CHAPTER 06

LIFE PROCESSES

Acknowledgment

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- Some images and video clips have been modified according to the syllabus.

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Contents

Life Processes

The processes in which living organisms perform maintenance functions are called life processes.

Diffusion insufficient to meet the oxygen requirements of multicellular organisms

- Multicellular organisms such as humans possess complex body design.
- multicellular organisms are not in direct contact with the outside environment.

Criteria for living organisms

- Visible movement such as walking, breathing or growing is generally used to decide whether something is alive or not.
- Presence of life processes is a fundamental criterion that can be used to decide whether something is alive or not.

Outside raw materials used by an organism

An organism uses outside raw materials mostly in the form of food and oxygen. The raw materials required by an organism vary depending on the complexity of the organism and its environment.

Processes essential for maintaining life

- Nutrition
- Respiration
- Transportation
- Reproduction
- Excretion.

Nutrition

The process of obtaining energy through consumption of food is called nutrition.

Autotrophic nutrition

The mode of nutrition in which an organism prepares its own food is called autotrophic nutrition. Green plants and blue-green algae are examples of autotrophs.

Photosynthesis

Photosynthesis is the process by which autotrophs take in carbon dioxide and water from the outside and convert them into carbohydrates in the presence of sunlight and chlorophyll.

Chemical equation of Photosynthesis

$$6CO_2 + 6H_2O \xrightarrow[\text{sunlight}]{\text{Chlorophyll}} C_6H_{12}O_6 + 6O_2$$

Steps of Photosynthesis

- Absorption of light energy by chlorophyll.
- Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen.
- Reduction of carbon dioxide to carbohydrates.

Photosynthesis in desert plants

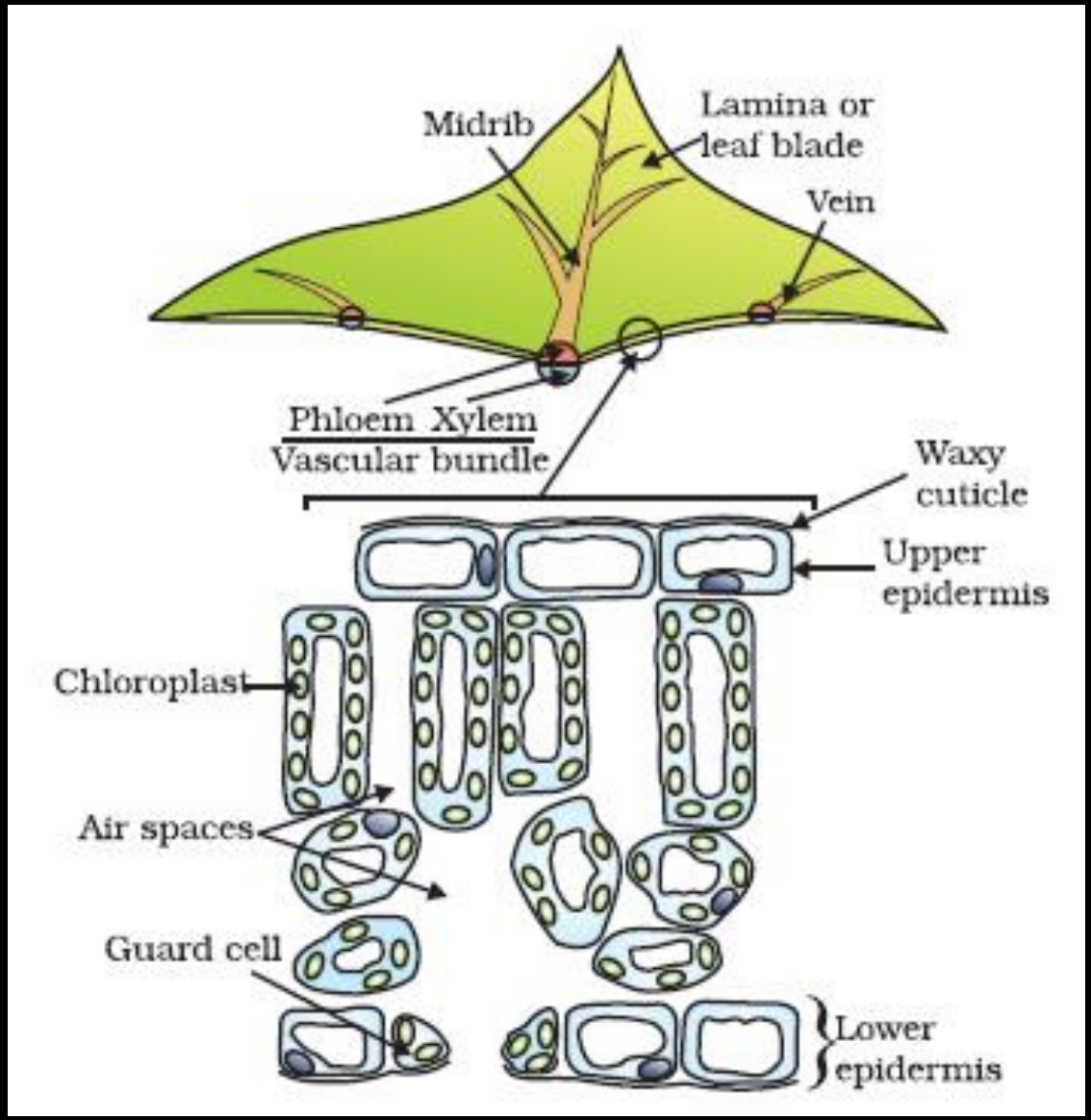
Desert plants take up carbon dioxide at night and prepare an intermediate which is acted upon by the energy absorbed by the chlorophyll during the day.

Raw materials for Photosynthesis

Water comes from soil; through the xylem tissue in roots and stems.

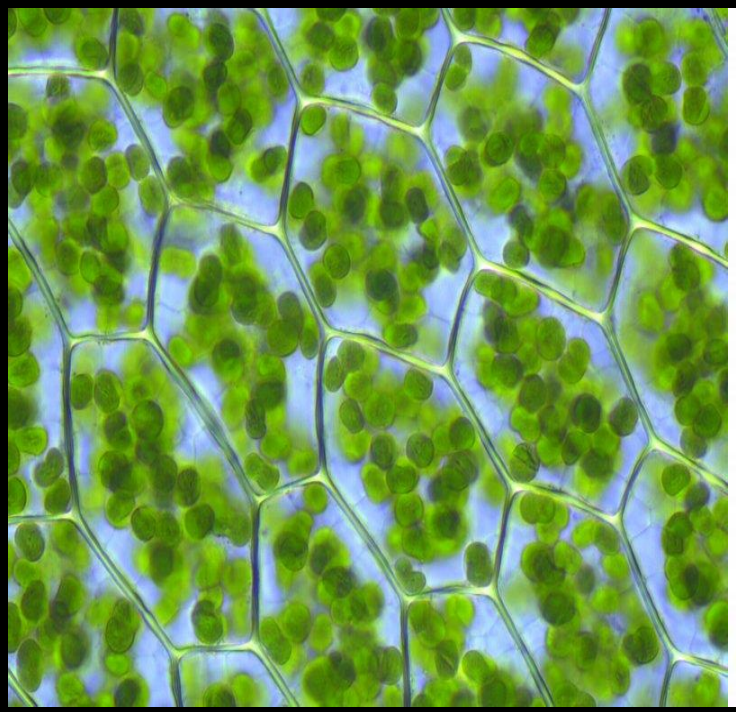
Carbon dioxide comes in the leaves through stomata.

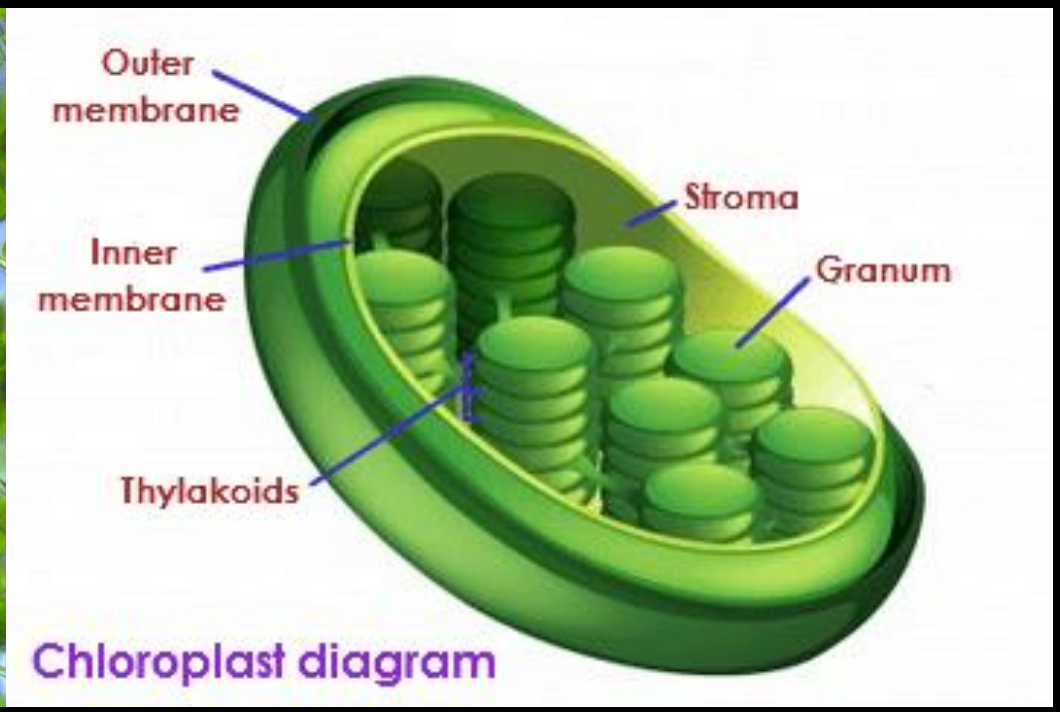
Cross section of leaf lamina



Chloroplasts

The green dots like cell organelles which contain chlorophyll are called chloroplasts.





Stomata

The Tiny pores present on the surface of the leaves are called stomata.

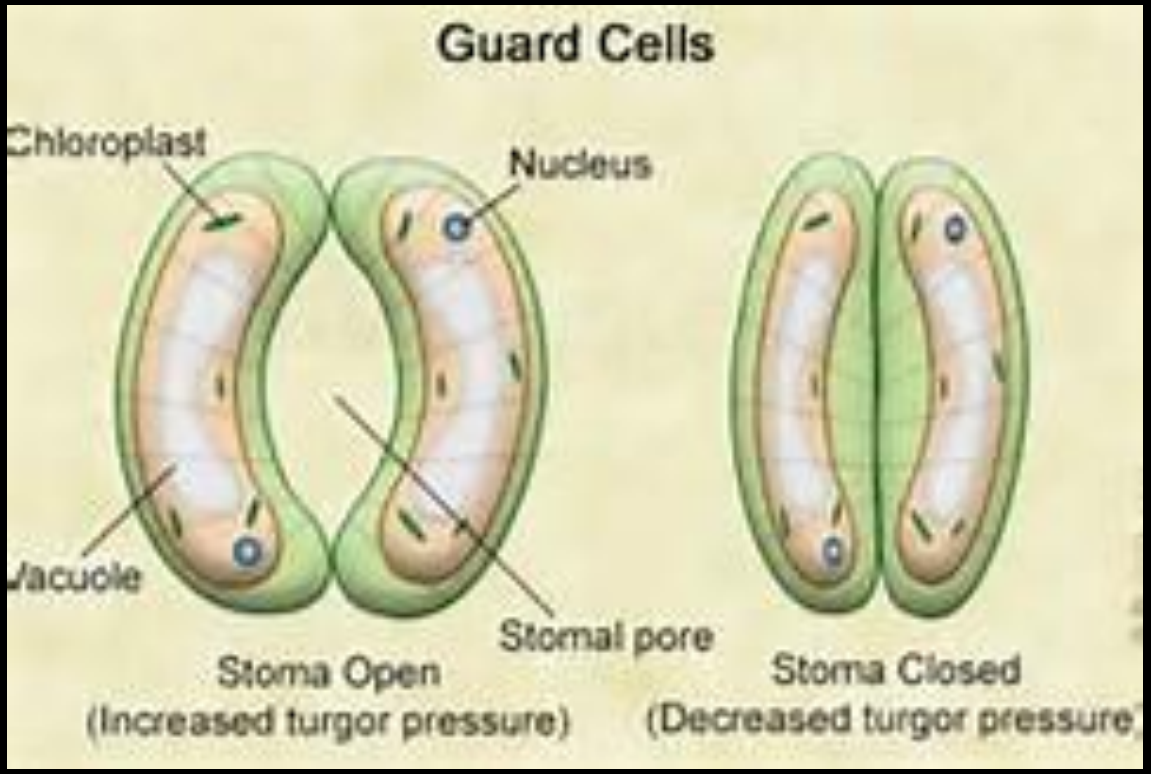
Function of Stomata

a) Exchange of gases (O_2/CO_2).

b) Loses large amount of water (water vapour) during transpiration.

Guard cells

The bean shaped cells on either side of stomata are called guard cells.

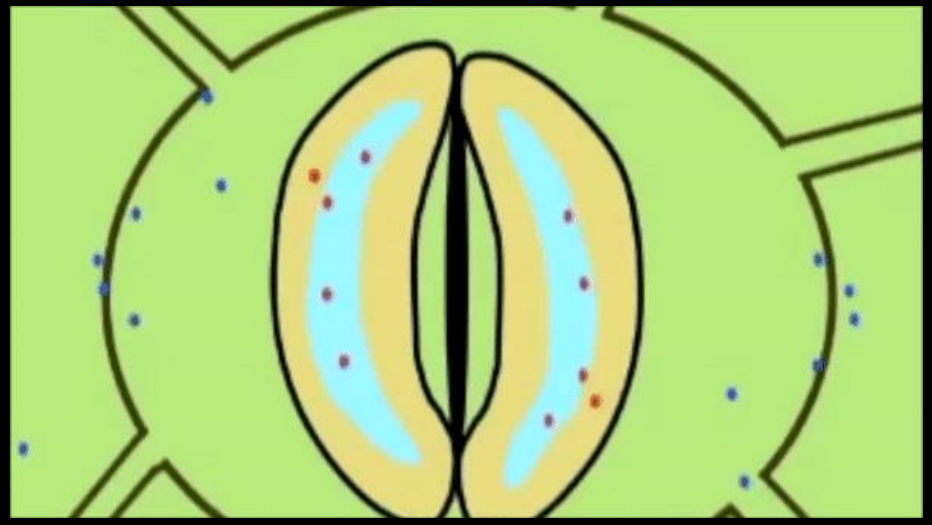


Function of Guard cells

The function of guard cells is to regulate the opening and closing of the stomatal pore.

Control of stomatal pore

The guard cells swell when water flows into them, causing the stomatal pore to open. Similarly the pore closes if the guard cells shrink.



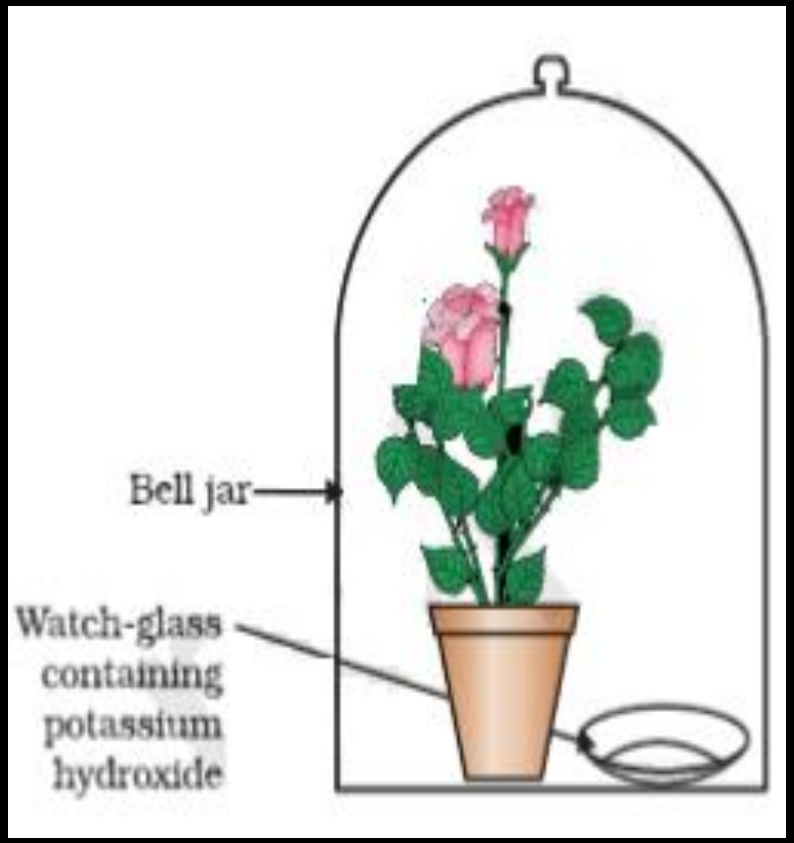
Stomata in desert plants

In deserts, temperature is very high so stomata are closed to reduce the loss of water due to transpiration. Desert plants are adapted to take up carbon dioxide at night when stomata are open. The carbon dioxide taken up in the night prepares an intermediate compound which is acted upon by the energy absorbed by the chlorophyll during the day to prepare food.

