Life Processes

Life processes– The processes that are necessary for an organism to stay alive. Eg. Nutrition, respiration, etc.

Criteria of life-
(I) Growth
(II) Movement

Nutrition- The process in which an organism takes in food, utilizes it to get energy, for growth, repair and maintenance, etc. and excretes the waste materials from the body.

Types of nutrition

1. **Autotrophic nutrition -** (Auto =self: trophos = nourishment) The organism which can synthesis their own food is known as autotrophic organism.

E.g. Plants, Algae, blue green bacteria.

Autotrophic nutrition in plant

Photosynthesis-

Photosynthesis is the process in which plants make their own food using carbon dioxide,water and sunlight.

Raw materials- (i) Carbon dioxide
(ii) Water

Equation-

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

Energy conversion- Light/Solar energy to Chemical energy

Role off Chlorophyll- To trap the sun's energy for photosynthesis

Factors affecting photosynthesis-

(i) Carbon dioxide

(ii) Water
(iii) Light
(iv) Temperature

Events/ Steps of photosynthesis-

I. Absorption of light energy by chlorophyll
II. Conversion of light energy to chemical energy & Splitting of water molecule into Hydrogen & oxygen
III. Reduction of Carbon dioxide to Carbohydrate

Gaseous exchange during photosynthesis

- Gas used- Carbon dioxide
- By product - Oxygen

Source of raw materials-

- Carbon dioxide –Land plants- Air, Aquatic plants- Water
- Water & Minerals – Soil

Steps during photosynthesis

1. Photochemical phase (Light or Hill Reaction) The reactions of this phase are driven by light energy. They are of two steps- photolysis of water and formation of assimilatory power.

   a. Photolysis of water:- Light energy splits up water into two components. The step requires an oxygen evolving complex (formerly called z-complex) having manganese ions. Calcium and chlorine are also required.

$$2H_2O \xrightarrow[Mn,\ Ca,\ Cl]{OEC} O_2 + 4H^+ + 4e^-$$

   b.Formation of Assimilatory power:-

   Electrons released by photolysis of water are picked up by chlorophyll a molecules. On absorption of light energy, each chlorophyll a molecule throws out an electron with gain of energy. This is primary reaction of photosynthesis which converts light energy into chemical energy. Electrons travel along an electron transport system, releasing energy in the process. The energy is used in the formation of ATP (adeno sine triphosphate) from ADP and inorganic phosphate. Synthesis of ATP and ADP and inorganic phosphate (pi) with the help of light energy is called Phototophosphory lation.

ADP + Pi + energy -------- ▶ ATP

The electrons ultimately activate NADP (nicotinamide di nucleotide phosophate) and makes it combine with hydrogen to form NADPH2.

$NADP^+ + 2e^- + 2H^+$ -------- ▶ NADPH + H^+ ($NADPH_2$)

Both ATP and NADPH2 together form assimilatory power

2.Biosynthetic phase (Dark or Blackman's Reaction):-

It is actually light independent reaction which can occur both in light as well as in dark. It requires the energy and reducing power contained in assimilatory power of light reaction. Common pathway of biosynthetic phase is calvin cycle. Carbon dioxide combines with ribulose biphosphate in the presence of enzyme ribulose biphosphate carboxylase or rubisco. It produces two molecules of phosphoglyceric acid (PGA).

RuBP + CO2 ⟶ rubisco 2PGA

In the presence of ATP, phosphoglyceric acid is reduced by NADPH2 to form glyceraldehydes phosphate (GAP).

PGA + ATP + NADPH2 ------- ▶ GAP + NADP + ADP + Pi

A part of glyceraldehydes phosphate is changed into dihydroxyacetone phosphate. The two condense and form glucose. Ribulose biphosphate is regenerated to combine with carbon dioxide again. Glucose undergoes condensation to form starch. Raw material of the photosynthesis:- The process of photosynthesis require various raw materials essential to synthesize energy complex compounds called carbohydrates. These include

Activities to demonstrate:-

1) Importance of Chlorophyll:- Take a variegated leaf of a garden plant that has been exposed to sunlight for few hours. Test it for starch with iodine test. Only green parts of the plant leaf will turn blue, showing that chlorophyll is necessary for photosynthesis.

2) Importance of Light:- Take a destarched potted plant, which has been kept in dark for 3 to 4 days. Cover one of its leaves completely with a carbon paper so that no light falls on it. Keep the plant in light for 4 to 6 hours. Test the covered leaf and uncovered leaf for starch with iodine test. The covered leaf will show negligible amount of starch, while the uncovered leaf will give positive test for starch. The process clearly shows that light is necessary for photosynthesis.

3) Necessity of Carbon dioxide:-

Take two de starched potted plants and cover them with transparent polythene bags, so that no fresh air enters into them. Keep NaoH (Soda lime) that would absorb CO_2 in one pot and $NaHCO_3$(Sodium Bi-Carbonate) solution that would produce more CO_2 in the other pot. Keep both the pots in the sunlight for 4 to 6 hours and test one leaf from each for starch. The leaf from the first Pot will show no starch due to the absence of CO_2, while the leaf from the second pot will give positive test for the starch, thereby showing that CO_2 is necessary for photosynthesis.

4) Evolution of oxygen:-

Take a beaker filled with water . Add a pinch of baking soda (NaHC03) to it and put a Hydrilla plant (Aquatic plant) in it. Cover the plant with a funnel. Invert a test tube containing water over the stem of the funnel. Keep this apparatus in the bright sunlight. After some time bubbles start emerging out from the plant, which gets collected in the upper part of the test tube. Remove the test tube and test the gas with a lighted splinter, it keeps on glowing showing that the gas is a supporter of combustion. Thus, the experiment clearly shows that O2 is evolved during photosynthesis.

