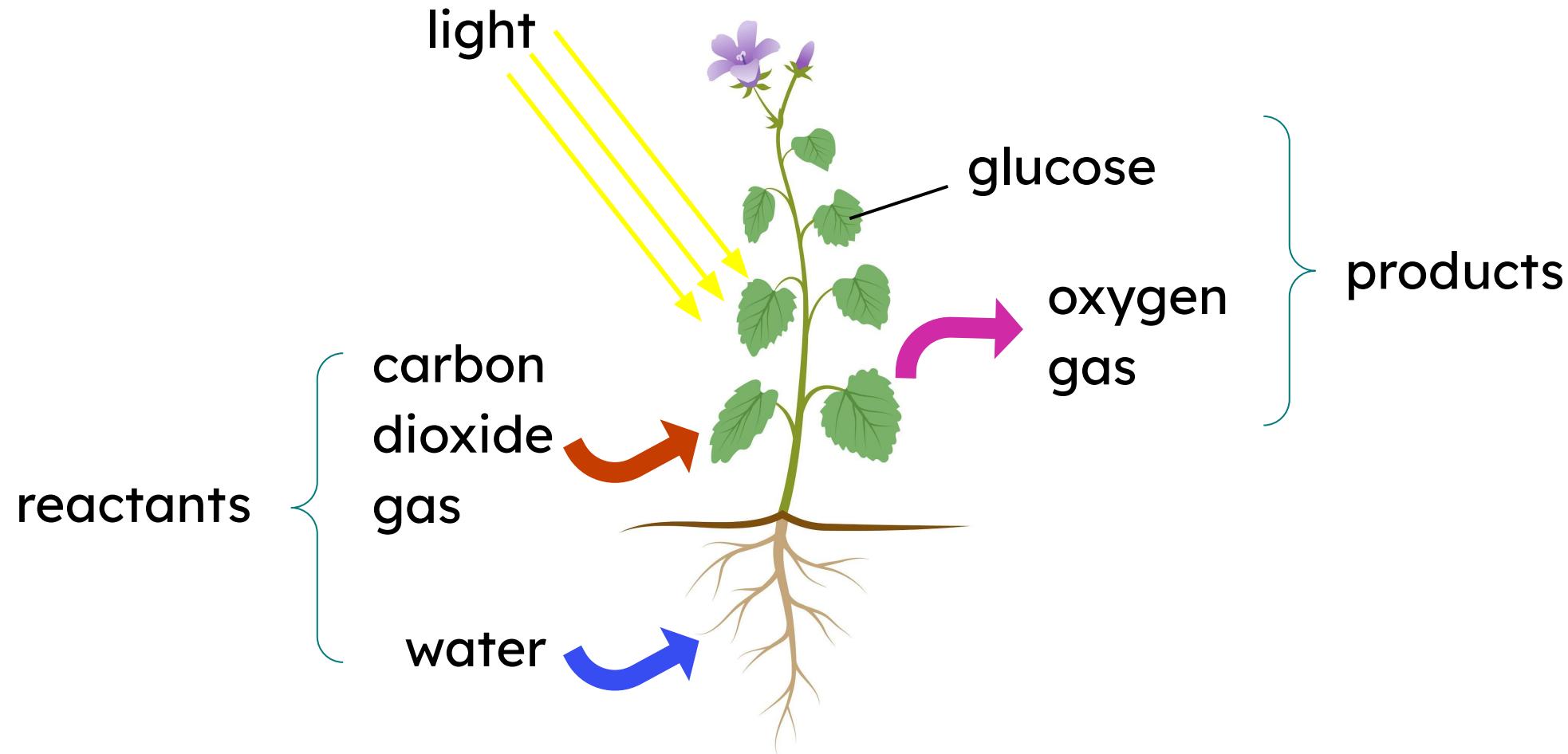
- one or more substances are broken down - these are the reactants
- one or more new substances are made - these are the products.



# The reactants and products of photosynthesis



Like any chemical process, photosynthesis has reactants and products.



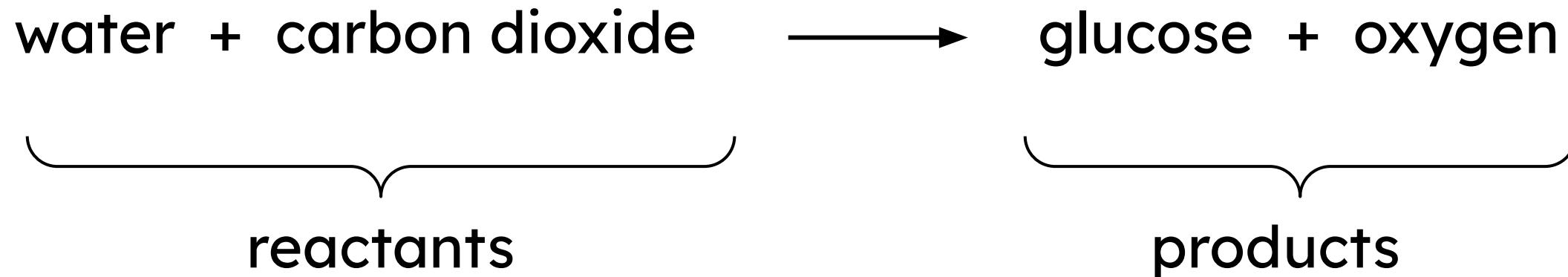
# The reactants and products of photosynthesis



# **Photosynthesis is not just one chemical reaction.**

It's a series of chemical reactions that happen inside plant cells.

But it is useful to remember a word summary of the reactants and products:



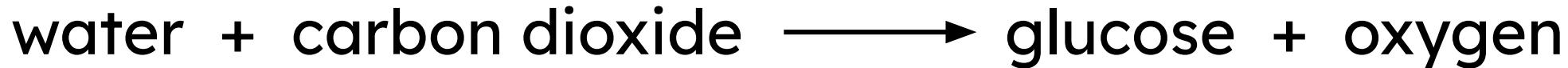
# The reactants and products of photosynthesis



Complete the word summary for photosynthesis.



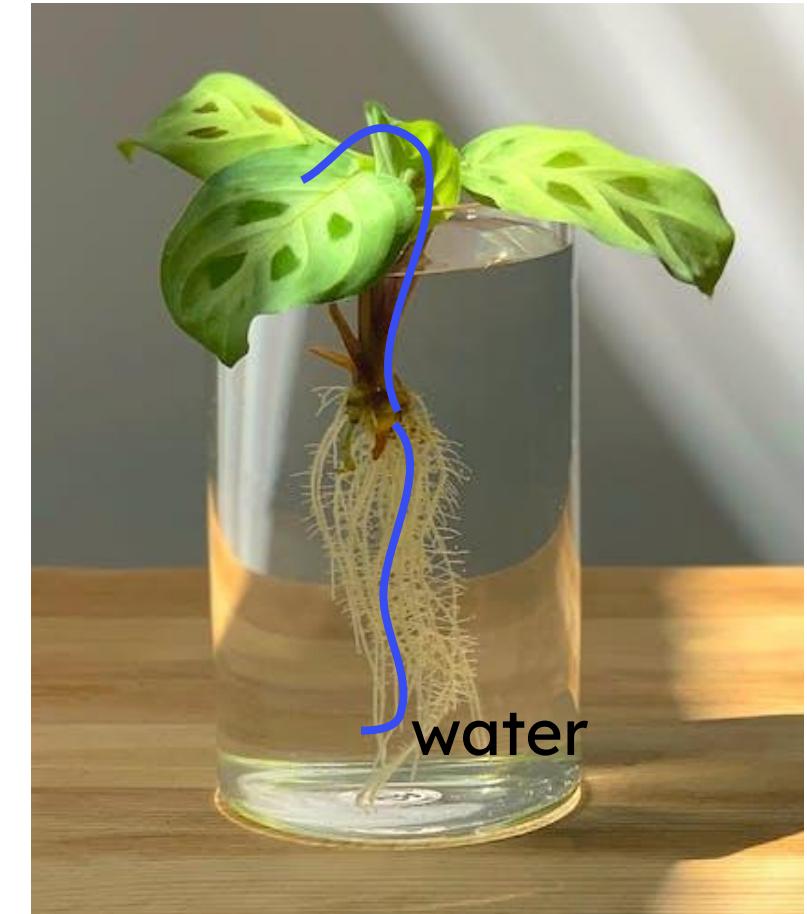
# The reactants and products of photosynthesis



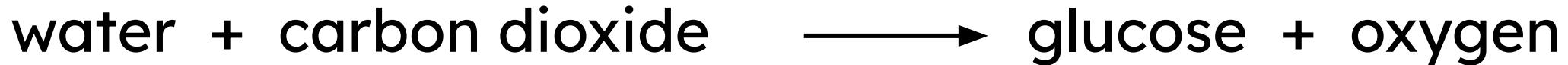
One of the reactants of **photosynthesis** is water.

Plants take in water for photosynthesis through their roots.

The water is transported to the leaves for photosynthesis.

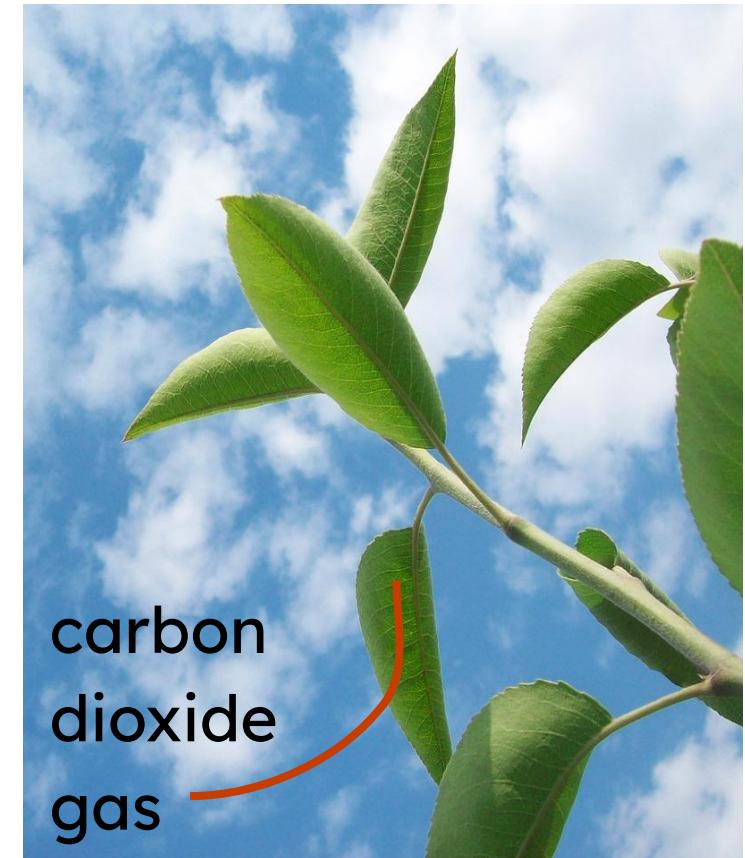


# The reactants and products of photosynthesis

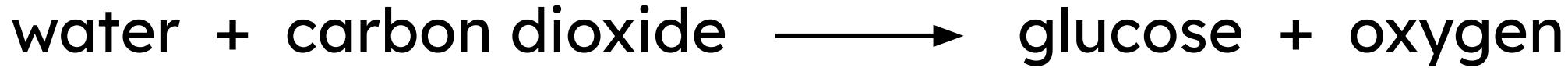


One of the reactants of **photosynthesis** is **carbon dioxide**.

Plants take in carbon dioxide gas for photosynthesis from the air, through their leaves.



# The reactants and products of photosynthesis

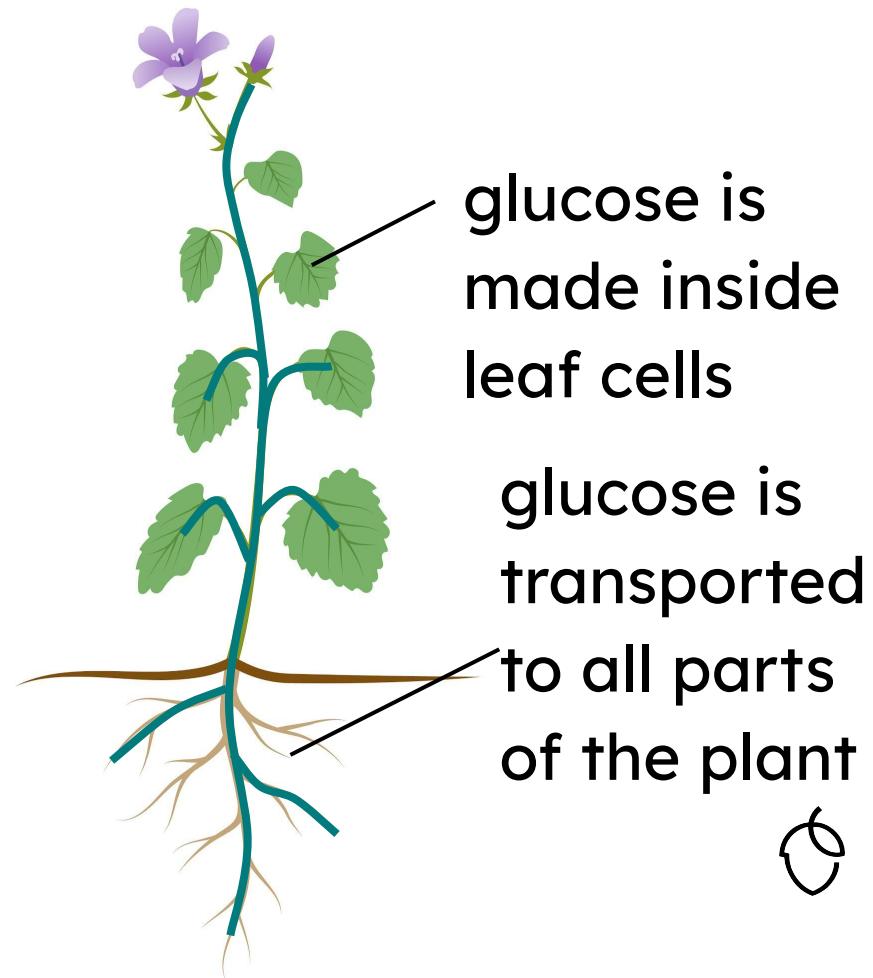


One of the products of photosynthesis is **glucose**.

Glucose is a type of sugar, which is a carbohydrate. It is the plant's food.

The glucose is transported to all parts of the plant where it is used:

- as a source of energy
- as a source of materials to make new cells and tissues for growth.

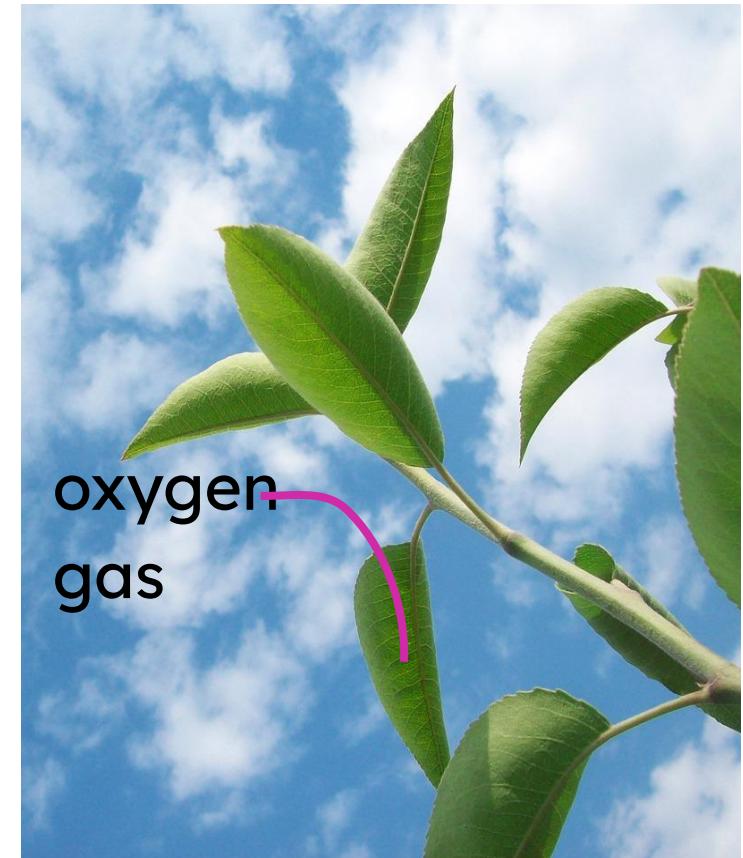


# The reactants and products of photosynthesis



One of the products of **photosynthesis** is oxygen.

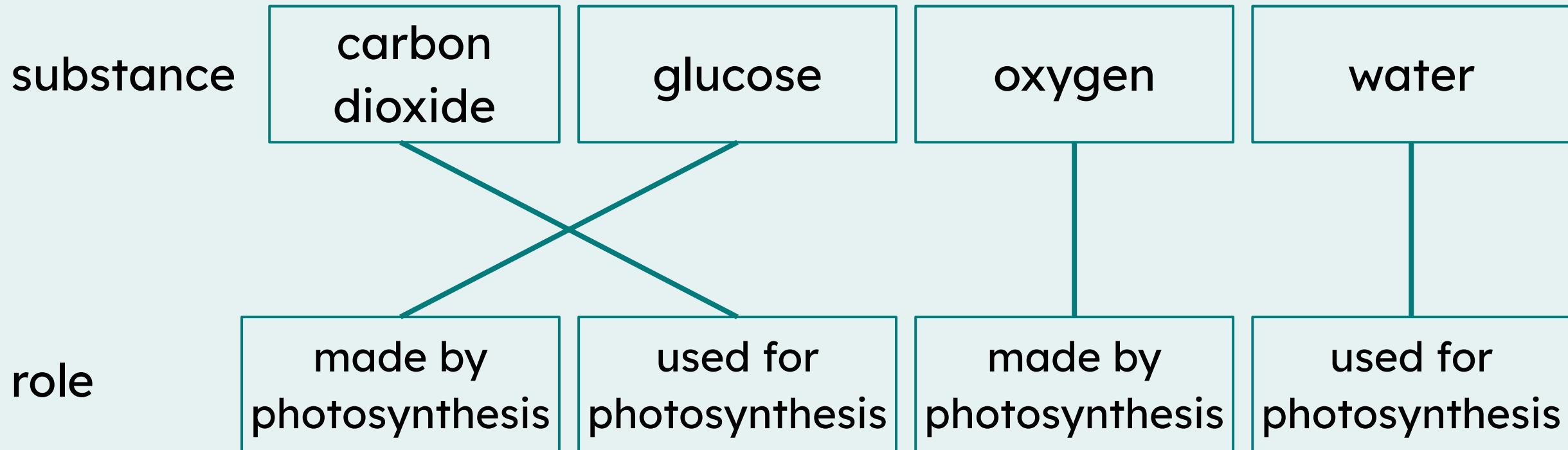
Plants release this oxygen into the air from their leaves.