In the experiment to demonstrate that sufficient quantity of carbon dioxide is necessary to carry out photosynthesis,

a) Why is a watch glass with potassium hydroxide placed?

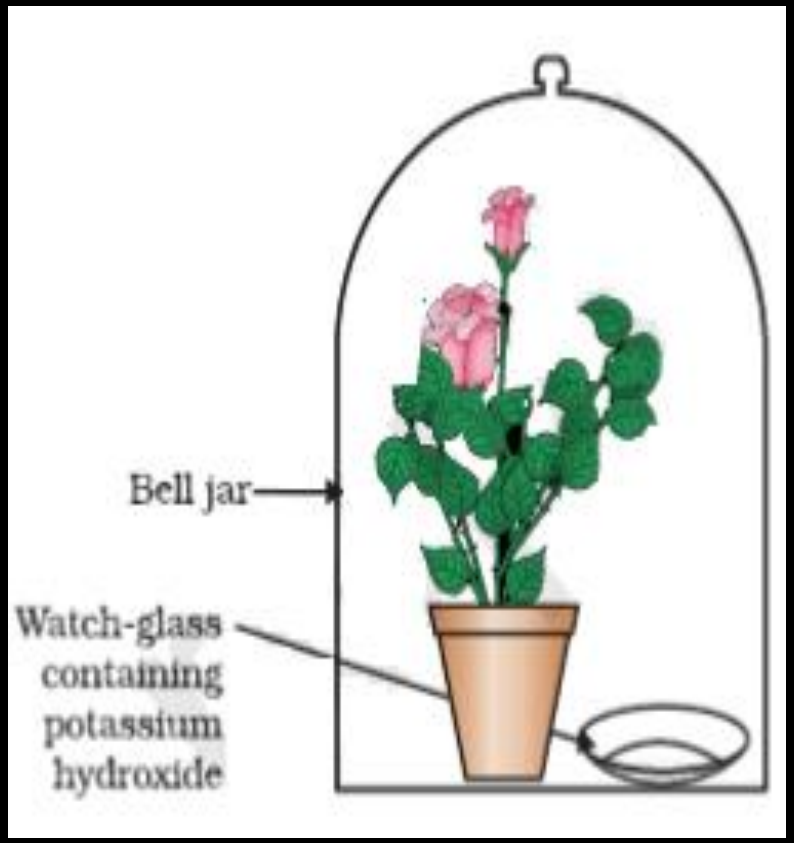
Potassium hydroxide is kept to absorb the carbon dioxide in the bell jar.



In the experiment to demonstrate that sufficient quantity of carbon dioxide is necessary to carry out photosynthesis,

b) Why is Vaseline is smeared at bottom of the bell jar?

Vaseline is applied to make the set-up air-tight.



Importance of nitrogen

Nitrogen is an essential element used in the synthesis of proteins and other compounds. It is obtained from the soil in the form of inorganic nitrates or nitrites or it is taken up as organic compound which has been prepared by bacteria from atmospheric nitrogen.

Heterotrophic nutrition

The type of nutrition in which organisms are dependent on other organisms for their food requirements is called heterotrophic nutrition.

Ex: Animals, fungi and bacteria

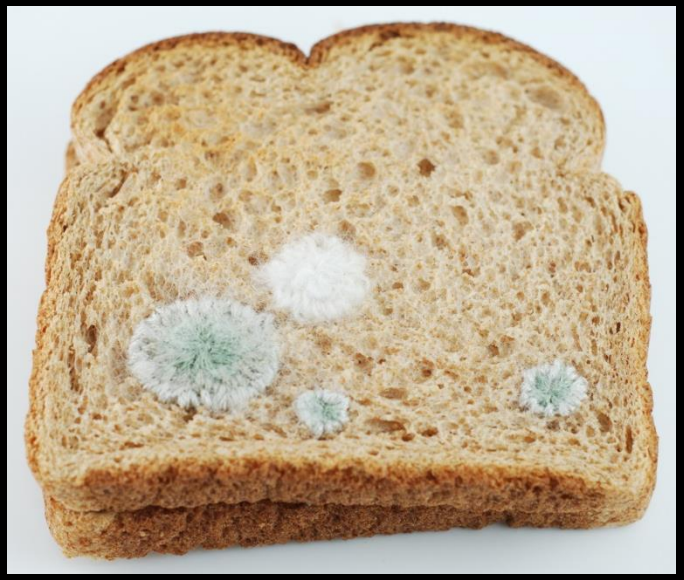
Saprophytes

Organisms that break-down the food materials outside the body and then absorb it are called saprophytes.

Ex: Fungi like bread moulds, yeast and mushrooms.

How do mushroom obtain food?

Organisms like bread moulds and mushrooms breakdown the food material outside the body and then absorb it.



Holozoic nutrition

The type of nutrition in which organisms take in whole material and break it down inside their body is called holozoic nutrition.

Parasitic nutrition

The type of nutrition in which organisms derive nutrition from plants and animals without killing them is called parasitic nutrition.
Ex: Cuscuta, orchids, ticks, lice, leeches and tape-worms.

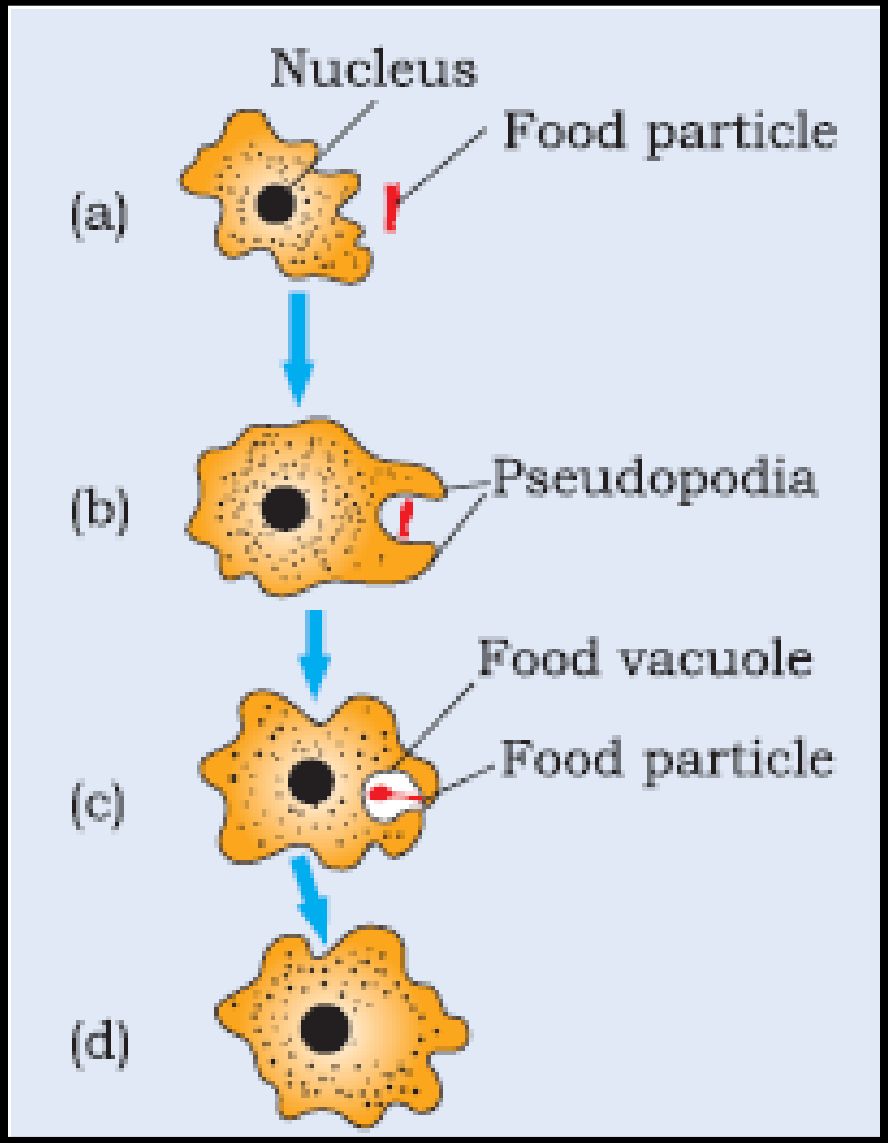
Saprophytic vs Holozoic

Saprophytic nutrition	Holozoic nutrition
It is an absorptive type of nutrition	It is an ingestive type of nutrition
Food is obtained in the liquid state	Food is taken in the solid state
Digestion is external	Digestion in internal

Nutrition in amoeba

Amoeba takes in food using temporary finger like extensions called pseudopodia which fuse over the food particle forming a food vacuole. Inside the food vacuole, complex substances are broken down into simpler ones which then diffuse into the cytoplasm. The remaining undigested material is thrown out.

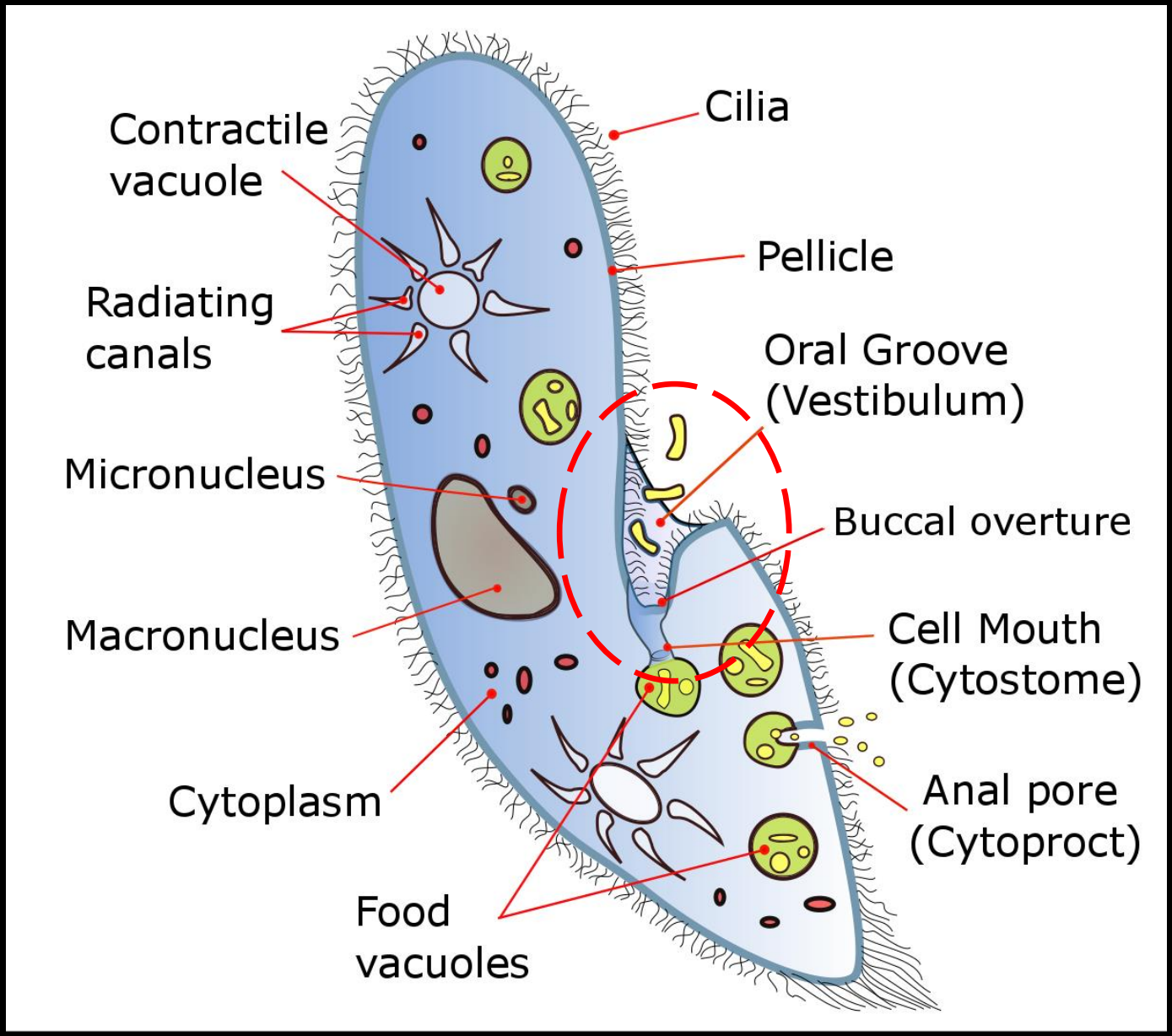
Nutrition in amoeba



Nutrition in Paramoecium

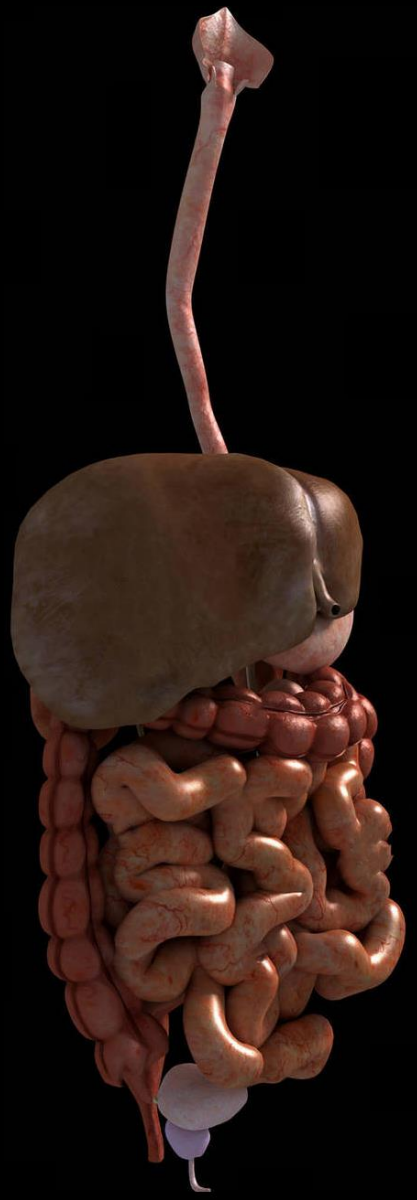
In Paramoecium, which is a unicellular organism, the cell has a definite shape and food is taken in at a specific spot. Food is moved to this spot by the movement of cilia which cover the entire surface of the cell.

Nutrition in Paramoecium



Alimentary canal

The long tube extending from the mouth to the anus is called alimentary canal.



Function of saliva

The lining of the canal is soft. The food we eat must be wetted to make its passage smooth.
This is achieved by mixing with food with saliva secreted by the salivary gland.

Enzymes in saliva

The saliva contains an enzyme called salivary amylase that breaks down starch which is a complex molecule to give sugar.

Peristaltic movement

Peristalsis is the contraction and relaxation of the muscles of the digestive tract to move the food through the digestive system.

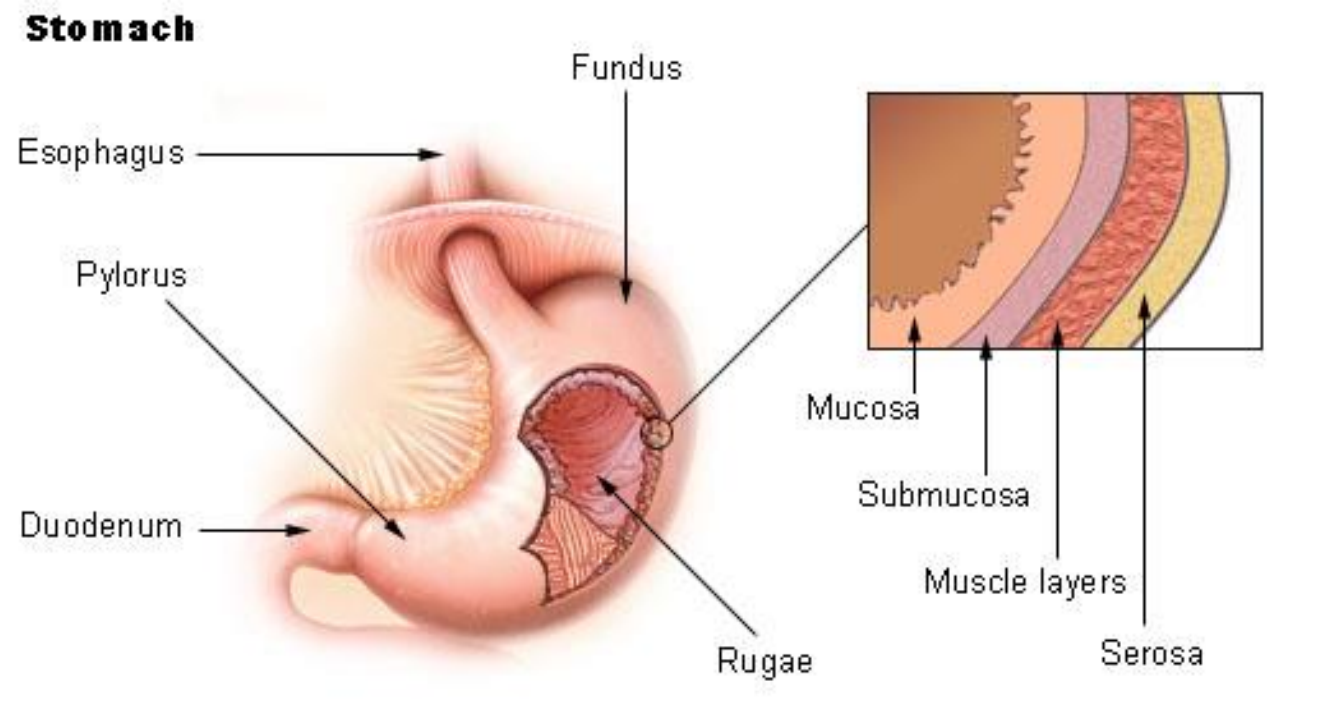
Function of HCl in stomach

The function of hydrochloric acid is:

- It makes the acidic medium which is necessary for the action of gastric enzymes like pepsin.
- It kills most of the harmful bacteria.

