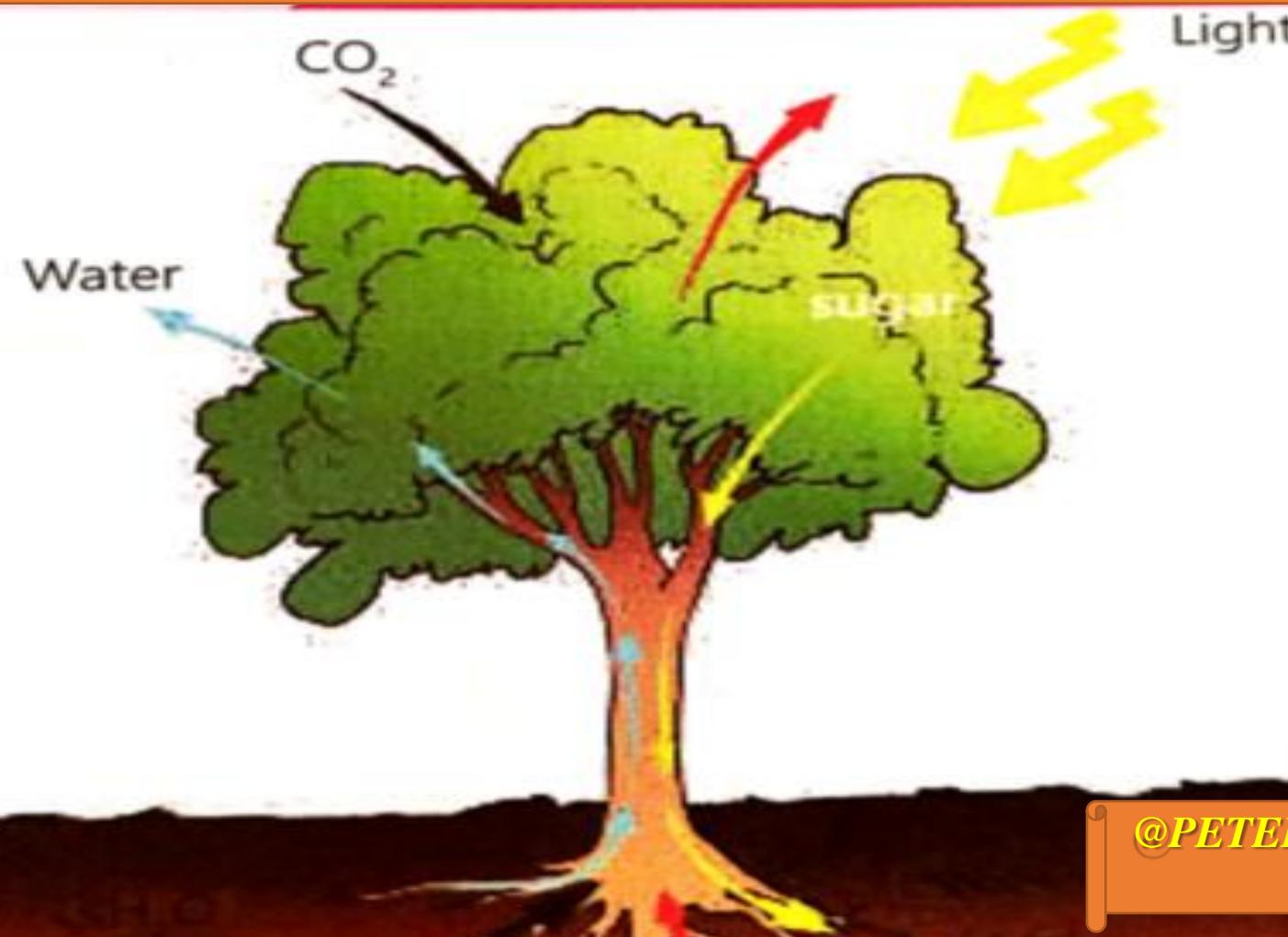


# TRANSPORT IN PLANTS



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758795415

# By the end of this chapter, I should be able to:

Understand the importance and key methods of movement of materials into and out of cells.

Investigate the different ways in which materials move into, through and out of cells.

Know how the root hair is adapted for absorption of water and mineral salts.

Understand the processes of transpiration and translocation.

Conduct experiments on and understand the factors that affect transpiration.

# Introduction

**Transport refers to the movement of materials from one part of the organism to another.**

Food for thought

While moving in the grass early in the morning, your feet or shoes get wet even though it did not rain the night before. Where do you think the water that wets your feet comes from?



# ***Movement of materials in and out of cells***

## **Activity :**

understanding the importance of movement of materials in and out of cells.

## **Procedure:**

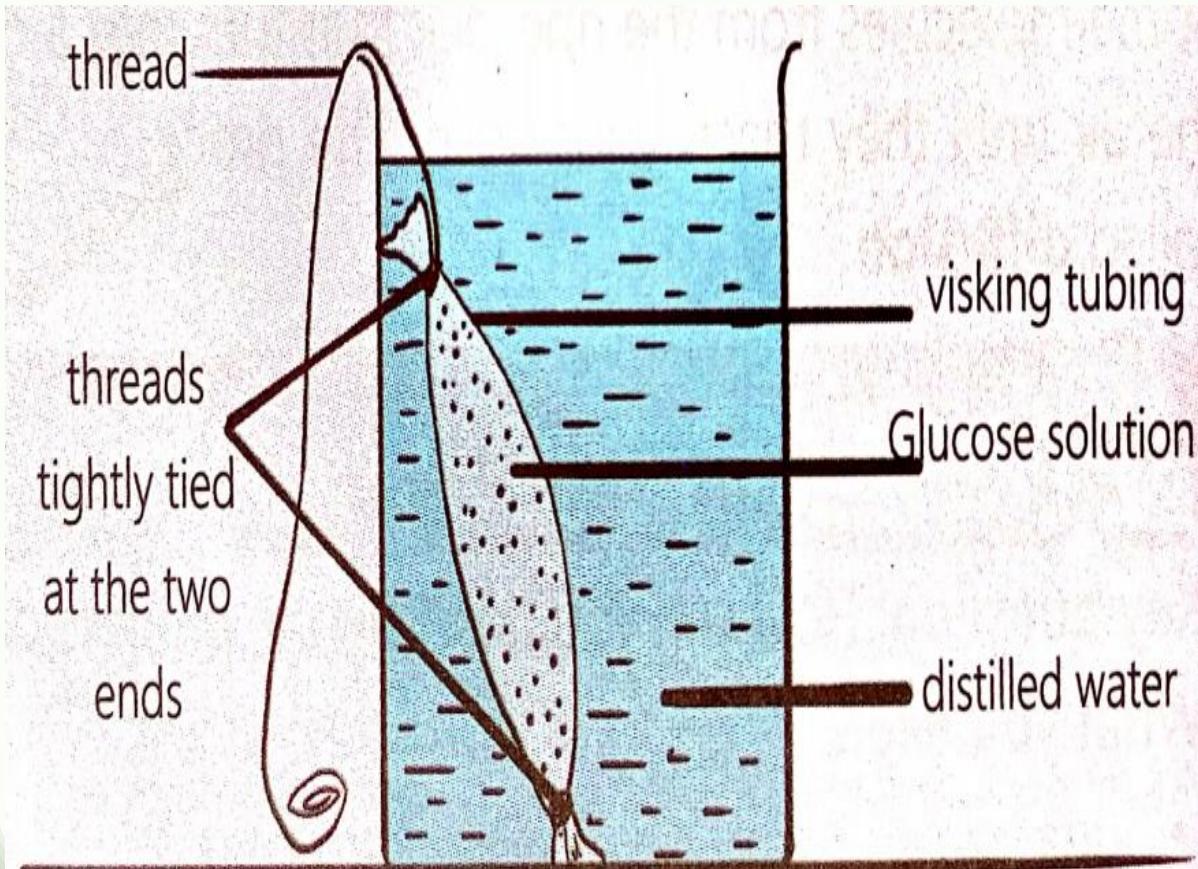
Set up the apparatus as shown below and leave them to stand for 10minutes

Note the appearance of the visking bag and carryout a test for reducing sugars on contents of the beaker just before the visking tube is lowered into the beaker.

Obtain the volume of the contents of the visking bag. Repeat the procedure above after 10minutes. Record your observations in the table below.

# Results

## Set up of the experiment



## Table of results

	At the start	After 10minutes
Appearance of the visking bag		
State of reducing sugars in beaker contents		
Volume of visking bag contents		

# Qns:

1. With reasons, identify the processes responsible for the observations made above.
2. Which structures in your body do you think can be similar to the visking tube?
3. Suggest what would happen to the body of the living organisms if the processes identified above are stopped in one way or another.

# Soln

	<b>At the start</b>	<b>After 10minutes</b>
Appearance of the visking bag	Shrunk	Thicker/ more swollen
State of reducing sugars in beaker contents	Reducing sugars absent	Reducing sugars present
Volume of visking bag contents	5cm3	More than 5cm3

Ctd

1. Movement of water into the visking tube from the beaker was by OSMOSIS. Movement of glucose molecules out of the visking tube to the beaker was by DIFFUSION.
  2. Lining of the ileum, kidney tubules, Alveolus walls
  3. .
- Absorption of end products of digestion stops
  - Re-absorption of materials across kidney tubules is slowed down and most of them are lost in urine hence their shortage in the body.
  - Exchange of gases is hampered with leading to accumulation of carbon dioxide in the body and shortage of oxygen in tissues leading to anemia.

# *Processes through which Materials Move In and Out of Cells*

## 1). DIFFUSION

This is the movement substances from a region where their concentration is high to a region where their concentration is low.

Diffusion is possible for small molecules of gases and liquids because they are in constant random motion, unlike in solids where molecules are closely packed together and have no freedom of movement.

*NB: Diffusion only takes place where there is a difference in concentration of a substance.*

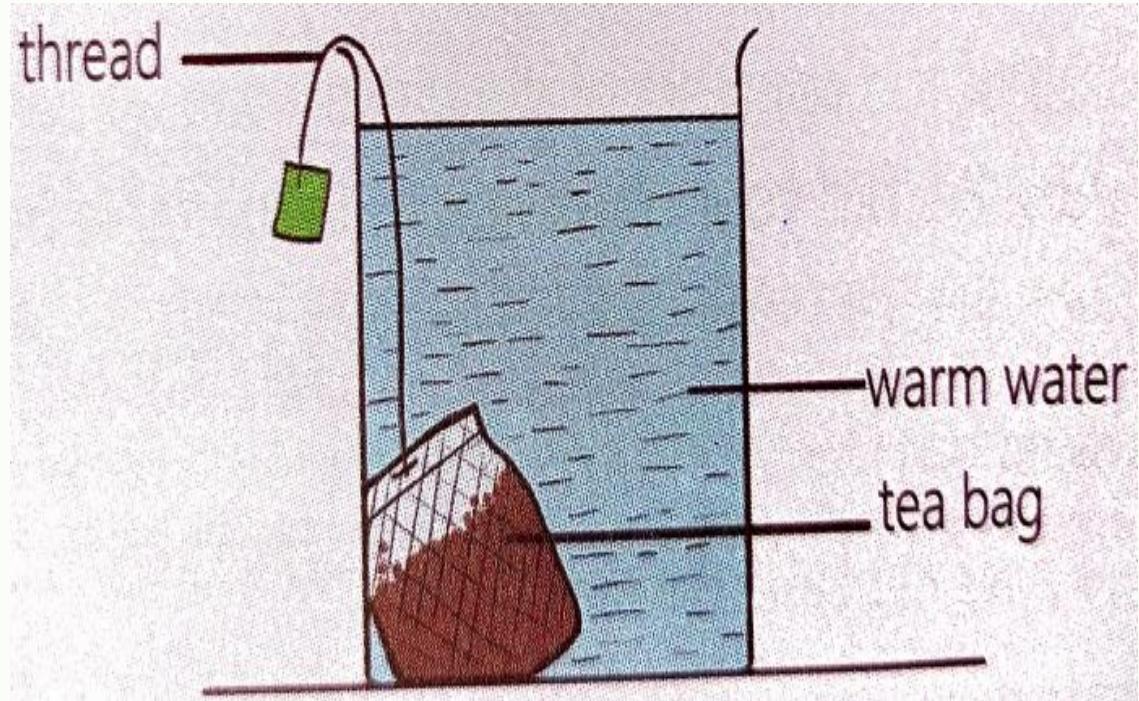
# **ACTIVITY: Investigating the process of diffusion**

## Materials:

Tea bag, warm water, stop clock, beaker, notebook, pen, clear glass

## Procedure (work in groups)

1. Pour warm water into a clean glass beaker to half fill the beaker
2. Obtain a new tea bag and dip it into a beaker containing warm water as shown in the figure below. Immediately start the timer.



# Ctd

3. Leave the set up to stand for 5 minutes and describe what you observe in the set up in the table below:

Color of water before adding a tea bag	2minutes after adding a tea bag	5minutes after adding a tea bag

4. Discuss and explain your observations.
5. Through a whole class discussion, explain the meaning of the term diffusion.

Questions:

- a) Why was warm water used instead of cold water in the experiment?
- b) Why was a glass beaker used in this investigation?

# Soln

Before	After 2 minutes	After 5 minutes
Colorless	Light brown tea color	Deep brown tea color

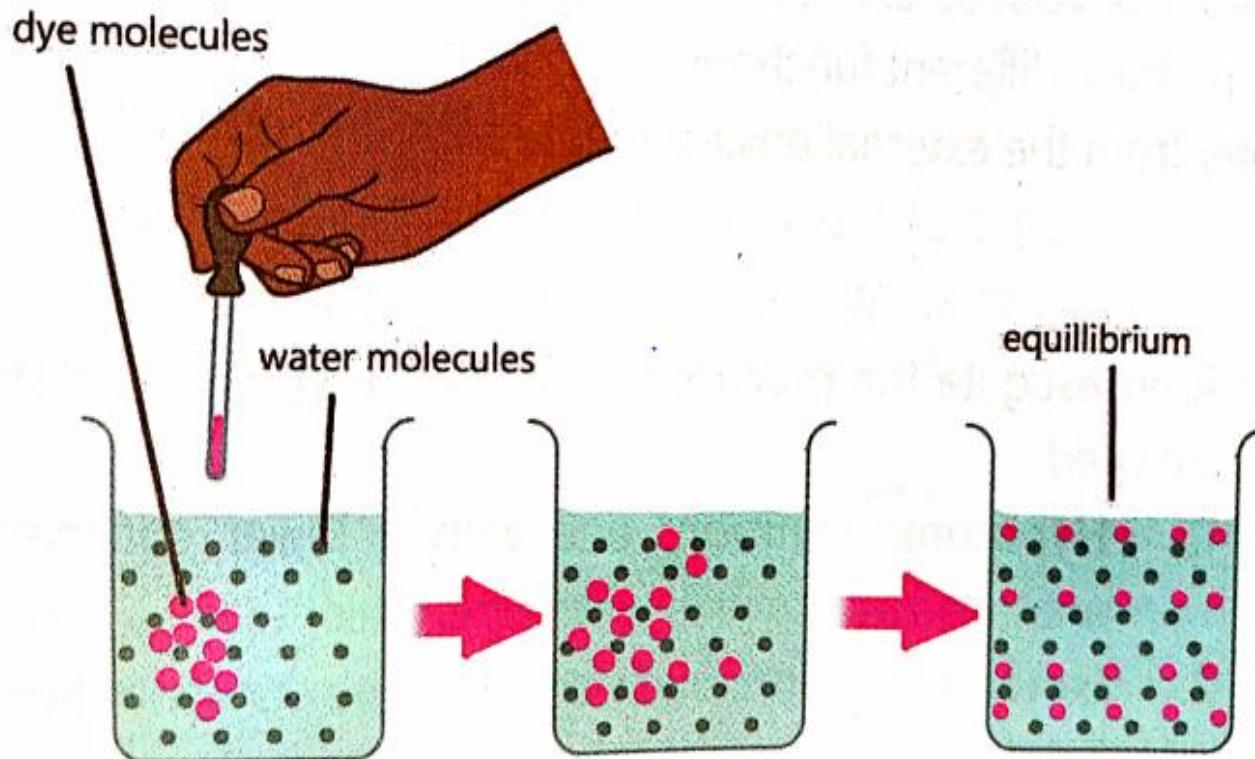
4. The tea molecules moved up by diffusion from the tea bag into the warm water spreading by diffusion to turn the entire water brown. The intensity of the brown color increased with time allowed for diffusion to occur.

# Ctd

5. Diffusion is the process by which molecules/ ions move from a region of their high concentration (for example tea molecules in the tea bag) to regions of their low concentration (for example the warm water). The molecules spread until an equilibrium is established between the two regions

- a) To increase the rate of diffusion by increasing the kinetic energy of tea molecules making them spread faster.
- b) It is transparent to allow easy and clear observations.

# Movement of molecules by diffusion



The molecules move between regions until equilibrium (Balance) is established and the molecules are uniformly distributed in the two regions as shown above

# Factors affecting the rate of diffusion

The movement of molecules by diffusion is influenced by a number of factors e.g.

- 1) Temperature
- 2) Concentration gradient
- 3) Distance over which diffusion occurs
- 4) Surface area over which diffusion occurs
- 5) Size of diffusing materials

## TASK

- a) Explain how each of the above factors affects the rate of diffusion.
- b) Explain the difference in the rate of diffusion when you dissolve sugar in cold water and in hot water.
- c) Why does sugar dissolve faster in water than in a sugar solution?

## Factors which affect the process of diffusion

### (i) Temperature

**Increase in temperature increase the rate of diffusion. This is because increase in temperature increases the kinetic energy of the diffusing molecules making them to move faster.**

### (ii) Size of diffusing molecules

**The smaller the molecules, the faster the rate of diffusion. The larger the diffusing particles, the slower the rate of diffusion. For example, molecules of glucose (monosaccharide) diffuse faster than those of starch (polysaccharide).**

### **(iii) Distance over which diffusion occurs**

*The shorter the distance between two regions over which diffusion has to occur, the faster the rate of diffusion.*

### **(iv) Surface area over which diffusion occurs**

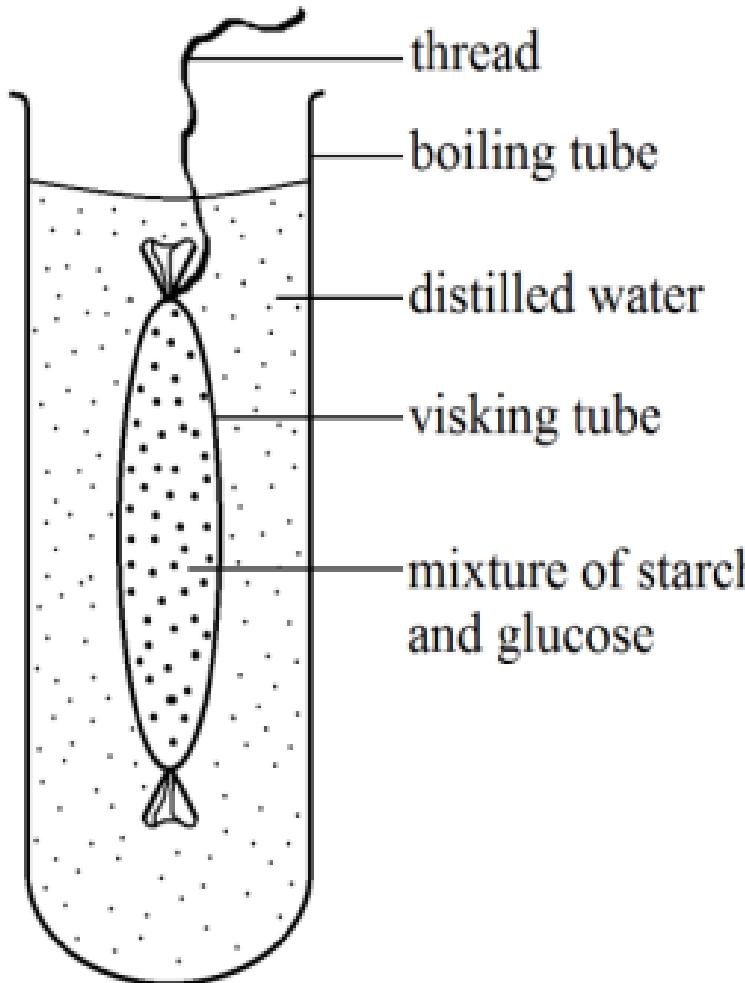
*The larger the surface area over which diffusion is to take place, the faster the rate of diffusion.*

### **(v) Concentration gradient**

*Concentration gradient is the difference in concentration between the two regions where diffusion is to take place. The higher the concentration gradient between two regions, the faster is the rate of diffusion.*

# Sample question

1. A solution containing starch and glucose was put in a visking tube in the set-up shown in figure below and left to stand for 30 minutes.



After 30 minutes, samples were drawn from the contents of the tube and boiling tube, then iodine and Benedict's tests carried out on each of them

- (a) Describe what was observed with iodine test on
  - (i) Visking tube content **(00½ mark)**
  - (ii) Boiling tube content **(00½ mark)**
- (b) Explain your observation in (a) **(02 marks)**
- (c) Describe what was observed with Benedict's test on
  - (i) Visking tube content **(01 mark)**
  - (ii) Boiling tube content **(01 mark)**
- (d) Explain your results in (c) **(03 marks)**
- (e) Giving reasons, state the nature of the visking tube **(02 marks)**

# **OSMOSIS**



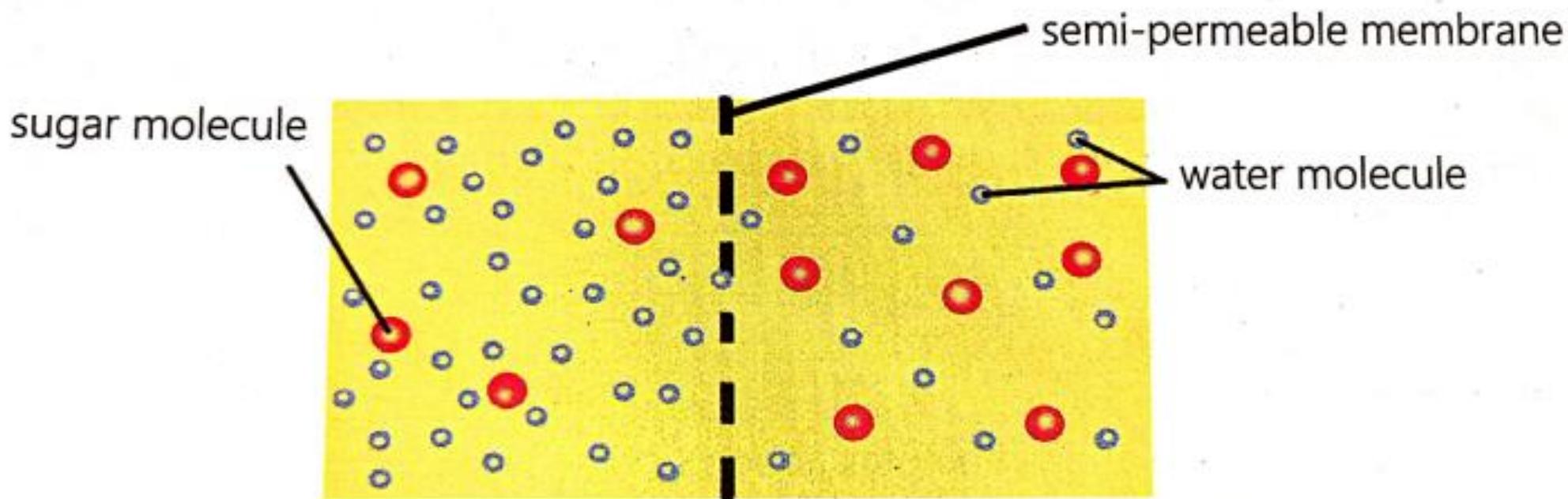
This is the *movement of water molecules from a region of their high concentration to a region of their low concentration across a semi permeable membrane.*

***Or***

*It is the movement solvent molecules from a solution of low solute concentration to a solution of high solute concentration across a semi permeable membrane.*

A semi/partially/selectively permeable membrane is one which allows the passage of some molecules and prevents other molecules from passing through it.

# *Illustration*



## **Solution A**

- less concentrated
- more water molecules
- hypotonic

## **Solution B**

- more concentrated
- less water molecules
- hypertonic

**water moves in this direction**

# ***Definition of terms***

- i) ***Hypotonic solution:*** is one with a lower concentration than another solution with which it is in contact.
- ii) ***Hypertonic solution:*** is one with a higher concentration than the other solution with which it is in contact.
- iii) ***Isotonic solution:*** is one with the same concentration as the other solution with which it is in contact.

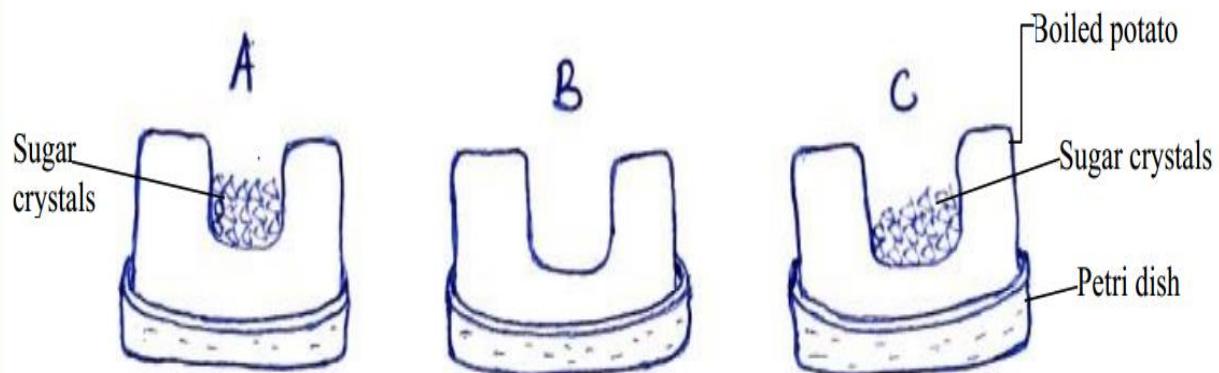
# *EXPERIMENT TO DEMONSTRATE OSMOSIS IN A LIVING TISSUE*

**Apparatus :** Fresh Irish potatoes, knife, Petri dishes, sugar or salt, water

## **Procedure**

- a) 2 fresh Irish potatoes are peeled and cut transversely to obtain 3 equal halves, A, B and C. They are trimmed so that the opposite transverse sides are flat.
- b) A cavity is created on one side of each of the three halves of the Irish potatoes.
- c) In A, sugar crystals are placed in the cavity, while the cavity of B is left empty as a control.
- d) C is boiled to kill the tissue and sugar crystals are put in the cavity.
- e) All the potato cups are placed in water in Petri dishes. The experiment is let to run for 2 hours.

# **SET UP**



## **Observation**

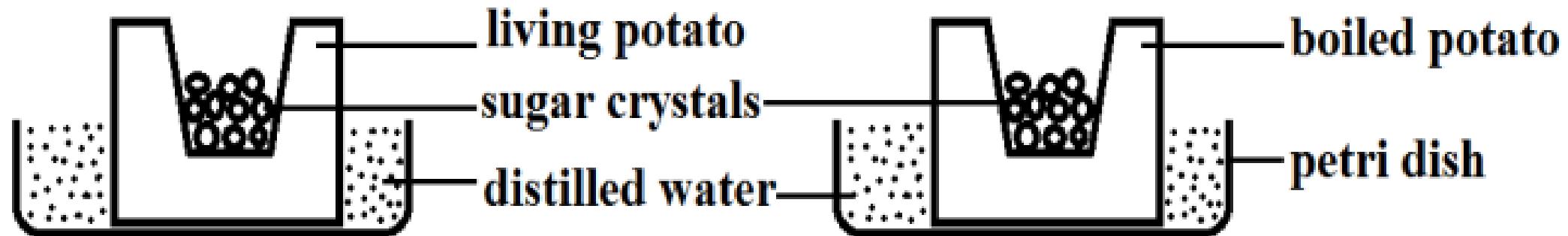
- ✓ Solution forms in cavity of A, volume of water in the petri dish reduces.
- ✓ Cavity of B remains empty, no solution forms, and level of water in petri dish remains constant
- ✓ No solution forms in cavity of C and level of water in petri dish remains constant

## **Conclusion**

Osmosis takes place in living tissues and does not take place in dead tissues. Boiling the Irish potato kills the tissue, destroying the semi permeable membrane

# *Sample question*

Figure below shows the set up of an experiment that was carried out by a senior three student to demonstrate a process in a plant tissue. Study it carefully and answer the following questions.