# The reactants and products of photosynthesis



Match each substance to its role in photosynthesis.



# The reactants and products of photosynthesis



Match each substance to the correct description.

substance

carbon  
dioxide

glucose

oxygen

water

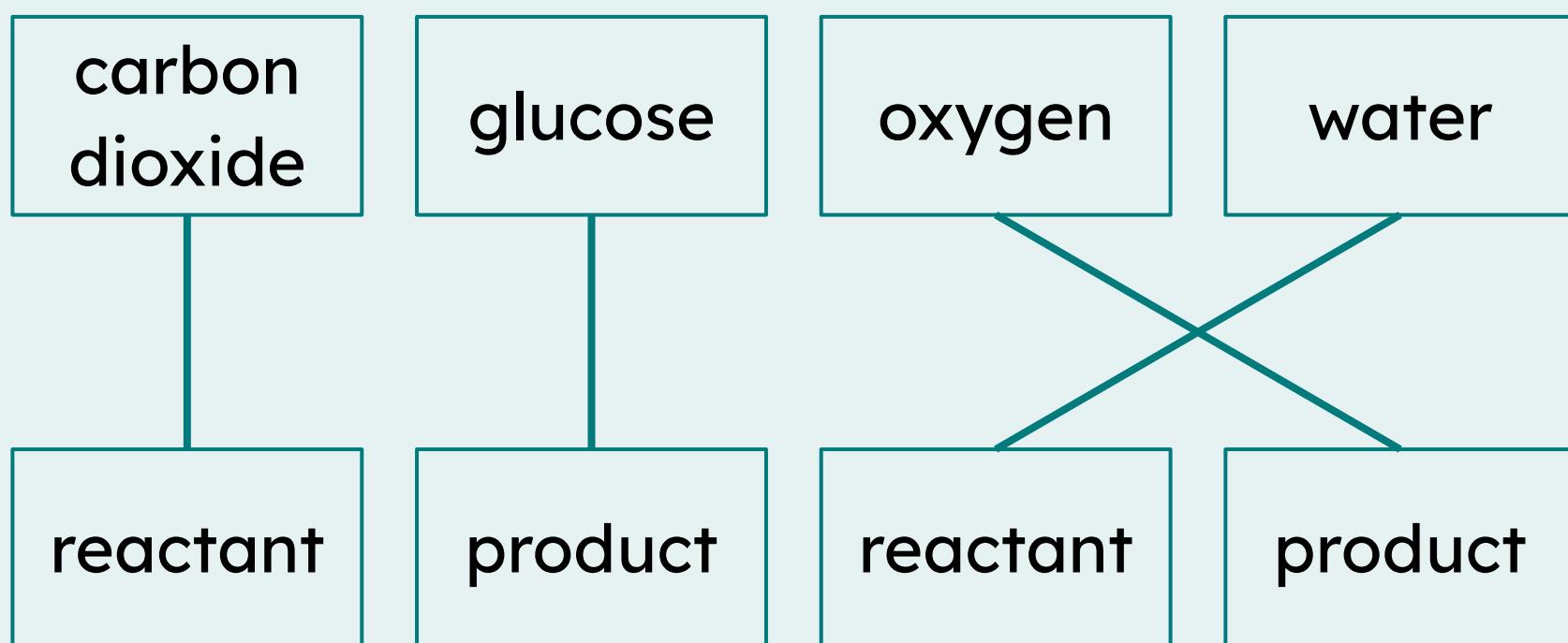
description

reactant

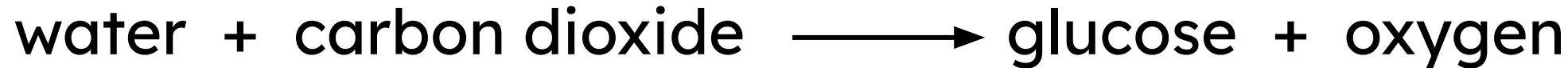
product

reactant

product



# The reactants and products of photosynthesis

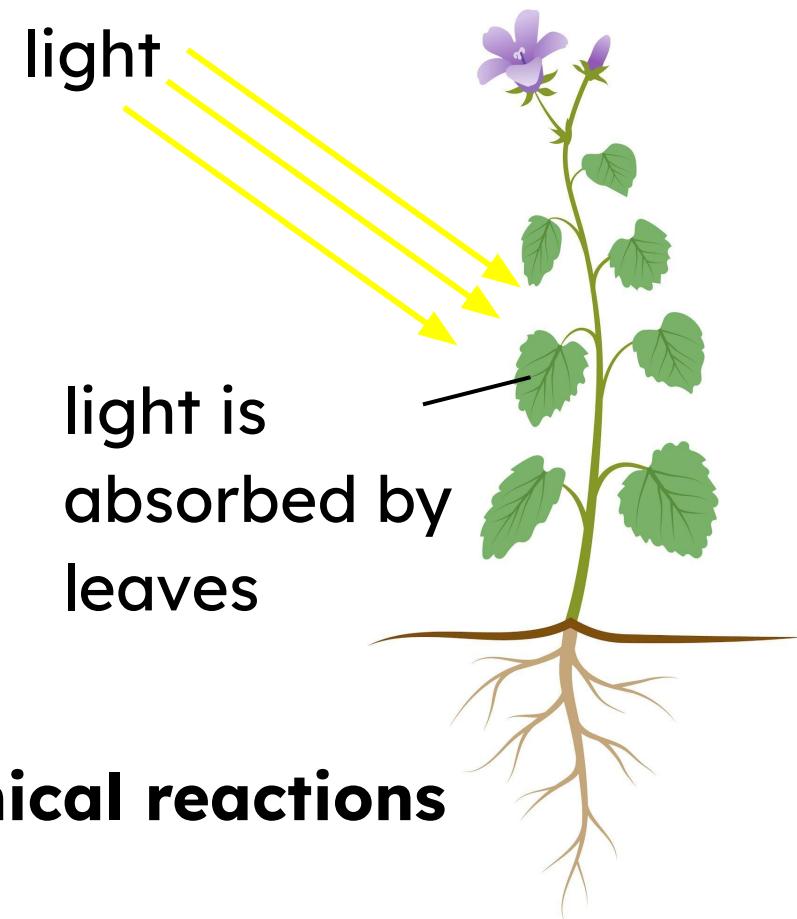


**Photosynthesis needs light.**

However:

- Light is not a substance.
- Light is not a chemical reactant in photosynthesis.
- Light is not turned into a product during photosynthesis.

Light provides the energy needed for the **chemical reactions** of photosynthesis to take place.



# The reactants and products of photosynthesis



Glucose is a type of sugar.



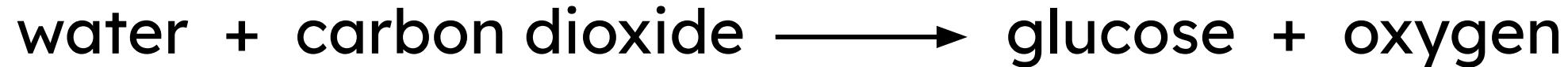
A bag of sugar from the shop has a mass of 1 kilogram (1 kg).



How many bags (kilograms) of sugar do you think a large tree can make in one sunny day?



# The reactants and products of photosynthesis



A large tree can produce around 90 kg of **glucose from photosynthesis** in one day.

Most of the mass of that glucose is made up of carbon atoms.

All of those carbon atoms came from **carbon dioxide** gas from the air!



# The reactants and products of photosynthesis



Complete the sentences about photosynthesis.

The reactants of photosynthesis are carbon dioxide from the air and water from the soil.

Photosynthesis makes a type of carbohydrate called glucose that the plant uses to grow bigger.

Most of the mass of this carbohydrate is made up of carbon atoms, which were taken in from the air.

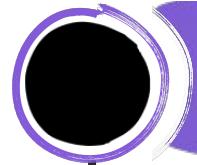


# **Adaptations of plants for photosynthesis: absorbing light**



## Lesson outline

# Adaptations of plants for photosynthesis: absorbing light



Adaptations of plant cells for photosynthesis



Adaptations of leaves for absorbing light



# Adaptations of plant cells for photosynthesis



Plants make their own food using **photosynthesis**.

Photosynthesis happens in the **leaves** and other parts of the plant above the ground.



Photosynthesis needs energy from **light**.



# Adaptations of plant cells for photosynthesis

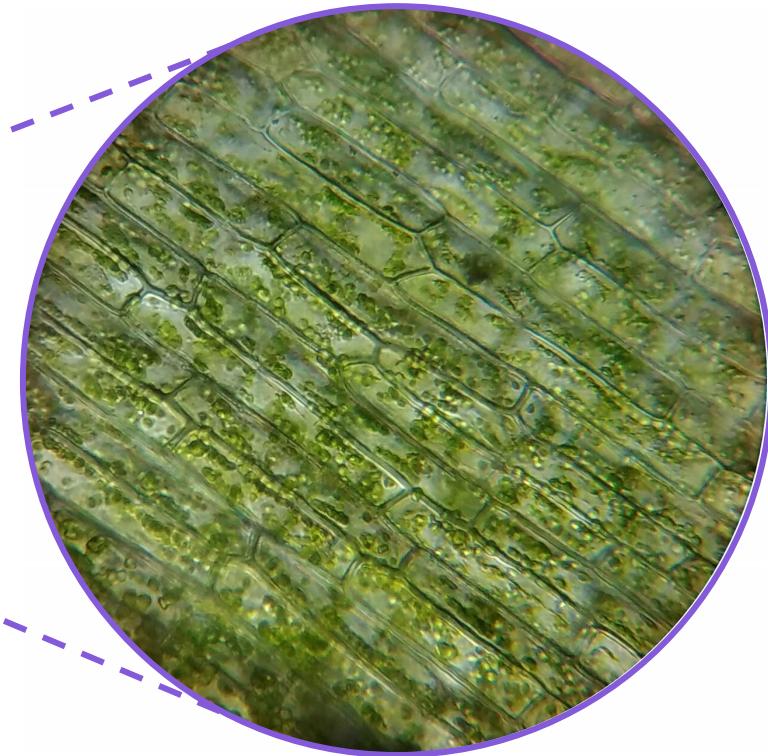


Leaves are made up of **cells**.

Photosynthesis takes place inside the cells.



Leaf of a maple tree

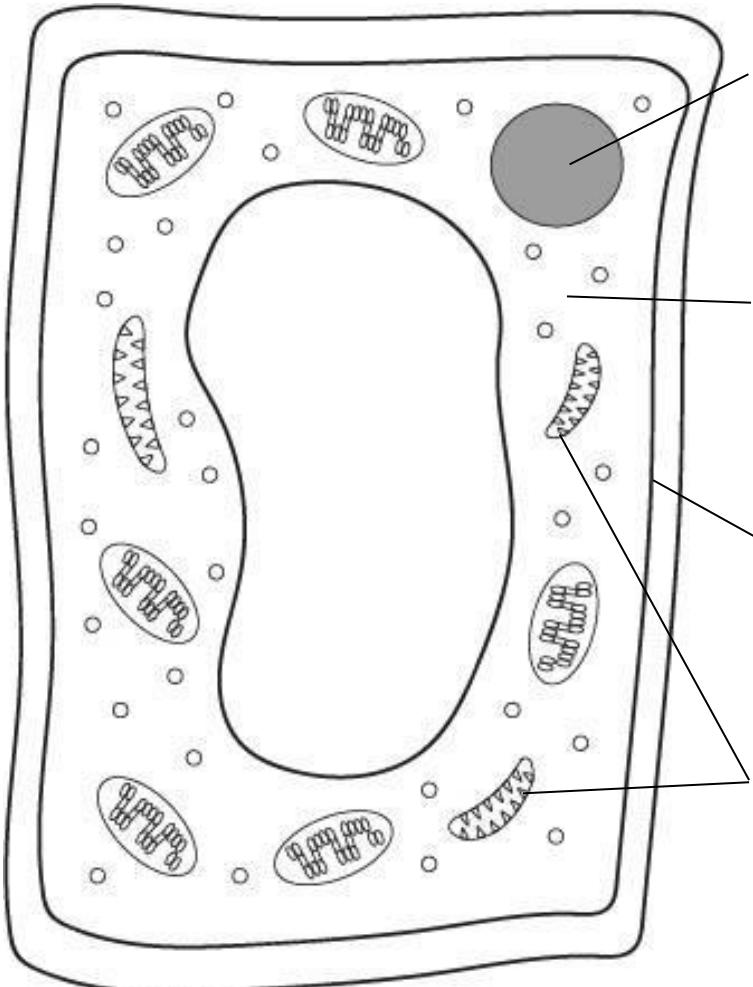


Leaf cells seen through a microscope

# Adaptations of plant cells for photosynthesis



Plant cells have some parts in common with animal cells, including:



**nucleus** - stores the cell's DNA and controls the cell's activities

**cytoplasm** - jelly-like substance where most chemical processes happen

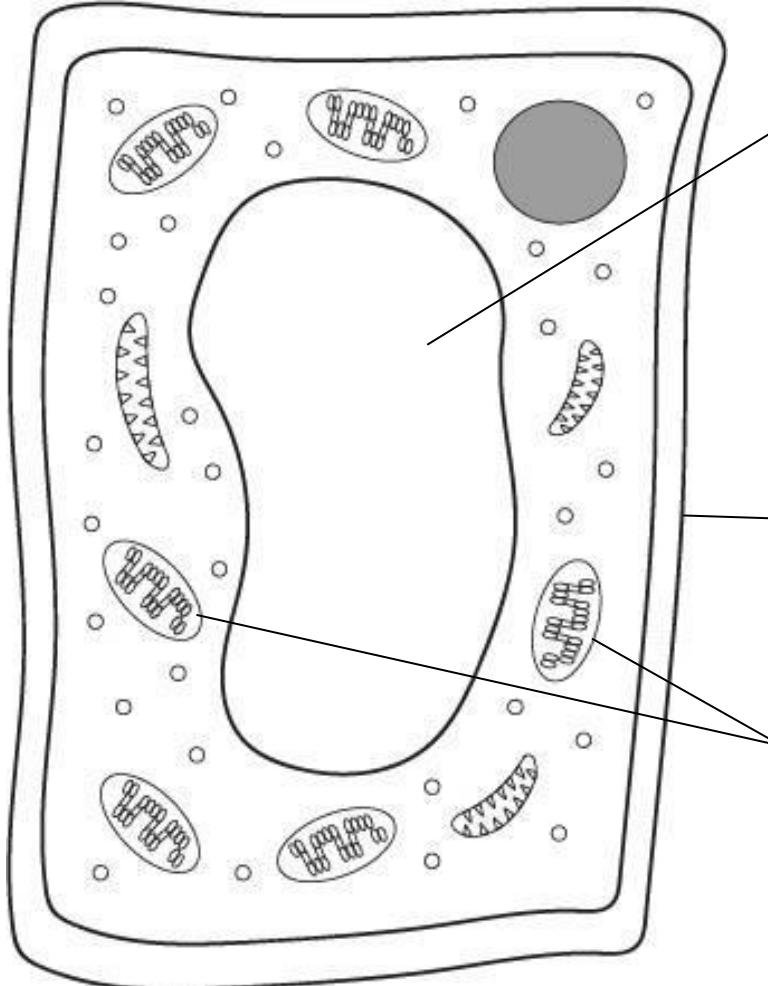
**cell membrane** - controls movement of substances into and out of the cell

**mitochondria** - where aerobic cellular respiration takes place

# Adaptations of plant cells for photosynthesis



Plant cells also have some parts that animal cells **don't** have, including:



**permanent vacuole** - where “cell sap” (a mixture of water and other substances) is stored

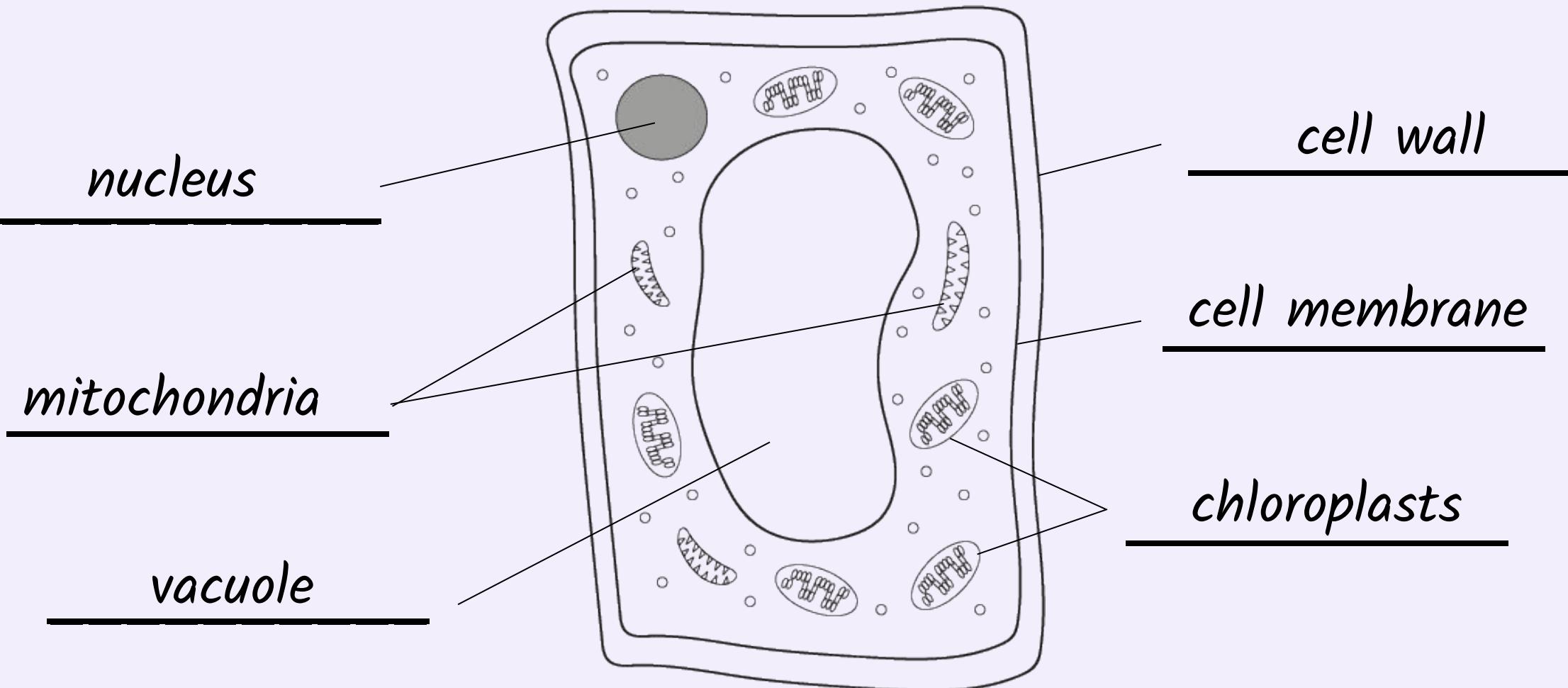
**cell wall** - strengthens and protects the cell

**chloroplasts** - where photosynthesis takes place

# Adaptations of plant cells for photosynthesis



Complete the labels on the diagram of a plant cell.