How is the inner lining of stomach protected from action of acid?

The mucus protects the inner lining of the stomach from the action of acid.



Acidity

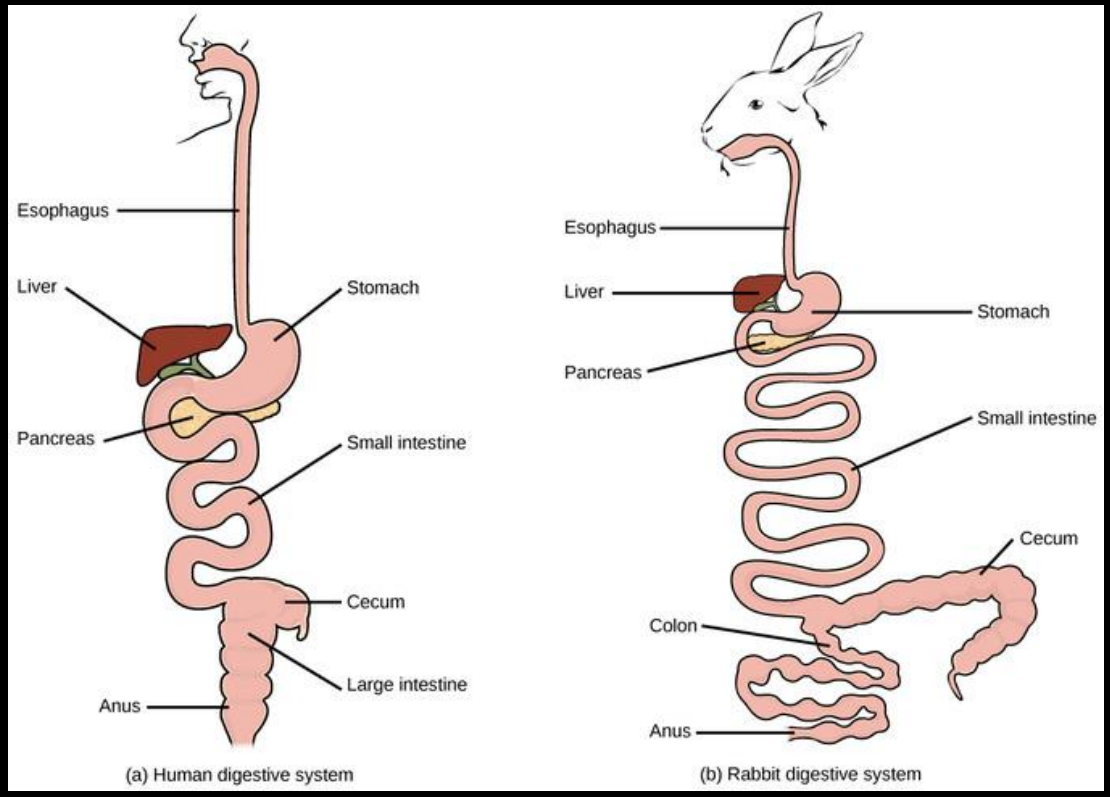
Acidity is a condition when there is excess secretion of acids in the gastric glands of the stomach.

What will happen if mucus is not secreted by the gastric glands?

If mucus is not secreted by the gastric glands, it will lead to erosion of the inner lining of stomach causing excessive acidity, ulcers and discomfort as mucus protects the inner lining of stomach from the action of hydrochloric acid.

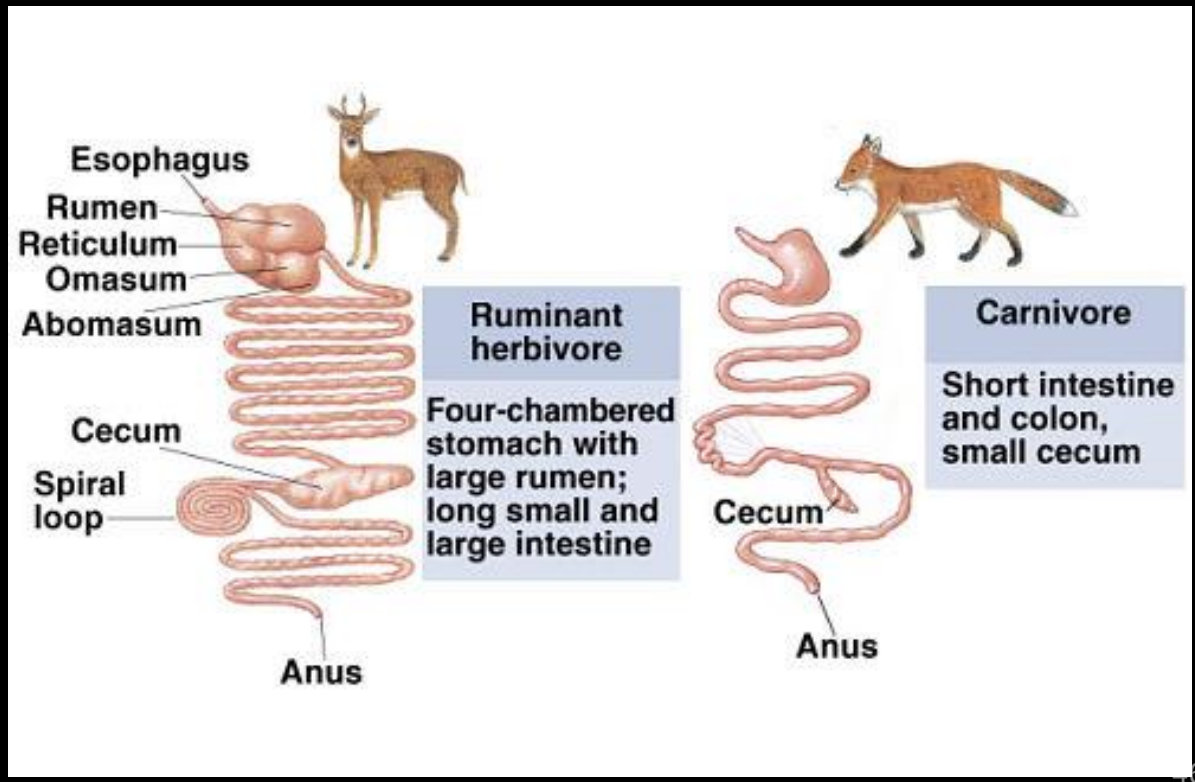
Why do herbivores need a longer small intestine?

Herbivores eating grass need a longer small intestine to allow the cellulose to be digested.



Carnivores have a shorter small intestine.

Meat is easier to digest. Hence carnivores have a shorter small intestine.



How are fats digested in our bodies?

Fats are present in the form of large globules in the small intestine. The small intestine gets the secretions in the form of bile juice and pancreatic juice respectively from the liver and the pancreas. The bile salts (from the liver) break down the large fat globules into smaller globules so that the pancreatic enzymes can easily act on them.

Function of small intestine

a) Small intestine receives the secretions from liver and pancreas.
b) Small intestine is the site of complete digestion of carbohydrates, proteins and fats.

How is the acidic food received from the stomach made alkaline in the small intestine?

The food coming from the stomach is acidic and it is made alkaline for the pancreatic enzymes to act by the Bile juice from the liver.

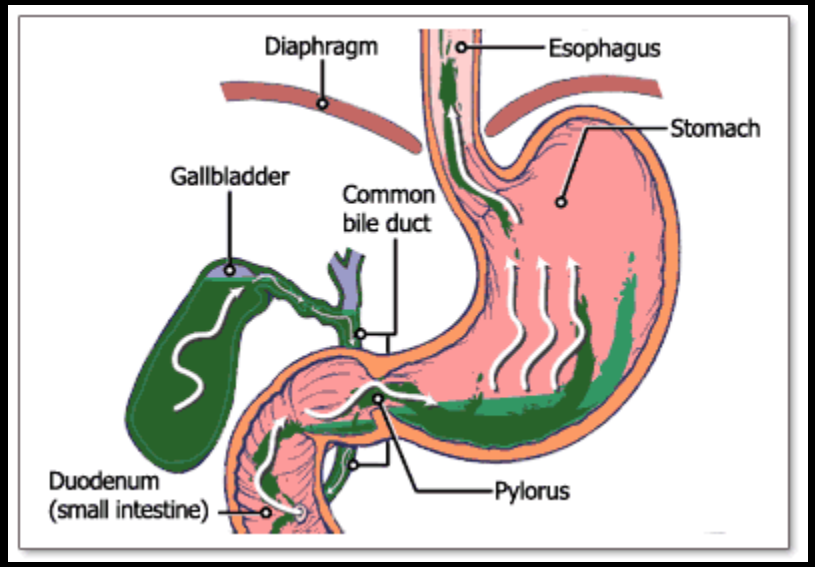
Function of bile juice secreted by the liver

a) Bile juice makes the food coming from the stomach alkaline.

b) It increases the efficiency of enzyme action by breaking down the fat into smaller globules.

How would digestion of food be affected if bile duct is completely blocked?

If the bile duct is completely blocked, bile juice will not reach the small intestine and the digestion of fats will be affected.



Function of pancreas

a) Pancreas secretes pancreatic juice which contains the enzyme trypsin for digesting proteins.

b) It also produces the enzyme lipase for breaking down emulsified fat.

Differentiate between the functions of enzyme pepsin and trypsin.

Pepsin	Trypsin
Pepsin acts in stomach.	Trypsin acts in small intestine.
It acts in acidic medium	It acts in alkaline medium

How would digestion of food be affected if pancreatic duct is completely blocked?

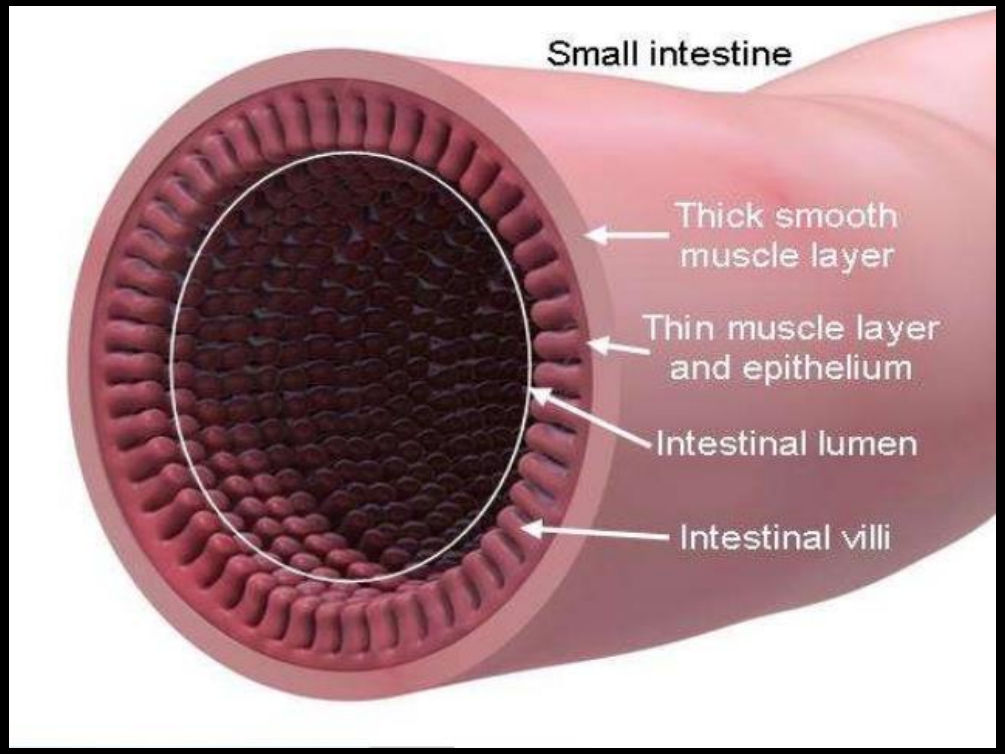
If the pancreatic duct is completely blocked, pancreatic juice will not reach the small intestine and the digestion of carbohydrates and proteins will be affected.

Function of intestinal juice

a) The enzyme in intestinal juice converts proteins to amino acids.
b) It also converts complex carbohydrates into glucose.
c) It converts fats into fatty acids and glycerol.

Villi

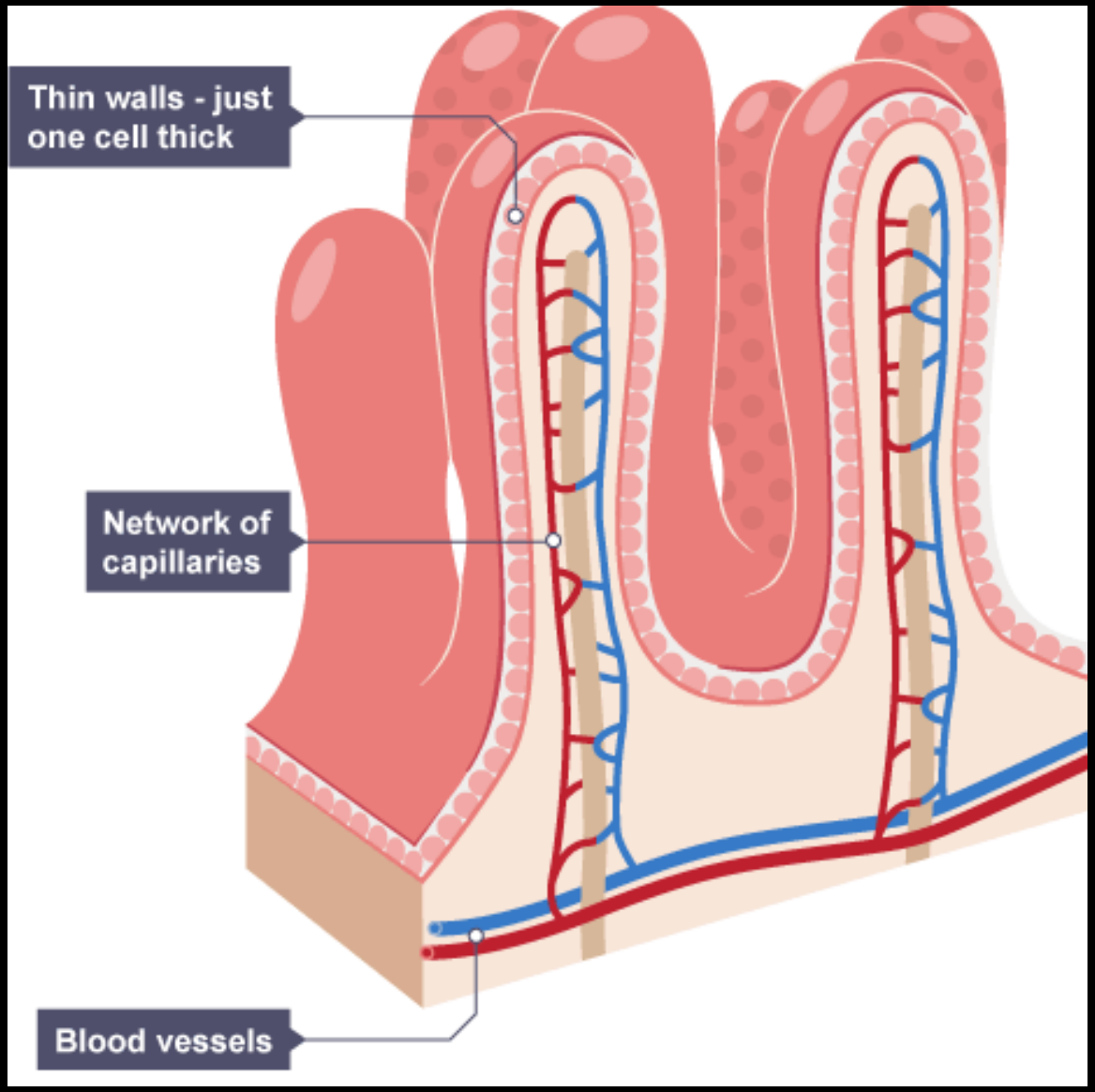
The inner lining of the small intestine has numerous finger-like projections called villi.



