



Life Process

By-

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1. Life Process

The process involved in the basic necessary activities and functions for the survival or maintenance of a living body are called life process.

1.1 Nutrition

The living organisms derive this energy from the food they eat. So the process of taking in food and obtaining energy from it for growth, repair and metabolism is called nutrition.

Or

Nutrition is the process of taking up nutrients (food) and then utilising them to fulfil the requirements of the body.

1.1.2 Types of Nutrition

1. Autotrophic Nutrition

2. Heterotrophic nutrition

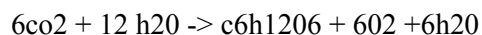
1. Autotrophic Nutrition - the mode of nutrition in which an organism prepare its own food from simple raw materials is called autotrophic nutritions.

Example- all green plants and blue green algae.

Photosynthesis

The process by green plants make their own food using carbon dioxide and water in the presence of sunlight and chlorophyll is called photosynthesis.

The process of photosynthesis can shown as



2. Heterotrophic Nutrition

The mode of nutrition in which an organism obtains readymade organic food from external sources plants, animals or their products is called heterotrophic nutrition.

Example - all animals, fungi and many protist.

The heterotrophic nutrition involves five major steps as described below-

1. Ingestion - the act of swallowing or injecting food materials so that it enters the body of an organism is called ingestion.

2. Digestion - The process by which organic nutrients broken down into simple substances with the help of enzyme is called digestion.
3. Absorption - The process of conversion of digestion food into substances that can be observed and assimilated by the organism is called absorption.
4. Assimilation - The process in which of component of food taken to each and every cell of the body after the food has digested and observed is called assimilation.
5. Egestion - The process in which undigested food is thrown out of the body of the organism is called egestion.

1.2 Nutrition In Amoeba

Food of amoeba consists of bacteria, small protozoa, diatoms, algal and Pieces of animal and plant materials, it has no fixed mouth for the ingestion of food. It ingests food by forming temporary finger like extensions called pseudopodia.

