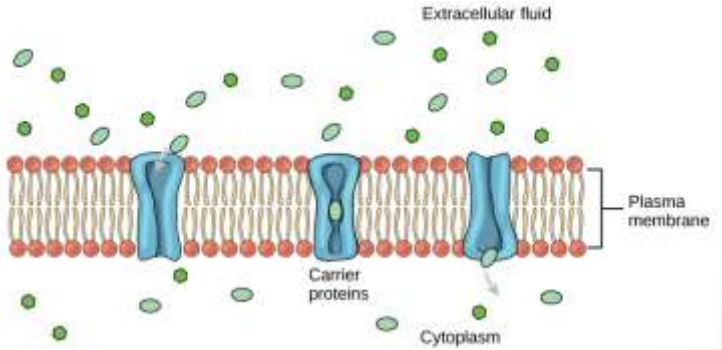
B3.1 Exchange in materials

Osmosis

- Movement of water molecules from a high concentration to a low, across a partially permeable membrane
- Salt in a solution (and other solutes) will affect osmosis, the more of the solute, the larger the movement of water into that area
- The consistency of the cytoplasm affects the rate of osmosis in and out the cell
- It helps plant support their stems and leaves, water moves into the vacuole to swell and press the cytoplasm against the cell walls. It is important that water moves into the cell, rather than out, so the solution around it needs to be dilute.

Active transport

- Allows cells to move substances **against the concentration gradient** (from low to high)
- Requires energy as it's an active process, this energy comes from respiration
- Cells can absorb ions from very dilute solutions
- Transport proteins in cell membranes are used to act as 'pumps' to move ions across the membrane.
- It is used in root hair cells and in the gut



Sports drinks

- When we exercise we lose water, sugar and mineral ions (e.g. sodium)
- Sports drinks contain mostly water, some sugar and mineral ions to replace electrolytes you have lost during exercise
- They're expensive, is it really worth it?

Exchanging materials

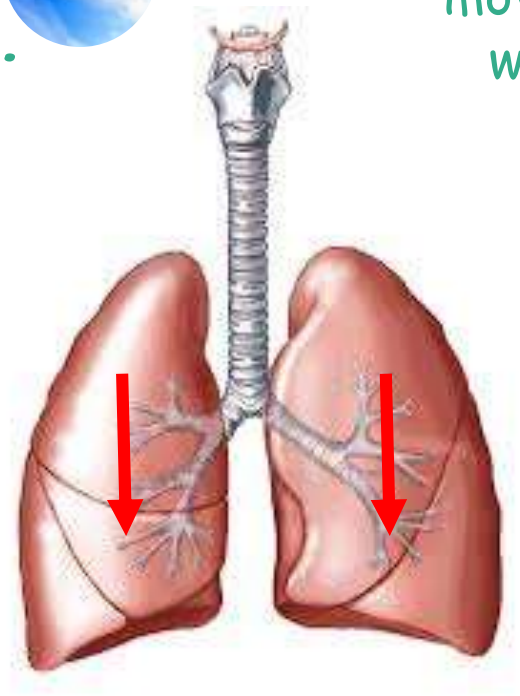
- For gaseous exchange we must have a large surface area, a short diffusion pathway (thinness), an efficient blood supply and good ventilation

In the lungs…

To move air in and out of the lungs the pressure gradient is very important

Air will move into the lungs… Hoorah!