How does villi help in absorption of food?

The inner lining of the small intestine has numerous finger-like projections called villi which increase the surface area for absorption. The villi are richly supplied with blood vessels which take the absorbed food to each and every cell of the body.

How does villi help in absorption of food?



Final products after digestion of carbohydrates and proteins

The final product produced after digestion of carbohydrates is glucose and proteins are amino acids.

Absorption of digested food in small intestine

a) Digestion of food is completed in the small intestine.
b) Inner lining of small intestine have a number of finger-like projections called villi, which increase the surface area for absorption.
c) Walls of intestine have blood vessels for carrying the absorbed food to different parts of the body.

Differences between autotrophic nutrition and heterotrophic nutrition

Autotrophic nutrition	Heterotrophic nutrition
1. Food is synthesized from simple inorganic raw materials such as $CO_2$and water.	1. Food is obtained directly or indirectly from autotrophs. This food is broken down with the help of enzymes.
2. Presence of green pigment (chlorophyll) is necessary.	2. No pigment is required in this type of nutrition.
3. Food is generally prepared duringday time.	3. Food can be prepared at all times.
4. All green plants and some bacteria have this type of nutrition.	4. All animals and fungi have this type of nutrition.

Absorption of digested food in small intestine

a) Digestion of food is completed in the small intestine.
b) Inner lining of small intestine have a number of finger-like projections called villi, which increase the surface area for absorption.
c) Walls of intestine have blood vessels for carrying the absorbed food to different parts of the body.

Dental caries

Dental caries is the tooth decay that causes gradual softening of enamel and dentine. It is caused when bacteria acts on sugars and produce acid that softens or demineralizes the enamel. It happens when masses of bacterial cell together with food particles stick to the teeth to from dental plaque.

Respiration

Respiration

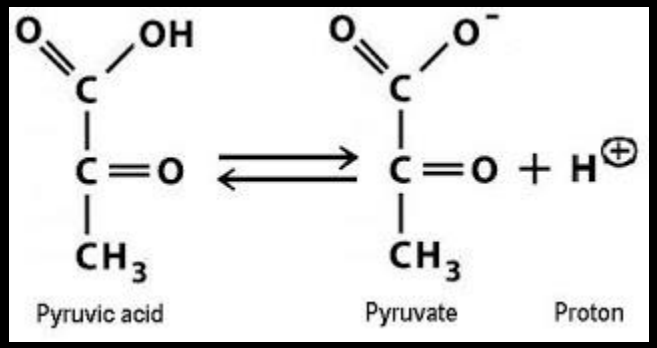
The process by which a living being utilizes the food to get energy is called respiration. Respiration is an oxidation reaction in which carbohydrate is oxidized to produce energy.

Steps of Respiration

a) Breaking down glucose into pyruvate: This step happens in the cytoplasm. Glucose molecule is broken down into pyruvic acid. Glucose molecule is composed of 6 carbon atoms, while pyruvic acid is composed of 3 carbon atoms.

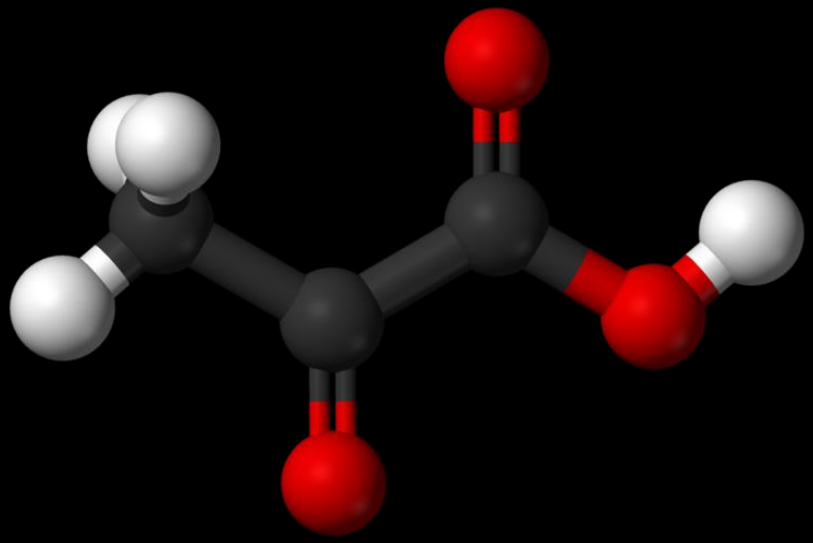
Steps of Respiration

b) Fate of Pyruvic Acid: Further breaking down of pyruvic acid takes place in mitochondria and the molecules formed depend on the type of respiration in a particular organism.



Pyruvate

The three carbon molecule formed by the breakdown of glucose is called pyruvate.

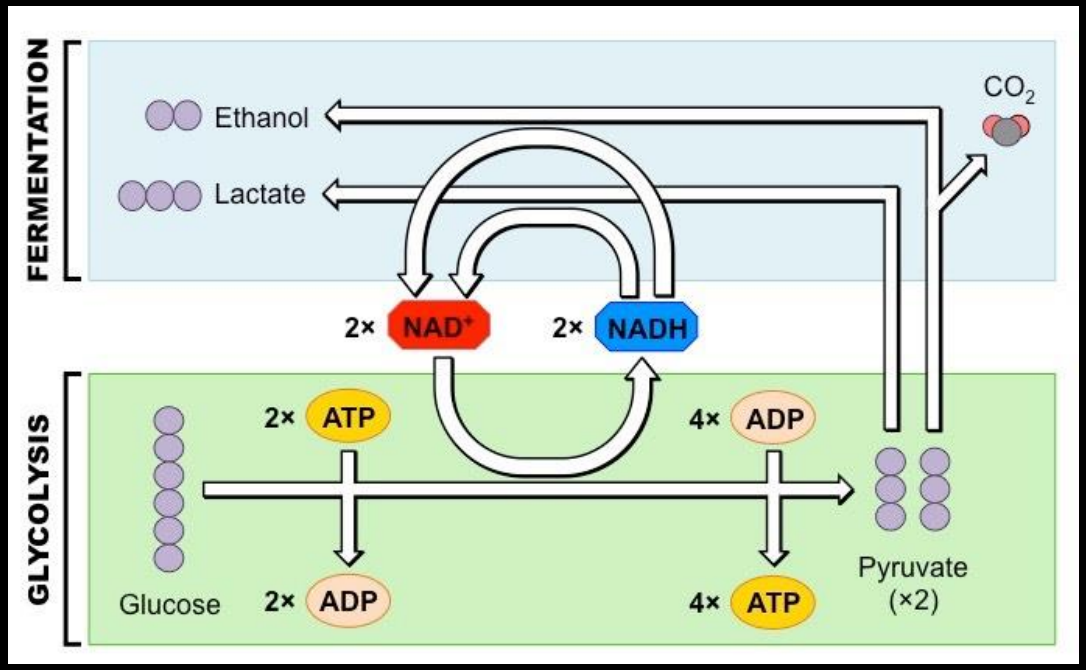


Anaerobic respiration

The process of breakdown of glucose in absence of oxygen is called anaerobic respiration. In this process small amount of energy is released.

Anaerobic respiration

Glucose (6-carbon molecules) is broken down into a three carbon molecule called pyruvate. The pyruvate is converted into ethanol and carbon dioxide.



Aerobic respiration

Aerobic respiration is the process in which glucose is completely broken down into carbon dioxide and water in presence of oxygen.

Aerobic respiration

Glucose (6-carbon molecules) is broken down into three carbon molecule called pyruvate using oxygen. Pyruvate breaks up to give three molecules of carbon dioxide and water.

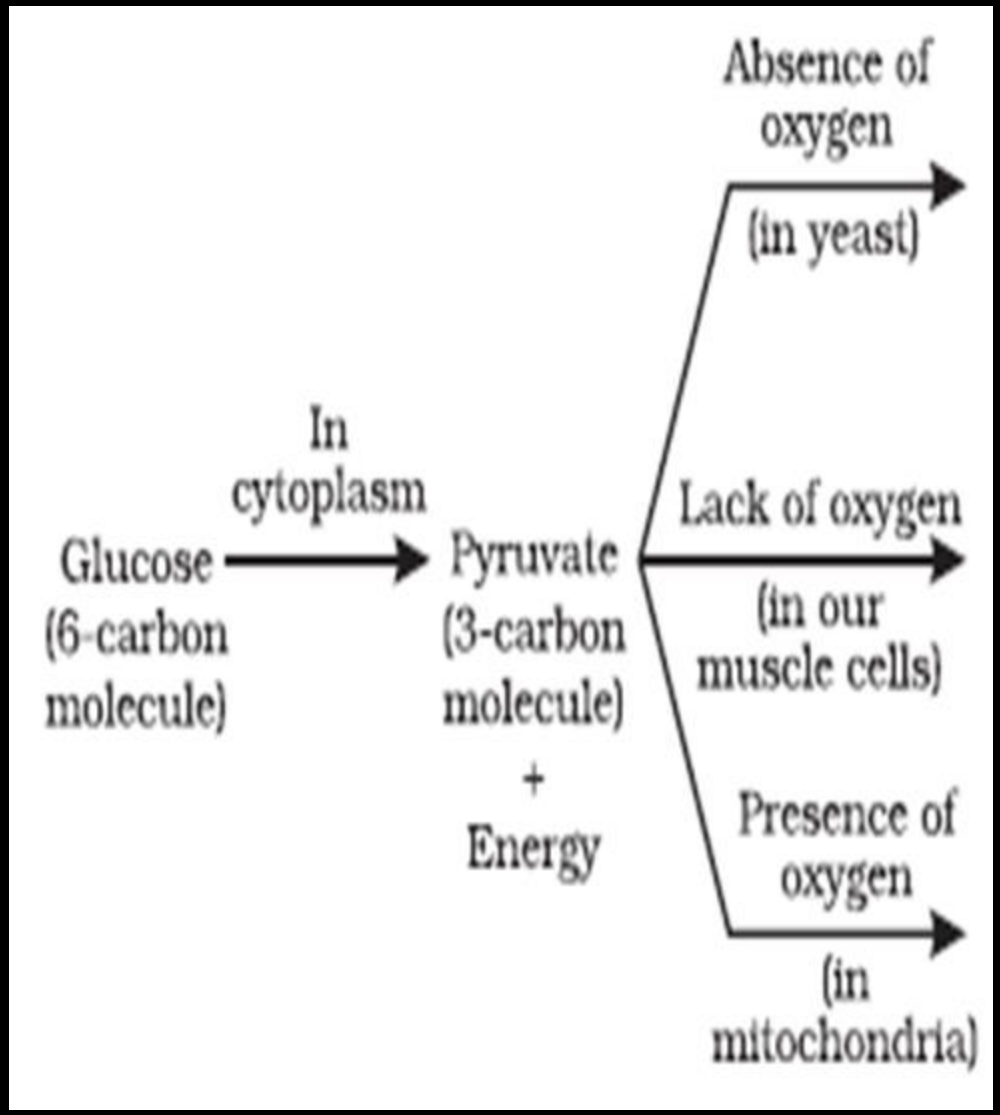
Aerobic vs. Anaerobic respiration

Aerobic respiration	Anaerobic respiration
Aerobic respiration takes place in the presence of oxygen.	Anaerobic respiration takes place in absence of oxygen.
End products are carbon dioxide and water.	End products are ethyl alcohol and carbon dioxide.
It yields more energy (36 ATP) compared to anaerobic respiration.	It yields less energy (2 ATP) compared to aerobic respiration.
The process takes place in cytoplasm and mitochondria.	The process takes place only in cytoplasm

Muscle cramps

When there is lack of oxygen in the muscle cells, pyruvate is converted into lactic acid which is also a three-carbon molecule. This build-up of lactic acid in the muscles during sudden activity causes muscle cramps.

Complete the breakdown of glucose



Ethanol + Co_2 + Energy

Lactic acid + Energy

Co_2 + water + Energy

Efficiency of anaerobic respiration

Anaerobic respiration is incomplete breakdown of glucose and produces less energy, so it is less efficient.

ATP

ATP stands for **Adenosine Triphosphate**

The energy released during respiration process is used to make an ATP molecule from ADP (adenosine diphosphate) and inorganic phosphate (P).

ADP + P $\xrightarrow{\text{Energy from respiration}}$ ATP

When the terminal phosphate linkage in ATP is broken using water, the energy equivalent to 30.5kJ/mol is released.

ATP is the energy currency for most cellular processes.

Exchange of gases in plants

At night, there is no photosynthesis occurring. Hence carbon dioxide is the major exchange taking place.

During the day, carbon dioxide generated during respiration is used up for photosynthesis; hence there is no release of carbon dioxide.

Activity

Observe fish in an aquarium. They open and close their mouths and the gill-slits (or the operculum which covers the gill-slits) behind their eyes also open and close.

a) Are the timings of the opening and closing of the mouth and gill-slits coordinated in some manner?

The opening and closing of the mouth and gill-slits are well coordinated. When the mouth opens to engulf water, the gill-slits remain closed. When the mouth of the fish closes, release of water through the gill-slits takes place. This is to provide sufficient time for exchange of gases over the gills.

Activity

Observe fish in an aquarium. They open and close their mouths and the gill-slits (or the operculum which covers the gill-slits) behind their eyes also open and close.

b) Compare the breathing of fish to the number of times you breathe in and out in a minute.

The rate of breathing of fish in a minute is much faster than that of humans because oxygen dissolved in water is very less than the air.

Why are the organs which absorb oxygen placed inside the body in terrestrial organisms?

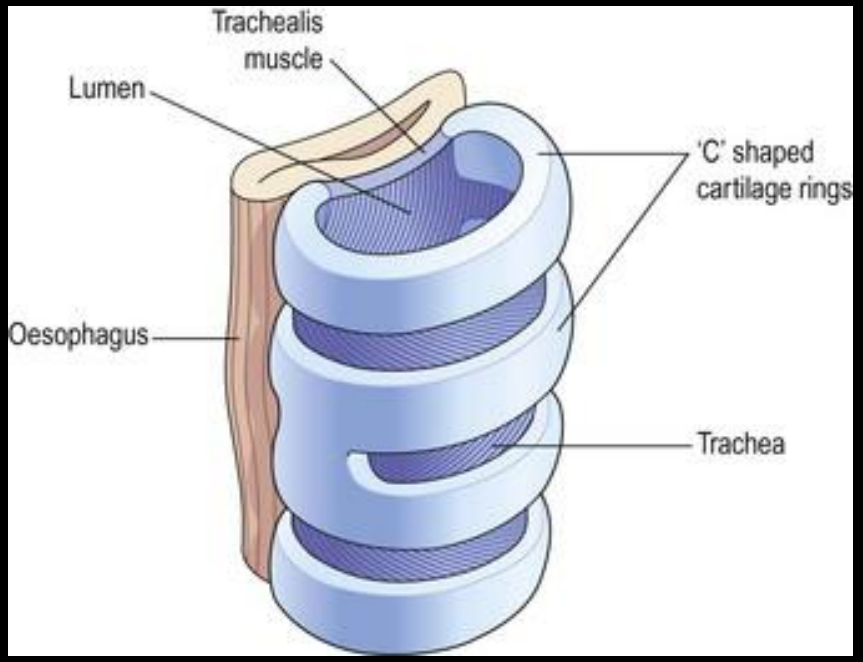
The structures that help respiration are very fine and delicate. To protect these organs, they are usually placed within the body.

How does the nasal cavity help in respiration?

Nasal cavity has fine hairs which filter the dust particles for the air passing through it. The passage is also lined with mucus which moistens to avoid friction and
trap dust particles.

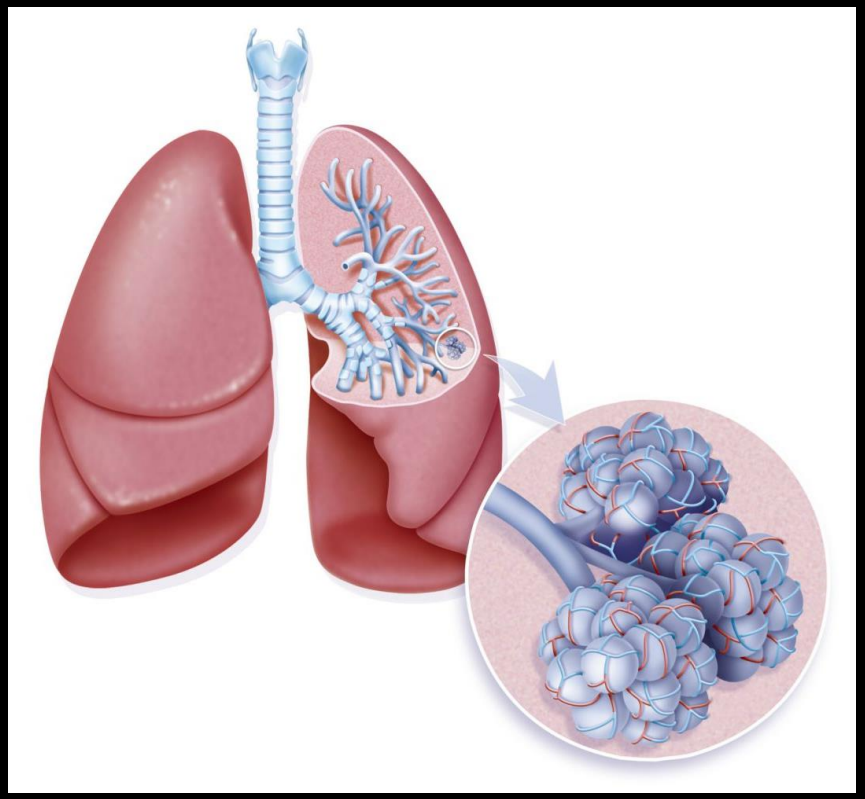
Why do the walls of trachea not collapse when there is less air in it?

