MYP 4
UNIT 2

LESSON 1 & 2

Breathing and Respiration.

Objectives.

By the end of the lesson, students will be able to:

- Explain the structure and function of the human gas exchange system.
- Understand the process and importance of cellular respiration.
- Compare aerobic and anaerobic respiration and their applications.

Keywords

Breathing is the process in which air moves in and out of the lungs.

The **lungs** are a pair of organs found in humans and some other animals.

Cellular respiration is a chemical process in cells, which uses sugar as a fuel to provide energy for life processes.

Subcellular structures called **mitochondria** use sugar and oxygen for cellular respiration.

The process of oxygen diffusing from the lungs into the blood, and carbon dioxide diffusing from the blood to the lungs, is known as **gas exchange.**

Lesson outline

Breathing, respiration and gas exchange

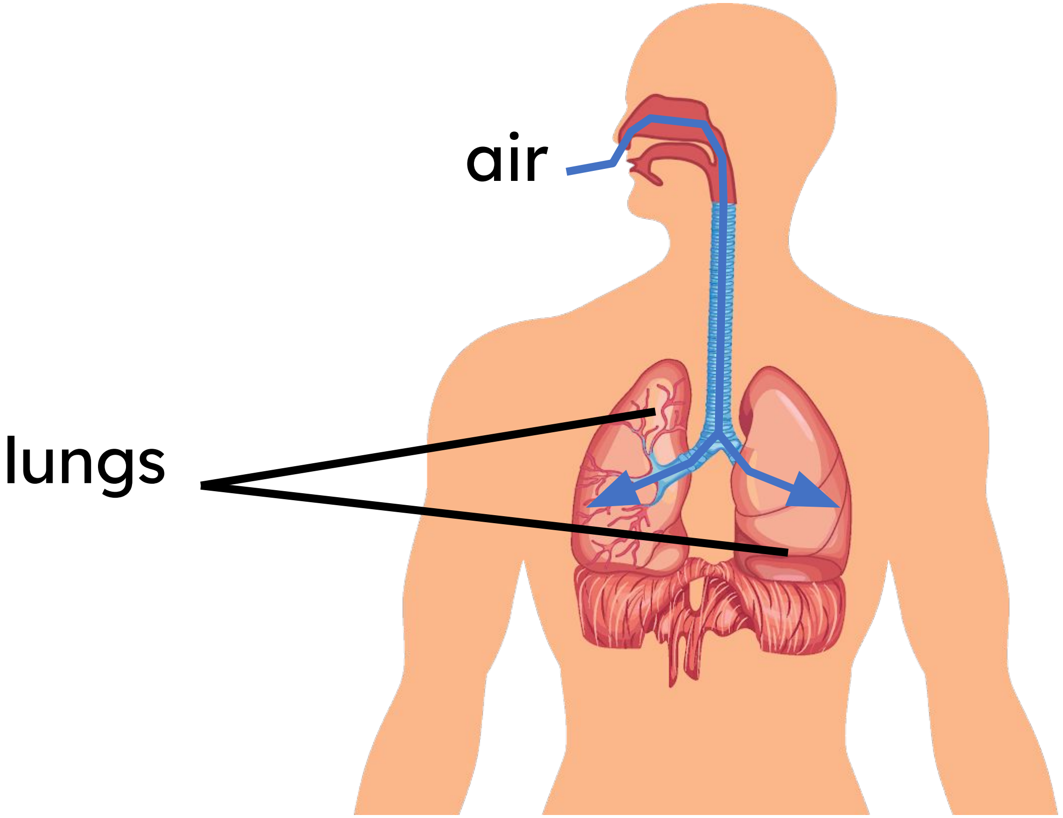
- Breathing and respiration
- Gas exchange

Humans can’t stay underwater for too long.

This is because we need to breathe in air.

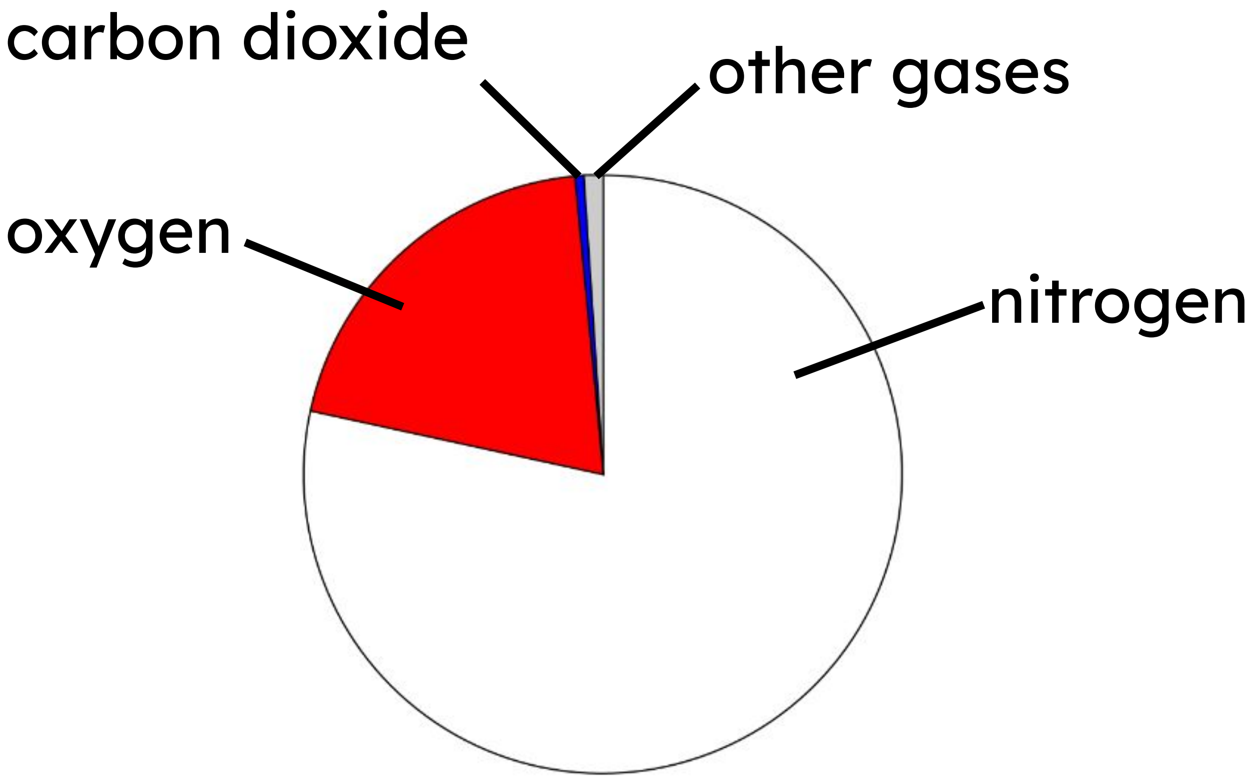
Explanation

Breathing is the process in which air is moved in and out of the **lungs**.



Explanation

Air is a mixture of different gases.



Humans and other animals need oxygen from the air to keep their cells alive.

True or false?

Our body needs all of the gases in the air to keep our cells alive.

T True

F False ✓

Justify your answer

a Cells only need oxygen to stay alive. ✓

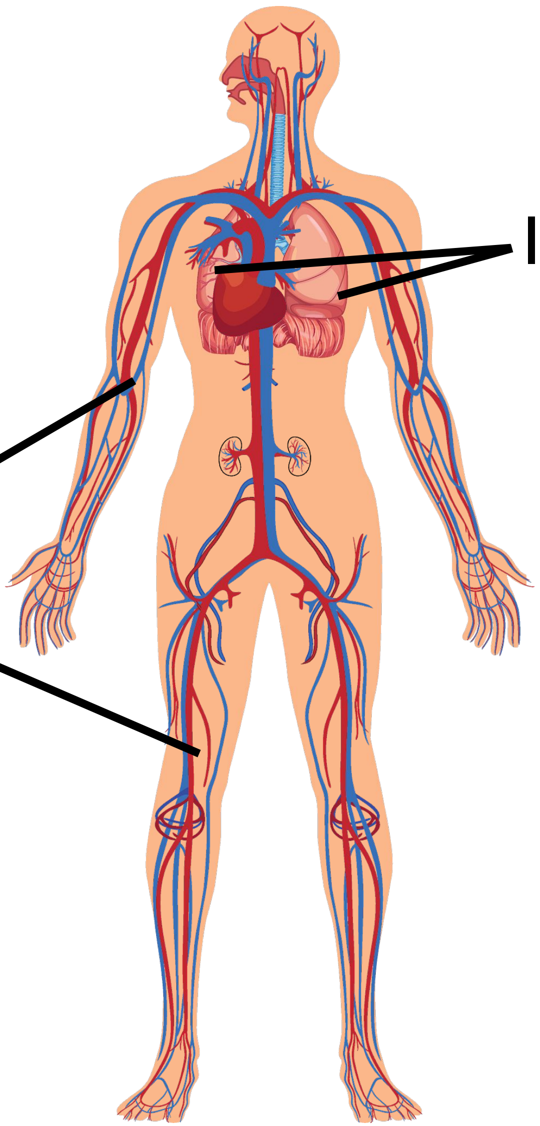
b Cells only need carbon dioxide to stay alive.

Breathing and respiration

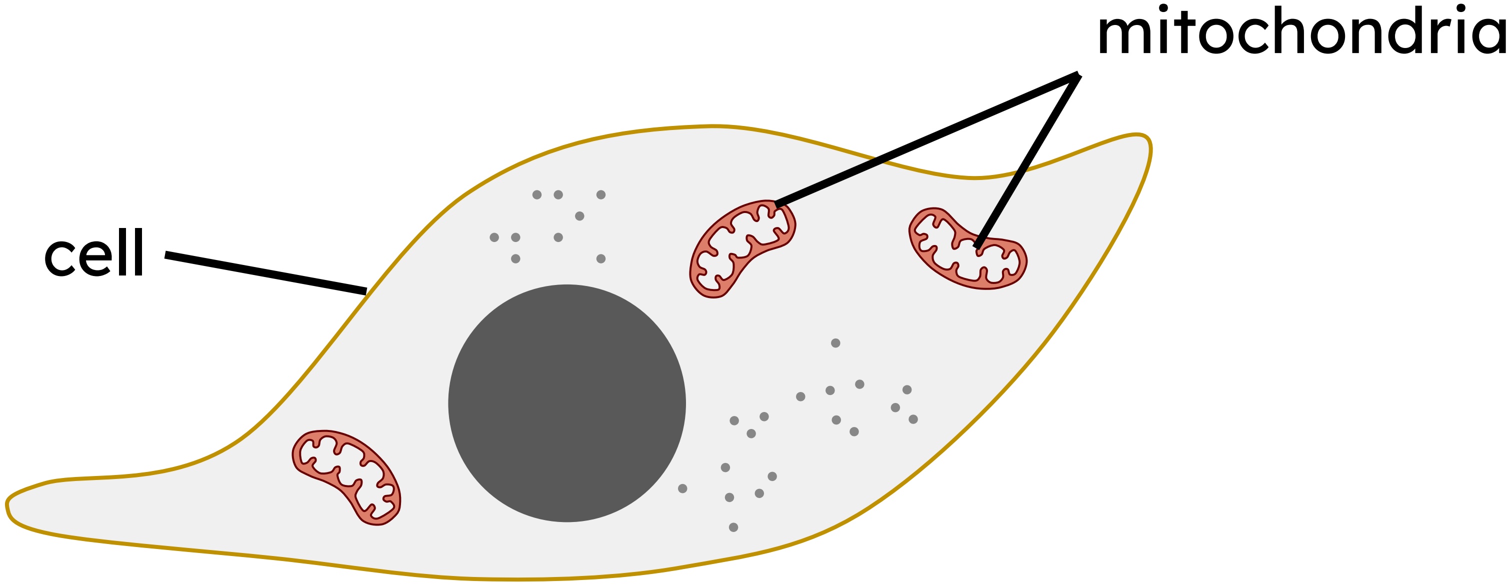
Explanation

When we breathe in air enters our lungs.

The oxygen is absorbed into our blood and transported through blood vessels to cells all over our body.



Body cells contain structures called **mitochondria** that use oxygen for **cellular respiration**.

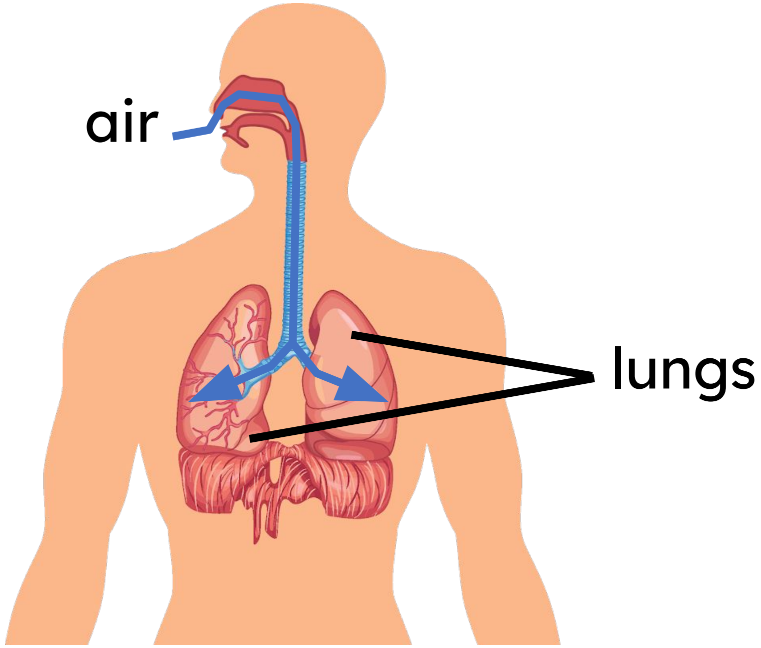


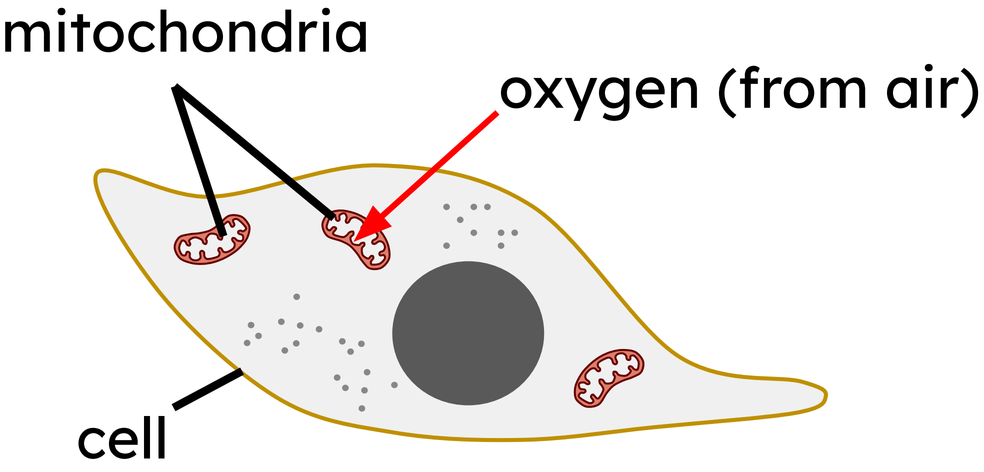
Cellular respiration in mitochondria is a chemical process. It uses oxygen and sugar from food as fuel to provide energy for life processes.

Breathing and respiration

Explanation

Breathing and **cellular respiration** are different processes.

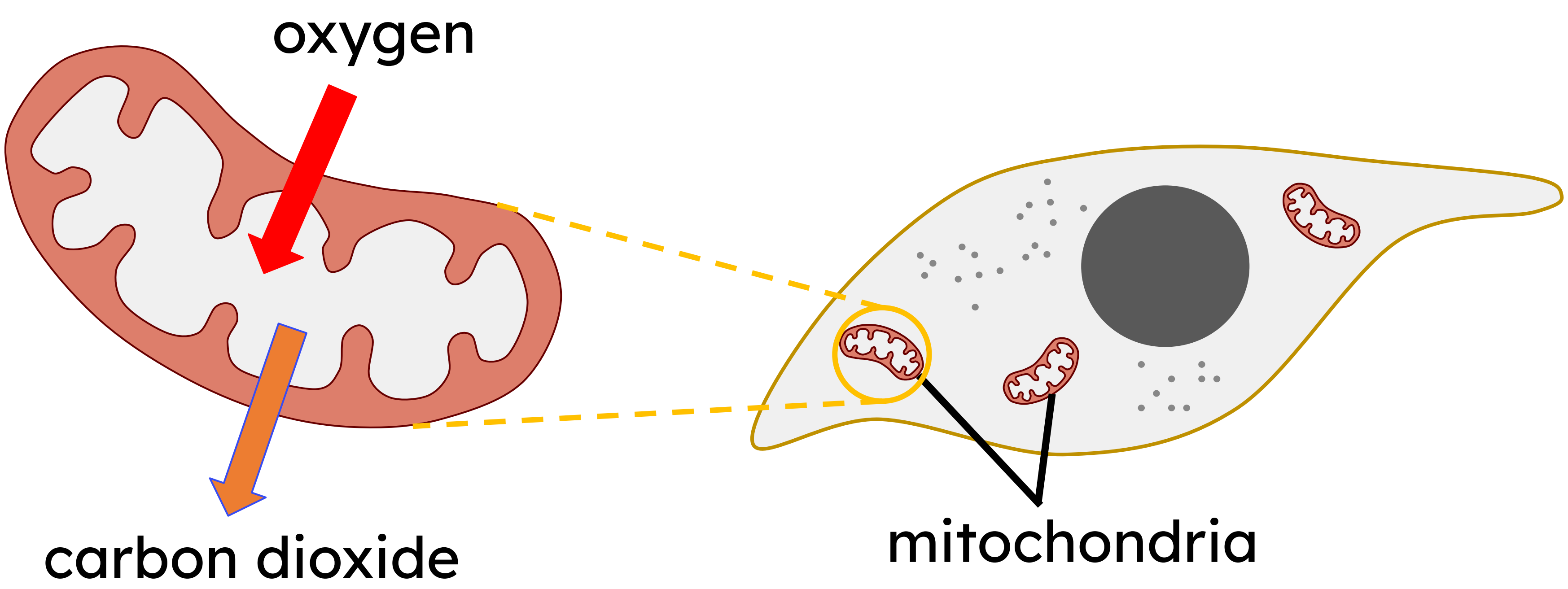




During **breathing**, air is moved in and out of the **lungs**.

During **respiration**, the **mitochondria** in cells combine oxygen with sugar to provide energy.

Oxygen diffuses into the **mitochondria** for **cellular respiration.**



Carbon dioxide is produced during **cellular respiration** and diffuses out of the **mitochondria**.

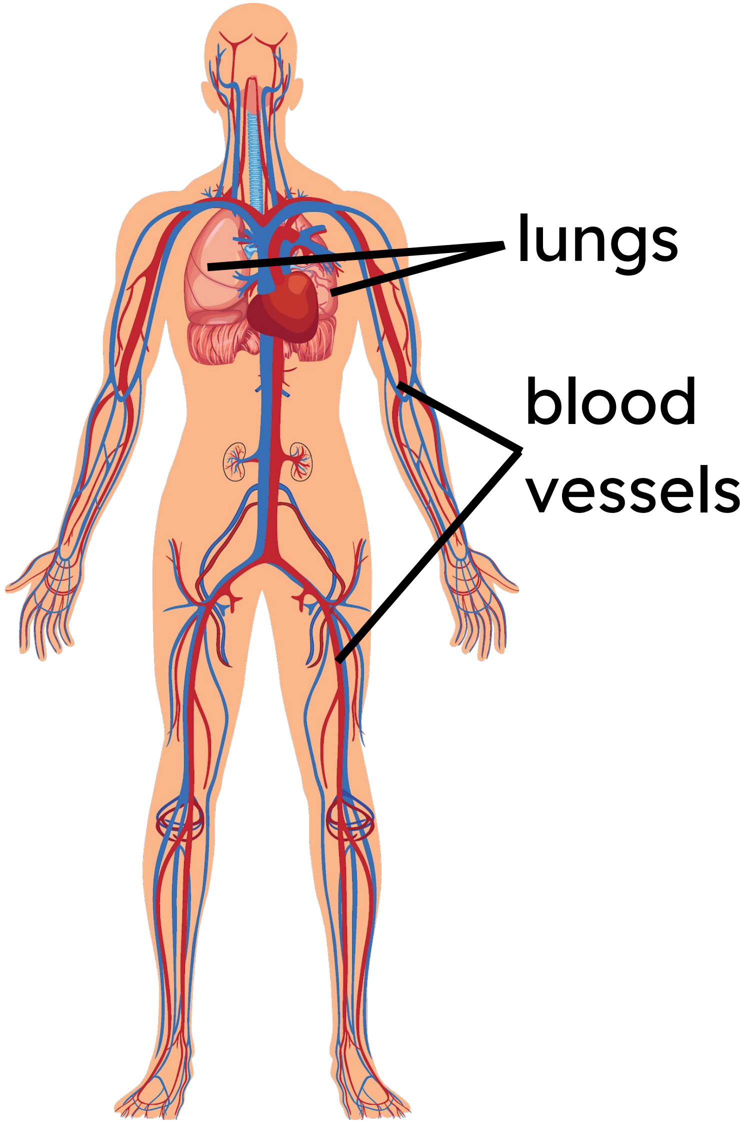
Breathing and respiration

Explanation

The carbon dioxide produced during **cellular respiration** is a waste product.

It is transported back to the lungs by the blood.

It is then breathed out.



Check

Put these statements about breathing and respiration in the correct order. The first one has been done for you:

1. Air is breathed into the lungs.

- Carbon dioxide is transported by the blood back to the lungs.
- The blood takes oxygen to all the cells in the body.
- Oxygen from the air in the lungs moves into the blood.
- Carbon dioxide is produced during cellular respiration.
- The oxygen is used by cells for cellular respiration.

Breathing and respiration

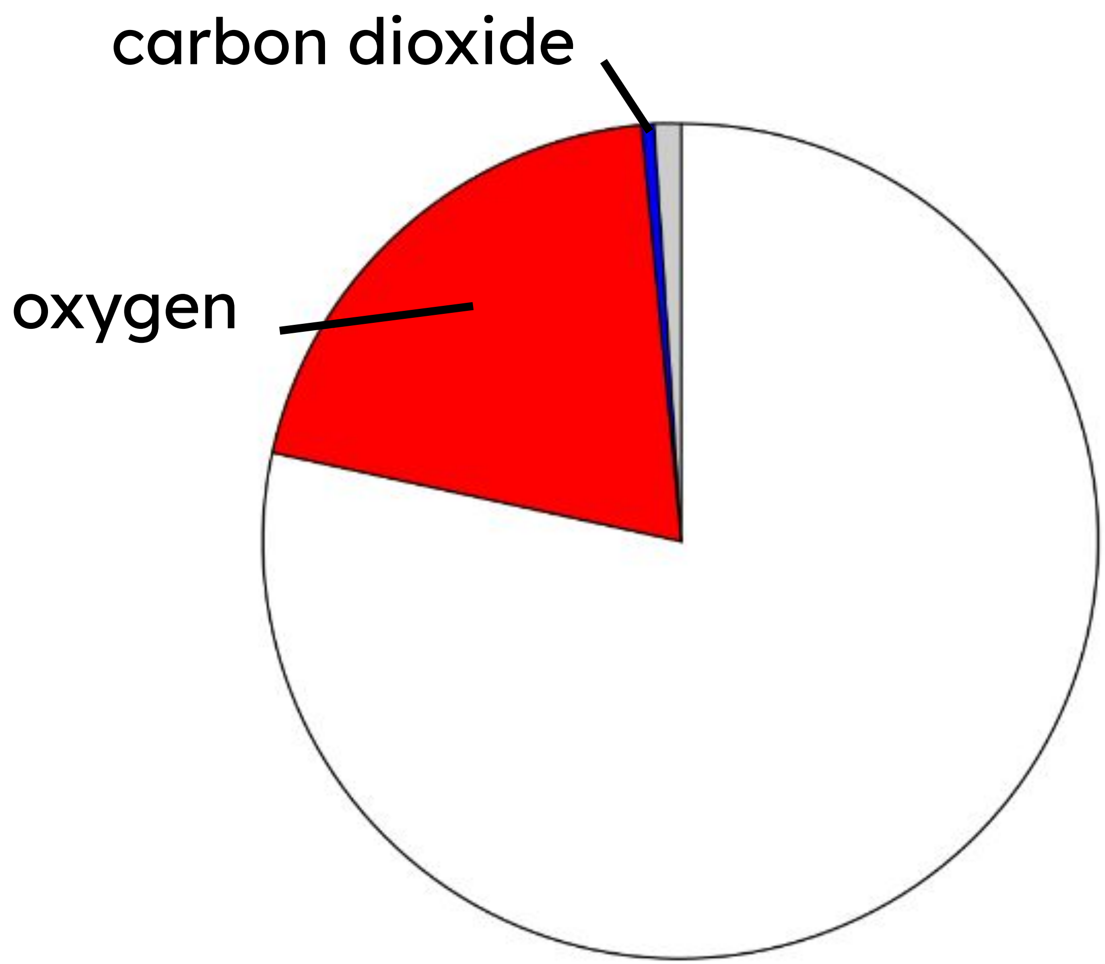
Check

Put these statements about breathing and respiration in the correct order. The first one has been done for you:

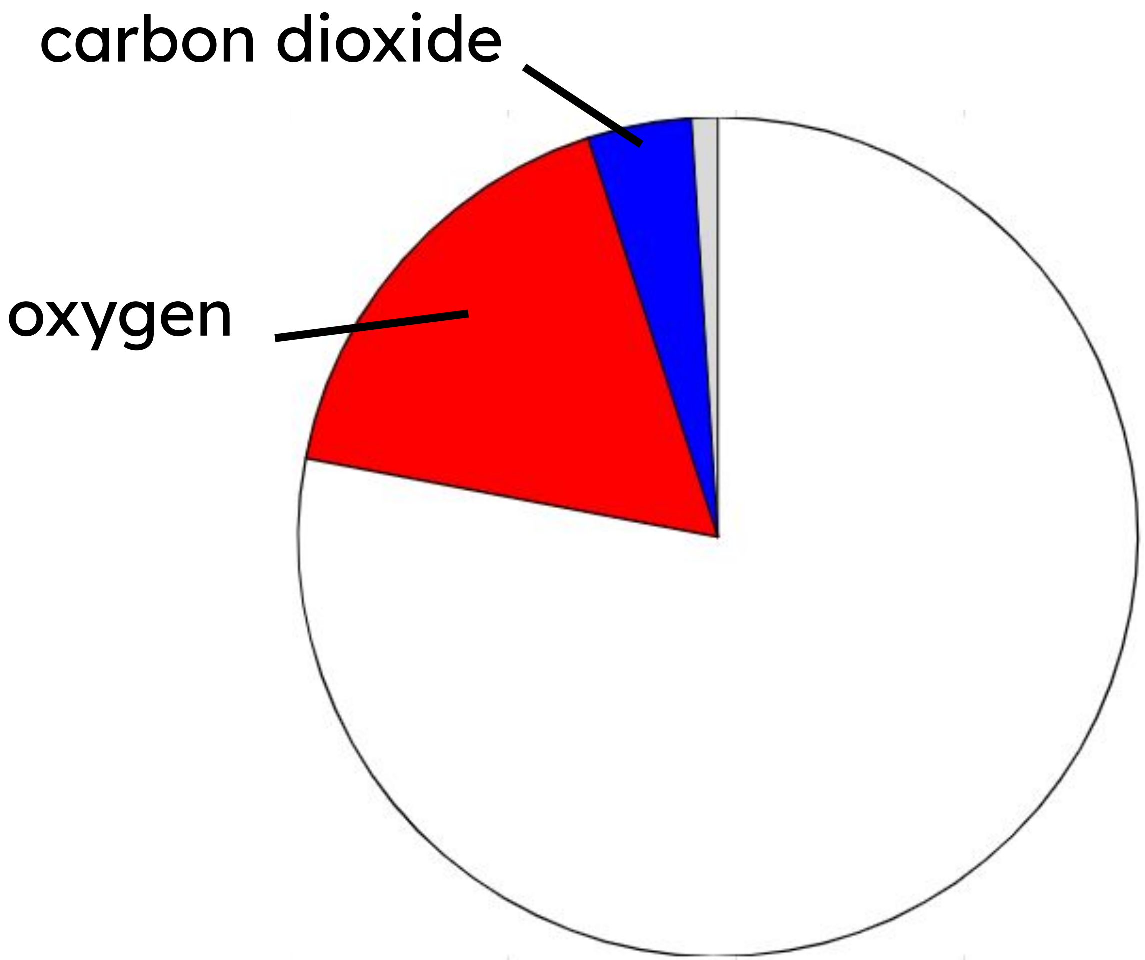
1. Air is breathed into the lungs.
2. Oxygen from the air in the lungs moves into the blood.
3. The blood takes oxygen to all the cells in the body.
4. The oxygen is used by the cells for cellular respiration.
5. Carbon dioxide is produced during cellular respiration.
6. Carbon dioxide is transported by the blood back to the lungs.

Breathing and respiration

Explanation



The air we breathe in



The air we breathe out

How do the gases in the air we breathe out, compare to the air we breathe in?

a The amount of oxygen has decreased.