# Adaptations of plant cells for photosynthesis



Match each part of the cell to its function.

**part**

chloroplasts

mitochondria

nucleus

**function**

stores the  
cell's DNA

where  
cellular  
respiration  
takes place

where  
photosynthesis  
takes place

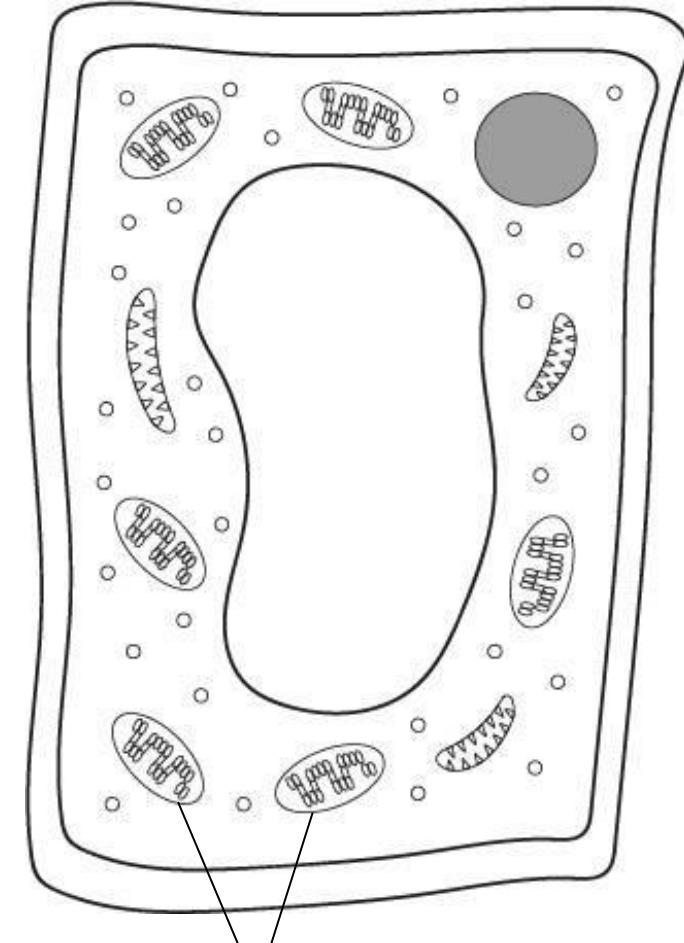


# Adaptations of plant cells for photosynthesis



In biology, an **adaptation** is a feature that helps an organism to function and survive.

Chloroplasts are an adaptation of plant cells that enables plants to photosynthesise.



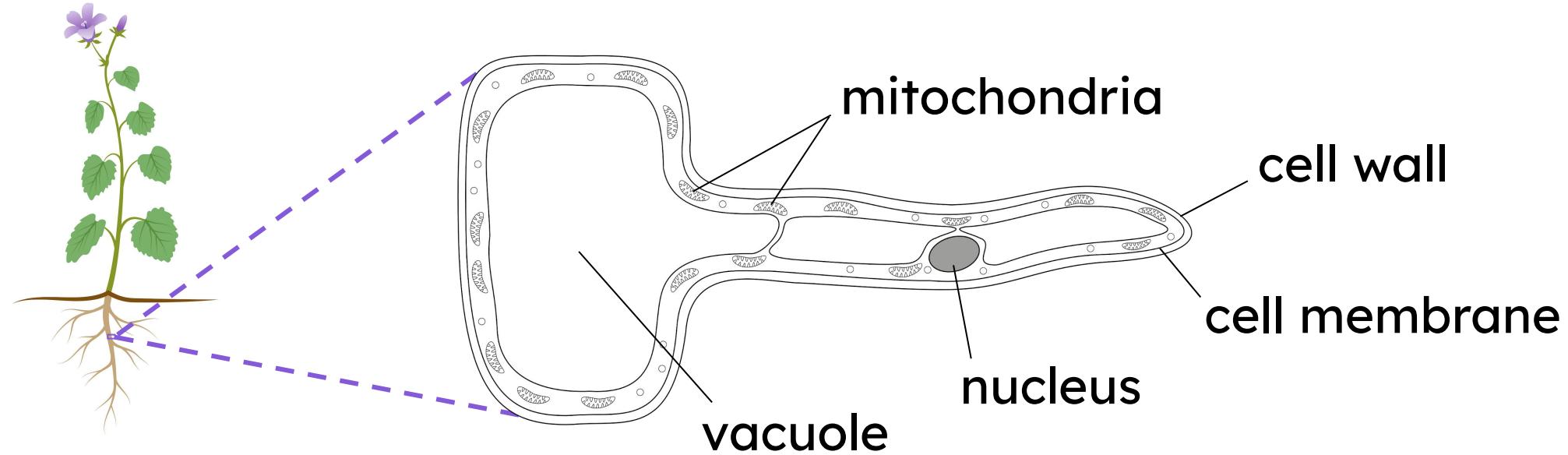
chloroplasts



# Adaptations of plant cells for photosynthesis



Not all plants cells have chloroplasts.



The diagram shows a cell from a root. It does **not** have chloroplasts. Cells in the leaves **do** have chloroplasts because there is light for photosynthesis.



# Adaptations of plant cells for photosynthesis



What is an **adaptation**?

- A A feature that helps an organism to function and survive. ✓
- B Part of a plant cell.
- C The structure where photosynthesis takes place.



## Lesson outline

# Adaptations of plants for photosynthesis: absorbing light



Adaptations of plant cells for photosynthesis



Adaptations of leaves for absorbing light



# Adaptations of leaves for absorbing light



Leaves are made up of cells containing chloroplasts.



Leaf cells seen through a microscope

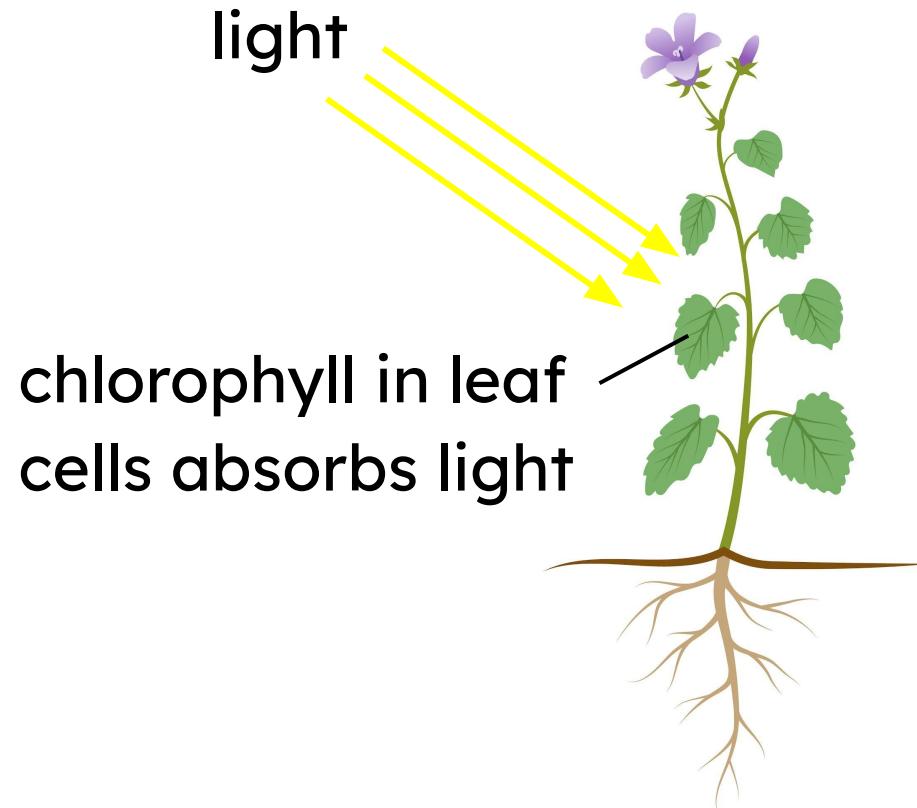
Chloroplasts contain a green substance called **chlorophyll**.



# Adaptations of leaves for absorbing light



Photosynthesis can only happen when it's light.



The light provides the energy needed for the chemical reactions of photosynthesis to take place.



# Adaptations of leaves for absorbing light



Complete the sentences about photosynthesis.

Use some of the words from the list:

**chlorophyll      chloroplasts      light      mitochondria      oxygen**

Photosynthesis takes place in structures called chloroplasts inside the cells of plant leaves.

These structures contain a green substance called chlorophyll.

This substance absorbs light for photosynthesis .



# Adaptations of leaves for absorbing light



Most leaves...



...are very thin.



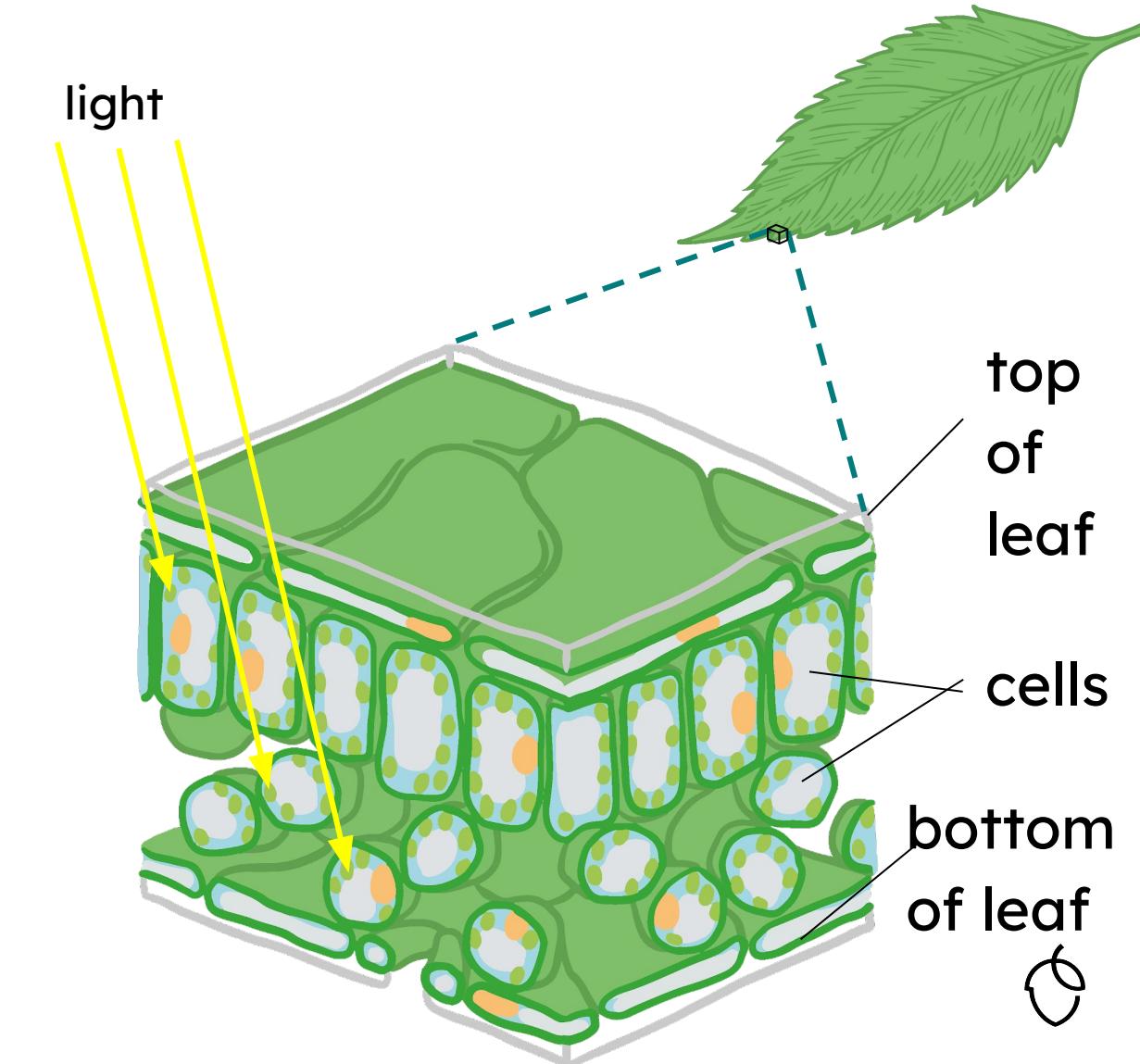
# Adaptations of leaves for absorbing light



Leaves are made of layers of cells.

Light is more likely to pass all the way through a leaf if it is **thin**.

Leaves are adapted to be thin so light can reach all the cells containing chloroplasts.



# Adaptations of leaves for absorbing light



Complete the sentences about leaves.

Use some of the words from the list:

**chloroplasts      cytoplasm      mitochondria      thick      thin**

Leaves are adapted to be *thin*.

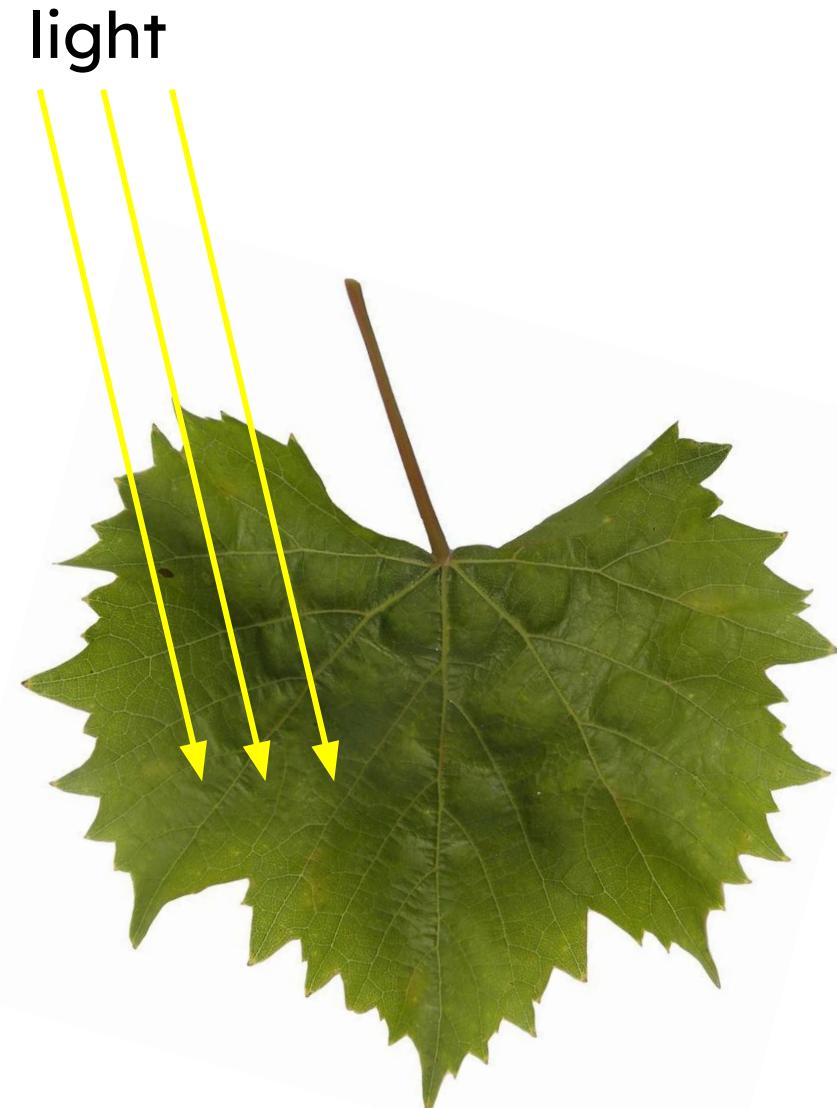
This allows light to pass through the leaf and reach all the cells that contain *chloroplasts*.



# Adaptations of leaves for absorbing light



Light for photosynthesis is mostly absorbed through the top side of a leaf.