Trachea is supported by C-shaped rings of cartilage. So the walls of trachea do not collapse.



Alveoli

Within the lungs, the passage divides into smaller and smaller tubes which terminate in balloon-like structures which are
called alveoli.



Function of Alveoli

The alveoli provide a surface where the exchange of gases can take place.

How is oxygen delivered from lungs to tissues?

Blood brings carbon dioxide from the rest of the body for release into the alveoli. The oxygen in the alveolar air is taken up by blood in the alveolar blood vessels to be transported to all the cells in the body.

Why do lungs always have residual volume of air?

The lungs always contain a residual volume of air so that there is sufficient time for oxygen to be absorbed and for the carbon dioxide to be released.

What advantage over an aquatic organism does a terrestrial organism have with regard to obtaining oxygen for respiration?

- Air contains more O_2 as compared to water.
- Terrestrial animals do not have to breathe faster to get more oxygen.

Oxygen and carbon dioxide transport in human beings

- The haemoglobin pigment present in the blood gets attached to four O_2 molecules that are obtained from breathing.
- Oxygenated blood is then distributed to all the body cells by the heart.
- After giving away O_2 to the body cells, blood takes away CO_2.
- CO_2 is mainly transported in the dissolved form.
- De-oxygenated blood gives CO_2 to lung alveoli and takes O_2 in return.

Deficiency of haemoglobin

Deficiency of haemoglobin in blood can affect the oxygen supplying capacity of blood. This can lead to deficiency of oxygen in the body cells. It can also lead to a disease called anaemia.

Transport

Transportation

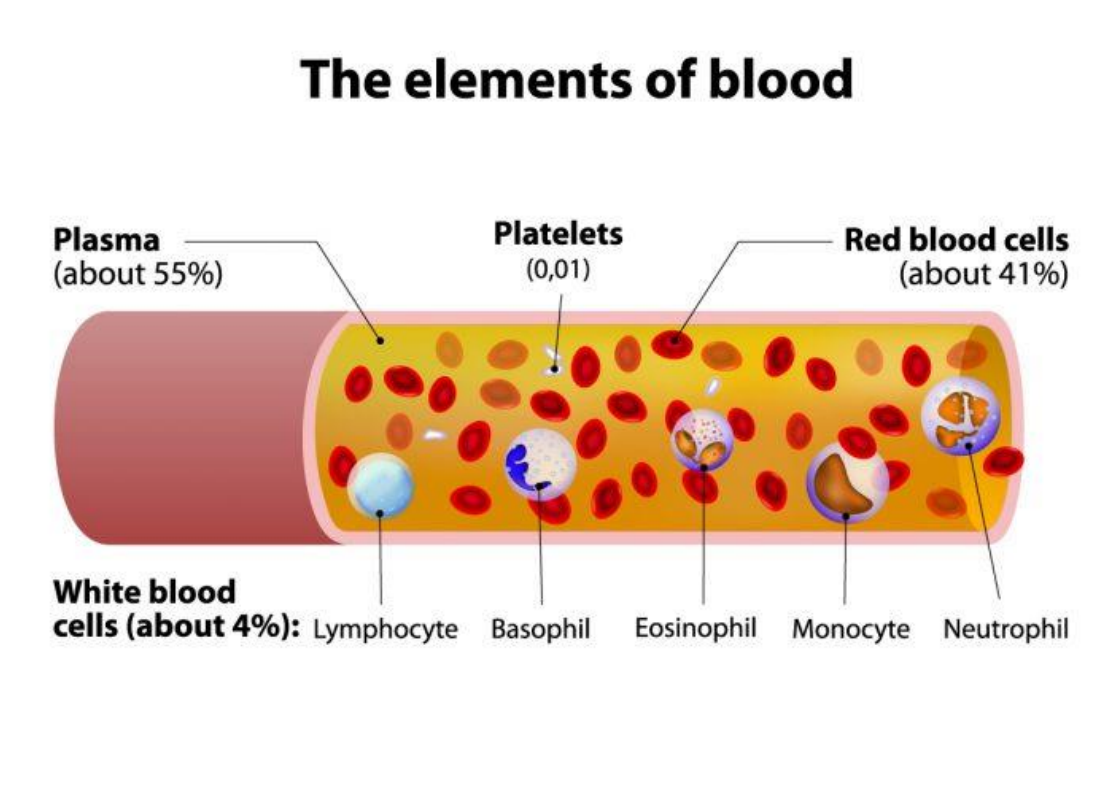
Transportation is the process by which the food and oxygen is carried from one organ to the other organs in the body.

Need for Transportation

Intake of food and oxygen are now taken up at one place in the body of the organisms, while all parts of the body need them. So there is a need for a transportation system for carrying food and oxygen from one place to another in the body.

Blood Plasma

Blood consists of fluid medium called plasma



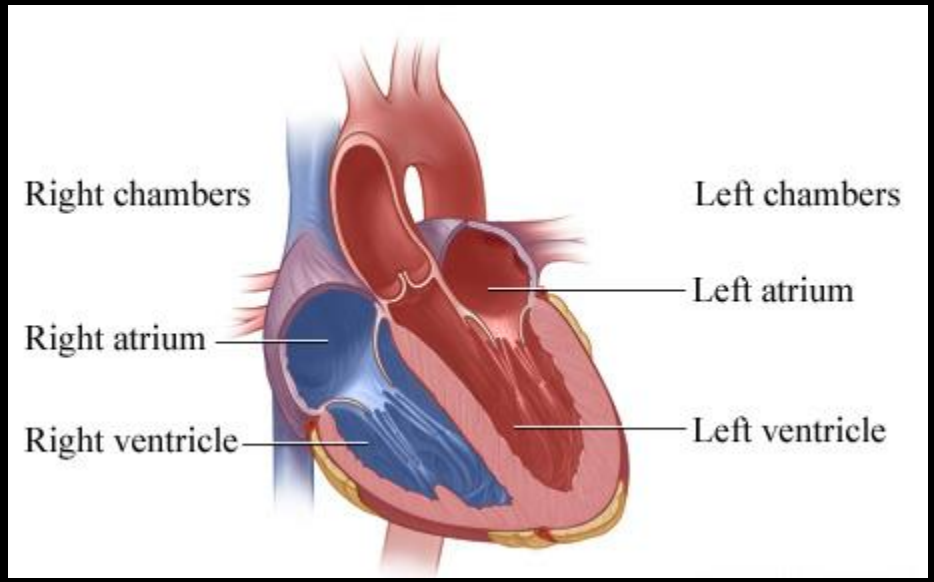
Function of Plasma

Plasma transports food, carbon dioxide and nitrogenous wastes in dissolved form.

Why are there chambers in heart?

Oxygen and carbon dioxide have to be transported by the blood.

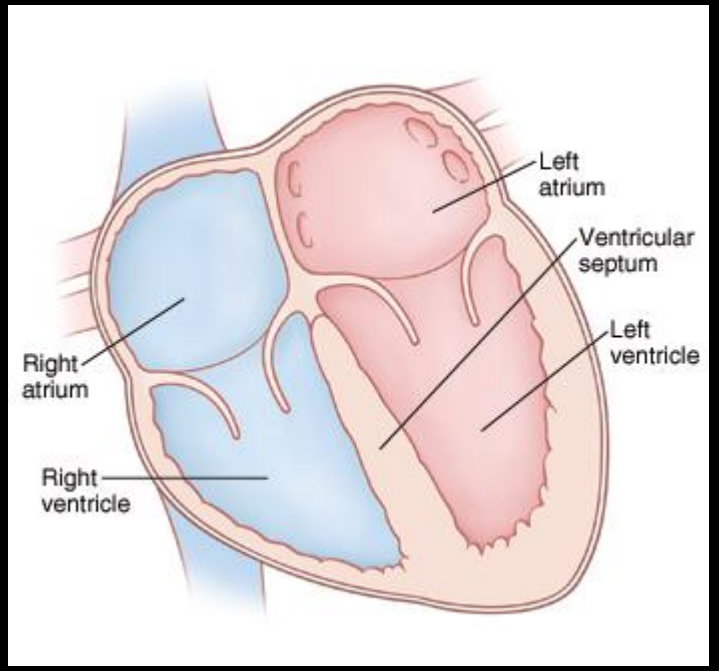
To prevent the oxygen-rich blood from mixing with the blood containing carbon dioxide.



Why there no mixing of oxygenated and deoxygenated blood?

There is no mixing of deoxygenated and oxygenated bloods in human heart due to the presence of inter-ventricular septum.

This divided the ventricle into right and left to avoid mixing of blood.



Ventricles have thicker walls

The ventricles have to pump blood into various organs, so they have thicker muscular walls than atria.

Why is it necessary to separate oxygenated and deoxygenated blood in mammals and birds?

The separation of oxygenated and deoxygenated blood provides high oxygen supply to the organs. This is useful in animals that have high energy needs such as birds and mammals which constantly us energy to maintain their body temperature.

Transport system in amphibians and reptiles

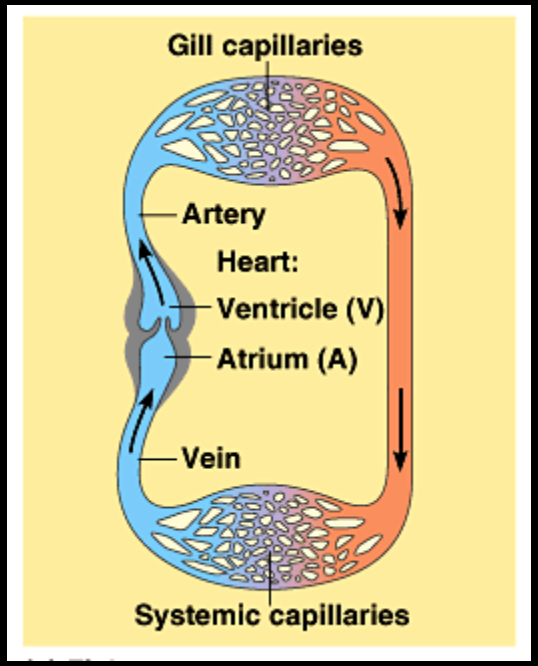
In amphibians and reptiles, the body temperature depends on the temperature in the environment. They have three-chambered hearts, and tolerate some mixing of the oxygenated and de-oxygenated blood streams.

Transport system in fish

Fishes have only two chambers to their hearts. The blood is pumped to the gills for getting oxygenated. Then it passes directly to the rest of the body. Blood goes only once through the heart in the fish during one cycle of passage through the body.

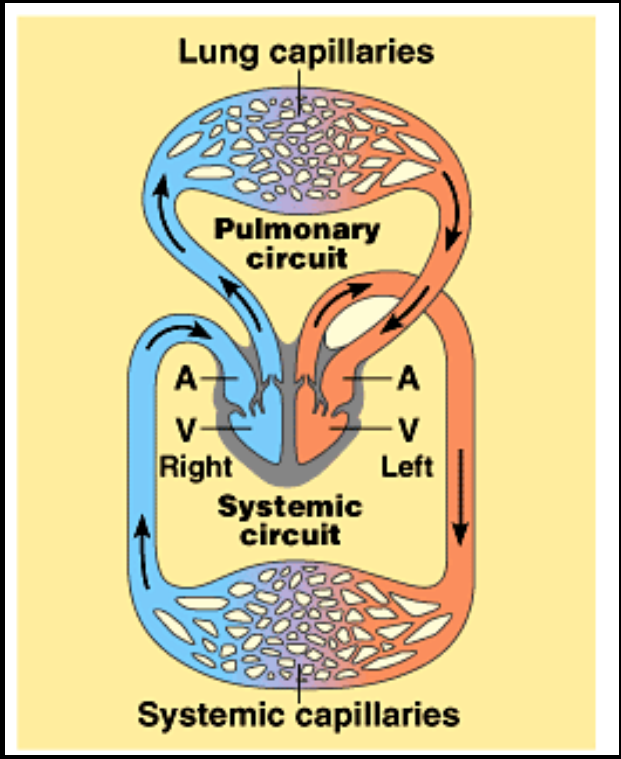
Single circulation

The type of circulation in which blood flows through the heart only once is called single circulation.



Double circulation

The type of circulation in which blood flows through the heart twice during each cycle is called double circulation.



Advantage of double circulation in humans

Double circulation of blood is useful to keep oxygenated and deoxygenated blood from mixing. Separation allows a high efficient supply of oxygen to the body. This helps human beings to use energy to maintain constant body temperature.

Components of transport system

The main components of the transport system in human beings are

- Heart
- Blood
- Blood vessels.

Components of transport system

Heart pumps oxygenated blood throughout the body. It receives deoxygenated blood from the various body parts and sends this impure blood to the lungs for oxygenation.

Components of transport system

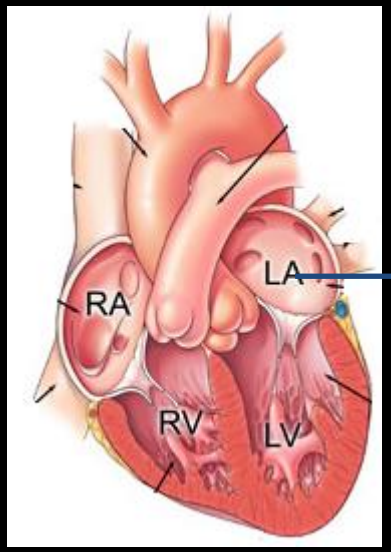
Blood helps in the transport of oxygen, nutrients, CO_2, and nitrogenous wastes.

Components of transport system

The blood vessels (arteries, veins, and capillaries) carry blood either away from the heart to various organs or from various organs back to the heart.

Left Auricle

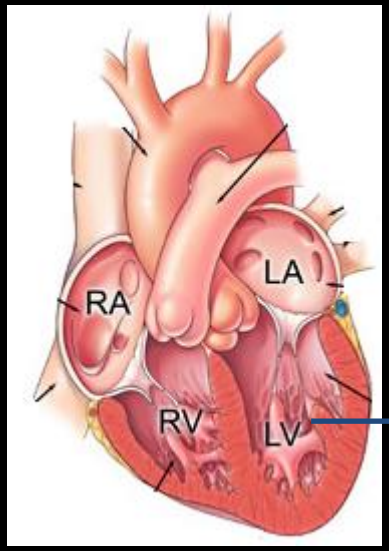
Left auricle is thin walled upper chamber. When the left auricle relaxes it collects oxygen rich blood from the lungs. When the left auricle contracts, it sends the oxygenated blood to the left ventricle.



Left Auricle

Left Ventricle

Left ventricle relaxes when the left auricle contracts to receive oxygenated blood from the left auricle. When the left ventricle contracts blood is pumped out to the body.



Left Ventricle

Function of valves

Valves present between left atrium & left ventricle and right atrium & right ventricle allow the flow of blood only in one direction (atrium to ventricle) and prevent the back flow of blood from ventricle to atrium at the time of ventricular contraction.