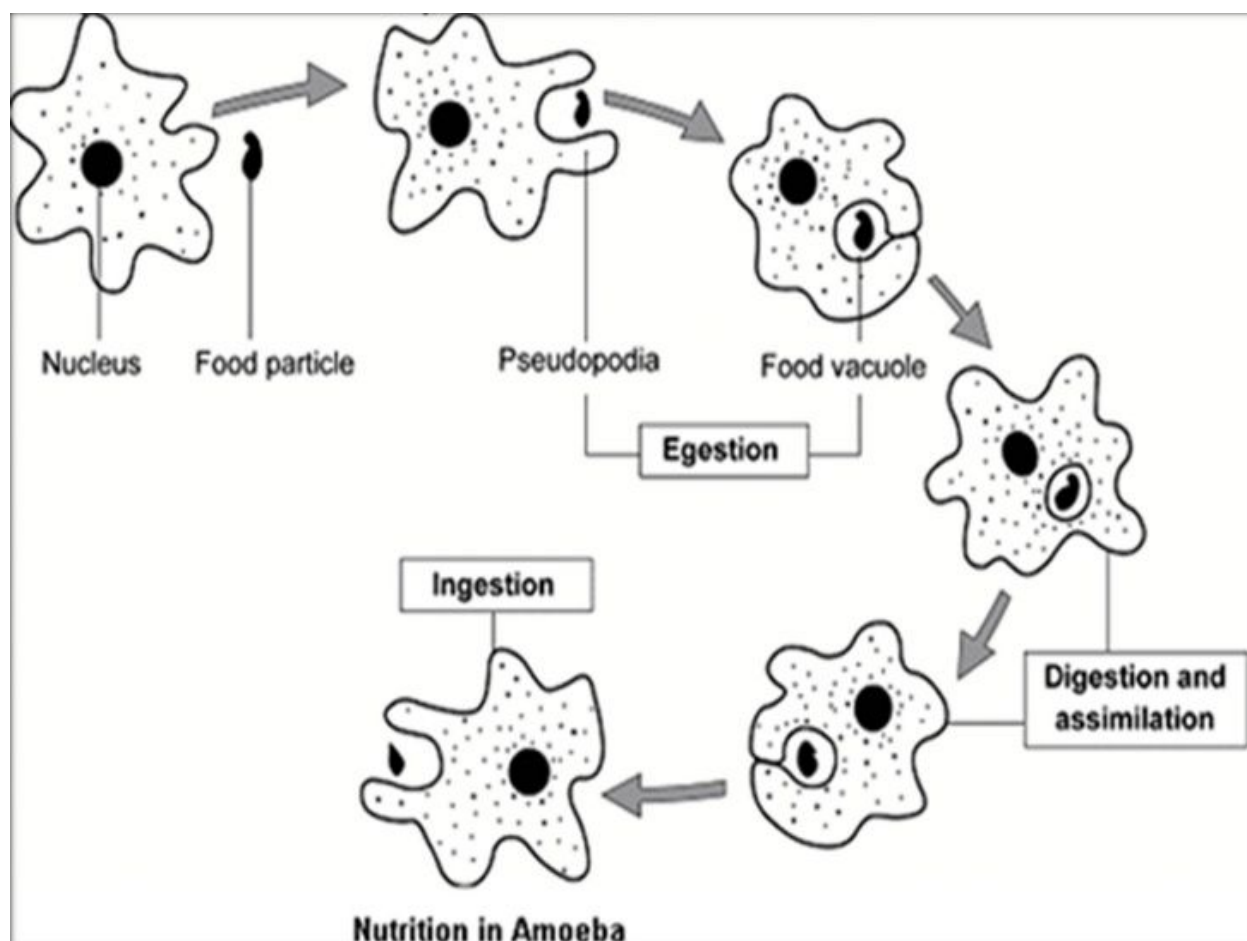


Fig.1.1 Nutrition in Amoeba

Paramecium also unicellular organism has a definite shape and food taken in at a specific spot called oral groove.

1.2 Nutrition In Human being

Humans are omnivorous organism they have a well developed digestive system like other multicellular animals.

Mouth - The mouth is bounded externally by lips and cheek internally by teeth and jaw. It opens into a cavity called buccal cavity.

1.2.1 Buccal Cavity or Oval Cavity-

It is a large space covered by the structure known as palate.

- A. **Teeth** are the hardest structure, partially embedded in the bony sockets of jaw.

There are four types of teeth

1. Incisors 2. Canines 3. Premolars 4. Molars

Dental formula for milk teeth : $\frac{2(i),1(c),2(pm),0(m)}{2(i),1(c),2(pm),0(m)} = 20$

Dental formula for permanent teeth: $\frac{2(i),1(c),2(pm),3(m)}{2(i),1(c),2(pm),3(m)} = 32$

- B. **Salivary glands**: The lining of the alimentary canal is soft, so the food needs to be moistened to make its passage smooth.

1. **Parotid glands** are located just in front of and beneath each ear.
2. **Submandibular glands** are situated close to the inner side of lower jaw on each side.
3. **Sublingual glands** are located below the tongue.

Starch (Polysaccharide) → Maltose (Disaccharide)

Pharynx

The pharynx is a common passage for food and air at the back of throat. The masticated food (or food that has been chewed) from the mouth passes into the oesophagus through pharynx. If accidentally a small particle of food enters the windpipe, coughing occurs and the particle is thrown out.

Oesophagus

The oesophagus or food pipe is a muscular tube that carries food from mouth to the stomach. The lining of the food pipe has muscles that contract rhythmically in order to push the soft and moist food toward the stomach. These special rhythmic waves of contractions are called **peristaltic movements or peristalsis**.