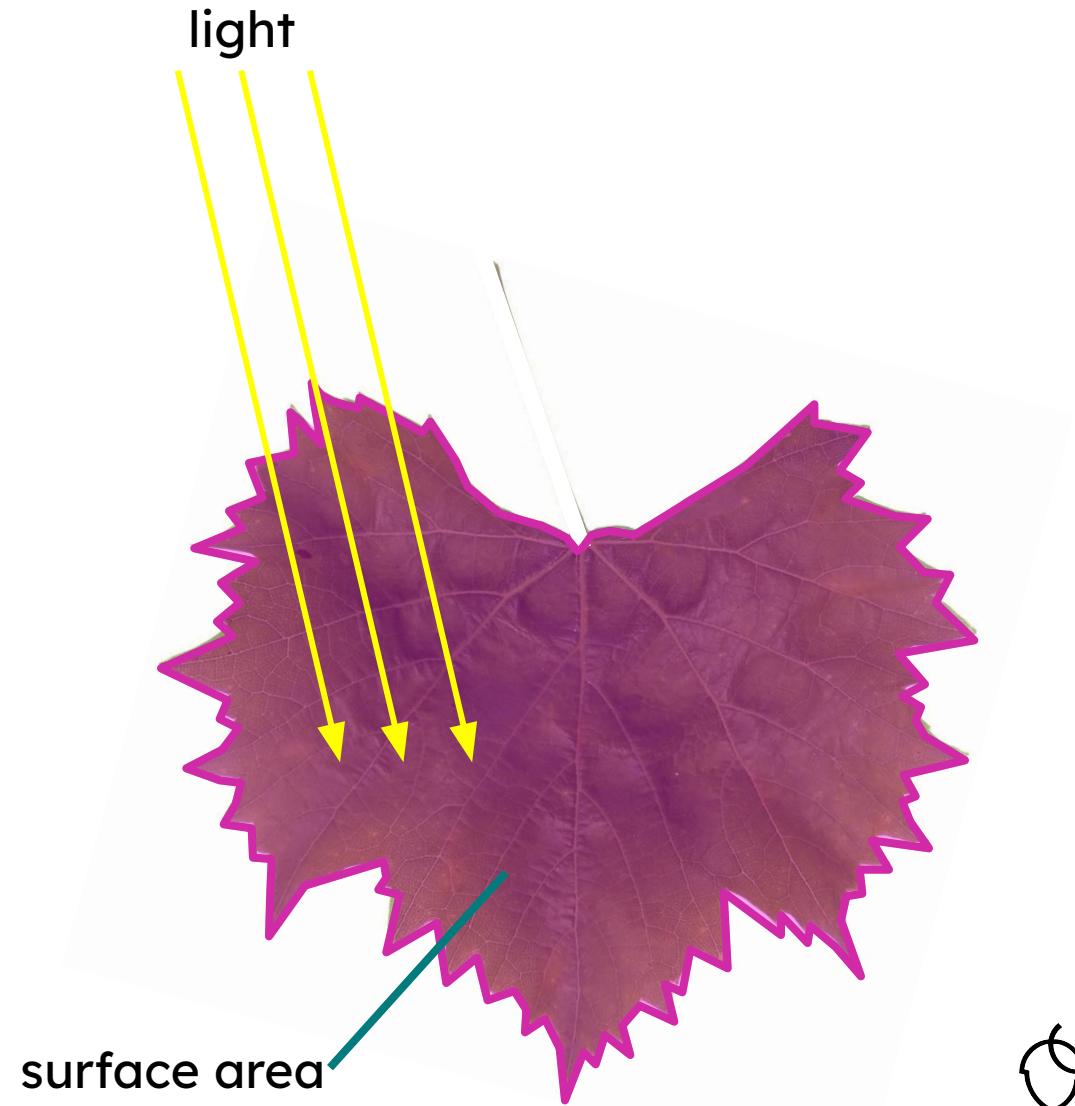
# Adaptations of leaves for absorbing light



Light for photosynthesis is mostly absorbed through the top side of a leaf.

The top side of a leaf has a **surface area**.

This is the area of the leaf through which light can be absorbed.



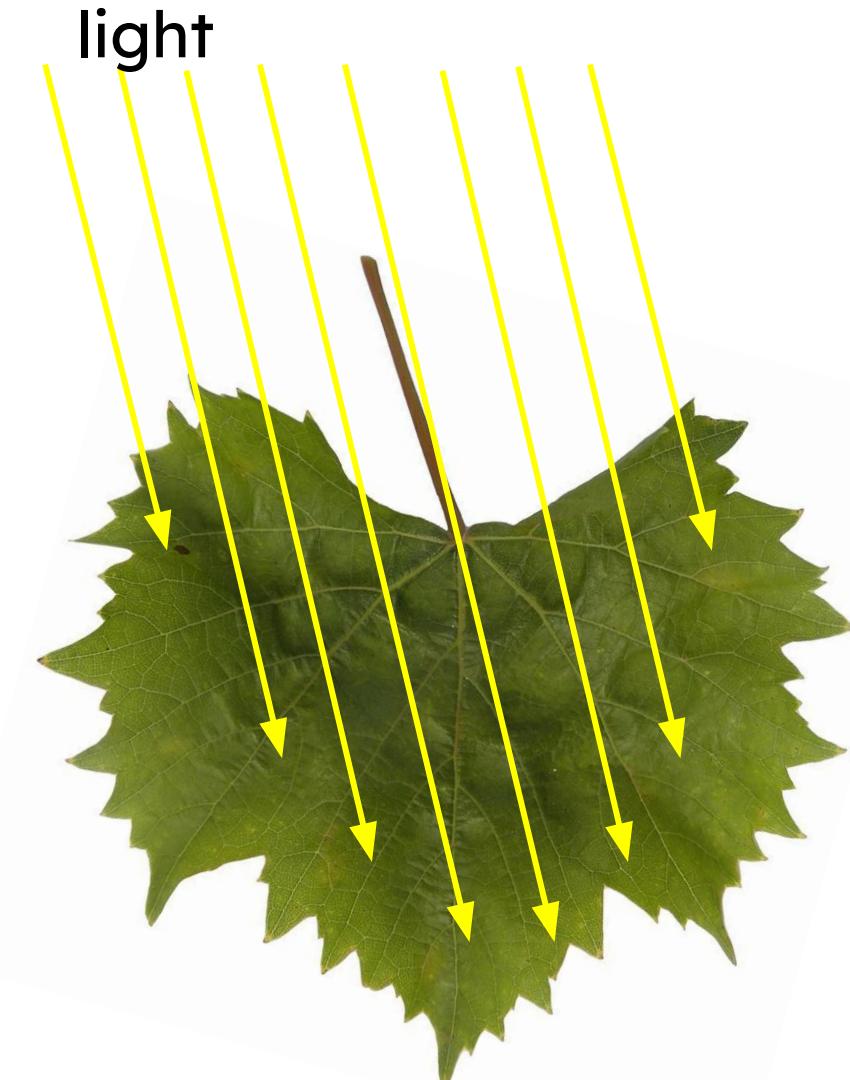
# Adaptations of leaves for absorbing light



Leaves are adapted to have a **large** surface area.

Having a large surface area means the leaf can absorb more light.

More light = more photosynthesis  
= more food is made

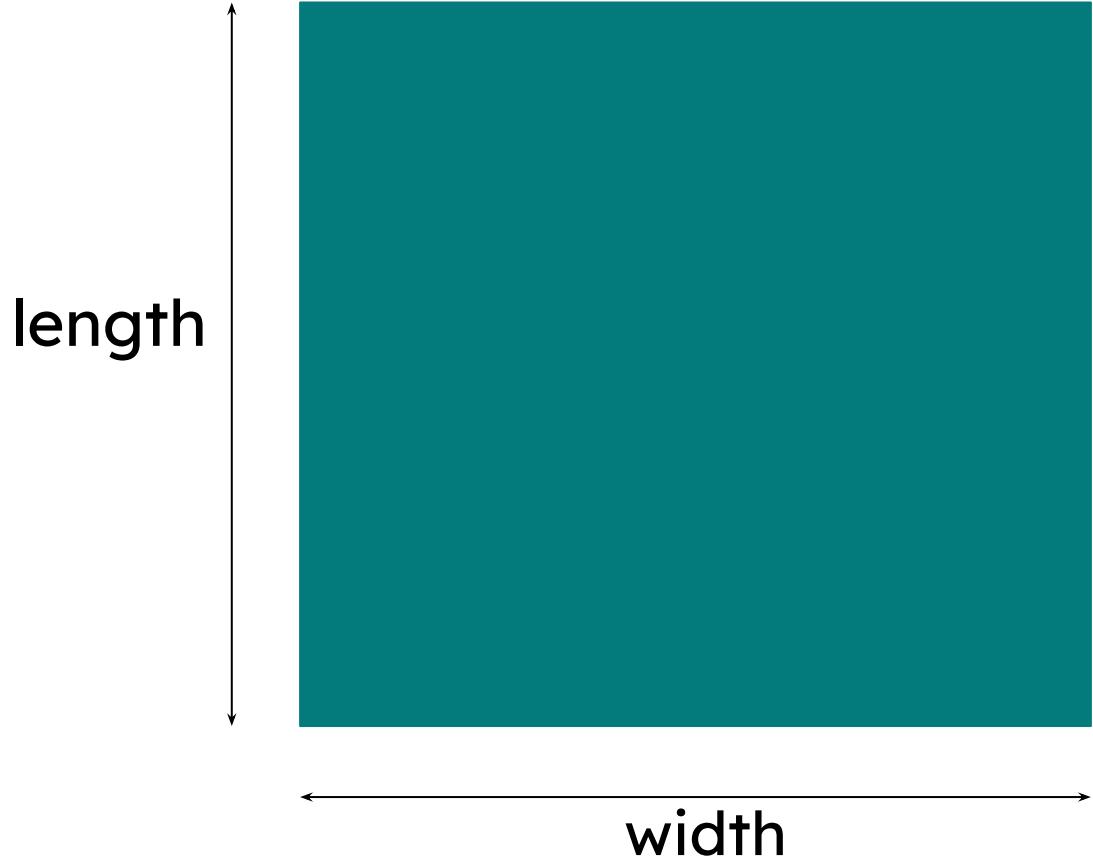


# Adaptations of leaves for absorbing light

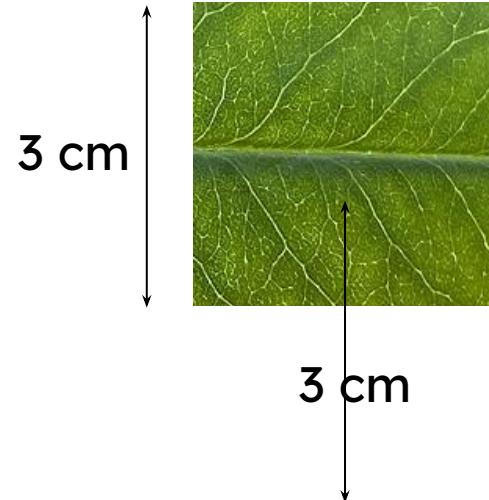


To calculate the **area** of a square or rectangle, we multiply its length by its width.

$$\text{area} = \text{length} \times \text{width}$$
$$(\text{cm}^2) \quad (\text{cm}) \quad (\text{cm})$$

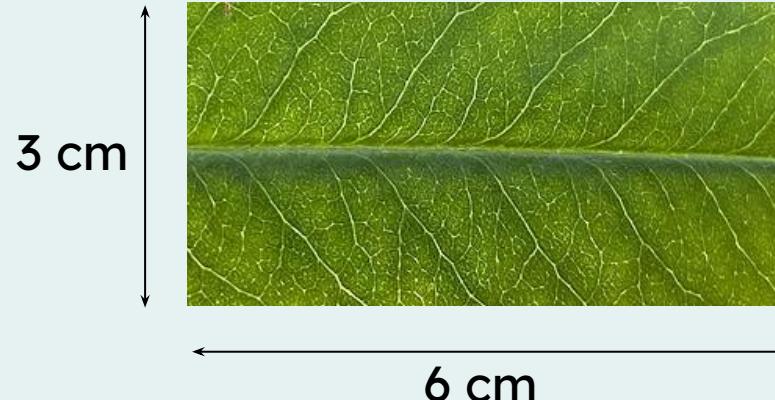


# Adaptations of leaves for absorbing light



The surface area of this piece of leaf is:

$$\begin{aligned}\text{surface area} &= 3 \text{ cm} \times 3 \text{ cm} \\ &= 9 \text{ cm}^2\end{aligned}$$



**Calculate** the surface area of this piece of leaf.

$$\begin{aligned}\text{surface area} &= 3 \text{ cm} \times 6 \text{ cm} \\ &= 18 \text{ cm}^2\end{aligned}$$

# Adaptations of leaves for absorbing light



Leaves are **not** usually square or rectangular in shape!



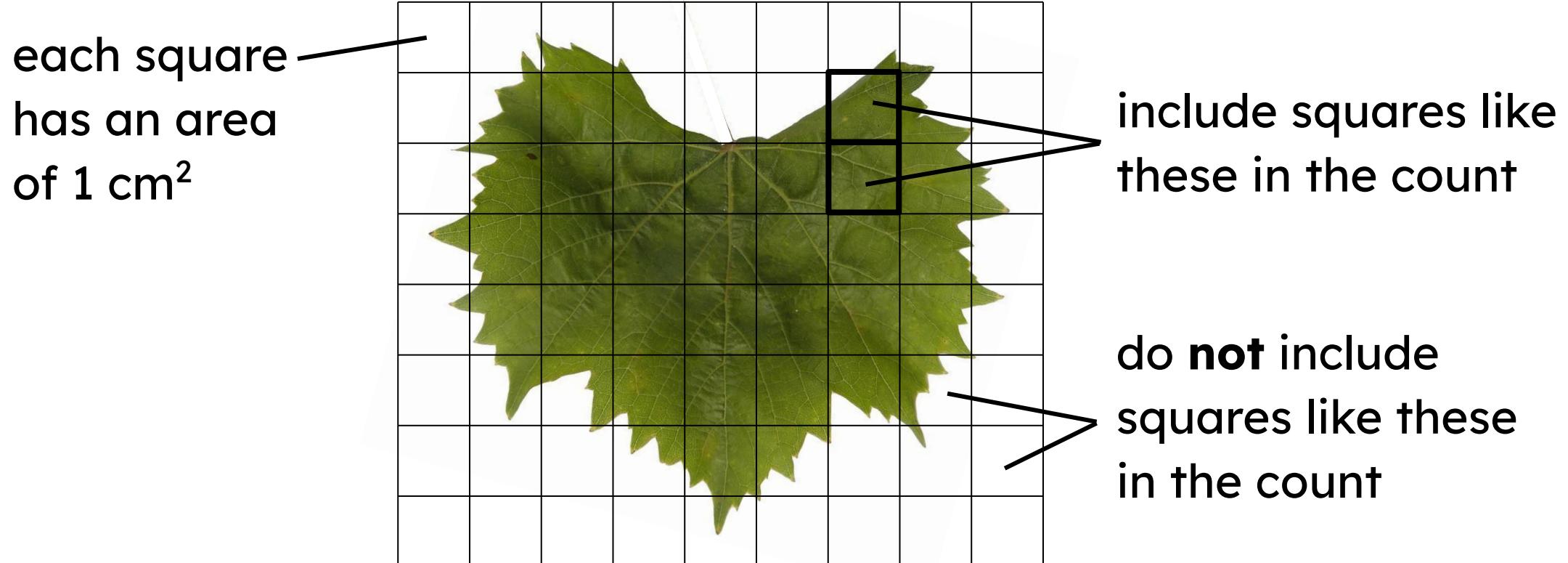
Leaves have an irregular shape.



# Adaptations of leaves for absorbing light



We can **estimate** the surface area of the leaf.



To estimate the total surface area of the leaf, we count up the squares that are **at least half filled with leaf**.

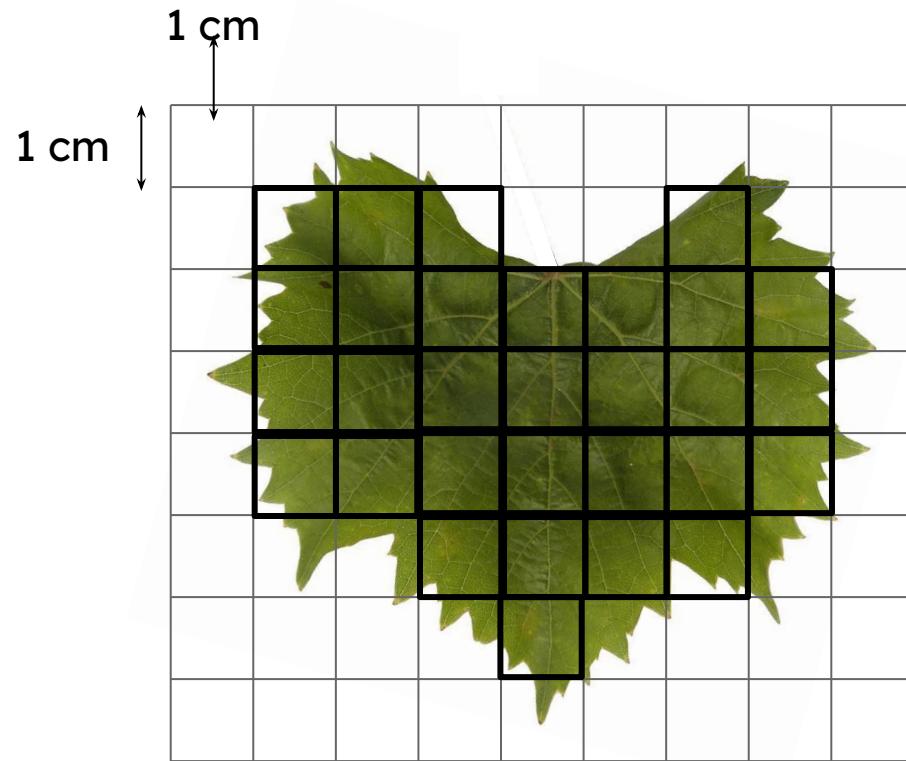


# Adaptations of leaves for absorbing light

Let's estimate the surface area:

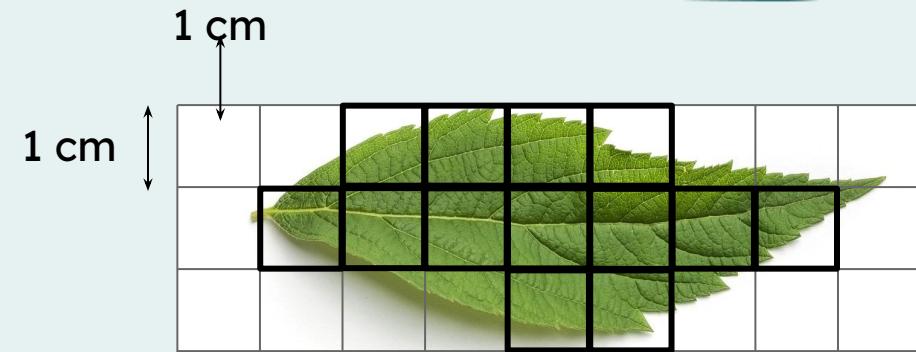


# Adaptations of leaves for absorbing light



Total number of squares at least half filled with leaf = 30

Estimate of total surface area of leaf =  $30 \text{ cm}^2$



**Estimate** the total surface area of this leaf.

Total number of squares at least half filled with leaf = 13

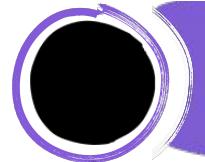
Estimate of total surface area of leaf =  $13 \text{ cm}^2$

# **Adaptations of plants for photosynthesis: gas exchange and stomata**



# **Lesson outline**

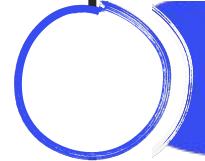
## **Adaptations of plants for photosynthesis: gas exchange and stomata**