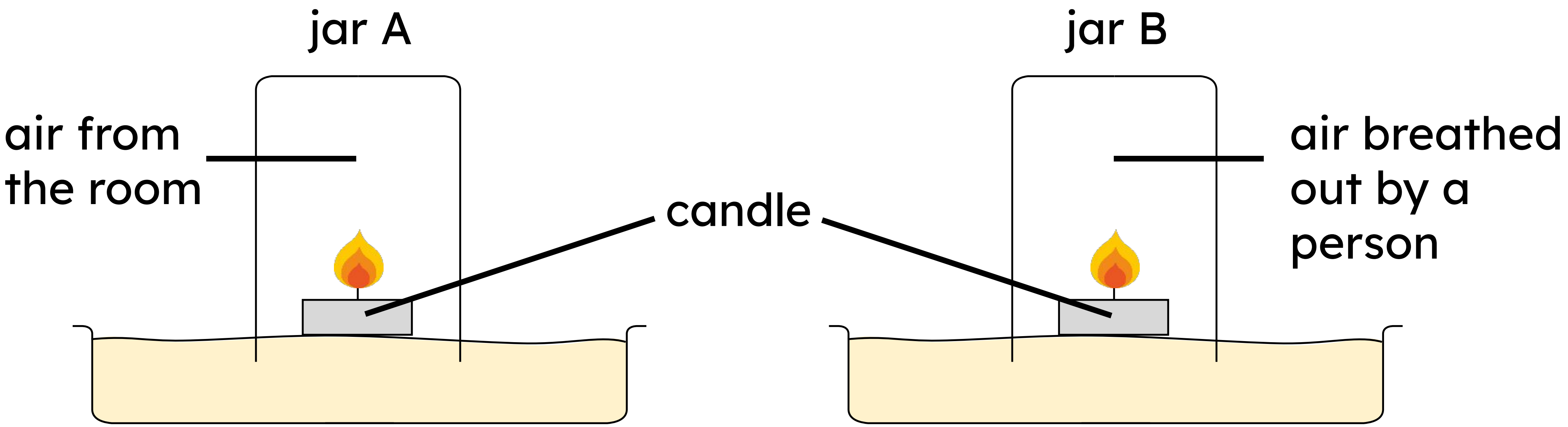
b The amount of carbon dioxide has increased.

c The amount of oxygen has decreased, and the amount of carbon dioxide has increased. ✓

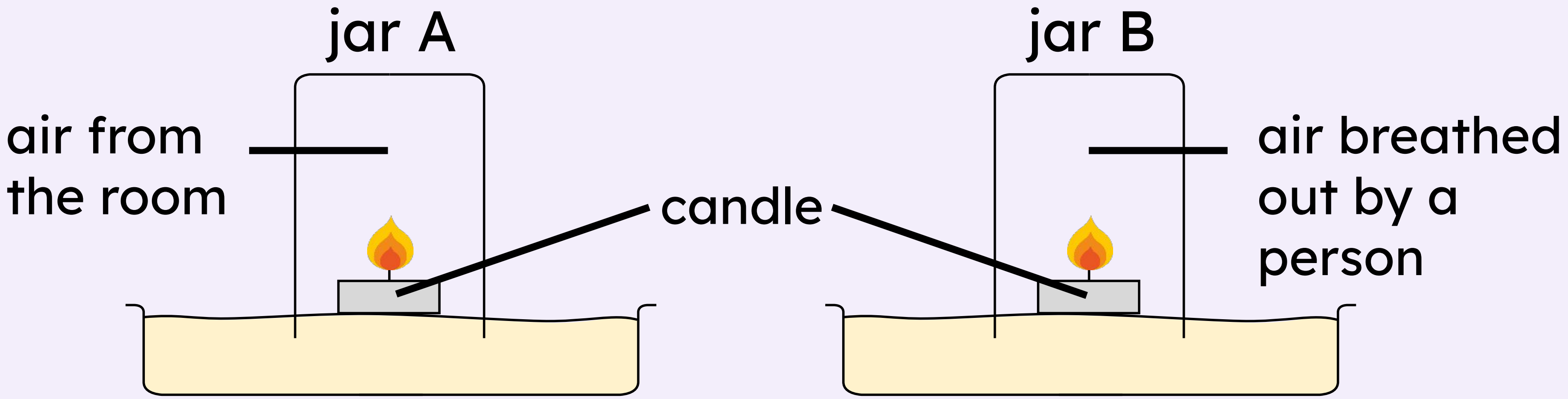
d The gases are present in exactly the same amounts.

Candles need oxygen to burn.

A student places burning candles inside two jars of air.



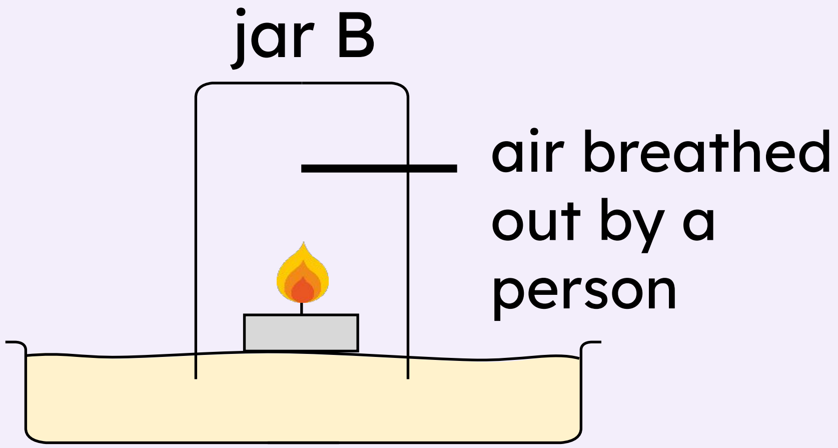
1) Predict what will happen to the candle in each jar.
2) Explain why you think this will happen.



1) Predict what will happen to the candle in each jar.

- *At first, both candles will burn.*
- *The candle inside jar B (containing air breathed out by a person) will go out first.*
- *Then the candle inside jar A (containing air from the room) will go out.*

2) Explain why you think this will happen.



- *At first, both candles will burn because both jars contain some oxygen.*
- *The candle inside jar B will go out first because there is less oxygen, and more carbon dioxide, in air breathed out by a person.*
- *This is because some of the oxygen is used for cellular respiration in the person's cells. The extra carbon dioxide was produced by cellular respiration and breathed out.*
- *Both candles eventually go out when all the oxygen in the jars is used up (has been combusted).*

Lesson outline

Breathing, respiration and gas exchange

- Breathing and respiration
- Gas exchange

Another process happens between **breathing** and **cellular respiration**. This process is called:

Gas exchange

Gas → Carbon dioxide and oxygen

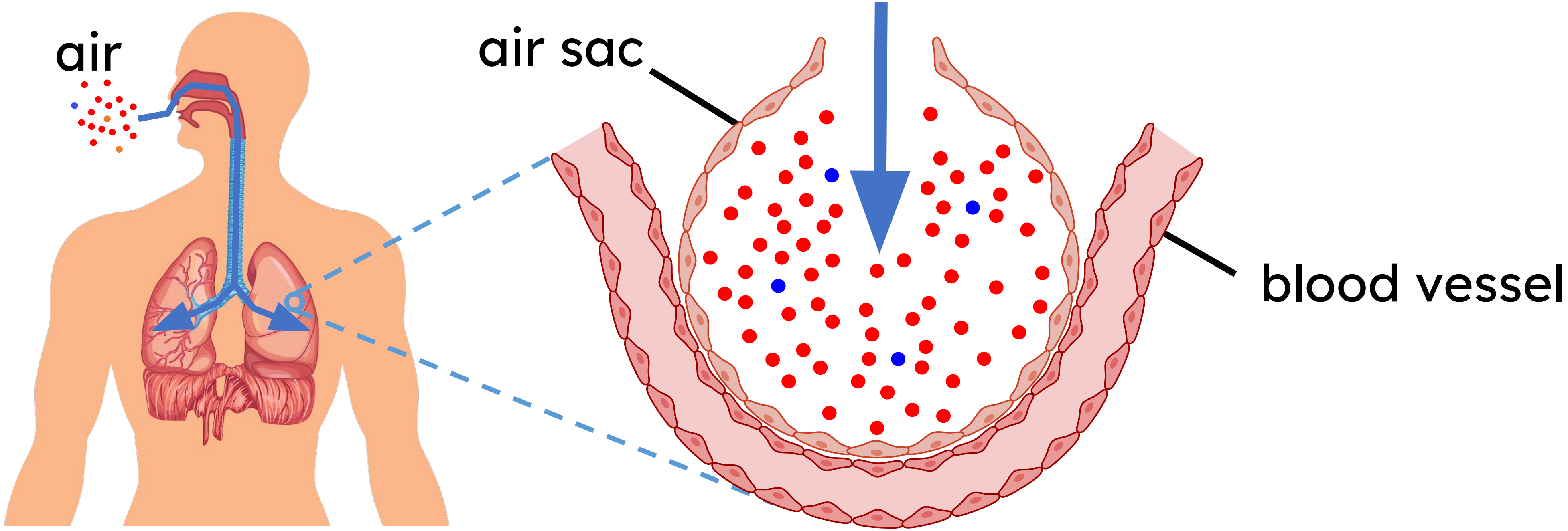
exchange → Switching, changing places

Gas exchange moves oxygen and carbon dioxide between the air and the blood.

Gas exchange

Explanation

Air containing particles of oxygen and carbon dioxide are breathed in.



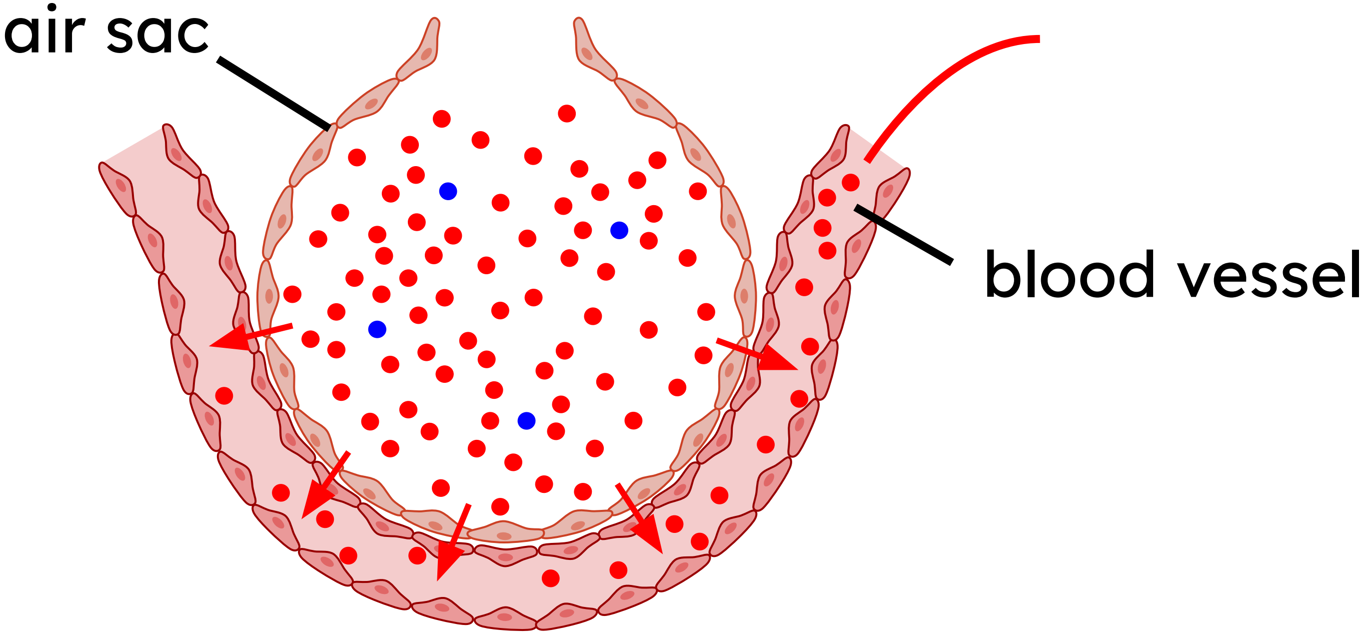
It fills tiny air sacs in the lungs. Each sac is surrounded by blood vessels.

This is where **gas exchange** takes place.

Gas exchange

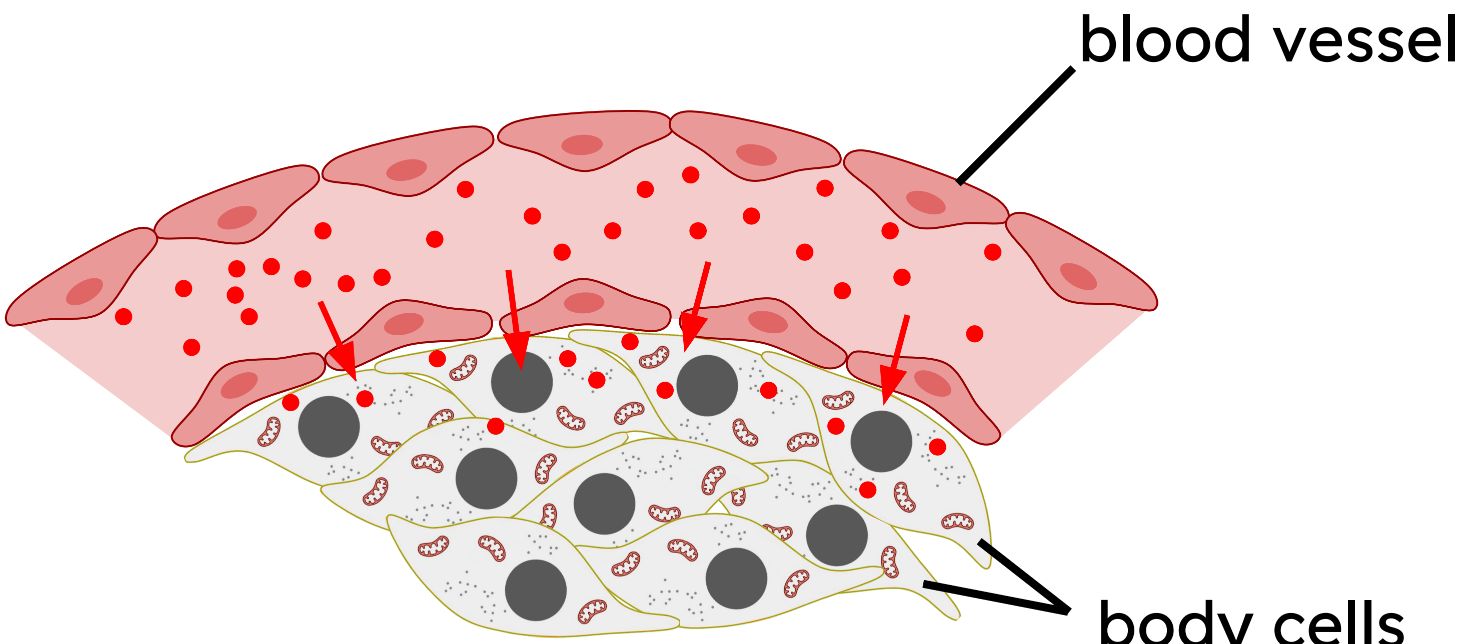
Explanation

Particles of oxygen from the air sac diffuse into the blood.

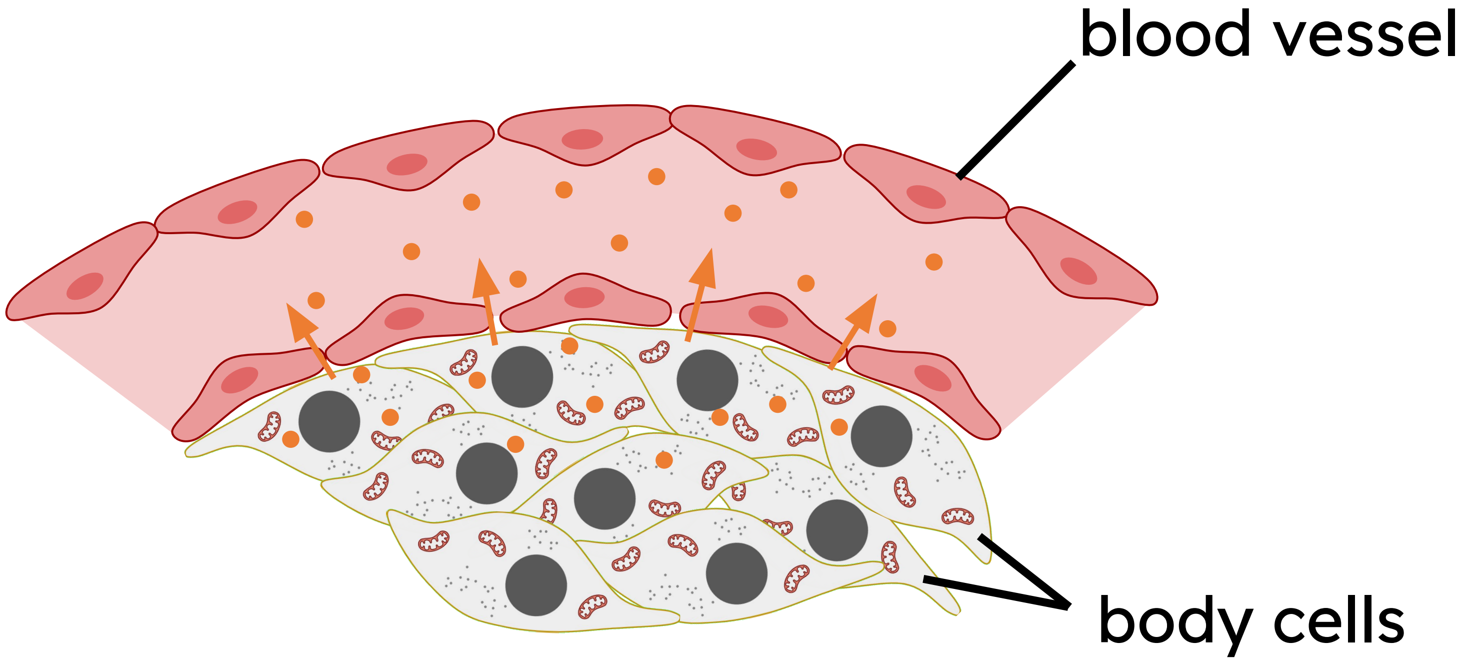


The oxygen is transported around the body by the blood.

Oxygen from the blood diffuses into cells and is used for **cellular respiration**.

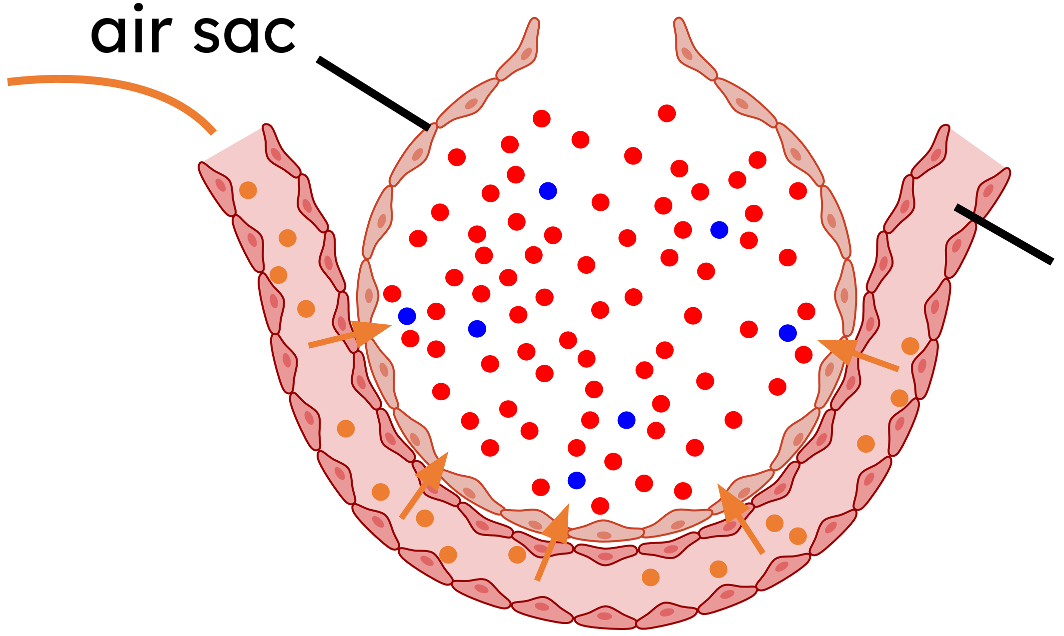


Carbon dioxide is formed in the **mitochondria** of cells during **cellular respiration**.



The carbon dioxide diffuses out of the cells and into the blood.

This carbon dioxide is brought back to the air sacs in the lungs by the blood.



The carbon dioxide diffuses into the air sacs and is breathed out by the lungs.

Gas exchange

Check

respiration

breathing

gas exchange

The process of oxygen diffusing from the lungs into the blood, and carbon dioxide diffusing from the blood into the lungs.

A chemical process in the mitochondria of cells that provides energy for life processes.

The process in which air is moved in and out of the lungs.

Lesson outline

The human gas exchange system and breathing

- The gas exchange system
- Pressure, volume and breathing

The gas exchange system

Explanation

Humans, other animals, plants and fungi need oxygen from the air to stay alive.

They need oxygen for cellular respiration in mitochondria, in their cells.

But not all organisms breathe.

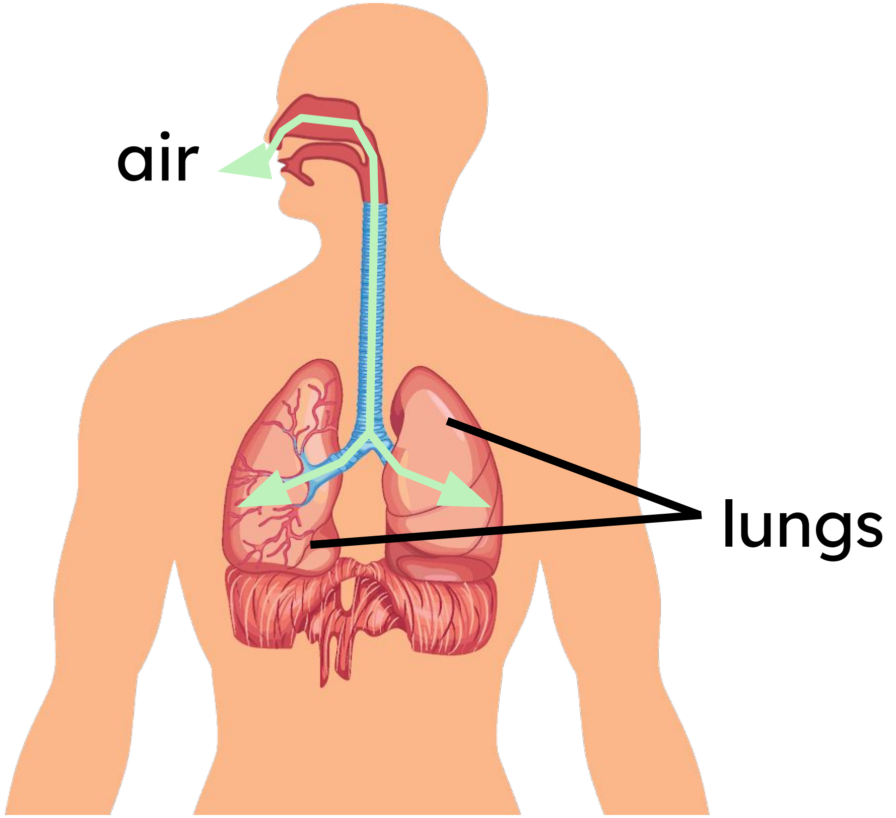
Humans and some other animals breathe to take in oxygen from the air.

The gas exchange system

Explanation

Breathing involves the lungs.

When we breathe, air is moved in and out of the lungs.

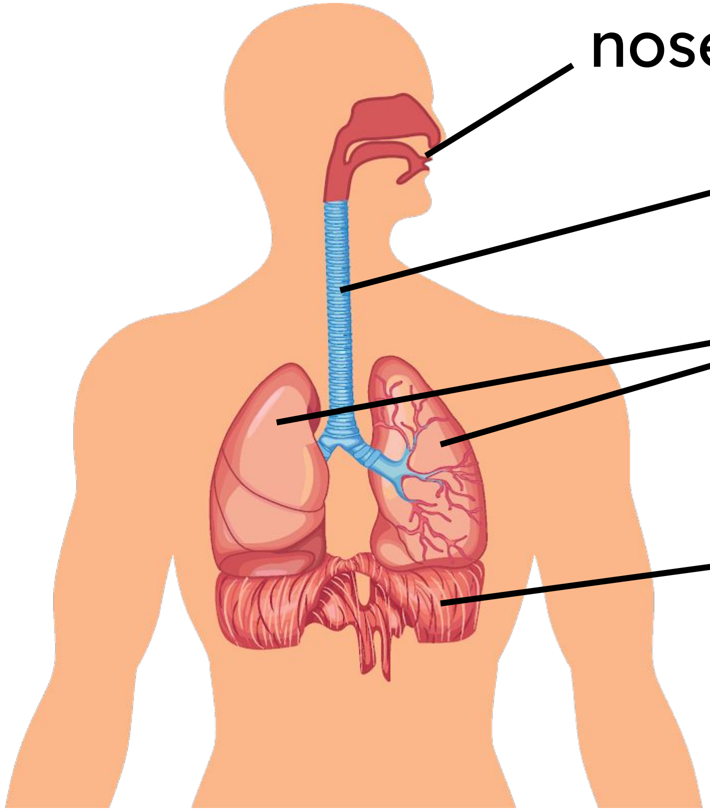


However, it isn’t just the lungs that are involved in breathing!

The gas exchange system

Explanation

Many parts of our **gas exchange system** work together to enable us to breathe.



nose and mouth
trachea } form a passageway for air to move in and out of the lungs

lungs - a pair of organs in humans and some other animals

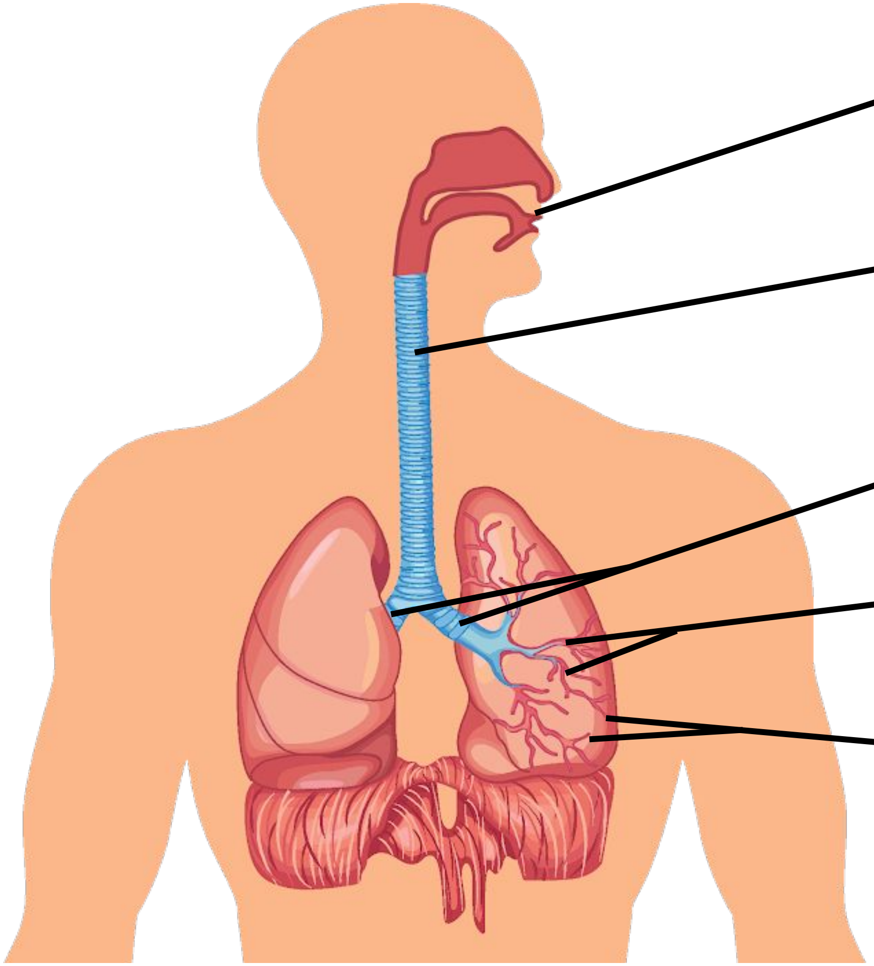
diaphragm - a sheet of muscle underneath the lungs which contracts and relaxes to help move air in and out of the lungs

Which structure is **not** part of the human gas exchange system?