- a) State the aim of the experiment. **(01 mark)**
- b) Describe what would be observed after 30 minutes. **(02 marks)**
- c) Explain the observations made in (b) above. **(03 marks)**
- d) Outline the importance of the process demonstrated in this experiment. **(03 marks)**
- e) State one application of the process taking place in the experiment **(01 mark)**

## *ACTIVITY (in groups)*

***AIM: To demonstrate effect of osmotic flow of water on plant tissue***

### **Materials :**

Cork borer 5mm diameter, Test tubes, Water (C), 10% sucrose solution (A), Measuring cylinder, Irish potato, Razor blade, 5% Sucrose solution(B)

### **Procedure**

- i) Peel the Irish potato and using a cork borer, obtain three cylinders by boring through the long ends of the potato
- ii) Trim the cylinders to a length of 4cm each

Ctd

- iii) Add 10cm<sup>3</sup> of solution A into a boiling tube and label it A
- iv) Repeat procedure (iii) using solution B and C
- v) Add one cylinder in each of the boiling tubes
- vi) Leave the setups for 30 minutes
- vii) Remove cylinders, feel the texture of the cylinders, measure the length of each cylinder.
- viii) Record your results in the table below

***Initial length=4cm***

Solution	Final length/cm	Change in length/cm	% change in length	Texture(soft/tough)
A	3.8			Soft and flabby
B	4.0			Relatively hard
C	4.3			hard

### ACTIVITY:

- Tabulate figures for change in length and percentage change in length, fill in the table above
- From the table, record suitable observations and conclusions regarding the state of the cylinders

### Observation

A.....  
 B.....  
 C.....

### Conclusion

A.....  
 B.....  
 C.....

Study the pictures A and B below.

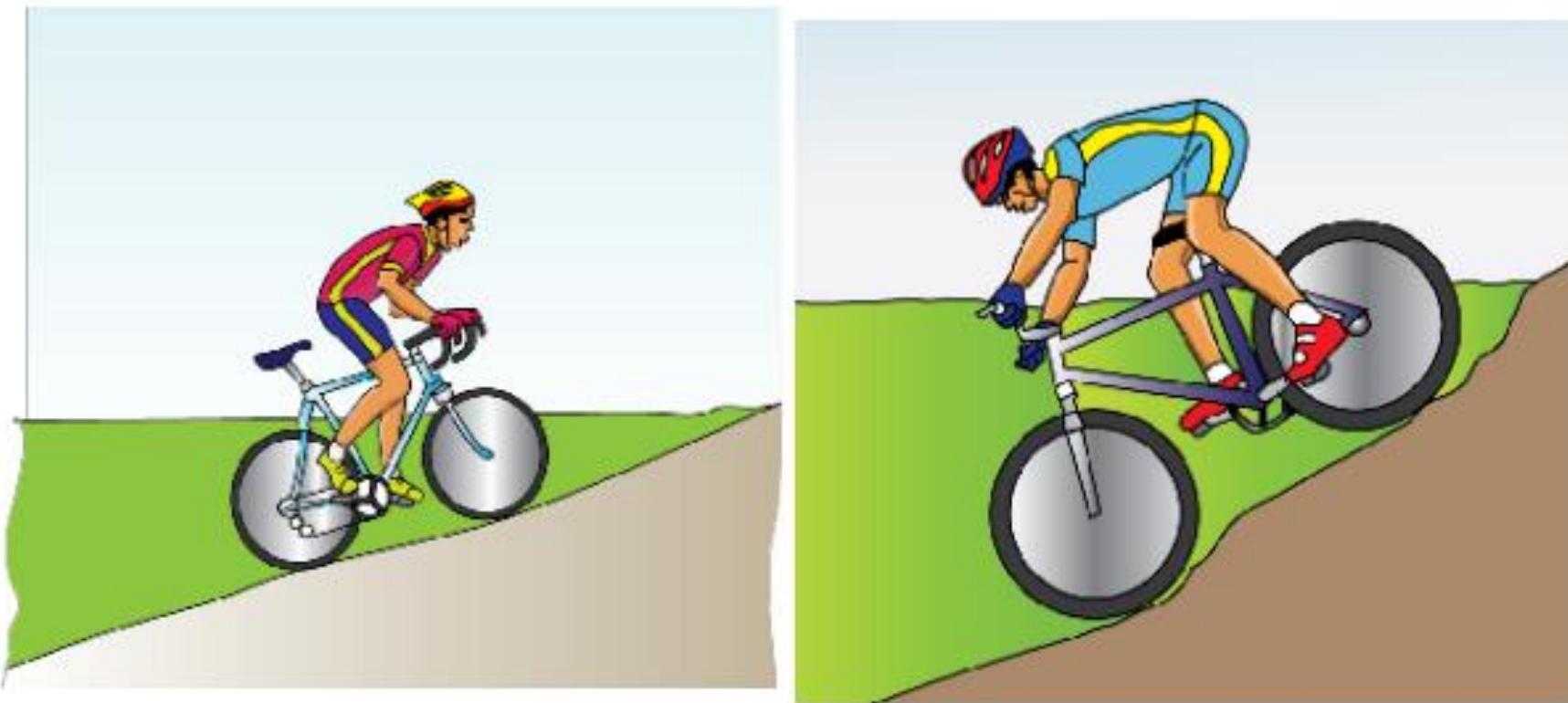


Fig 4.1 A

B

What is going in the pictures? Which is easier, climbing uphill or going downhill? Why is that the case? How do actions in the pictures relate to active transport? Think about how things are transported in our bodies. Are there special things that help in the transportation process? What do they do?

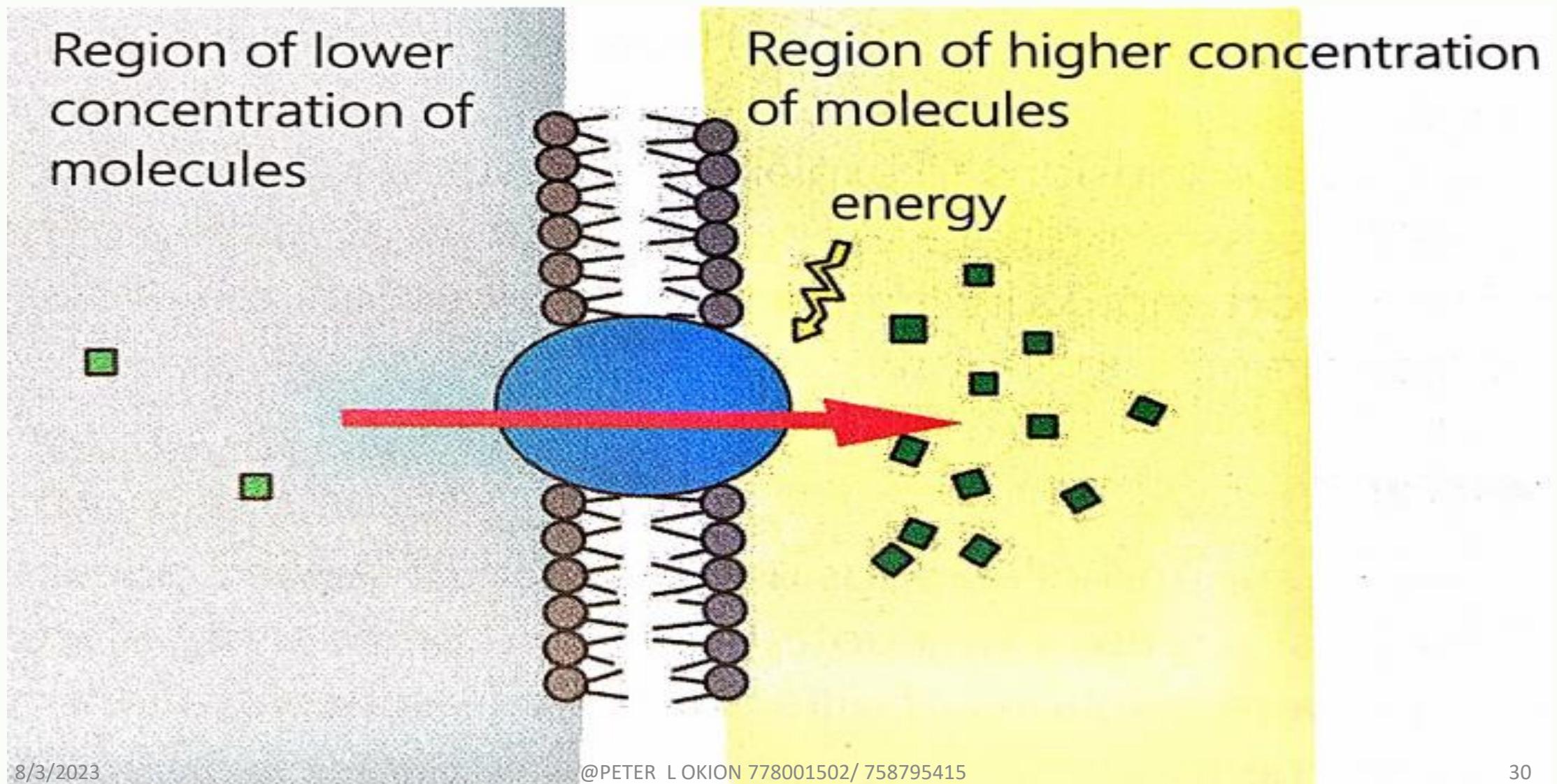
# ACTIVE TRANSPORT

*This is the movement of substances from a region where their concentration is low to where it is high using energy from a cell.*

During active transport, molecules move against a concentration gradient.

The energy used is derived from ATP formed during respiration.

# Illustration of the process of Active Transport



# *Applications and differences between Diffusion, Osmosis and Active Transport*

	Diffusion	Osmosis	Active Transport
<b>Materials moved</b>	Both molecules and ions	Only solvent molecules (water)	Both molecules and ions
<b>Direction of movement of molecules</b>	Along a concentration gradient	Along a concentration gradient	Against a concentration gradient
<b>Energy Requirement</b>	Passive process	Passive process	Active process
<b>Requirement for movement of materials</b>	<ul style="list-style-type: none"><li>➤ Existence of a concentration gradient</li><li>➤ Semi –permeable membrane</li></ul>	<ul style="list-style-type: none"><li>• Semi- permeable membrane</li><li>• Concentration gradient of solvent molecules</li></ul>	<ul style="list-style-type: none"><li>✓ Transport proteins</li><li>✓ Carrier protein</li><li>✓ Energy</li></ul>

	<b>Diffusion</b>	<b>Osmosis</b>	<b>Active Transport</b>
<b>Application</b>	<p><b>Plants:</b></p> <ul style="list-style-type: none"> <li>✓ Absorption of mineral salts by plant roots</li> <li>✓ Exchange of gases by mesophyll cells</li> </ul> <p><b>Animals:</b></p> <ul style="list-style-type: none"> <li>➤ Exchange of gases at the alveolus</li> <li>➤ Absorption of end products of digestion across the walls of the ileum</li> <li>➤ Selective reabsorption of materials in kidney tubules</li> </ul>	<p><b>Plants:</b></p> <ul style="list-style-type: none"> <li>✓ Absorption of water molecules from the soil by roots</li> <li>✓ Imbibition of water by germinating seeds.</li> <li>✓ Opening and closing of stomata and flowers of some species</li> <li>✓ Support in woody plants</li> </ul> <p><b>Animals:</b></p> <ul style="list-style-type: none"> <li>➤ Reabsorption of water across kidney tubules</li> <li>➤ Movement of water into unicellular protists</li> </ul>	<p><b>Plants:</b></p> <ul style="list-style-type: none"> <li>✓ Further absorption of mineral salts from the soil by plant roots</li> </ul> <p><b>Animals:</b></p> <ul style="list-style-type: none"> <li>➤ Exchange of ions during transmission of nerve impulses</li> <li>➤ Selective reabsorption of materials across kidney tubules</li> <li>➤ Absorption of end products of digestion in the ileum</li> <li>➤ Removal of toxic wastes from kidney tissues into the nephron</li> </ul>

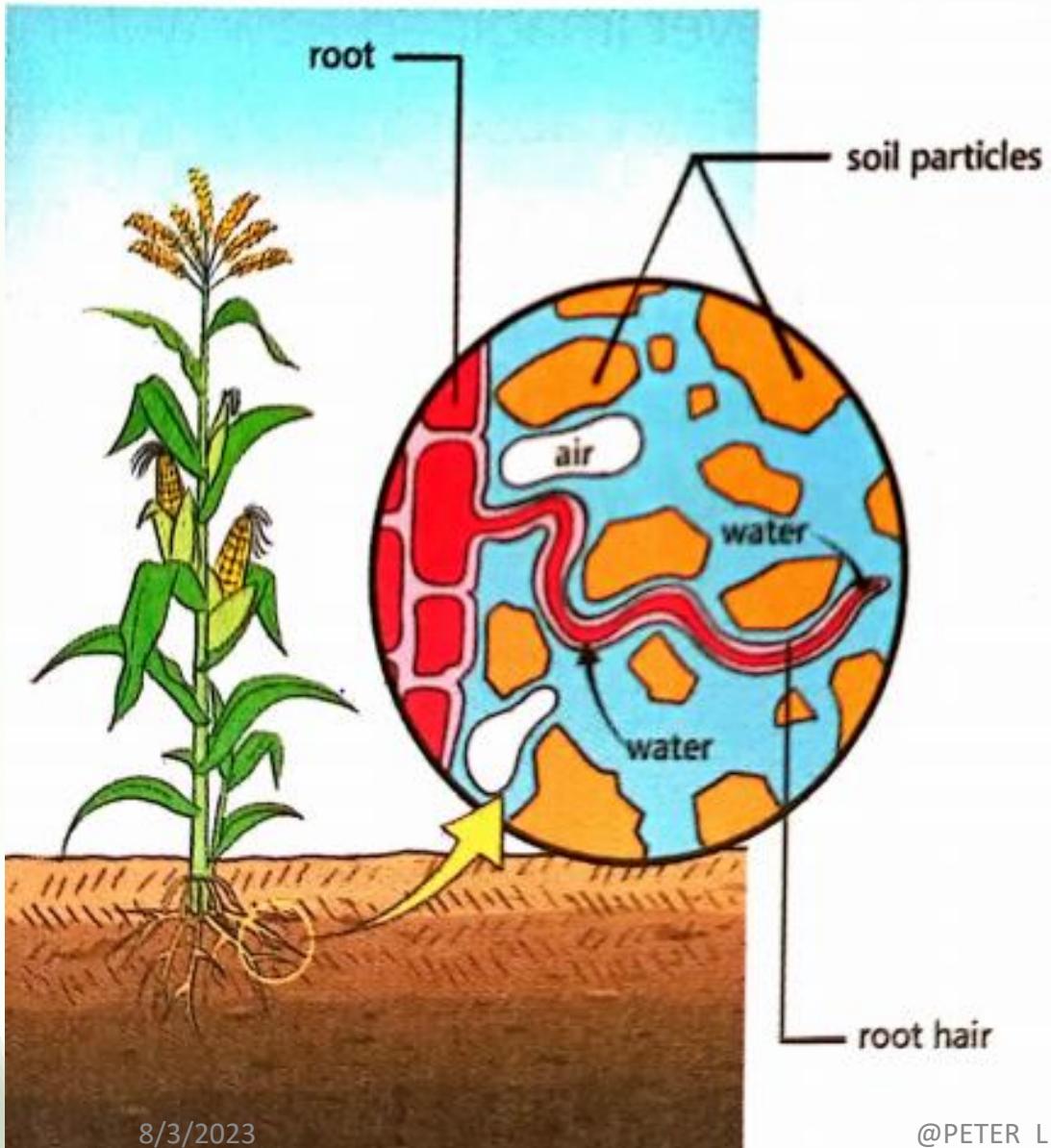
# Quiz:

1. Why is Osmosis considered a form of diffusion?
2. If the land on which maize crops are growing is flooded by sea water, suggest the effect sea water could have on the plants.

Soln

1. Because it involves movement of molecules of molecules along the concentration gradient
2. Drying of plants due to their plant roots losing water by osmosis to the concentrated soil.

# *Absorption of Water and Mineral salts in Plants*



**QN:** Which structures are necessary for absorption water and minerals by the plant?

**Tip:** Mineral salts are soluble in water, they dissolve in water and are transported together with water depending on the concentration gradient.

# Adaptations of the root hair for its function

- ✓ They are numerous to increase the surface area over which absorption of mineral salts and water can take place.
- ✓ They are highly flexible thus can grow between soil particles avoiding obstacles
- ✓ They are thin walled to reduce the distance over which materials diffuse
- ✓ They contain solutes which create a concentration gradient along which water molecules move.

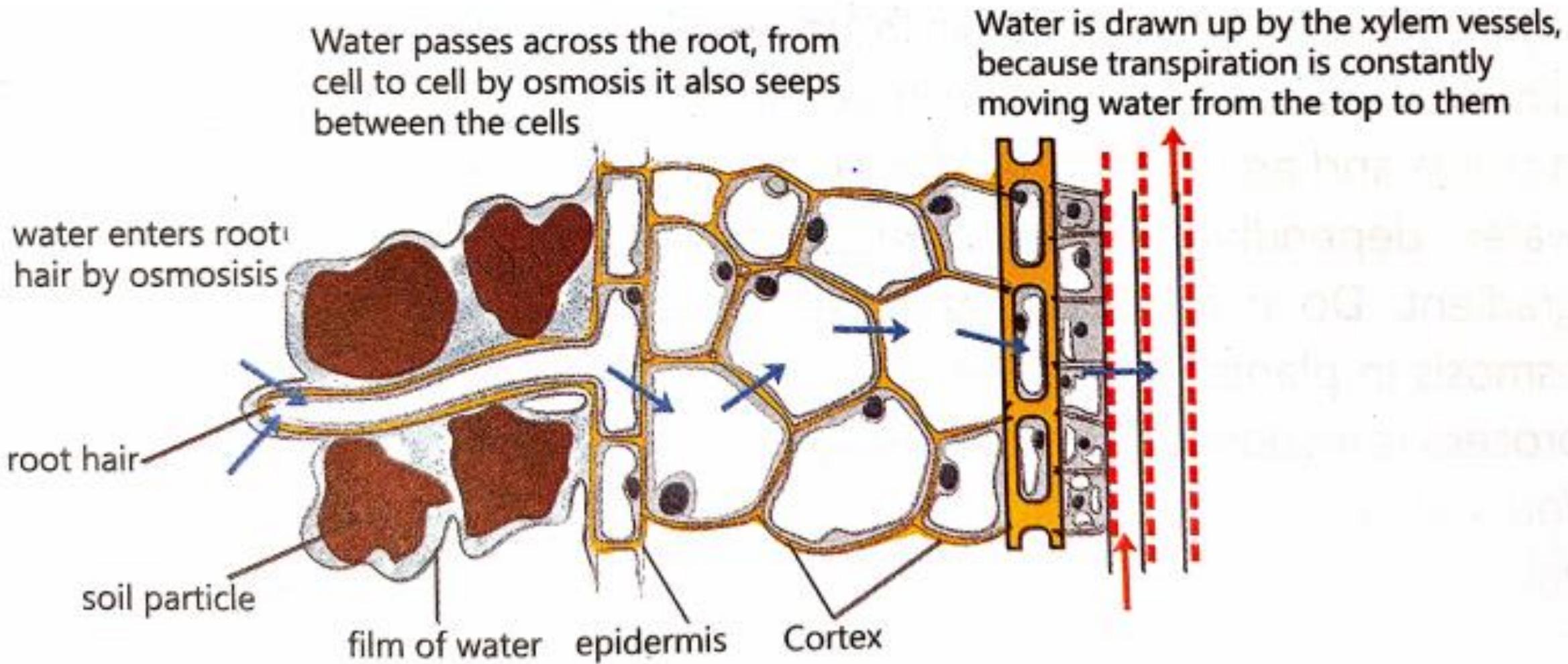
## *Exercise*

1. What is the importance of root hairs to plants?
2. The region of the root above the piliferous layer is covered with a layer of water proof material
  - i) Explain why the root hairs are not coated in this way.
  - ii) The piliferous layer represents the exchange surface of a root. What properties does this layer share with other exchange surfaces, e.g. lungs of a mammal?

## *Soln:*

1. Increasing surface area for absorption of water and mineral salts from the soil.
2. i) to keep them porous to allow passage of materials  
ii) numerous or many in number, porous, thin walled

# Transport of water and Mineral Salts in Plants



Ctd

Water absorbed by root hairs moves from cell to cell by **Osmosis** across the cortex of the roots and then into the endodermis to the **Xylem** vessels in roots and stem.

It then moves through the **Xylem** of the stem up to the leaves by action of forces which include; **capillarity, cohesion-adhesion forces, transpiration pull and root pressure.**

**Capillarity** This is the ability of water to move up the fine tube. It is usually caused by the surface tension but because the capillary tube is narrow, the water rise is limited.

**Cohesion forces** This is a force of attraction between the molecules of the same substance. Cohesion between water molecules allows water in a continuous column without breaking.

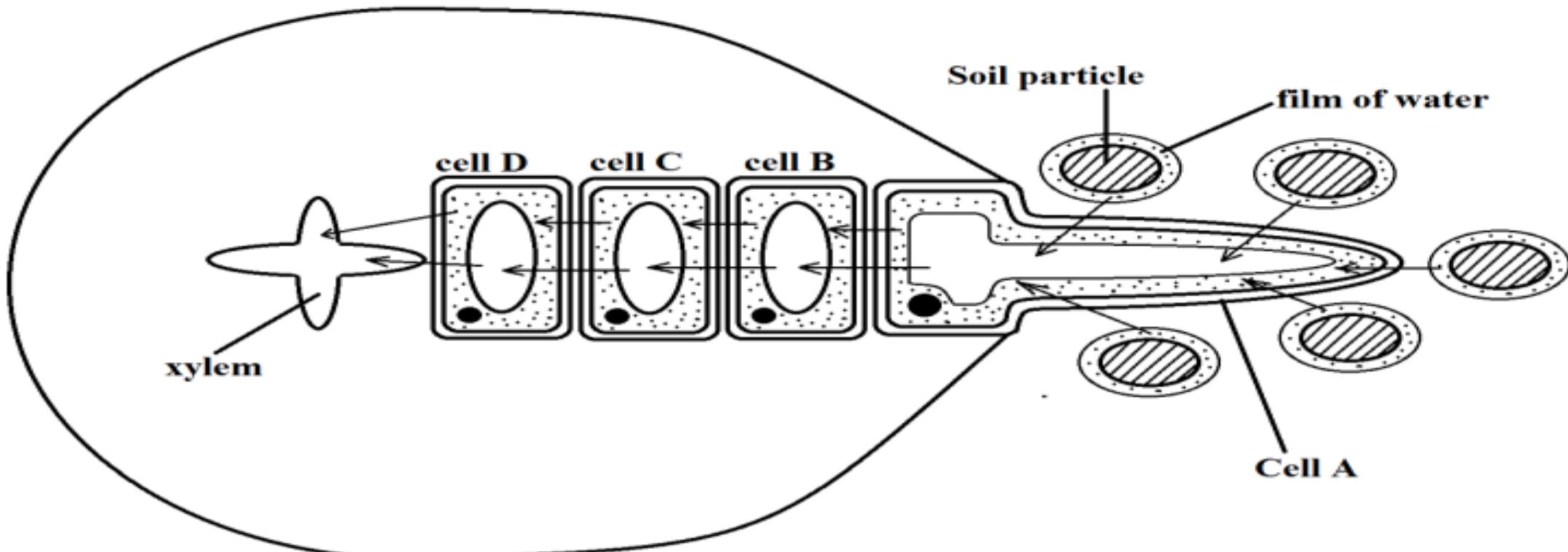
**Adhesion** This is the force of attraction between molecules of water and xylem. It enables water molecules to move up the walls of the xylem.

**Transpiration pull** This is the pulling force generated by the evaporation of water from the leaves.

**Root pressure** This is a pressure that pushes water up the xylem of the root to the shoot. It results from the water accumulated in the xylem of the root.

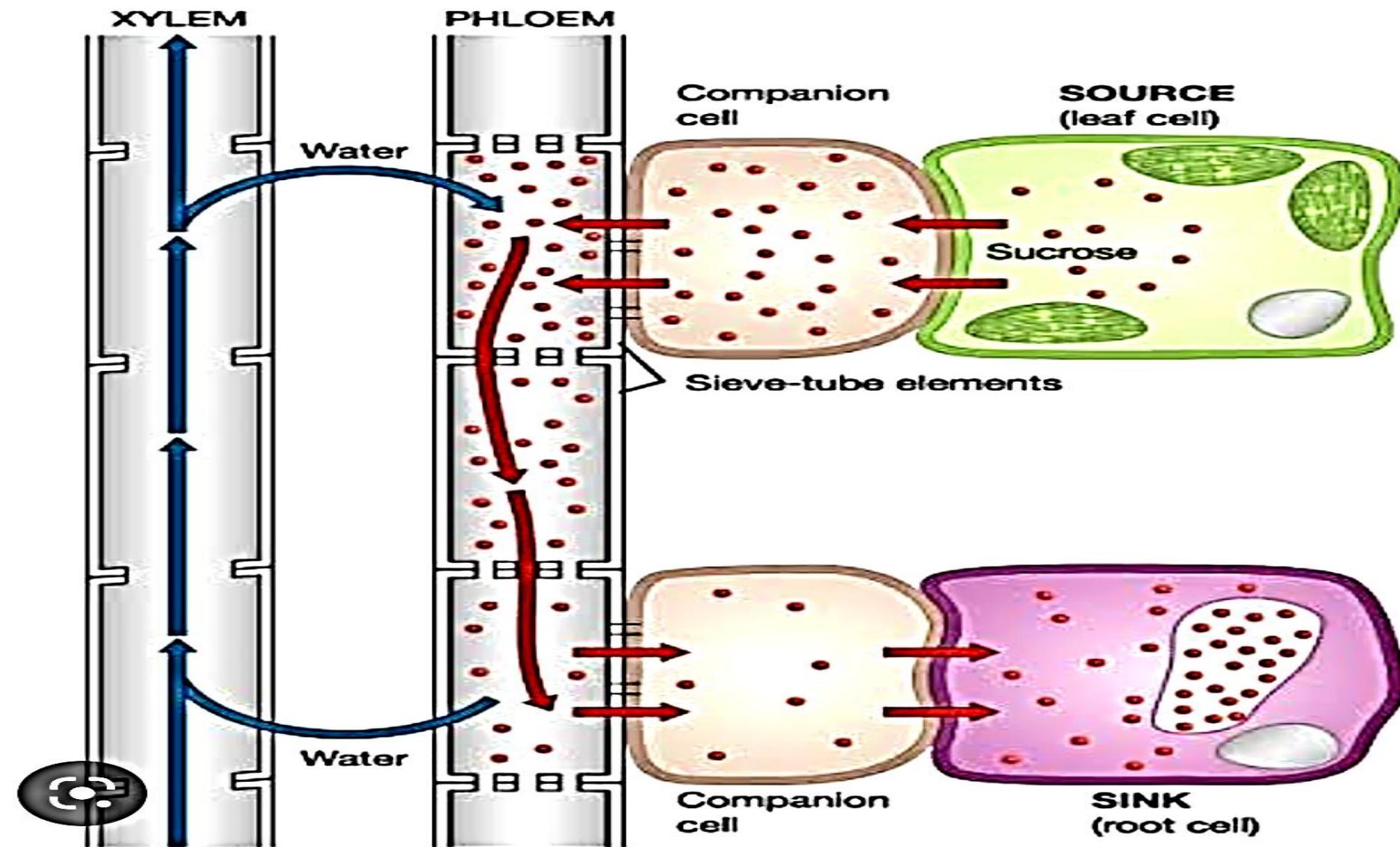
# Sample question

1. The figure below shows a section through a plant root. Study it carefully and answer the questions that follow.



- (a) (i). Name the cell labelled A **(01 mark)**  
(ii). Describe how cell A is adapted to its functions **(04 marks)**
- (b) Describe how water around the soil particles is absorbed by cell A until it reaches the xylem **(05 marks)**

# Translocation



Ctd

Translocation is the process by which soluble products of photosynthesis are carried in plants.