To make the air move into the lungs we must reduce the pressure

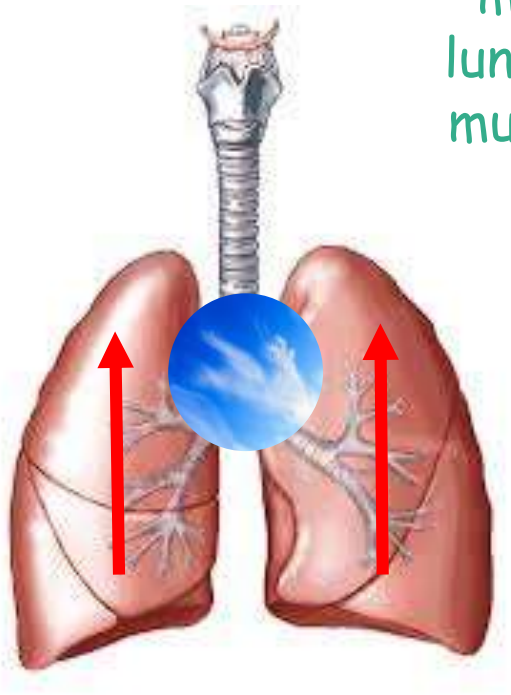


This means the **pressure outside** of the **lungs** is higher

In the lungs…

To move air in and out of the lungs the pressure gradient is very important

Air will move out of the lungs…



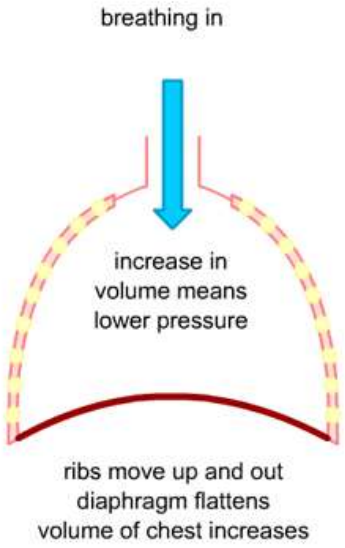
To make the air move out of the lungs the pressure must be increased

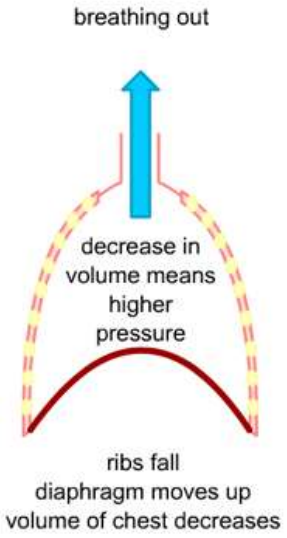
This means the **pressure outside** of the **lungs** is smaller

How do we change the pressure?

Change the size and shape of the lungs…

Larger space, lower pressure





Smaller space, higher pressure

Ventilation

The ribs, intercostal muscles and diaphragm all play important roles in **ventilation** (breathing).

Breathing in

- When you inhale:
- the internal intercostal muscles relax and the external intercostal muscles contract, pulling the ribcage upwards and outwards
- the diaphragm contracts, pulling downwards
- lung volume increases and the air pressure inside decreases
- air is pushed into the lungs

Breathing out

- When you exhale:
- the external intercostal muscles relax and the internal intercostal muscles contract, pulling the ribcage downwards and inwards
- the diaphragm relaxes, moving back upwards
- lung volume decreases and the air pressure inside increases
- air is pushed out of the lungs

Breathing aids

You might need a breathing aid if:

1. The tubes leading to your lungs become very narrow
2. The structure of the alveoli break down
3. Paralysis of the lungs

Breathing aids work through negative or positive pressure.

- Iron long – negative-pressure ventilator ('sucking' out the air)
- Positive pressure – 'breathing' air into the lungs

Exchange in the gut

- Food is broken down in your gut and these are absorbed into the blood stream.
- They do this by a combination of diffusion and active transport.
- The molecules in our food are broken down so they are small enough to move freely out of the gut and into the blood stream.
- The gut must have a very large SA for this, the villi help this
- As your last meal gets longer and longer ago, the concentration of molecules in the gut gets longer. Therefore active transport is used to continue moving these against the concentration gradient.

Exchange in plants

- Carbon dioxide, oxygen and water diffuse in through the leaves. The leaves have a large SA to increase this, and are thin for a short diffusion pathway
- The leaves have a waxy cuticle layer that makes them waterproof and 'gas proof' to reduce the loss of water, carbon dioxide and oxygen
- The stomata are the pores on the underside of the leaf that allow diffusion in and out, along the concentration gradient. They are opened and closed by the guard cells.

Transpiration

- Water enters root hair cells
- In the centre of the root the water enters the xylem vessels.
- Water rises from the roots to the leaves through the xylem vessels because the water molecules sort of stick together via cohesion-tension theory
- Water leaves the leaves through little holes on the bottom of the leaf – these are called stomata
- The loss of water from the leaves causes the water to be pulled up the xylem
- There is now room for water to enter the roots, this is the transpiration stream.

How can a plant control the loss of water?

1. Waxy, waterproof cuticle layer
2. Wilting – reducing the surface area for evaporation
3. Stomata close using guard cells

Draw a set of balanced scales with these labels. Write what affects transpiration and how it is controlled under one side, and how a plant obtains carbon dioxide and why it needs it under the other.

Need for carbon dioxide

Control of water loss

Q1. The table shows the percentage of some gases in the air a boy breathed in and out.

Gases	Air breathed in	Air breathed out
carbon dioxide	0.04%	4.0%
oxigen	20.0%	16.0%
water vapour	1.0%	6.0%

(a) What happens in the lungs to change the levels of oxygen and carbon dioxide in this way?

Oxygen .....

.....

.....

Carbon dioxide .....

.....

.....

(4)

(b) Compare the percentage of water vapour in the air breathed out with the percentage in air breathed in.