2. **Heterotrophic nutrition**- (Hetero =others: trophos = nourishment) organisms that can not make their own food are known as heterotrophic organism.

Eg. Animals, plants lacking chlorophyll like fungi.

There are following type of heterotrophic nutrition-

(a) Saprophytic nutrition: Organisms feeds on dead decaying plants or animals material. E.g. Fungi, Bacteria

(b) Parasitic nutrition: Organisms obtain food from the body of another living (host)

- Endoparasite : Parasite lives inside the body of the host e.g. tapeworm, roundworm.
- Exoparasite: Parasite lives on the body of the host. E.g. lice, leech.

Note- The parasite benefits while the host is usually harmed e.g. Cuscutta-plant parasite (amarbel), plasmodium (malarial parasite).

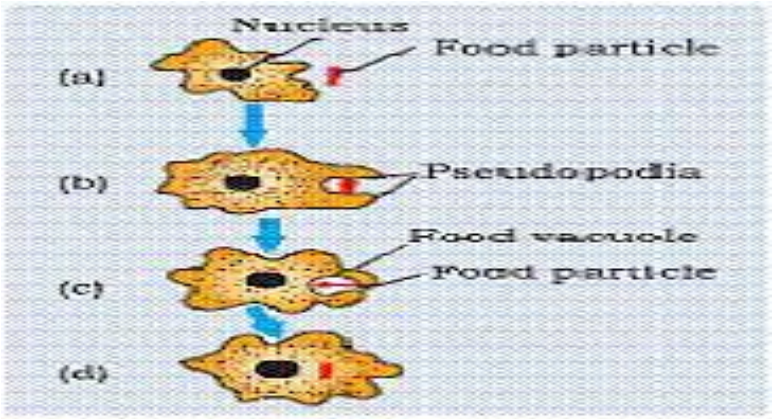
(c) Holozoic nutrition: Organism (mostly animals) take in whole food and then digest it into smaller particles with enzyme. Eg.Amoeba, Paramoecium.Animals, human beings.

Steps in Holozoic nutrition-

- Ingestion: taking in of food.
- Digestion: breaking down of complex food into simpler, absorbable form.
- Assimilation: Utilization of digested food from the body.
- Egestion: Removing undigested food from the body

Nutrition in amoeba- Unicellular Amoeba engulfs ting particles of food by surrounding it with false feet or pseudopodia. The pseudopodia then join together to form a small cavity a food vacuole.

- Digestion in amoeba is generally intracellular (within the cell) as the food is digested inside the food vacuole and the digestive enzymes are secreted by the cell itself.
- In Amoeba the absorption occurs in the cytoplasm.
- In Amoeba assimilation of food occurs through steaming movements of protoplasm inside the body cavity.
- In Amoeba when sufficient amount of undigested food collects inside the body cavity its cell membrane can rupture at any place to throw out the undigested food.



Nutrition in Amoeba

Nutrition in Paramoecium-

- Paramoecium is a unicellular organism has fine hair like structure called cilia all over its body. The cilia sweep the food particles along. With the water current into its mouth like structure.
- Digestion in Paramoecium is generally intracellular (with in the cell) as the food is digested inside the food vacuole and the digestive enzymes are secreted by the cell itself.
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Paramoecium

Nutrition in human being

The nutrition in human beings (or man) takes place through human digestive system.

The human digestive system consists of the alimentary canal and its associated glands. The various organs of the human digestive system in sequence are:

Mouth, Oesophagus (or Food pipe), Stomach, Small intestine and Large intestine.

Various steps of nutrition in human beings (or man).

1. Ingestion :
The human beings have a special organ for the ingestion of food. It is called mouth. So, in human beings, food is ingested through the mouth. The food is put into the mouth with the help of hands.

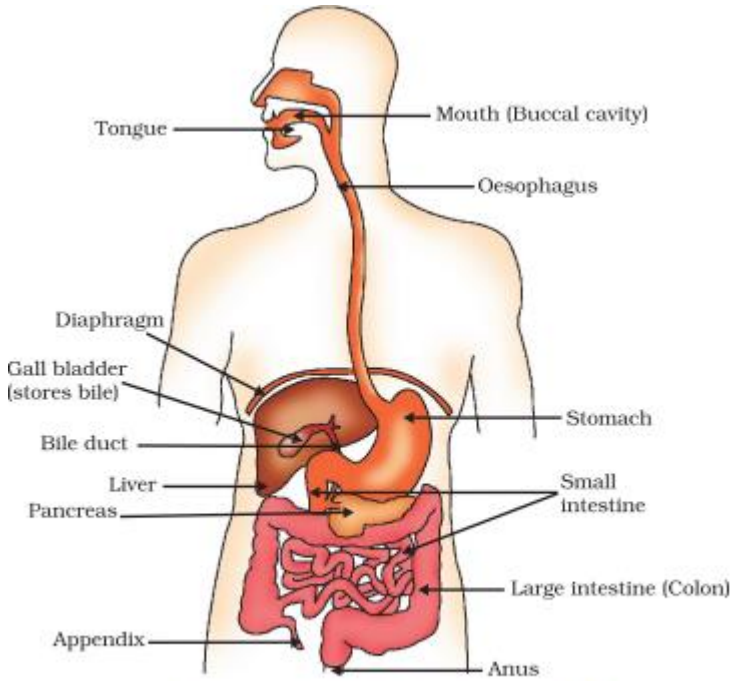


Figure 6.6 *Human alimentary canal*

2. Digestion :In human beings, the digestion of food begins in the mouth itself.

- The mouth cavity (or buccal cavity) contains teeth, tongue, and salivary glands
- The teeth cut the food into small pieces, chew and grind it. So, the teeth help in physical digestion.
  The salivary glands in our mouth produce saliva.
- The salivary glands help in chemical digestion by secreting enzymes.
- The human saliva contains an enzyme called salivary amylase which digests the starch present in food into sugar.
- The slightly digested food in the mouth is swallowed by the tongue and goes down the food pipe called oesophagus.