- **a** diaphragm
- **b** heart ✓
- **c** lungs
- **d** trachea

The gas exchange system

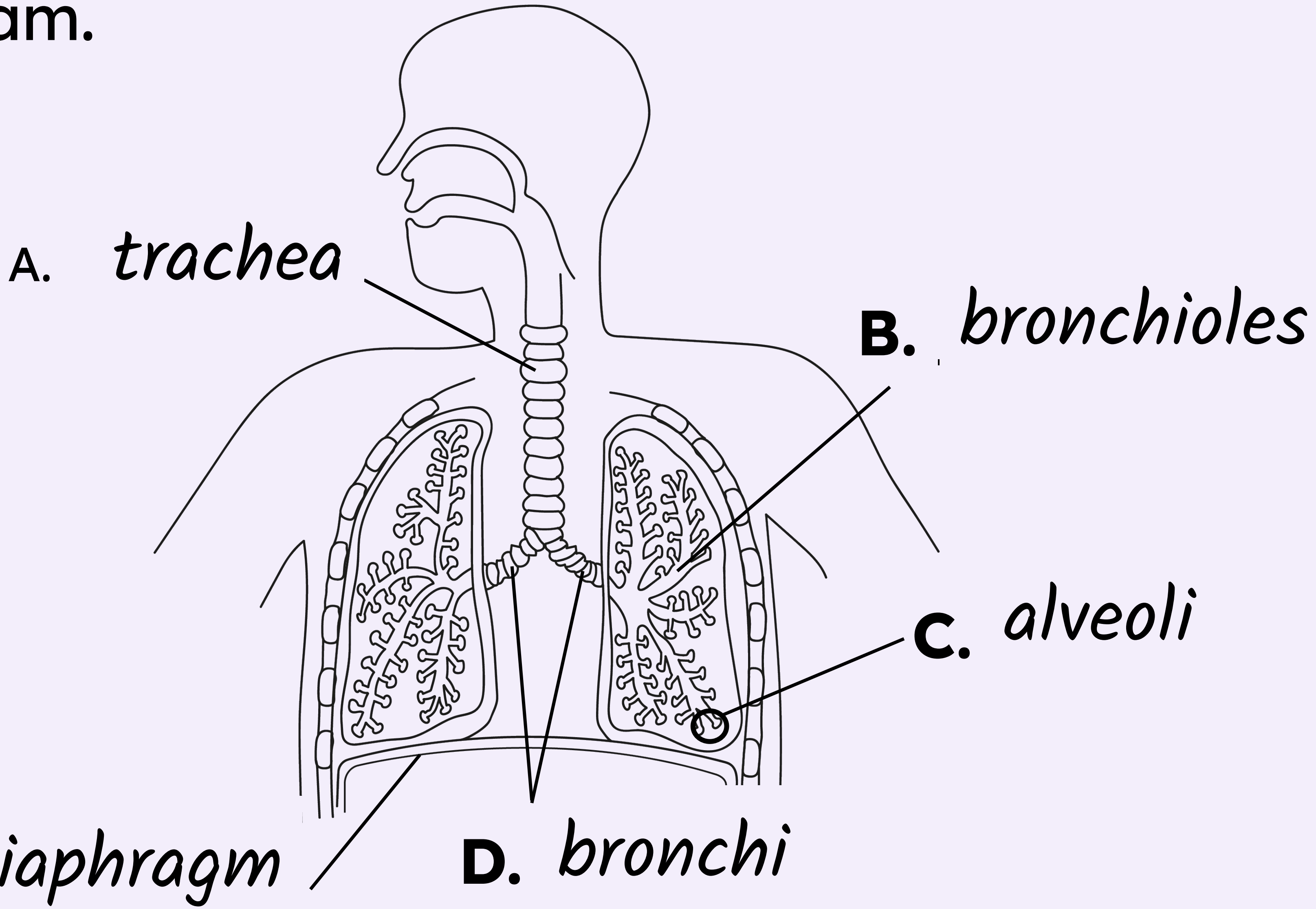
When we breathe in, air flows through the following structures:



The gas exchange system

Check

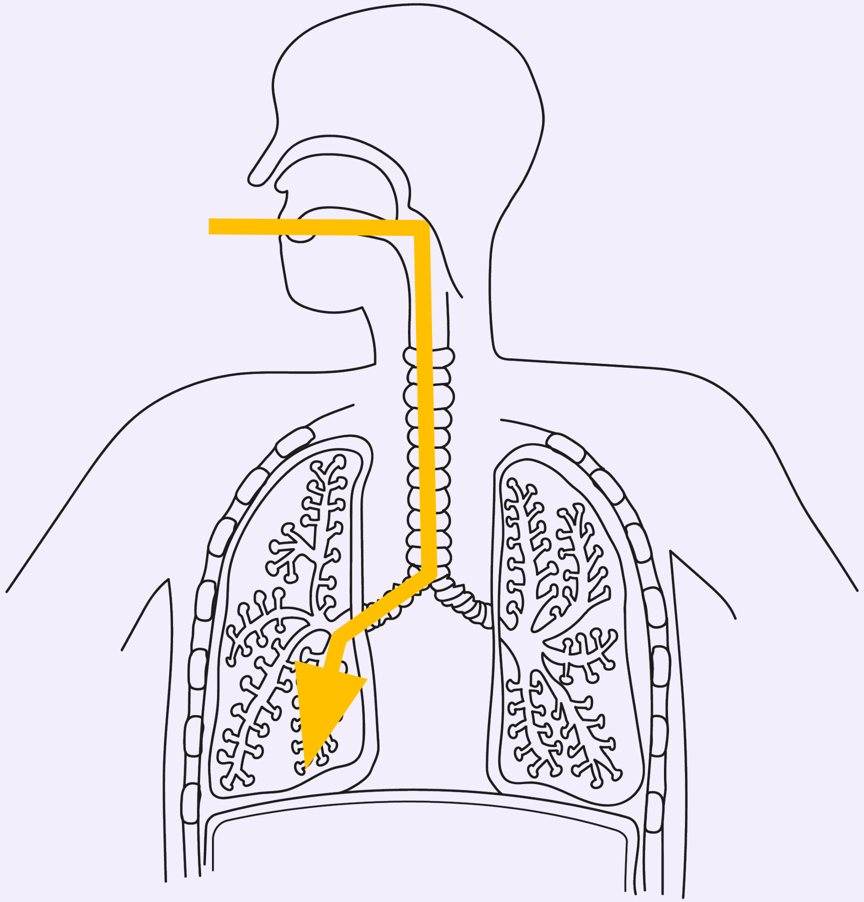
Label the diagram.



Check

Starting with the mouth, sort these structures into the order that air passes through them when we breathe in.

1. *mouth*
2. *trachea*
3. *bronchi*
4. *bronchioles*
5. *alveoli*



Lesson outline

The human gas exchange system and breathing

- The gas exchange system
- Pressure, volume and breathing

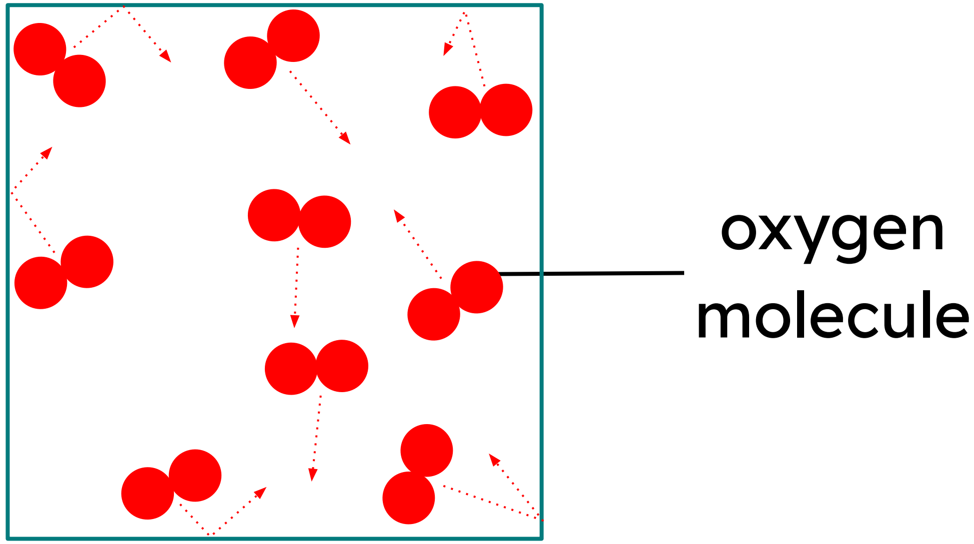
Pressure, volume and breathing

To understand how breathing occurs, we need to think about **pressure** and **volume**.

Imagine a box filled with oxygen gas.

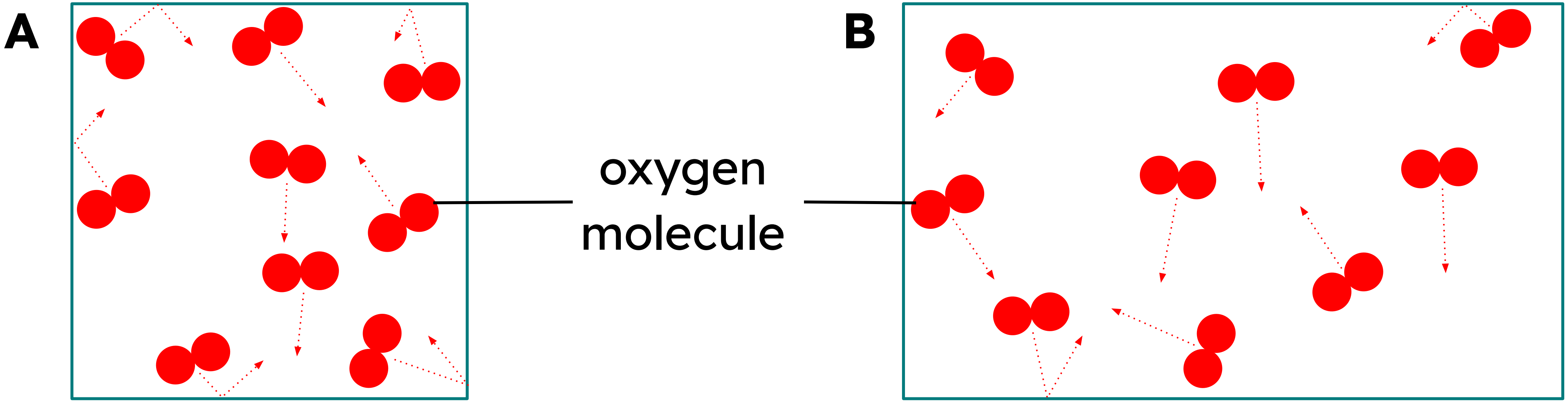
The oxygen molecules in the box move around randomly.

They collide with the walls of the box, and this creates **pressure**.



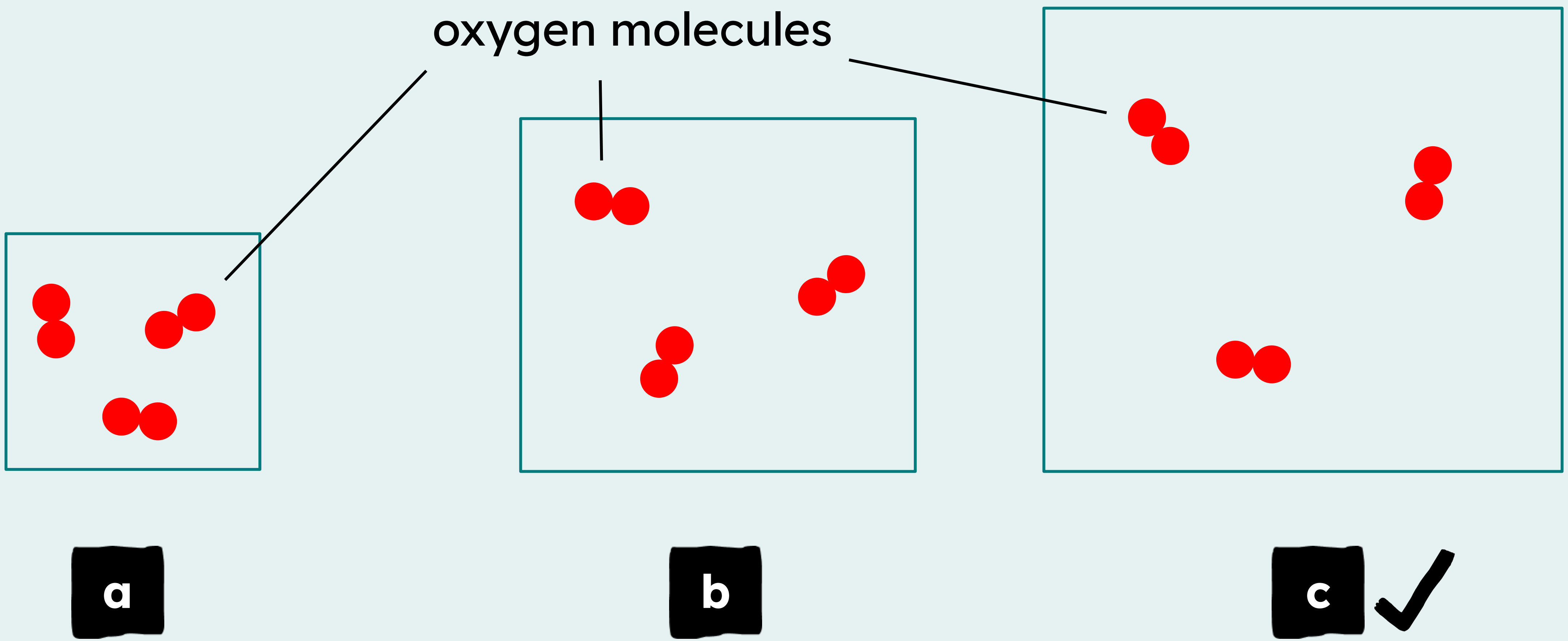
Box B has a larger **volume** than Box A, but contains the same amount of oxygen gas.

In Box B, the molecules have more space to move around so collide with the walls less often. So the **pressure** inside the box is lower.



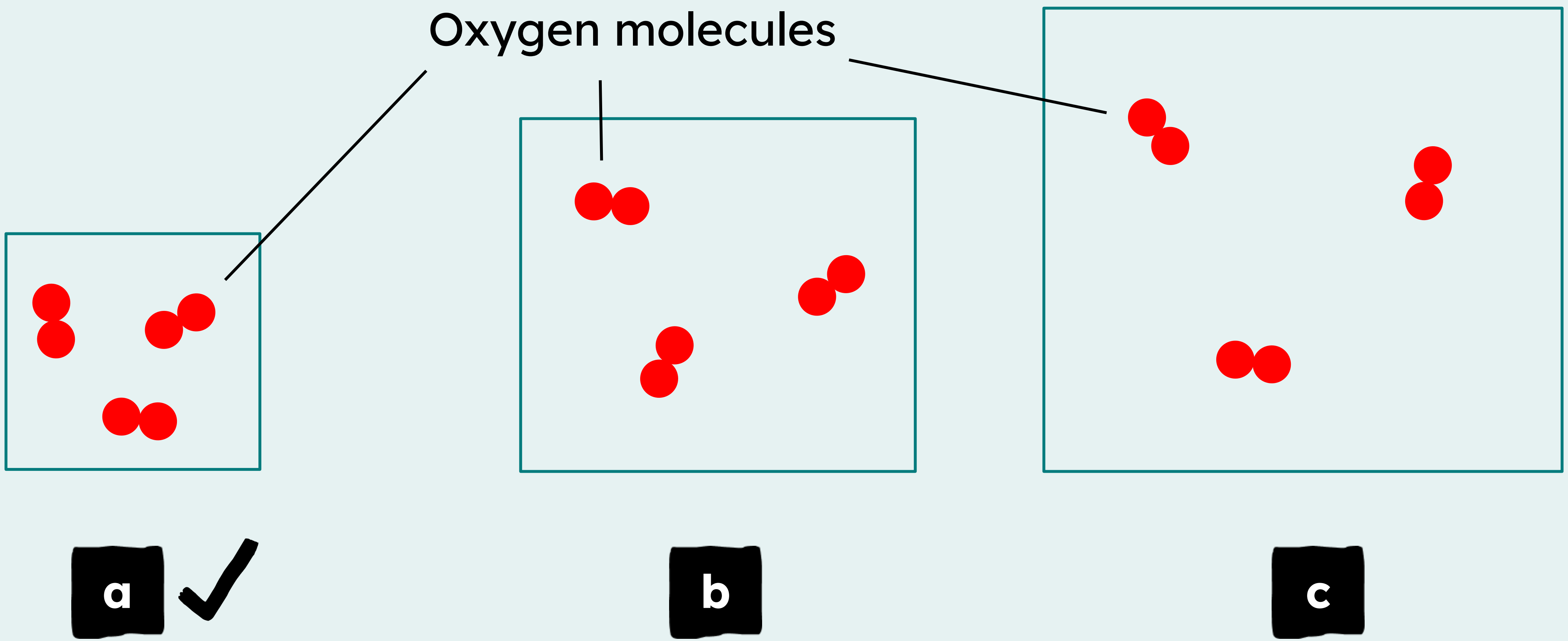
Check

Which box has the largest volume?



Check

Which box has the highest pressure?

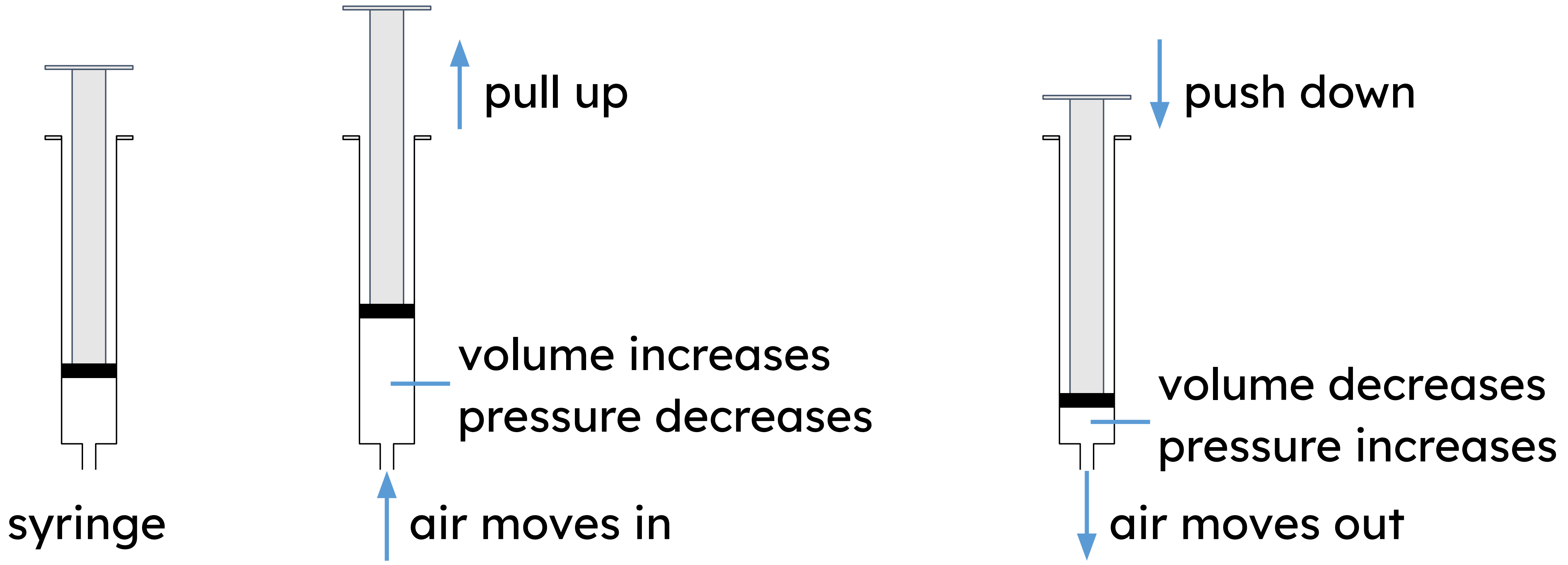


Pressure, volume and breathing

Explanation

If air can move into and out of a container, it will:

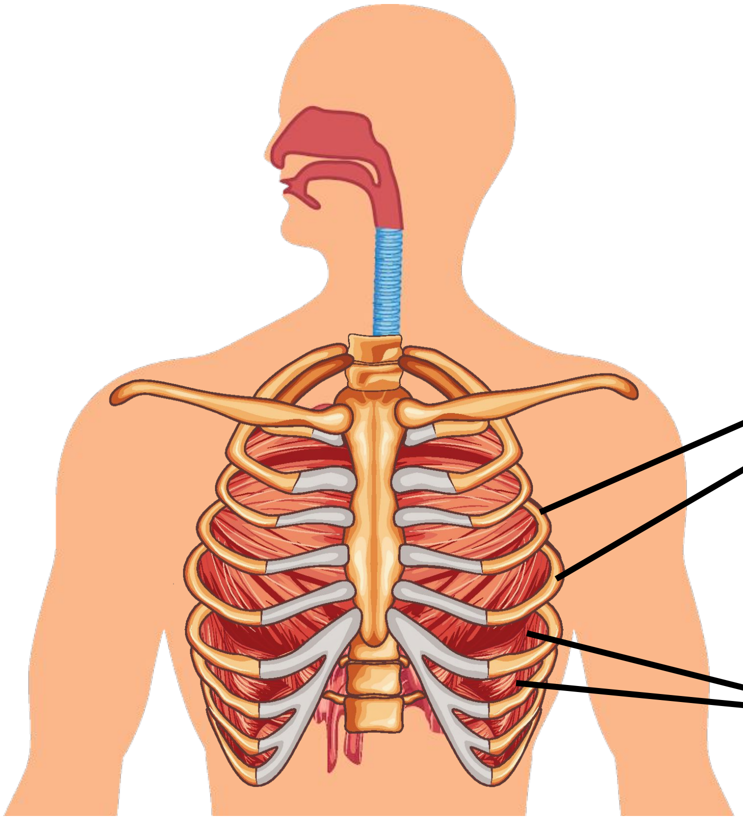
- move **in** when the pressure inside is **lower**
- move **out** when the pressure inside is **higher**.



Pressure, volume and breathing

Explanation

When we breathe, muscles and bones move to change the volume and pressure inside the chest.



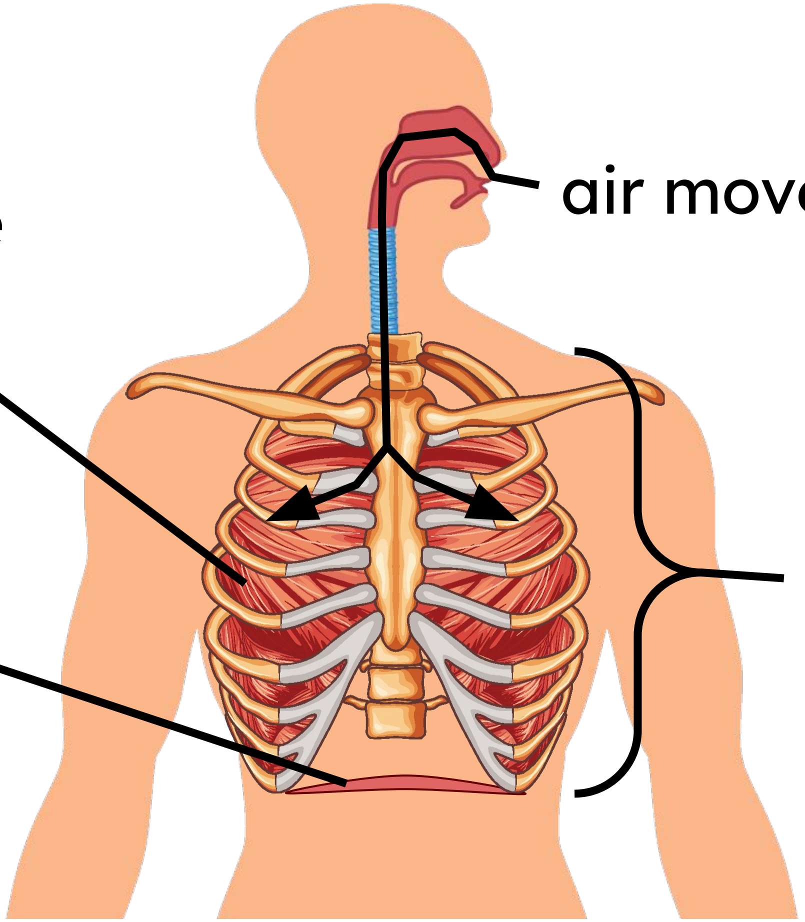
ribs - rib bones form a structure called the ribcage around the lungs

intercostal muscles - muscles between the ribs, which can contract and relax

Breathing in is called **inhalation**.

The intercostal muscles contract, which pulls the ribcage upwards and outwards.

The diaphragm contracts and flattens.



air moves in

volume increases
pressure decreases

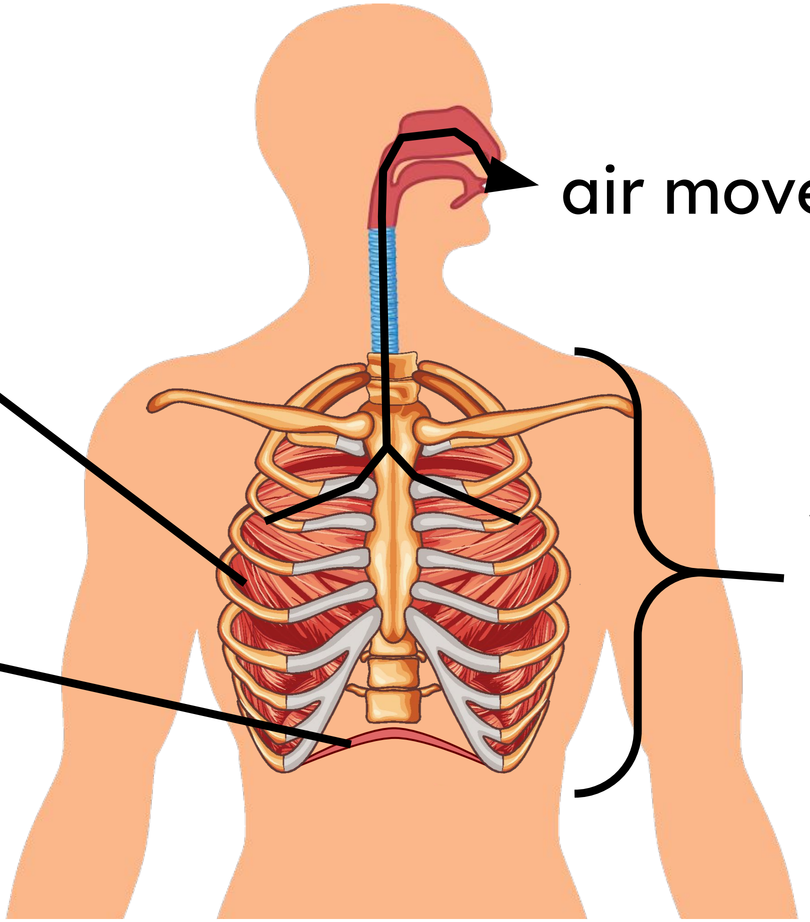
Pressure, volume and breathing

Explanation

Breathing out is called **exhalation**.

The intercostal muscles relax, and the ribcage moves downwards and inwards.

The diaphragm relaxes and curves up.



air moves out

volume decreases
pressure increases

Pressure, volume and breathing

Check

Sort these statements about **inhalation** into the correct order.

The first one has been done for you:

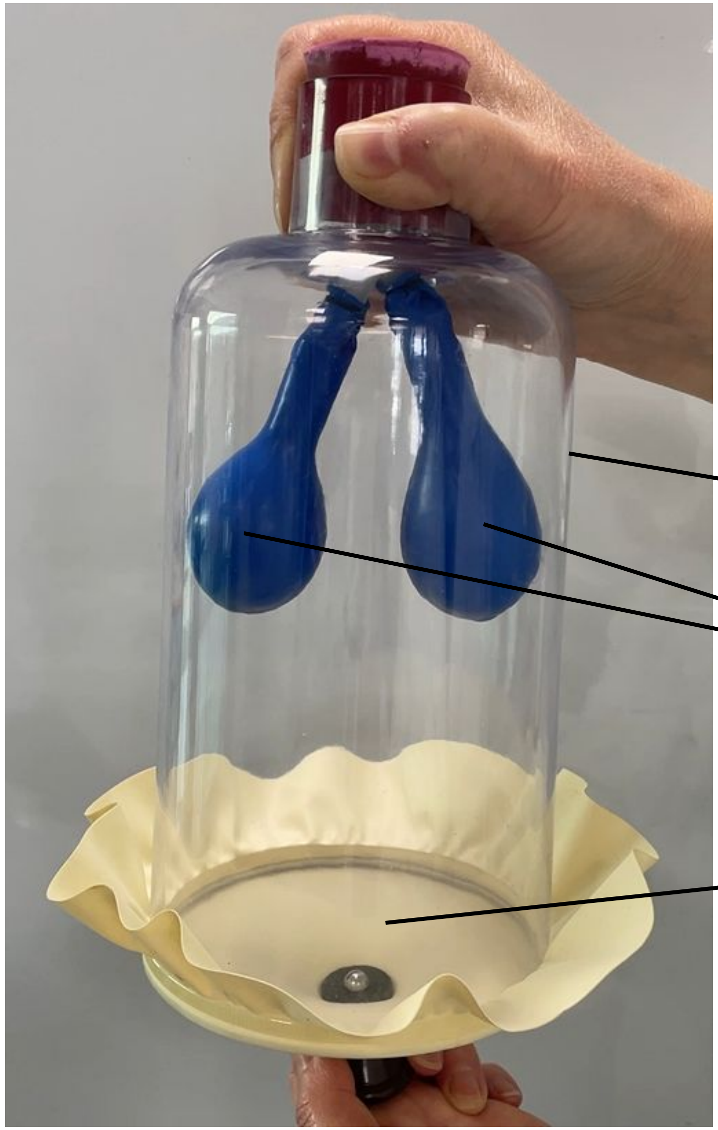
1. *The intercostal muscles contract.*

- The diaphragm also contracts and flattens.
- This decreases the pressure in the lungs.
- This pulls the rib cage up and out.
- Air is drawn into the lungs.
- The volume of the lungs increases.

Sort these statements about **inhalation** into the correct order.

The first one has been done for you:

1. *The intercostal muscles contract.*
2. *This pulls the rib cage up and out.*
3. *The diaphragm also contracts and flattens.*
4. *The volume of the lungs increases.*
5. *This decreases the pressure in the lungs.*
6. *Air is drawn into the lungs.*



This apparatus is a model of the changes that occur in the chest during inhalation and exhalation.

bell jar - represents the ribcage

balloons - represent the lungs

rubber sheet - represents the diaphragm

Pressure, volume and breathing

Explanation

Inhalation

- The **rubber sheet** is pulled down
- This represents the diaphragm contracting
- This increases the volume, and decreases the pressure
- The balloons inflate
- This represents air moving into the lungs

Exhalation

- The **rubber sheet** is pushed up
- This represents the diaphragm relaxing
- This decreases the volume, and increases the pressure
- The balloons deflate
- This represents air moving out of the lungs

Check

What does the rubber sheet represent in the bell jar model of breathing?

a Diaphragm ✓

b Lungs

c Ribs

Keywords

volume The amount of three-dimensional space occupied by a substance; usually measured in cm^3.

vital capacity The maximum volume of air that can be breathed out after breathing in fully.

accurate The closer a measurement is to the true value, the more accurate it is said to be.

meniscus The surface of a liquid, which may appear curved.

estimate An approximate (rough) value of a quantity (obtained without taking accurate measurements).