In the schematic representation of transport and exchange of oxygen and carbon dioxide. Identify the letters A through F

A – Lung capillaries

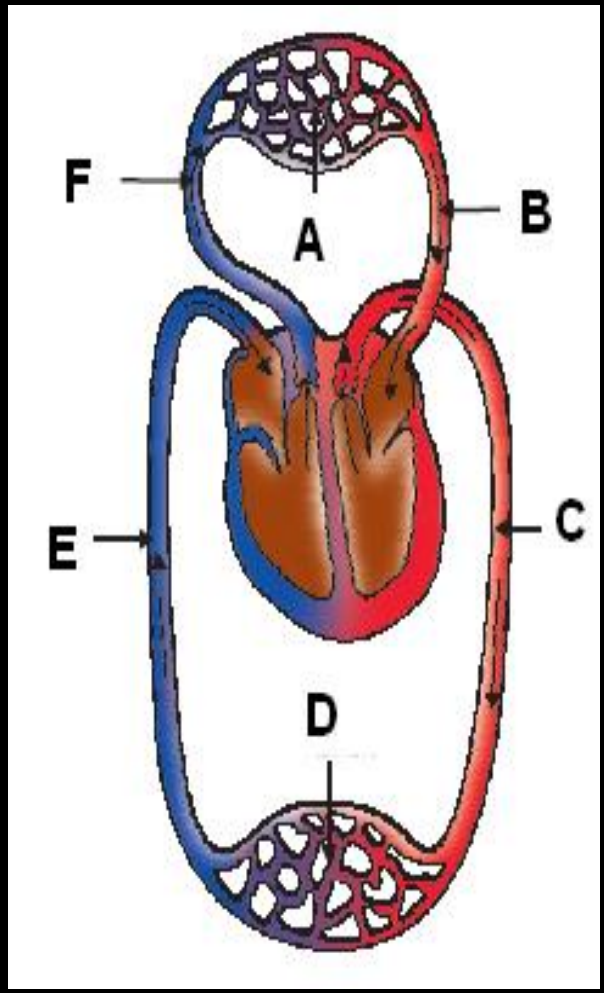
B – Pulmonary vein from lungs

C – Aorta to body

D – Capillaries in body organs

E – Vena cava from body

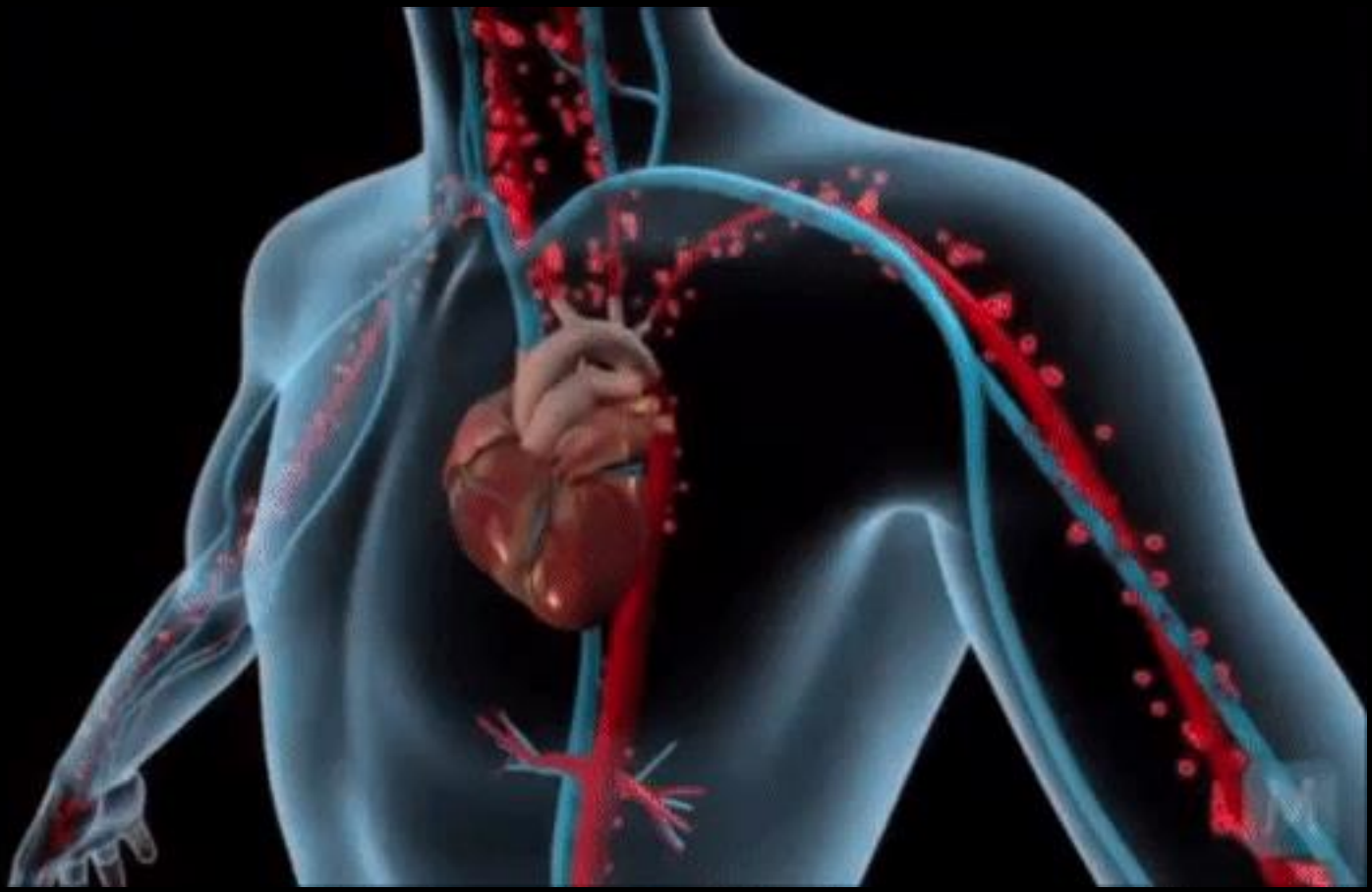
F – Pulmonary artery to lungs.



Blood pressure

Valves present between left atrium & left ventricle and right atrium & right ventricle allow the flow of blood only in one direction (atrium to ventricle) and prevent the back flow of blood from ventricle to atrium at the time of ventricular contraction.

Blood pressure



Systole & Diastole

The contraction of heart is called systole. The relaxation of heart is called diastole.

Systolic pressure & Diastolic pressure

The pressure of blood inside the artery during ventricular systole (contraction) is called systolic pressure. It is 120mmhg

The pressure of blood inside the artery during ventricular diastole is called diastolic pressure. It is 80mmhg

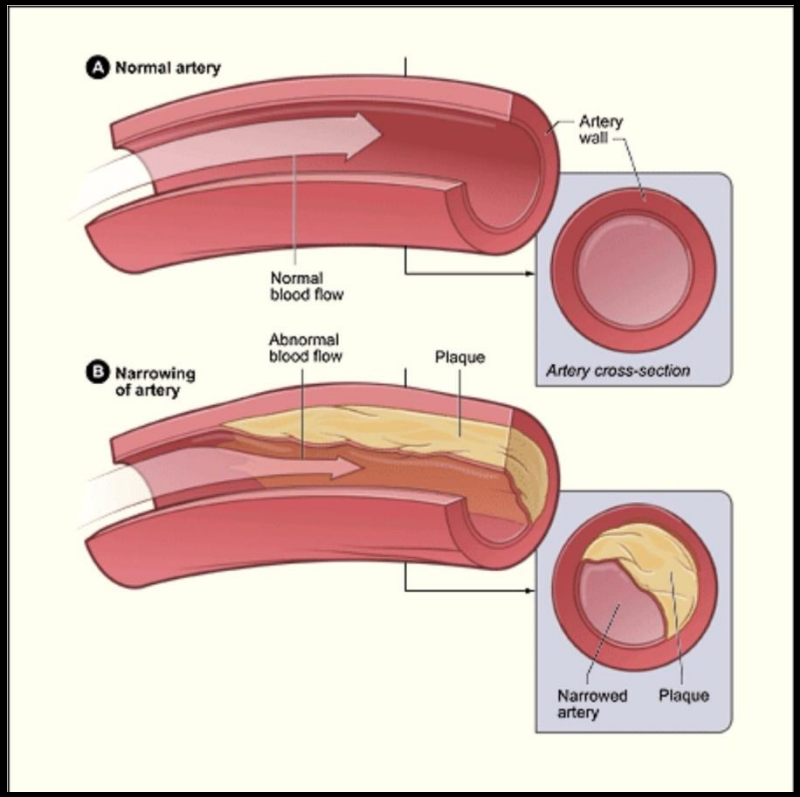
Hypertension & its effects

If the blood pressure is higher than the normal blood pressure (120/80) it is referred to as hypertension.

It can lead to the rupture of an artery and internal bleeding.

Cause of Hypertension

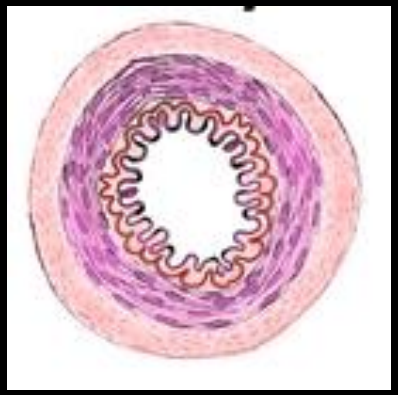
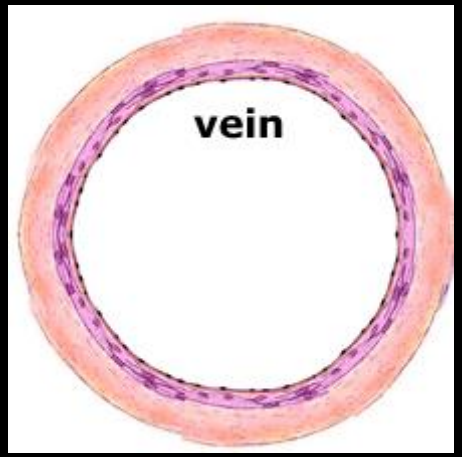
Hypertension is caused by the constriction of arterioles which results in increased resistance to blood flow.



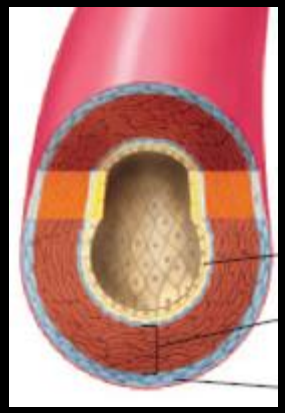
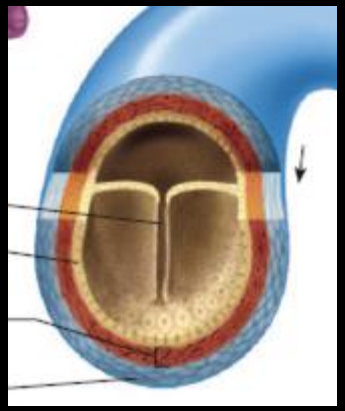
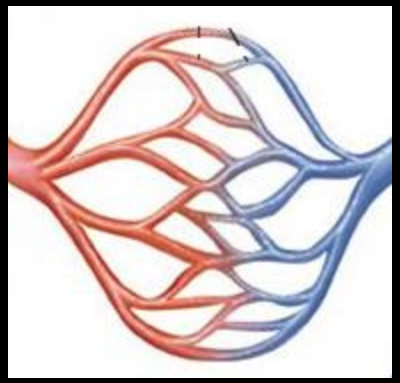
Blood vessels and their functions

Arteries	Veins	Capillaries
Arteries carry oxygenated blood from heart to various organs of the body.	Veins carry deoxygenated blood from various organs to heart.	Exchange of materials between blood and surrounding cells take place in the capillaries.

Blood vessels and their functions

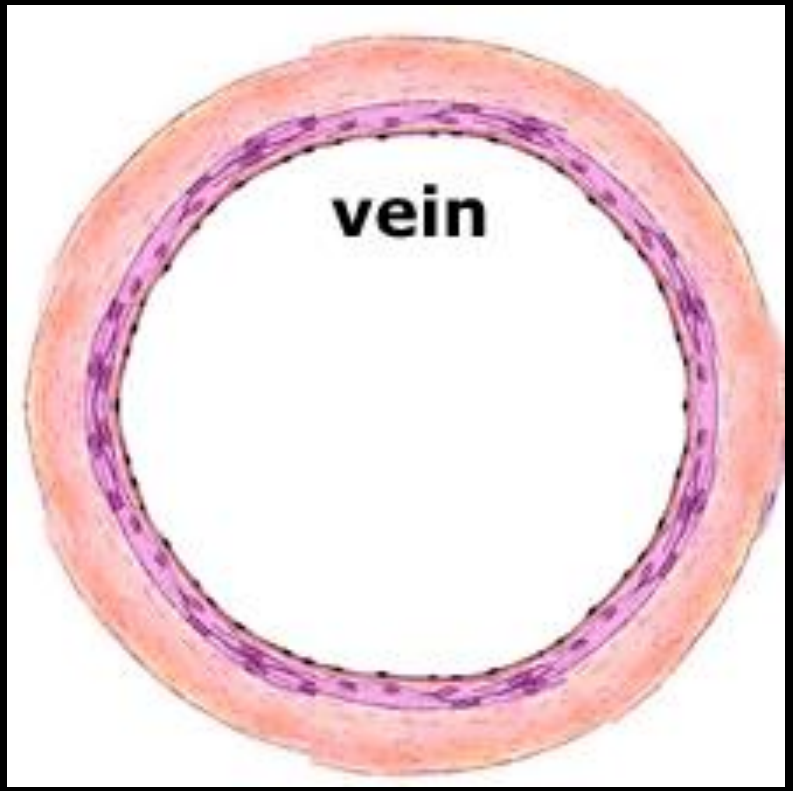
Arteries	Veins	Capillaries
They have thick and elastic walls. 	They are thin walled. 	They are thin walled and extremely narrow tubes or blood vessels which connect arteries to veins.

Blood vessels and their functions

Arteries	Veins	Capillaries
They do not have valves. 	They have valves to ensure that the blood flows only in one direction. 	They do not have valves. 

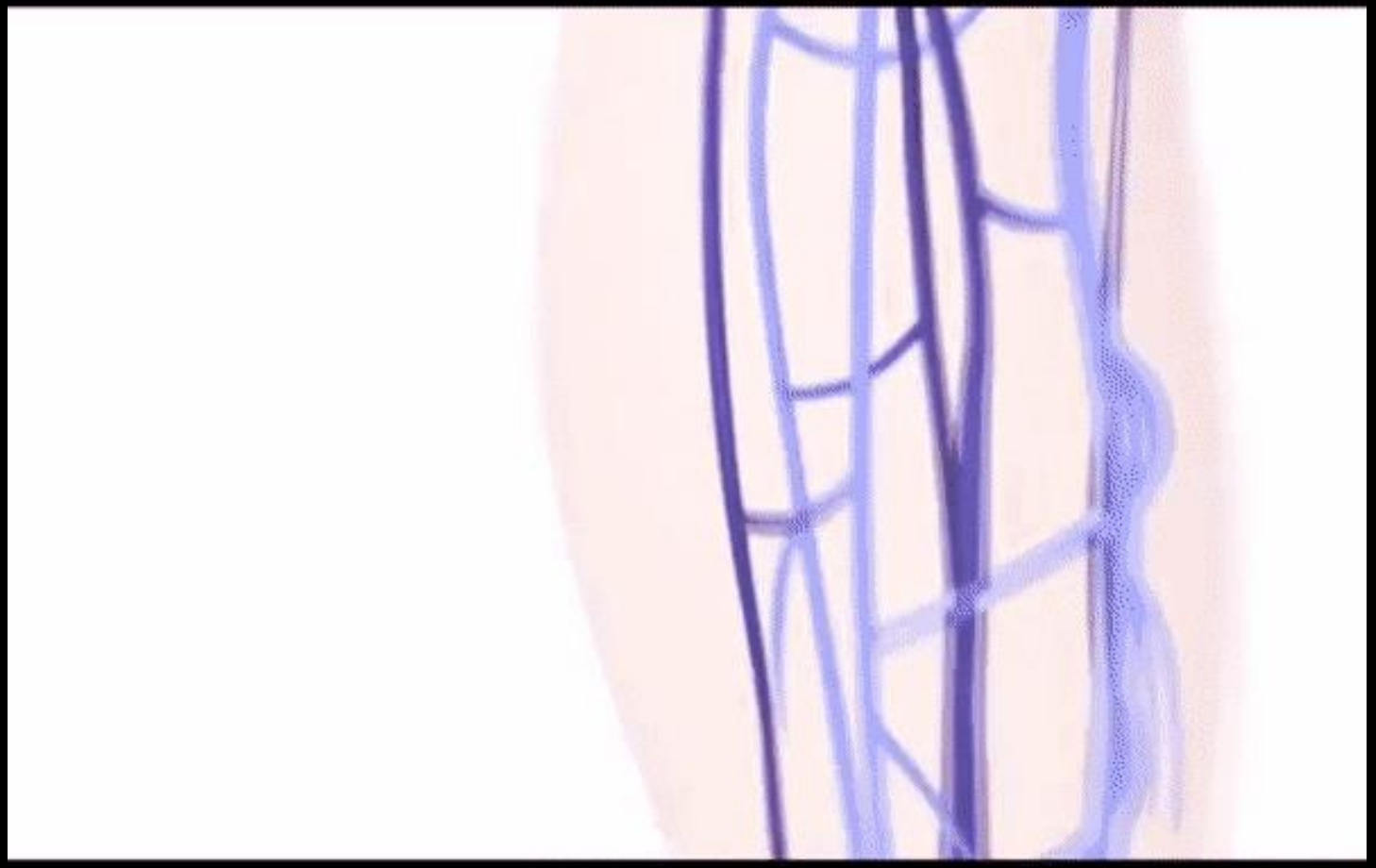
Why are veins not thick walled?

Veins need not be thick walled because the blood is no longer under pressure.



Why do veins have value?

Veins have valves to ensure that the blood flows only in one direction.



Blood clotting

Blood clotting is the mechanism that prevents the loss of blood at the site of an injury or wound by forming a blood clot. The blood has platelet cells which circulate around the body and plug these leaks by helping to clot the blood at these points of injury to prevent it from excessive bleeding.