<u>The oesophagus carries food to the stomach. This happens as follows:</u>

The walls of food pipe have muscles which can contract and expand alternately. When the slightly digested food enters the food pipe, the walls of food pipe start contraction and expansion movements. This type of movement of food is known as peristaltic movement.

<u>Digestion of food in stomach</u>

- The stomach is a J-shaped organ present on the left side of the abdomen. The food is further digested in the stomach.
- The food is churned in the stomach for about three hours. During this time, the food breaks down into still smaller pieces and forms a semi-solid paste. The stomach wall contains three tubular glands in its walls. The glands present in the walls of the stomach secrete gastric juice.

- The gastric juice contains three substances: hydrochloric acid, the enzyme pepsin and mucus
- Enzyme pepsin begins the digestion of proteins present in food to form smaller molecules..

- Protein digesting enzyme pepsin is active only in the presence of an acid. So, the function of hydrochloric acid in the stomach is to make the medium of gastric juice acidic so that the enzyme pepsin can digest the proteins properly.
- Another function of hydrochloric acid is that it kills any bacteria which may enter the stomach with food.
- The mucus helps to protect the stomach wall from its own secretions of hydrochloric acid.

Digestion in small intestine

- The partially digested food then goes from the stomach into the small intestine.
- The exit of food from stomach is regulated by a 'sphincter muscle' which releases it in small amounts into the small intestine.
- The small intestine in human beings is the site of complete digestion of food (like carbohydrates, proteins and fats). This happens as follows:
- The small intestine receives the secretions of two glands: liver and pancreas.

Liver secretes bile. Bile is a greenish yellow liquid made in the liver which is normally stored in the gall bladder.

Bile performs two functions:

1-Makes the acidic food coming from the stomach alkaline so that pancreatic enzymes can act on it.

2- Bile salts break the fats present in the food into small globules making it easy for the enzymes to act and digest them.

Pancreas secretes pancreatic juice which contains digestive enzymes like pancreatic amylase, trypsin and lipase.

- The enzyme amylase breaks down the starch.
- The enzyme trypsin digests the proteins.
- The enzyme lipase breaks down the emulsified fats.

The walls of small intestine contain glands which secrete intestinal juice.

The intestinal juice contains a number of enzymes which complete the digestion of complex carbohydrates into glucose, proteins into amino acids and fats into fatty acids and glycerol.

3. Absorption :

The inner surface of small intestine has millions of tiny, finger like projections called villi. The presence of villi gives the inner walls of the small intestine a very large surface

area. And the large surface area of small intestine helps in the rapid absorption of digested food. The digested food which is absorbed through the walls of the small intestine goes into our blood.

4. Assimilation:

The blood carries digested and dissolved food to all the parts of the body where it becomes assimilated as part of the cells. This assimilated food is used by the body cells for obtaining energy as well as for growth and repair of the body.

5. Egestion:

A part of the food which we eat cannot be digested by our body. This undigested food cannot be absorbed in the small intestine. So, the undigested food passes from the small intestine into a wider tube called large intestine.

The walls of large intestine absorb most of the water from the undigested food (with the help of villi). Due to this, the undigested part of food becomes almost solid. The last part of the large intestine called 'rectum' stores this undigested food for some time. And when we go to the toilet, then this undigested food is passed out (or egested) from our body through anus .

Q-What is small intestine?

The small intestine is the largest part of the alimentary canal. It is about 6.5 metres long in an adult man. Though the small intestine is very long, it is called small intestine because it is very narrow.

The small intestine is arranged in the form of a coil in our belly.

Length of the small intestine differs in various animals depending on the type of food they eat.

- For example, cellulose is a carbohydrate food which is digested with difficulty. So, the herbivorous animals like cow which eat grass need a longer 'small intestine' to allow the cellulose present in grass to be digested completely.
- On the other hand, meat is a food which is easier to digest. So, the carnivorous animals like tigers which eat meat have a shorter 'small intestine'.

Respiration

The process by which digested food is broken down with the help of Oxygen to release energy.

Types of respiration-

(i) Aerobic respiration

(ii) Anaerobic respiration

Aerobic respiration	Anaerobic respiration
1. Takes place in presence of Oxygen.	1. Takes place in absence of Oxygen.
2. End products- Carbon dioxide & Water	2. End products- Ethanol & Carbon dioxide
3. More energy is released.	3. Less energy is released.
4. Takes place in Cytoplasm & Mitochondria	4. Takes place in only in Cytoplasm.
5. Complete oxidation of glucose takes place.	5. Incomplete oxidation of glucose takes place.
6. It occurs in most organisms.	6. It occurs in certain bacteria, yeast & certain tissues of higher organisms. E.g. In humans during vigorous exercise, when the demand for Oxygen is more than the supply, muscle cells respire anaerobically for some time.
7. Equation- Glucose→ Pyruvate→ CO_2 + H_2O + Energy	7. Equation- <u>In Yeast-</u> Glucose→ Pyruvate→ Ethanol + H_2O + Energy <u>In muscle cells -</u> Glucose→ Pyruvate→ Lactic acid + Energ

Respiration system in Human being

The respiratory system in human beings consists of the following organs: nose, pharynx, trachea, bronchi and lungs.