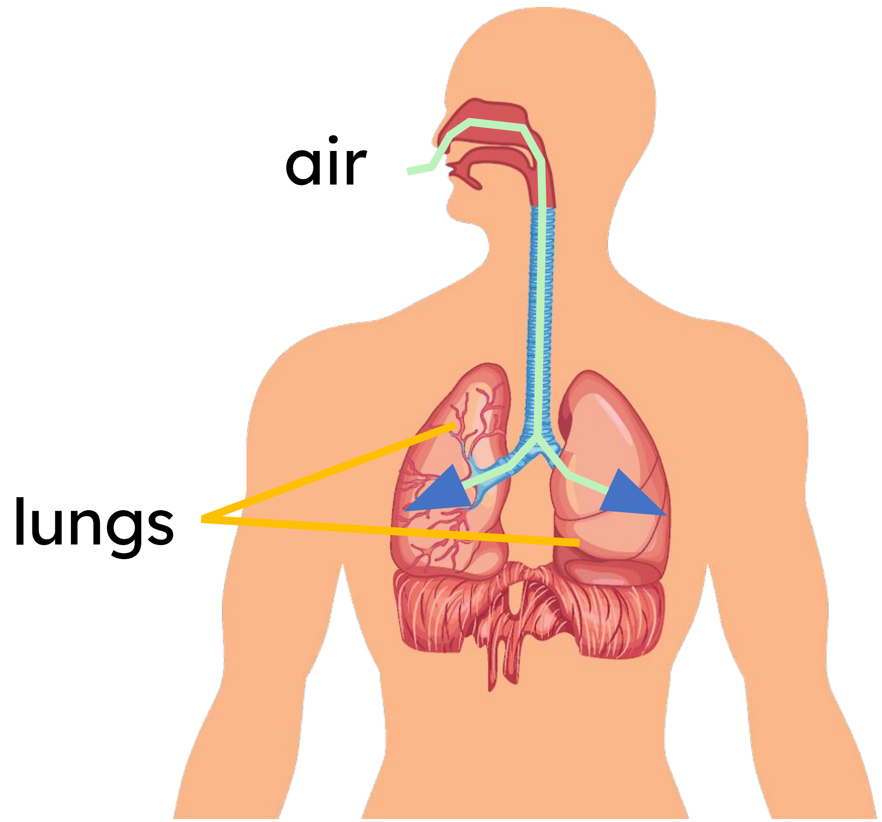
Lesson outline

Estimating lung volume

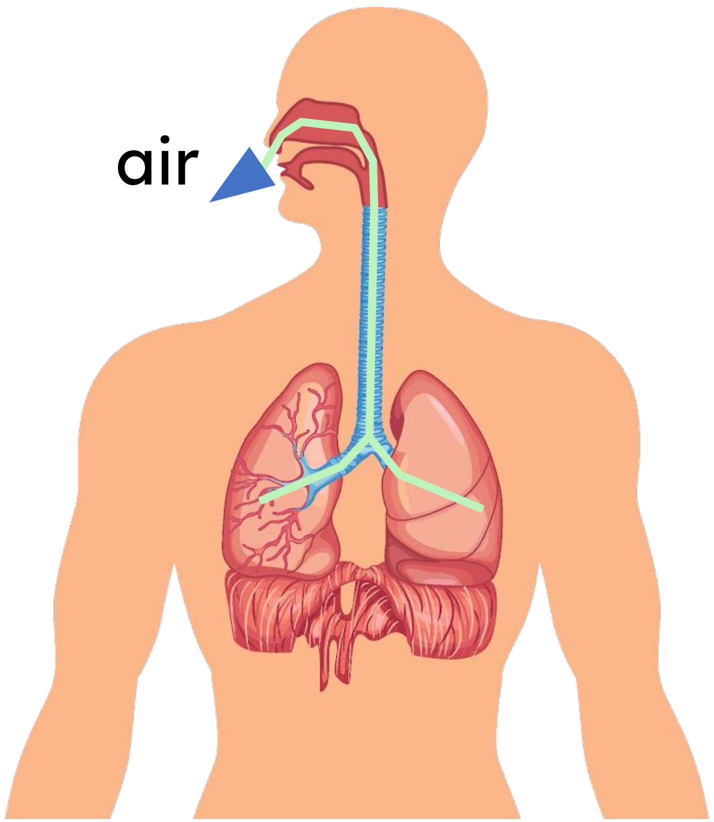
- Apparatus for measuring vital capacity
- Simple measurement of vital capacity
- Estimating lung volume

Apparatus for measuring vital capacity

Explanation



When we inhale (breathe in), air is moved into our lungs.



When we exhale (breathe out), air is moved out of our lungs.

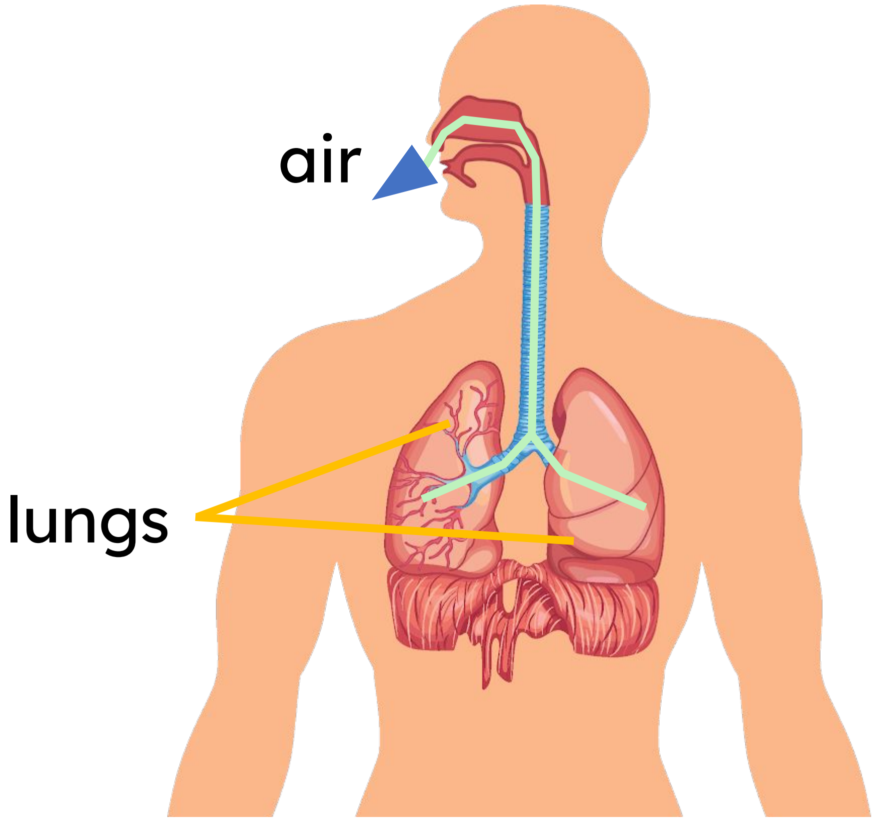
Apparatus for measuring vital capacity

Explanation

When we exhale, most of the air is moved out of the lungs, but some stays behind.

The maximum **volume** of air you can breathe out after breathing in fully is called your **vital capacity**.

Vital capacity is affected by several factors such as a person’s age, activity levels and whether they smoke or have asthma.



Apparatus for measuring vital capacity

Check

Vital capacity is the maximum volume of air that…

a …the lungs can hold.

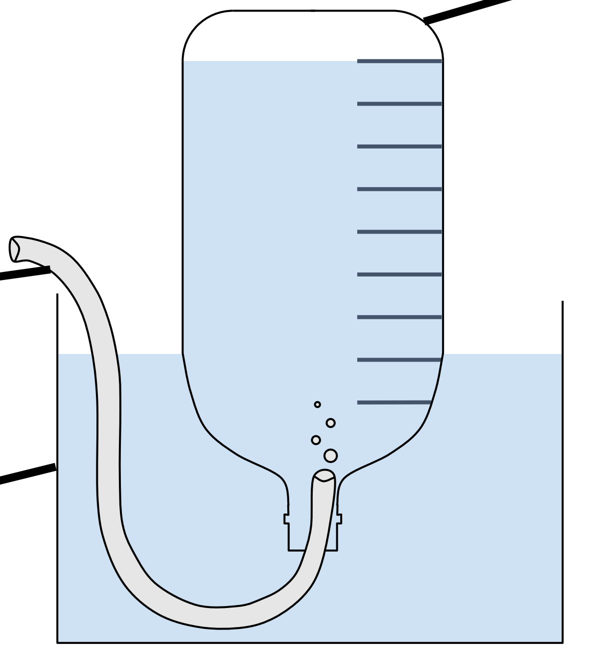
b ….can be exhaled after inhaling fully. ✓

c …. can be inhaled by the lungs.

Apparatus for measuring vital capacity

Explanation

You can measure your vital capacity using simple apparatus:

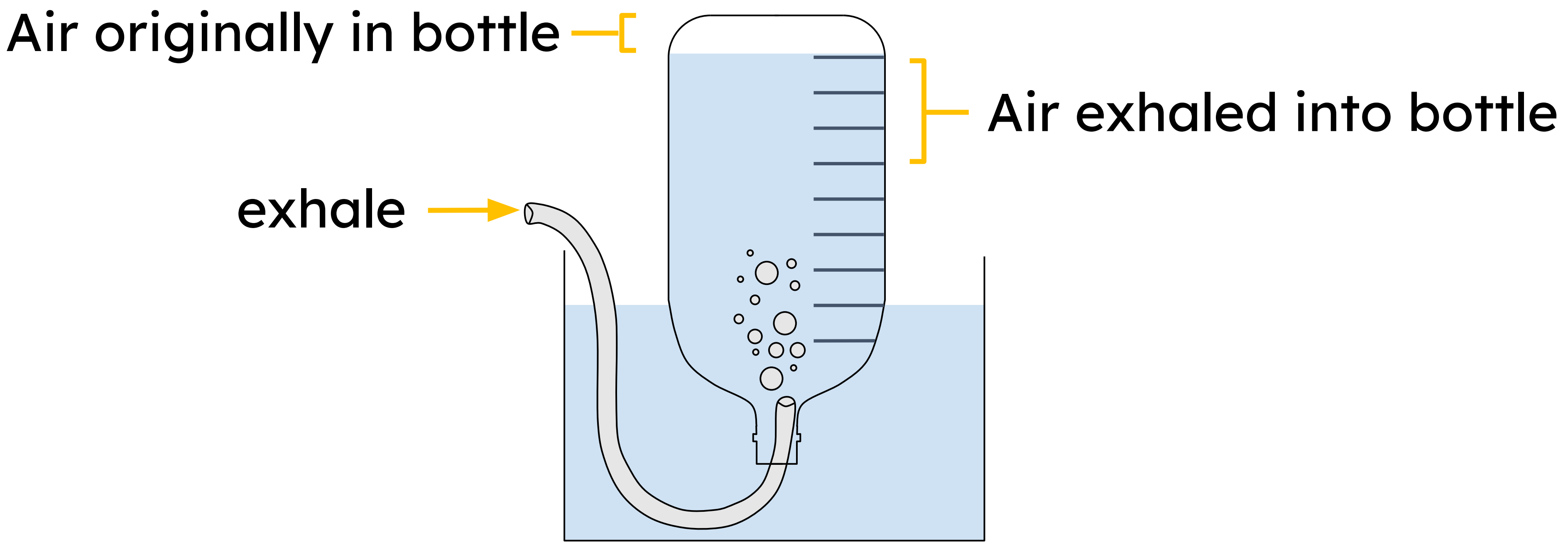


Apparatus for measuring vital capacity

Explanation

Exhaling into the tube moves air from your lungs into the bottle.

This displaces some of the water from the bottle into the tank.

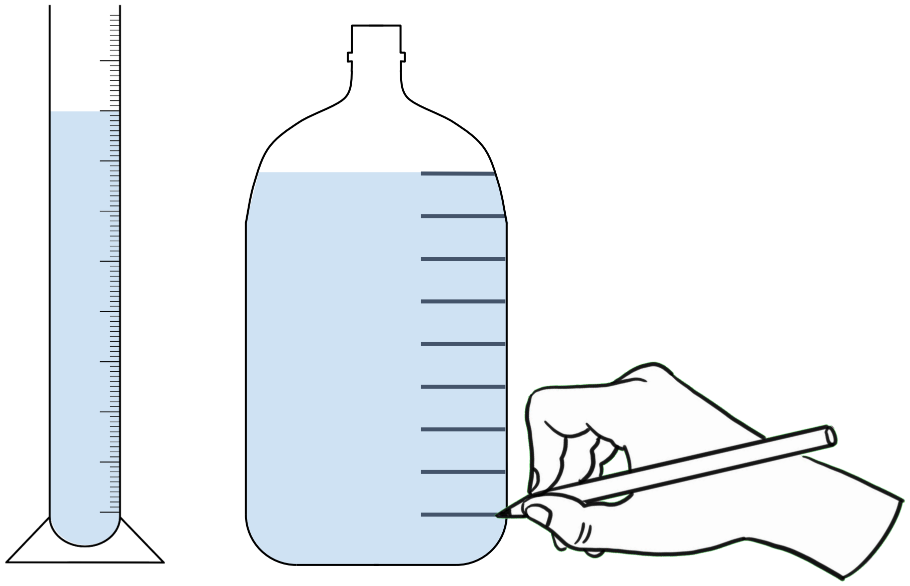


Apparatus for measuring vital capacity

Explanation

Instructions for setting up the apparatus:

1. Measure 200 cm^3 of water in a measuring cylinder.
2. Pour the 200 cm^3 of water into a 5 litre (5 l) bottle.
3. Mark the water level on the outside of the bottle with a permanent marker.
4. Repeat steps 1, 2 and 3 until the bottle is almost filled with water.



Apparatus for measuring vital capacity

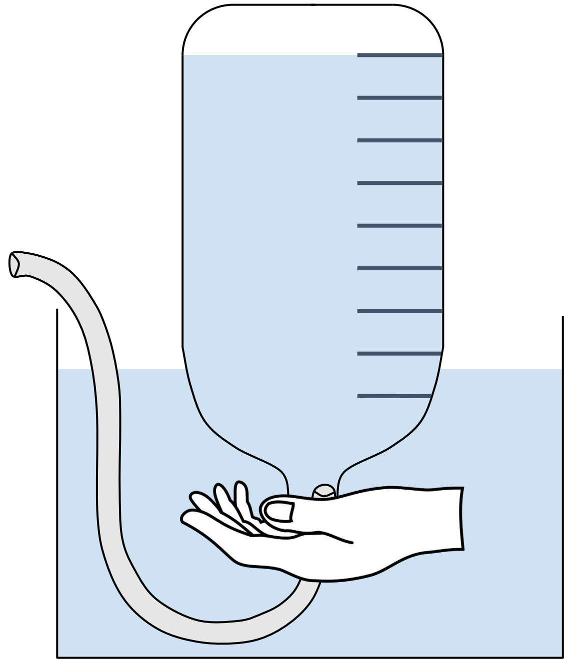
Explanation

5. Cover the open end of the bottle and then turn the bottle upside down.

   Be careful not to spill any of the water!

6. Place the bottle in a tank of water, with the open end of the bottle under the water.

7. Insert one end of the plastic tube into the bottle. Leave the other end outside the water.



Apparatus for measuring vital capacity

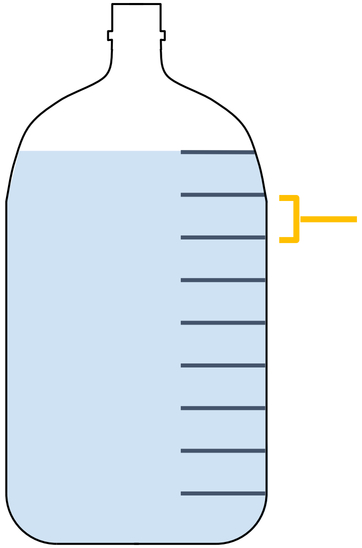
Check

Put the steps in the correct order to set up the apparatus.

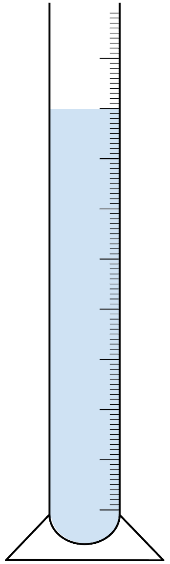
a	Place the bottle upside down in a tank of water.	4
b	Pour 200 cm^3 of water into a large bottle.	2
c	Measure 200 cm^3 of water in a measuring cylinder.	1
d	Repeat and mark the level of each 200 cm^3 of water on the outside of the container.	3
e	Insert one end of a plastic tube into the bottle.	5

Apparatus for measuring vital capacity

Explanation



There is supposed to be 200 cm^3 of water between each line.



This will only be the case if the volume of water was measured accurately using the measuring cylinder.

The closer the volume is to the true value (200 cm^3), the more **accurate** the measurement is.

Check

What does accurate mean?

a. A measurement is close to the true value. ✓

b. A pipette was used to add the last bit of water carefully.

c. The measurement has been repeated.

Apparatus for measuring vital capacity

Explanation

To measure a volume of 200 cm^3 of liquid as accurately as possible using a measuring cylinder:

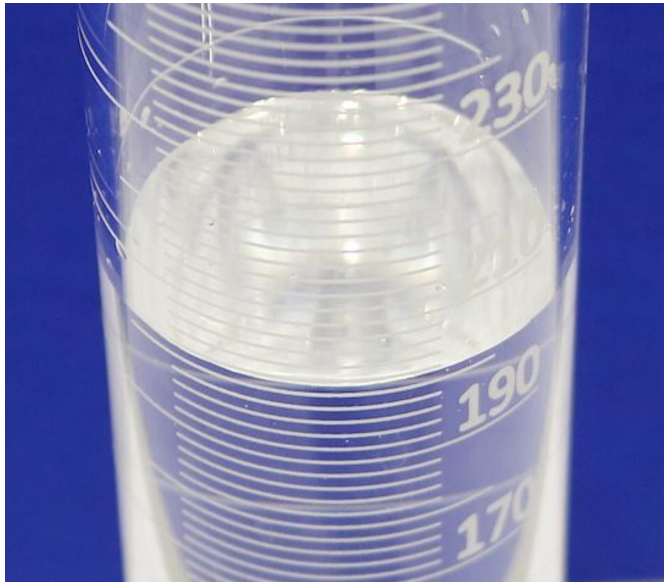
1. Look at the measuring cylinder from the side. Position your eye so it is level with the 200 cm^3 mark.
2. Use a beaker to pour water into the measuring cylinder until it almost reaches the 200 cm^3 mark.
3. Use a pipette to run water down the inside wall of the measuring cylinder until it reaches the 200 cm^3 mark.

Watch

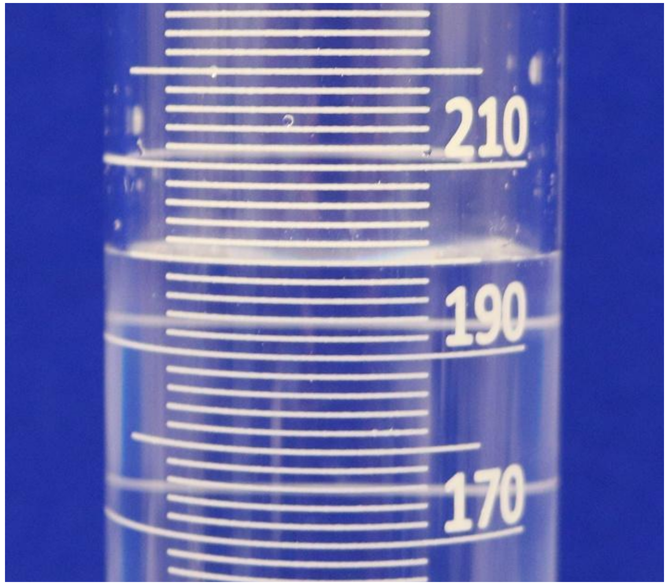
Apparatus for measuring vital capacity

Explanation

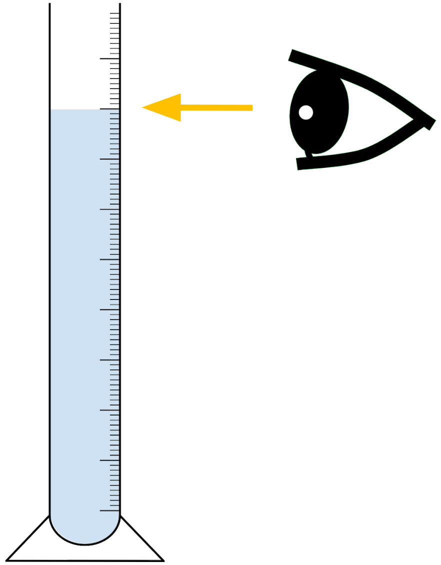
It is important to look at the measuring cylinder from the side and position your eye so it is level with the mark you want to fill it to.



Viewed from above, the **volume** of liquid appears to be slightly more than 200 cm^3.



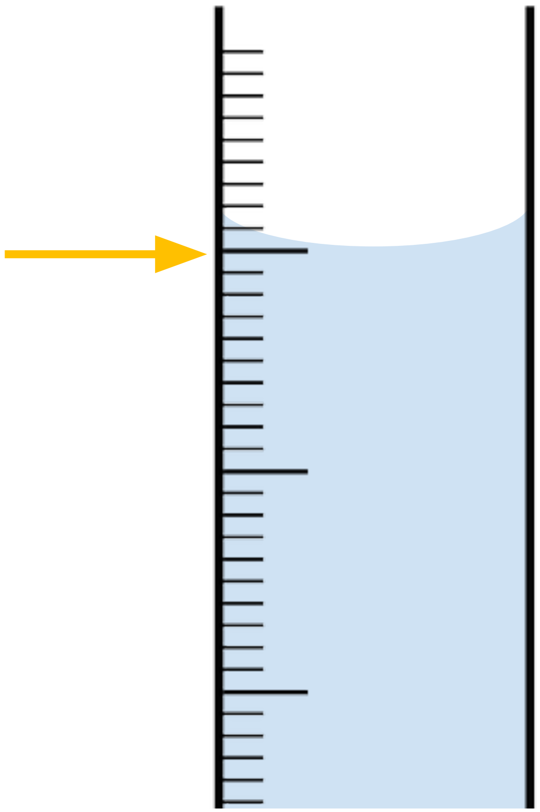
But when viewed from the side, we see that it is exactly on the 200 cm^3 mark.



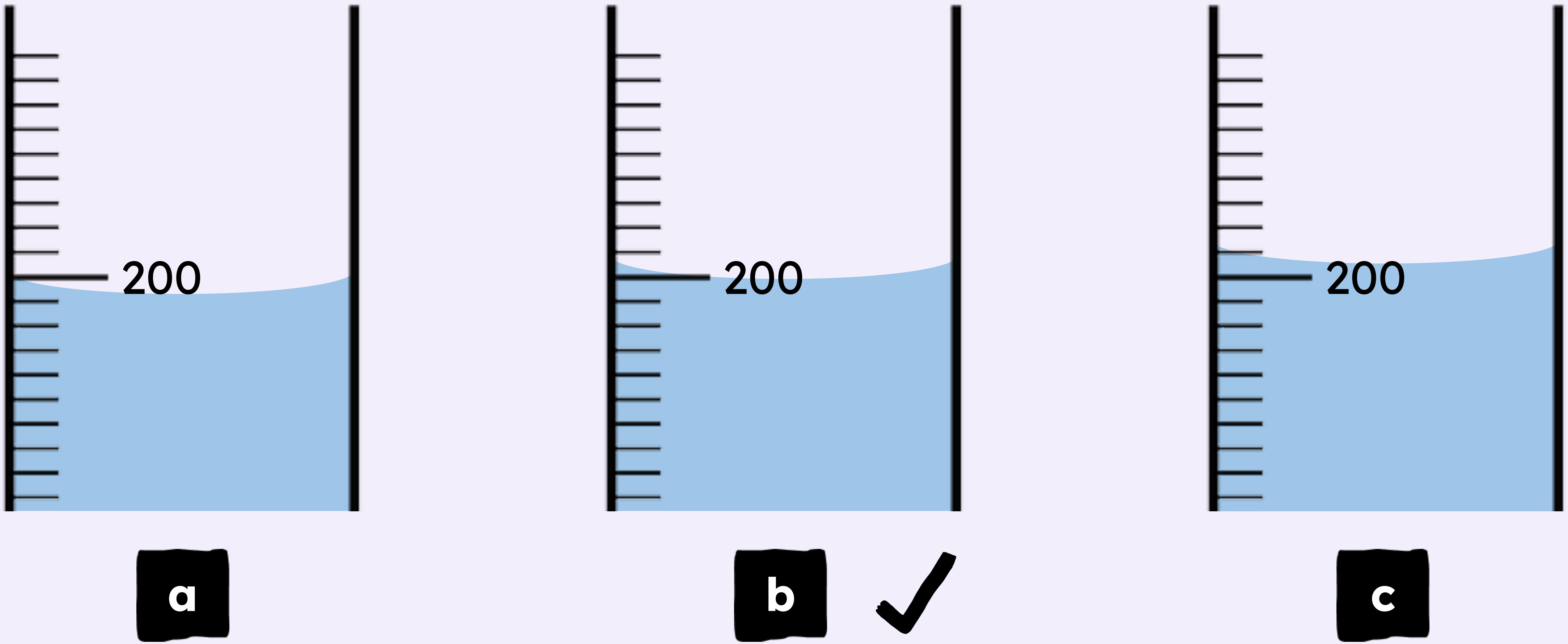
You might notice that the surface of the water in a measuring cylinder is curved.

This is called the **meniscus.**

We read the volume of the water from the bottom of the meniscus.



Which measuring cylinder contains 200 cm^3 of water?



Lesson outline

Estimating lung volume

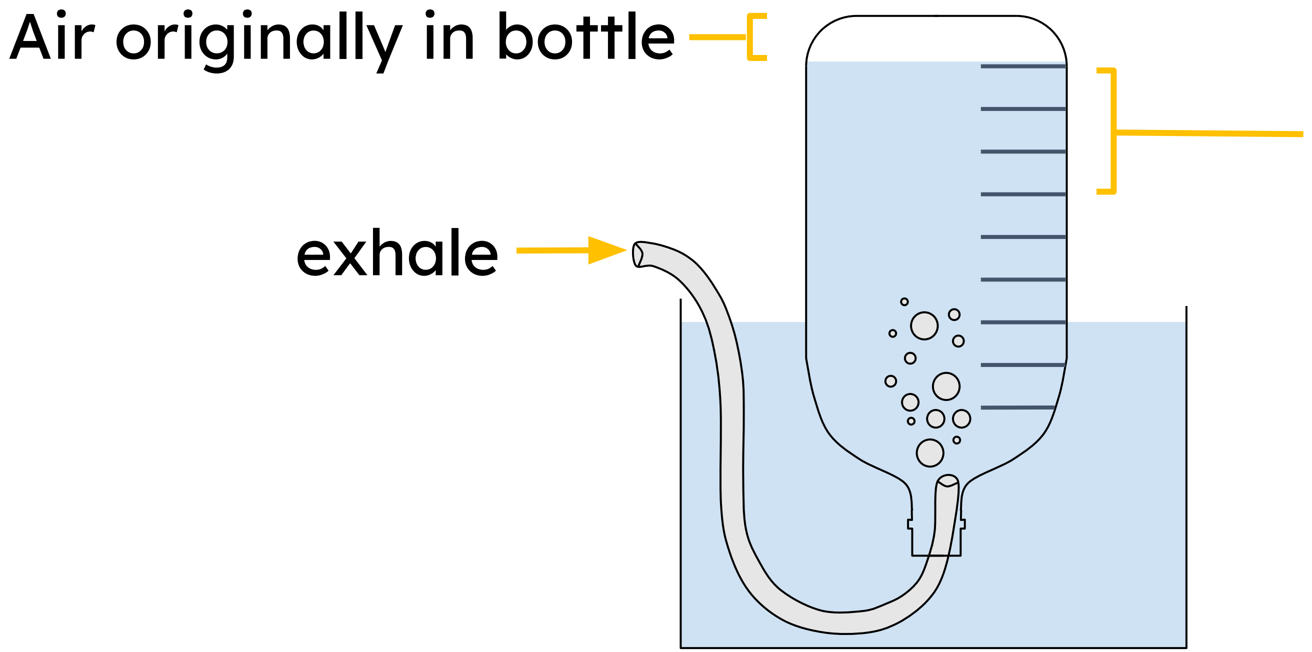
- Apparatus for measuring vital capacity
- Simple measurement of vital capacity
- Estimating vital capacity

Simple measurement of vital capacity

Explanation

To use the apparatus to measure vital capacity, start by noting which line the water level starts at.

Then exhale into the tube.



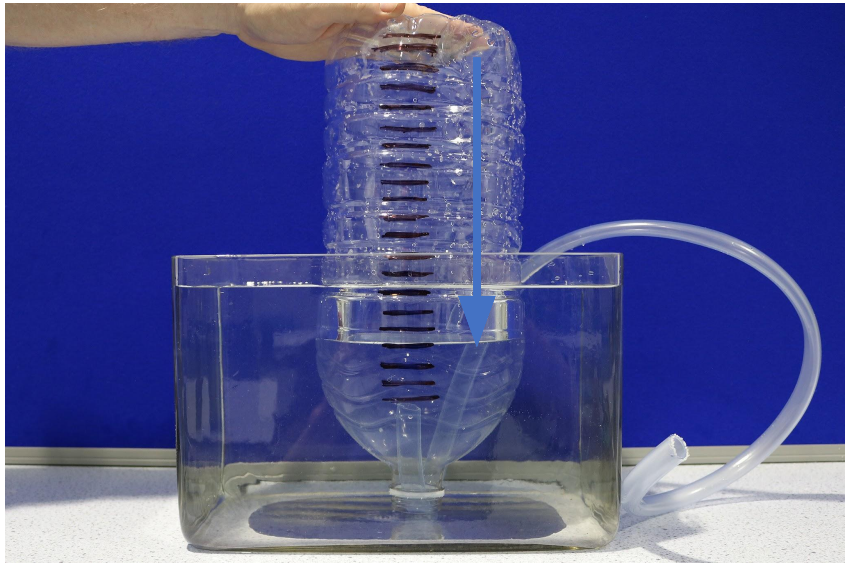
Count how many lines the water level has dropped by.

Each gap between the lines represents 200 cm^3.

Simple measurement of vital capacity

Using the apparatus to measure vital capacity:

1. Note which line the water level is at in the bottle.
2. Breathe in (inhale) as fully as you can.
3. Breathe out (exhale) into the tube as fully as you can.
4. Count how many lines the water level inside the bottle has fallen by.
5. Multiply the number of lines by 200 cm^3 to estimate your vital capacity.



Lesson outline

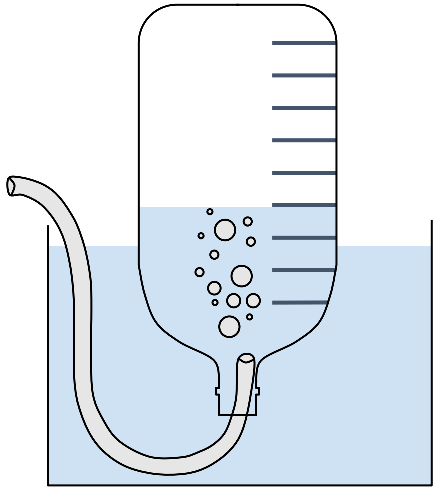
Estimating lung volume

- Apparatus for measuring vital capacity
- Simple measurement of vital capacity
- Estimating lung volume

Estimating lung volume

Explanation

Even if 200 cm^3 of water is measured accurately each time it is added into the bottle, the measurement of **vital capacity** may not be **accurate** (close to the true value).



Reasons for this include:

- The person may not have inhaled fully before exhaling into the tube.
- The person may not have exhaled fully into the tube.
- The lines indicating each 200 cm^3 may not have been marked accurately on the bottle.
- After exhaling, the water level might end up between two lines.