Through out the plant, sugars and amino acids are trans located in the **PHLOEM** from the leaves to the **GROWING PARTS** of the plant or **STORAGE ORGANS**.

Food substances may move downwards or upwards.

## Structures involved in translocation

- (i) **Leaves.** These are the source of the food materials.
- (ii) **Transport channels.** These are the phloem vessels.
- (iii) **Sinks.** These are storage organs (stems, roots and some leaves) and points of utilization for the food materials for example actively growing points like shoot apex.
- (iv) **The xylem vessels.** The food materials are transported as dissolved solutes in water supplied by the xylem vessels.

## Importance or significance of translocation in plants

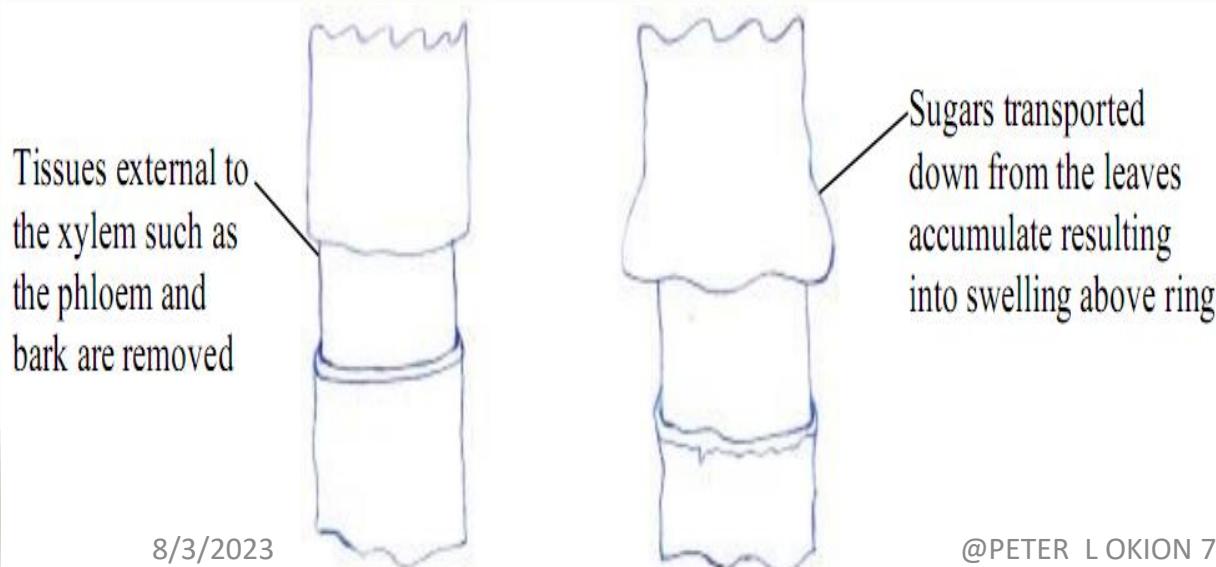
- ✓ *Provides actively growing points such as the shoot apex with food materials that are respiration to provide energy for their growth.*
- ✓ *Manufactured food materials are stored within storage organs for use during adverse/harsh conditions.*

# EVIDENCE TO SHOW THAT FOOD MADE IN LEAVES IS TRANSLOCATED BY THE PHLOEM

## RING EXPERIMENT

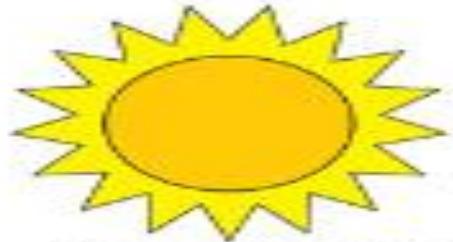
Removal of a complete ring of phloem from around the stem causes swelling of the part of the stem above the ring with no increase in size of the stem below the ring.

### Illustration



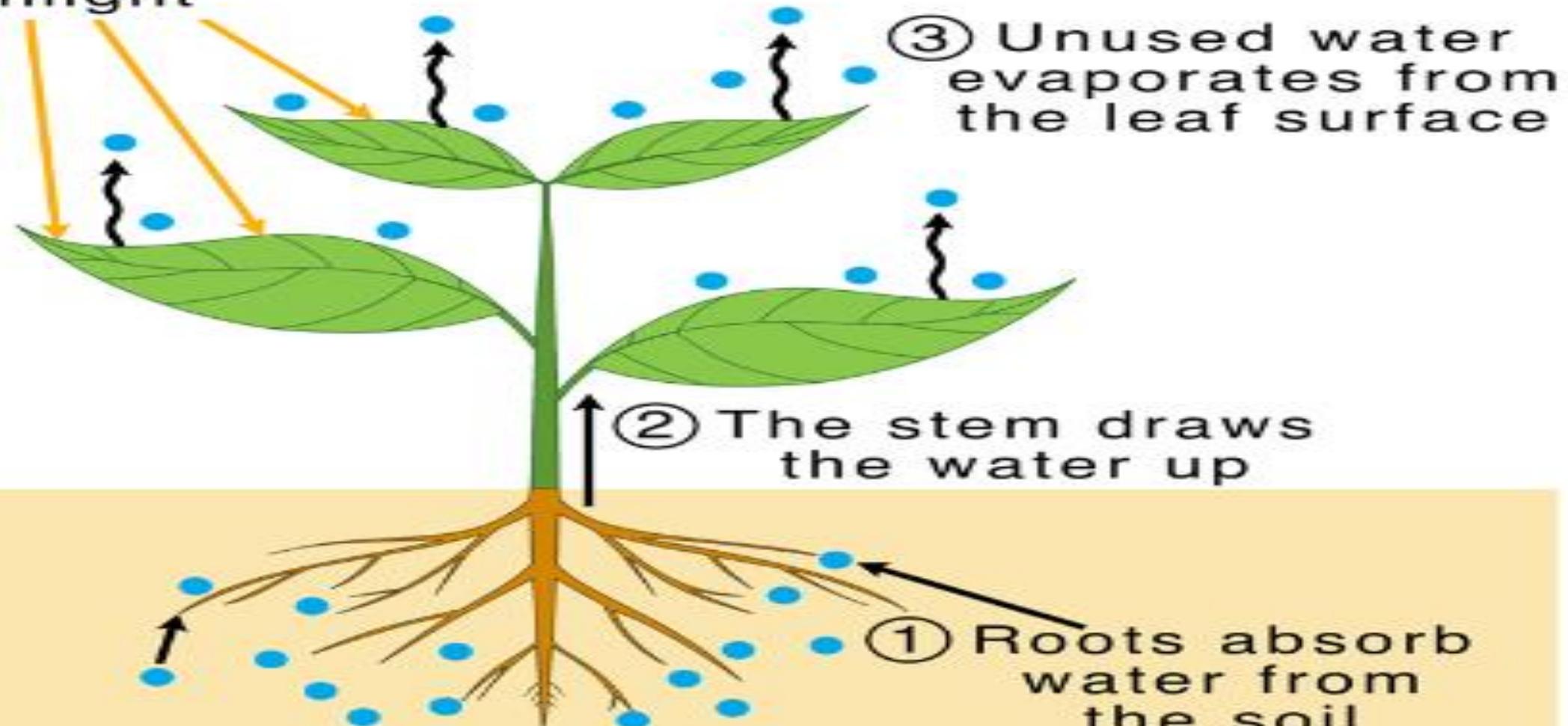
**Explanation:** removal of the ring results into removal of phloem which is located just beneath the bark such that flow of organic food materials is disrupted, causing the swelling as food accumulates.

**Conclusion:** since phloem and not xylem were removed, translocation of manufactured food occurs in the phloem.



Sunlight

## Transpiration



# TRANSPIRATION

This is the process by which plants lose water in form of water vapor to the atmosphere.

## TYPES OF TRANSPIRATION

(i) Stomatal transpiration.

This is the evaporation of water through stomata found in the epidermis of leaves.

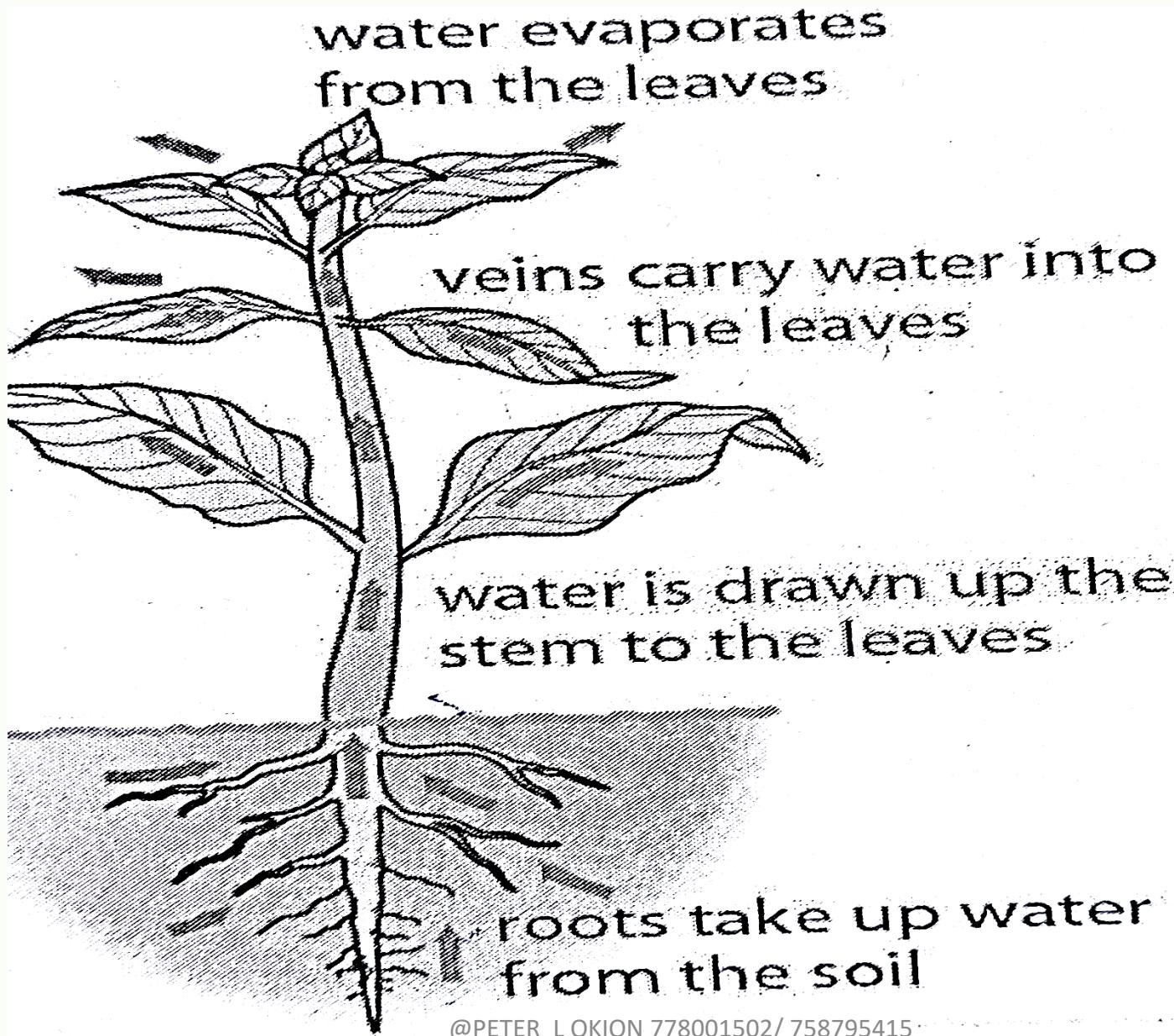
(ii) Cuticular transpiration

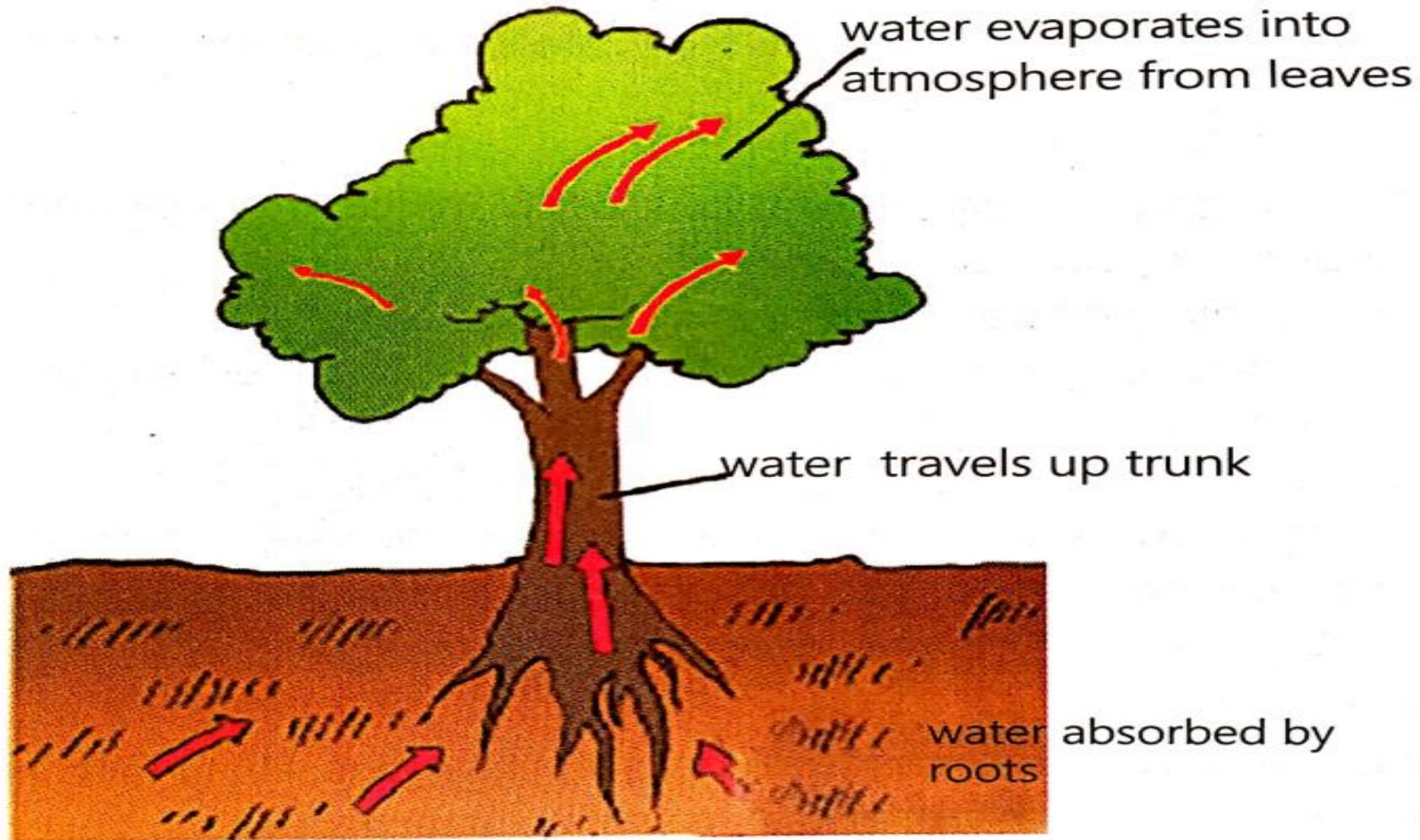
The loss of water by evaporation through the cuticle of the leaf or stem epidermis

(iii) Lenticular transpiration

Water is lost by evaporation through small slits called lenticels which are found in the stems of woody trees.

## **THE PROCESS OF TRANSPiration**





**Figure 6.12: Transpiration in plants**

## Water loss by transpiration occurs in following stages ;

- ✓ *Water from the roots is brought up to the leaf mesophyll cells through the xylem vessels.*
- ✓ *The heat from the surrounding makes water molecules to evaporate from the moist mesophyll cells into the intercellular spaces of spongy mesophyll cells.*
- ✓ *The water vapour then diffuses from the intercellular spaces, through the stomata then into the atmosphere.*

# Factors affecting the rate of transpiration

## Environmental factors

### (i) Temperature

*Increase in temperature increases the rate of transpiration. This is because, an increase in temperature increases the kinetic energy of water molecules hence increasing the rate of evaporation of water from the leaf mesophyll cells.*

*An increase in temperature also reduces the amount of water vapour around the leaf surface and the stomata. This results into rapid evaporation of water from the leaf.*

## **(ii) Light intensity**

*An increase in light intensity increases the rate of transpiration. This is because exposure of a plant to much light results into opening of many stomata which provide a large surface area for water loss by transpiration.*

**iii) Relative humidity:** *Humidity is the amount of water vapor in the atmosphere. As humidity increases, the rate of transpiration decreases. This is because the environment becomes saturated with the water vapor.*

**iv) Availability of water:** *With water available, a continuous stream of water is present, continuously delivering water to leaf air spaces from which it's lost to the atmosphere. However when little water is available, little can be lost during transpiration.*

## (v) Wind velocity

*In still air (low wind speed) rate of transpiration reduces. This is because water vapour accumulates onto the surface of the leaf and onto the stomata, this reduces the rate of evaporation of water from the leaf.*

*Under windy conditions, rate of transpiration increases. This is because the wind blows away water molecules from the leaf surface. This creates a steep diffusion gradient for water molecules to move from the leaf into the atmosphere.*

# **Non environmental factors**

## **i) Distribution of stomata**

The rate of transpiration is low when more stomata are on the lower side and is higher when more stomata are on the upper side of the leaf.

## **ii) Number of stomata**

The greater the number of stomata, the higher the rate of transpiration because more water vapour is lost through the stomata.

## **iii) Surface area for transpiration**

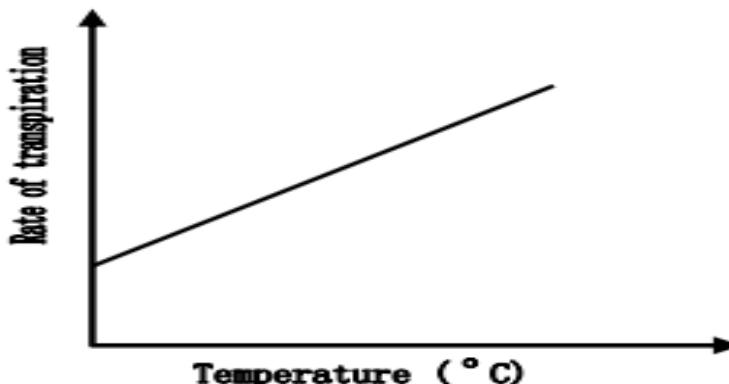
Plants with wide/broad leaves have a larger surface for transpiration thus they experience a higher rate of transpiration. But that with small leaves e.g. desert plants have a small surface area hence low rate of transpiration.

## **iv) Thickness of the plant cuticle**

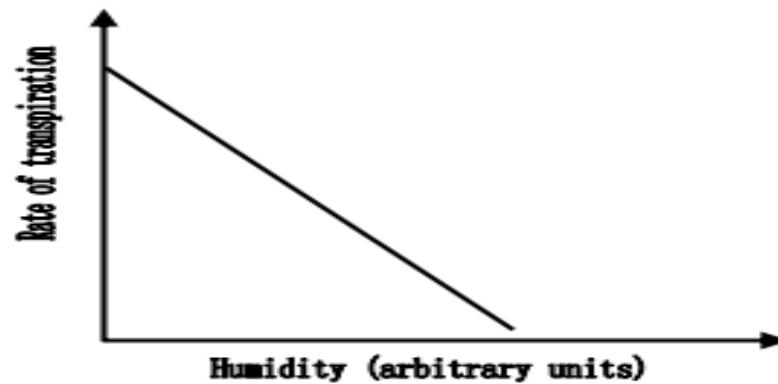
The rate of transpiration decreases with increase in thickness of the cuticle. For that reason, plants found in deserts have extremely thick cuticle than those in tropical regions.

# Sample question

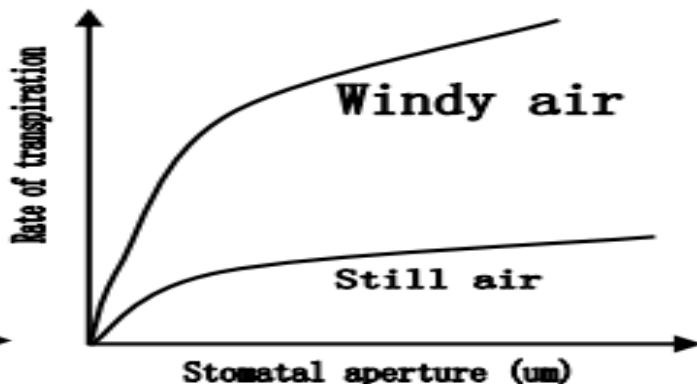
1. Figures (i), (ii), and (iii) show variation of the rate of transpiration in different environmental conditions.



**Fig. (i)**



**Fig. (ii)**



**Fig. (iii)**

- a) What **four** conclusions can you draw from the graphs in figure (i), (ii), and (iii) above? **(04 marks)**
- b) Explain the conclusions you have drawn for:
- Graph in figure (i) **(03 marks)**
  - Graph in figure (ii) **(03 marks)**
- c) Describe and explain the shape of the curves in figure (iii) for:
- Windy air **(04 marks)**
  - Still air **(04 marks)**
- d) State the three environmental conditions affecting the rate of transpiration in the above figure **(02 marks)**

## Importance of transpiration to plants

- ✓ Heat is lost along with the water vapour hence cooling the plant.
- ✓ Transpiration contributes to uptake and distribution of water and mineral salts throughout the plant within the xylem vessels.
- ✓ Results in the absorption of water and its movement up the plant to aid processes like photosynthesis

# **DISADVANTAGES / DANGERS OF TRANSPIRATION**

- a) Excessive water loss from the plant may lead to wilting, drying and even death of the plant.
- b) Results into shading of leaves thus reducing surface area for photosynthesis

# **AN EXPERIMENT TO SHOW THAT WATER IS LOST DURING TRANSPIRATION**

## **Apparatus**

Potted plant,

Polythene bag,

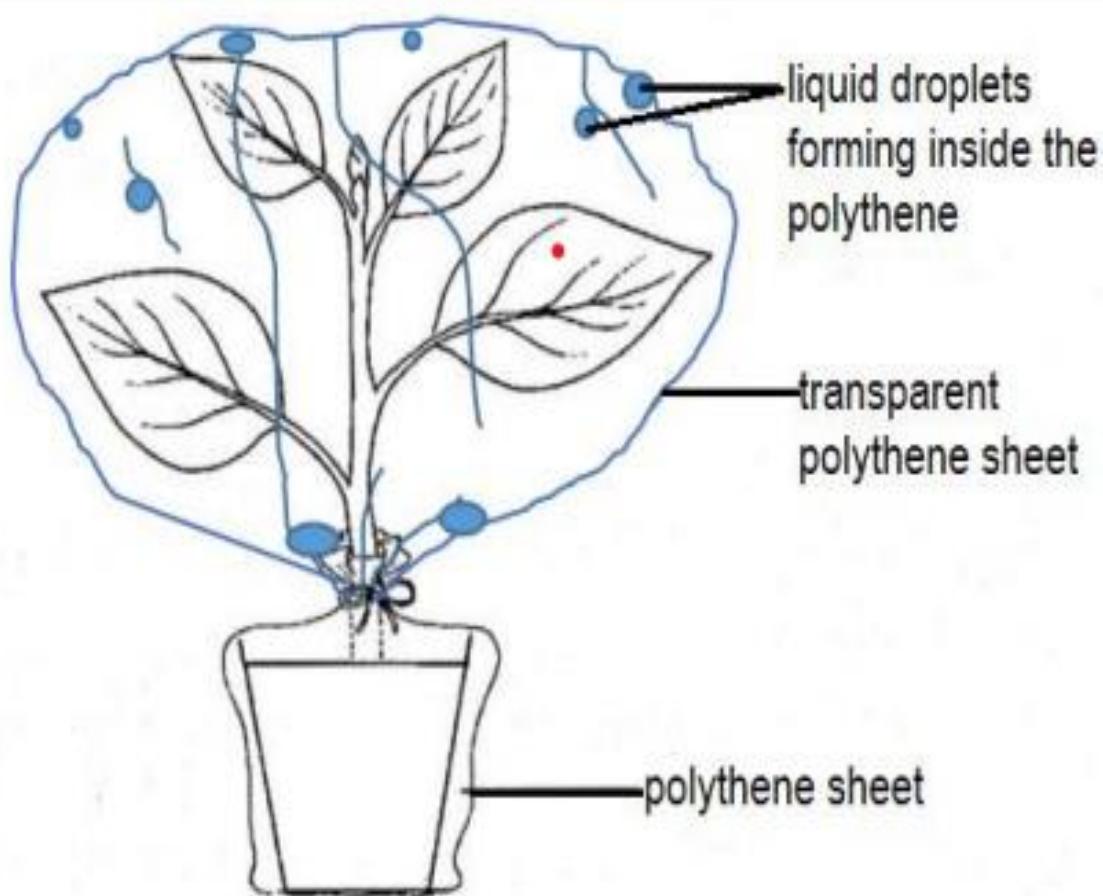
String,

Cobalt (ii) chloride paper or anhydrous copper (ii) sulphate.

## **Procedure**

- a) Tie polythene around the tin of the potted plant. Using a string to avoid evaporation of water from the soil surface.
- b) Tie transparent polythene around the leafy shoot of the plant.
- c) Set up another similar control experiment but with leaves removed and dry plant.
- d) Leave the experiment to settle for 3 hours in bright sunlight.
- e) Remove the polythene around the leafy shoot and test the drops of liquid inside the polythene using anhydrous copper (ii) sulphate / cobalt (ii) chloride paper.

# Diagram



## Observation

Colorless droplets form inside the polythene which turn anhydrous copper (ii) sulphate from white to blue or blue cobalt (ii) chloride paper to pink.

No vapor is observed from experiment with no leaves / dry plant.