Nose:

Nose encloses a nasal cavity which opens to the outside through two nostrils.

Larynx:

The upper part of trachea is a box-like chamber called larynx or voice box. Glottis is guarded by a flap-like structure called epiglottis which prevents food from entering into the windpipe.

Trachea:

Trachea or windpipe is a long cylindrical tube supported by cartilaginous rings (rings made of cartilage), which prevent it from collapsing.

Bronchi:

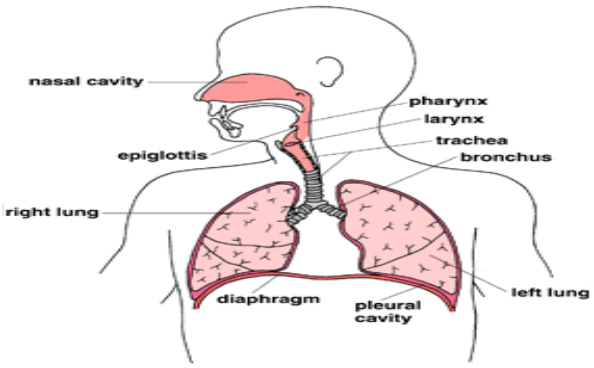
Trachea branches braches into two tubes called bronchi, one of which enters each lung. Inside the lung, bronchi branch into fine breaches called bronchioles.

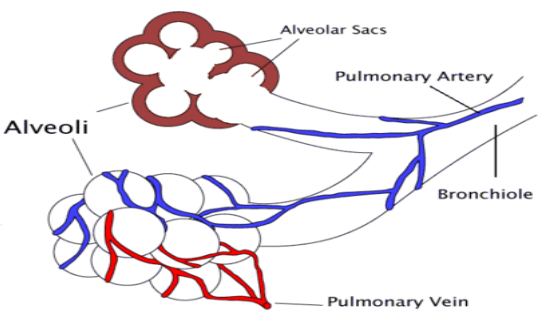
Lungs:

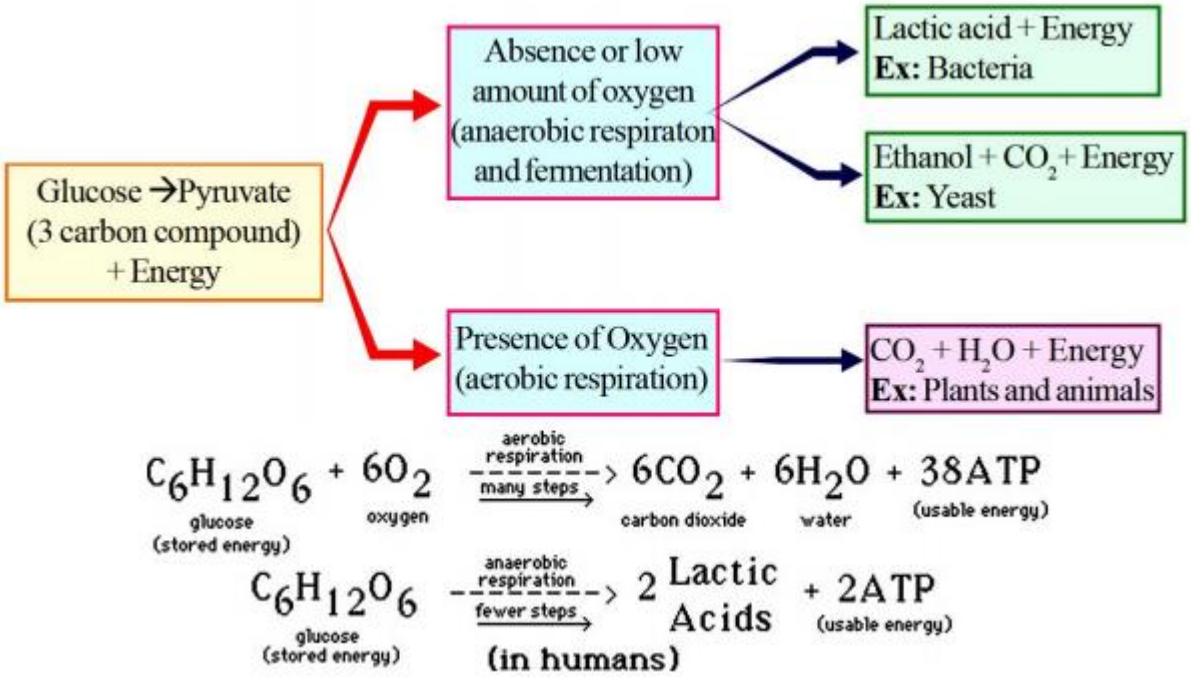
A pair of lungs is the organs of gaseous exchange in human beings.

Respiration Process

- The muscles of respiration contract thereby expanding the chest cavity.
- This causes a negative pressure within the pleural cavity (where the lungs are housed) which forces the lungs to expand.
- The expansion of the lungs reduces the air pressure in the lungs.
- This draws air from the environment which is at a higher pressure. Air will flow from an area of high pressure to low pressure.
- Air is taken in through the nose and the air is 'filtered' and heated in the nasal cavity.
- It then passes down the throat and enters the trachea where it rushes into the bronchi.
- The bronchi divides the air flow between the two lungs.
- The air then passes into smaller air tubes known as bronchioles and empty into the lungs.
- The air enters the tiny air sacs within the lungs, called alveoli, where oxygen crosses into the blood and carbon dioxide empties into the lung.
- The respiratory muscles relax and the chest cavity contracts.
- The elastic lungs recoil and push air out through the air passages where it is emptied into the environment.