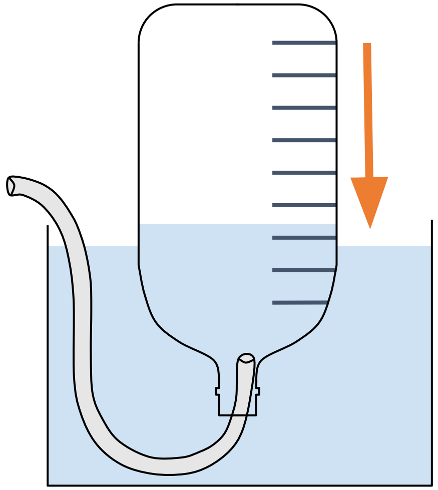
Estimating lung volume

When the water level ends up between two lines after exhaling, we have to either:

- decide which line it is closest to and calculate the volume to the nearest 200 cm^3 (e.g. 6 lines x 200 cm^3)

  or

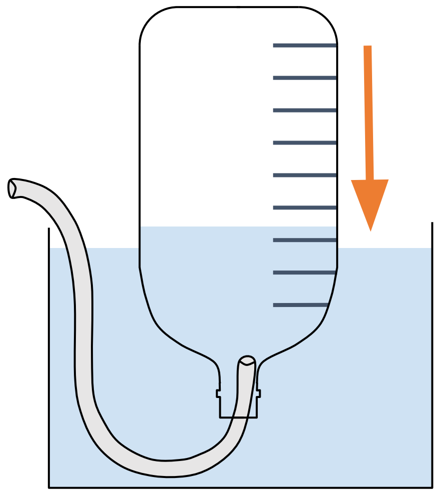
- use our judgement to decide how far between the lines it is and use a decimal to calculate the volume (e.g. 5.5 lines x 200 cm^3)



Estimating lung volume

All of these factors mean the measurement of vital capacity using this apparatus may not be accurate, it is an **estimate**.

An estimate is an approximate (rough) value of a quantity (obtained without taking accurate measurements).



We could get a better estimate by:

- measuring the water into the bottle in volumes smaller than 200 cm^3 and drawing the lines closer together
- repeating the procedure several times and calculating the mean (average) of the measurements. This reduces the effects of people not inhaling or exhaling fully during an attempt.

What is an estimate?

a an accurate measurement

b an approximate measurement ✓

c a guess

Estimating lung volume

Explanation

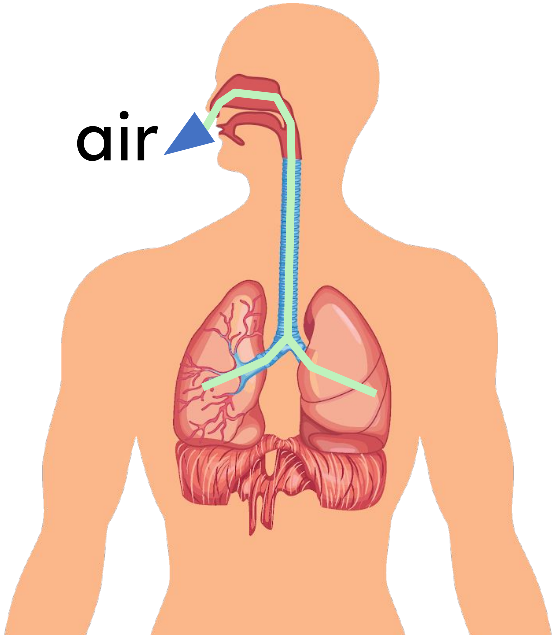
Not all of the air leaves our lungs when we exhale. Some stays behind to stop the lungs from collapsing.

Our **vital capacity** is usually around 80% of our lung **volume**.

So, we can use a measurement of vital capacity to produce an estimate of lung volume.

It will only be an estimate of lung volume because:

- the measurement of vital capacity was an estimate
- vital capacity might not be exactly 80% of lung volume.



Lesson outline

Adaptations of the human lungs for gas exchange

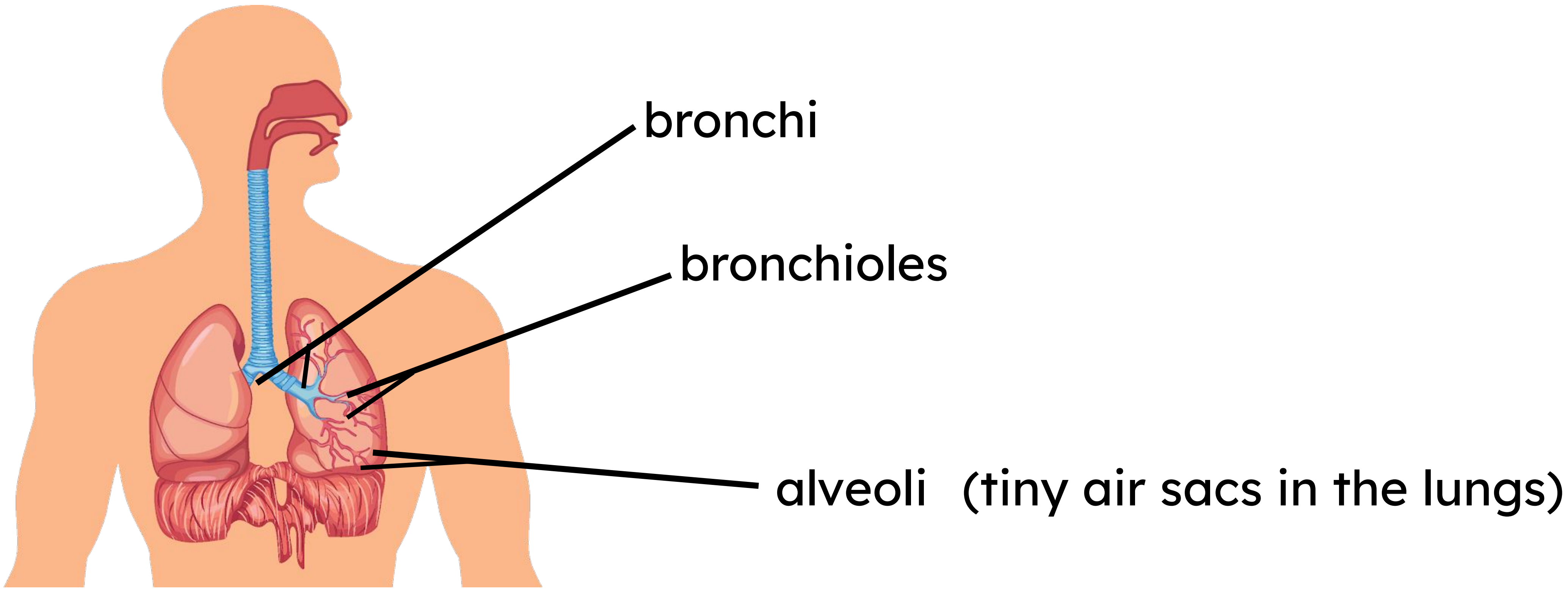
- The structure and function of an alveolus
- Adaptations of an alveolus

The structure and function of an alveolus

Explanation

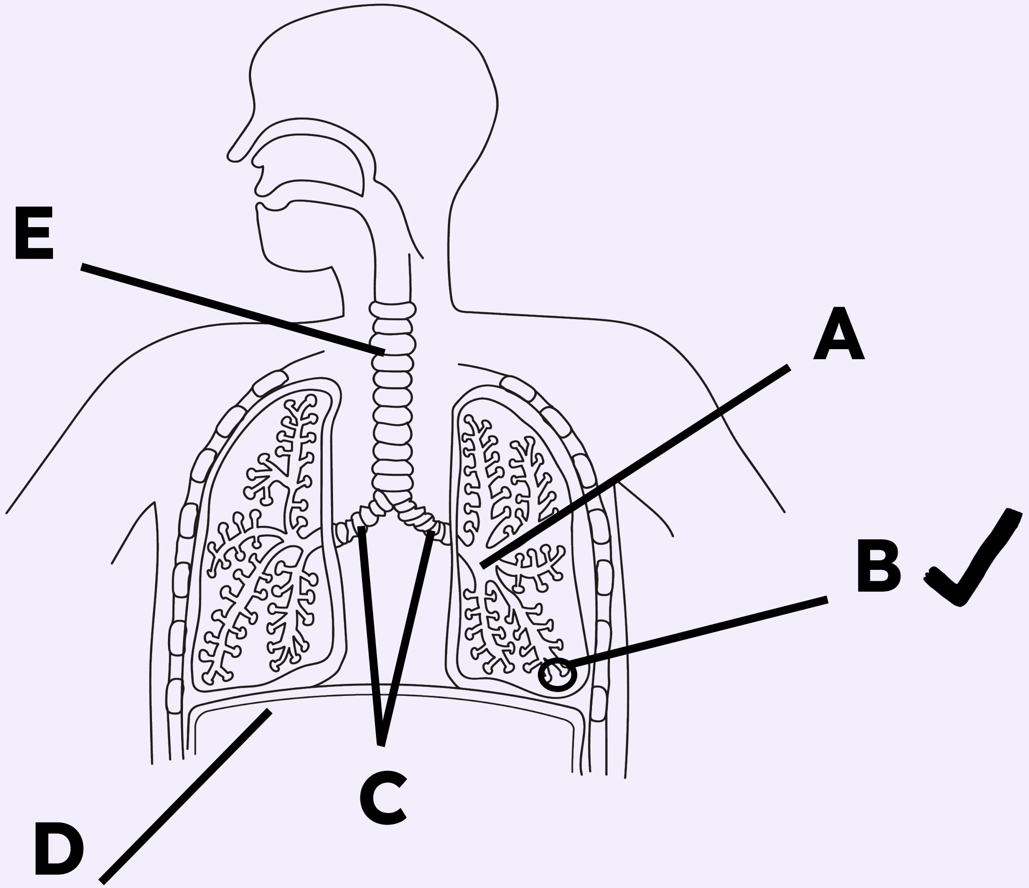
The lungs are involved with breathing, and they carry out gas exchange.

They are made up of many different parts.



The diagram shows the human gas exchange system.

Which letter shows the alveoli?

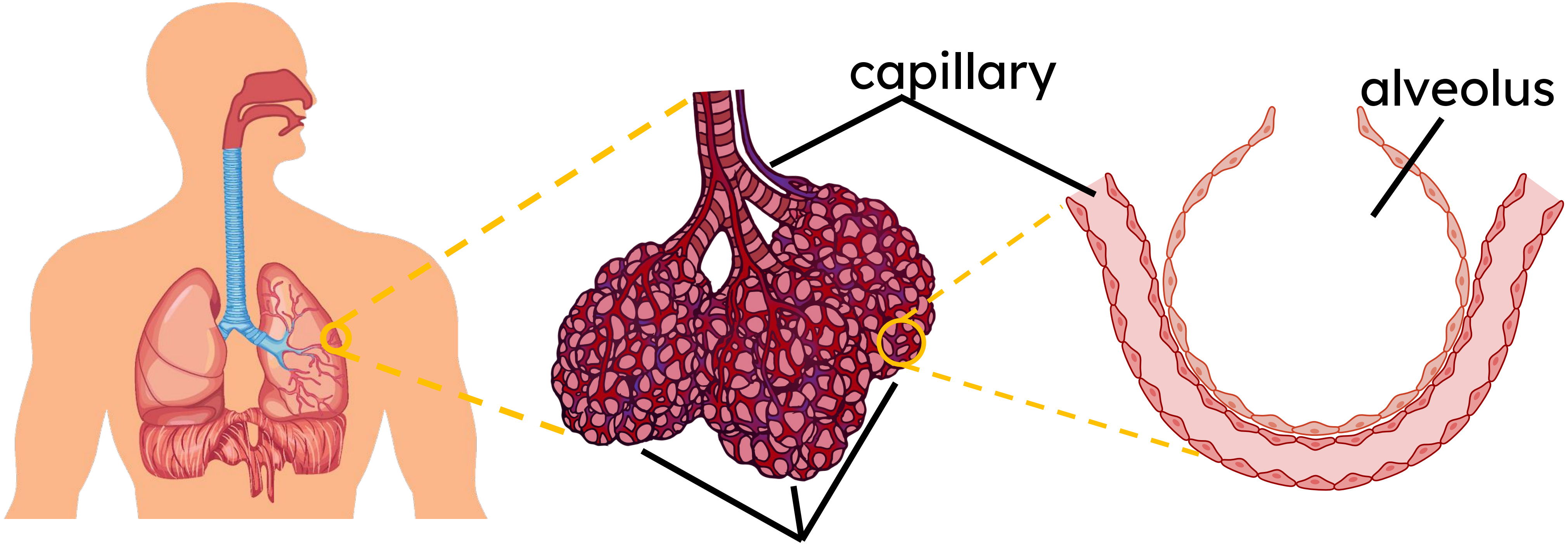


The structure and function of an alveolus

Explanation

Alveoli are tiny air sacs in the lungs that carry out gas exchange.

They are an important tissue in the lungs.

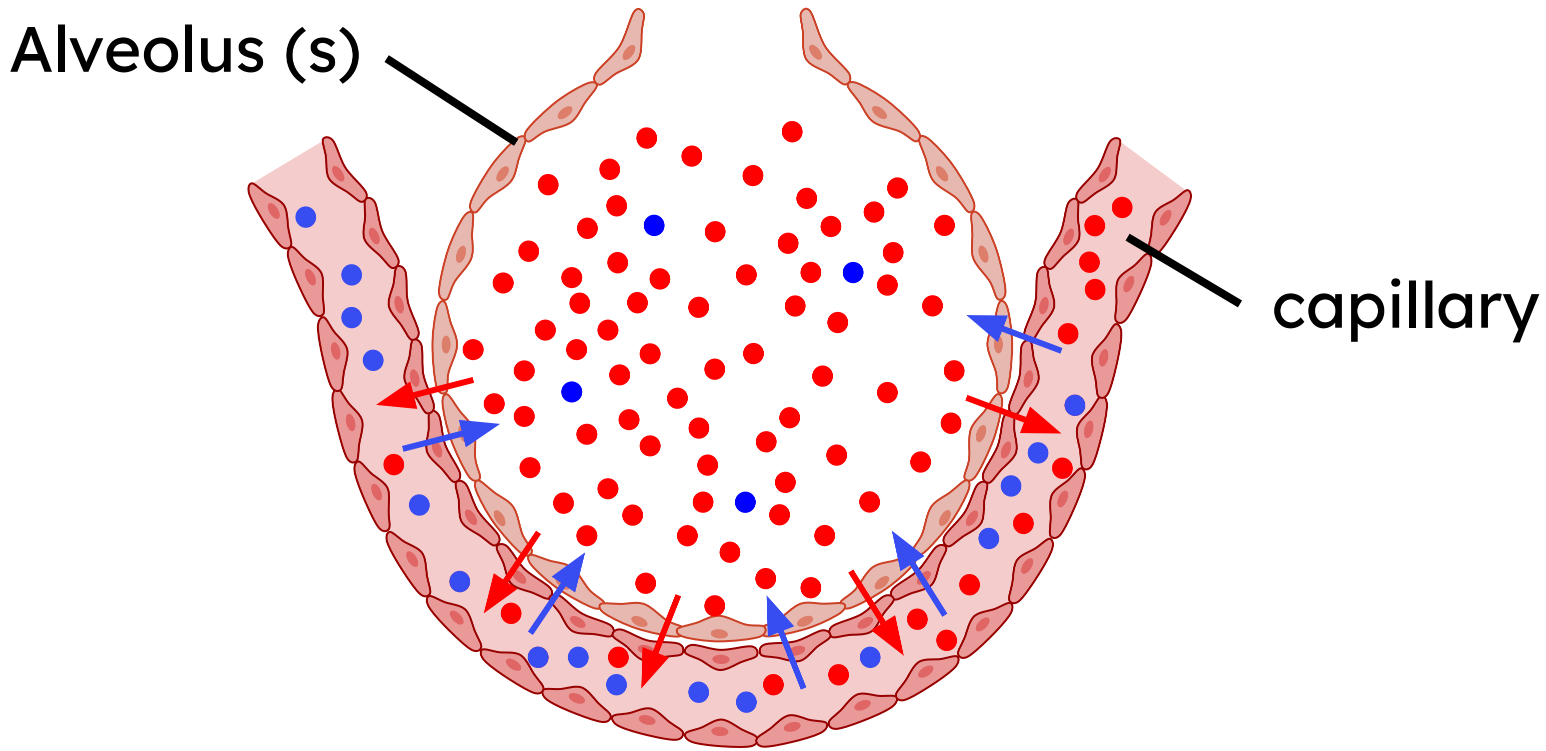


The structure and function of an alveolus

Explanation

During gas exchange:

- Oxygen **diffuses** out of the **alveolus** and into the **capillary.**
- Carbon dioxide **diffuses** out of the **capillary** and into the **alveolus.**



Check

True or false?

Alveoli are important cells in the lungs.

T **True**

F **False** ✓

Justify your answer

a The alveoli are an organ because they are made of cells.

b The alveoli are a tissue because they are made of cells. ✓

Lesson outline

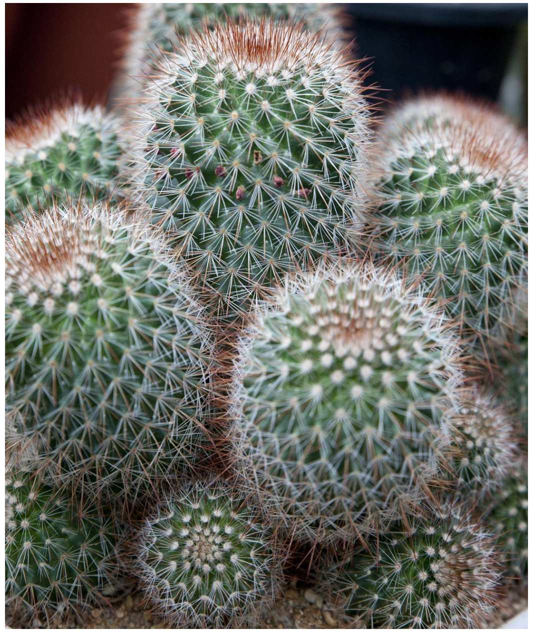
Adaptations of the human lungs for gas exchange

- The structure and function of an alveolus
- Adaptations of an alveolus

Adaptations of an alveolus

Explanation

Adaptations are special features living things have that help them survive and perform their function.

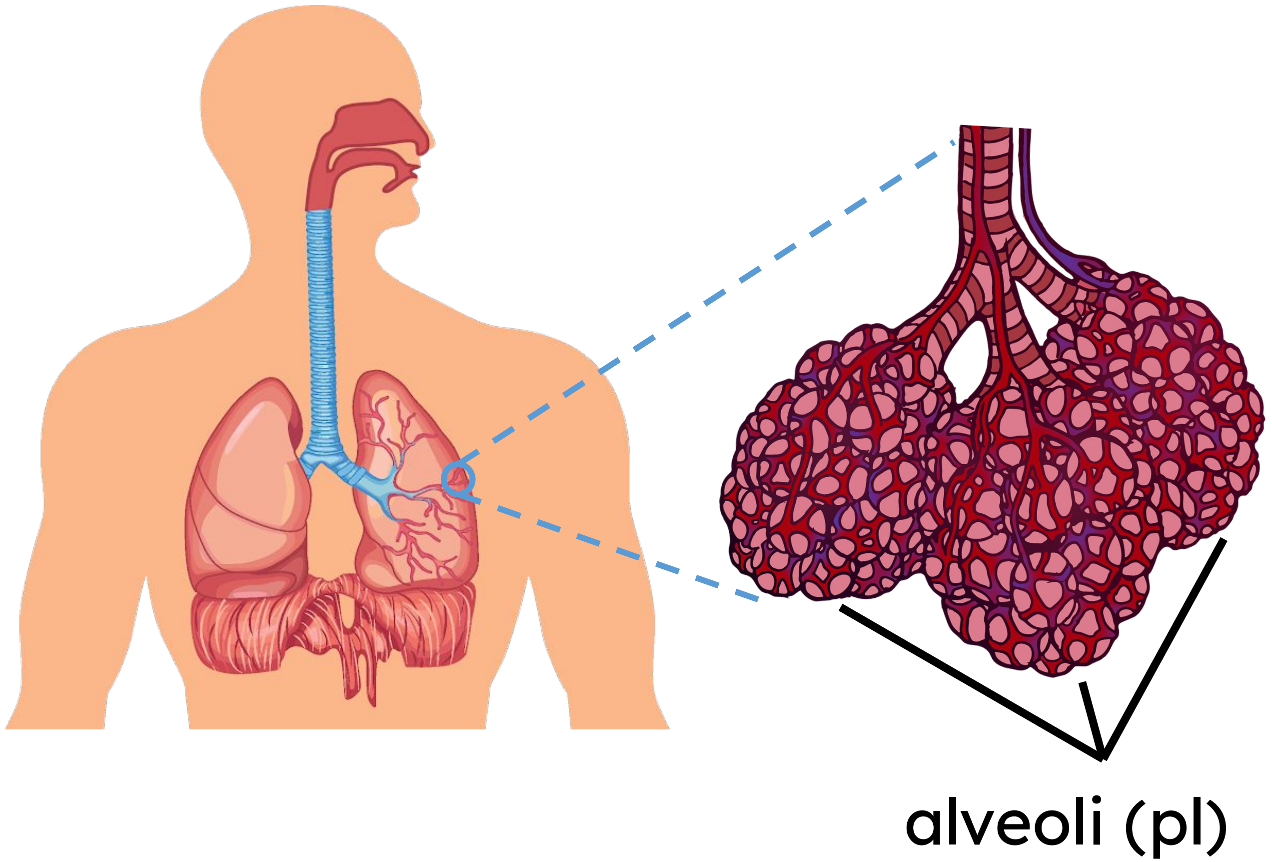


Adaptations of an alveolus

Explanation

The lungs have many **alveoli** which increases the **surface area.**

This means there are more opportunities for oxygen and carbon dioxide molecules to diffuse in and out of an alveolus.



Therefore, more gas exchange can occur.

Adaptations of an alveolus

Explanation

Surface area is the total area of all the exposed surfaces of an object.

Adaptations of an alveolus

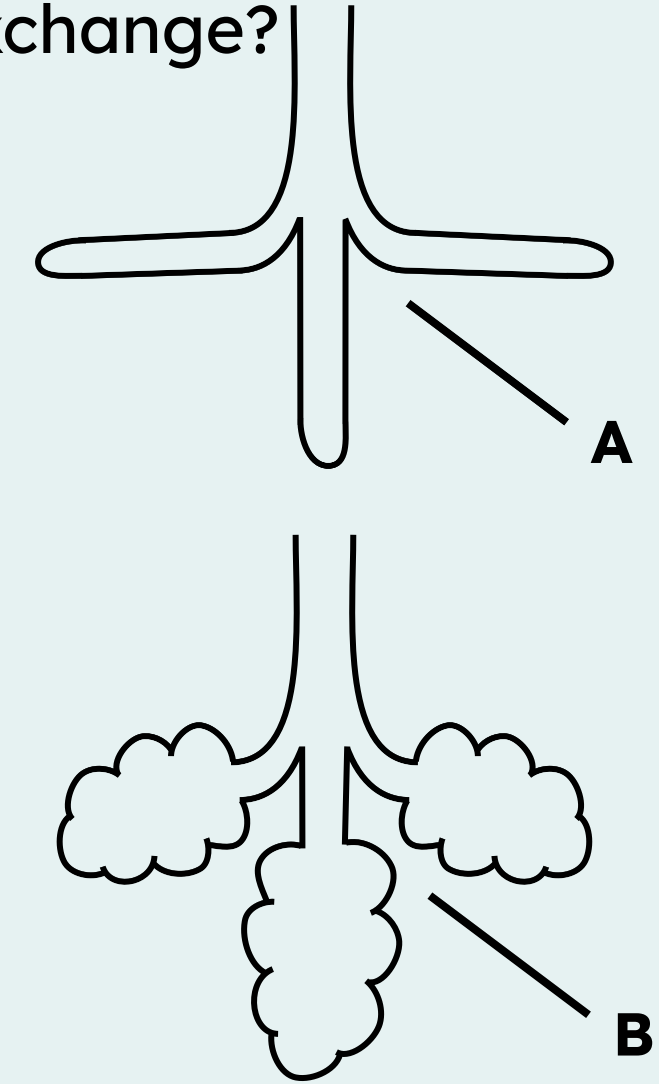
Check

Which structure would carry out more gas exchange?

a structure A would be better

b structure B would be better ✓

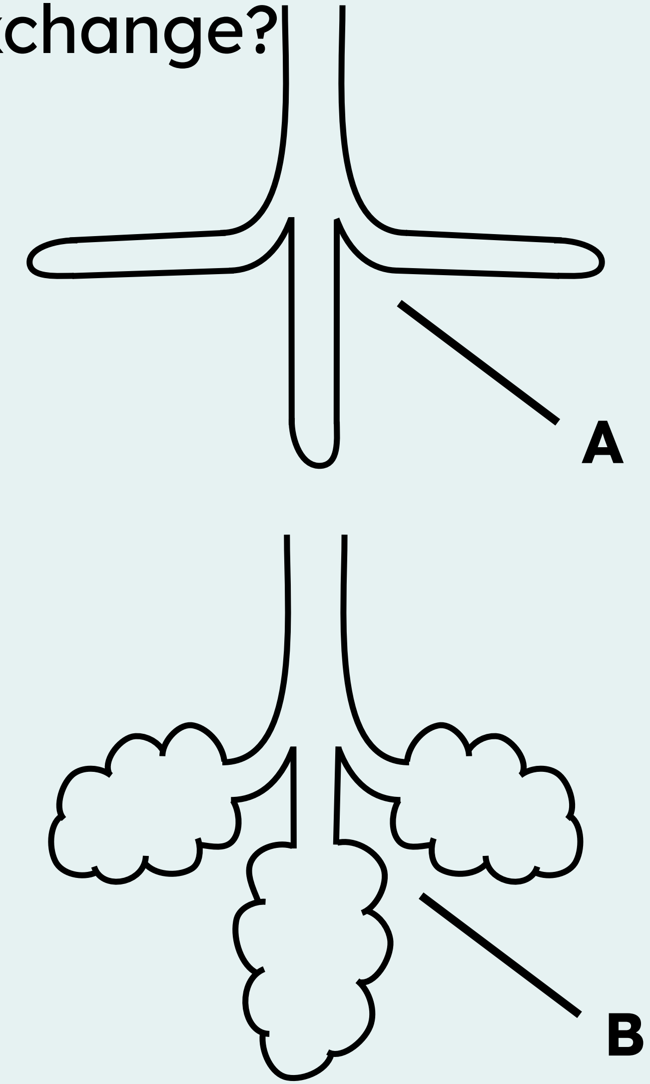
c they would be equally as good



Adaptations of an alveolus

Check

Why would structure B carry out more gas exchange?



a it has a larger surface area ✓

b it has a bigger volume

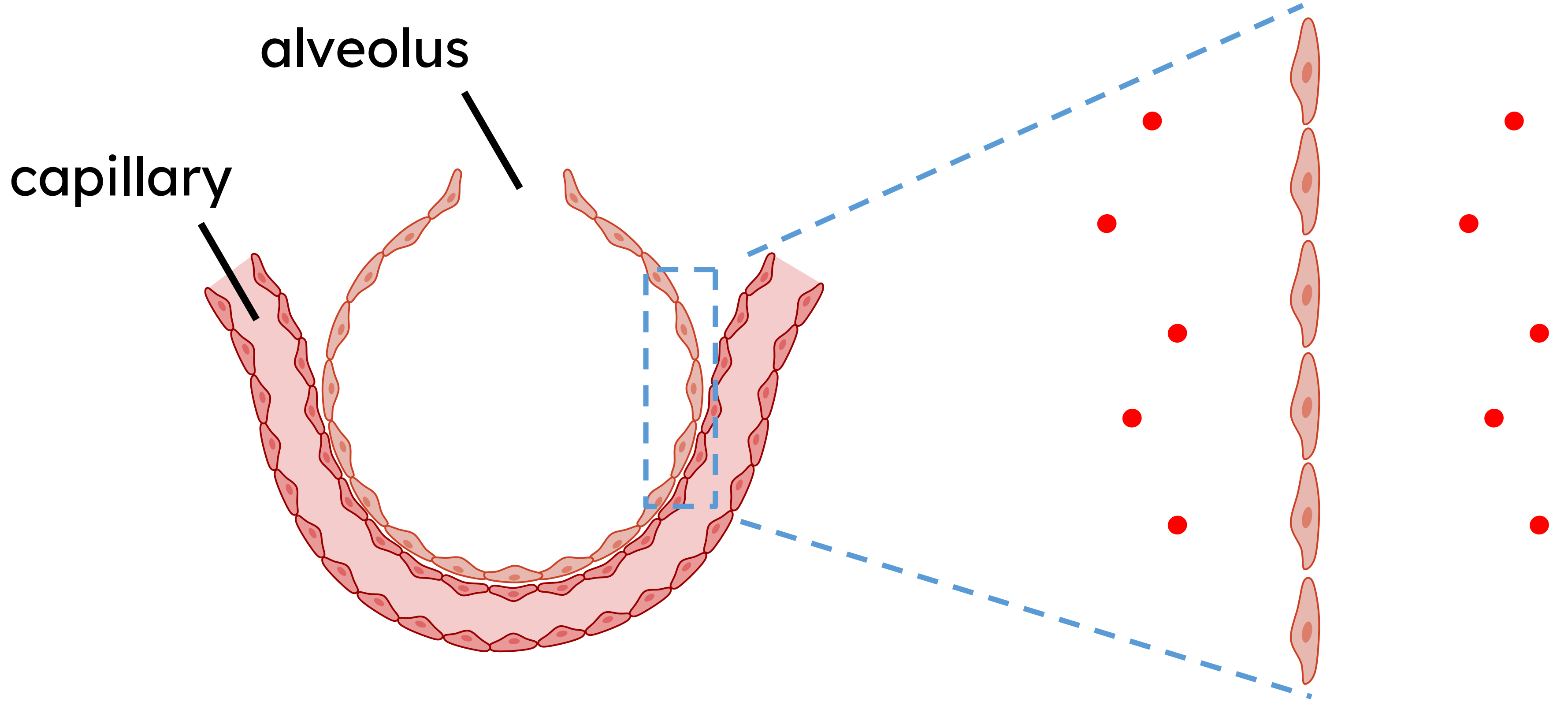
c it's more spherical

Adaptations of an alveolus

Explanation

The walls of an alveolus are one cell thick.

This provides a short diffusion distance for the oxygen and carbon dioxide molecules to travel.