**Photosynthesis and gas exchange**



**Adaptations of leaves for gas exchange**



**Diffusion and gas exchange**



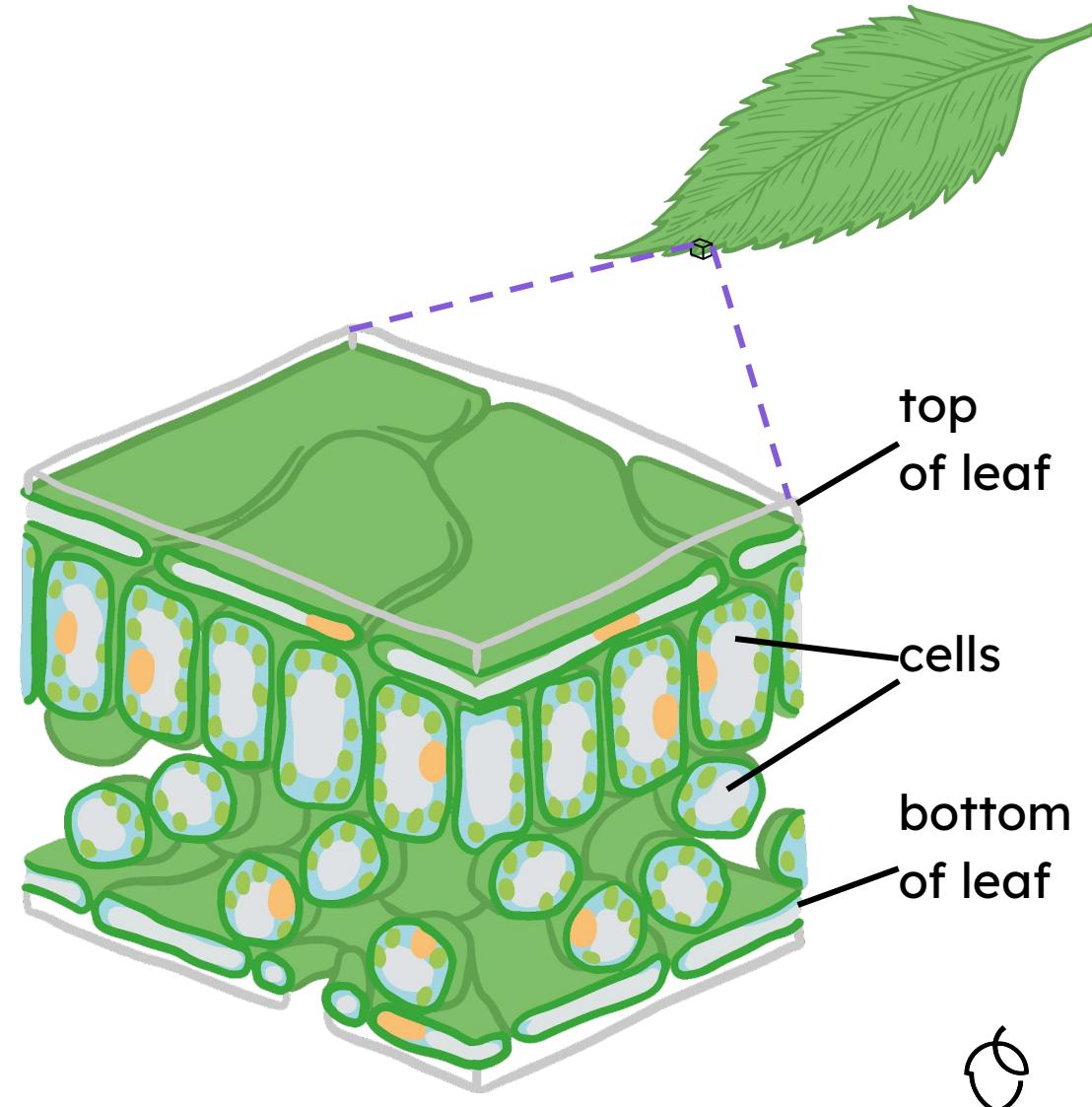
# Photosynthesis and gas exchange



Plants make their own food using the process of photosynthesis.

Photosynthesis takes place in the cells that make up the plant's leaves.

The food that plant cells make using photosynthesis is **glucose** (a type of carbohydrate).

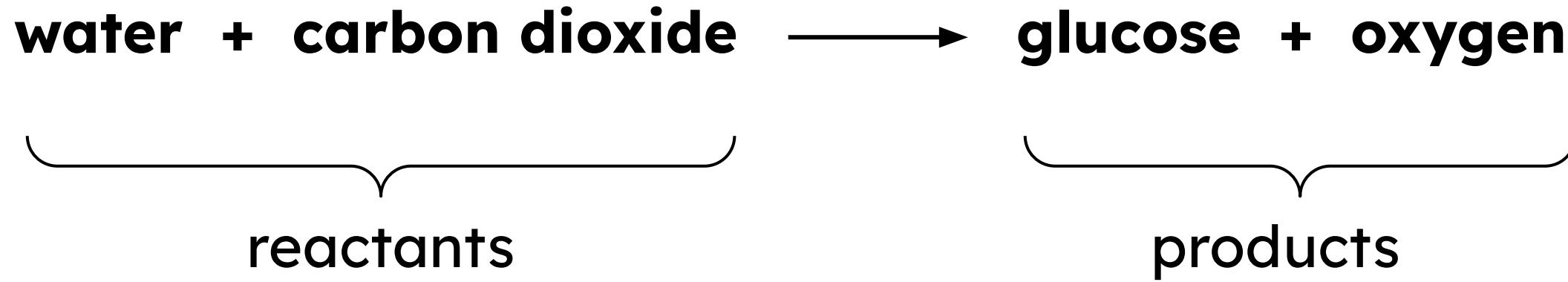


# Photosynthesis and gas exchange

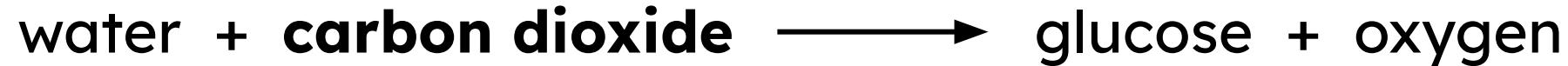


**Photosynthesis is a series of chemical reactions.**

The word summary for photosynthesis is:



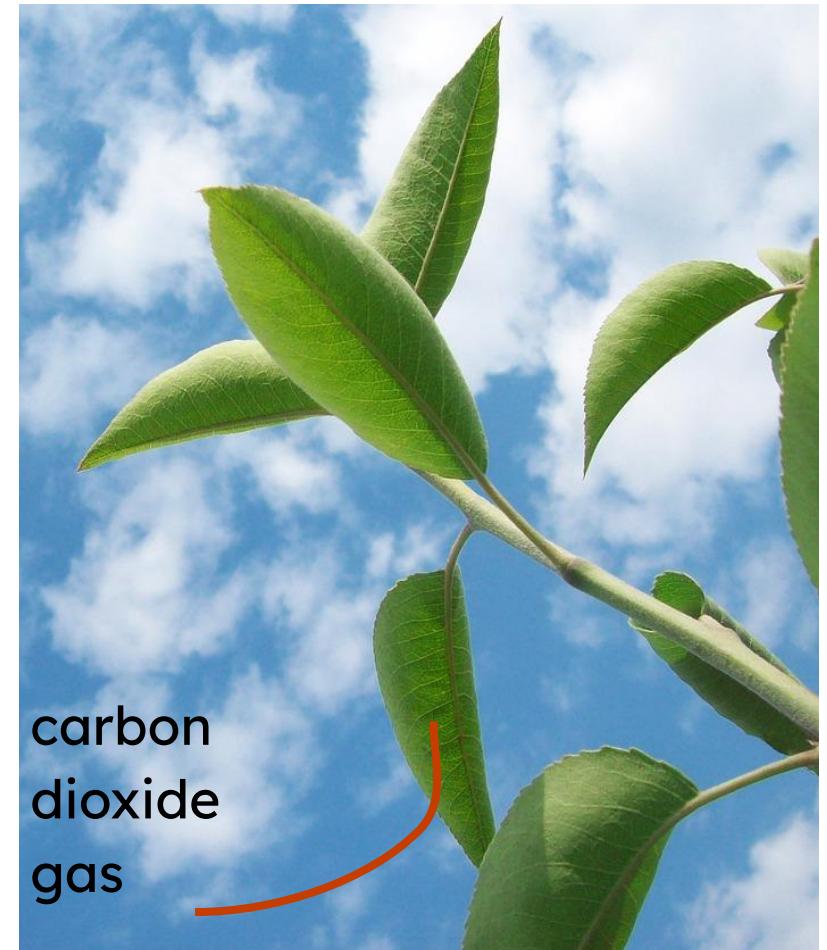
# Photosynthesis and gas exchange



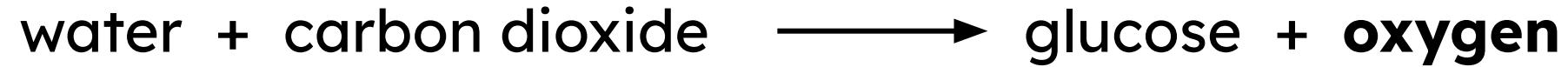
One of the **reactants** of photosynthesis is **carbon dioxide**.

Plants get carbon dioxide for photosynthesis from the air.

Plants take in carbon dioxide gas from the air, through their leaves.



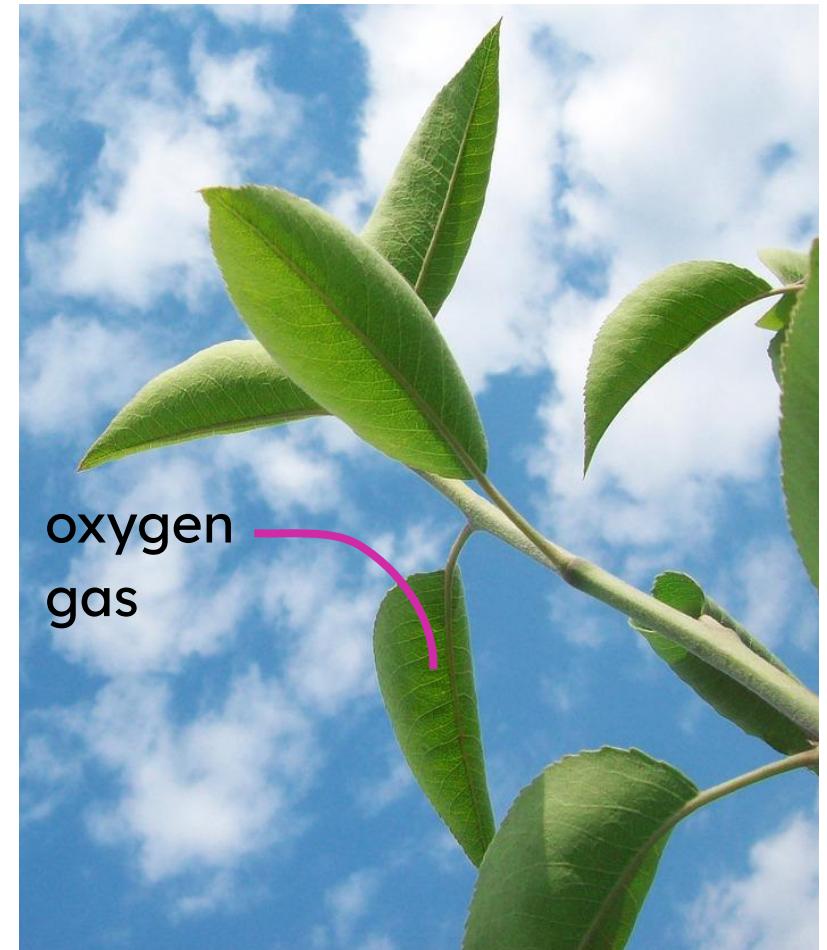
# Photosynthesis and gas exchange



One of the **products** of photosynthesis is **oxygen**.

Oxygen is a waste product of photosynthesis.

Plants release oxygen gas into the air from their leaves.



# Photosynthesis and gas exchange



This movement of...

- carbon dioxide gas into leaves
- oxygen gas out of leaves

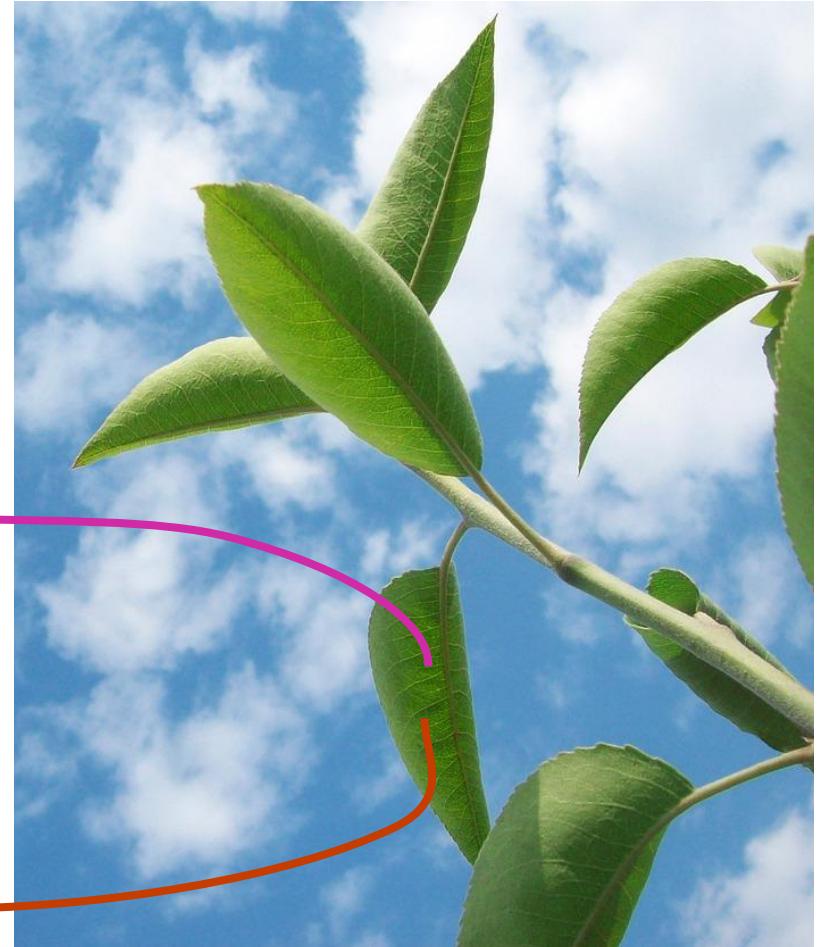
...is called **gas exchange**.

gas exchange

{

oxygen  
gas

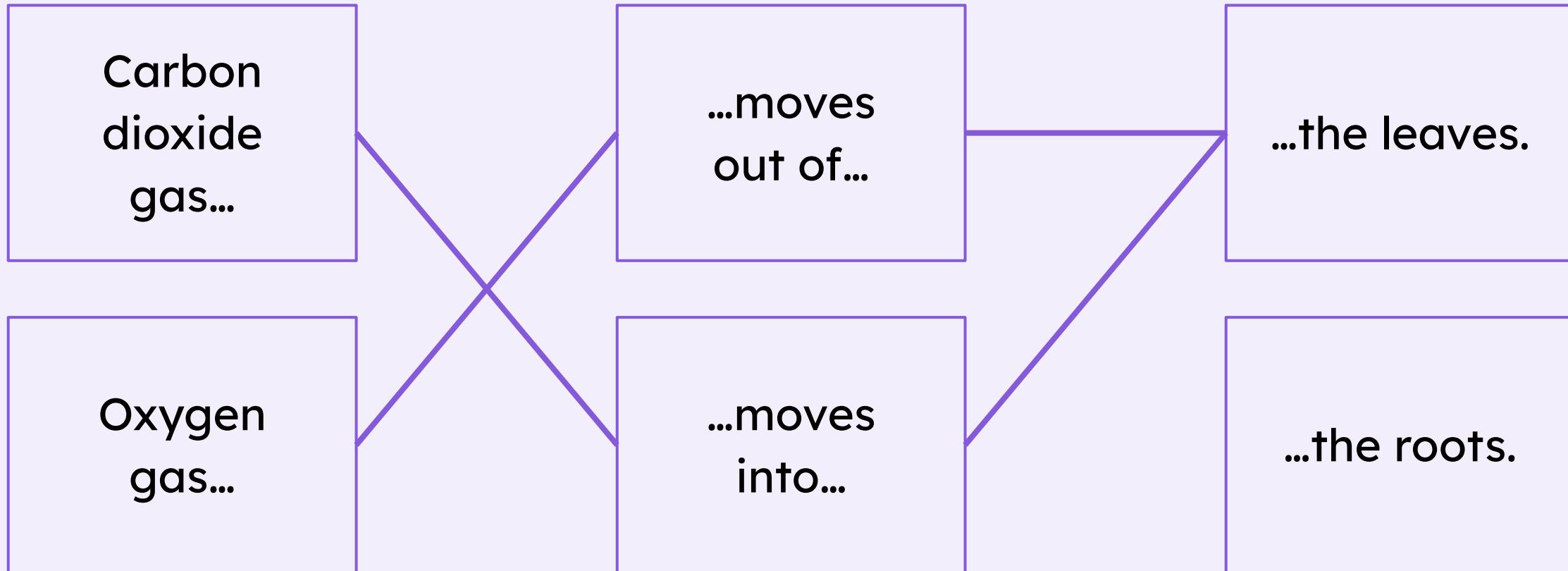
carbon  
dioxide  
gas



# Photosynthesis and gas exchange



Join the boxes to describe the process of **gas exchange** for photosynthesis.

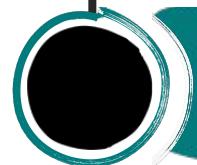


# **Lesson outline**

## **Adaptations of plants for photosynthesis: gas exchange and stomata**



**Photosynthesis and gas exchange**



**Adaptations of leaves for gas exchange**



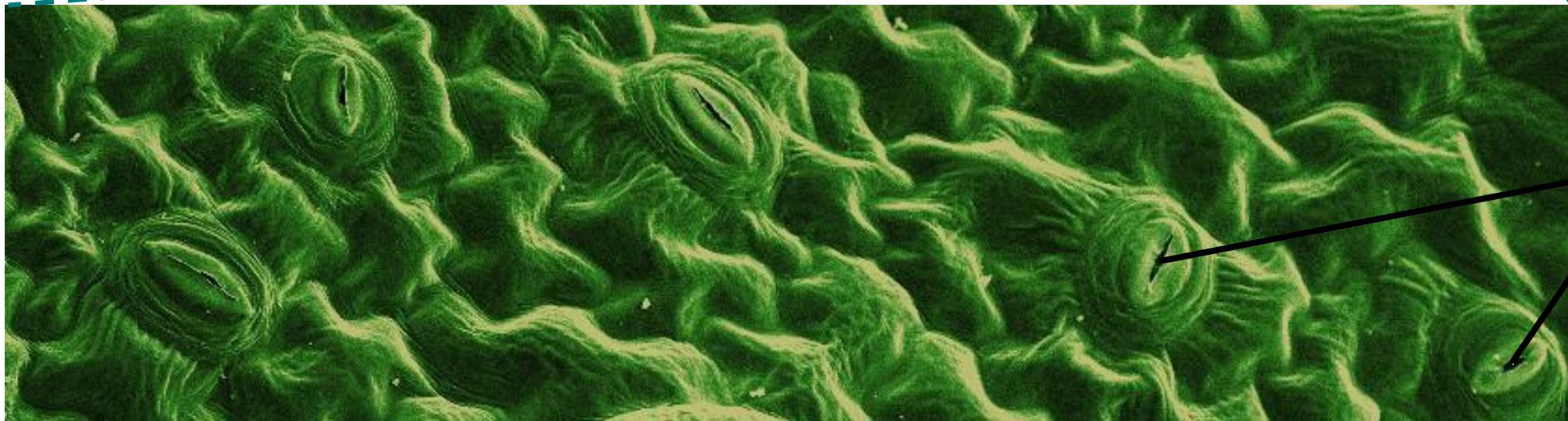
**Diffusion and gas exchange**



# Adaptations of leaves for gas exchange



If we look at the surface of a leaf using a powerful microscope...



stomata

...we see that there are tiny holes in the leaf surface.