## Conclusion

Water is given off during Transpiration

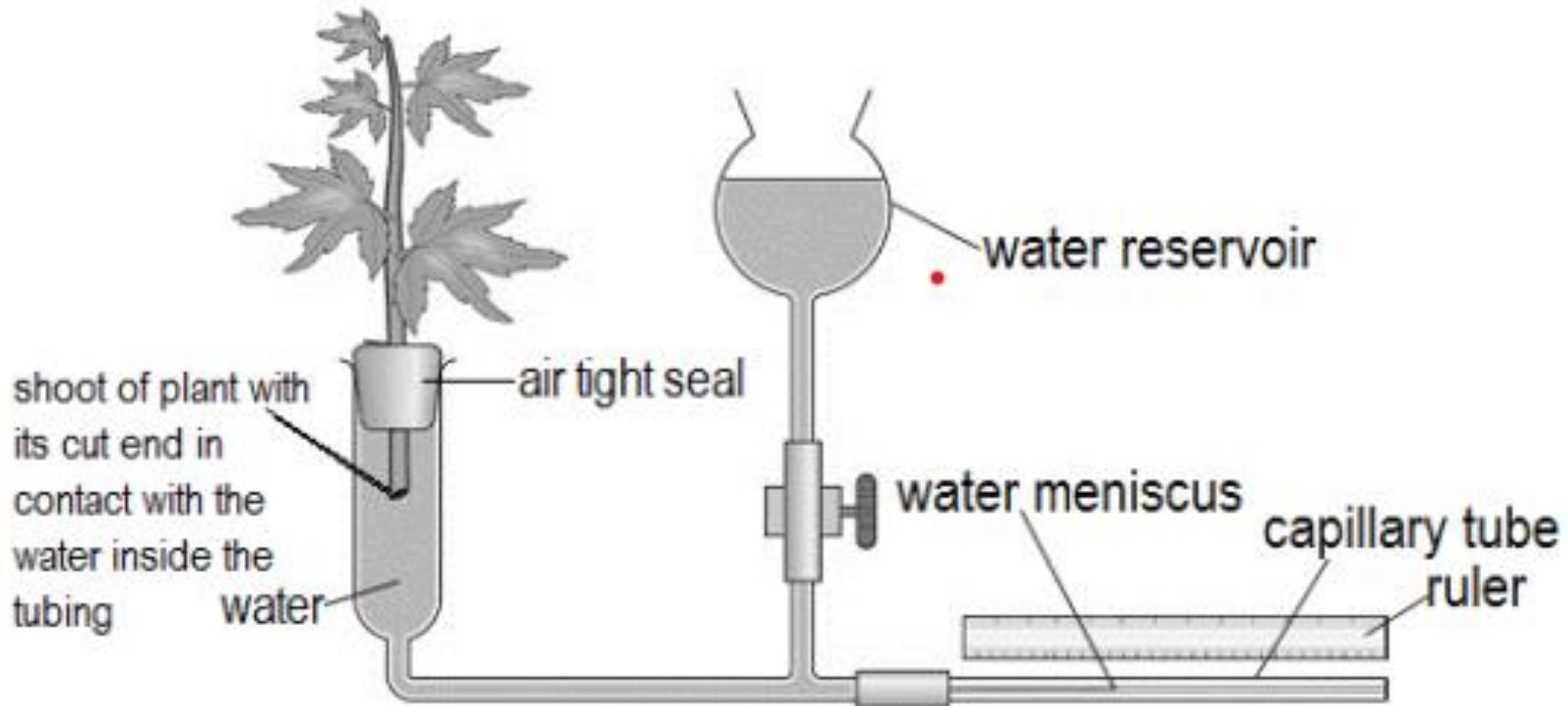
# **MEASURE THE RATE OF TRANSPiration using a POTOMETER**

This is done using an instrument called a potometer. The potometer works on assumption that water lost from the leaves during transpiration equals water absorbed by the plant. Therefore the potometer:

- ✓ Directly measures the rate of water uptake/ absorption of the shoot and
- ✓ Indirectly measures rate of water loss / evaporation of water/ transpiration from the leaves.

**ASSIGNMENT**  
**READ AND MAKE NOTES ABOUT THIS METHOD**

## Set up of a potometer



# PROCEDURE

- i) A leafy shoot of a plant is cut under water to prevent air bubbles from entering as these would block the xylem vessels.
- ii) The leafy shoot is fixed into the air-tight seal (cork) and then fitted into the mouth of the potometer vessel full of water.
- iii) Vaseline is smeared at the interface of the shoot and the cock to prevent entry of air into the apparatus.
- iv) A meniscus is set inside the capillary tube and its cm level with the ruler is noted and recorded. V<sub>1</sub>
- v) At a given mark V<sub>1</sub>, reached by the meniscus, a stop clock is started and after a given time t, the new position of the meniscus, V<sub>2</sub>, is noted and recorded.

ctd

$$\begin{aligned}\text{Rate of transpiration} &= \frac{\text{distance moved air bubble}}{\text{Time taken}} \\ &= \frac{V_2 - V_1}{t}\end{aligned}$$

- vi) In any given set of environmental conditions, about 3 experiments can be performed, resetting the meniscus after each experiment by opening the tap and then closing it.
- vii) Average rate is then calculated and taken as the rate of transpiration in that environment.

# Precautions taken when using a potometer in order to ensure that accurate results are obtained

- ✓ A leafy shoot should be used to ensure significant water loss.
- ✓ The shoot must be cut under water to prevent air from entering and blocking the xylem vessels.
- ✓ The whole apparatus must be full of water.
- ✓ There should be no air bubbles in the capillary tube.
- ✓ The meniscus should not be allowed to go past the ruler calibrations.

# Exercise

1. Transpiration is a necessary cost in plants. Explain the statement.
2. Various processes of movement of materials in and out of cells are needed to fulfill the mineral requirements of a plant. Discuss each process in detail and highlight their unique role in enhancing life processes.
3. A laboratory assistant accidentally poured common salt on grass and he observed that over time, the grass dries up. Explain this observation in relation to osmosis.
4. In terrestrial environments, some plants shed off their leaves during the dry season. Explain the significance of this behavior to plants.
5. A student assembled a simple potometer. The time taken by a bubble to move along the capillary tube was determined under different conditions. The readings of time were taken 3 times under each of the considered conditions, and the average time was recorded in the table below;

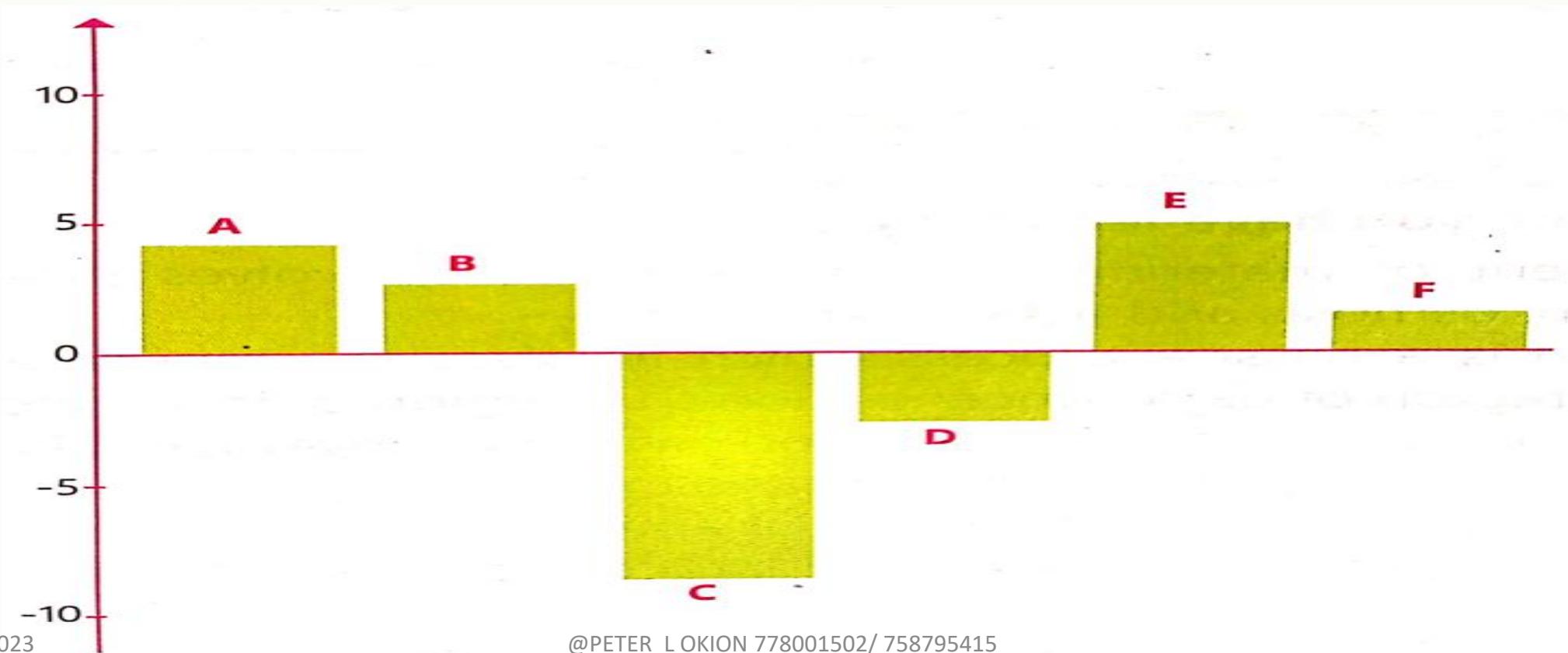
Condition of potometer	Average time taken for bubbles to move 10cm
<b>Windy air</b>	<b>50</b>
<b>Under shade</b>	<b>69</b>
<b>Air saturated with water</b>	<b>80</b>
<b>Bright light</b>	<b>54</b>
<b>Leaves of twig enclosed in a plastic bag</b>	<b>95</b>

## ***Qns:***

- a) What conclusion can you draw from those results about the factors which affect evaporation of water from leaves?
- b) Why were 3 readings necessary for each condition?
- c) Suggest reasons why the evaporation rates vary as indicated by the results above.
- d) Why are the results from the potometer not considered to accurately represent the rate of transpiration under the conditions investigated?

# *Test yourself*

1. Six similar cylinders of fresh potato (A to F) each weighing 10 grams, were immersed in salt solutions of different concentrations for 2 hours. They were removed and reweighed. The change in mass of each cylinder was recorded in a bar graph as shown below.



# Qns:

- a) Identify the physiological process responsible for the observed changes.
- b) Which cylinder has been immersed in the salt solution with;
  - i) the highest salt concentration?
  - ii) the lowest salt concentration?
  - iii) a concentration closest to that of the potato cells?
- c) Explain the changes in the cells of potato cylinder D.
- d) Mention other processes by which materials move in and out of cells.

Ctd

2. a group of students investigated leaves from different plants, thyme and mint, in order to find out which leaf surface had more stomata. The thyme plant had fewer leaves compared to the mint plant.

	Average weight loss %	
Plants	Mint	Thyme
Petroleum jelly on both leaf surfaces	14	13
Petroleum jelly on lower leaf surface only	44	30
Petroleum jelly on upper leaf surface only	41	20

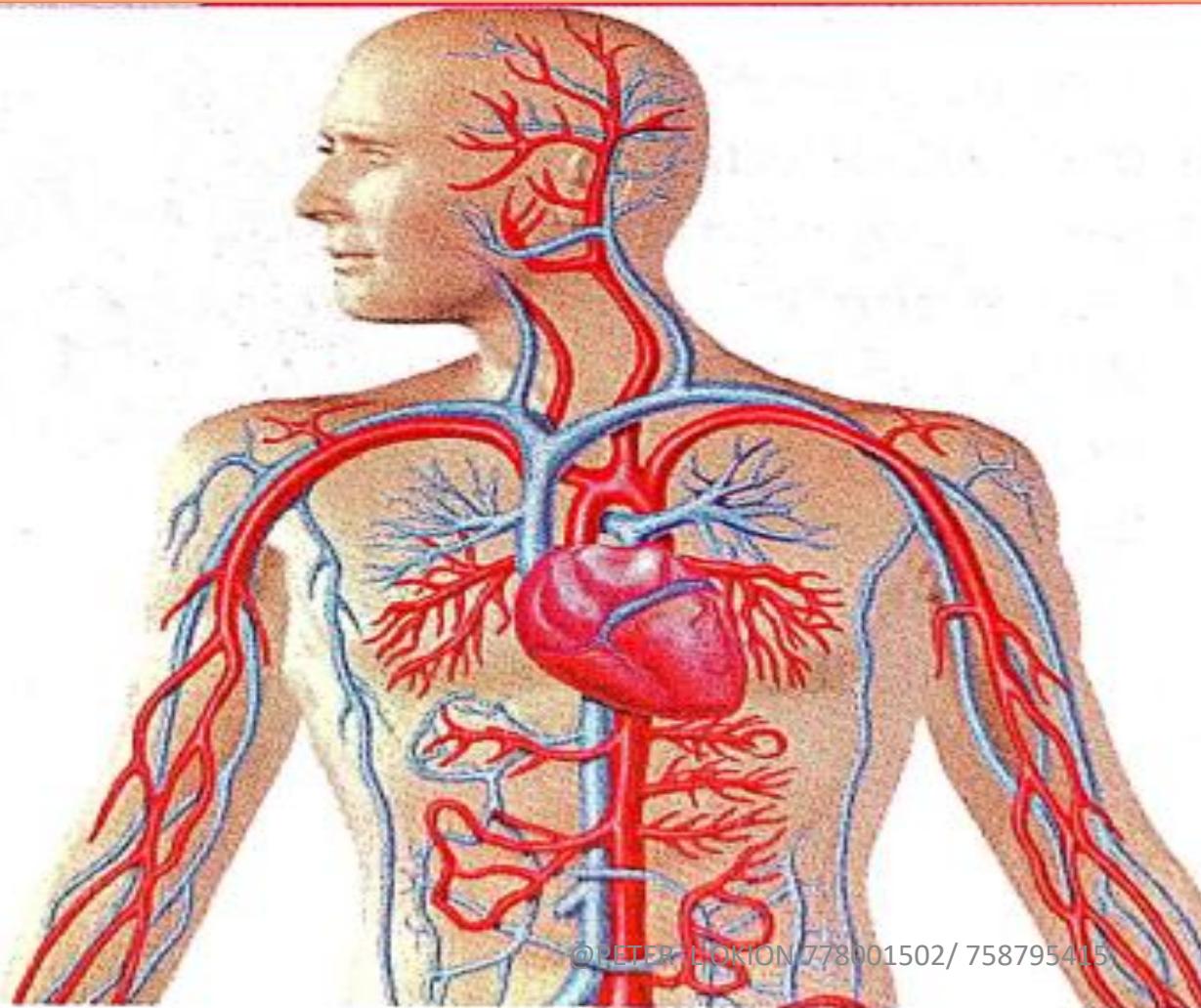
## **Qns:**

- a) From which surface did the mint leaf lose the most water? Explain your answer.
  - b) Explain the difference in the results for the two plants.
  - c) Based on the experimental results, which plant would be adapted to hotter and drier conditions? Give a reason for your answer.
3. Describe how the adaptation of plant root is similar to the adaptation of the lining of the small intestine in humans for the absorption of nutrients.

# Soln

1.
  - a) Osmosis
  - b) i) C    ii) E    iii) F
  - c) Cells shrink; **D** was placed in a solution more concentrated than cell sap; water molecules moved from cells to surrounding solution by Osmosis
  - d) Active transport, Diffusion
2.
  - a) **Upper surface**; once exposed had the highest average weight loss.
  - b) The average weight loss is **more** in **Mint than in Thyme**; Thyme had fewer leaves; presenting a smaller surface area for water loss; less water was lost during transpiration.
  - c) **Thyme**; has reduced surface area for water loss
3. Numerous to provide a larger surface area for absorption  
Thin walled to reduce the distance over which materials move

# ***TRANSPORT IN ANIMALS***



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758795415

**@ PETER L OKION 778001502 /  
758795415**

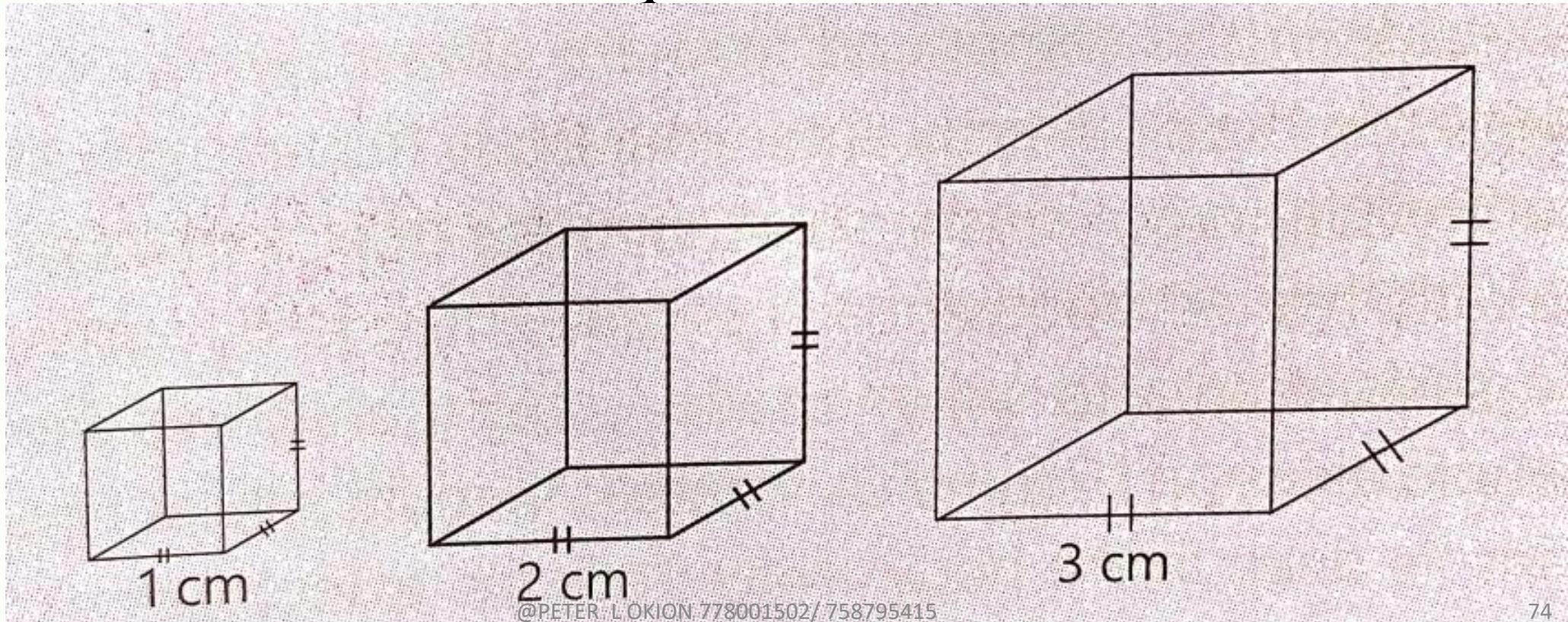
# The principle of Surface Area to Volume Ratio

## ***THINK:***

On a rainy day, it is usually very cold, so young ones e.g. babies feel colder than the adults. Why is this so?

# Activity: determining the Surface Area to Volume ratio

You are provided with the following cubes, use them to fill the table below and answer the questions that follow;



# Table of results

Cube size	Surface Area (cm <sup>2</sup> ) (SA= 6S <sup>2</sup> )	Volume (cm <sup>3</sup> ) (v = S <sup>3</sup> )	Surface Area to Volume ratio
1cm			
2cm			
3cm			

## **Qns:**

- a) Which cube has the largest surface area to volume ratio?
- b) Which cube has the lowest surface area to volume ratio?
- c) Discuss and explain the biological significance of the ratios calculated to the organisms.

**NOTE:** Surface area to volume increases with decrease in the body of organisms. Therefore, large sized organisms have a smaller surface area to volume ratio than small sized ones.

## **Answer to c)**

Organisms with a large surface area to volume ratio e.g. single celled Amoeba do not need a transport system as diffusion alone is enough to supply and remove materials to and from their bodies.

## **Answer to THINK:**

BABIES, like all small sized organisms, have small bodies and mass.

As individuals grow to become adults, they increase in size, hence their volume increases more rapidly than surface area. Therefore, babies with a larger surface area to volume ratio lose more heat to the surrounding than the adults.

# Exercise

1. Why do organisms need to continuously exchange materials with their environment?
2. Why are cells in multicellular organisms :
  - a) microscopic?
  - b) numerous?

# *Soln*

1. Organisms need to take in materials required for life processes in their bodies to take place and also remove unwanted materials out of their bodies.
2.
  - a) to provide a large surface area to volume ratio so as to be more efficient at exchanging materials within the organisms.
  - b) to increase the surface area over which exchange of materials can occur

# Transport systems in mammals

## THE NECESSITY FOR TRANSPORT SYSTEMS

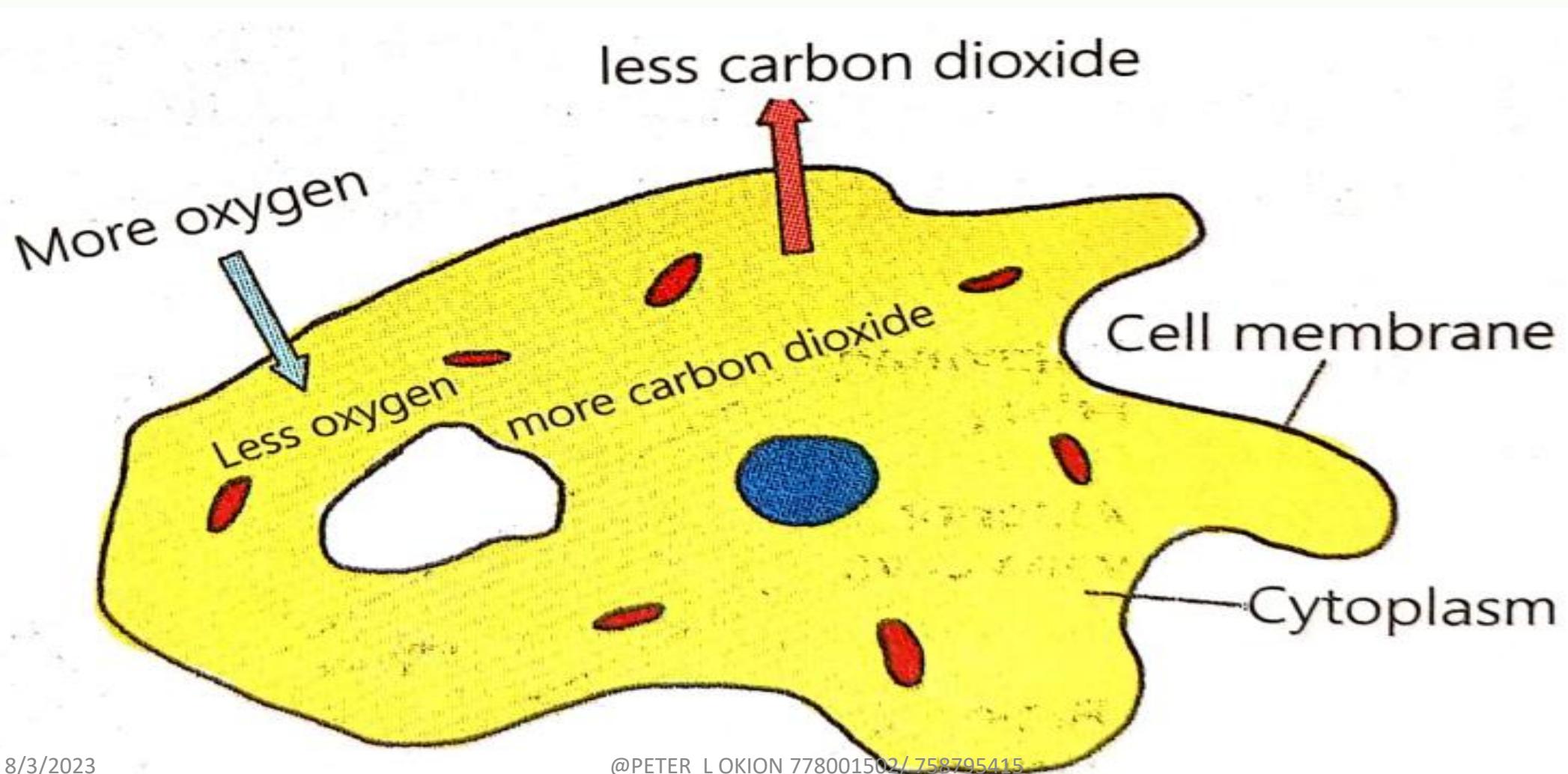
**Unicellular organisms** e.g. **Amoeba**, directly exchange oxygen and carbon dioxide with their environment across the entire body surface.

In unicellular organisms, the **surface area to volume ratio is high**, enabling them to exchange materials by **simple diffusion** as seen in the figure below.

**While in multicellular organisms**, the body organs lie deep into the body away from the external environment. Due to their smaller surface area to volume ratio they **cannot** easily exchange materials with their environment by simple diffusion.

They need a mechanism that brings such materials close to organs so that they can be taken up by diffusion. This mechanism is **a transport system**

# *Exchange of materials in a unicellular organism by simple diffusion*



# Quiz

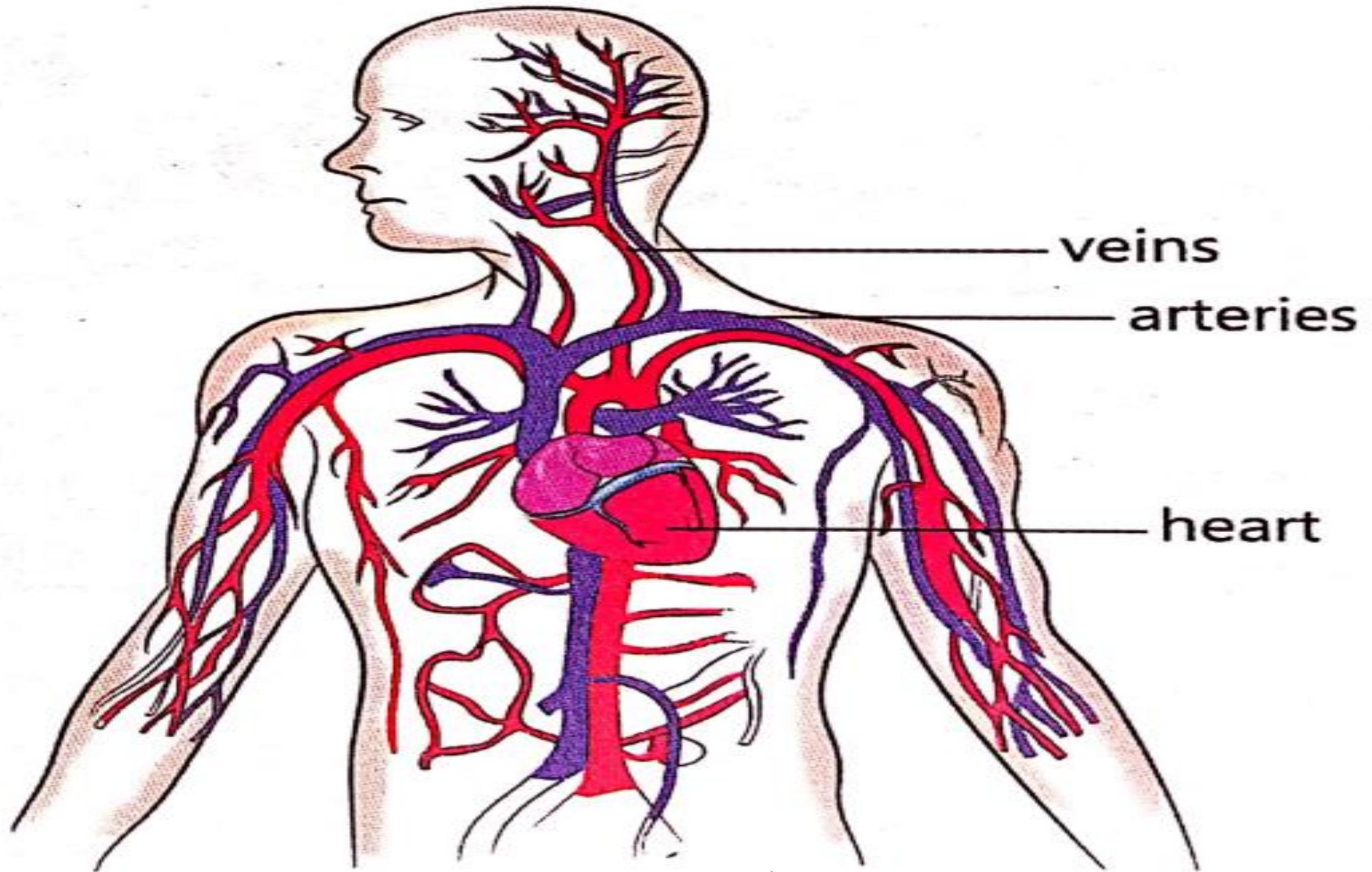
1. While seated outside in the compound, you are always surrounded by **air rich in Oxygen**. Can oxygen in the air directly enter your body through the skin? **Why or why not ?**
2. Why do unicellular organisms e.g. **amoeba** directly exchange oxygen and carbon dioxide with their environment across their entire body surface ?

# **Components of the transport system**

**What transport system is found in your body?** The main transport system in all mammals is the .....

The system is made up of different components that perform different functions i.e.