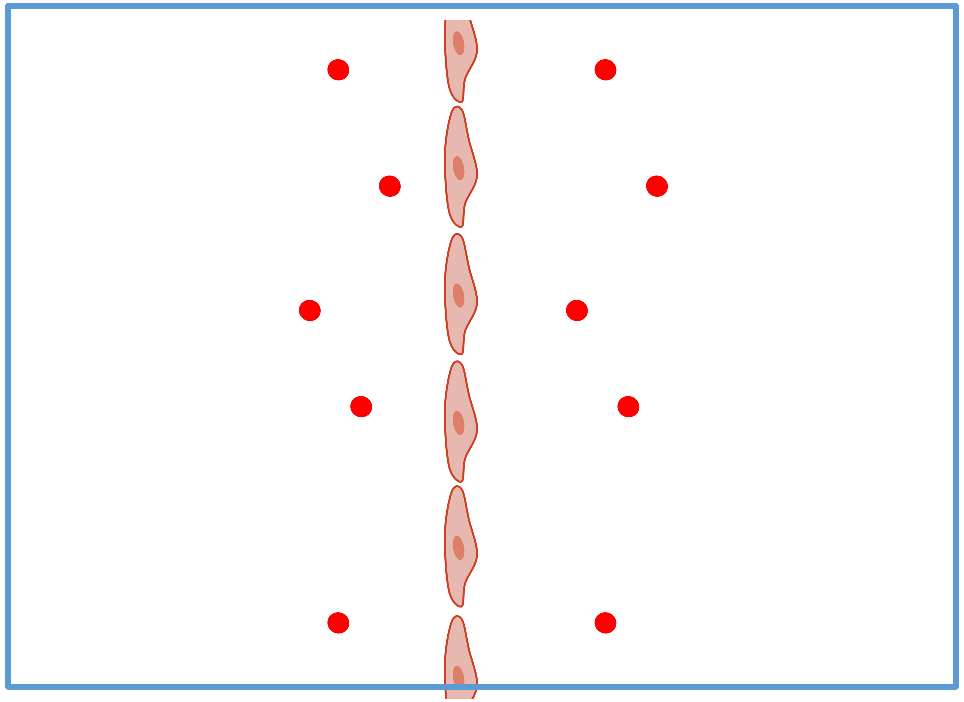


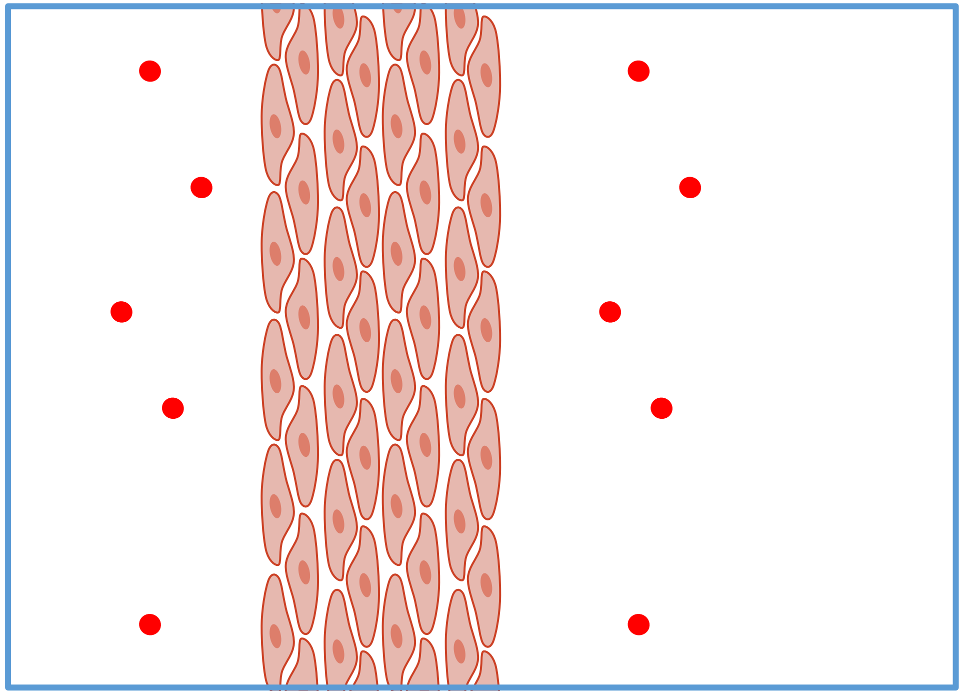
Adaptations of an alveolus

Explanation

The molecules cross the one cell thick walls faster than they would if the alveolus wall was thicker.

This means more gas exchange can occur.



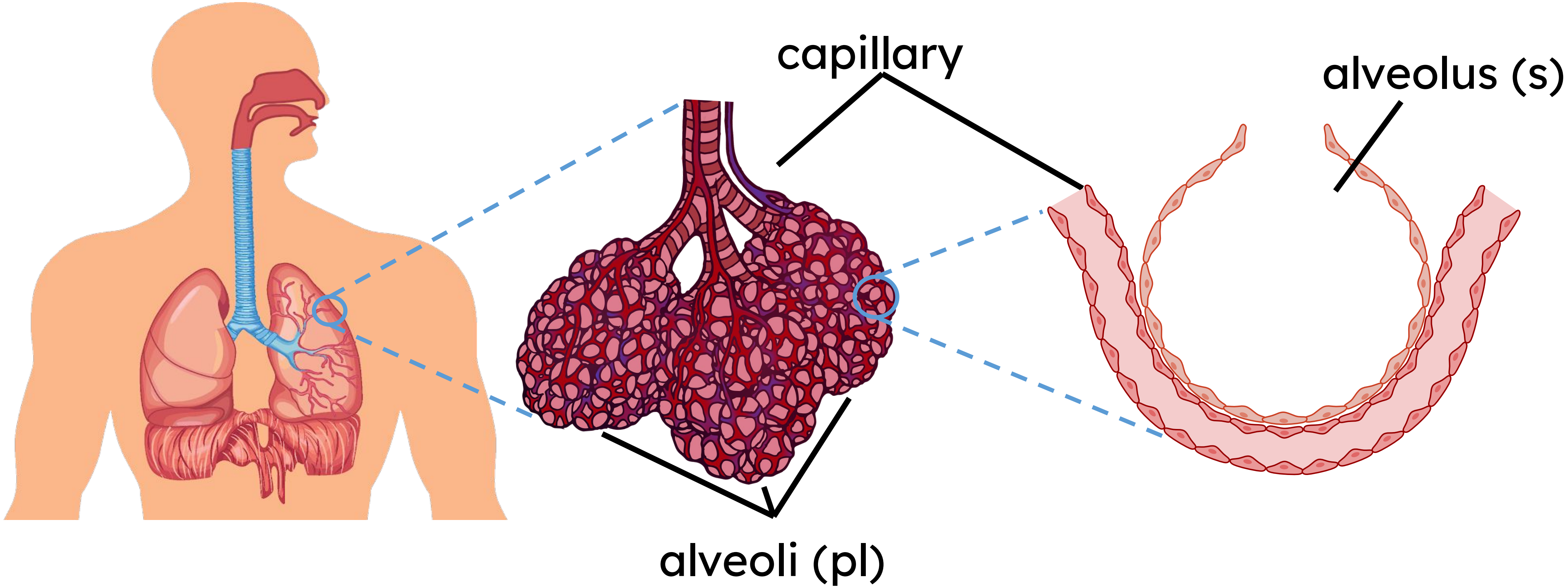


Adaptations of an alveolus

Explanation

Alveoli are surrounded by a network of **capillaries.**

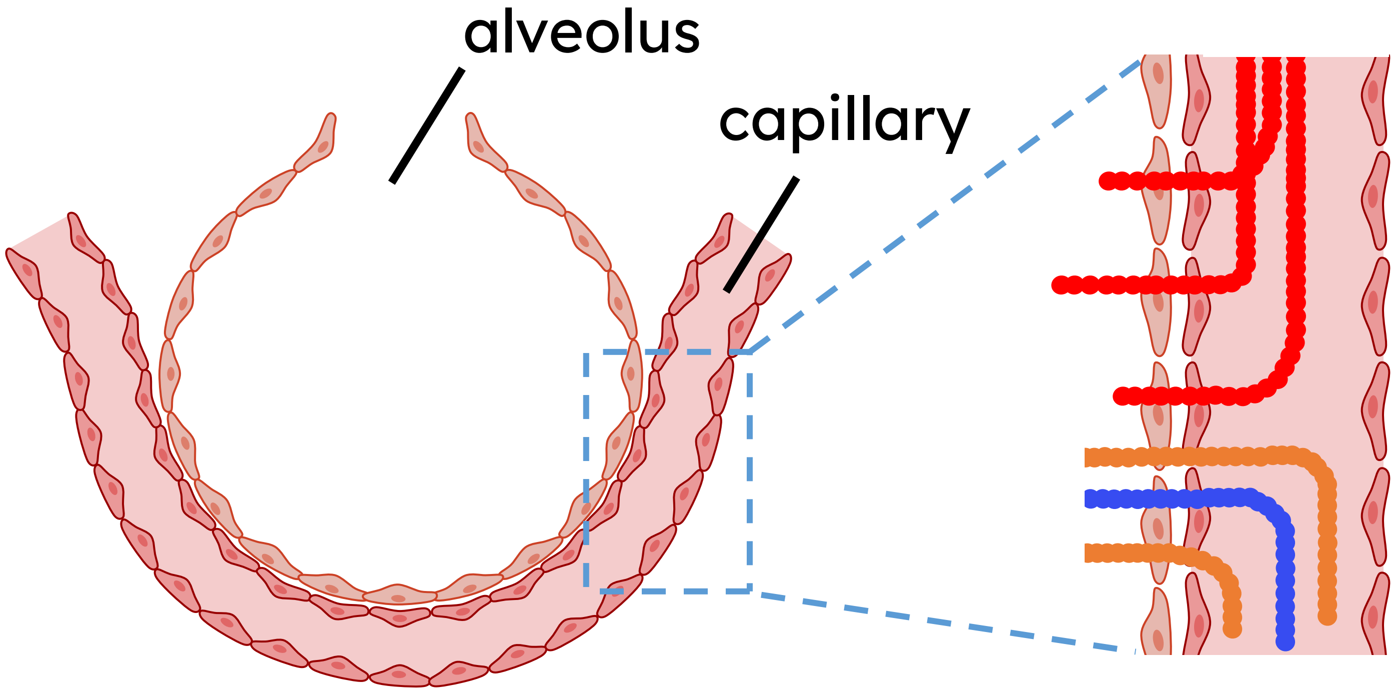
Capillaries are tiny blood vessels that bring oxygenated blood to body cells.



Adaptations of an alveolus

The movement of blood takes oxygen away from the lungs and brings carbon dioxide to lungs.

This maintains the concentration gradient of gases between the alveolus and the capillary.



This means more gas exchange can take place.

Adaptations of an alveolus

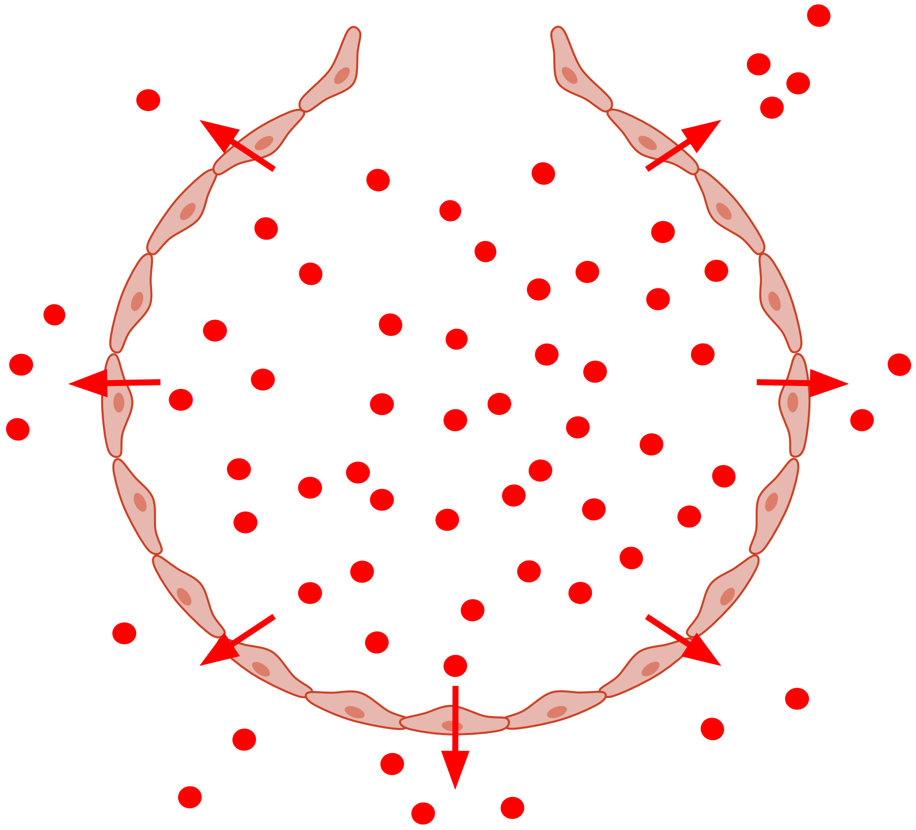
Explanation

Without capillaries, carbon dioxide would not be brought to the alveoli and be removed from the body.

Oxygen would diffuse out of the alveoli and build up.

Eventually, there would be an equal concentration of oxygen in and out of the alveoli so no concentration gradient.

Gas exchange would stop.



Adaptations of an alveolus

Check

Match the adaptation to the reason why it helps gas exchange occur.

lots of alveoli…	for a short diffusion distance
one cell thick walls…	for a large surface area
good blood supply…	to maintain a concentration gradient

Keywords

Cellular respiration is a chemical process that uses glucose from food as a fuel to provide energy for life processes.

A **cell** is the smallest living building block of an organism.

Mitochondria are cell organelles in which cellular respiration takes place in animals and plants.

Glucose is a sugar that cells use as fuel for cellular respiration.

Breathing is the process in which air is moved in and out of the lungs.

Lesson outline

Cellular respiration

- Cellular respiration
- Plants and cellular respiration
- Breathing and cellular respiration

Cellular respiration

Explanation

All living organisms carry out the same life processes:

- **Movement**
- **Reproduction**
- **Sensitivity**
- **Growth**
- **Respiration**
- **Excretion**
- **Nutrition**

Cellular respiration

Cellular respiration provides the energy for all life processes.

For example:

movement

growing

sensitivity

It is constantly taking place in every **cell** of every living organism.

If a cell stops respiring, it will eventually die.

Cellular respiration

Cellular respiration is a chemical process that uses **glucose** from food as a fuel to provide energy for life processes.

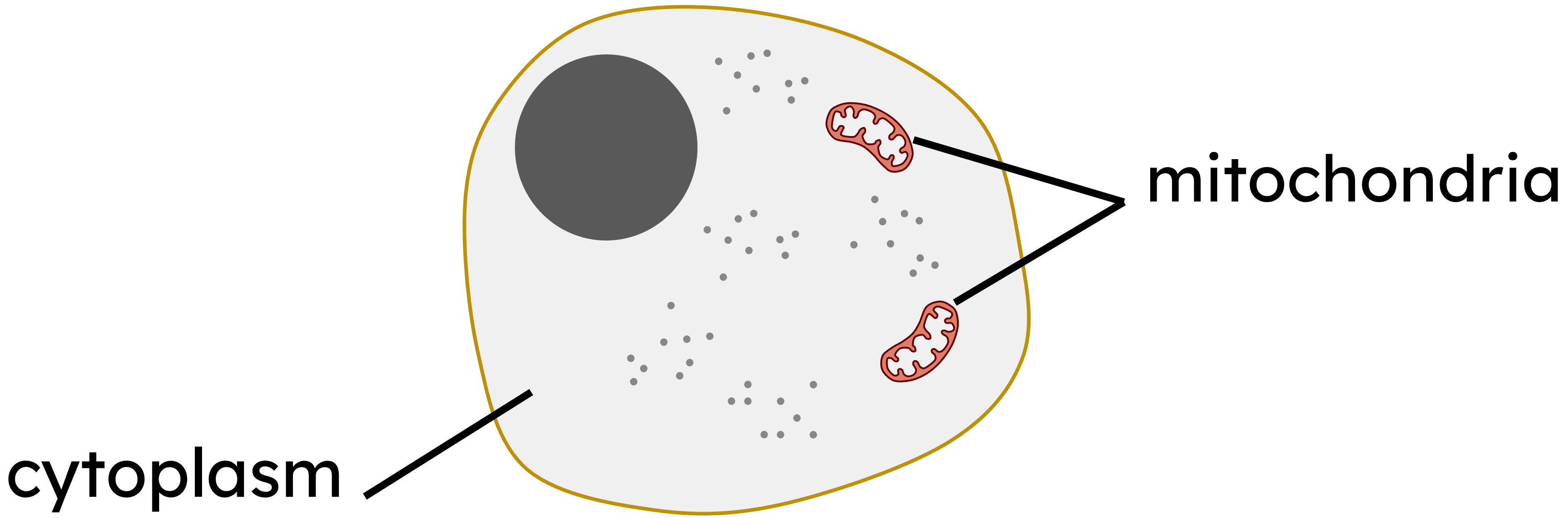
Glucose is a sugar that our cells use as fuel.

We get it from eating carbohydrates and sugar.

Cellular respiration

Explanation

Cellular respiration takes place inside every cell of every living organism.

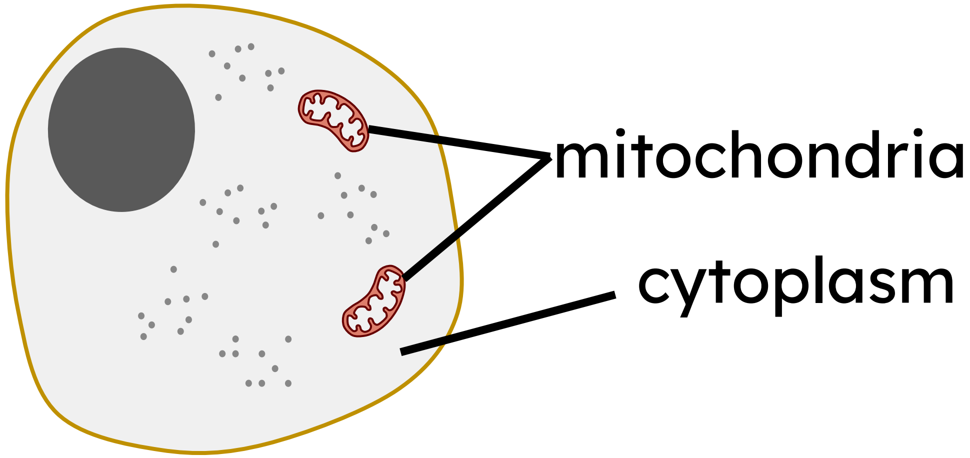


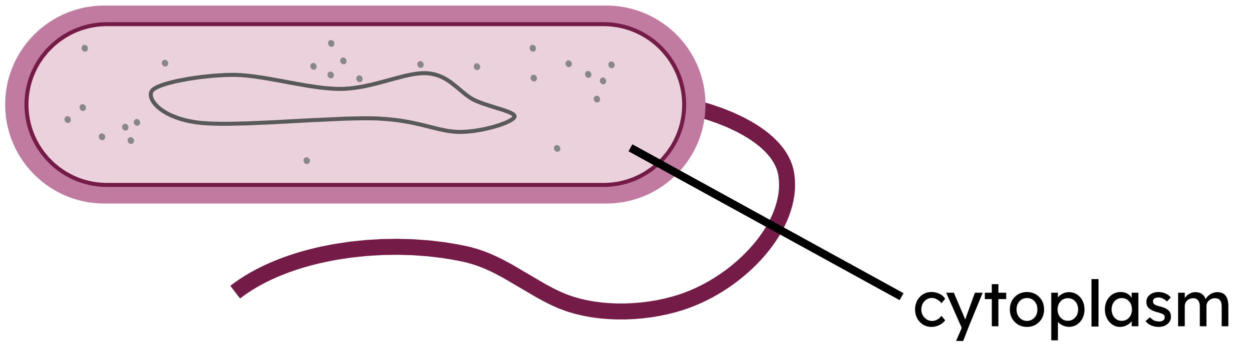
Cellular respiration

Explanation

Within the cell, it can take place:

- Inside the mitochondria and cytoplasm of animal and plant cells.
- In the cytoplasm of organisms that don't have mitochondria such as bacteria.





Tick one box for each statement.

		I am **sure** this is	I **think** this is	I **think** this is	I am **sure** this is
a	Respiration provides energy for life processes.	✓			
b	Respiration involves chemical reactions.	✓			
c	Only some living organisms respire.				✓

Cellular respiration

Check

Tick one box for each statement.

		I am **sure** this is	I **think** this is	I **think** this is	I am **sure** this is
d	Respiration takes place in muscle cells only.				✓
e	If respiration stops happening in an organism, the organism will die.	✓			

Lesson outline

Cellular respiration

- Cellular respiration
- Plants and cellular respiration
- Breathing and cellular respiration

Plants and cellular respiration

Explanation

Plants are also living organisms.

movement

reproduction

sensitivity

growth

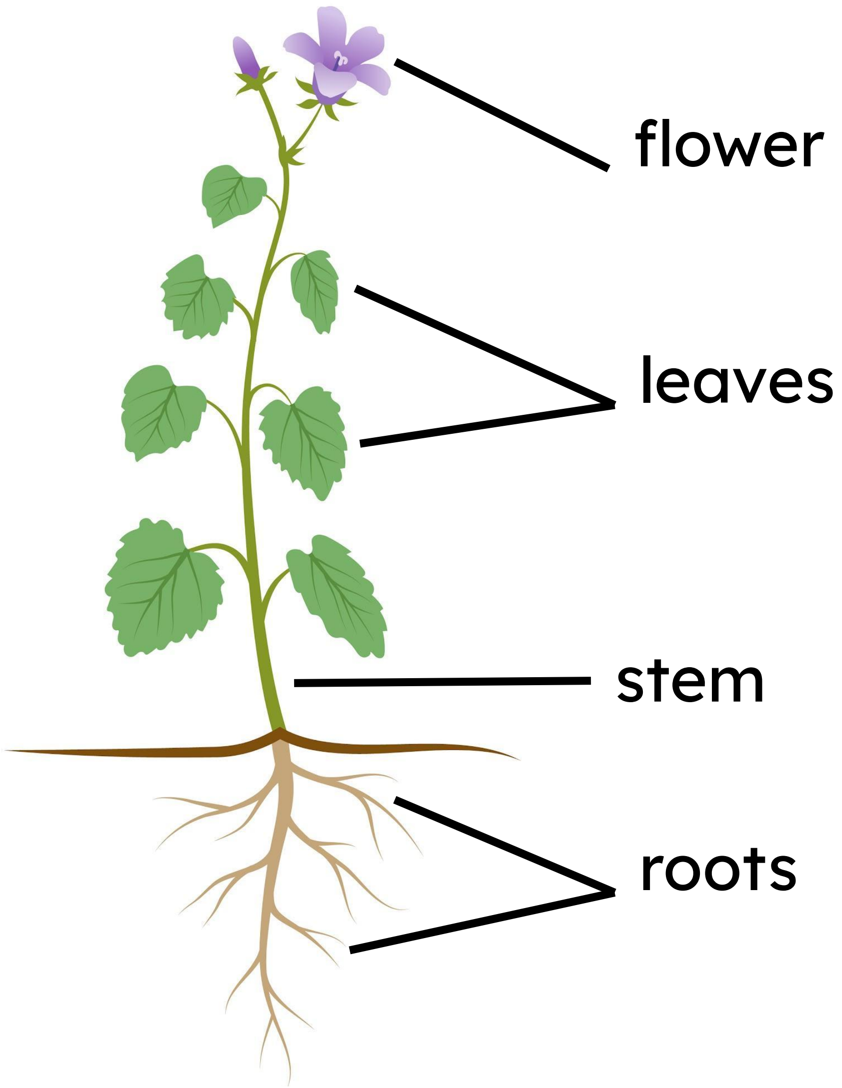
They also need to carry out cellular respiration.

Plants and cellular respiration

Explanation

If plants can't carry out cellular respiration they won't have the energy they need for life processes and they will die.

All parts of a plant need to carry out cellular respiration as all parts of the plant need energy.

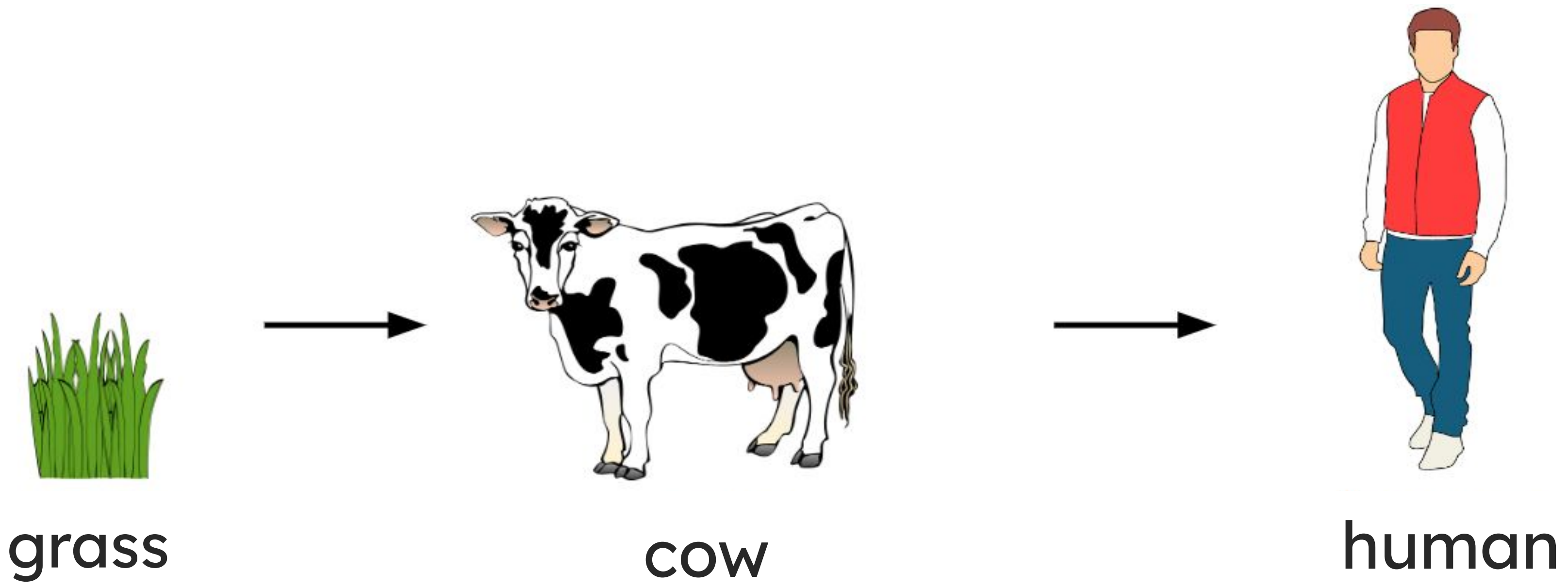


Plants and cellular respiration

Explanation

Animals get glucose from eating other animals or plants.

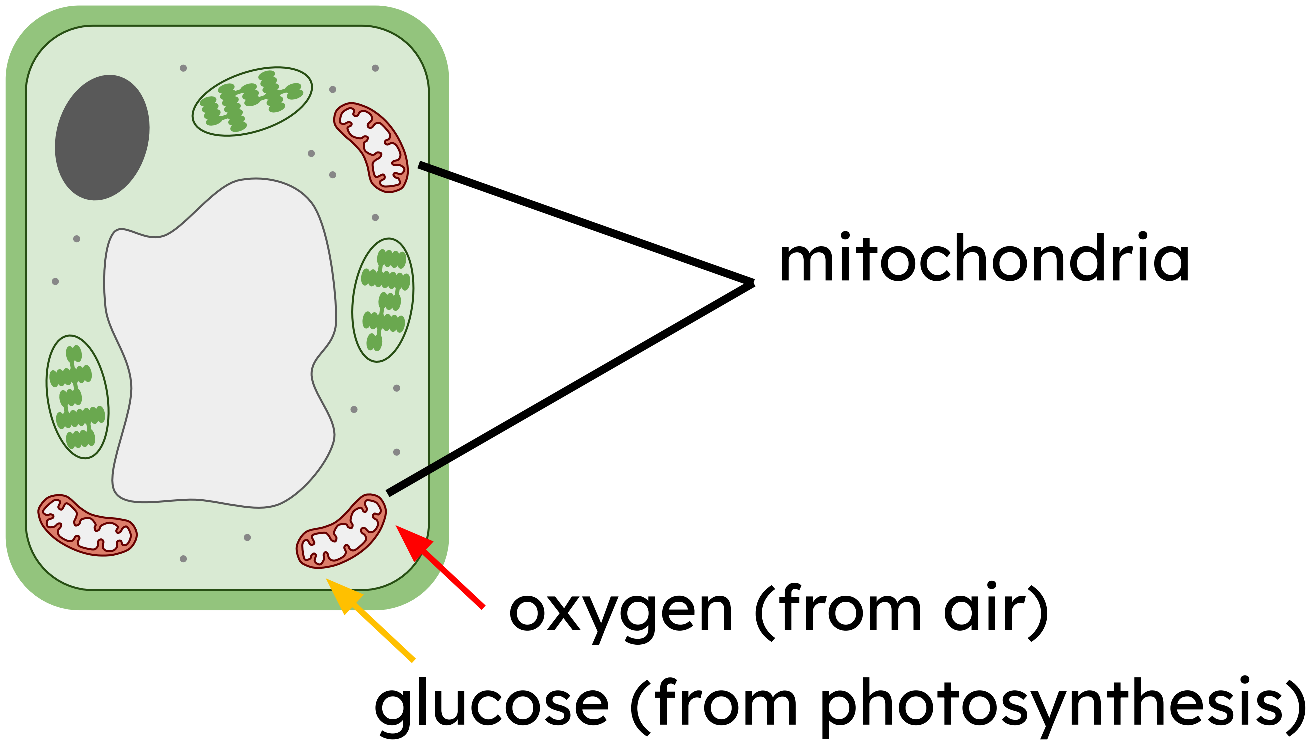
Plants don't eat, they create their own glucose in a process called photosynthesis.



Plant cells, just like other types of cell, use glucose to provide energy for life processes.

They carry out cellular respiration using oxygen from the air and glucose from photosynthesis.

This takes place in mitochondria.



Plants and cellular respiration

Check

In which part of the cell does cellular respiration take place, and when?