Pain in Leg Muscles on Running: When someone runs too fast, he may experience a throbbing pain in the leg muscles. This happens because of anaerobic respiration taking place in the muscles. During running, the energy demand from the muscle cells increases. This is compensated by anaerobic respiration and lactic acid is formed in the process. The deposition of lactic acid causes the pain the leg muscles. The pain subsides after taking rest for some time.

Gaseous exchange in plants-

The gaseous exchange in plant take place through the Process of Diffusion

Direction of diffusion depends on-

(i) Environmental conditions
(ii) Requirement of the plant.

Day time- Carbon dioxide given out during respiration is used for photosynthesis. Therefore only Oxygen is released, which is a major activity during the day.

Night time –Only respiration takes place. Therefore only Carbon dioxide is released, which is a major activity during the night.

Transportation

Transportation in human beings-

Blood-

It is a fluid connective tissue.

Components-

(1) Fluid medium- Plasma
(2) Red blood corpuscles
(3) White blood corpuscles
(4) Platelets suspended in plasma
(iii) Plasma transports food, Oxygen, Carbon dioxide, Nitrogenous wastes, etc.

Functions of blood-

(i) Transport of respiratory gases.
(ii) Transport of nutrients.
(iii) Transport of waste products.
(iv) Defence against infection

Blood vessels-

(i) Arteries
(ii) Veins
(iii) Capillaries

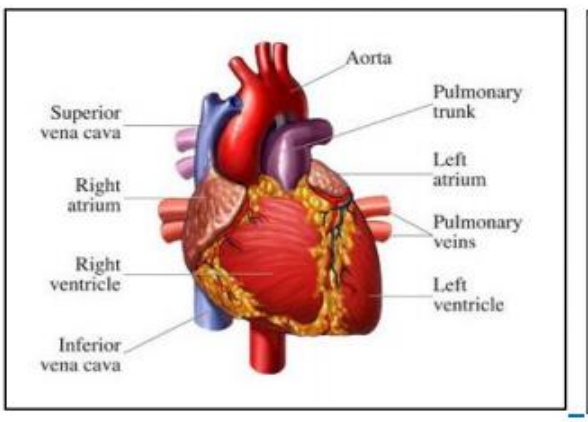
Artery	Vein	Capillaries
• An artery is a blood vessel which carries blood away from the heart towards any organ.	• A vein is a vessel which carries the blood away from an organ towards the heart.	• A capillary is a very narrow blood vessel which is located within the tissue.
• It has elastic and thick muscular walls.	• It has thin muscular walls.	• It has an extremely thin wall.
• Narrow cavity through which the blood flows.	• Broad cavity through which the blood flows.	-
-	• The veins have valves which prevent the backflow of blood.	• The arteries branch to form arterioles, and arterioles break up into capillaries.
• The largest artery is the aorta.	-	• The capillaries gradually reunite to form venules. Venules further combine to form veins.
-	-	• Capillaries allow the exchange of materials such as nutrients, metabolic wastes and respiratory gases between the blood and cells.

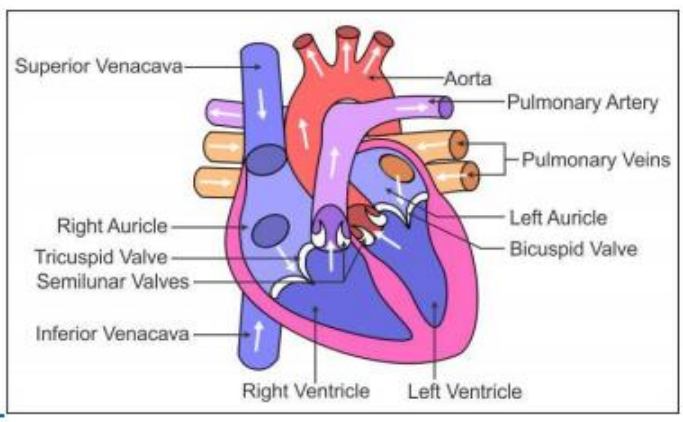
Heart-

(i) It is a muscular organ, which works as a pump in the circulatory system.
(ii) the size of heart is equal to our fist.
(iii) It has two sides, which are separated by a partition so that the oxygenated and deoxygenated blood do not get mixed up.
(iv) <u>It has four chambers</u>-