- i) Heart/ pumping organ
- ii) Blood/ transport fluid
- iii) Blood vessels/ transport channels



# **Functions of:**

## **HEART**

This contracts and relaxes to generate a force that pumps blood at high pressure to the rest of the body

## **BLOOD**

This is a liquid in nature and it freely flows to transport dissolved materials e.g. respiratory gases and food materials to their respective destinations

## **BLOOD VESSELS**

These provide channels through which blood passes as it transports materials to the respective organs.



Heart  
Artwork



Shape of a  
Heart



Heart  
Shape Art



Clip Art of a  
Heart



A Cartoon  
Heart



Cool Love  
Hearts



A Hea  
Diagram



Red Heart PNG Clipart



Heart PNG Clipart



Heart Wallpapers, Pictures, Images



2 Heart Png - ClipArt Best



Heart Bea  
Transparent



Heart PNG, Heart Transparent Background  
- FreelconsPNG  
8/3/2023



Beautiful Heart PNG Clipart - Best WEB  
Clipart



Clipart - Heart Symbol  
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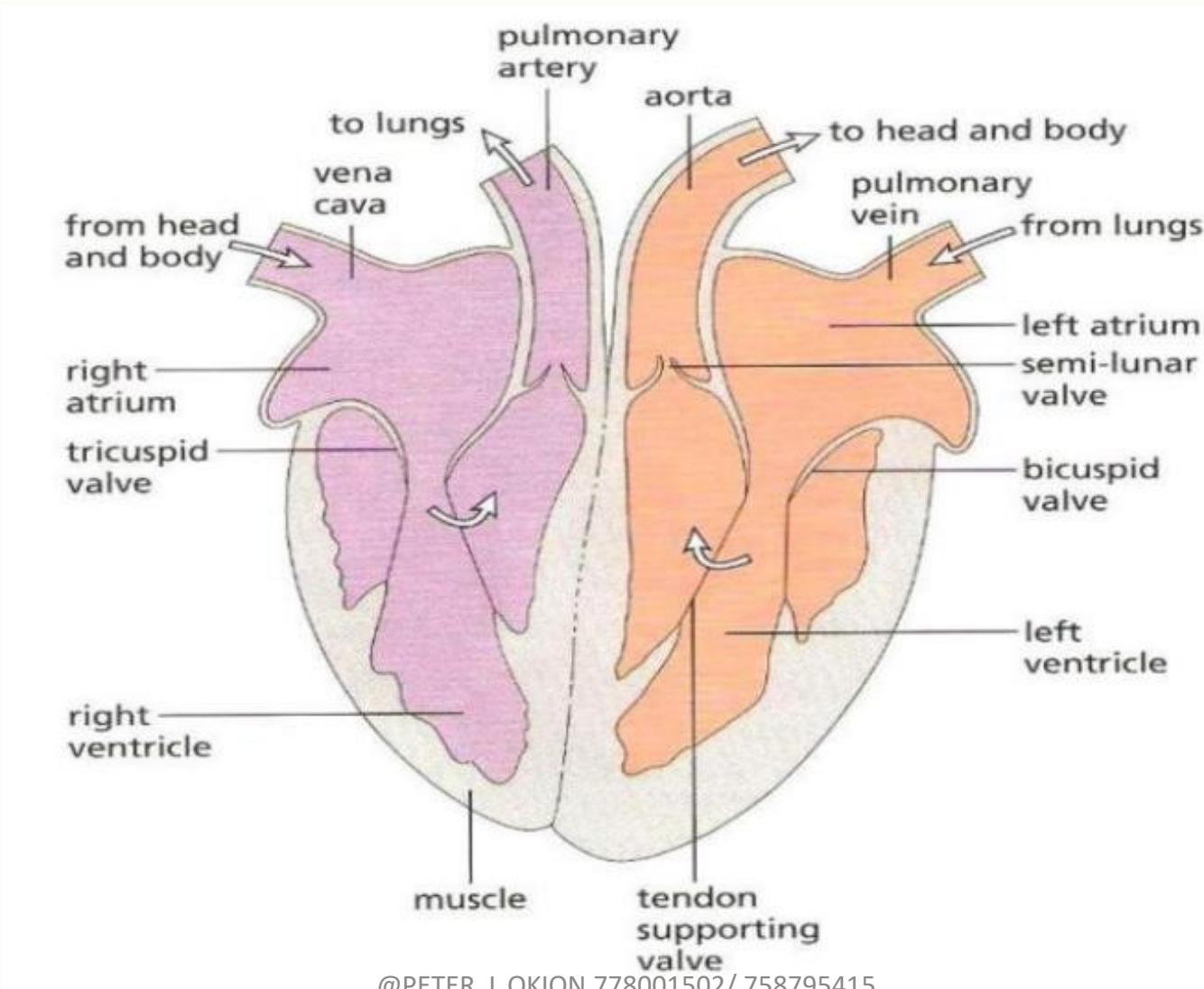


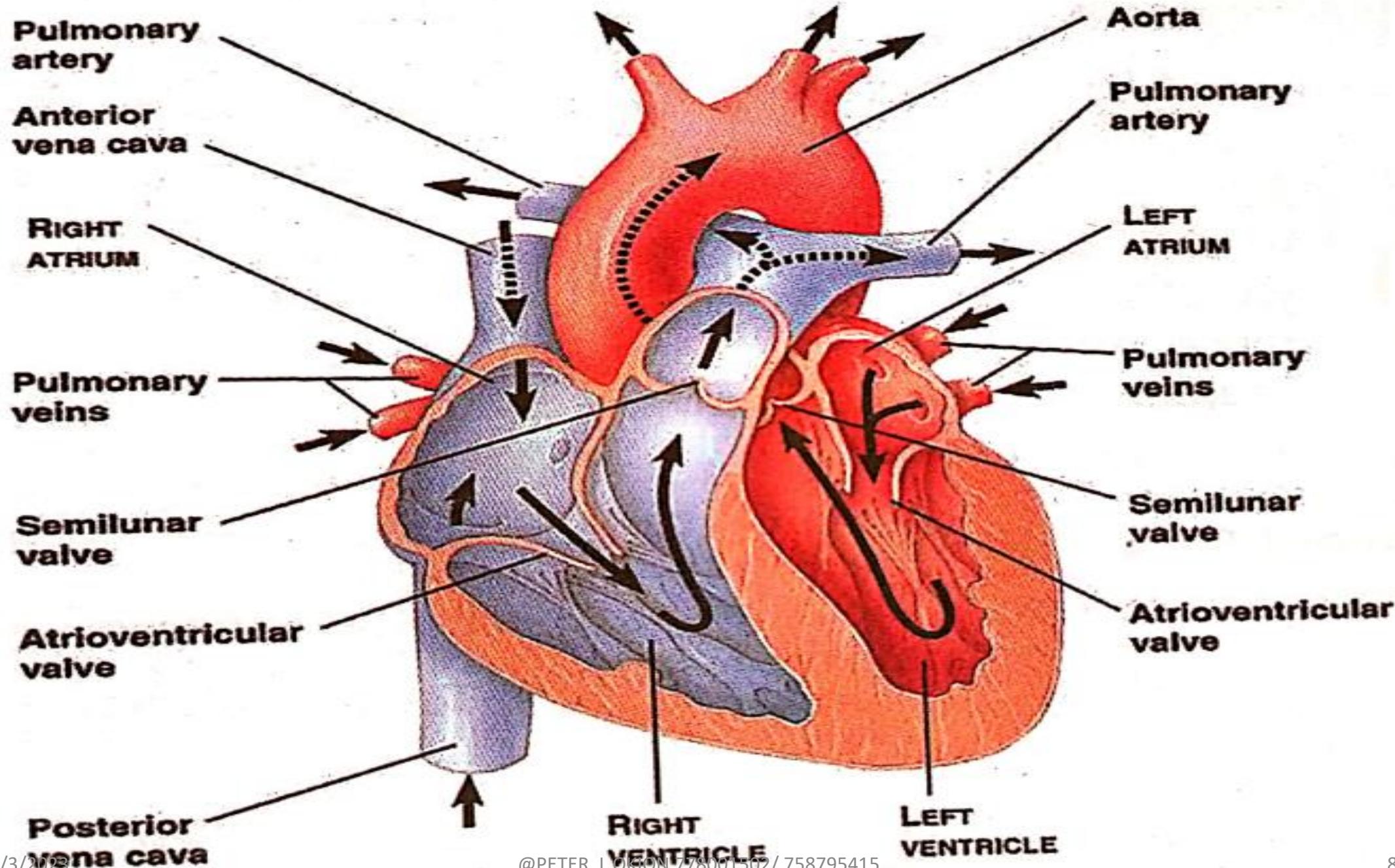
Red Heart Vector Graphics image -  
Free stock photo - Public Do...



Free Heart Pict

# THE MAMMALIAN HEART





## Description

Its function is to pump blood around the body. The whole heart is surrounded by a tissue called **pericardium** which has two layers. The **pericardial fluid** between the layers of pericardium reduce **friction** between them during the pumping action of the heart. The heart is made of a unique muscle tissue called **cardiac muscle** which has ability to contract on its own and does not **fatigue**

It's divided in to **four** chambers. The **two** upper chambers are called **atria / auricles** and the **two** lower chambers are each called **ventricles**. The heart is divided in to the **left** and **right** sections by a **muscular septum** whose function is to prevent mixing of **oxygenated blood** on the left with **deoxygenated blood** on the right Flow of blood in the heart is maintained in a single direction i.e. from the auricle to ventricle and then out to blood vessels by **valves**. There are two sets of valves

ctd

- i. **Semilunar valves** which prevent backflow to the ventricles
- ii. **Atrio-ventricular valves** which prevent backflow to the atria.

The atrio-ventricular valves on the right are called **tricuspid valves** while those on the left are called **bicuspid valves**

The **left atrium** receives **oxygenated blood** from **lungs** through the **pulmonary vein** and pump it to the left ventricle.

The **right atrium** receives de-oxygenated blood from the rest of the body through the vena cava and pumps it to the right ventricle.

ctd

The ventricle walls are **more muscular** (**have thicker walls**) than those of the auricles **because** the auricle pump blood to **shorter distance** i.e. to the ventricle while the ventricles pump blood **longer distances** i.e. to **body and lungs**.

The walls of the left ventricle that pump blood to the rest of the body through the aorta which is a longer distance away from the heart are **thicker** than those of the right ventricle which pump blood to lungs through the pulmonary artery which is a shorter distance away from the heart

# Quiz

1. Why do the valves between the ventricles and atria open towards the ventricles?
2. Why is oxygen less blood restricted to the right side of the heart while oxygen rich blood is restricted to the left side?
3. What prevents the heart from expanding until it bursts, in case it is filled with blood?

# **soln**

1. To allow the blood to flow from atria to ventricles and close upon increase in pressure in ventricles preventing the backflow of blood to atria.
2. Prevent them from mixing up which will reduce the efficiency of oxygen delivery to respiring tissues.
3. Surrounded by a tissue called pericardium membrane that prevents bursting of the heart upon expansion

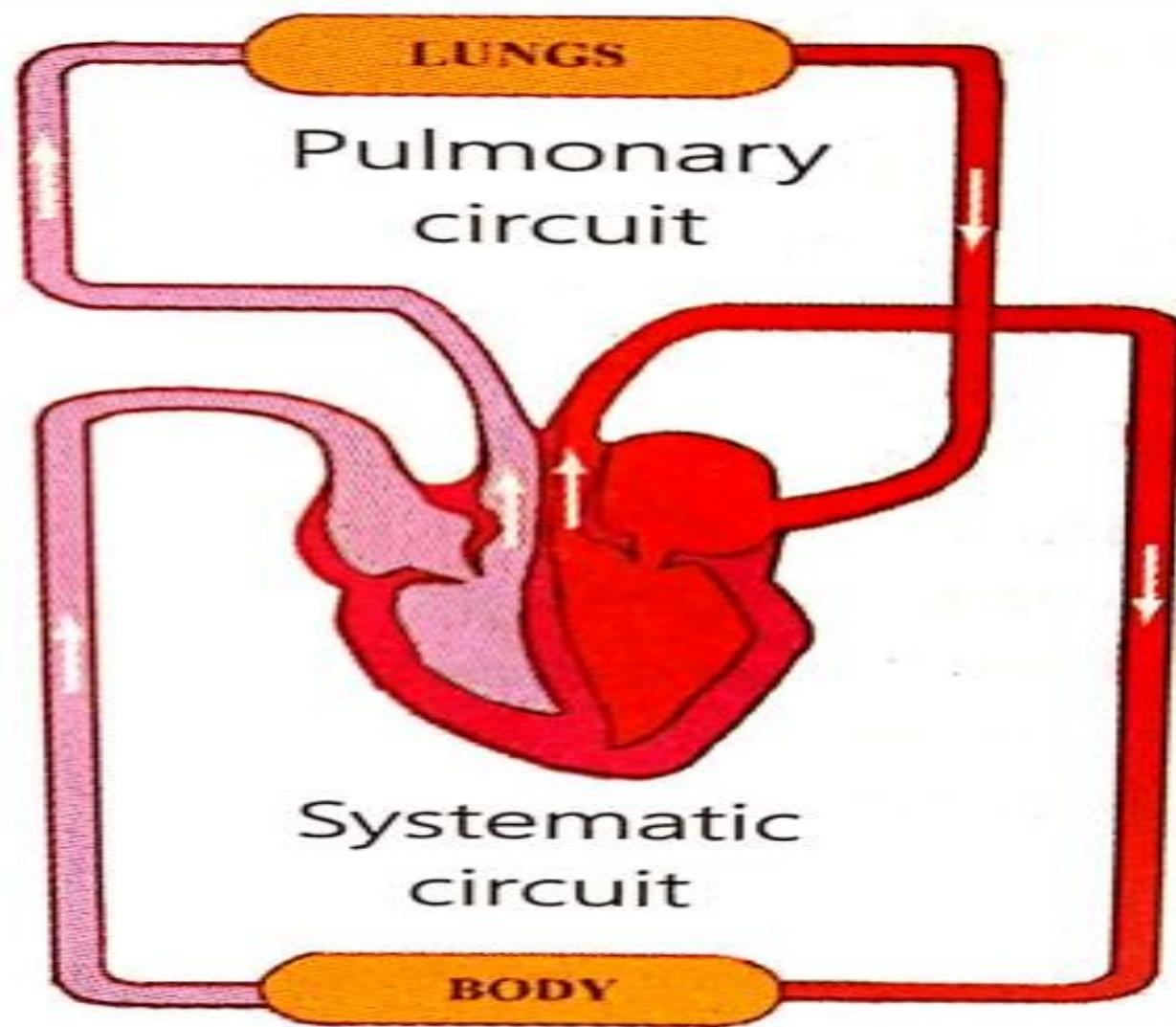
# Circulation of blood in the human body

The blood in the body moves through restricted channels – the **veins** and **arteries** by the pumping action of the heart. The human circulatory system is a double circulatory system. It Has two separate circulations and blood passes through the heart twice:

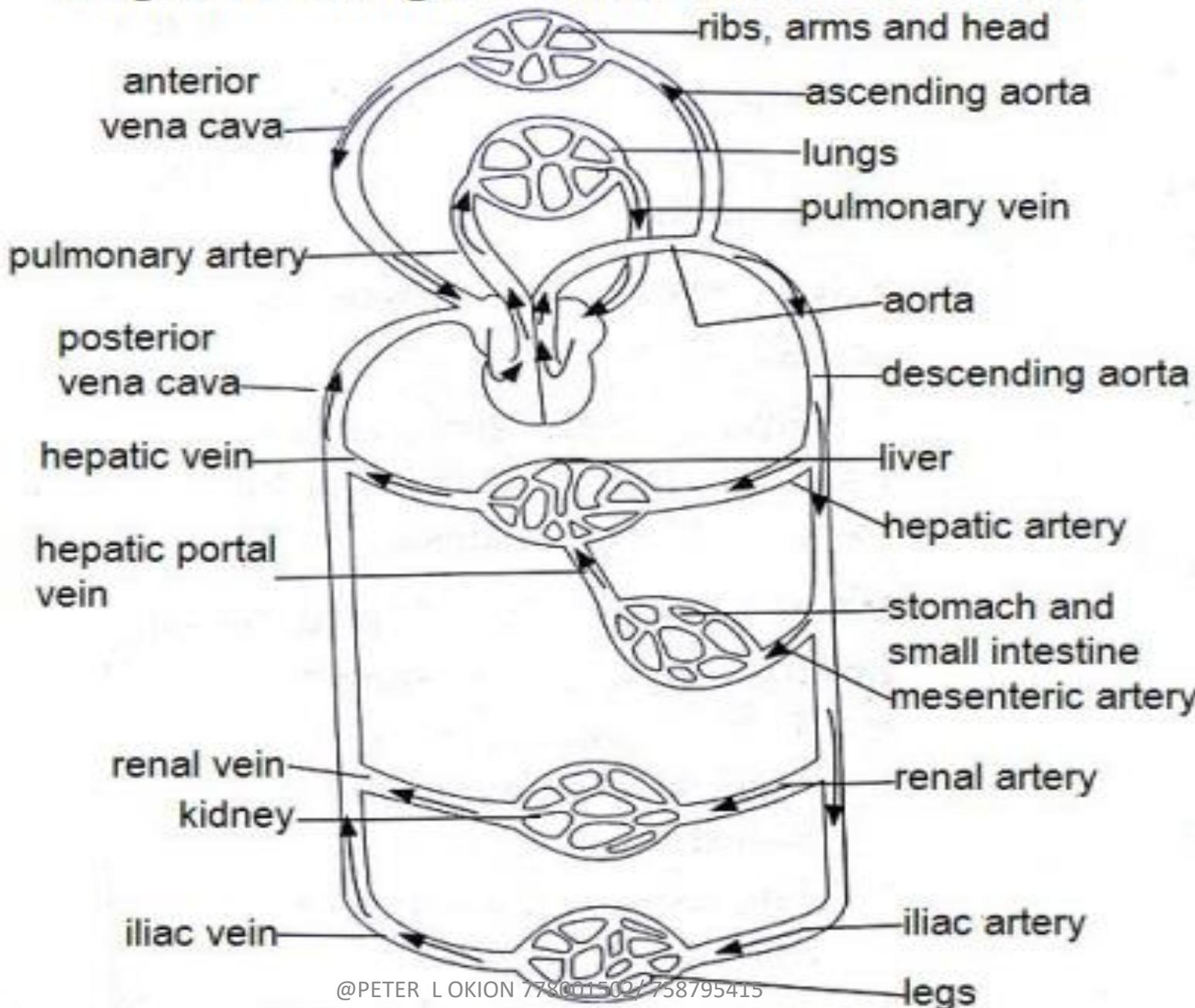
The **Pulmonary circulation** is between the heart and the LUNGS.

The **systemic circulation** is between the heart and other organs

# *Illustration*

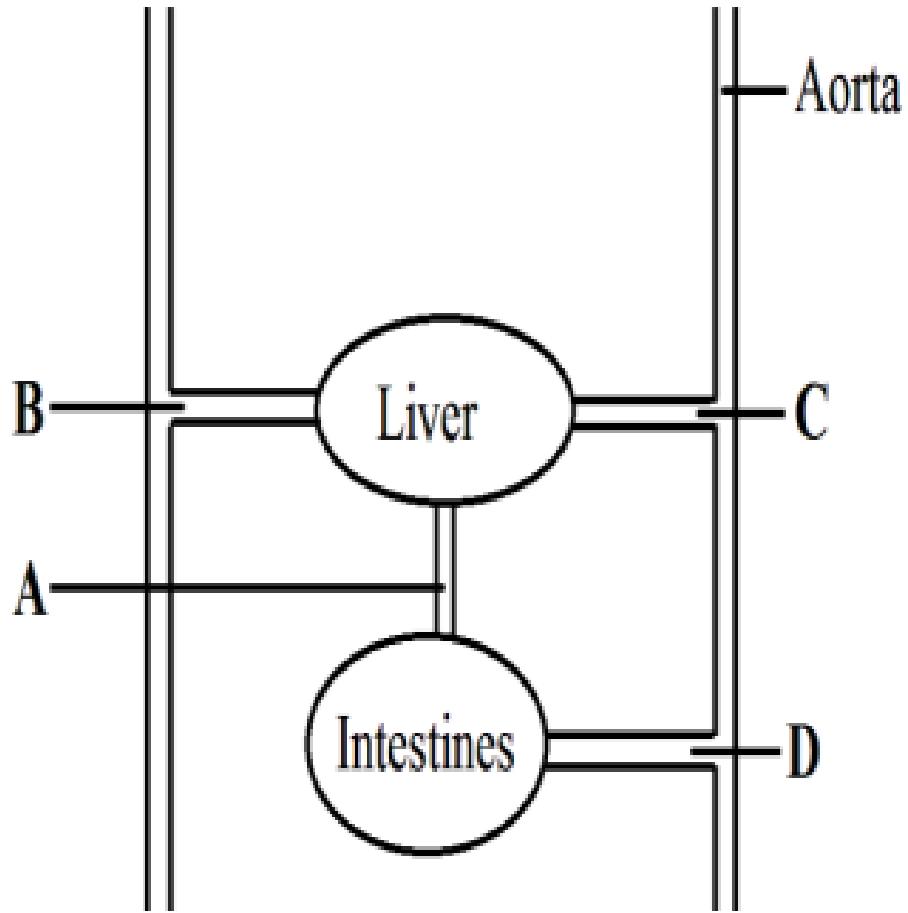


## Diagram showing the flow of blood in a mammal



# Sample question

1. The figure below shows part of the mammalian circulatory system.



- a) Name the blood vessels labeled A, B, C and D. **(02 marks)**
- b) Using arrows, show on the diagram the direction of blood flow in the blood vessels labeled A and B. **(01 marks)**
- c) State **three** differences in composition of blood flowing in A and B **(03 marks)**
- d) Explain the changes in the composition of glucose in A and B. **(02 marks)**
- e) How is blood vessel A structurally adapted to perform its function? **(02 marks)**

# **GROUP PROJECT**

**AIM:** To explain how blood flows in the human body.

***What to do:***

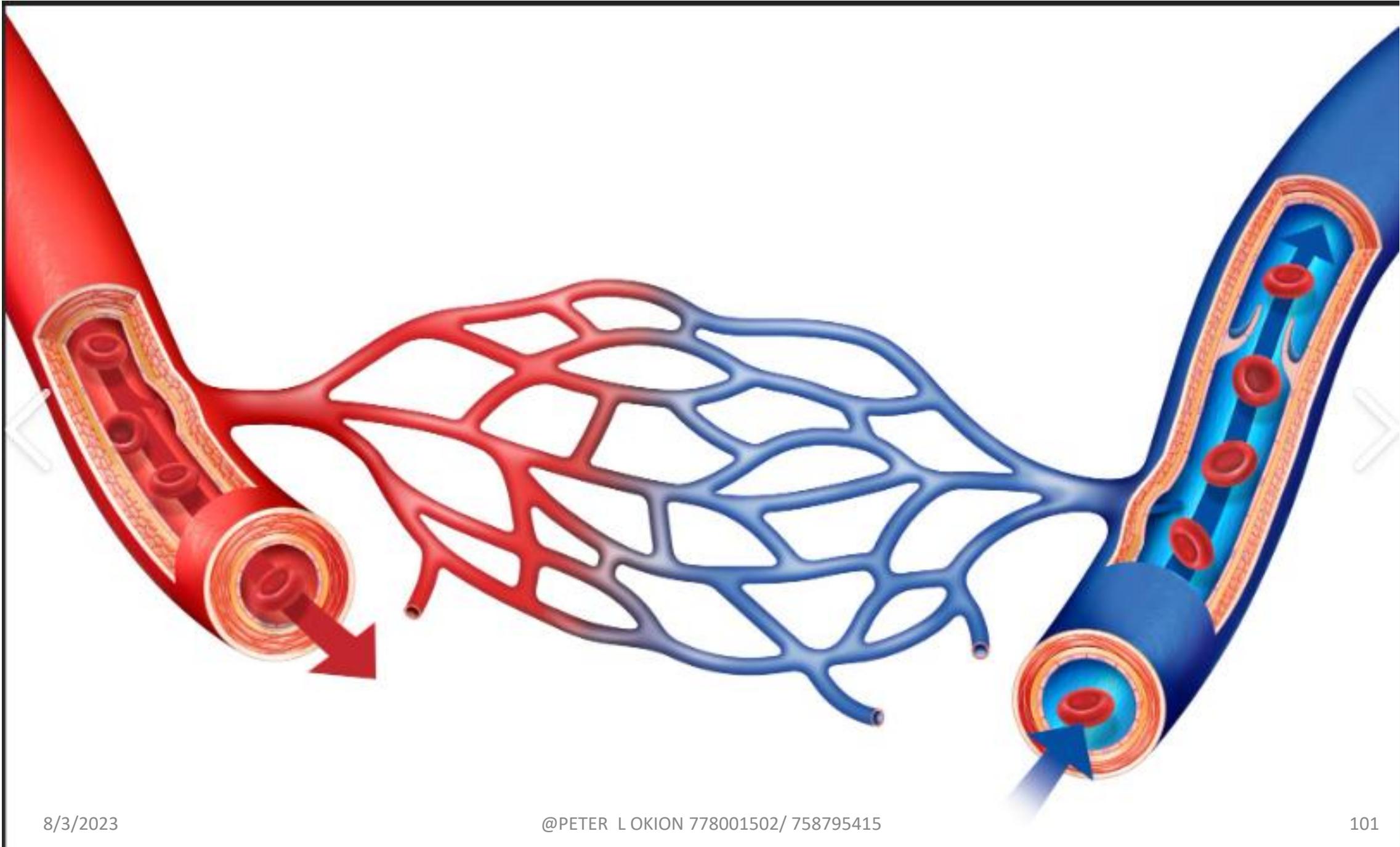
In groups, using the materials available in your environment, design a model showing the blood flow in the human body.

Share your model to the rest of the class after 2 weeks.

# *Exercise*

1. Why do large multicellular animals need transport systems?
2. Explain why the blood in systemic circulation is always at a higher pressure than that in pulmonary circulation.
3. What would happen to a living organism if the flow of blood to the lungs via the pulmonary vein is interrupted permanently?
4. How is having a double circulation in mammals advantageous?
5. Describe the route taken by a red blood cell that has just picked oxygen at the lungs, until it reaches the liver where it gives it up.
6. What will happen to the amount of oxygen in the red blood cell as it passes through the:
  - a) lungs
  - b) capillaries of the liver

1. Large sized multicellular animals have a smaller surface area to volume ratio and their organs are further away from the surface thus the supply of materials and removal of wastes cannot be satisfied by simple diffusion
2. Systemic circulation pumps blood to greater distance, high pressure will ensure faster delivery of materials to body organs
3. No oxygenation of blood will occur, body tissues will lack oxygen causing their reduced functioning and carbon dioxide will accumulate which will lower the pH of the blood and tissues, reducing metabolism in the body.
4. Blood is pumped at a higher pressure, ensuring efficient delivery of materials to tissues.
5. Consider blood circulation from the lungs to the liver
6. A) increases as more oxygen is picked  
b) decreases as oxygen is removed from blood to support metabolism in the liver cells



# Structure of blood vessels

Blood is carried throughout the body in tube like structures called **Blood vessels**.