Connect two boxes.

cell wall	
chloroplasts	all the time
mitochondria	when it’s dark
nucleus	when it’s light
vacuole	

Lesson outline

Cellular respiration

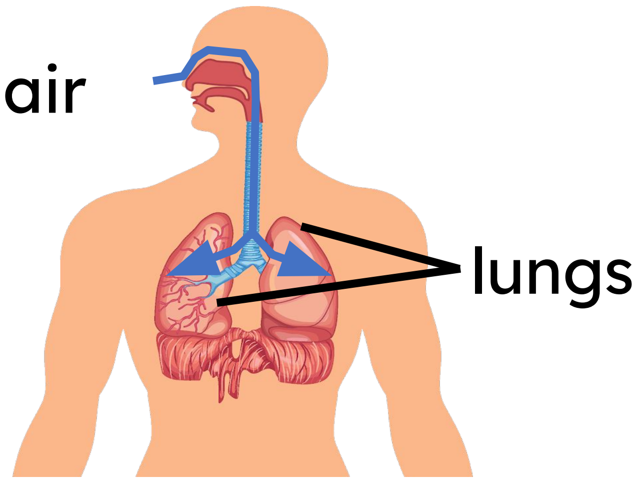
- Cellular respiration
- Plants and cellular respiration
- Breathing and cellular respiration

Breathing and cellular respiration

Explanation

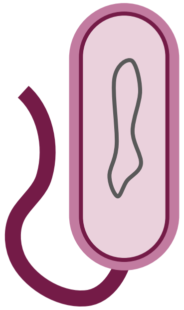
Breathing and cellular respiration are different processes.

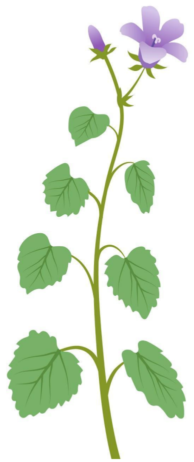
Breathing is a mechanical process in which muscles contract and relax to move air in and out of the lungs.



No chemical reactions are taking place.

Not all living organisms breathe.





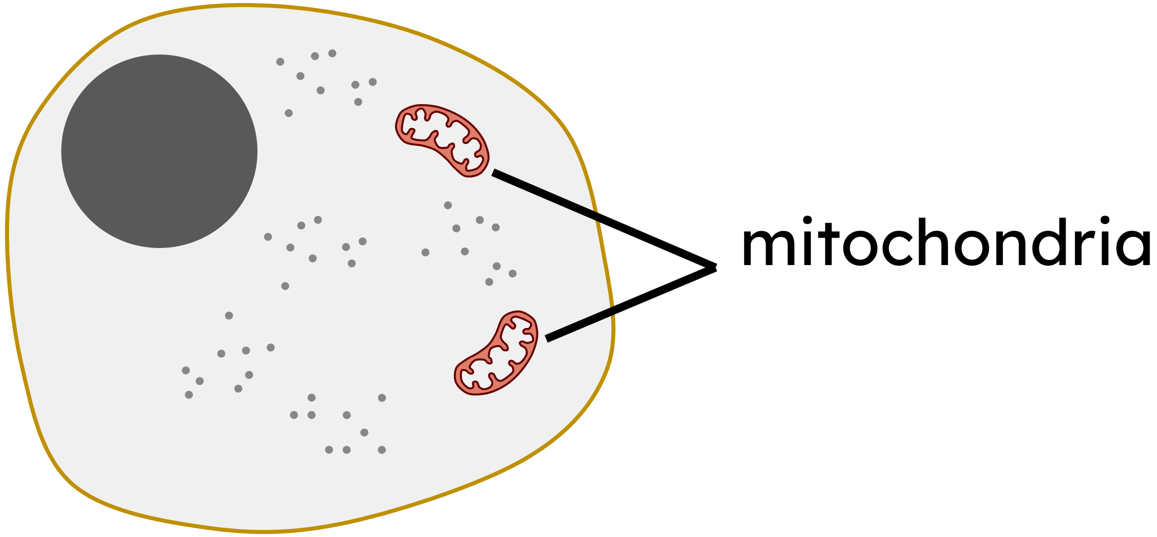
Breathing and cellular respiration

Explanation

Cellular respiration uses glucose from food as a fuel to provide energy for life processes.

It is a series of chemical reactions.

It occurs in every cell of every living organism.

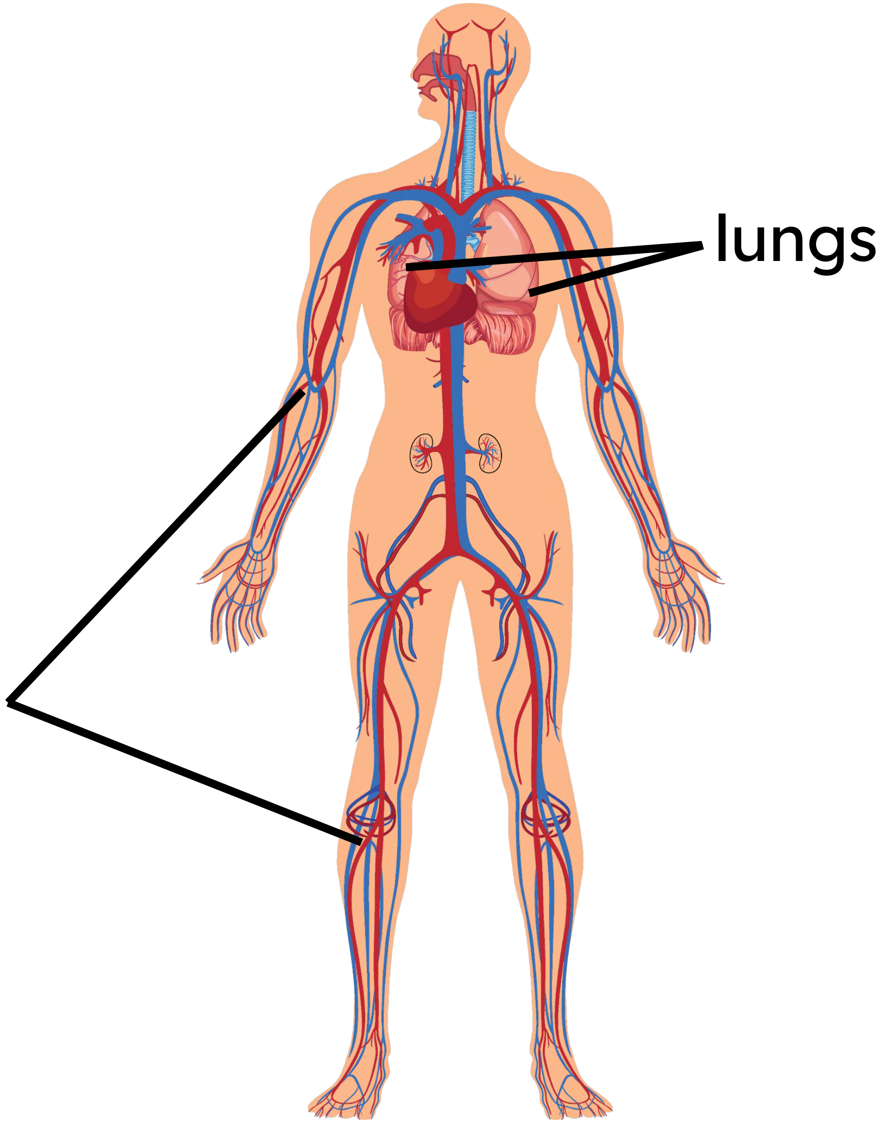


Breathing and cellular respiration

Explanation

We breathe in air, and this provides the oxygen we need for cellular respiration.

Oxygen, along with the glucose that we gain from eating food, is transported to our body cells via our bloodstream.

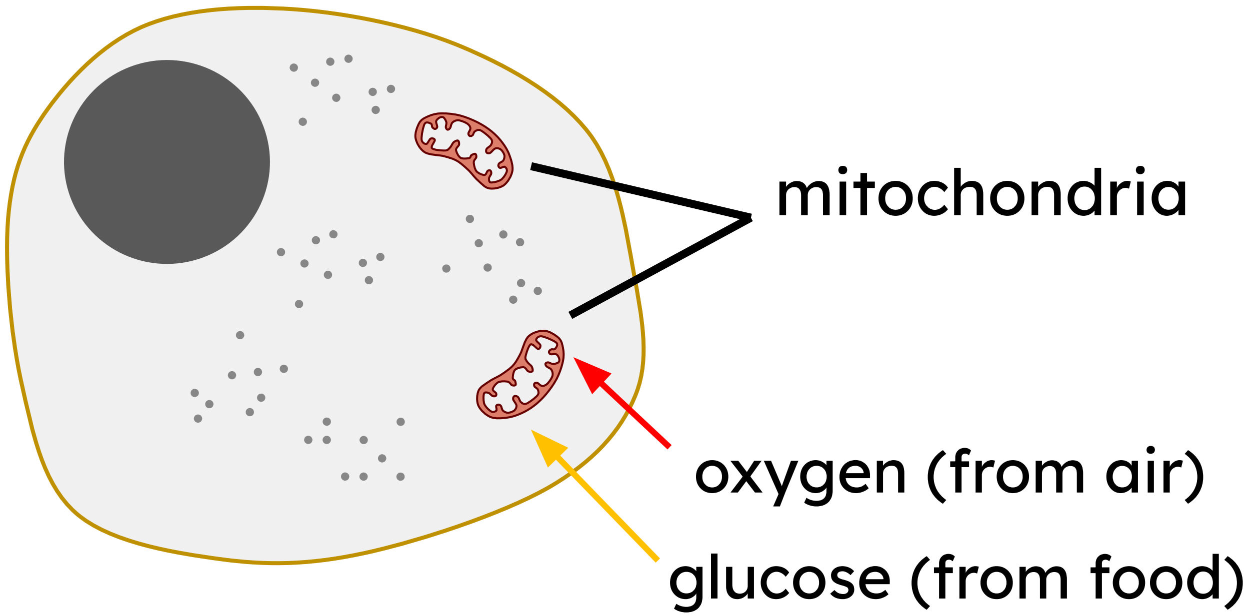


Breathing and cellular respiration

Explanation

Oxygen and glucose diffuse into the mitochondria of our cells.

They are used in cellular respiration to provide energy for life processes.

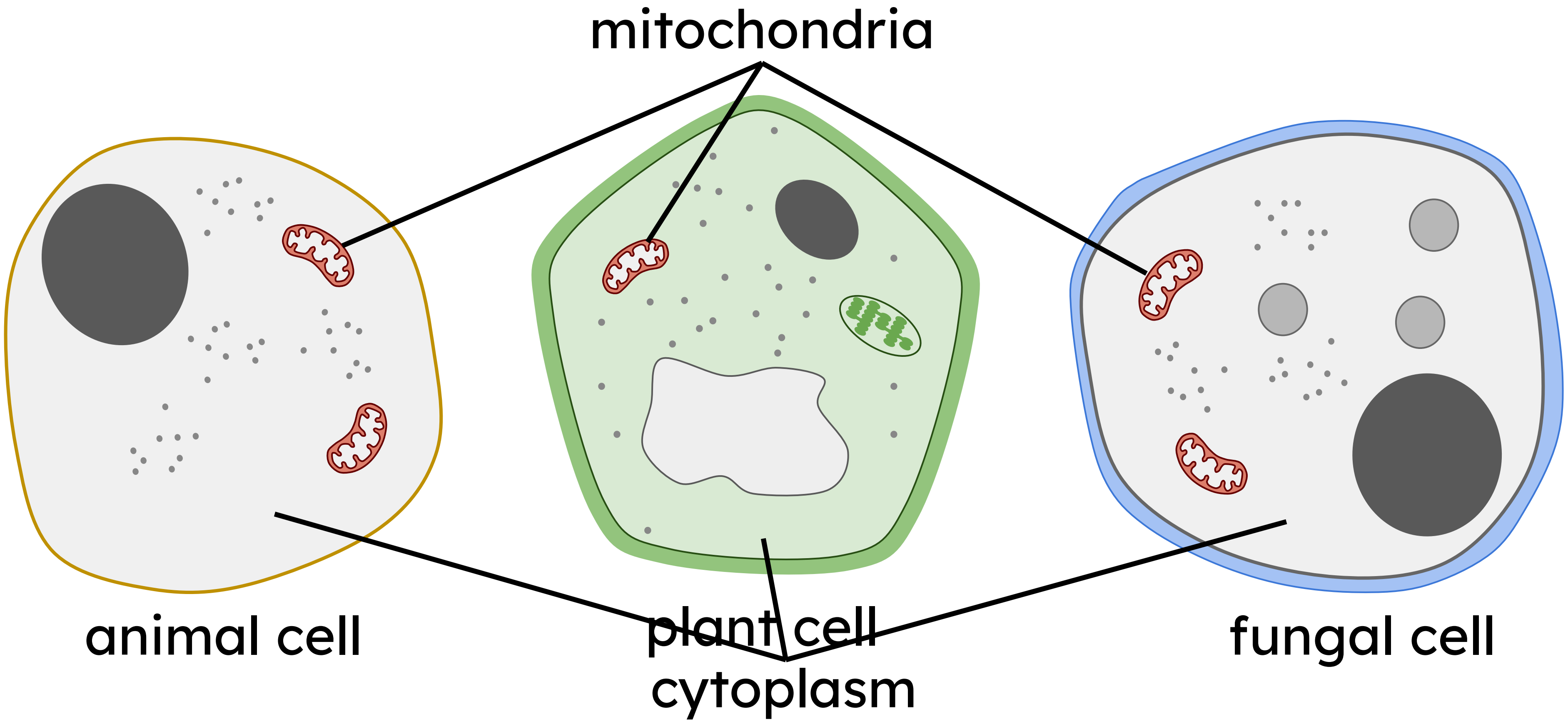


Lesson outline

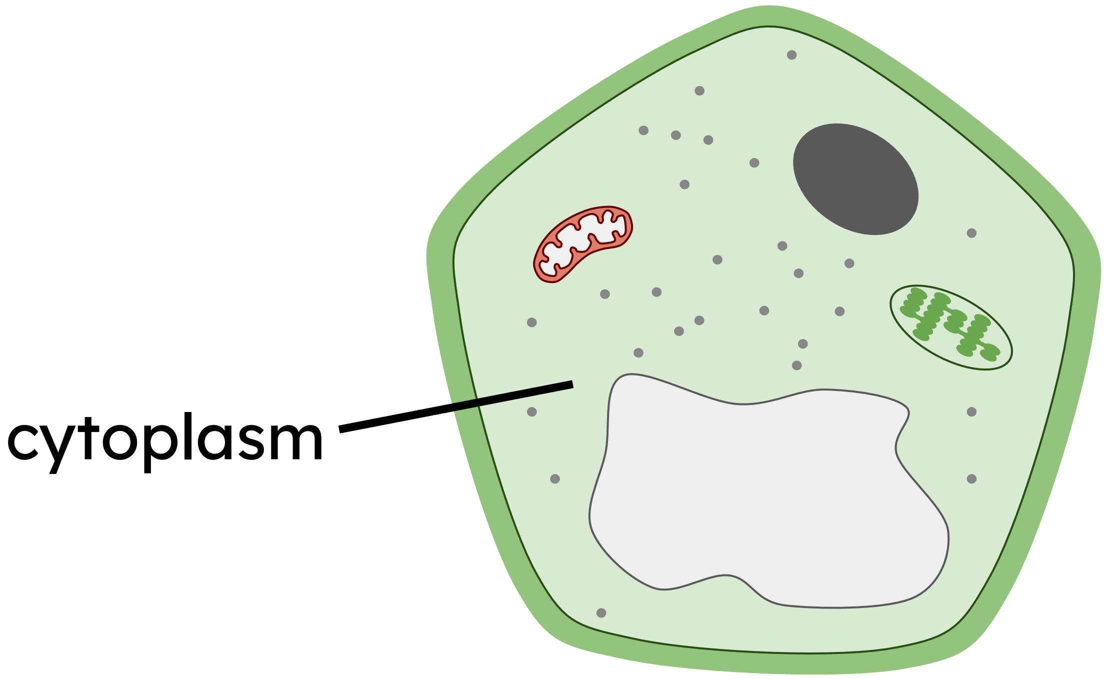
Aerobic cellular respiration

- Where aerobic cellular respiration happens
- The reactants and products of cellular respiration

Aerobic cellular respiration is a chemical process that happens inside the **cytoplasm** and **mitochondria** of cells.



Cytoplasm is the jelly-like substance inside a cell where chemical reactions of the cell take place.

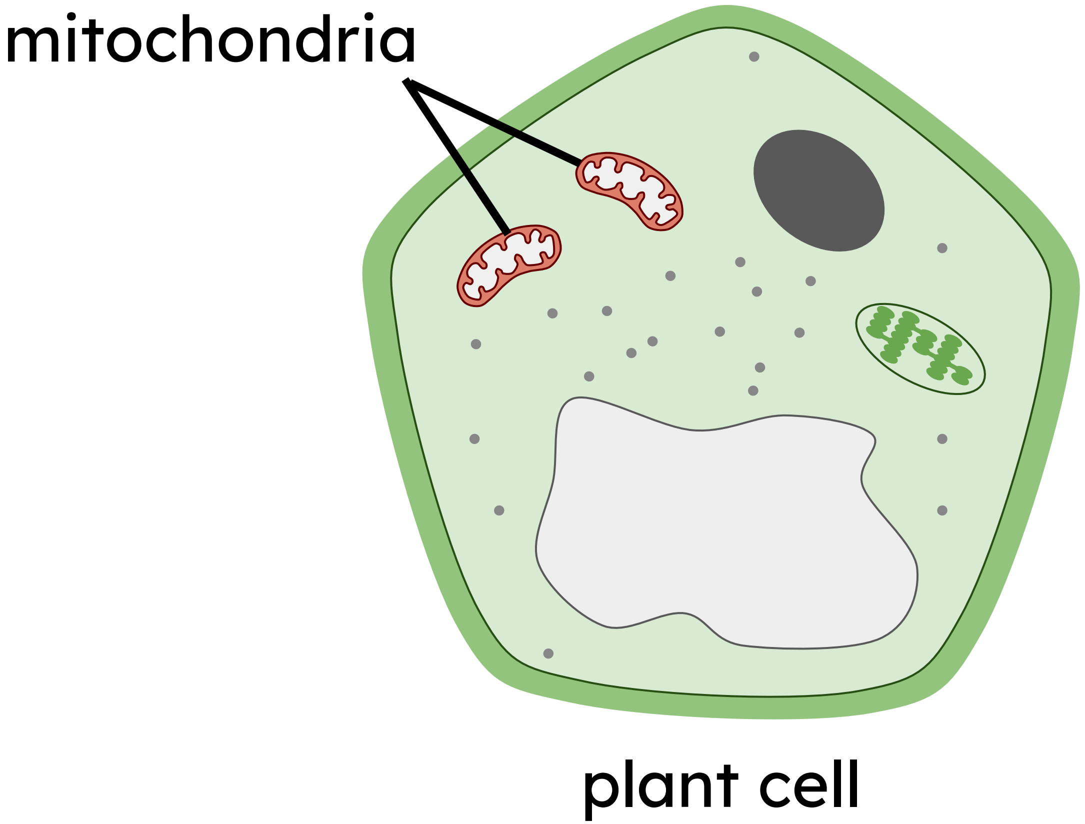


plant cell

Mitochondria are subcellular structures.

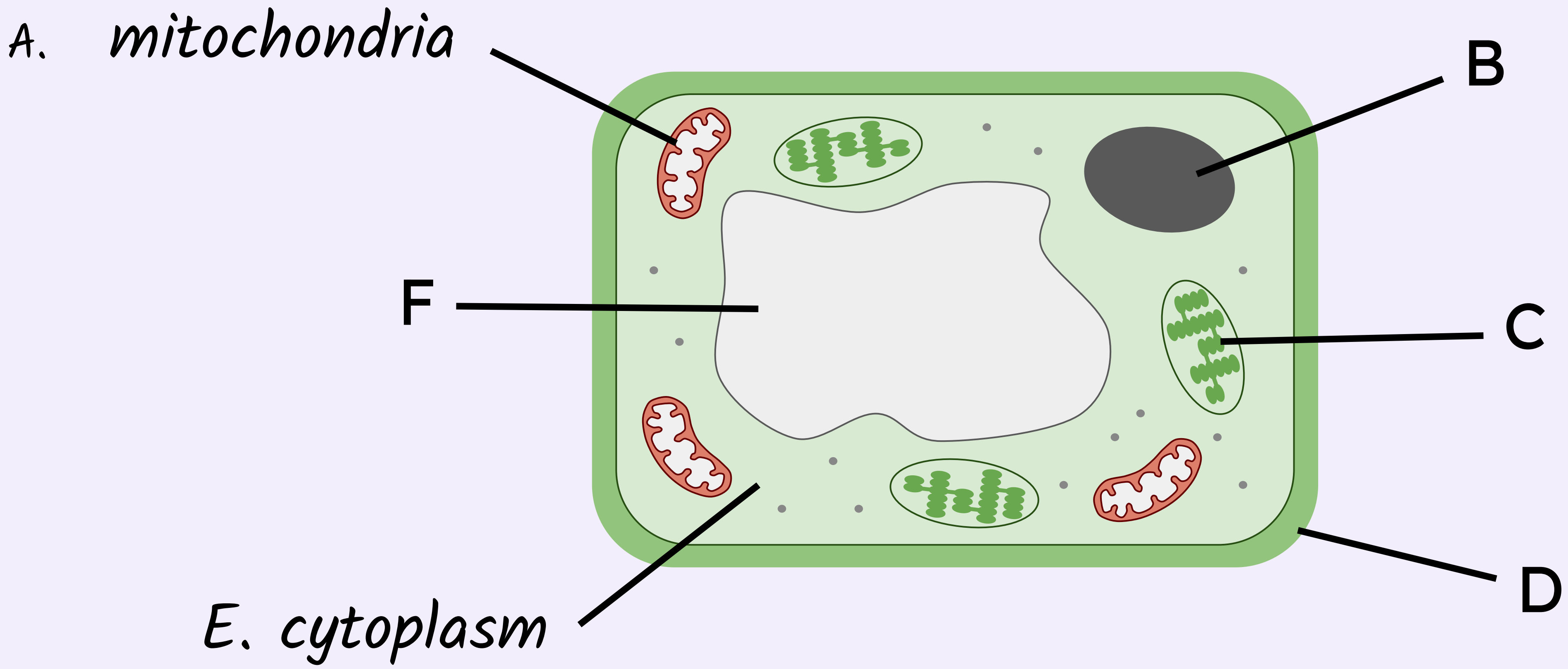
This means they are small structures inside cells.

Mitochondria are an important site of **aerobic cellular respiration.**



Check

Where does aerobic cellular respiration take place in this cell?



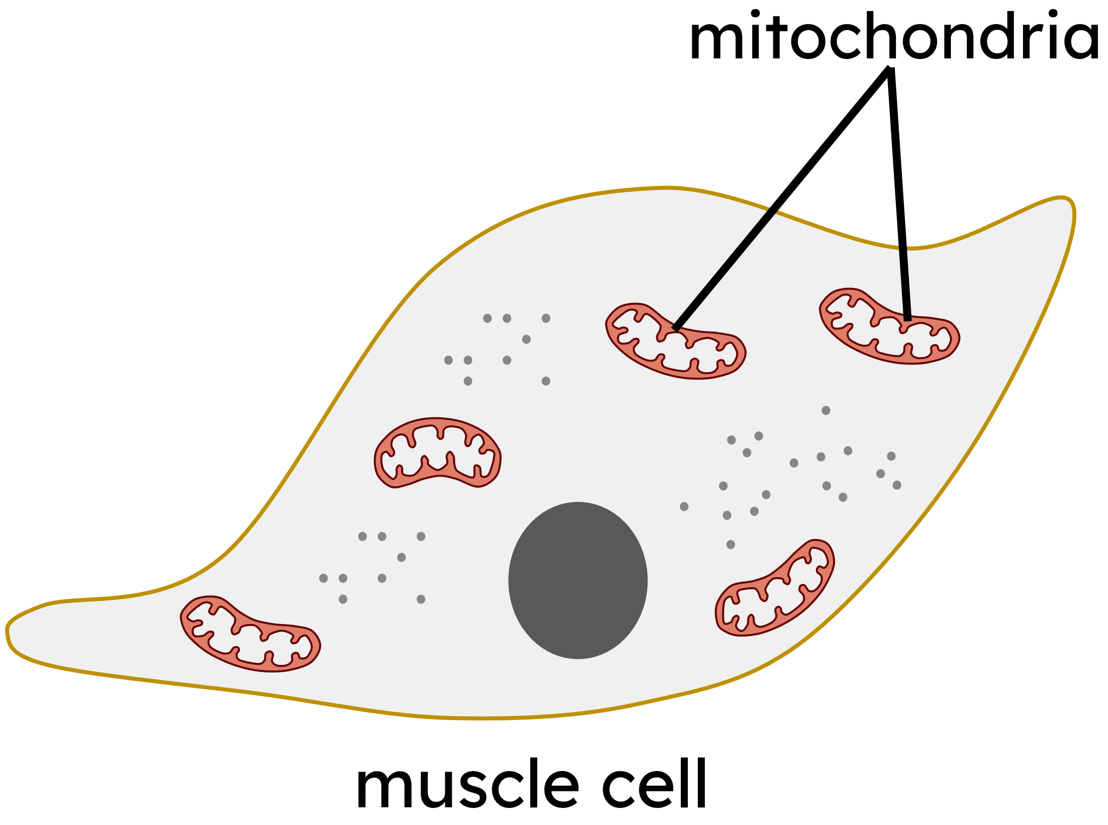
Where aerobic cellular respiration happens

Explanation

Some cells need lots of energy to perform their function.

For example, muscle cells contract and relax to move the skeleton. This requires a lot of energy.

They have lots of **mitochondria** to carry out lots of **aerobic cellular respiration**.



Lesson outline

Aerobic cellular respiration

- Where aerobic cellular respiration happens
- The reactants and products of aerobic respiration

The reactants and products of aerobic respiration

Explanation

Aerobic cellular respiration is a series of chemical reactions.

During chemical reactions:

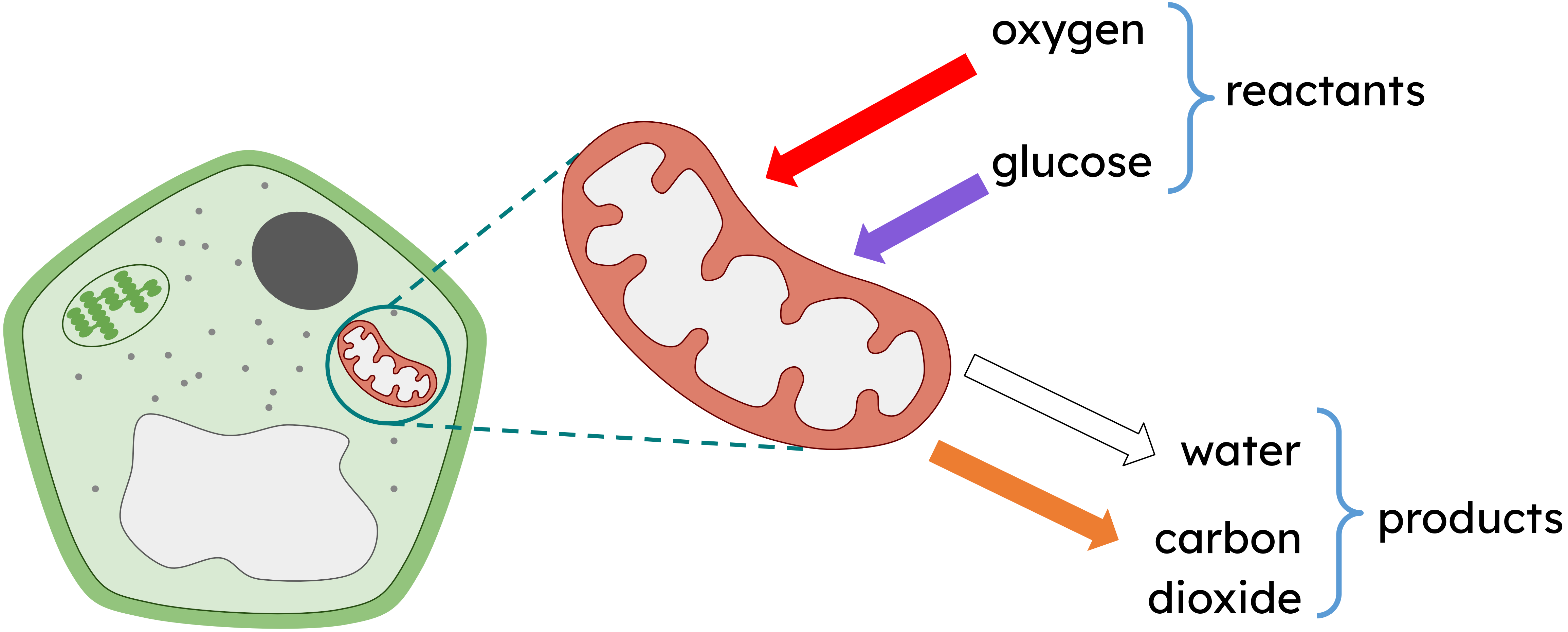
- One or more substances are broken down - these are the reactants.
- One or more new substances are made - these are the products.

$$\underbrace{A \quad + \quad B}_{\text{reactants}} \longrightarrow \underbrace{C \quad + \quad D}_{\text{products}}$$

The reactants and products of aerobic respiration

Explanation

Like any chemical process, **aerobic cellular respiration** has reactants and products.



The reactants and products of aerobic respiration

Explanation

Aerobic cellular respiration is not just one chemical reaction.

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

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

$$\underbrace{\text{oxygen} + \text{glucose}}_{\text{reactants}} \longrightarrow \underbrace{\text{water} + \text{carbon dioxide}}_{\text{products}}$$

The reactants and products of aerobic respiration

Explanation

oxygen + glucose ⟶ carbon dioxide + water

One reactant of **aerobic cellular respiration** is **oxygen**.

$\underbrace{\text{Aerobic}}_{\text{Air}}$ cellular respiration

The reactants and products of aerobic respiration

Explanation

oxygen + glucose → carbon dioxide + water

One reactant of **aerobic cellular respiration** is **oxygen**.

Some animals get oxygen by breathing in air.

In plants, oxygen diffuses into the leaves through small holes on the underside of the leaves.