These holes are called **stomata**.



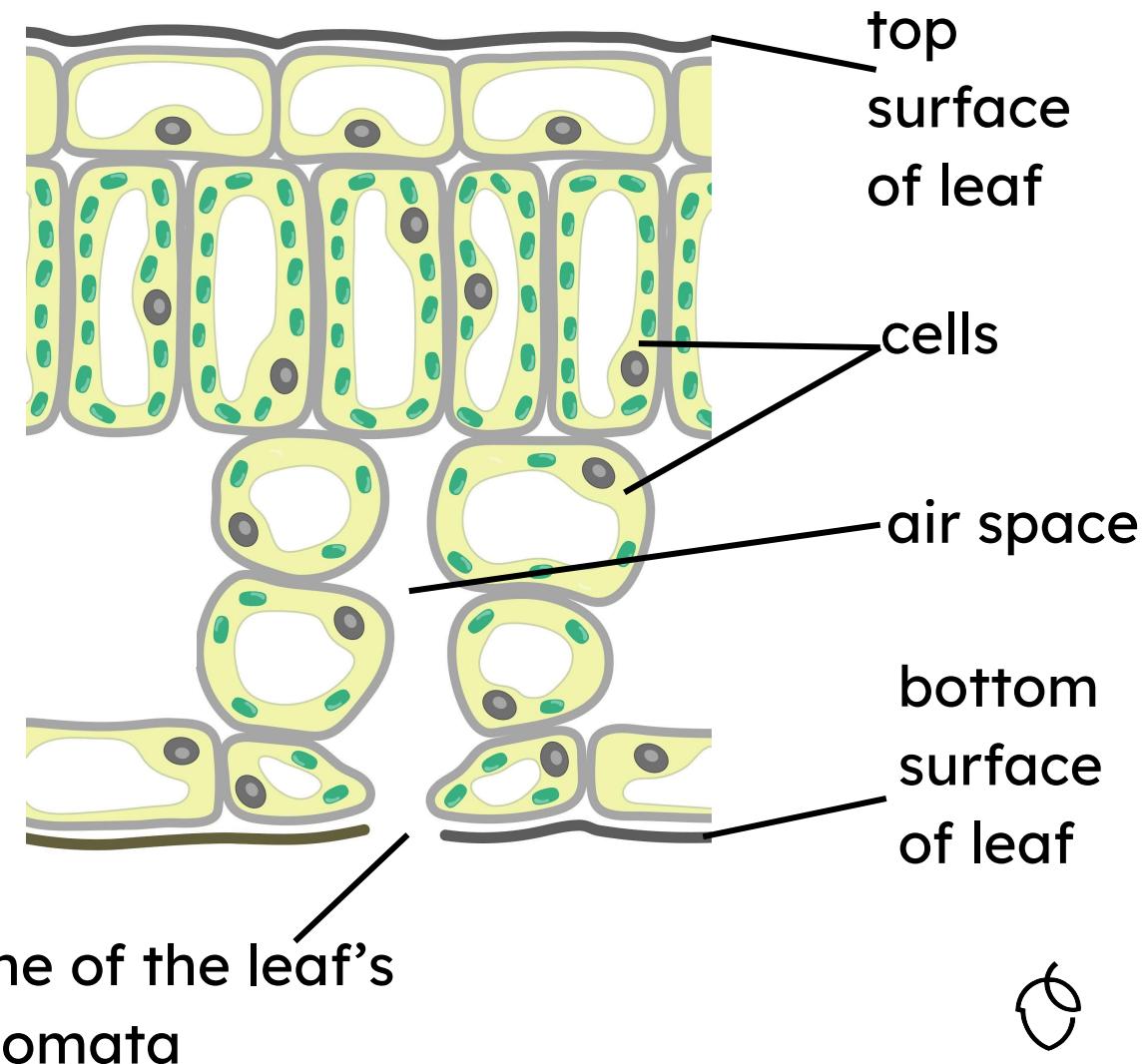
# Adaptations of leaves for gas exchange



Leaves are made of layers of cells.

The stomata (holes) in the leaf's surfaces lead to spaces between the cells.

The spaces are filled with air.



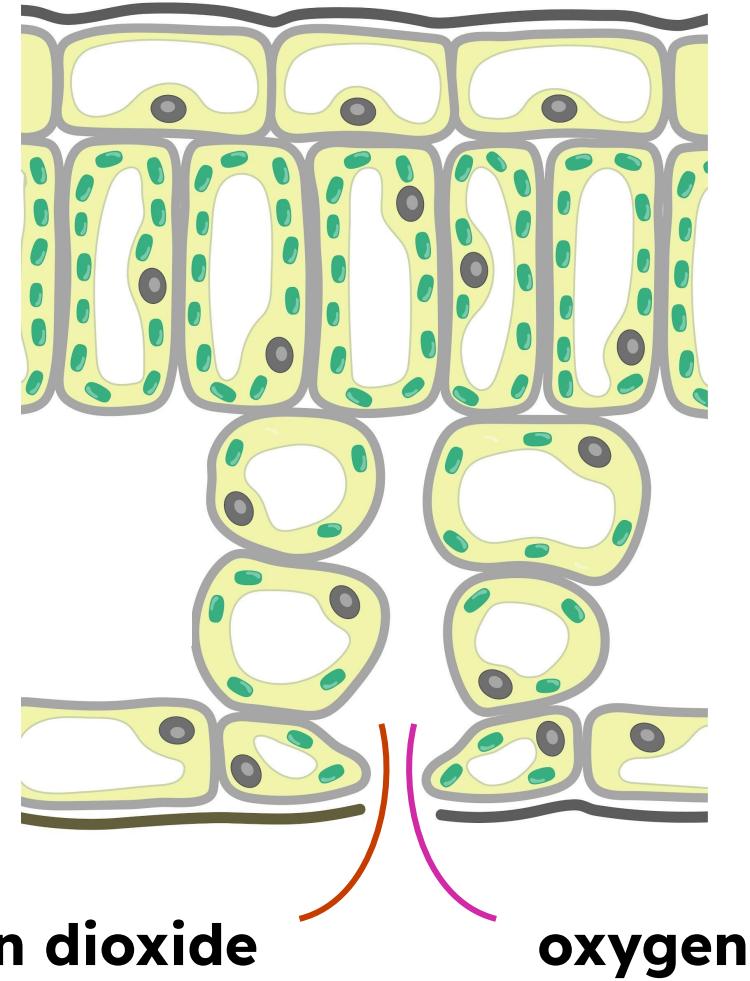
# Adaptations of leaves for gas exchange



Stomata are an **adaptation** for photosynthesis.

Stomata allow:

- carbon dioxide gas to move **into** the leaf for photosynthesis
- waste oxygen made by photosynthesis to move **out of** the leaf.



carbon dioxide

oxygen

# Adaptations of leaves for gas exchange



Complete the sentences about how plant leaves are adapted for gas exchange.

There are holes called stomata in the surface of plant leaves.

Carbon dioxide gas for photosynthesis moves in through the holes.

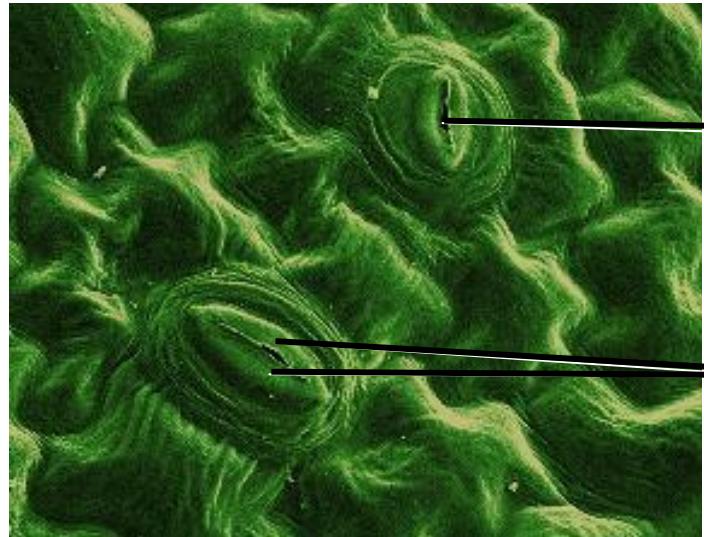
Oxygen gas made by photosynthesis moves out through the holes.



# Adaptations of leaves for gas exchange



The word 'stomata' refers to the holes in the leaf surface.



Leaf surface seen through a microscope

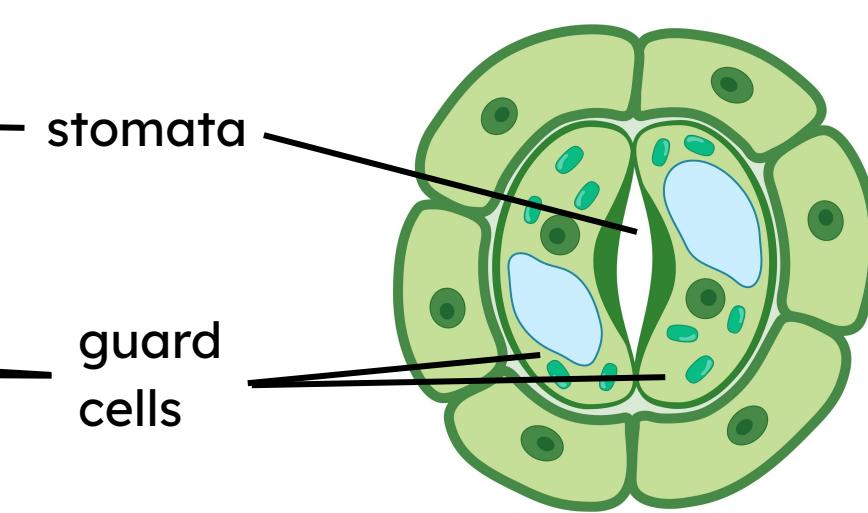


Diagram of cells around one of the stomata

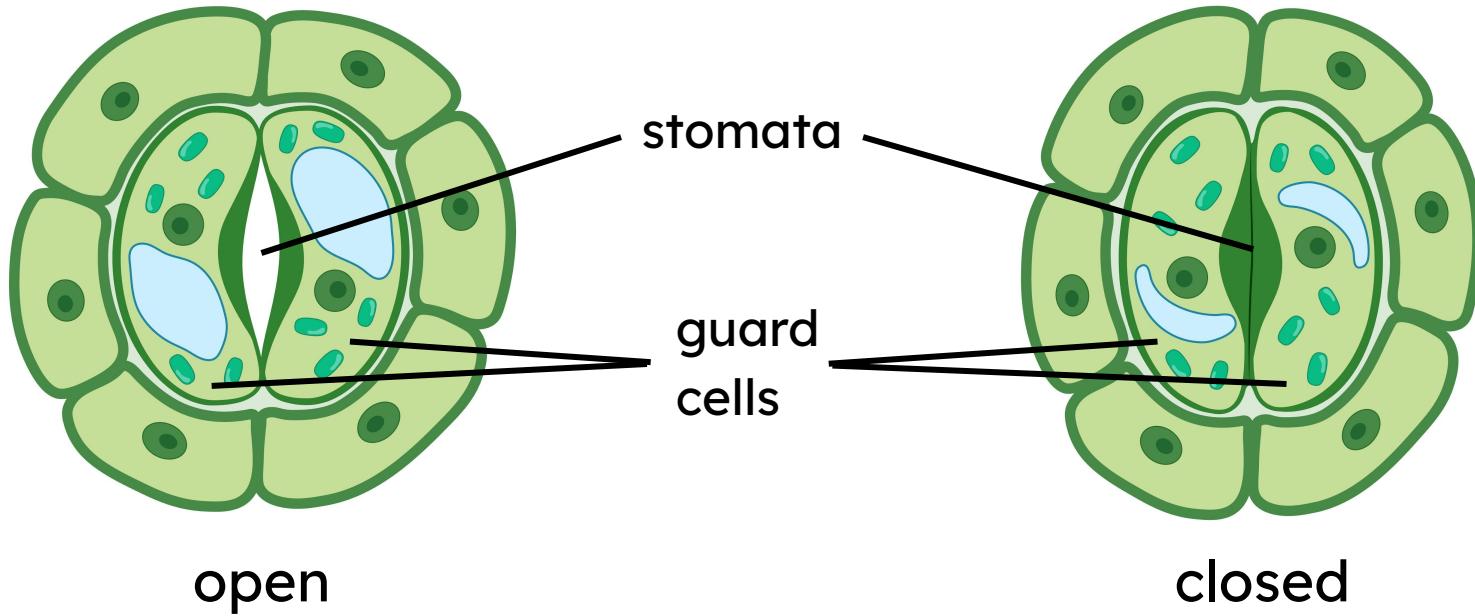
Each of the stomata is surrounded by two **guard cells**.



# Adaptations of leaves for gas exchange



Guard cells can change shape to open and close the stomata.



Water vapour (water in the gas state) can move out of leaves through open stomata.

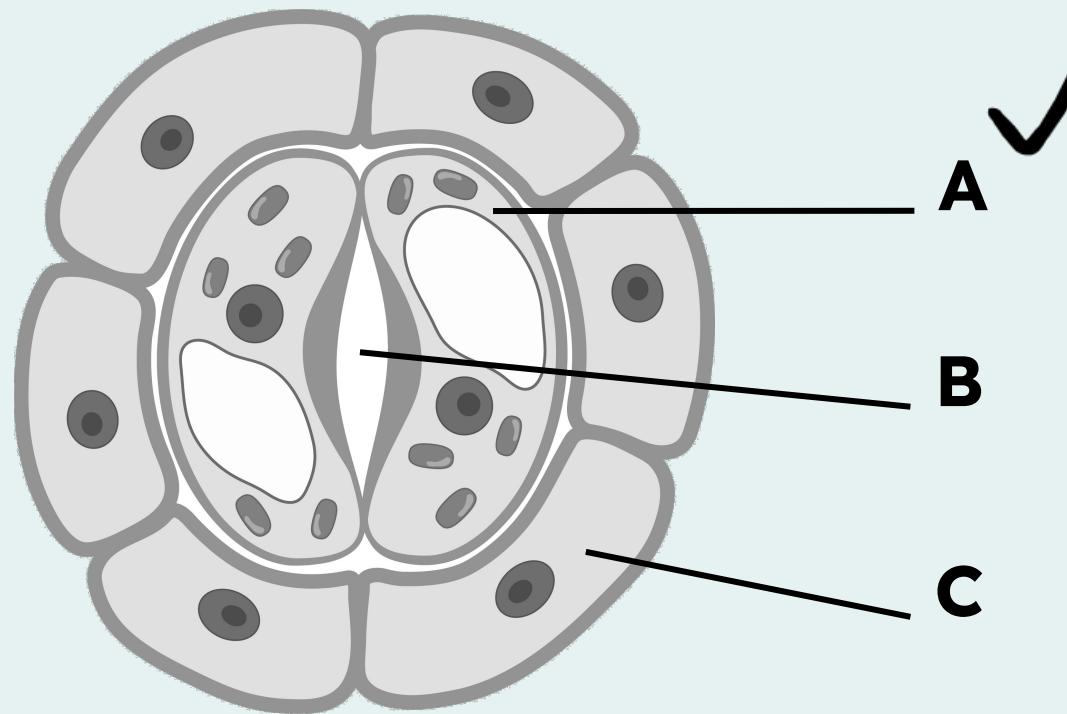
Closing the stomata can help to prevent the plant from losing too much water through its stomata.



# Adaptations of leaves for gas exchange



Which of the labelled structures are **guard cells**?