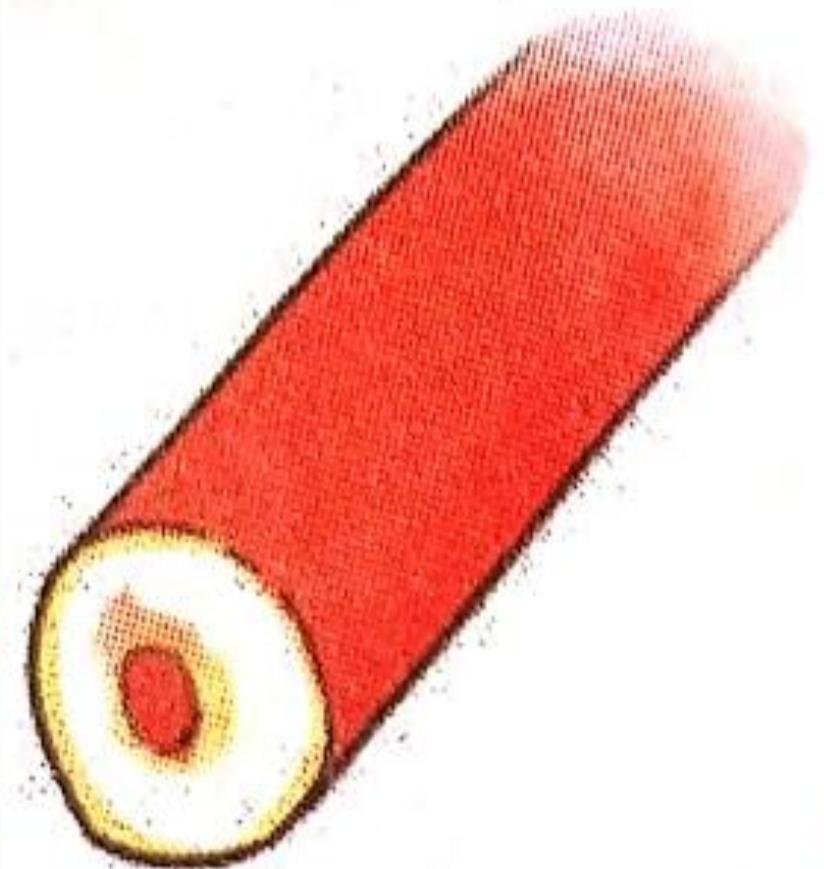
The blood vessels are categorized into 3 types i.e. **veins, arteries and capillaries**

Arteries carry blood away from the heart. They divide and eventually form very tiny vessels called capillaries

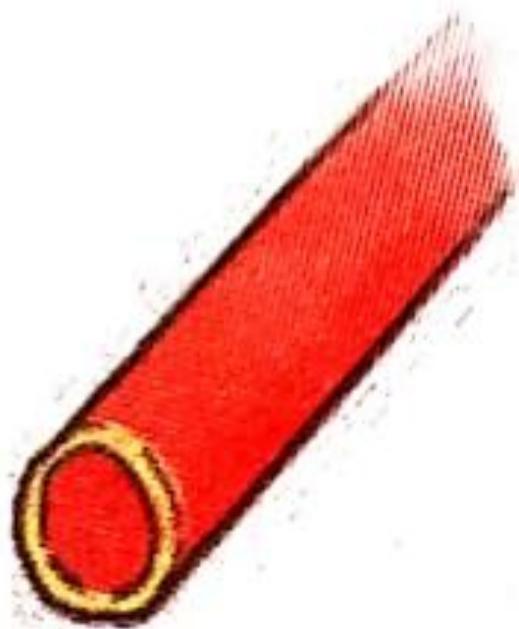
The capillaries gradually join up with one another to form large vessels called veins.

Veins carry blood towards the heart.

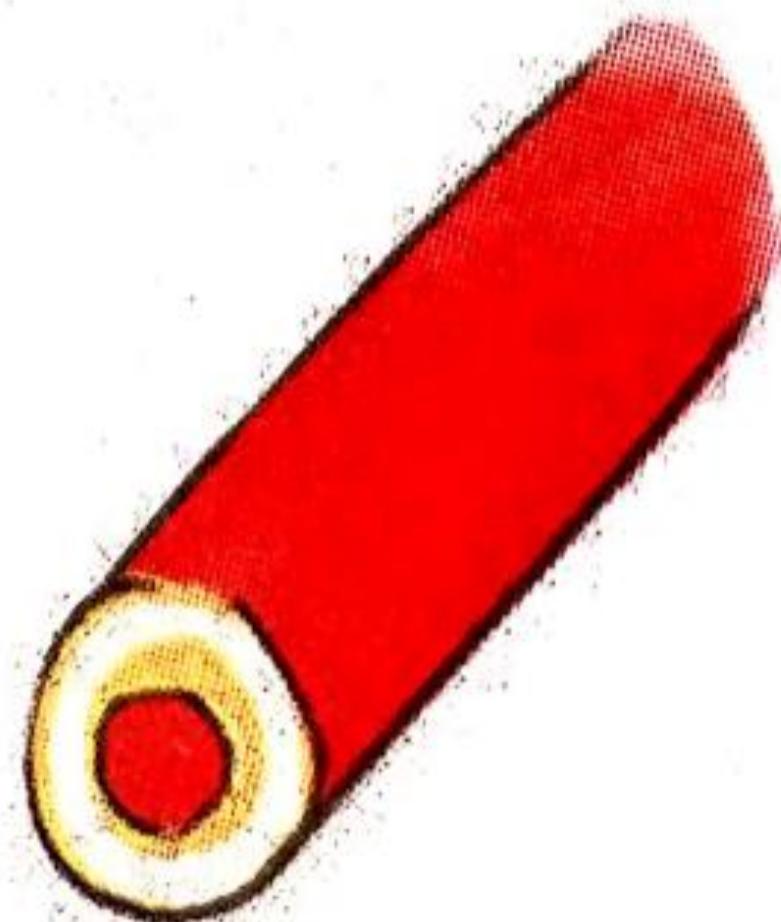
**Qn:** how are these three categories different from each other?



arteries

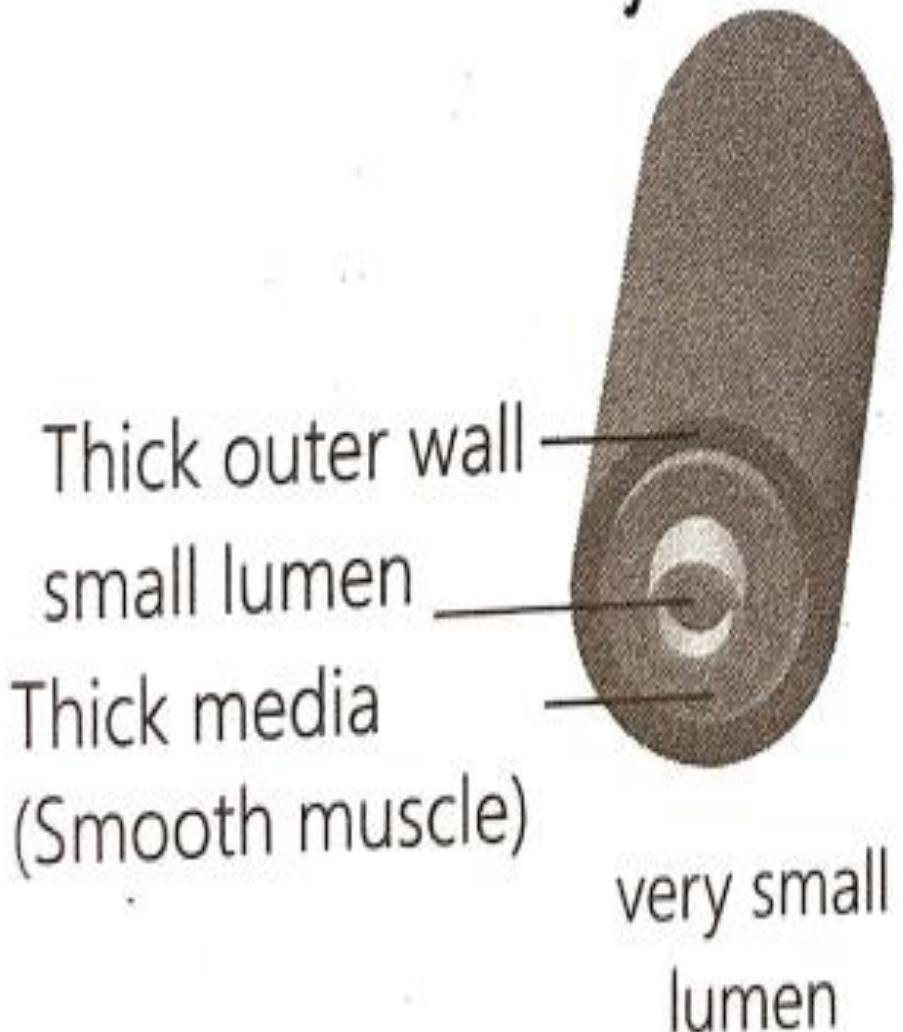


capillaries



veins

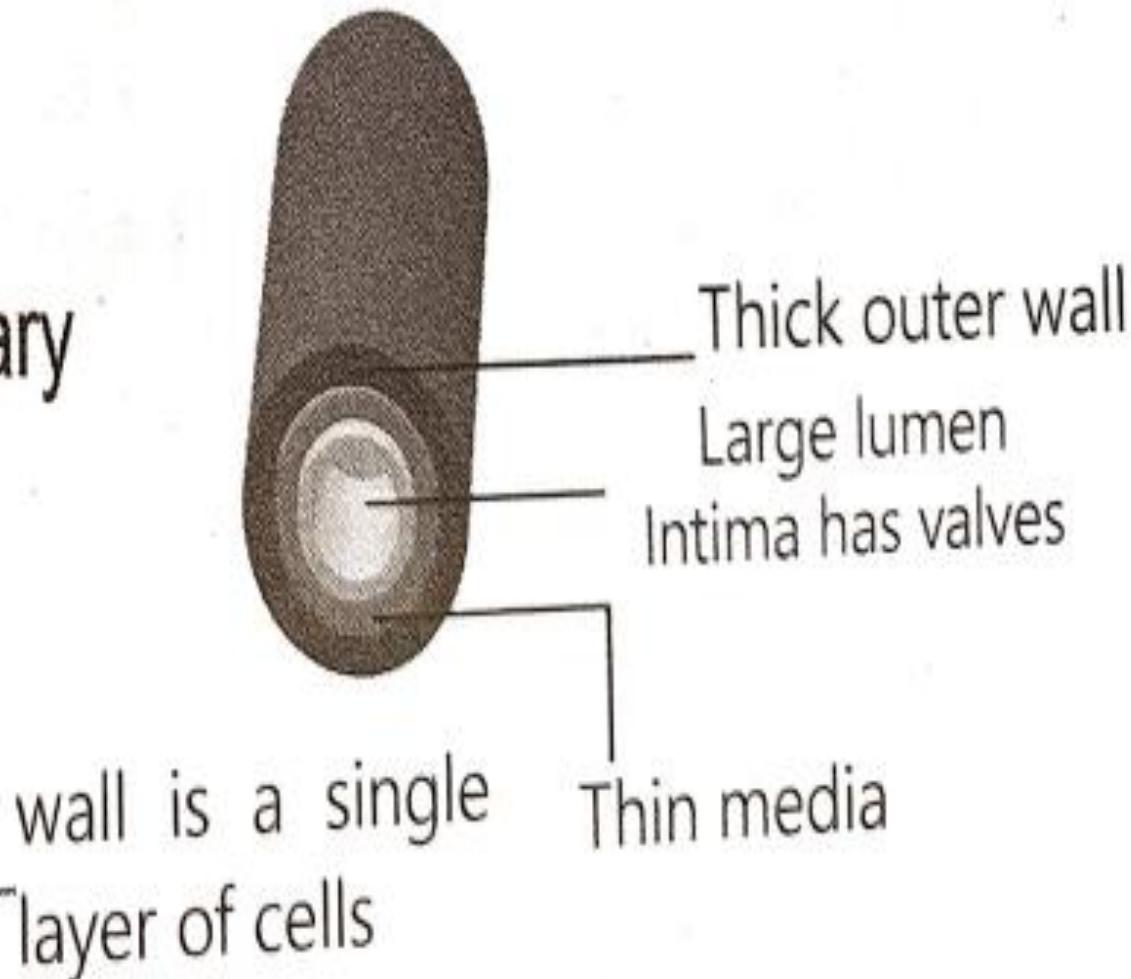
An artery



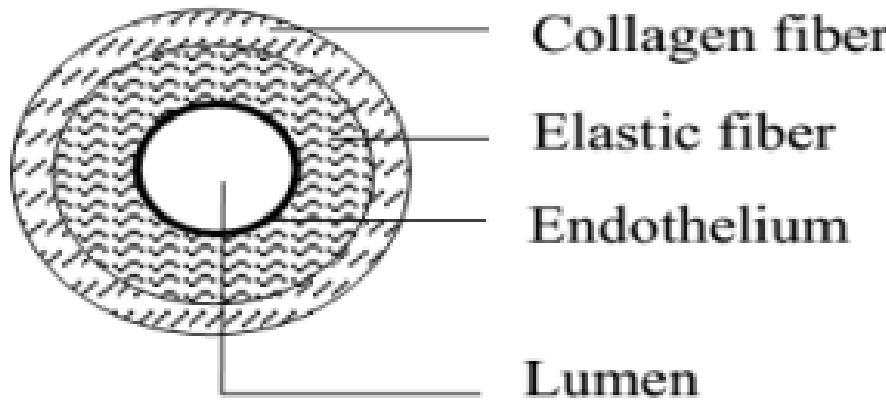
A capillary



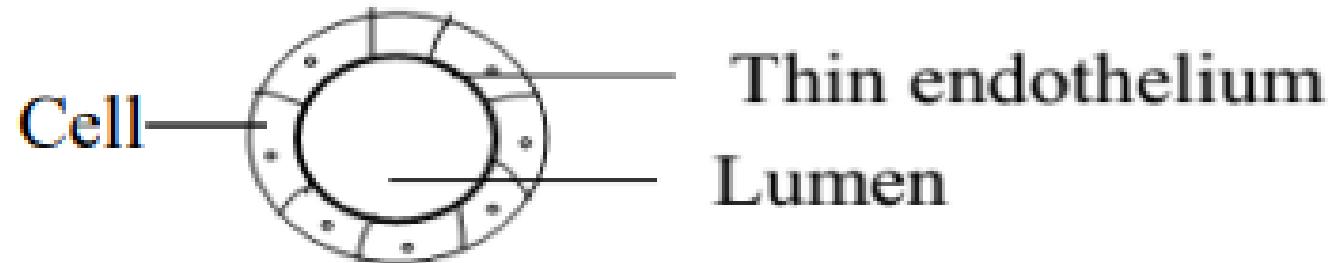
A vein



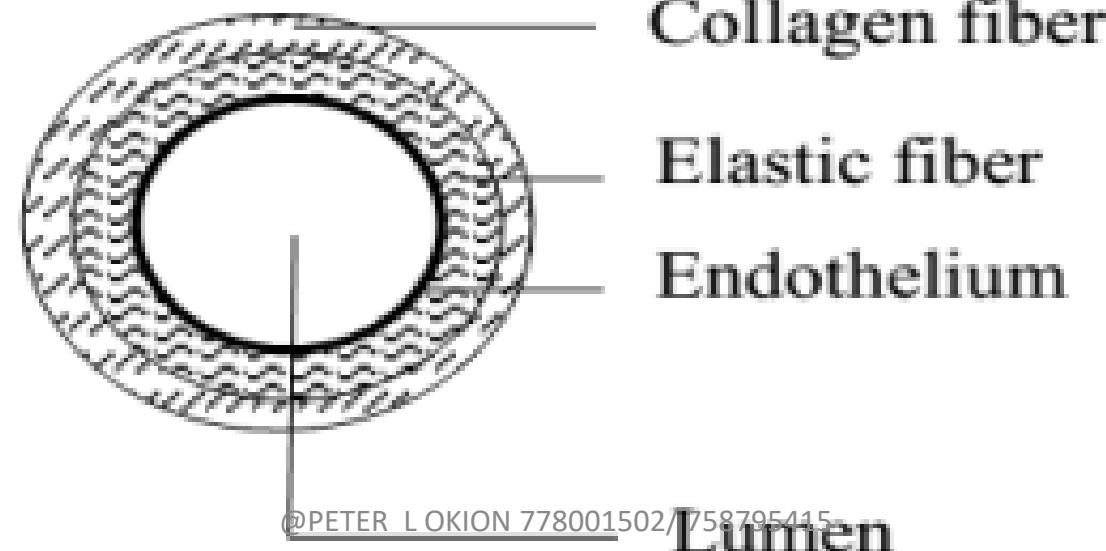
## Structure of an artery in cross section



## Cross-section through a capillary



## Cross section through a vein



## Differences between arteries, veins and capillaries

### Structural:

Artery	Veins	Capillaries
Have thick walls with smooth muscles	have thin walls with smooth muscles	Have thinnest walls with smooth muscles
have more elastic fibres	Have less elastic fibres	Do not have elastic fibres
Have smaller lumen relative to diameter	Have a wider lumen relative to diameter	Have largest lumen relative to diameter
Have no valves except at the base of aorta & pulmonary artery	Have valves throughout their length	Have no valves
Can constrict	Can't constrict	Can't constrict
Walls not permeable	Walls not permeable	Walls permeable

## Functional

Artery	Vein	Capillaries
Carry blood away from the heart	Carry blood towards the heart	Carry blood in a direction to and from the heart in tissues
Carry oxygenated blood except pulmonary artery and umbilical artery	Carry deoxygenated blood except pulmonary vein and umbilical vein	Carry both oxygenated and deoxygenated blood
Blood flow at high pressure	Blood flow at low pressure	Blood flow at low pressure
Blood flow in pulse	Blood does not flow in pulse	Blood does not flow in pulses



Blood  
Biology



Blood  
Anatomy



Blood  
Flow



Blood  
Wound



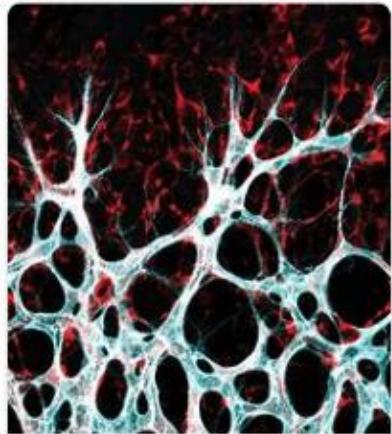
Blood  
Emoji



Blood  
Template



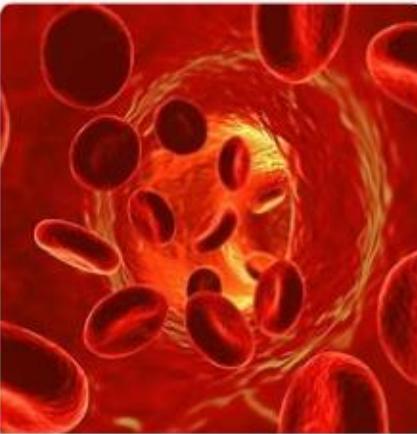
Blood  
Cell Types



Interpretation of a dream  
in which you saw «Blo...



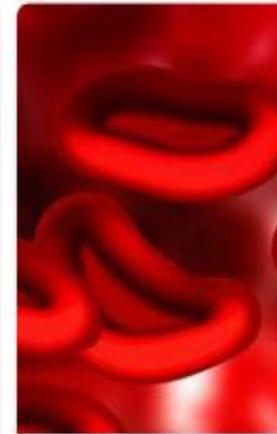
Interpretation of a dream in which you  
saw «Blood»



COVID Vaccine Linked to Low  
Blood Platelet Count ...



Interpretation of a dream in which you saw «Blood»



Reduce 80% of the t  
with these two step



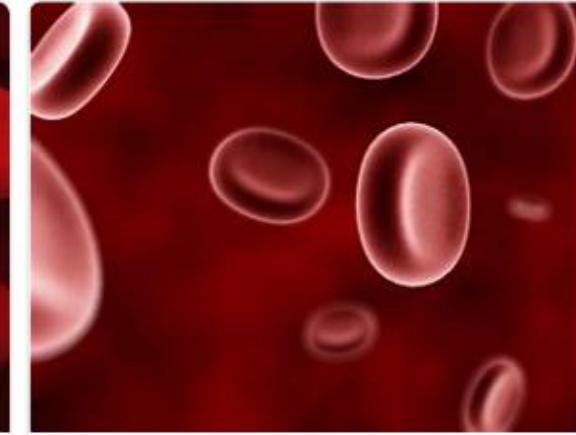
Picture of red blood cells



Blood



Spring Cleaning for the Blood | Reno Integrative  
Medical Center  
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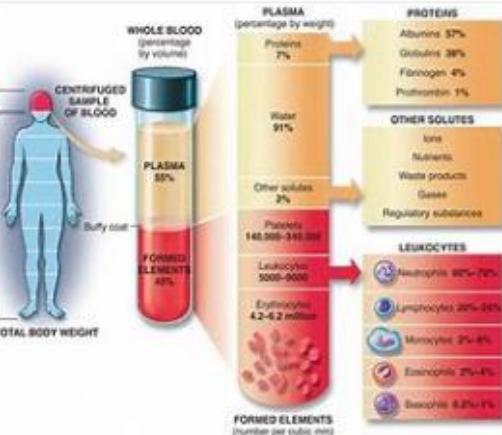


Red Blood Cells (Left).jpg



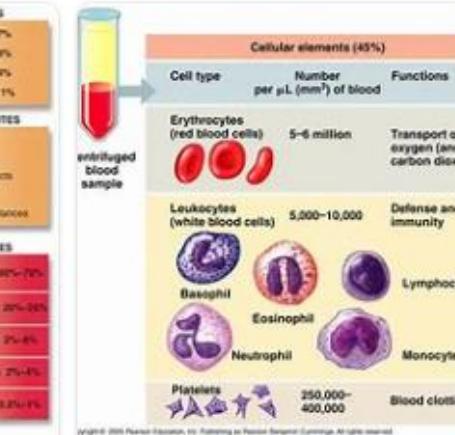
Blood-Platelets.jpe

## 4 Parts of Blood



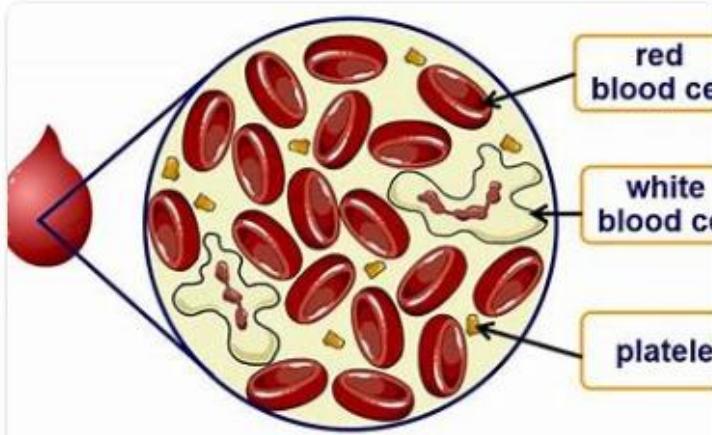
Body System: Blood Components

## 4 Components of Blood



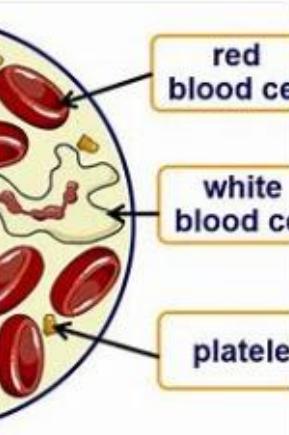
Associate Degree Nursing  
Physiology Rev...

## Components of Plasma

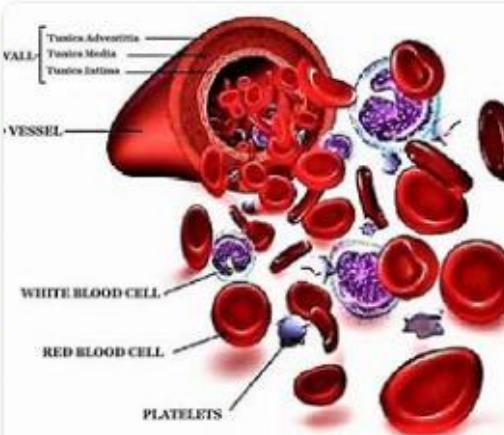


Blood Components - FORENSIC SCIENCE

## The Elements of Blood



## Cellular Components of Blood

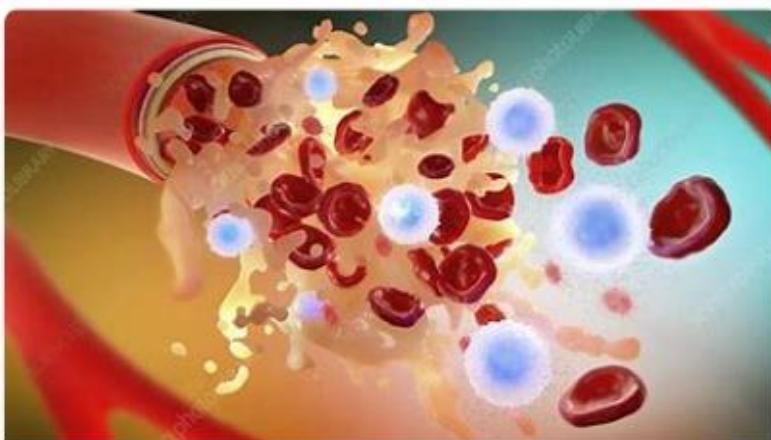


COMPOSITION OF BLOOD |  
HEMATOLOGY NOTES

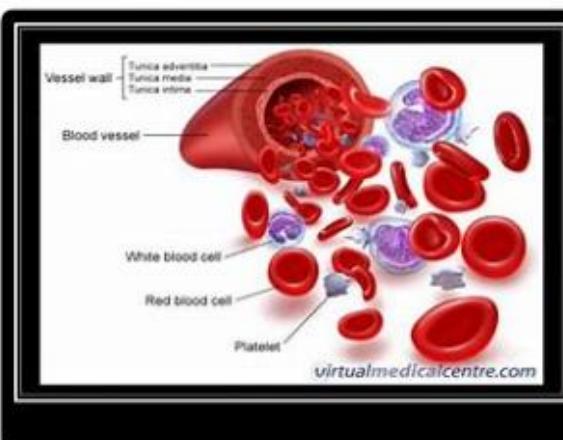
## Cor Wor

- 
- Whole blood
    - RBCs
    - WBCs
    - Platelets: cell fragment
  - Plasma
    - 90% water (allows mat
    - Amino acids, glucose,
    - Concentrations allows

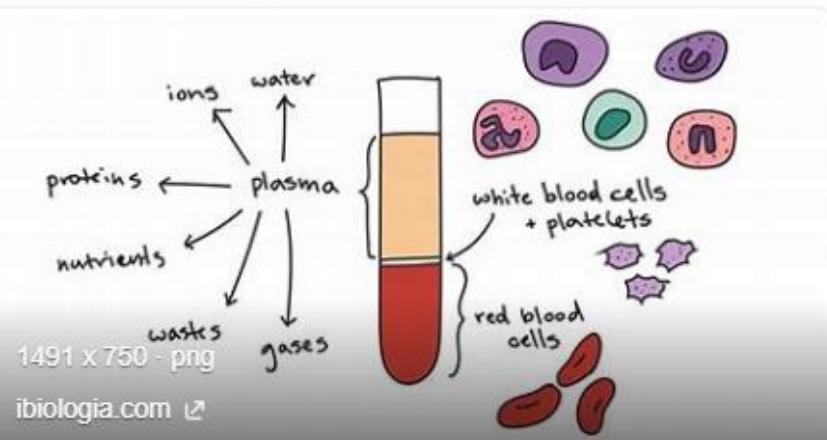
PPT - Blood Pov  
free download -



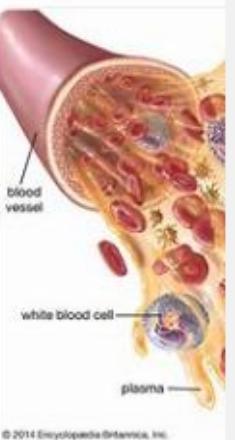
Blood components, illustration - Stock Image - F025/0440  
- Science ...



Blood components



Blood Components | Definition | Functions



serum albumin |

# BLOOD

Blood is the fluid which flows in blood vessels. Blood is made up of different substances and cells that enable it to carry out its functions.

These include: .....(thrombocytes),  
.....(leucocytes), .....(erythrocytes)

And .....

**Other components of blood** that may be periodically added include; blood proteins like globulin, hormones and antibodies

## **General importance of blood in the bodies of animals**

1. It transports oxygen from the lungs to all parts of the body.
2. It transports digested food from the ileum to other parts of the body for use.
3. It transports Carbon dioxide from the tissues to the lungs.
4. It transports nitrogenous wastes from the liver to the kidney where they are excreted.
5. It transports hormones from their site of production to where they perform their functions.
6. It distributes heat and aids in temperature control.
7. It prevents infection by transportation of white blood cells.
8. It prevents loss of fluids and cells through forming blood clots.