The reactants and products of aerobic respiration

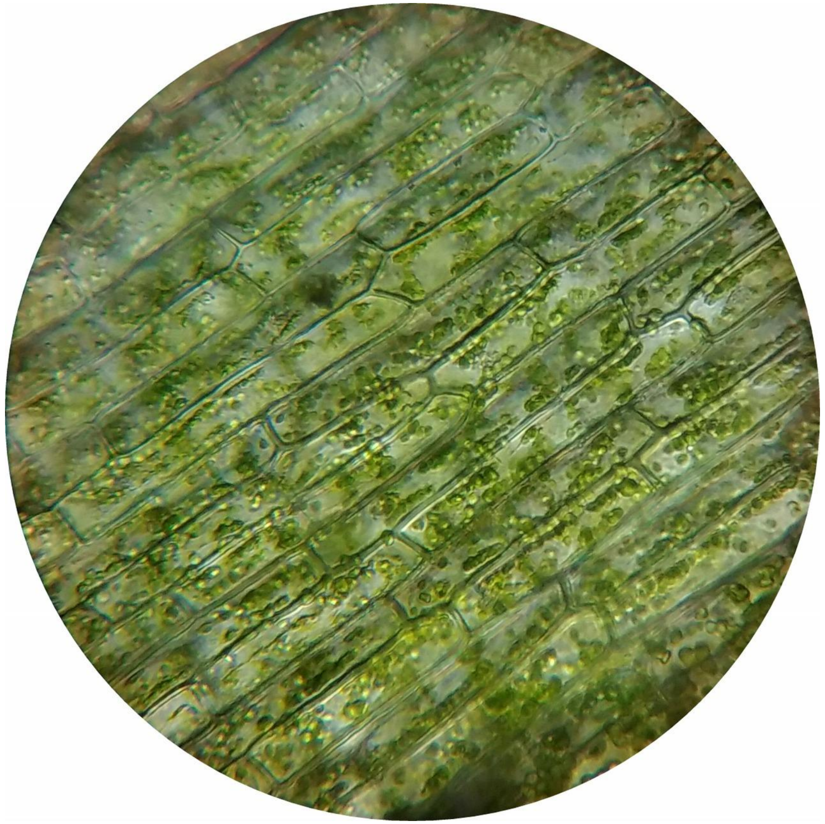
Explanation

oxygen + glucose ⟶ carbon dioxide + water

Another reactant of **aerobic cellular respiration** is glucose.

Animals get glucose by eating and digesting carbohydrates.

Plants get glucose by carrying out a chemical process called photosynthesis.



The reactants and products of aerobic respiration

Explanation

oxygen + glucose ⟶ carbon dioxide + water

One of the products of **aerobic cellular respiration** is **carbon dioxide**.

Too much carbon dioxide is poisonous to cells.

Some animals excrete (get rid of) carbon dioxide by breathing out.

In plants, carbon dioxide diffuses out of the leaves through holes in the underside of the leaves.

The reactants and products of aerobic respiration

Explanation

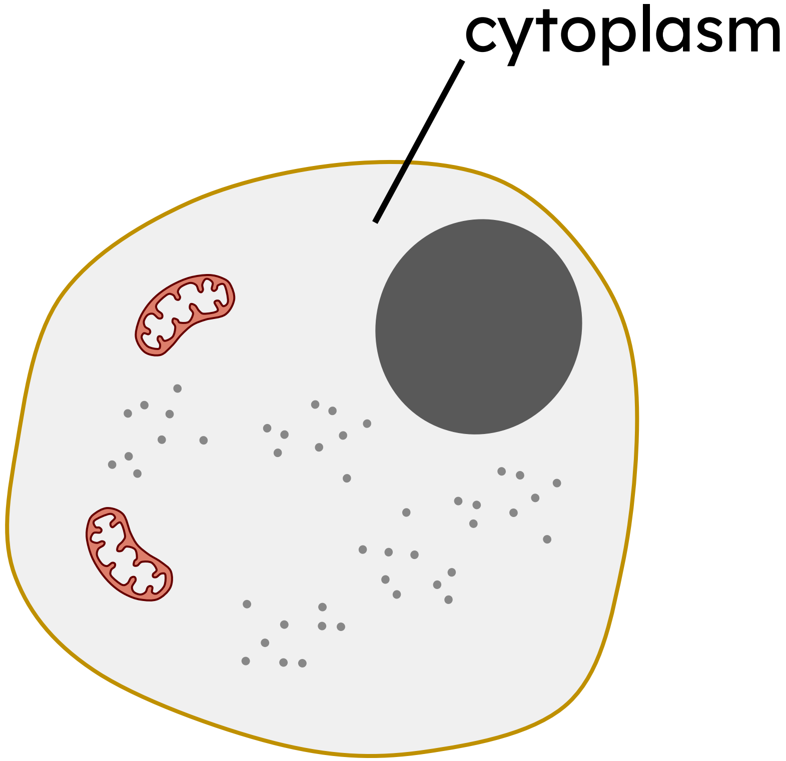
oxygen + glucose ⟶ carbon dioxide + water

The other product of **aerobic cellular respiration** is water.

Water has many uses in living organisms.

Most of the **cytoplasm** in a cell is made from water.

Living organisms excrete (get rid of) excess water.



The reactants and products of aerobic respiration

Check

Put some of the words into the table to state the reactants and products of aerobic cellular respiration.

- mitochondria
- oxygen
- water
- cytoplasm
- carbon dioxide
- nitrogen
- glucose
- animal cell

Reactants	Products
oxygen	*water*
glucose	*carbon dioxide*

Lesson outline

Anaerobic cellular respiration in humans

- Aerobic and anaerobic cellular respiration in humans
- Comparing aerobic and anaerobic respiration

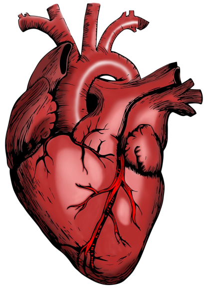
Aerobic and anaerobic cellular respiration in humans

Explanation

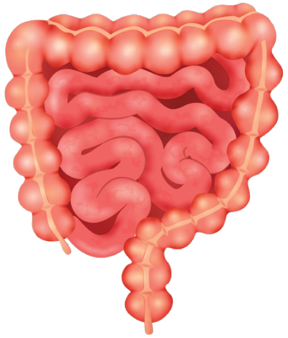
A chemical process called cellular respiration takes place in our cells to provide the energy we need for life processes.

Muscle contraction is a life process that requires energy from cellular respiration.

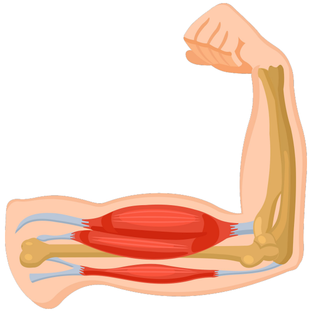
Muscle contraction:



makes our heart beat



moves food through our digestive system



moves our bones

Aerobic and anaerobic cellular respiration in humans

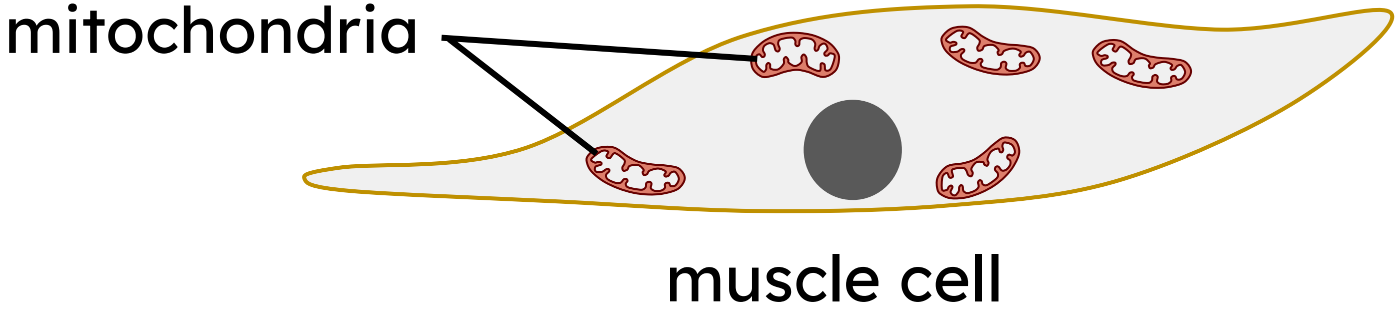
Explanation

Aerobic cellular respiration is a form of respiration that occurs in cells when they have plenty of oxygen.

The reactants and products of aerobic cellular respiration are:

$$\text{glucose} + \text{oxygen} \longrightarrow \text{carbon dioxide} + \text{water}$$

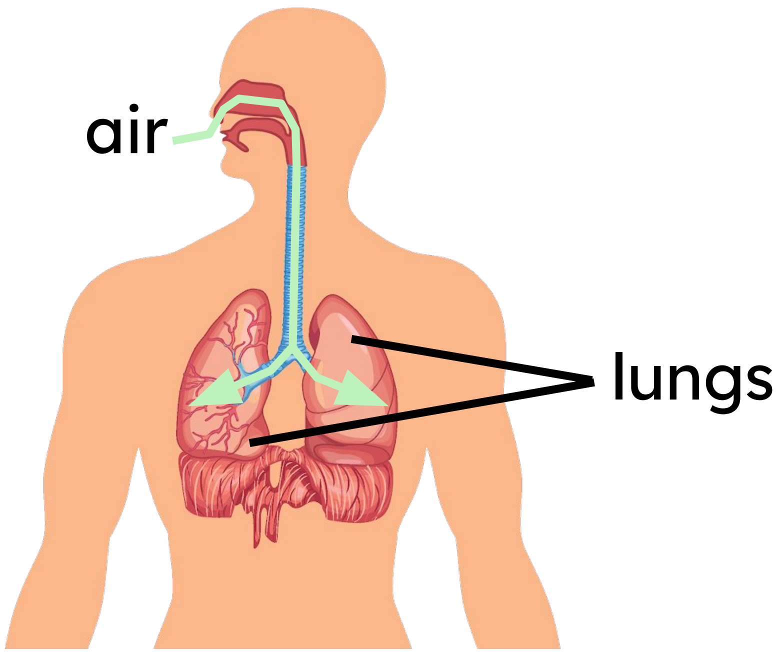
Aerobic respiration takes place in the cytoplasm and mitochondria in our cells.



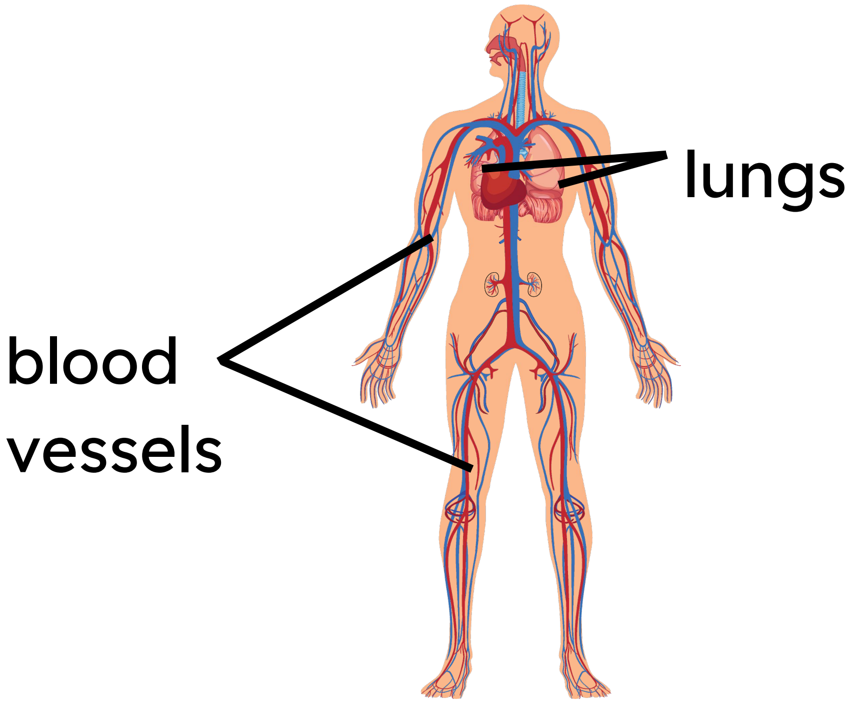
Aerobic and anaerobic cellular respiration in humans

Explanation

The oxygen that is needed for cellular respiration comes from the air we breathe in.



During breathing, air is moved in and out of the lungs.



Oxygen from the air in the lungs is transported to every cell in the body by the blood.

Which statements explain why muscle cells have a lot of mitochondria?

- **a** They are animal cells.
- **b** The mitochondria are needed for aerobic cellular respiration. ✓
- **c** The mitochondria make food for the cells.
- **d** Cellular respiration provides energy for muscle contraction. ✓

Aerobic and anaerobic cellular respiration in humans

Explanation



Our muscles work hard when we exercise.

The mitochondria in the contracting muscle cells need a lot of oxygen for cellular respiration.

Sometimes oxygen cannot be transported to the muscle cells fast enough.

Aerobic and anaerobic cellular respiration in humans

Explanation

Anaerobic cellular respiration takes place when there is no oxygen available for aerobic cellular respiration.

$\underbrace{\text{aero}}_{\text{air}}\text{bic}$

$\underbrace{\text{an}}_{\text{without}}\underbrace{\text{aero}}_{\text{air}}\text{bic}$

True or false?

Anaerobic respiration takes place when oxygen is not available.

T **True** ✓

F **False**

Justify your answer

a I know this because ‘anaerobic’ means without oxygen. ✓

b I know this because ‘respiration’ means without oxygen.

The word summary for anaerobic cellular respiration in humans is:

$$\underbrace{\text{glucose}}_{\text{reactant}} \longrightarrow \underbrace{\text{lactic acid}}_{\text{product}}$$

Glucose is the only reactant.

Lactic acid is the only product of anaerobic cellular respiration in humans.

When we exercise, we can sometimes get muscle cramps.

These are caused by a buildup of lactic acid in the muscle tissue.

This is because anaerobic cellular respiration has taken place because there was not enough oxygen reaching the cells for aerobic cellular respiration to take place.

muscle cramps

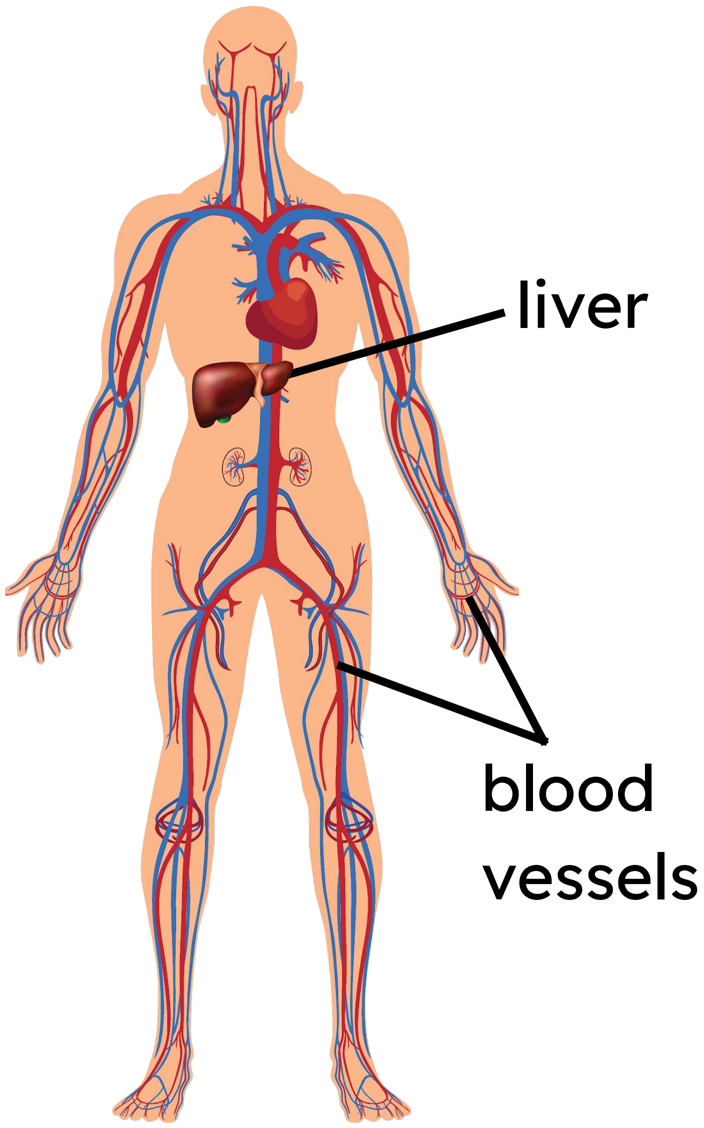
Aerobic and anaerobic cellular respiration in humans

Explanation

The lactic acid produced during anaerobic cellular respiration is a waste product.

It is transported to the liver by the blood.

The lactic acid is broken down in the liver to remove it from the body.



Check

Fill in the gaps to complete the word equations for aerobic and anaerobic cellular respiration in humans:

Use some of the key words from the list:

oxygen, glucose, carbon dioxide, lactic acid, water

Aerobic: glucose + oxygen → carbon dioxide + water

Anaerobic: glucose → lactic acid

Lesson outline

Anaerobic cellular respiration in humans

- Aerobic and anaerobic cellular respiration in humans
- Comparing aerobic and anaerobic respiration

Comparing aerobic and anaerobic respiration

Explanation

There are a number of similarities and differences between aerobic and anaerobic cellular respiration in humans.

They are both chemical reactions which use glucose as a fuel to provide energy for life processes.

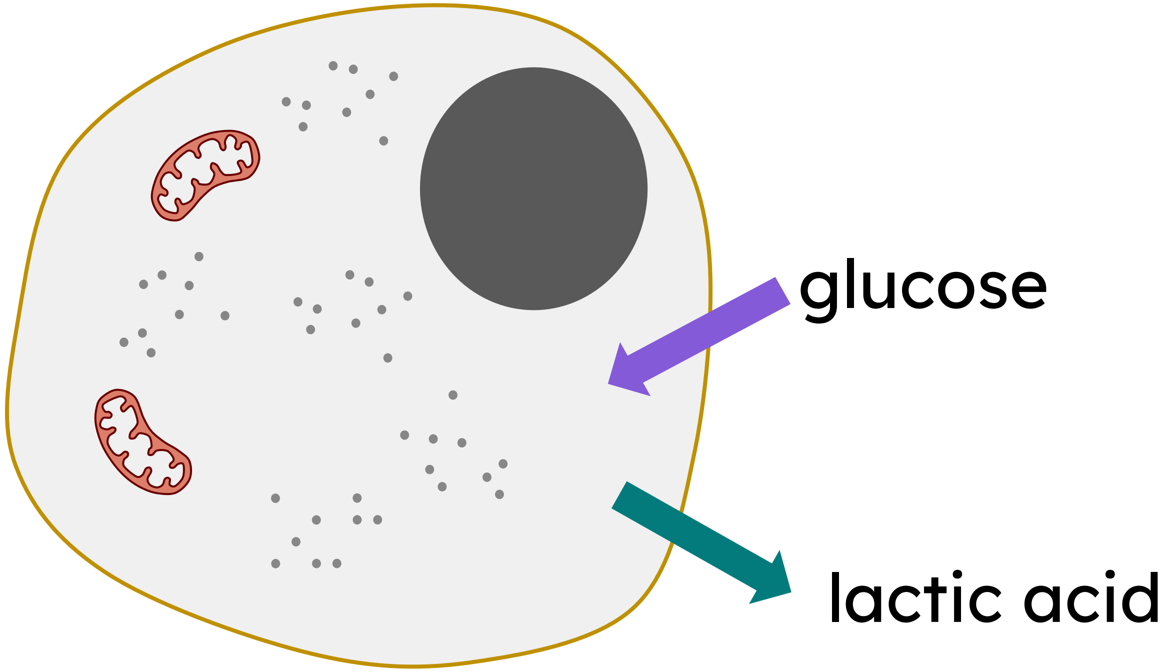
	Reactants	Products
Aerobic	→	
Anaerobic	→	

Comparing aerobic and anaerobic respiration

Explanation

One difference between the two processes is that **anaerobic** cellular respiration is a shorter process so provides energy more quickly.

However, it provides less energy for life processes than aerobic cellular respiration.



Which of the following statements are true?

a Anaerobic respiration provides energy more slowly than aerobic respiration.

b Anaerobic respiration provides less energy than aerobic respiration. ✓

c Anaerobic respiration provides more energy than aerobic respiration.

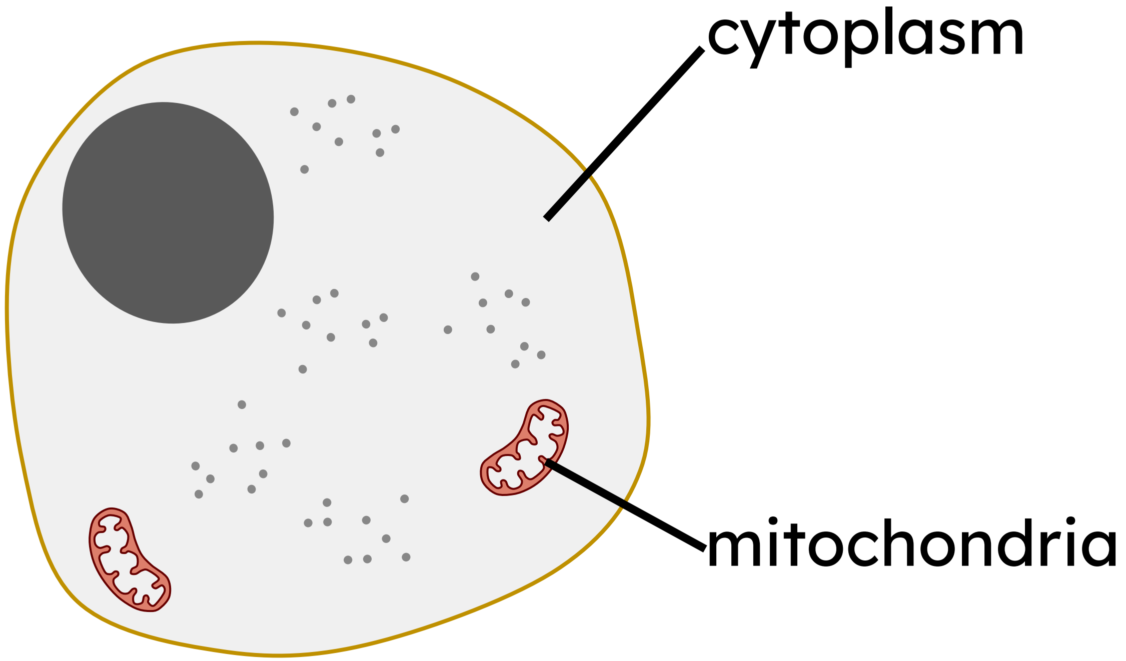
d Anaerobic respiration provides energy more quickly than aerobic respiration. ✓

Comparing aerobic and anaerobic respiration

Another difference between the two processes is the location where they occur inside cells.

Aerobic respiration takes place in the **cytoplasm** and partly in the mitochondria.

Anaerobic respiration takes place only in the cytoplasm.

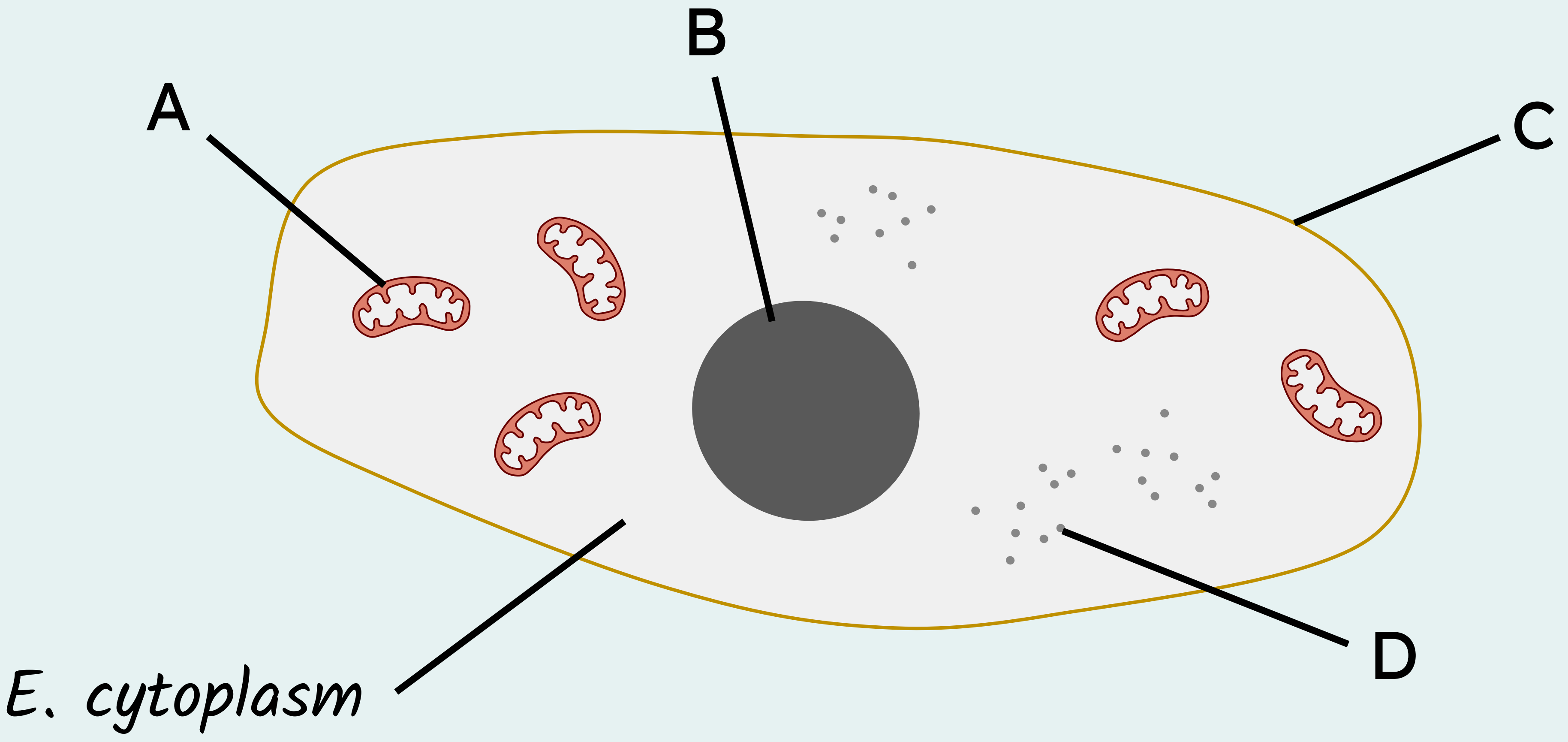


animal cell

Comparing aerobic and anaerobic respiration

Check

Where does anaerobic cellular respiration take place in the cell?



Lesson outline

Anaerobic cellular respiration and fermentation in microorganisms

- Anaerobic respiration in microorganisms
- Fermentation

Fermentation

Anaerobic cellular respiration in microorganisms is known as fermentation.

Humans have been using fermentation to make food and drink for thousands of years.

bread

wine

beer

yoghurt

Fermentation

Explanation

glucose ⟶ carbon dioxide + ethanol

Yeast is a microorganism added to dough in order to make it rise.

It breaks down the carbohydrates in the flour into glucose.

As the yeast anaerobically respires, carbon dioxide gas is produced causing the bread to rise.

bread

Fermentation

Explanation

glucose ⟶ carbon dioxide + ethanol

Yeast can be added to fruit or other plants to make alcoholic beverages.

In wine making, the yeast breaks down the carbohydrates in the grapes to glucose.

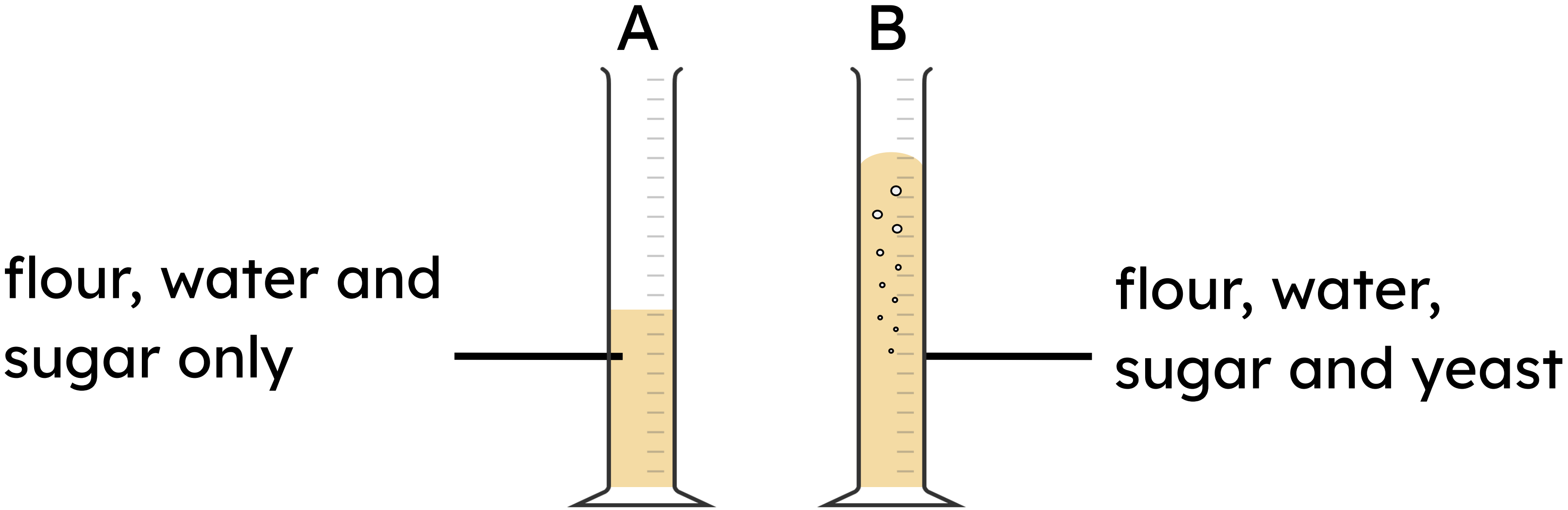
As the yeast anaerobically respires, ethanol is produced making the drink alcoholic.

wine

A student is conducting an experiment into yeast.

They fill two measuring cylinders with flour, sugar and water.

They add yeast to one cylinder only.



Explain as fully as you can why the dough in cylinder B rose, but the dough in cylinder A did not rise.

Task B Fermentation

Feedback

Explain as fully as you can why the dough in cylinder B rose but the dough in cylinder A did not rise.

- *Cylinder B contained yeast but cylinder A did not.*
- *Yeast is a microorganism which carries out anaerobic cellular respiration (fermentation) when in the dough.*
- *The yeast in cylinder B broke down the sugar into glucose.*
- *It used this glucose to carry out fermentation / anaerobic respiration.*
- *This caused carbon dioxide to be produced.*
- *This carbon dioxide gas causes bubbles in the dough, causing it to rise.*

END