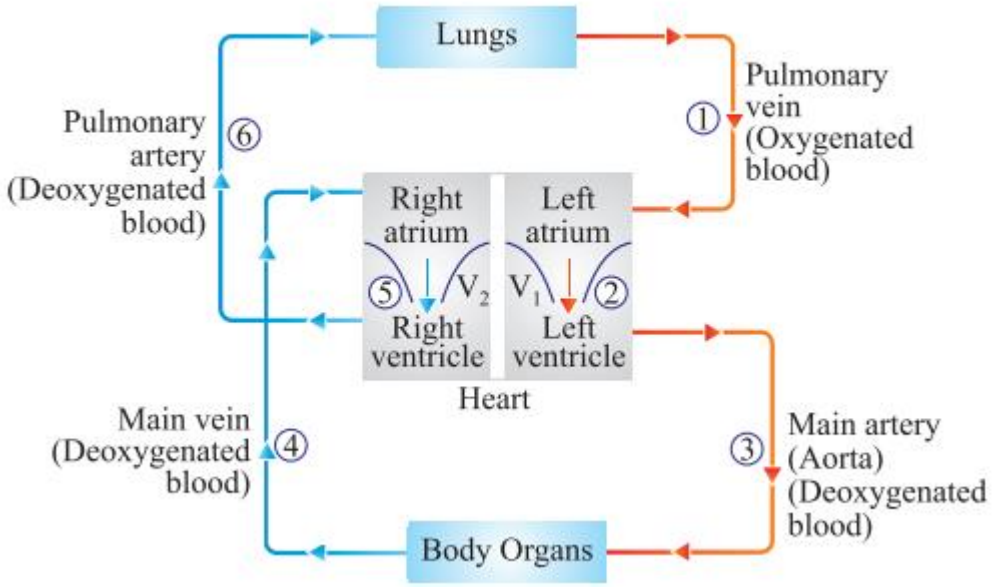
- Two upper chambers called Atria.

- Two lower chambers called Ventricles.





Working of heart-



Left side-

- Left atrium relaxes & the Oxygenated blood enters it from the lungs through the pulmonary vein.
- Left atrium contracts & the blood enters the left ventriclethrough the valve.
- Left Ventricle contracts and the blood is pumped into the largest artery 'Aorta' and is carried to all parts of the body.

Right side-

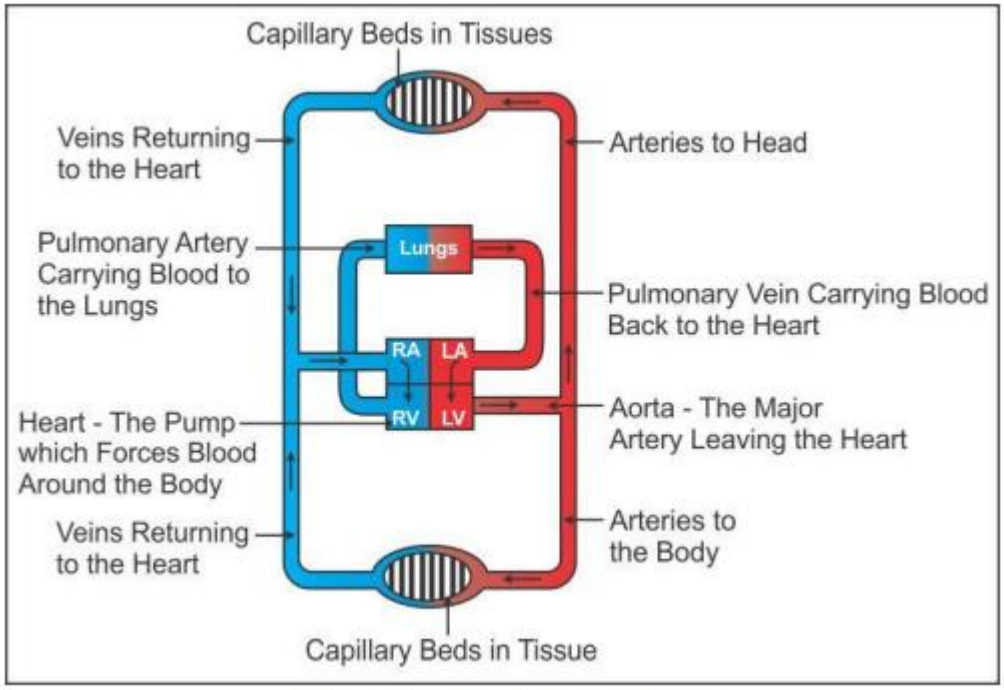
- Right atrium relaxes & the deoxygenated blood from the body enters it through superior and inferior Vena cava.
- Right atrium contracts & the blood enters the right Ventricle throughthe valve.
- Right Ventricle contracts and the blood is pumped into the Pulmonary artery and is carried to lungs.

Function of Valves-

- Unidirectional to prevent the backward flow of blood.
- Pulmonary vein is the only vein that carries Oxygenated blood.
- Aorta is the only artery that carries Deoxygenated blood.

Double circulation in man-

The circulation in human is known as double circulation because the blood passes through the heart twice in one complete cycle of the circulation.



Pulmonary and systemic circulation

Platelets-

Plug the leaks of arteries and veins by clotting the blood.

Lymph-

Extracellular fluid similar to plasma but colourless with lesser protein.

Function of lymph-

- Transportation of digested & absorbed fats from the small intestine.
- Drains excess fluid from the intercellular spacesback in the blood.

Heart in Higher animals-

TRANSPORTATION IN PLANTS

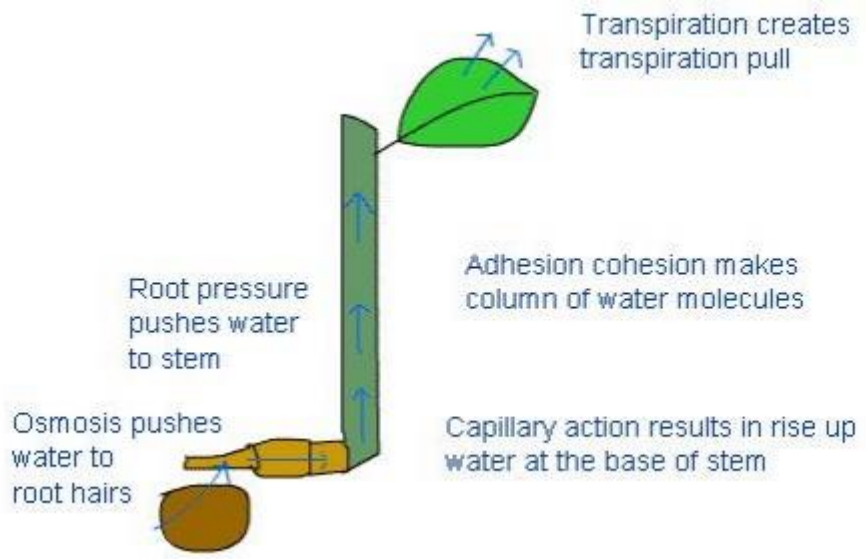
Plants have specialized vascular tissues for transportation of substances. There are two types of vascular tissues in plants, viz. xylem and phloem.