# ***Blood components***

<b>Components</b>	<b>function</b>
Red Blood Cells	Transports oxygen and carbon dioxide
White Blood Cells	Defend the body against disease
Platelets	Clotting of blood to prevent excess loss of blood
Globulin	Makes antibodies for body immunity
Fibrinogen	For blood clotting
Albumin	Makes blood thick and viscous

# **Adaptation of Red Blood Cells to carry out their function**

- ✓ They are biconcave in shape so as to avail a large surface area to volume ratio for absorption of oxygen.
- ✓ They have hemoglobin molecules that bind oxygen and transport it from the lungs to the tissues.
- ✓ They have a thin membrane which reduces the diffusion distance for the respiratory gases in and out of the cells.
- ✓ Have no nucleus which provides enough space for packaging of haemoglobin
- ✓ Have no mitochondria to prevent them from using the oxygen they are carrying.
- ✓ They are numerous to increase surface area for transportation of oxygen
- ✓ They have flexible membranes which make them able to squeeze through capillary networks.

**NB:**

The **concentration of red blood cells increases** as one slowly climbs up a mountain because **the concentration of oxygen in the air reduces** with **increase** in height above sea level.

So the **body acclimatizes** by producing **more red blood cells** to increase the available total surface area to bind and carry oxygen to the tissues regardless the reducing oxygen concentration.

# ***HEART DISEASES***

These are also called **cardiovascular diseases**.

A heart disease is any condition that affects the structure and functioning of the heart. They **are non-communicable diseases**

Examples include: **stroke, coronary heart disease, high blood pressure**

## Heart Disease Diagram



Heart Disease Infographic



Pulmonary Heart Disease



Heart Disease Drawing



Person with Heart Disease



Heart Health



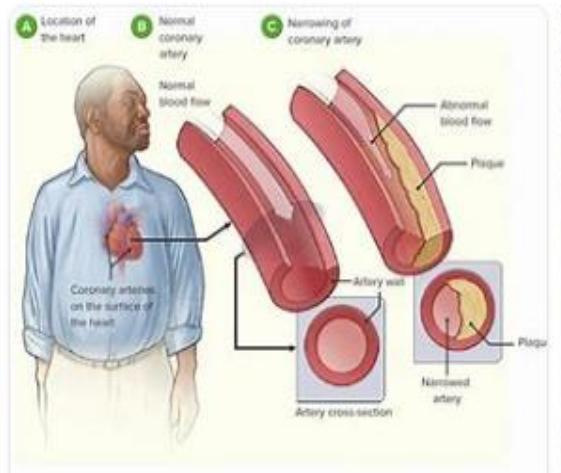
Understanding cardiovascular diseases | The Guardian  
Nigeria News ...



Heart Disease: Symptoms, Diagnosis,  
and Treatment



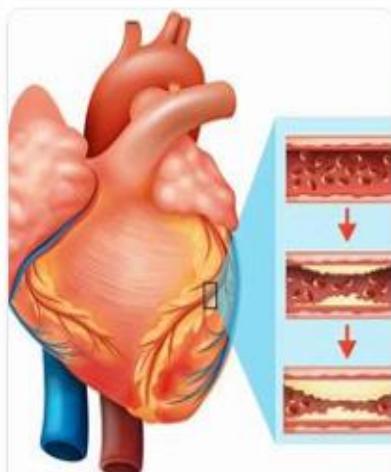
The Facts About Heart Disease ...



Coronary Heart Disease | Concise Medical Knowledge



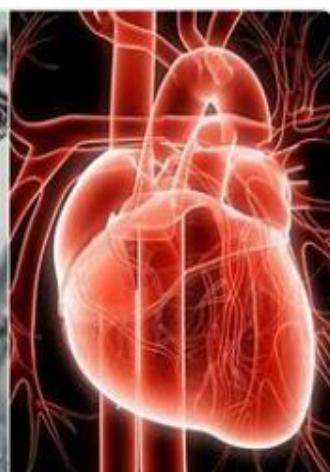
Signs of Heart Disease Seniors Should Know



A closer look at heart disease risk Harvard H...  
8/3/2023



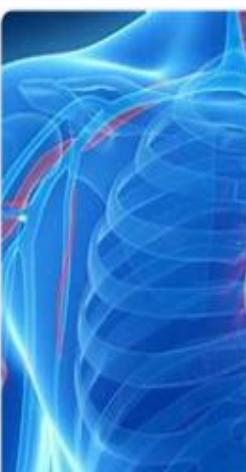
Can You Overcome Your Genetic Risk of Heart Disease? | Everyday Health



Exercise Stress Test - What is Your Risk of Having Heart Disease DTAP ...  
LOKION 7780015024758795415



6 signs of heart disease you should NEVER ignore ...



Heart Disease: What You Need to Know | Fitness Together  
116

# Table of causes and prevention of heart diseases

Disease	Causes	Prevention
Stroke	Blood clot Head injury Burst of blood clot	Avoid smoking cigarettes Having regular exercises Having a balanced diet
Coronary heart disease	Tobacco smoking High emotional stress	
High blood pressure	Excessive salt consumption High fat diet Lack of exercise Obesity Stress Tobacco smoking High alcohol consumption	Regular aerobic exercises Moderate intake of salt, fats and alcohol



**Most Rare Blood Group**



**Blood Type B**



**Rarest Blood Group**



**Blood Group a Antigen**



**Blood Group Transfusion**



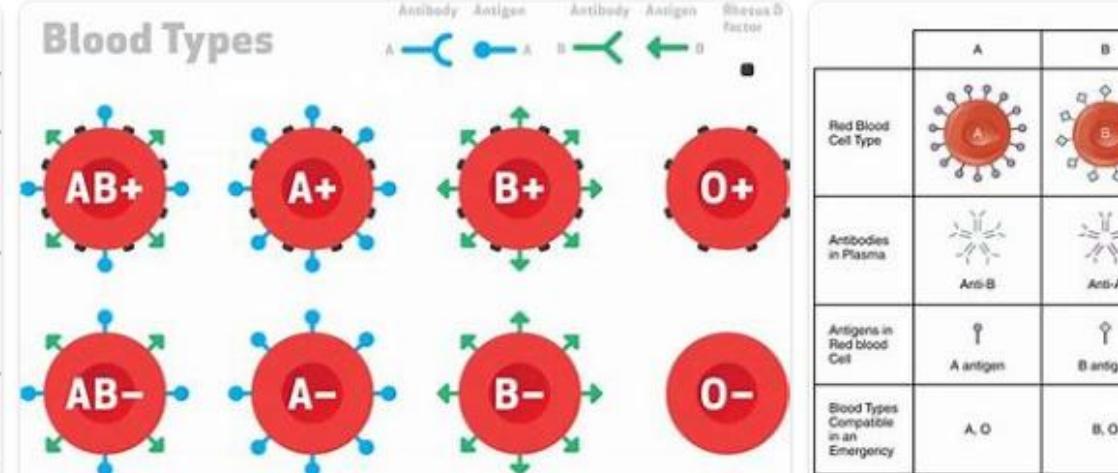
**A Positive Blood Type**

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies in plasma	Anti-B	Anti-A	None	Anti-A and Anti-B
Antigens in red blood cell	A antigen	B antigen	A and B antigens	None

[Blood type - Wikipedia](#)

ABO Blood Group System				
Group	A	B	AB	O
Red Blood Cell Type				
Antigens Present	Antigen A	Antigen B	Antigen A & B	None
Antibodies Present	Anti-B	Anti-A	None	Anti-A & Anti-B

ABO Blood Group System - Dr Robert Brody



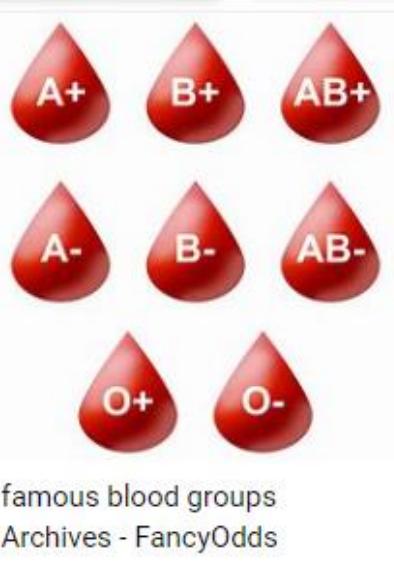
What are the four major blood groups? | Socratic

	A	B
Red Blood Cell Type		
Antibodies in Plasma	Anti-B	Anti-A
Antigens in Red blood Cell	A antigen	B antigen
Blood Types Compatible in an Emergency	A, O	B, O

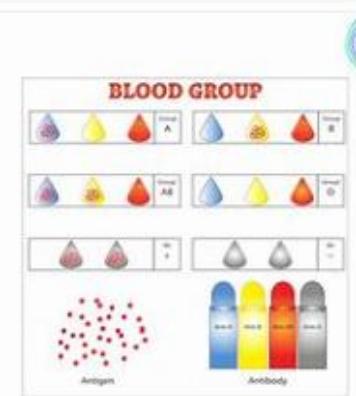
Difference Between Bl  
and O | Difference Betw

RECIPIENT GROUP	A	B	AB	O
RECIPIENT ANTIGEN	A	B	A AND B	NONE
RECIPIENT ANTIBODY	ANTI-B	ANTI-A	NONE	ANTI-A & ANTI-B
COMPATIBLE DONOR CELL				
COMPATIBLE DONOR PLASMA				

Blood Grouping - LearnHaem |  
Haematology Made Simple  
8/3/2023



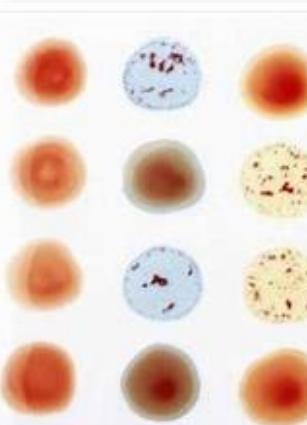
famous blood groups  
Archives - FancyOdds



Blood Groups: Types, ABO and  
Rh Blood Groups - Emb  
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Type A	Type B	Type AB	Type O
Antigen A	Antigen B	Antigens A + B	Neither A or B
Anti-B Antibody	Anti-A Antibody	Neither Antibody	Both Antibodies
Cannot have B or AB blood	Cannot have A or AB blood	Can have any type of blood	Is the universal donor

BLOOD GROUP



The ABO and the Rhesus B Systems 118

# *Blood groups*

## *Do you know your blood group?*

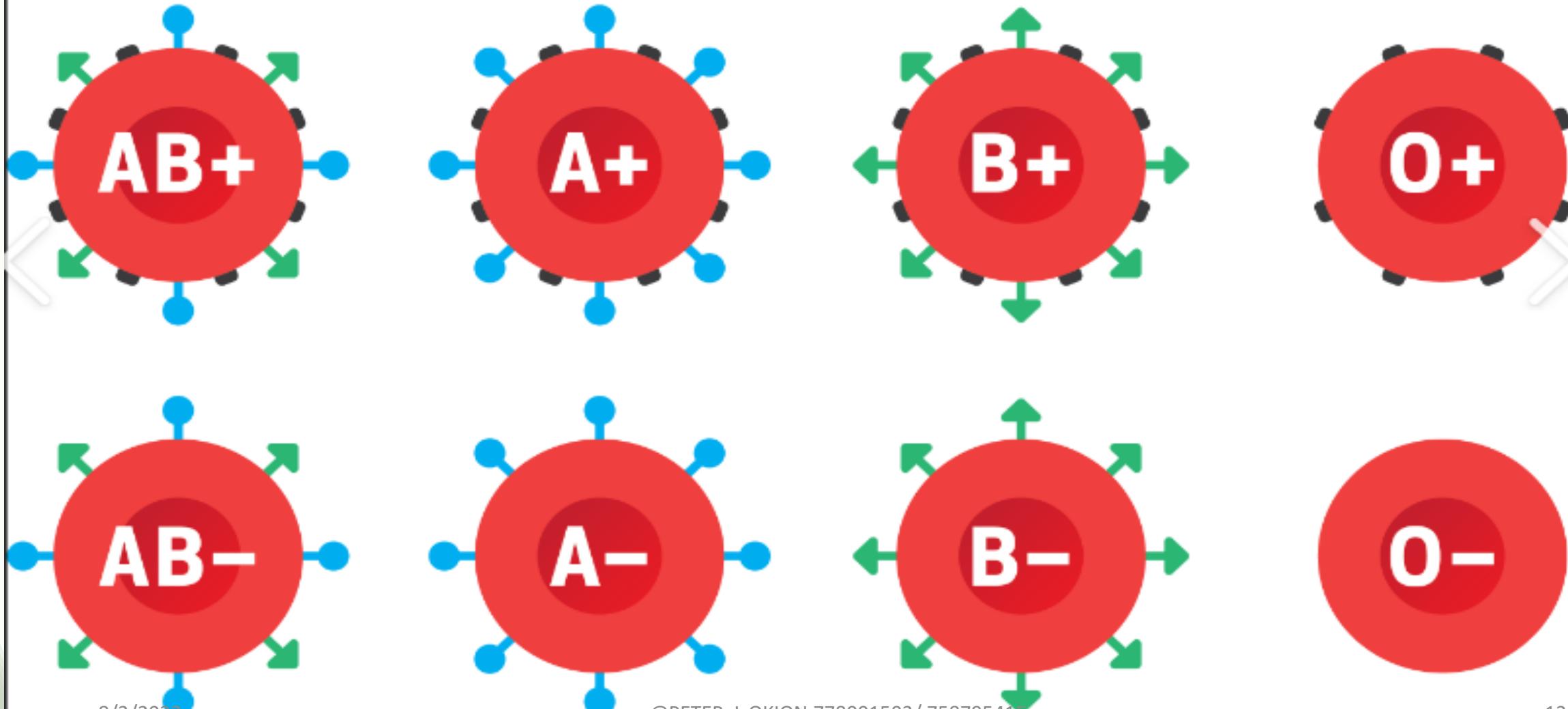
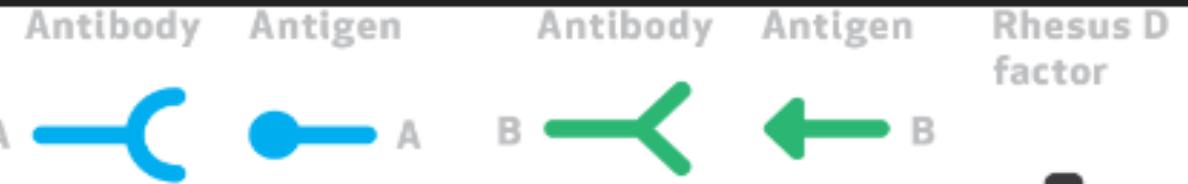
There are different blood groups and the group you have is determined by the type of antigen present on the surface of your Red Blood cells.

### **KEY WORDS**

1. **An antigen:** is a chemical substance recognized as foreign in the body.
2. **An antibody:** is a protective protein produced by the immune system in response to the presence of a foreign substance called an antigen.

**NB:** there are 4 major blood groups, based on whether you have or not have the two specific antigens, that is **anti-A** and **anti-B**. these are summarized in the table below:

# Blood Types



# Table of blood groups

Blood group	Antigen present	Antibody produced
A	A	b
B	B	a
AB	A and B	NONE
O	NONE	a and b

## **NOTE:**

1. Antigens are represented by capital letters while antibodies are represented by small letters
2. There is another antigen called **rhesus factor** or **anti-D (Rh+ or Rh-)**

## **ASSIGNMENT:**

**Read and make notes on Rhesus factor, how it affects blood transfusion and its implications on pregnancies.**



Storing Blood Before Transfusion | National Institutes of Health (NIH)



1024 x 684 · jpeg  
[holycrossleonecenter.com](http://holycrossleonecenter.com)

[Blood Transfusions During Surgery - The Leone Center for Orthopedic Care](#)



Blood Transfusion in Horses - Procedure, Efficacy, Recovery, Prevention ...



Topics in blood transfusion - C



5 Risks You Should Know About Blood Tra...



Fountain of youth, people are buying blood transfusions to st...



Fresh blood no better for transfusions, Canadian-led study shows ...



Blood Transfusions American Pregnanc



8/3/2023



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Caregiver  
Blood bag  
IV



123  
Feedback

# **BLOOD TRANSFUSION**

**Have you ever donated blood? OR have you ever received blood?**

During blood transfusion, the one who receives blood is called the ..... While the one who gives blood to the patient is called the .....

**NB:** DOCTORS always match the blood of the donor with that of the recipient to make sure that they are **compatible**. This is because, if incompatible blood is mixed, **agglutination** occurs (**red blood cells stick together and blood clots**)

Therefore, for blood transfusion to be safe and effective, it is important for the donor and the recipient to have blood groups that are compatible. Thus, a recipient with a given blood group can only receive blood from donors of specific blood groups.

## Table of compatibility:

		Recipient			
		A	B	AB	O
Donor	A	✓	X	✓	X
	B	X	✓	✓	X
	AB	X	X	✓	X
	O	✓	✓	✓	✓

**Key**

X ----- Incompatible

✓ ----- Compatible

### Note.

- 1) Blood group AB can receive blood from all other blood groups because it has no antibodies and it is therefore called a **universal recipient**.
- 2) Blood group O can donate blood to all blood groups because it has no antigens and it is therefore called a **universal donor**.

# **Benefits/ importance of blood transfusion**

- ✓ Replaces blood which is lost during hemorrhages
- ✓ Provides platelets which may be needed by patients on chemotherapy
- ✓ Provides platelets to prevent post-operation bleeding
- ✓ Plasma provides clotting factors that allow hemophiliacs to live a normal life
- ✓ Plasma contains immunoglobulins/ antibodies, these give passive immunity to individuals at risk of certain infections
- ✓ Red blood cells provide oxygen to the body

## ***Risks of blood transfusion***

- ✓ Accidental administration of ABO incompatible blood
- ✓ Hemolytic reaction: when transfused, the red blood cells of the recipient are destroyed
- ✓ Transfusion associated acute lung injury due to presence of anti-granulocyte antibodies in the donor's plasma.
- ✓ Sepsis- bacterial contamination of the transfused products.
- ✓ Allergic reactions due to presence of allergens in the donor's blood
- ✓ Transfusion of infectious diseases e.g. malaria, AIDS, syphilis
- ✓ Pyrogens (fever-producing substances) in the transfused products

## *Exercise*

1. What is the difference between blood donor and recipient?
2. How are antigens different from antibodies?
3. Why is blood transfusion necessary?
4. During blood transfusion, giving safe blood is always emphasized
  - a) what do you understand by safe blood?
  - b) why should only safe blood be transfused?
5. A woman of child-bearing age requires a blood transfusion before she has had any children. Her blood is group B and Rh- and she is married to a man who is Rh+.
  - a) what does Rh-/+ stand for in this case?
  - b) What blood group(s) can she safely receive blood from?
  - c) Why should the Rhesus factor be such an important issue in this case?

# *The role of blood in the defense of the Human body*

**QN:** which components of blood are important for the defense of the body?

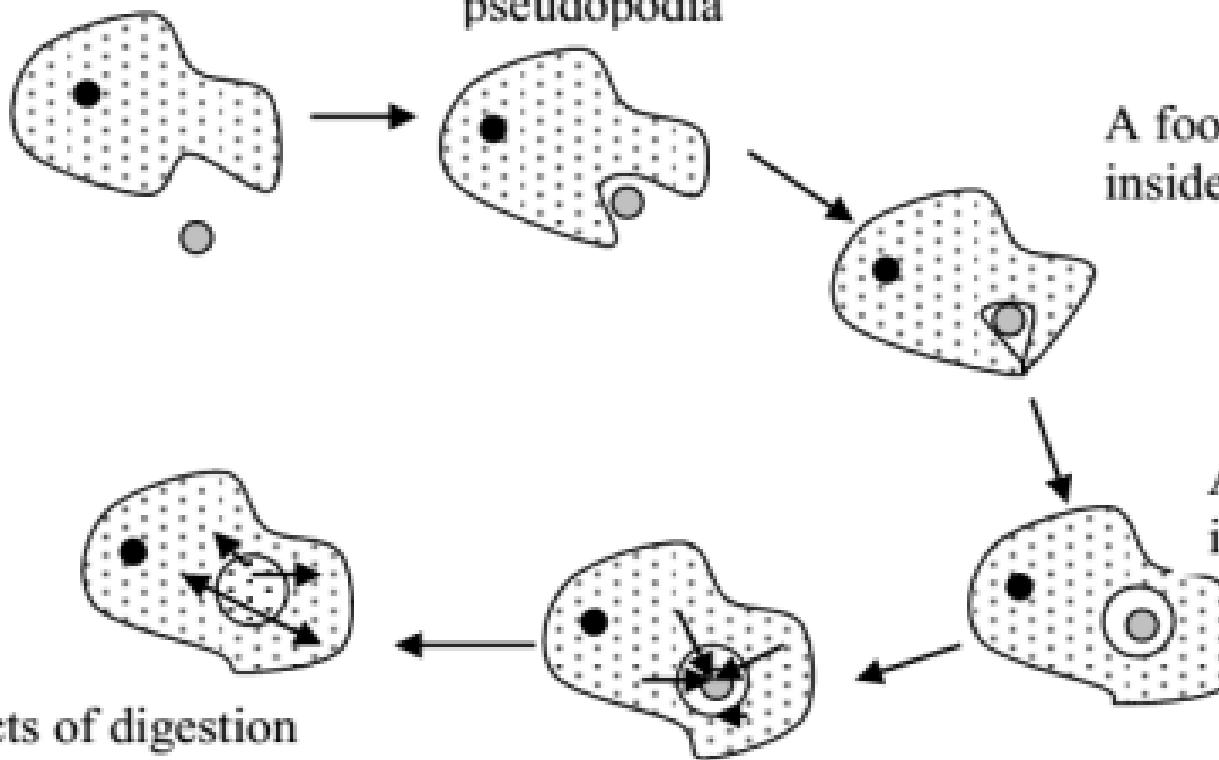
## **1. Action of white blood cells on the foreign particles**

In this process the white blood cells form pseudopodia, surround the pathogen and engulf it by Phagocytosis.

After engulfing the foreign particle, a food vacuole is formed, digestive enzymes are introduced into the vacuole such that the enzymes break down the particle and useful materials are released into cytoplasm of white blood cell while the wastes are excreted out of the cell.

## Illustration of Phagocytosis

The WBC moves towards the foreign particle and forms pseudopodia



The WBC engulfs the foreign particle using pseudopodia

A food vacuole forms inside the WBC

A food vacuole formed inside the WBC

Products of digestion are absorbed into the cytoplasm of the WBC

Digestive enzymes are secreted inside the food vacuole to digest foreign particle

# 2.

Some white blood cells destroy foreign particles by releasing antibodies, which destroy the particles. White blood cells, which produce antibodies

# Blood clotting

is the process by which blood stops oozing out of a cut or wound by formation of a clot.

**It is important because of the following reasons.**

1. It prevents excessive loss of blood from the body.
2. it is a step towards healing of cuts and wounds.
3. The blood clot creates a barrier to prevent entry of bacteria and other pathogens in the body



# The Process of Blood Clotting:

When blood is exposed to air as a result of a cut or wound, the platelets in the blood at the damaged tissue stimulate the release of a chemical called **thromboplastin (thrombokinase)**.

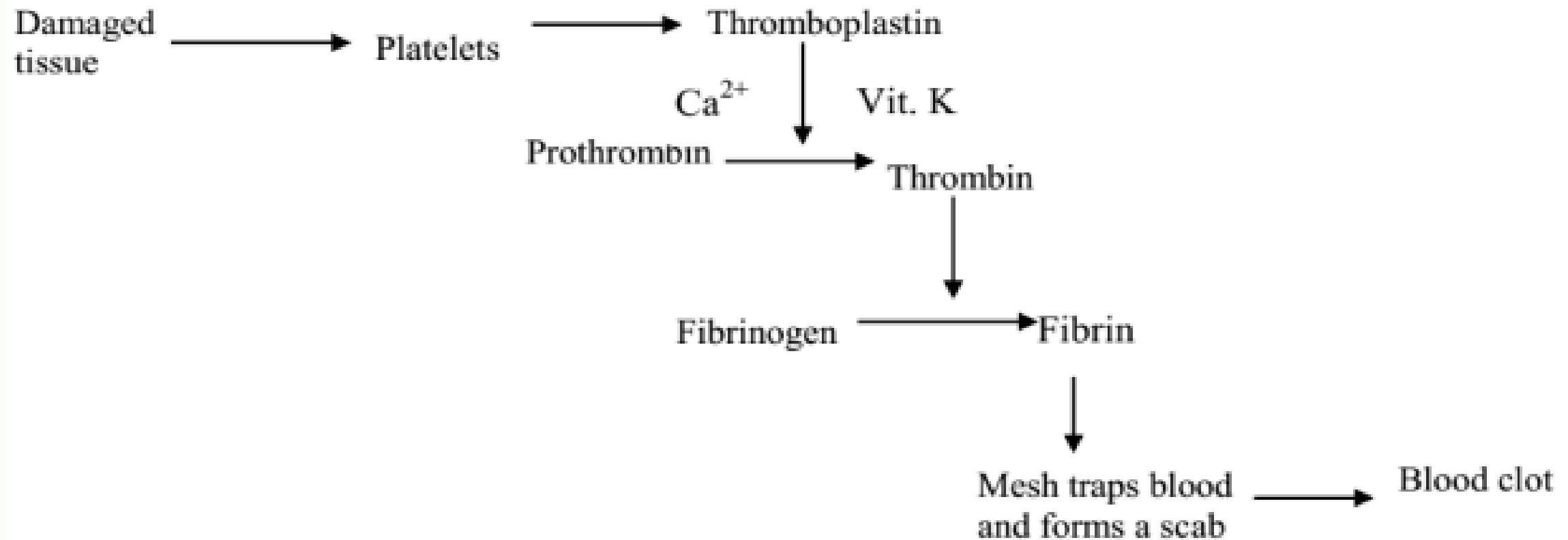
In the presence of **calcium ions** and **vitamin K**, thromboplastin stimulates the conversion of **prothrombin** to **thrombin enzyme**.

**Thrombin** then catalyzes the conversion of **soluble** blood protein **fibrinogen** to the **insoluble** form **fibrin**.

Fibrin forms **fibers**, which form a mesh and trap blood cells and proteins.

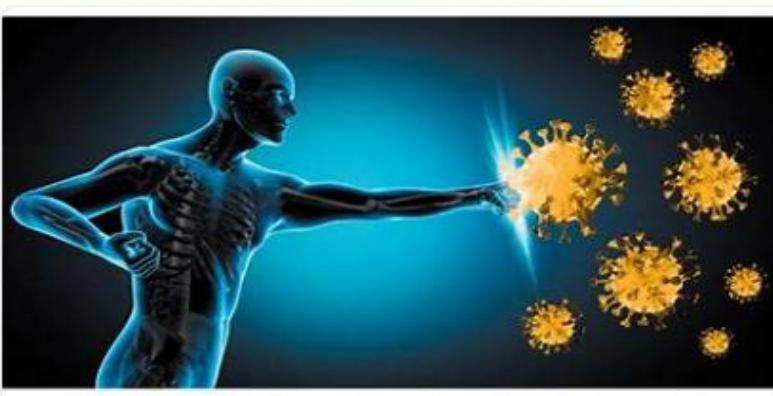
This mesh dries to form a scab, which is called the blood clot.

## Summary of blood clotting

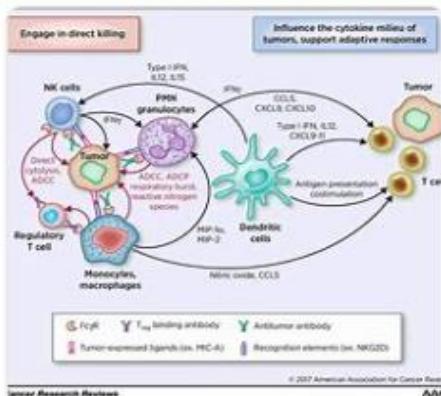




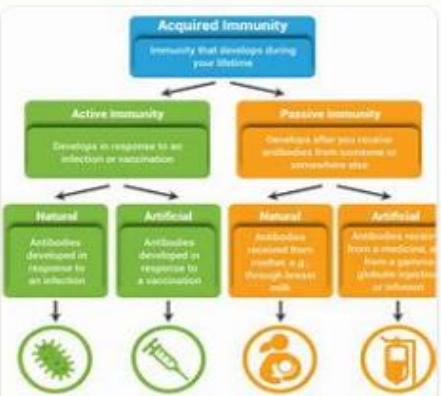
Influenza, Part 2: Immunity | Medical Preparedness | Doom and Bloom (...)