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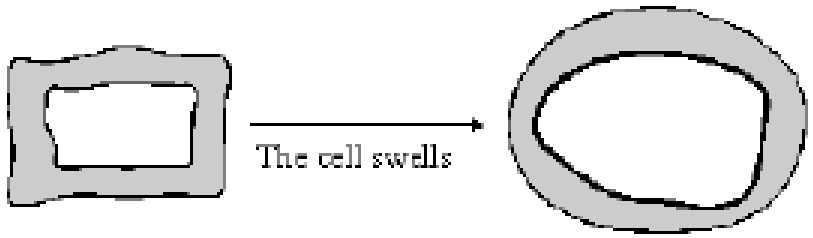
(2)

(Total 6 marks)

Q2. (a) The diagrams show what happens to the shape of a plant cell placed in distilled water.



(ii) Give **one** feature of the cell wall which allows the cell to become turgid.

.....

(1)

(b) Describe the change which will occur if a piece of peeled potato is placed in a concentrated sugar solution and explain why this change occurs.

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.....

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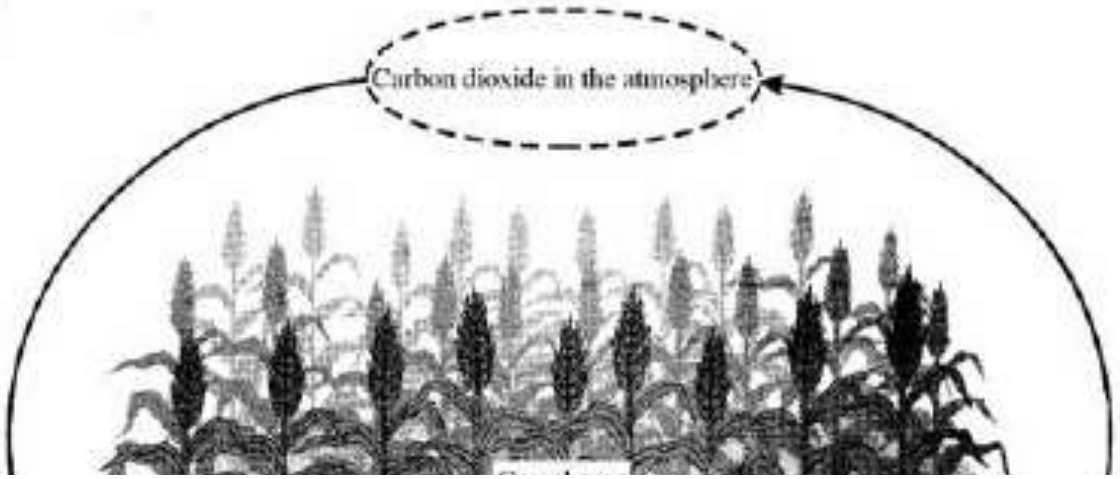
(3)

(Total 6 marks)

Q3. (a) The diagram shows a cereal crop.

Complete spaces (i) and (ii).



(b) Describe the process of transpiration in plants.

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.....

.....

.....

(3)

(Total 6 marks)

##

(a) oxygen passes from the air/lungs into the body

gains 1 mark

but

oxygen passes from the air/lungs into the blood

gains 2 marks

carbon dioxide passes from the body into the air/lungs

gains 1 mark

but

carbon dioxide passes from the blood into the air/lungs

gains 2 marks

4

(b) increased/5% more

gains 1 mark

but

6 times more (in air breathed out)

gains 2 marks

2

[6]

M2. (a) (i) water (molecules) enter(s) (the cell)

or water (molecules) pass(es) through the (semi-permeable) cell membrane

1

by osmosis

or because the concentration of water is greater outside (the cell than inside it the vacuole)

accept because of the concentration gradient provided there is no contradiction

1

(ii) any one from

(it is) elastic

(it is) strong

(it is fully) permeable (to water)

or water can pass through it

do not credit semi-permeable

do not credit cell membrane is semi-permeable

1

(b) (the piece of) potato shrinks

or loses its turgor
or becomes flabby
or becomes flaccid
or plasmolysis occur
or cytoplasm pulls away from the cell wall

(because) concentration of sugar

or because concentration of water

1

(solution) is greater than concentration inside the cell / vacuole

inside the cell / vacuole is greater than concentration (of water) outside

1

water is drawn out of the cell

1

[6]

M3. (a) (i) photosynthesis

1

(ii) respiration

do not credit combustion

do not credit decay

1

(iii) dry

accept hot or windy or drought

1

(b) any **three** from

* evaporation (of water)

or loss of water vapour

* (mostly) from the leaf / leaves

do not credit incorrect reference to leaves

* through the stomata

accept through each stoma

accept through the stomas(sic)