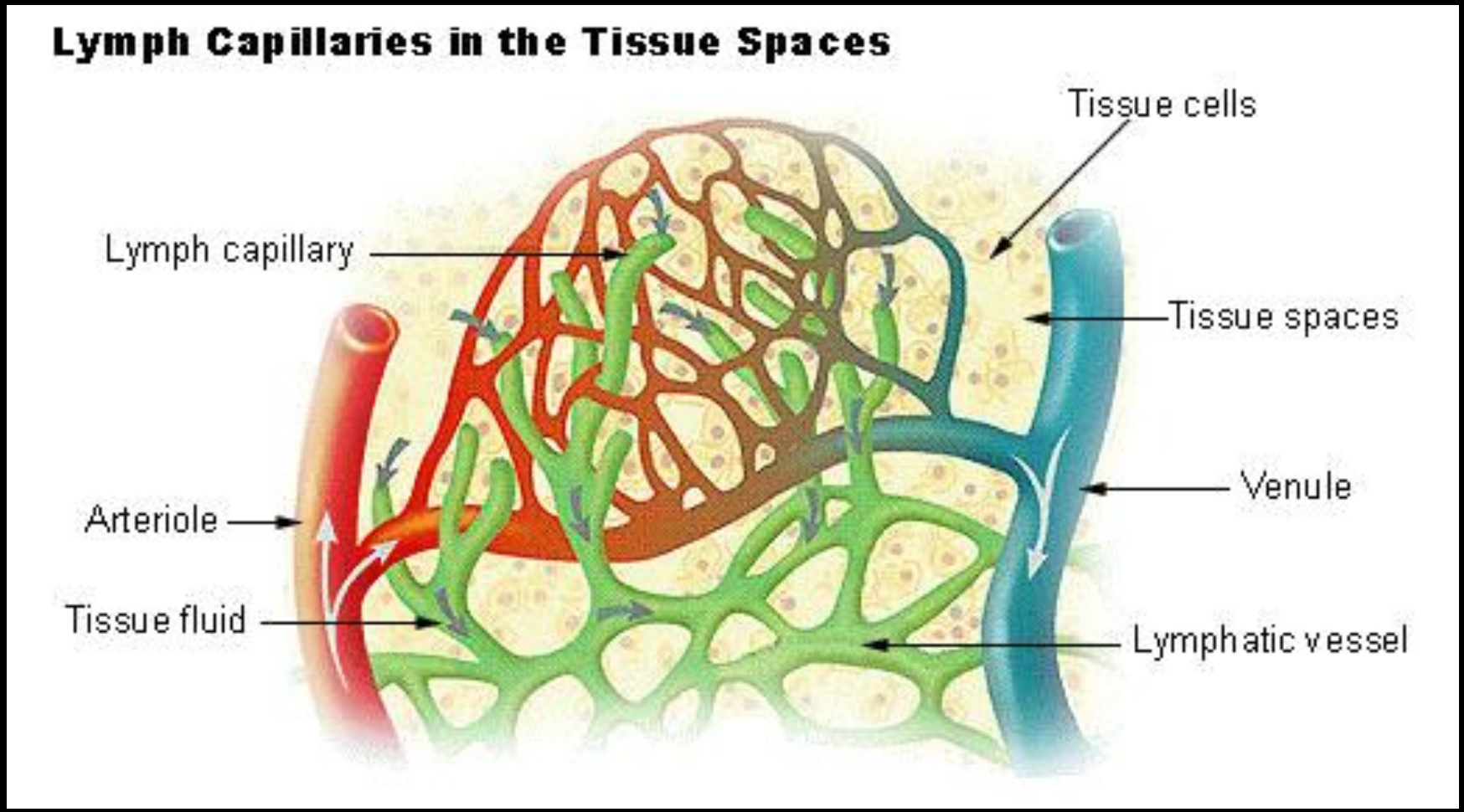
Function of platelets in blood clotting

Blood has platelets cells which circulate around the body and plug the leaks by helping to clot the blood at the point of injury.

Lymph

Lymph is a type of fluid that is colourless and involved in transportation. Lymph is formed when some amount of plasma, proteins and blood cells escape through the pores present in the walls of capillaries into intercellular spaces in the tissues.

Lymph


Lymph Capillaries in the Tissue Spaces
Tissue cells
Lymph capillary
Tissue spaces
Venule
Arteriole
Tissue fluid
Lymphatic vessel

Function of Lymph

Lymph carries digested and absorbed fat from intestine and drains excess fluid from extra cellular space back into the blood.

Blood vs Lymph

Blood	Lymph
Red in colour due to the presence of haemoglobin	Colourless due to the lack of haemoglobin.
Contains plasma, RBC, WBC and platelets.	Contains plasma and WBC only.
Transports materials from one organ to another in body.	Transports materials from tissue cells into the blood
The path of circulation of blood in heart is Arteries → capillaries → veins → heart	The path of circulation of lymph is tissue spaces →lymphatic capillaries →lymph vessels → veins.

Transportation in plants

Water and minerals transport in plants

The components of xylem tissue (tracheids and vessels) of roots, stems, and leaves are interconnected to form a continuous system of water-conducting channels that reaches all parts of the plant...

Water and minerals transport in plants

Transpiration creates a suction pressure, as a result of which water is forced into the xylem cells of the roots. Then there is a steady movement of water from the root xylem to all the plant parts through the interconnected water-conducting channels.

Food transport in plants

- Phloem transports food materials from the leaves to different parts of the plant body.
- The transportation of food in phloem is achieved by utilizing energy from ATP.
- As a result of this, the osmotic pressure in the tissue increases causing water to move into it.

Food transport in plants

- This pressure moves the material in the phloem to the tissues which have less pressure.
- This is helpful in moving materials according to the needs of the plant.
- For example, the food material, such as sucrose, is transported into the phloem tissue using ATP energy.

Transport in xylem vs phloem

Transport of materials in xylem	Transport of materials in phloem
1. Xylem tissue helps in the transport of water and minerals.	1. Phloem tissue helps in the transport of food.
2. Water is transported upwards from roots to all other plant parts.	2. Food is transported in both upward and downward directions.
3. Transport in xylem occurs with the help of simple physical forces such as transpiration pull.	3. Transport of food in phloem requires energy in the form of ATP.

Plants have low energy needs

Plants do not move and plant bodies have large proportion of dead cells in many tissues. So plants have low energy needs.

Plants have slow transport system

Plants have low energy needs so they can use relatively slow transport systems. The distances over which transport systems have to operate can be very large in plants such as very tall trees.

Diffusion is not sufficient to provide raw materials

- Diffusion is a slow process compared to the need of leaves, roots and other parts.
- If the distance between leaves containing chlorophyll and roots in contact with soil is small, energy and raw materials can easily diffuse to all parts of plant body.

Diffusion is not sufficient to provide raw materials

- In shrubs and trees, the distance becomes large.
- So diffusion process is not sufficient to provide raw materials in leaves and energy in roots. So a proper system of transport is essential.

How does water move in plants?

- At the roots, cells in contact with the soil actively take up ions.
- This creates a difference in the concentration of these ions between the root and the soil.
- Water moves into the root from the soil to eliminate this difference.
- There is steady movement of water into root xylem, creating a column of water that is steadily pushed upwards.

Transpiration

The loss of water in the form of vapour from the aerial parts of the plant is known as transpiration.

Function of Transpiration

- Transpiration helps in the absorption and upward movement of water and minerals dissolved in it from roots to the leaves.
- It helps in temperature regulation.

Transpiration is a necessary evil

Transpiration is the process by which land plants lose water. Plants absorb large amount of water and lose most of the water by transpiration. Transpiration helps the absorption and upward movement of water and dissolved mineral salts to the leaves.

Importance of root pressure

The effect of root pressure in transport of water is more important at night.

During the day when the stomata are open, the transpiration pull becomes the major driving force in the movement of water in the xylem.

Translocation

The transport of soluble products of photosynthesis is called translocation.

It occurs through phloem.

Function of phloem

Phloem transports amino acids and other substances to storage organs of roots, fruits and seeds and to growing organs.

How does translocation take place?

- Translocation of food and other substances takes place in the sieve tubes with the help of adjacent companion cells both in upward and downward directions.
- Translocation in phloem is achieved by utilizing energy. Material like sucrose is transferred into phloem tissue using energy from ATP.

How does translocation take place?

- This increases the osmatic pressure of the tissue causing water to move into it.
- This pressure moves the material in the phloem to tissues which have less pressure.
- This allows the phloem to move material according to the plant's needs.

Example to show how translocation supplies food to places where it is needed.

In the spring season, sugar stored in root or stem tissue would be transported to the buds which need energy to grow.

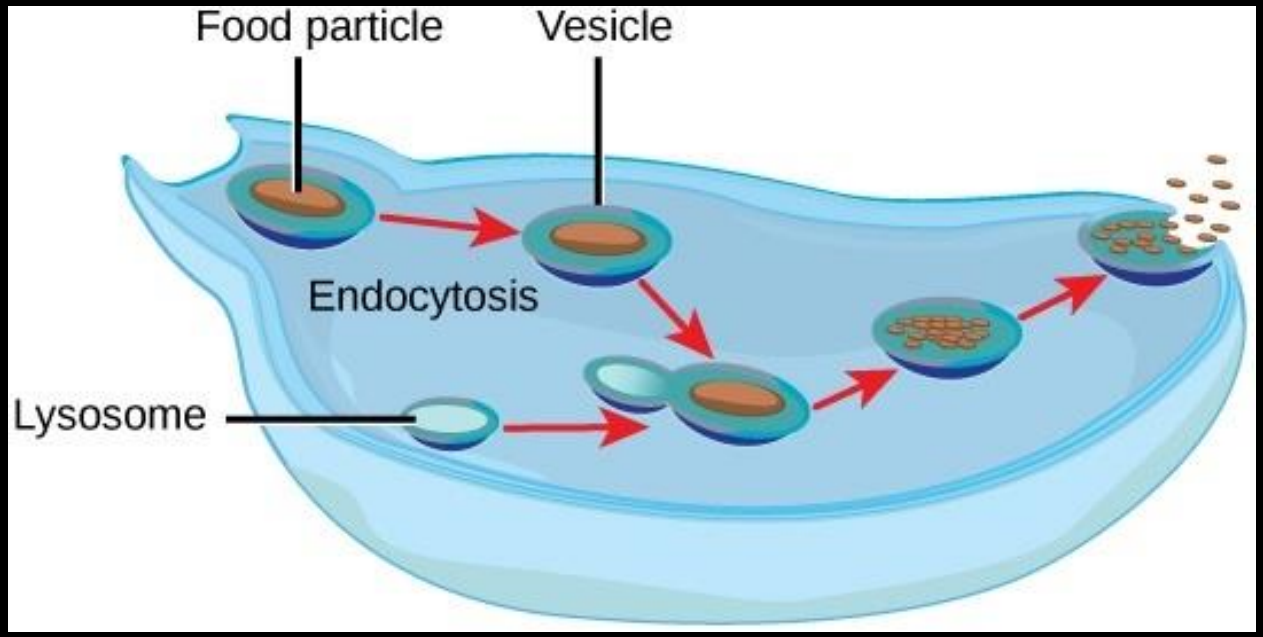
Excretion

Excretion

The biological process involved in the removal of these harmful metabolic wastes from the body is called excretion.

Excretion in unicellular organisms

Unicellular organisms remove wastes by simple diffusion from the body surface into the surrounding water.



Why is there a need for excretory system in multi-cellular organisms?

When chemical reactions use the carbon source and the oxygen for energy generation, they create by-products that are not only useless for the cells of the body, but also be harmful. These waste by-products are therefore needed to be removed from the body and discarded outside. Hence there is a need for excretory system.

Human Excretory system

The excretory system of human beings includes

- a pair of kidneys,
- a pair of ureters,
- a urinary bladder and
- a urethra.

Wastes secreted by kidneys

Nitrogenous wastes such as urea or uric acid are removed from the blood in the kidneys.

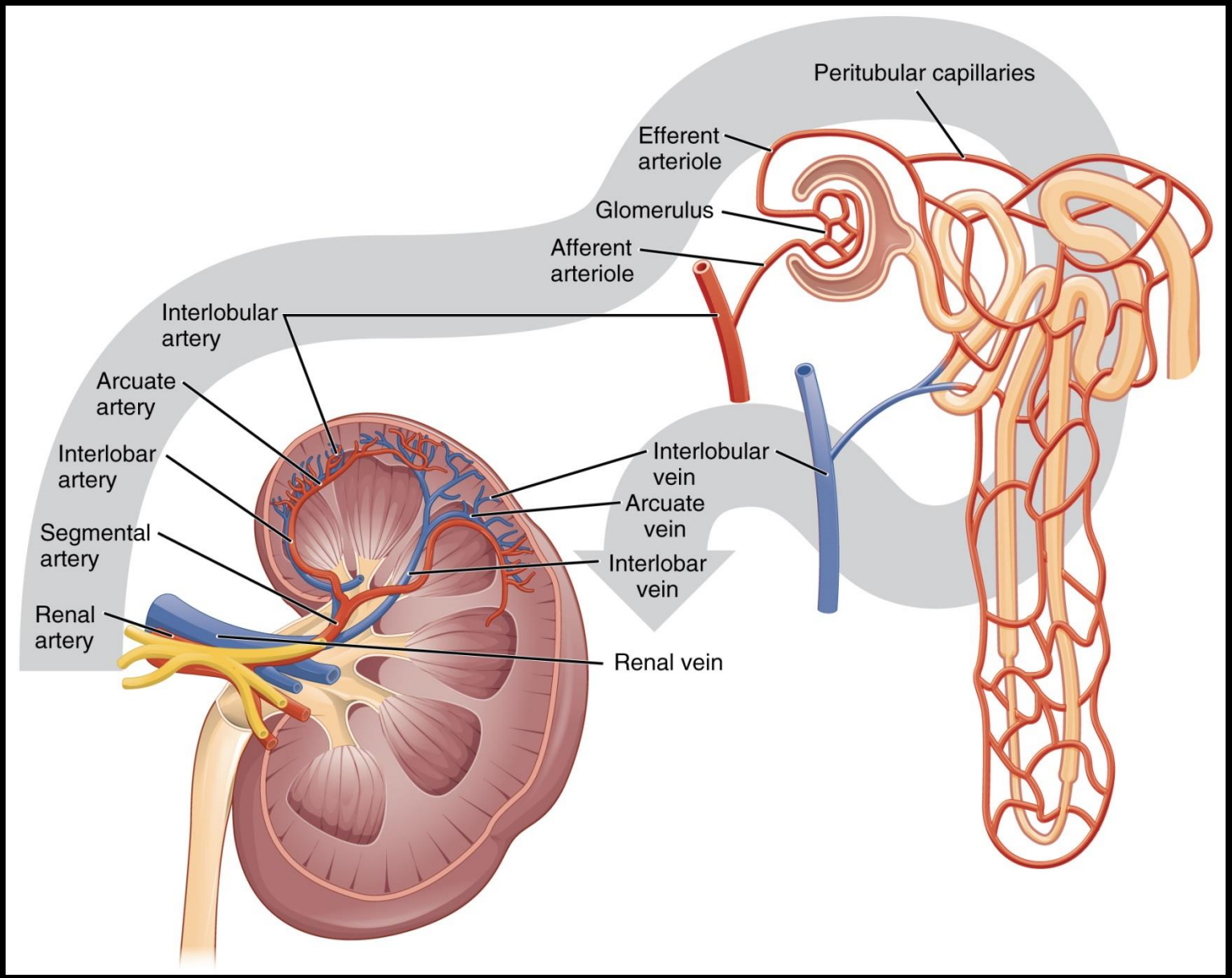
Nephron

The large number of filtration units packed close together is called nephron.

Structure of Nephron

- Nephrons are the basic filtering units of kidneys.
- Each kidney possesses large number of nephrons.
- The main components of the nephron are :
  - glomerulus,
  - Bowman's capsule,
  - a long renal tubule.