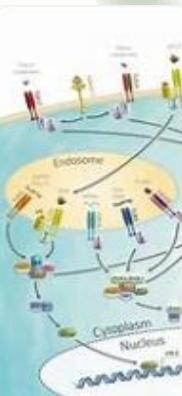
Eat to Boost Immunity - Tufts Health & Nutrition Letter



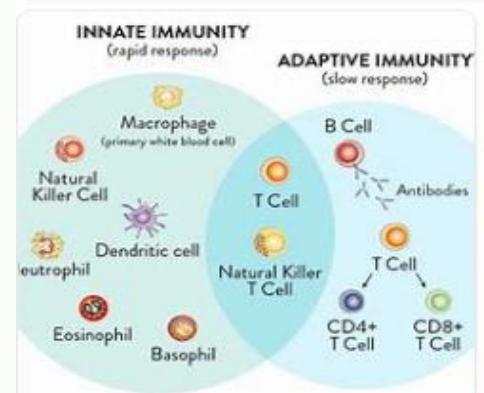
## Roles for Innate Immunity in Combination Immunotherapy



Acquired Immunity | NIH



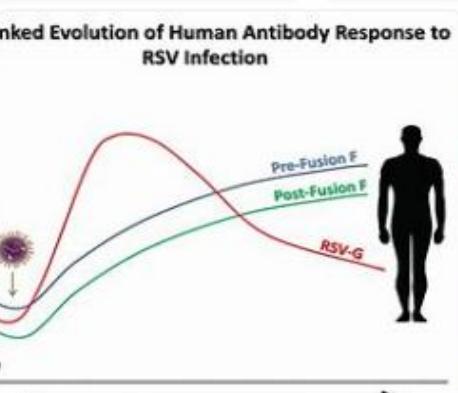
## Innate Immur



## Majority Are Already Immune Against SARS-CoV-2 – Diet... ...



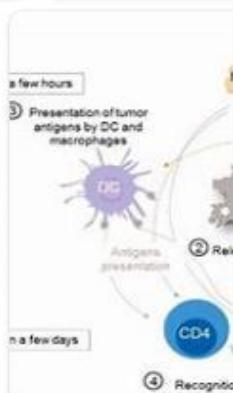
## How to Boost Immune System Quickly and Naturally - Meadbery



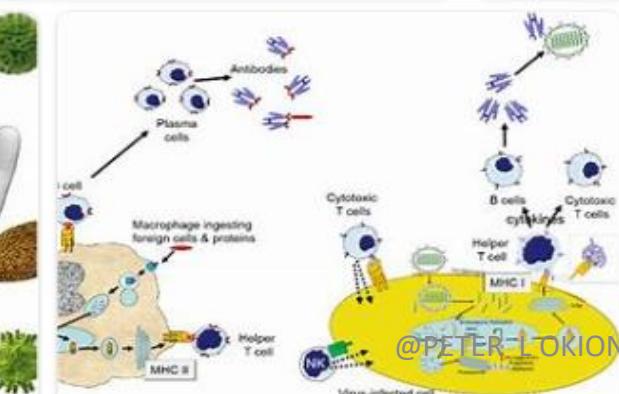
How immunity to RSV develops in childhood but deteriorates i...



## 6 Ayurvedic Ingredients That Can Assure A Stronger Immunity - 6 ...



innate immunity



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Thrive Global ↗



# Know How To **BOOST YOUR IMMUNITY**

136

# **IMMUNITY**

Immunity is the ability of an organism to resist and fight infection.

Types of immunity

**Inborn or innate immunity**

This is the type of resistance to diseases that one is born with.

**Acquired immunity**

This is the type of immunity developed by the body during the life of an individual.

It is divided into;

- i. **Acquired passive immunity**
- ii. **Acquired active immunity:**

**ASSIGNMENT:** Read and make notes about the 2 types of acquired immunity

# Explain how the body's immunity may be weakened by disease or pathogens?

Some pathogens such as the **HIV** which attack white blood cells, weaken the body's immunity.

The receptor site of HIV is on special white blood cells called **CD4 cells**. Thus, the virus attacks the white blood cells and destroy them, reducing their count in the body.

This weakens the body's immune response making the body susceptible to attack by other secondary infections, called **opportunistic infections** or diseases like tuberculosis

# **CAPILLARY EXCHANGE, FORMATION OF TISSUE FLUID AND LYMPH**

Pressure of blood from arteries through arterioles and then capillaries forces small molecules like **glucose, amino acids, vitamins, hormones and the fluid** part of blood to leave the capillaries and enter the **intercellular spaces**, leaving behind large molecules **like proteins in plasma and cells**.

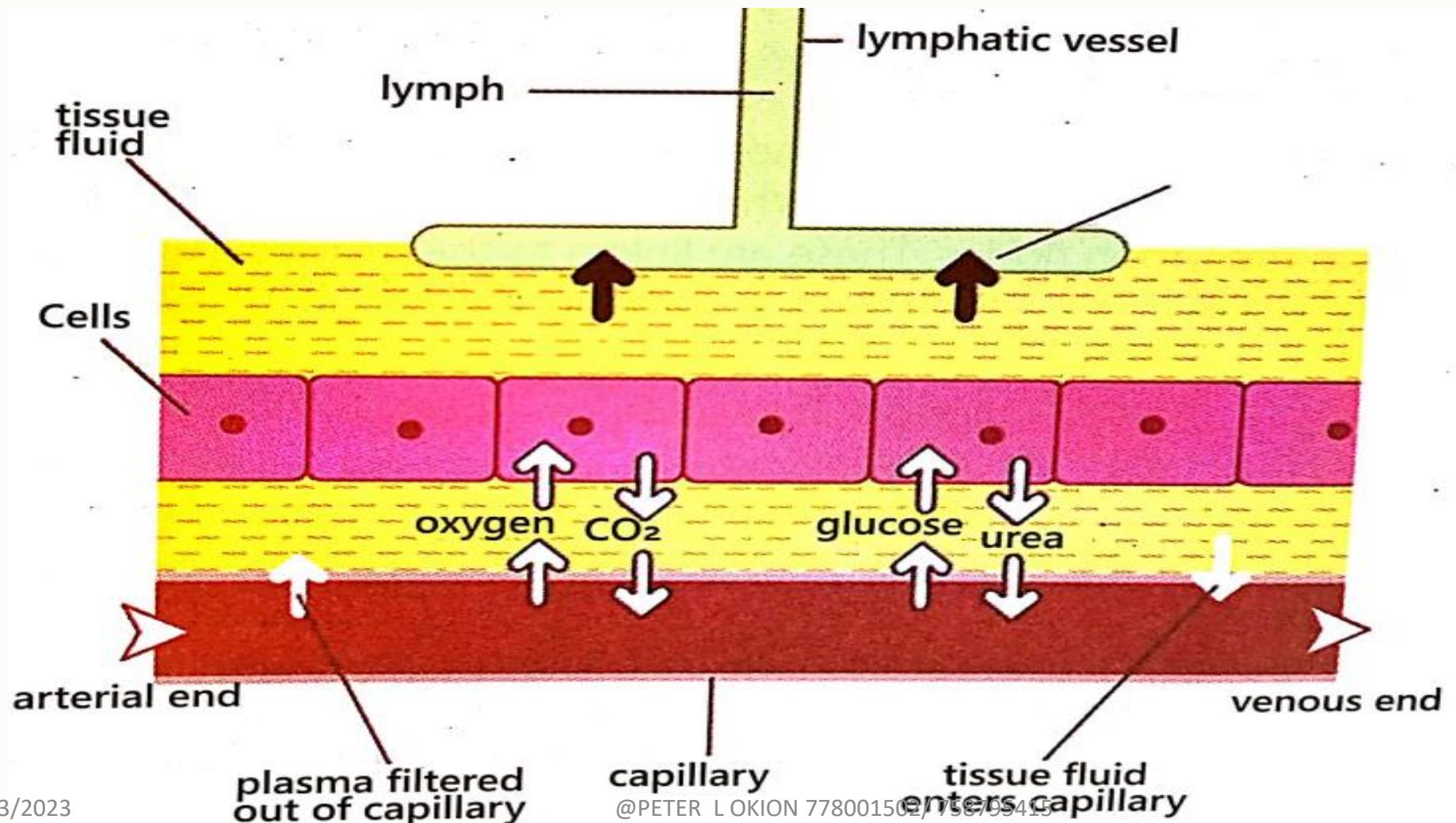
Once the fluid is in the intercellular spaces of tissues, it is called **tissue fluid**.

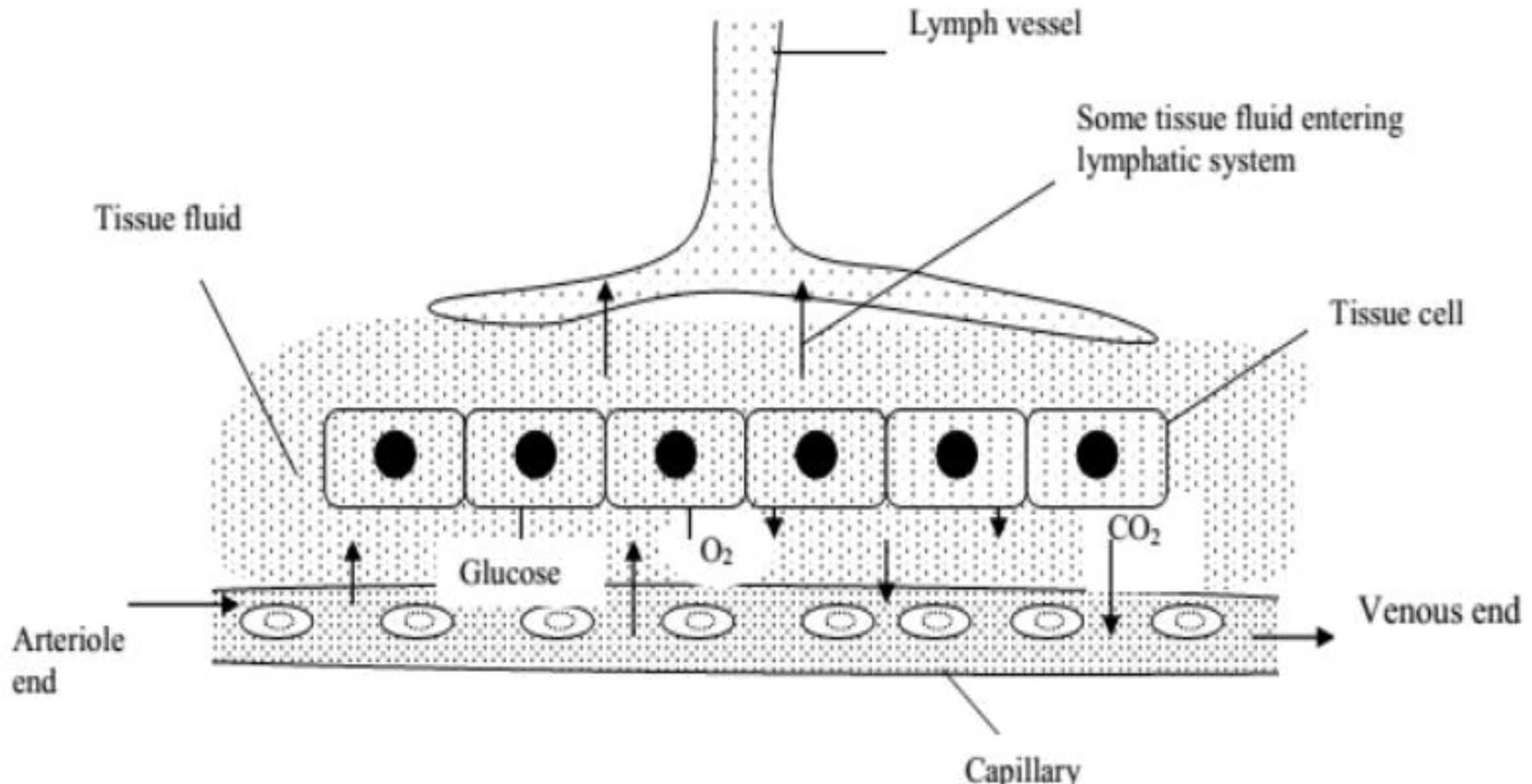
Tissue fluid bathes body cells. Body cells obtain their requirements e.g. glucose, amino acids oxygen, etc. from the tissue fluid and they add excretory materials into the fluid.

Some of the fluid returns in to the capillaries and the other is drained in to a system of narrow vessels called **lymph vessels**. The fluid in these vessels is called lymph.

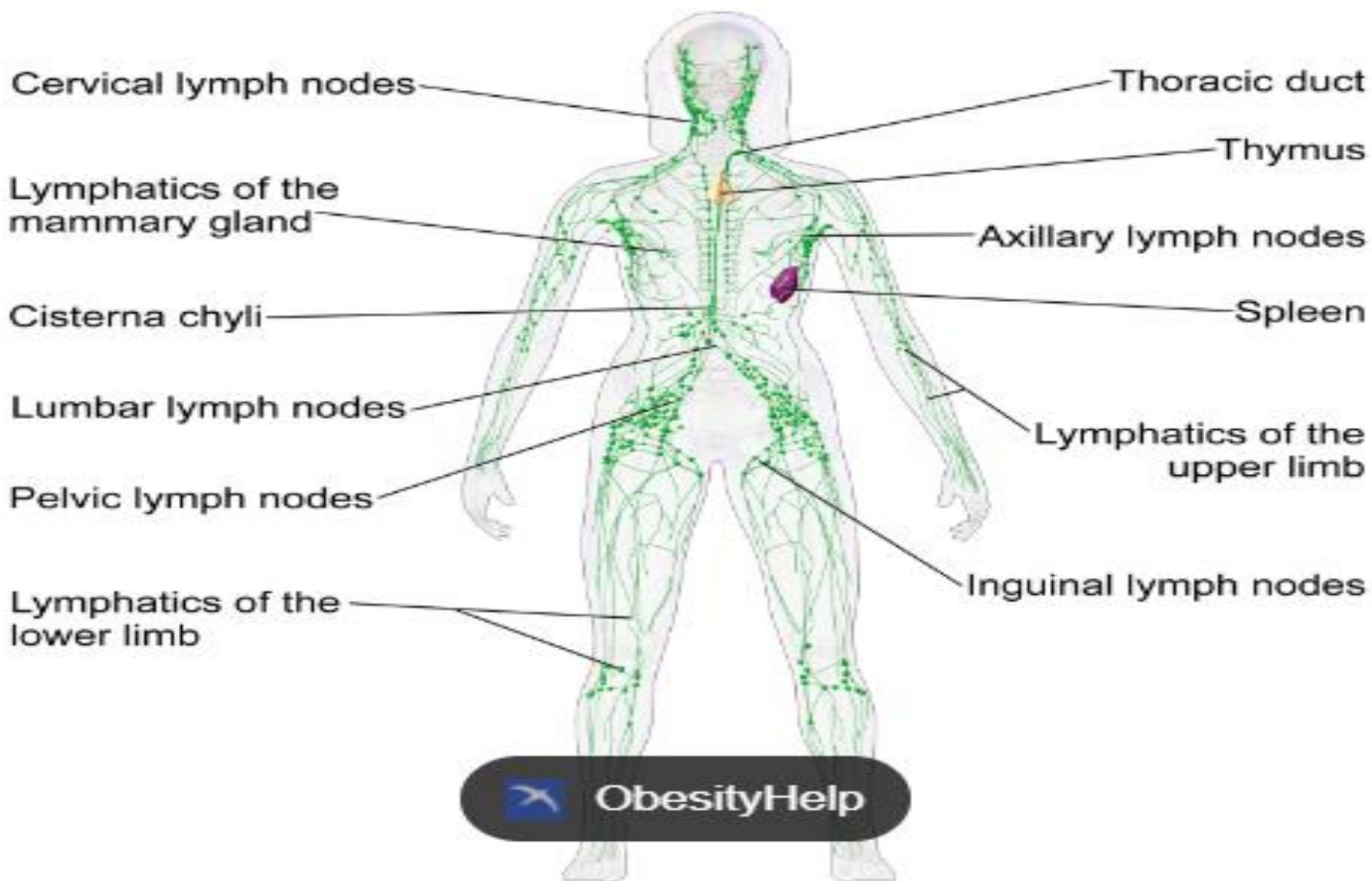
**Note;** lymph is formed from tissue fluid.

# THE DIAGRAM BELOW ILLUSTRATES EXCHANGE OF MATERIALS BETWEEN BLOOD, TISSUE FLUID AND LYMPH





# The Lymphatic System



ObesityHelp

# THE LYMPHATIC SYSTEM

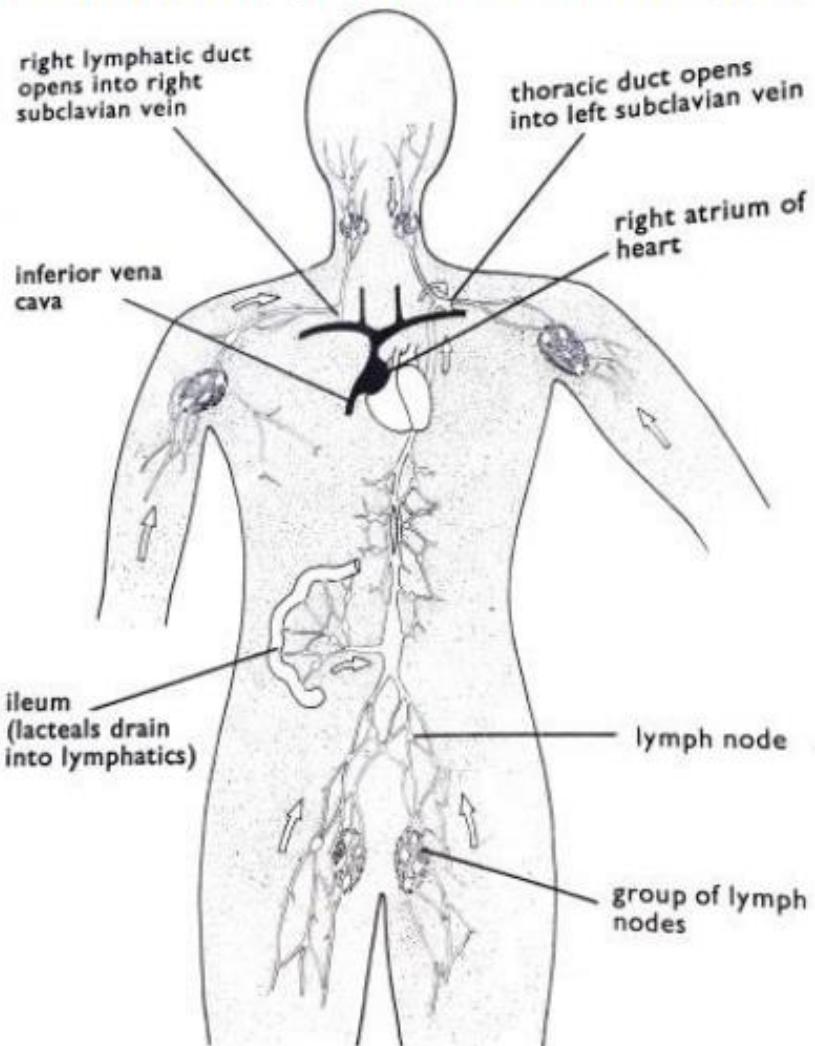
This is part of the vascular system. It forms the second type of circulation. Most of the tissue fluid as explained above goes back into the blood capillaries and the remainder enters the lymphatic system and becomes lymph.

- Lymph is transported through lymph vessels.
- Lymph vessels are similar to veins but they have more valves than the veins.
- The movement of the lymph fluid through the lymph vessels is due to the contractions of the surrounding skeletal muscles. As they contract and relax, they squeeze the lymph vessels to gain the force by which lymph moves. The walls of the lymphatic vessels have pores, which allow the entry of fatty acids, glycerol, wastes, bacteria and other small molecules

# CTD

- ✓ Before reaching the blood, lymph passes through the lymph nodes where pathogens like bacteria are removed. The lymph joins the blood circulation via the thoracic ducts, which joins to the vena cava leading to the heart.
- ✓ The lacteals of the ileum are also connected to the left thoracic duct

## MAIN DRAINAGE ROUTES OF THE LYMPHATIC SYSTEM



Deep lying vessel cut open to show lymph moving in one direction due to action of valves



# ***Functions of the lymphatic system***

1. transports fatty acids and glycerol from the ileum to the heart where they join the blood system.
2. carries excretory substances from tissues to the blood stream.
3. produces white blood cells, which carry out defense in the body.
4. filters out bacteria before they reach the blood stream.
5. Transports hormones from glands to other body parts.
6. Temporary storage of fatty acids and glycerol before they join general blood circulation.



Elephantiasis  
Face



Man with Testicular  
Elephantiasis



Elephantiasis  
Treatment



Lymphedema



Elephantiasis  
Nostras



Elephantiasis  
Disease



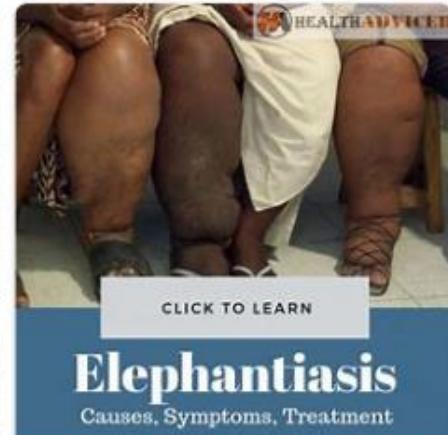
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painnow.blogspot.com ↗

[Disease Of The World: Elephantiasis](#)



[Elephantiasis - Images, Causes, Symptoms, Treatment, Facts | Diseases ...](#)



[Elephantiasis: Causes, Picture, Symptoms And Tre...](#)



[Volcanic soil behind mystery outbreak CNN](#)



[Elephantiasis - Stock Image - ...](#)



[5 People Contract Elephantiasis In Dormaa Central | News Ghana](#)



[Elephantiasis - Stock Image - ...](#)



[File:Elephantia...](#)



[Elephantiasis - Stock Image - ...](#)



[Cases of 'Elephantiasis' Traced to Unexpected Cause | Live S...](#)



[Elephantiasis.I...](#)

# **ELEPHANTIASIS**

This is the gross enlargement of an organ whose lymphatic vessels have been infested with filarial worms, ***Wuchereria bancrofti***.

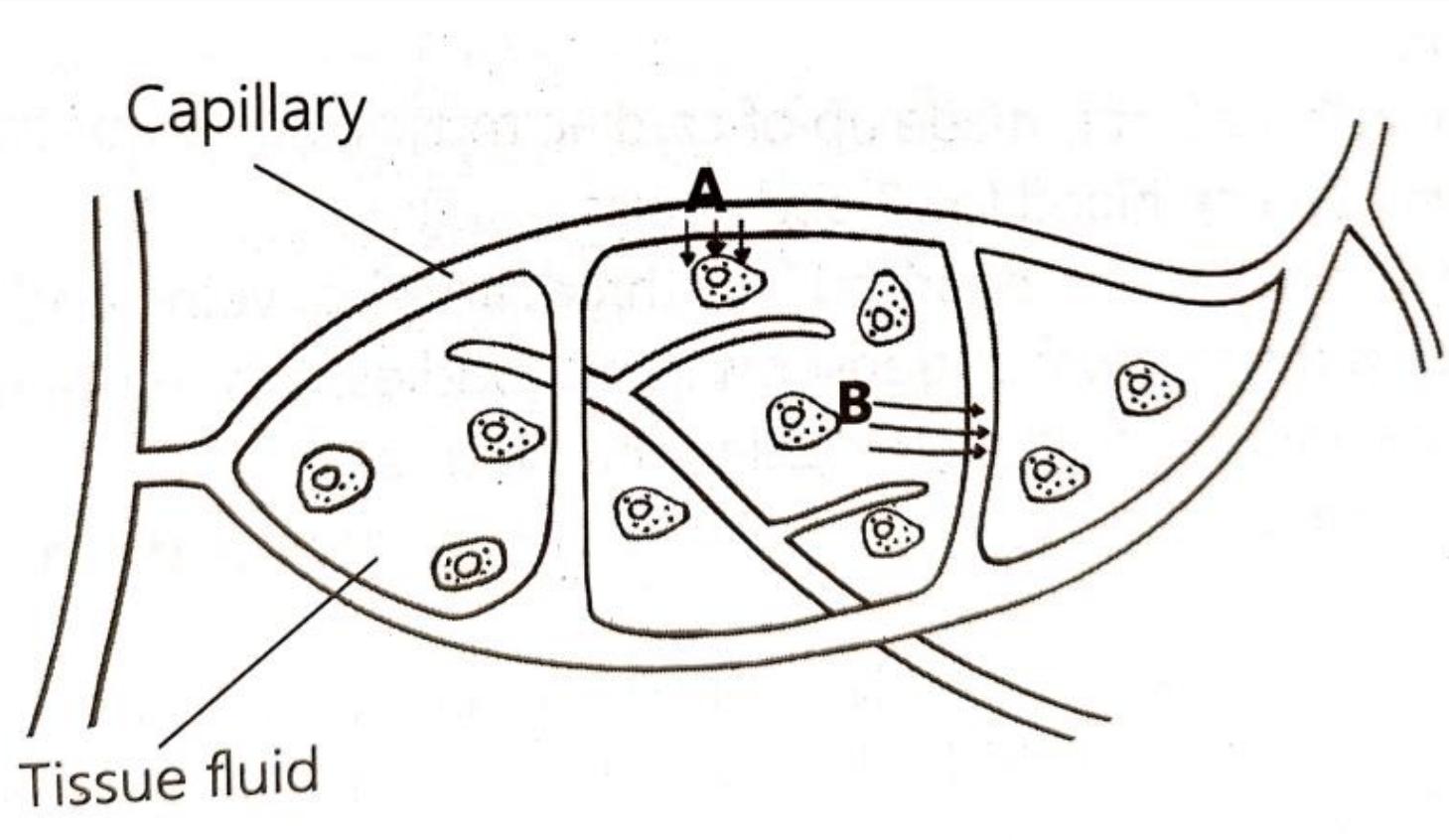
Filarial worms are nematodes that cause elephantiasis and are spread by mosquitoes especially the culex mosquito

# **TEST YOURSELF**

1. a) Determine the surface area to volume ratio of a cube of sides 2cm representing a mouse.  
b) how would the surface area to volume ratio of an elephant compare to that of a mouse.  
c) how do living organisms benefit from having
  - i) a small surface area to volume ratio
  - ii) a large surface area to volume ratio
2. a) draw a well labeled diagram of the circulatory system of a mammal.  
b) identify the components of the transport system labeled in (a) above
3. How does each of the following suit to the heart to its function(s)
  - i) septum between heart chambers
  - ii) valves between atria and ventricles
  - iii) thicker wall of the left ventricle

ctd

4. The diagram below illustrates the transfer of materials between capillaries and tissue fluid.



Describe what happens at:

i) Point A

8/3/2023

ii) point B

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Ctd

5. A person's blood group can be identified by mixing his or her blood with serum containing antibodies onto a test panel like the one below.

a) Complete the table using a(✓) if agglutination occurs, and an (X) if agglutination does not occur.

Blood group	Test panel (serum)		
	Anti-A antibody	Anti- B antibody	Control (no antibody)
A			
AB			
B			
O			

# CTD

- b) Why is the control test needed?
- c) What will happen if a patient of blood group O is given a transfusion of blood type AB.

***END***  
***BIOLOGY IS LIFE***  
***SLIDES PREPARED BY TR.***  
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