# **Lesson outline**

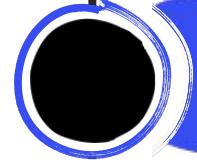
## **Adaptations of plants for photosynthesis: gas exchange and stomata**



**Photosynthesis and gas exchange**



**Adaptations of leaves for gas exchange**



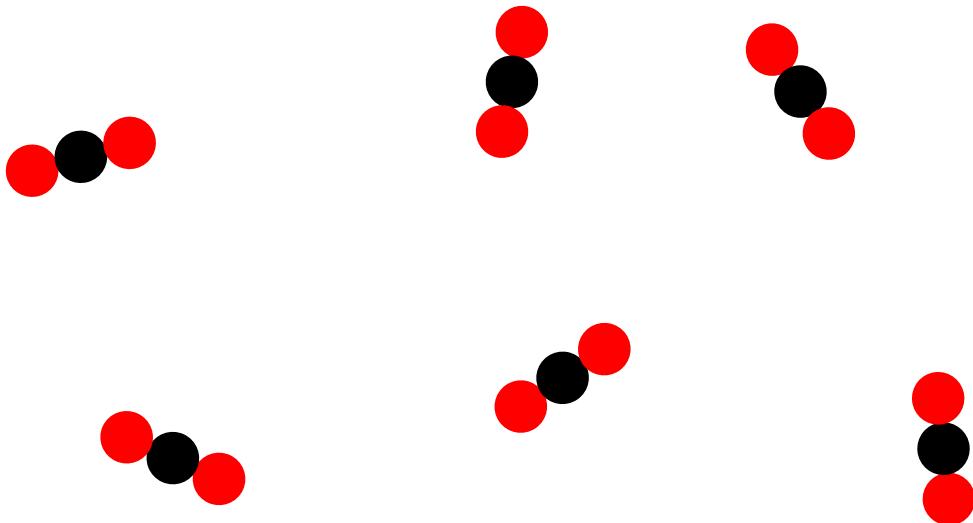
**Diffusion and gas exchange**



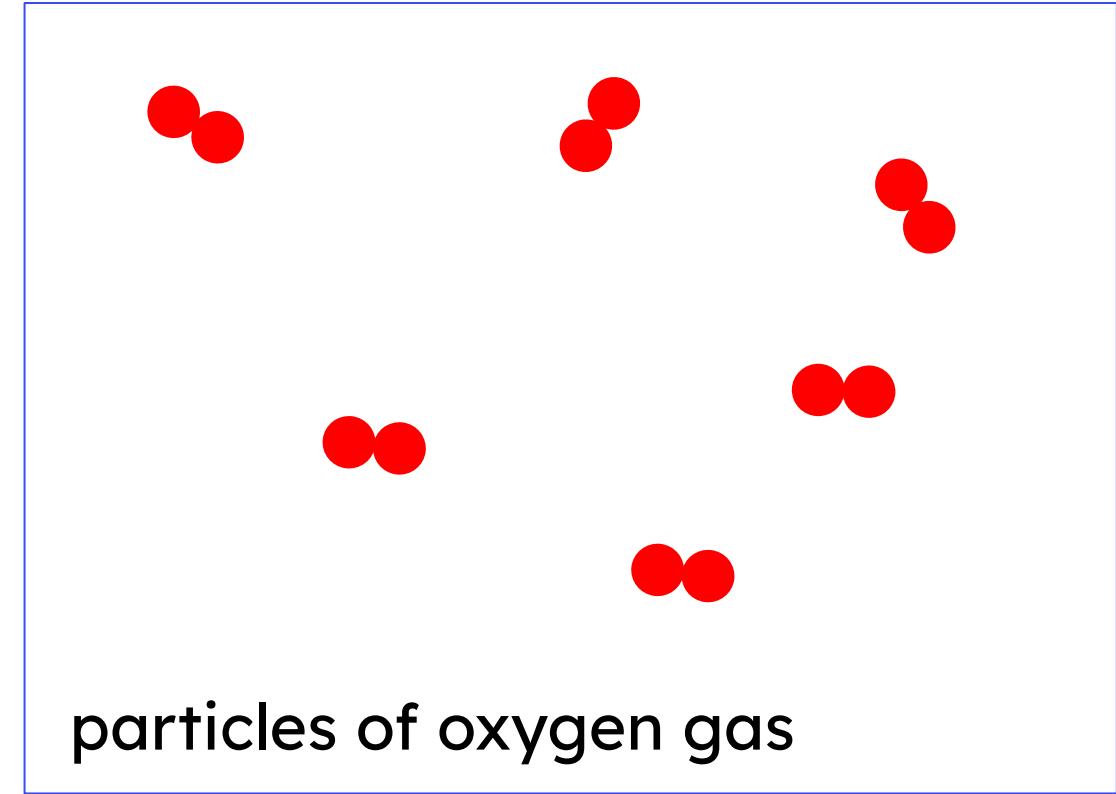
# Diffusion and gas exchange



Carbon dioxide gas and oxygen gas are made up of **particles**.



particles of carbon dioxide gas



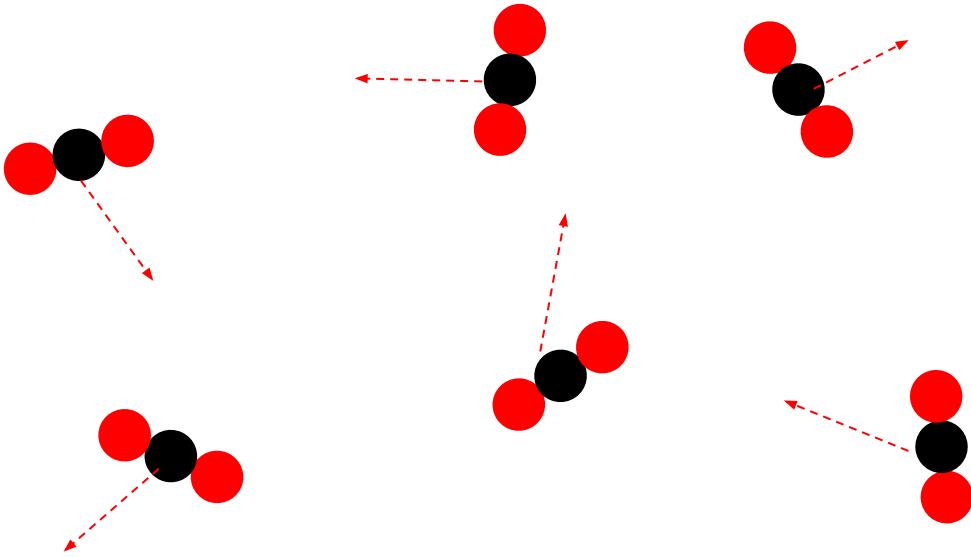
particles of oxygen gas



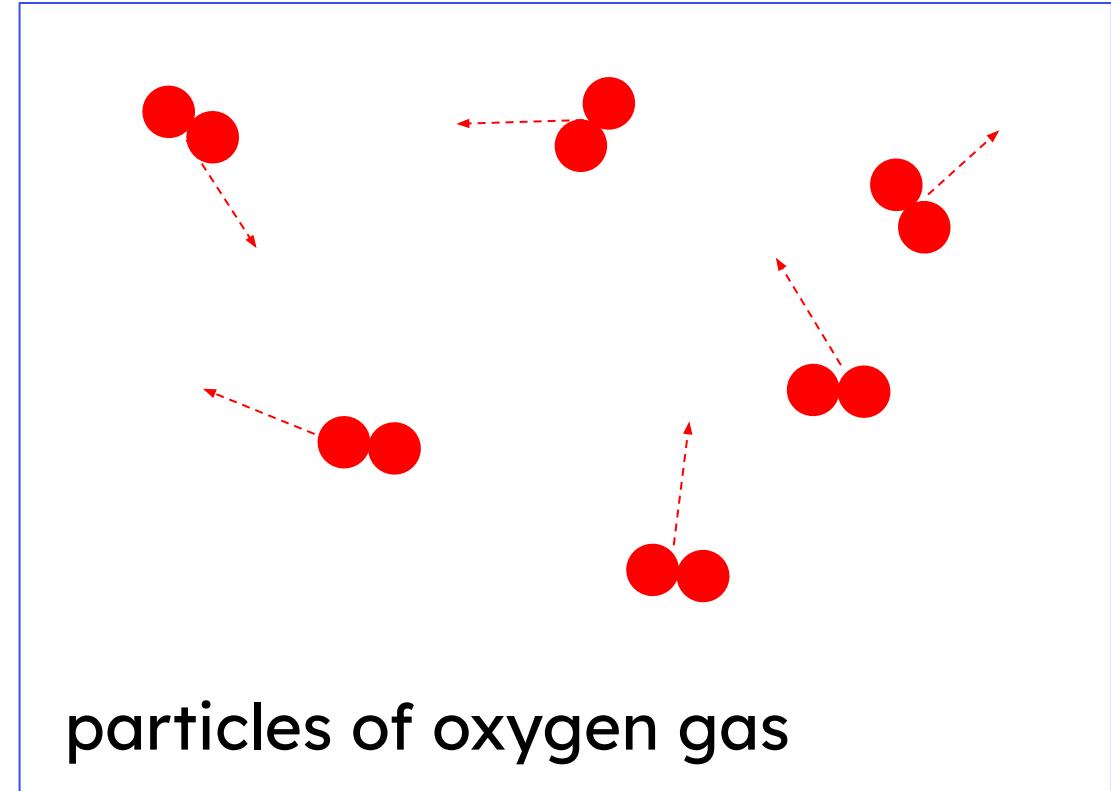
# Diffusion and gas exchange



The particles move all the time in random directions.



particles of carbon dioxide gas



particles of oxygen gas

This movement causes **diffusion**.

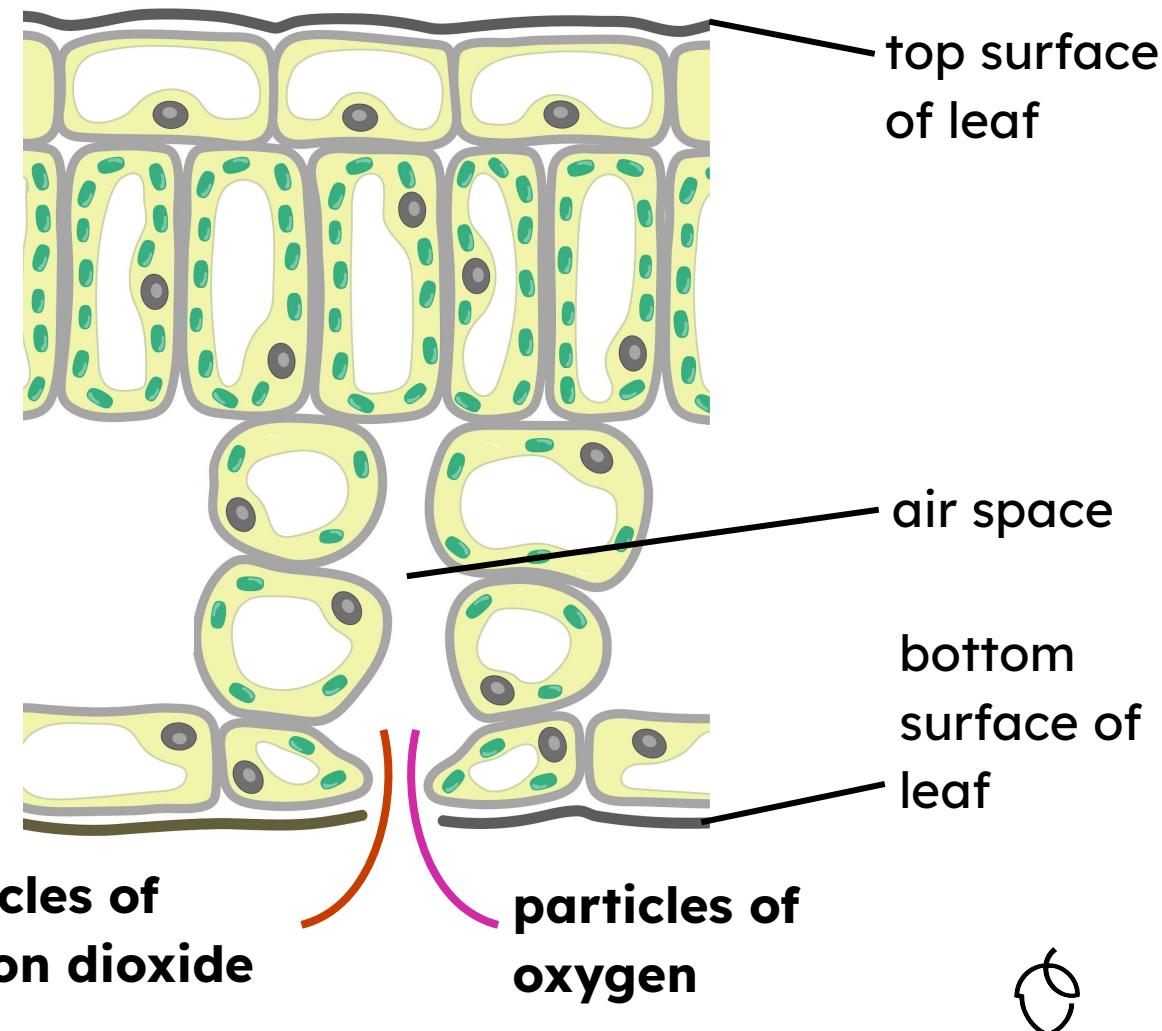


# Diffusion and gas exchange



Diffusion is what causes particles of carbon dioxide and oxygen to move:

- into and out of the air space inside a leaf
- through open stomata.

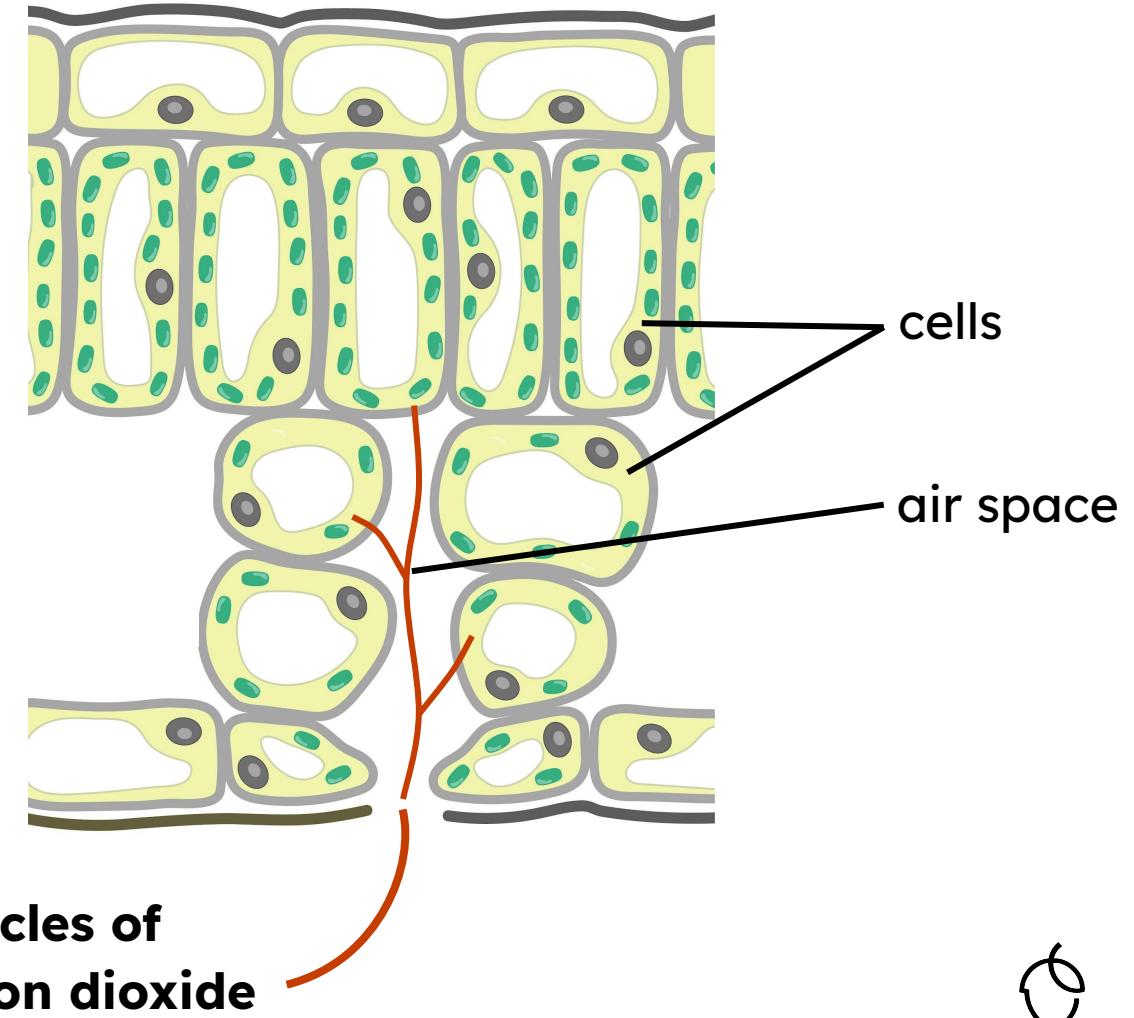


# Diffusion and gas exchange



Particles of **carbon dioxide** diffuse:

- **into** the air space inside a leaf through open stomata
- **into** leaf cells, where they are used as reactants in photosynthesis.

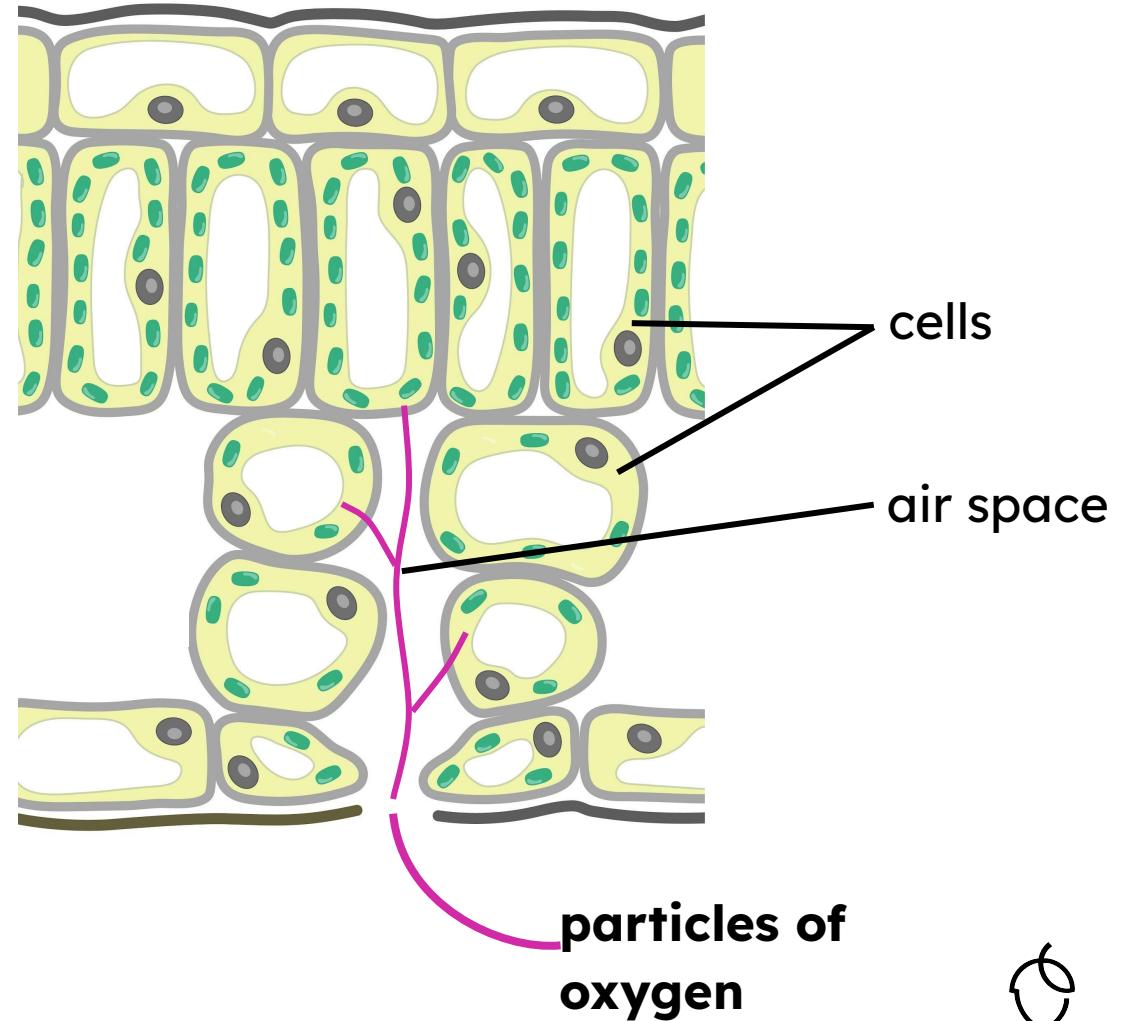


# Diffusion and gas exchange



Particles of **oxygen** gas made by photosynthesis diffuse:

- **out of cells into the air space**
- **out of the leaf through open stomata.**



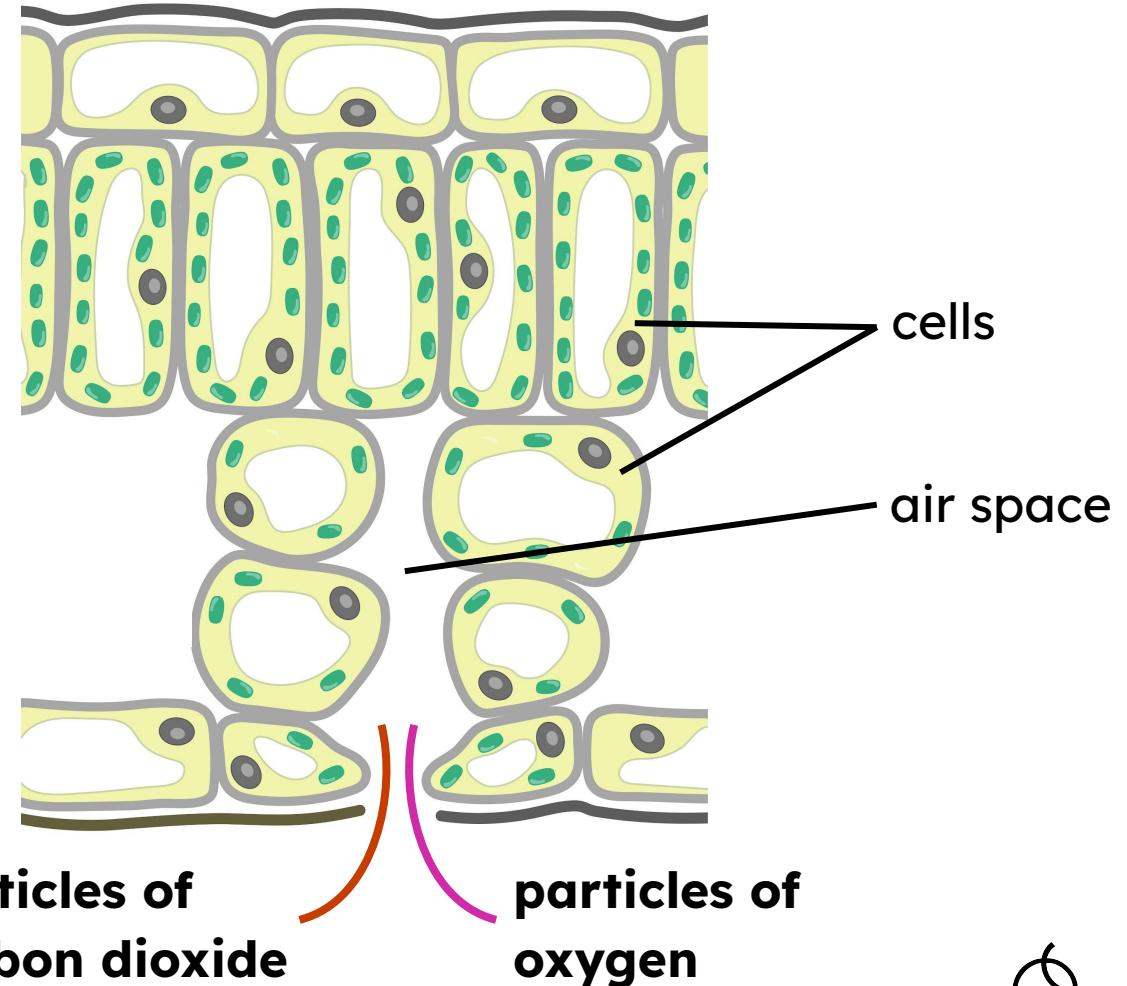
# Diffusion and gas exchange



Leaves are **thin**, which keeps the diffusion distance short.

This allows:

- cells to be supplied with carbon dioxide gas quickly so they can keep photosynthesising
- waste oxygen made by photosynthesis to be removed quickly.



# Diffusion and gas exchange



Which process moves particles of gases through open stomata?

A Adaptation

B Diffusion ✓

C Photosynthesis



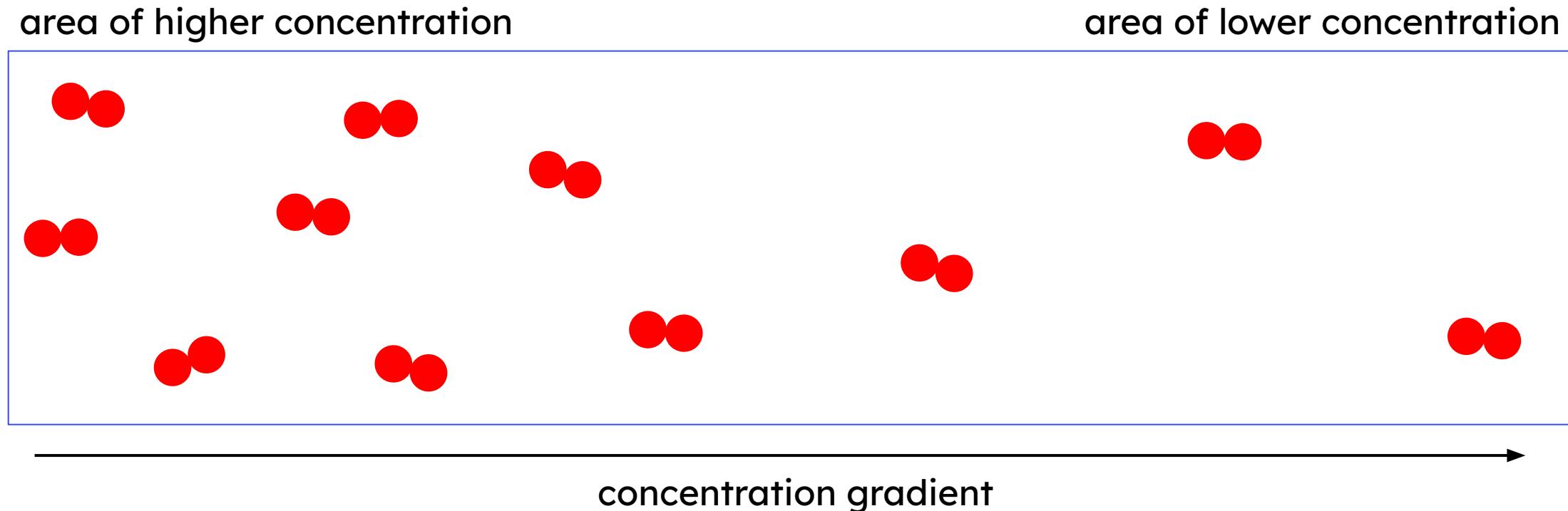
# Diffusion and gas exchange



If particles of a gas are...

- more concentrated in one area
- and less concentrated in another area

...this creates a **concentration gradient**.



# Diffusion and gas exchange

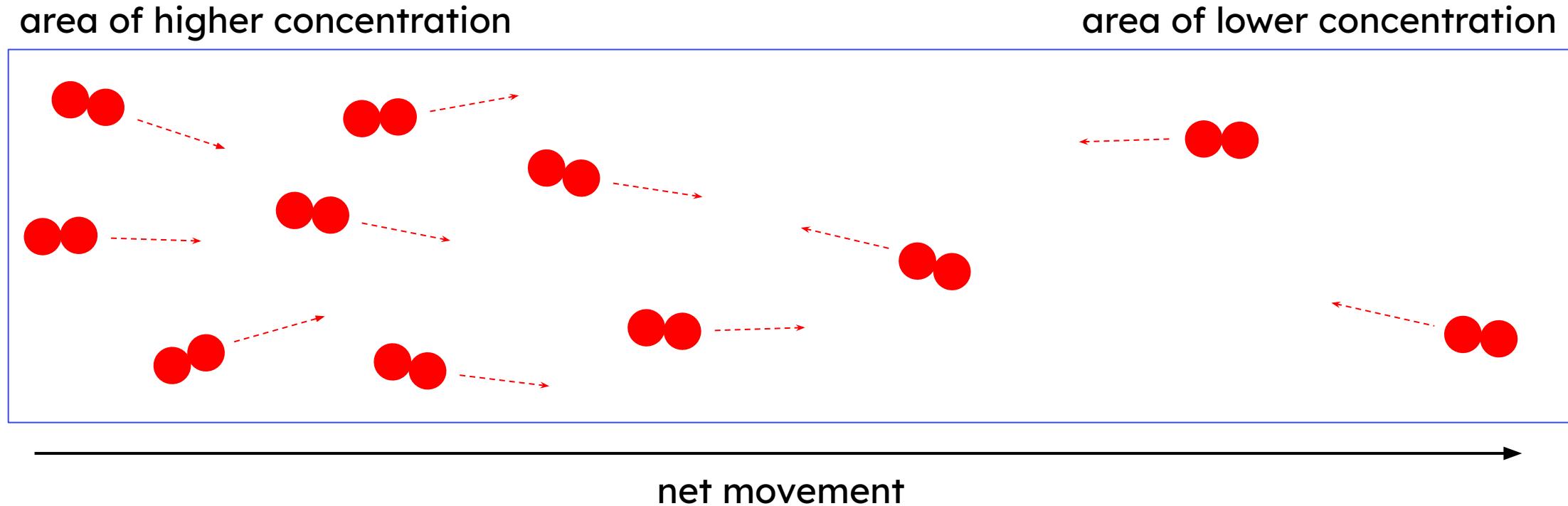


More of the particles will be moving...

- from the area of higher concentration to the area of lower concentration

...than are moving in the opposite direction.

This is called the **net movement**.



# Diffusion and gas exchange



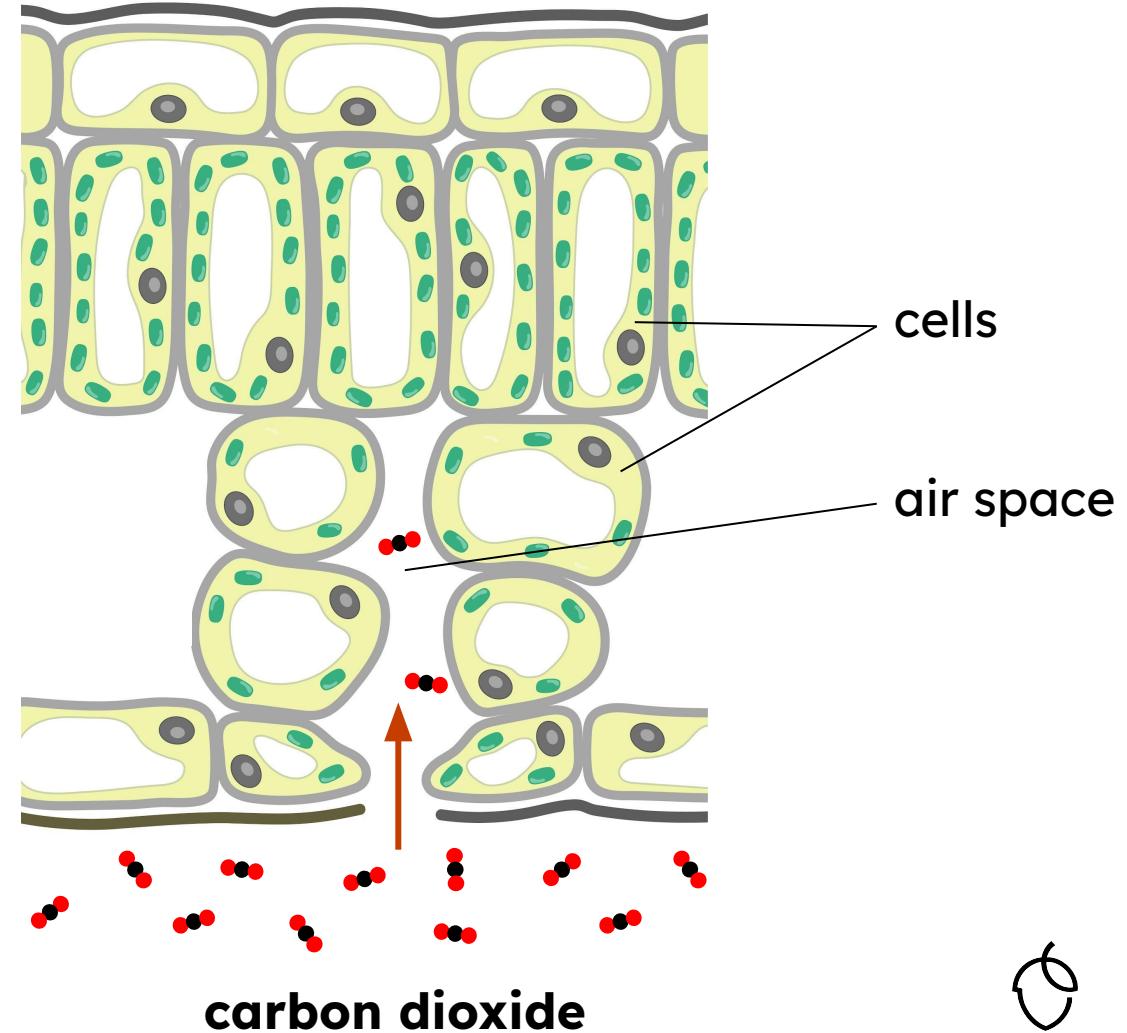
When leaf cells are photosynthesising, they use up the carbon dioxide from the air space inside the leaf.

This means there are:

- **fewer** particles of carbon dioxide in the air space inside the leaf
- than there are in the air outside the leaf.

The concentration gradient is from outside to inside.

The net movement of carbon dioxide particles is from outside to inside.



# Diffusion and gas exchange



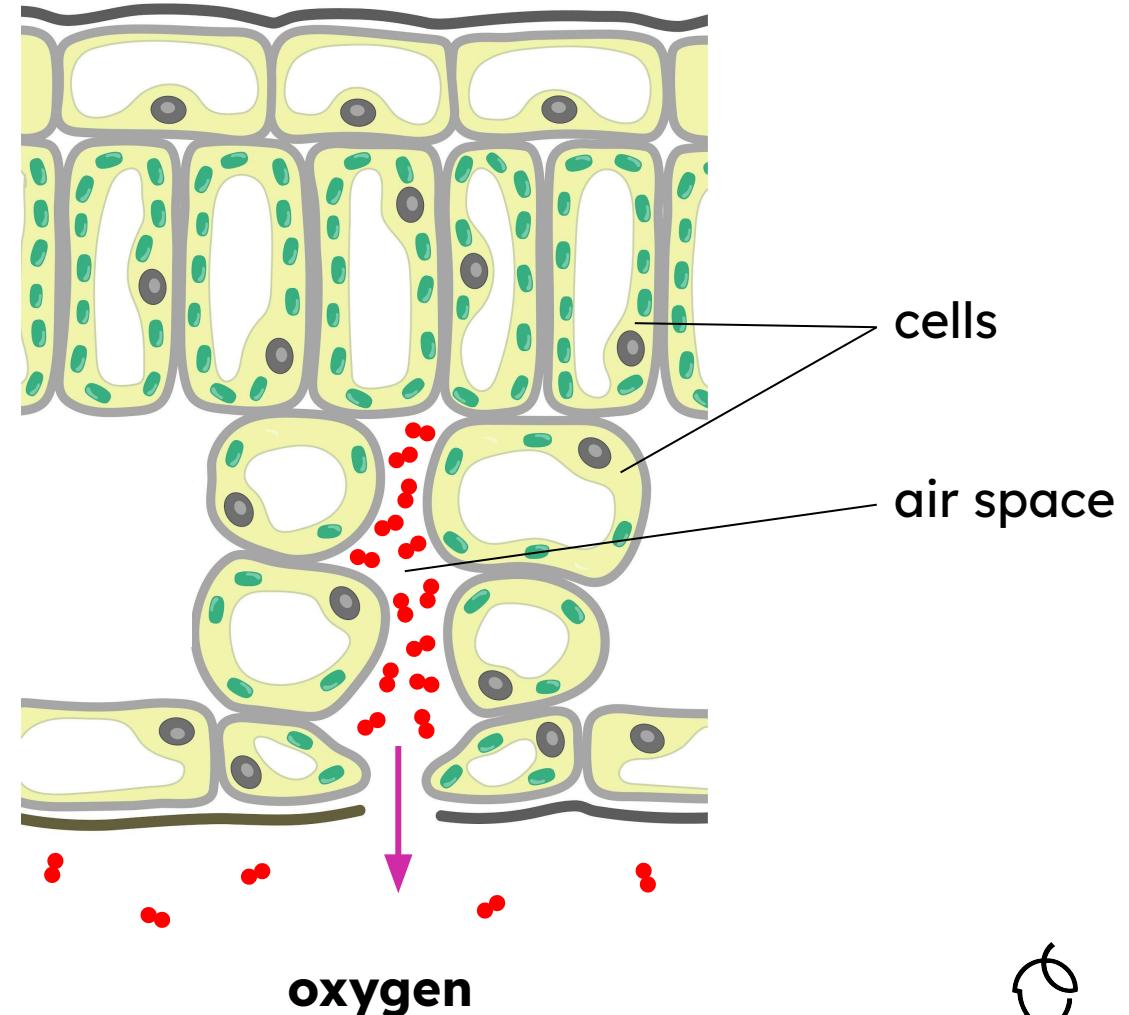
When leaf cells are photosynthesising, they fill up the air space inside the leaf with waste oxygen.

This means there are:

- **more** particles of oxygen in the air space inside the leaf
- than there are in the air outside the leaf.

The concentration gradient is from inside to outside.

The net movement of oxygen particles is from inside to outside.



# Diffusion and gas exchange



Complete the sentences about diffusion of particles of a gas.

Use some of the words from the list:

**equal      gradient      higher      lower      movement      net**

If particles of a gas are more concentrated in one area than in another, this creates a concentration *gradient*.

More of the particles will be diffusing:

- from the area of *higher* concentration
- to the area of *lower* concentration.

This is called the *net* movement.



**END**