Xylem: Xylem is responsible for transportation of water and minerals. It is composed of trachieds, xylem vessels, xylem parenchyma and xylem fibre. Trachieds and xylem vessels are the conducting elements. The xylem makes a continuous tube in plants which runs from roots to stem and right up to the veins of leaves.

Phloem: Phloem is responsible for transportation of food. Phloem is composed of sieve tubes, companion cells, phloem parenchyma and bast fibres. Sieve tubes are the conducting elements in phloem.

Ascent of Sap

The upward movement of water and minerals from roots to different plant parts is called ascent of sap. Many factors are at play in ascent of sap and it takes place in many steps. They are explained as follows:



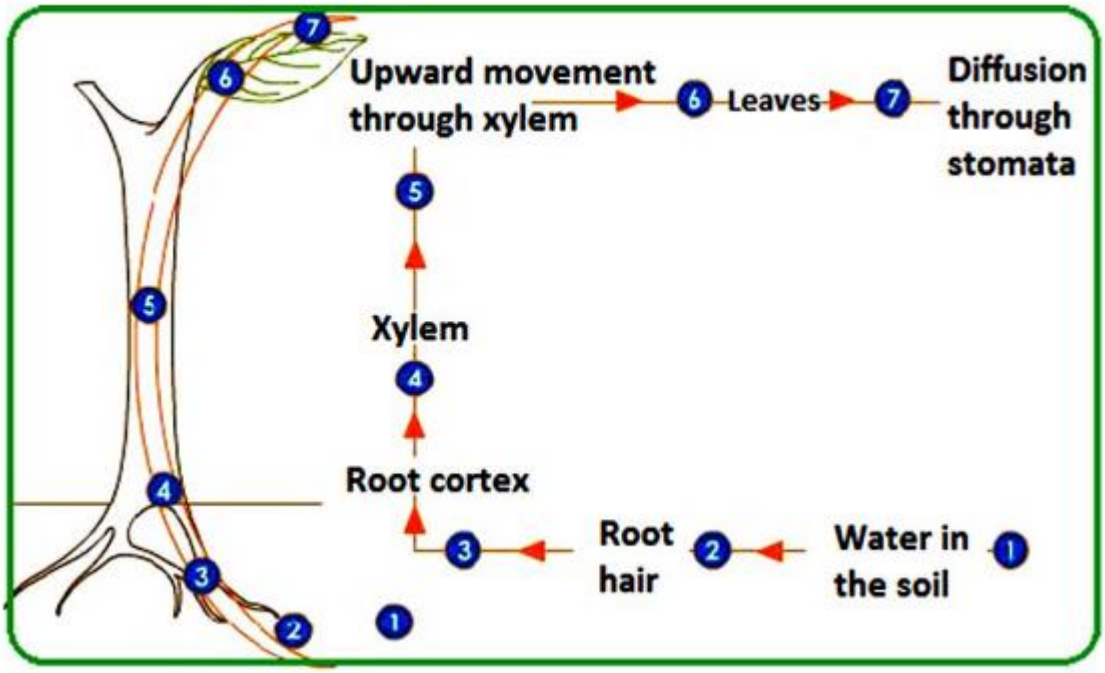
Root Pressure: The walls of cells of root hairs are very thin. Water; from soil; enters the root hairs because of osmosis. Root pressure is responsible for movement of water up to the base of the stem.

Capillary Action: A very fine tube is called capillary. Water; or any liquid; rises in the capillary because of physical forces and this phenomenon is called capillary action. Water; in stem; rises up to some height because of capillary action.

Adhesion-cohesion of Water Molecules: Water molecules make a continuous column in the xylem because of forces of adhesion and cohesion among the molecules.

Transpiration Pull: Loss of water vapour through stomata and lenticels; in plants; is called transpiration. Transpiration through stomata creates vacuum which creates a suction; called transpiration pull. The transpiration pull sucks the water column from the xylem tubes and thus water is able to rise to great heights in even the tallest plants.

Transport of Food: Transport of food in plants happens because of utilization of energy. Thus, unlike the transport through xylem; it is a form of active transport. Moreover, the flow of substances through phloem takes place in both directions, i.e. it is a two-way traffic in phloem.



Excretion-

The biological process of removal of harmful metabolic wastes in living organisms.

Excretion in human beings-

Organs of excretory system-

(i) Kidneys (iii) Urinary bladder

(ii) Ureters (iv) Urethra

Kidneys-

- Two in number
- Bean shaped
- Present in abdomen on either side of the backbone
- Basic unit is nephron.

Parts of kidney

a.Glomerulus-It is a group of capillaries (cluster) present in Bowman's capsule to receive blood from renal artery and filters it.

b. Bowman's capsule-It is a Cup shaped structure, which contains glomerulus.

c.Convoluted tubule-It is long and reabsorbs vital nutrients like glucose, amino acids, salts, urea and water.