Structure of Nephron



Stages of urine formation

Urine is formed in three stages:

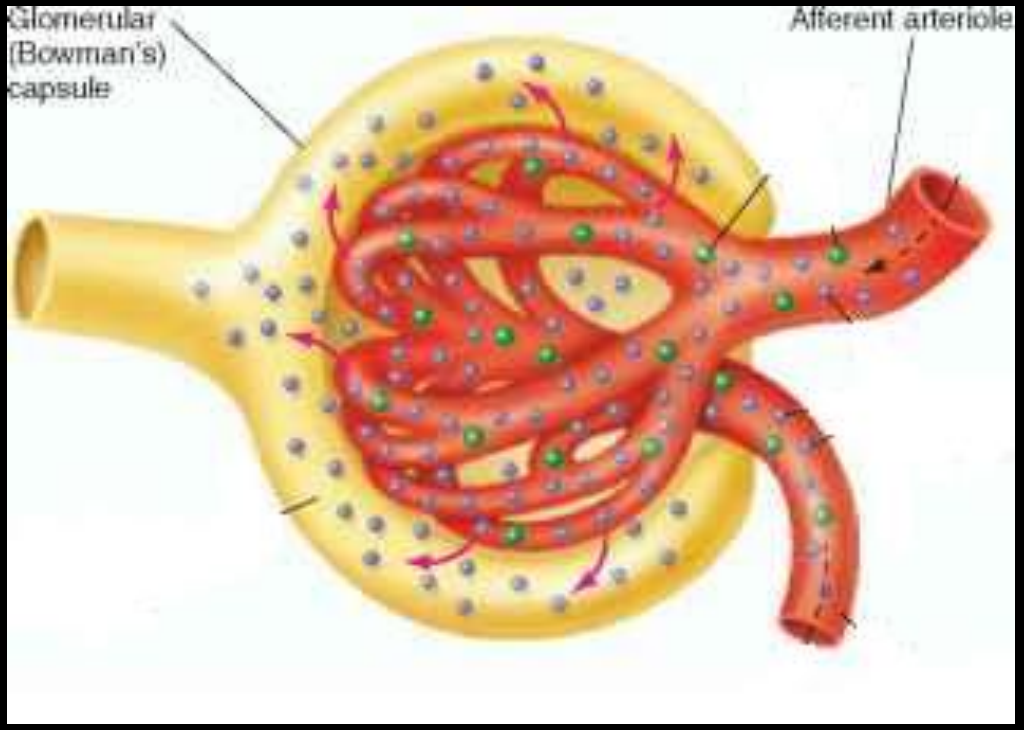
a) Glomerular filtration

b) Tubular reabsorption

c) Tubular secretion.

Glomerulus

A branch of artery enters the Bowman's capsule breaks to form a network of capillaries called **glomerulus**.



Urine formation

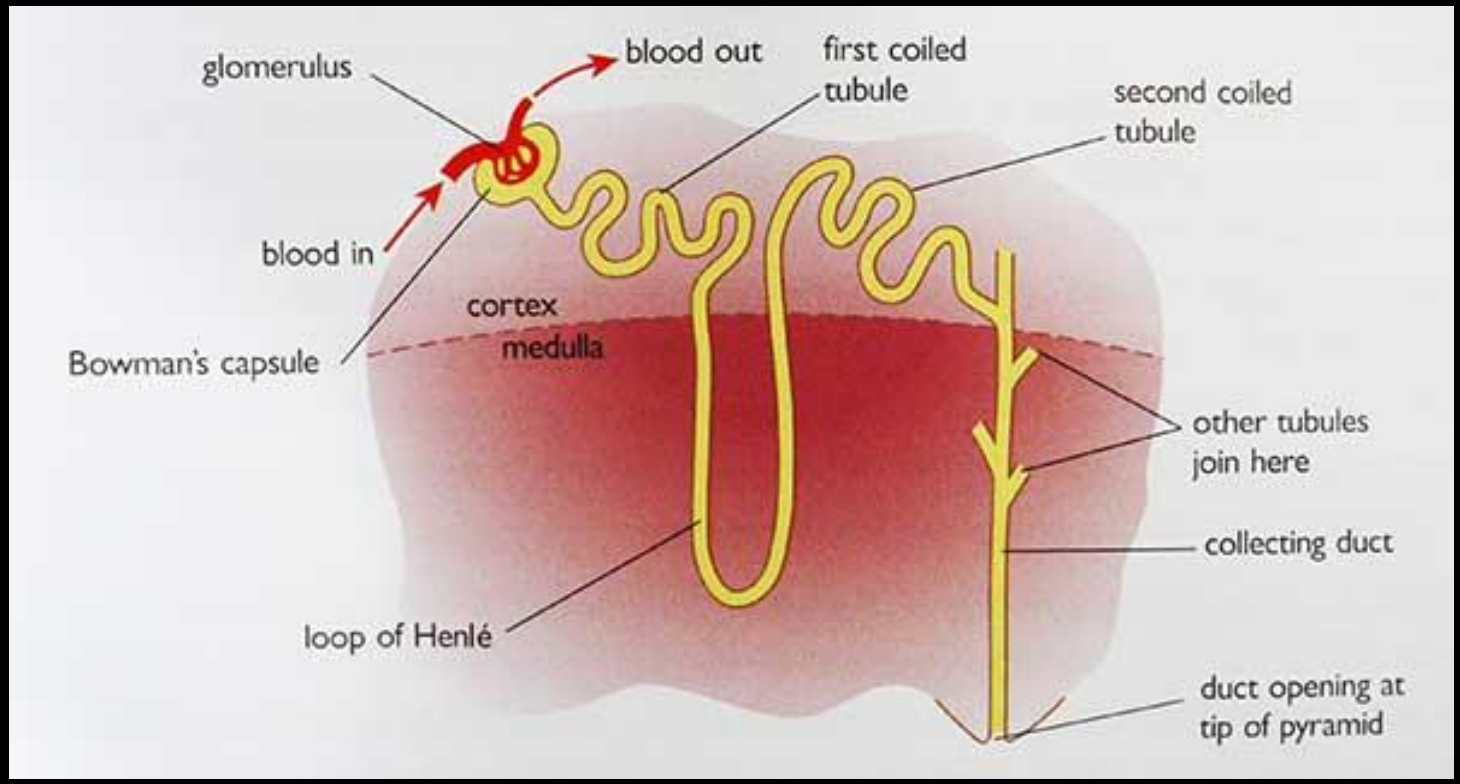
1) Nephrons are made up of a cluster of thin walled capillaries called glomerulus which is associated with a cup like structure called as Bowman's capsule and the long tube which terminates through this capsule.

Urine formation

2) The renal artery brings oxygenated blood to the kidneys along with the nitrogenous wastes like urea and uric acid and many other substances.

Urine formation

3) The blood gets filtered through the glomerulus and this filtrate enters the tubular part of nephron.



Urine formation

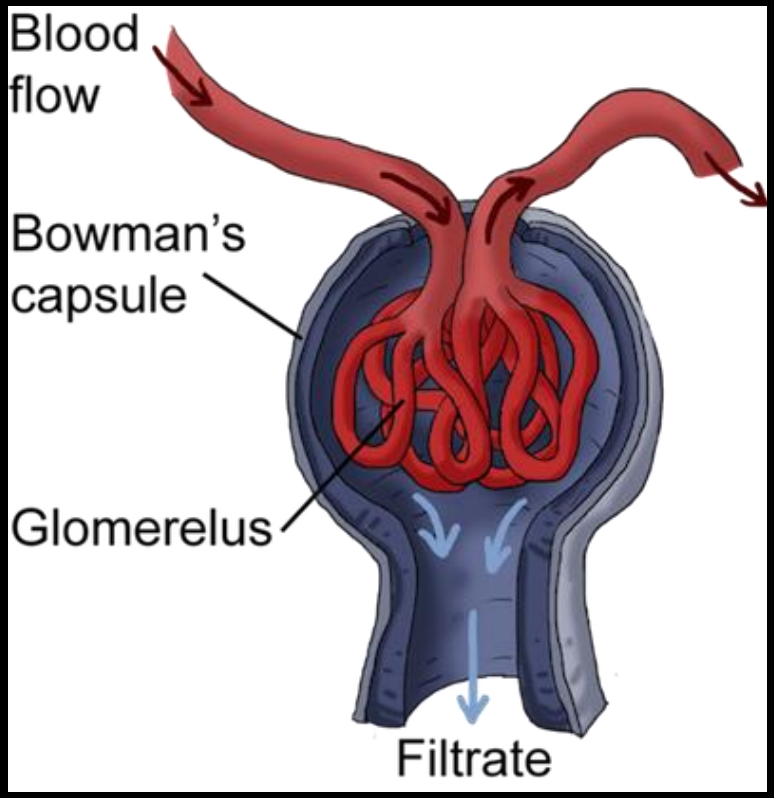
4) As this filtrate moves down the tubular part, glucose, amino acids, salts and excess of water gets selectively reabsorbed by the blood vessels surrounding these tubules.

Urine formation

5) The fluid now flowing in the tubular part is urine which gets collected in collecting ducts of nephrons.

Bowman’s capsule

Bowman's capsule is a cup-like sack at the beginning of the tubular component of a nephron in the human kidney.



Glomerular filtration

The process in which filtration of substances like glucose, amino acids, salts and water from blood takes place when blood flows at high pressure into Bowman's capsule is called Glomerular filtration.

Substances reabsorbed from urine

Glucose, amino acids, salts and water

Factors on which reabsorption depends

The amount of water reabsorbed depends upon:

a) Amount of excess of water in the body.

b) Amount of dissolved wastes need to be excreted out.

Selective reabsorption

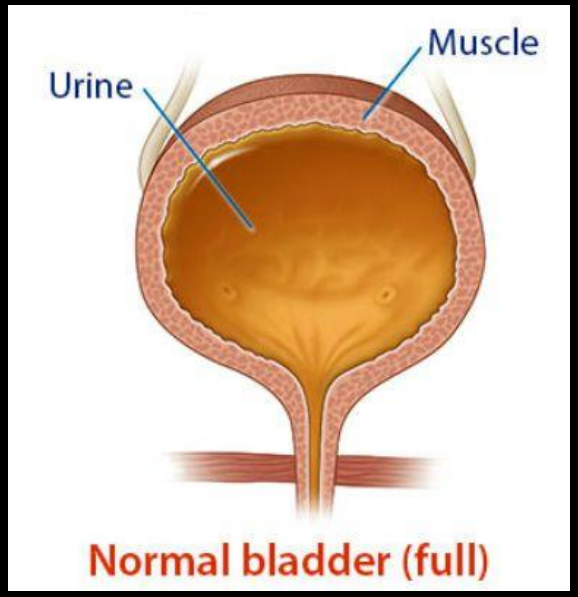
The process in which useful and essential constituents like water, glucose, amino acids and salts from the Glomerular filtrate are reabsorbed back into blood is called **selective reabsorption**.

What will happen if there is not tubular reabsorption in the nephrons of kidney?

Tubular reabsorption helps in absorbing most of the nutrients. It helps in absorption of water, salts, glucose etc. If this does not occur, all the essential nutrients will be passed away with urine. The body will get dehydrated. Glucose will not be absorbed, so person feels weak.

Why is urine stored in the urinary bladder?

Urine is stored in the urinary bladder until the pressure of the expanded bladder leads to the urge to pass it out through the urethra.

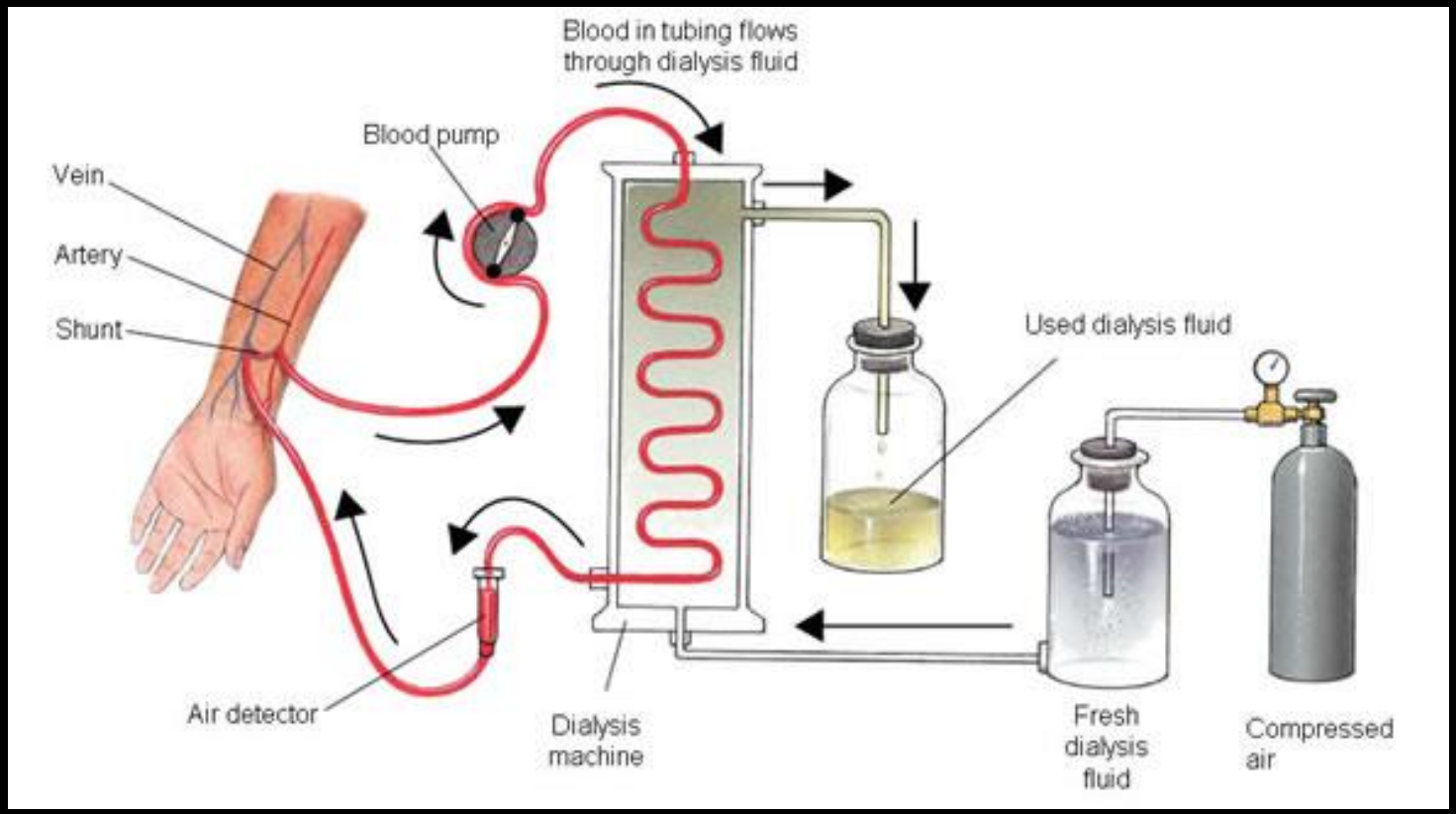


Artificial Kidney

An artificial kidney is a device to remove nitrogenous waste products from the blood through dialysis.

Dialysis

Dialysis is the process used in artificial kidney to remove nitrogenous wastes from the body.

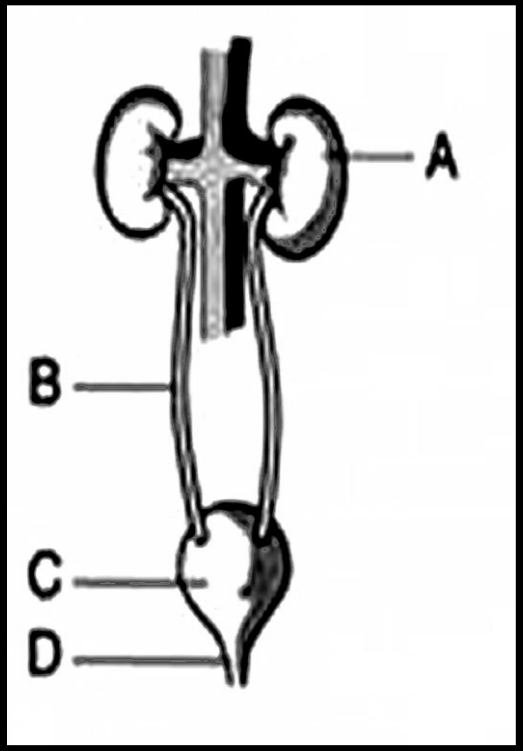


Regulation of urine output

The amount of urine produced depends on the amount of excess water and dissolved wastes present in the body. Some other factors such as habitat of an organism and hormone such as Anti-diuretic hormone (ADH) also regulates the amount of urine produced.

The diagram below represents urinary system in the human body. Identify the structure through which urine leaves the urinary bladder.

D – Urethra



Functioning of alveoli and nephron

ALVEOLI	NEPHRON
Structure	
(i) Alveoli are tiny balloon-like structures present inside the lungs. (ii) The walls of the alveoli are one cell thick and it contains an extensive network of blood capillaries.	(i) Nephrons are tubular structures present inside the kidneys. (ii) Nephrons are made of glomerulus, bowman's capsule, and a long renal tube. It also contains a cluster of thin-walled capillaries.

Functioning of alveoli and nephron

ALVEOLI	NEPHRON
Function	
(i) The exchange of O_2 and CO_2 takes place between the blood of the capillaries that surround the alveoli and the gases present in the alveoli. (ii) Alveoli are the site of gaseous exchange.	i) Remove nitrogenous wastes. ii) Selectively reabsorb glucose, amino acids and water.

Exercise (MCQ)

1) The kidneys in human beings are a part of the system for:

(a) nutrition.
(b) respiration.
(c) excretion.
(d) transportation.

2. The xylem in plants are responsible for:

(a) transport of water.
(b) transport of food.
(c) transport of amino acids.
(d) transport of oxygen.

3. The autotrophic mode of nutrition requires:

(a) carbon dioxide and water.
(b) chlorophyll.
(c) sunlight.
(d) all of the above.

4. The breakdown of pyruvate to give carbon dioxide, water and energy takes place in:

(a) cytoplasm.
(b) mitochondria.
(c) chloroplast.
(d) nucleus.

END