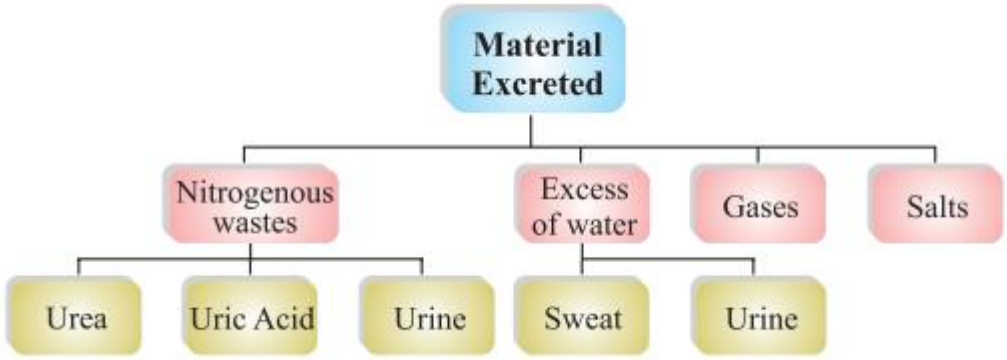
Vital functions of kidneys-

(a) Filtration & removal of Nitrogenous wastes
(b) Reabsorption of vital nutrients

Ureters-Transport the urine formed in the kidneys to the urinary bladder.

Urinary bladder- Muscular bag like structure to store urine.

Urethra-It helps in removal of urine when the Urinary bladder is full.



Formation of Urine

- Each kidney contains many filtration units called as nephrons.
- 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.

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

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

- 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.

- <u>The amount of water reabsorbed depends upon :</u>
    - How much excess of water is there in the body and,
    - How much nitrogenous wastes need to be excreted out.

- So the fluid now flowing in the tubular part is urine which gets collected in collecting ducts of nephrons.
- These collecting ducts together leave the kidney at a common point by forming the ureter.
- Each ureter drains the urine in the urinary bladder where it is stored until the pressure of expanded bladder leads to an urge to pass it out through urethra.
- This bladder is a muscular structure which is under nervous control.

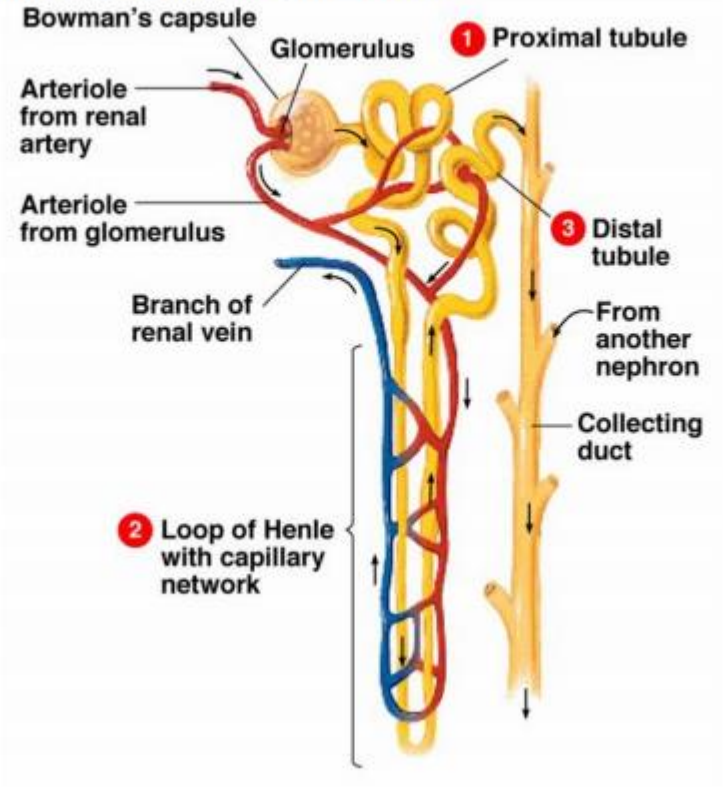
- 180 litres of filtrate is formed daily but only 2 litres is excreted out as urine so the rest is reabsorbed in the body.

<u>Functions of Nephron</u>

- Excretion of nitrogenous wastes.
- To maintain the water and ionic balance (osmic regulation).

Q- Explain structure and functioning of nephrons.

Answer : Nephrons are the basic filtering units of kidneys. Each kidney possesses large number of nephrons, approximately 1-1.5 million. The main components of the nephron are glomerulus, Bowman's capsule, and a long renal tubule.



Functioning of a nephron:

The blood enters the kidney through the renal artery, which branches into many capillaries associated with glomerulus.

The water and solute are transferred to the nephron at Bowman's capsule.

In the proximal tubule, some substances such as amino acids, glucose, and salts are selectively reabsorbed and unwanted molecules are added in the urine.

The filtrate then moves down into the loop of Henle, where more water is absorbed.

From here, the filtrate moves upwards into the distal tubule and finally to the collecting duct. Collecting duct collects urine from many nephrons.

The urine formed in each kidney enters a long tube called ureter. From ureter, it gets transported to the urinary bladder and then into the urethra.

Excretion in plants-

Gaseous wastes-

CO_2 in respiration & O_2 in photosynthesis are removed by the process of diffusion.
Excess water- is removed by transpiration.

Other wastes-

(i) Stored in cellular vacuoles or in leaves, which fall off or as gums, resins, etc. in old xylem.
(ii) Excreted in soil.

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