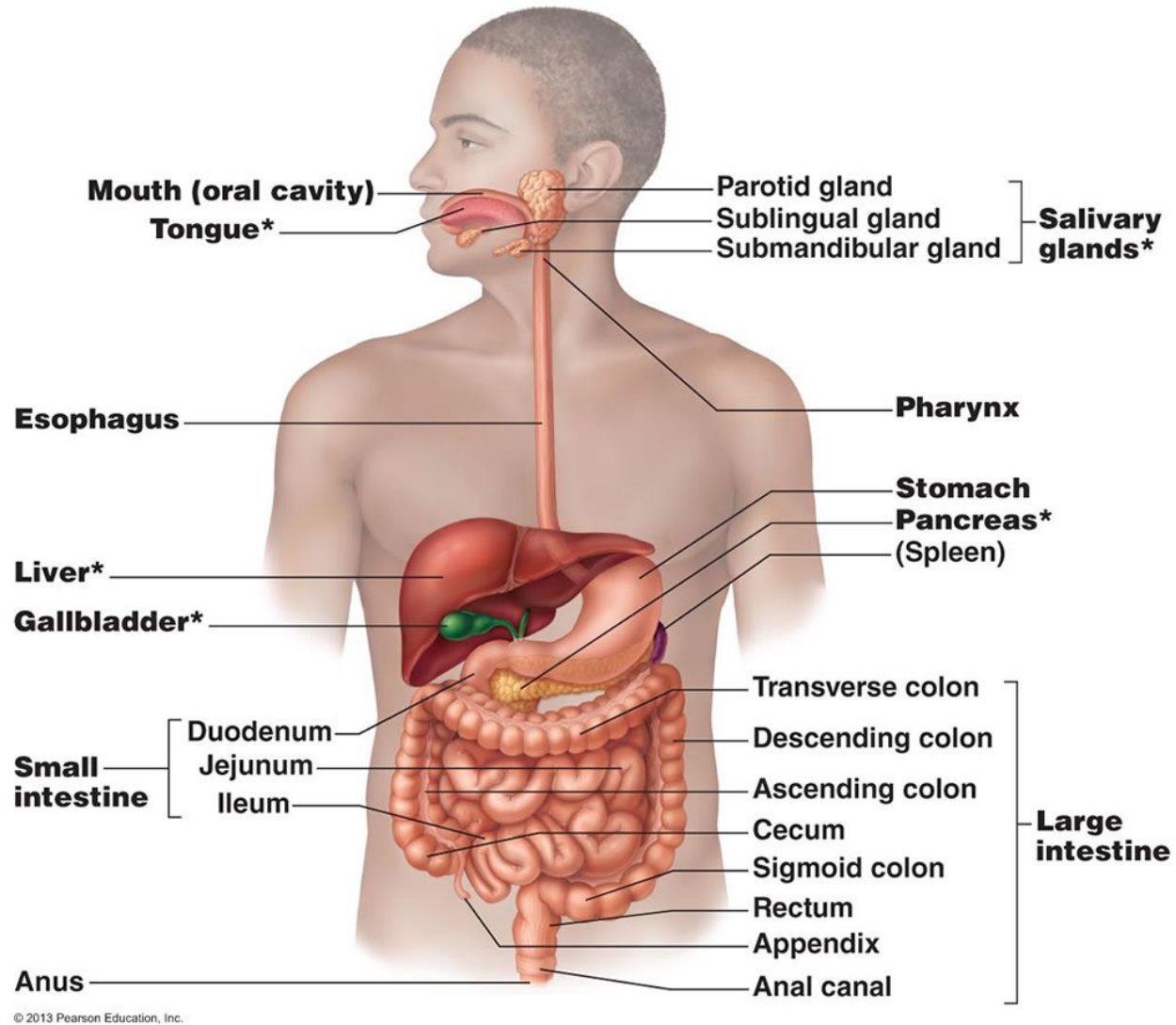


Fig 1.2 Human alimentary canal

Stomach

It is a large, j-shaped muscular bag like structure located below the diaphragm. Food is passed from oesophagus into the stomach. It expands when food enters into it. It has three main regions - cardia, fundus and pylorus regions.

The gastric glands secrete gastric juice. Gastric juice is a colourless and highly acidic liquid that contains hydrochloric acid, protein digesting enzymes called pepsin and rennin, gastric lipase and mucus.

Pepsinogen (inactive) → pepsin (active)

Proteins → proteoses + peptones

Small Intestine

From the stomach, the semi-digested food enters into the small intestine. The small intestine is the longest part (about 6 m in length and 2.5 cm wide in humans) of the alimentary canal which is fitted into a compact space due to extensive coiling.

Small intestine is divisible into three parts-

1. Duodenum is the shortest and c- shaped part of the small intestine. The bile duct from liver and the pancreatic duct from the pancreas pour their secretions into the duodenum.
2. Jejunum is about 2 m long. No chemical digestion takes place in this part.
3. Ileum is about 3.5m long and remains in twisted form. The digestion process completes in ileum.

Fat -> Emulsified fat

Acidic chyme -> alkaline chyme

Absorption of food

The process of conversion of digested food into substances that can be absorbed and assimilated by an organism is called absorption. The digested food is absorbed by the walls of the intestine. The inner lining of the small intestine has numerous finger-like projections called villi. The villi increase the surface area for absorption. The digested food remains in the small intestine for nearly four hours.

Assimilation of food

The process in which the components of food are taken to each and every cell of the body after the food has been digested and absorbed is called assimilation. The properly ingested, digested and absorbed food is used for obtaining energy, growth and repair of the body.

Large Intestine

It has three parts. 1. Caecum 2. Colon 3. Rectum

1. Caecum is a small pouch at the junction of the small and large intestine. a narrow, worm-shaped tube is called vermiform appendix projects from the caecum.
2. Colon is a continuous part of the caecum and is situated in the right side of the abdominal cavity. In colon, absorption of water and formation of faeces takes places.

3. Rectum is the last part of the large intestine. It is about 15 cm long. It opens outside through anus. The rest of the undigested food is removed from the body through anus.

Respiration

Respiration is a biochemical process in which the breakdown of organic compounds takes place in a stepwise oxidation process with the subsequence of energy inside a living cell.



ATP- the energy currency of cell

Adenosine triphosphate or ATP is a triphosphate of the nucleotide adenosine. It stores energy in the bonds between three phosphate groups. It is just like a battery which can be used to obtain mechanical energy, light energy, electrical energy and so on. One molecule of glucose produces energy worth 38 molecules of ATP.

Process of Respiration

1. Breathing: It is a physical process in which the atmospheric air is taken in and forced out of lungs. In breathing, oxygen is inhaled from outside and carbon dioxide is released.
2. Gaseous transport to tissues: the oxygen inhaled by breathing is absorbed by the blood in the lungs. The red blood cells carry oxyhaemoglobin to all the tissues or cells of the body by means of arteries.
3. Tissue Respiration : The arteries terminate into capillaries which deliver the oxygen to the body cells. In the cells, oxygen diffuses through the thin walls of capillaries.
4. Cellular respiration: it involves release of energy by oxidation of food in the cells and conversion of the energy released into usable forms such as ATP.

Difference between Photosynthesis and Respiration

Photosynthesis	respiration
1. It occurs only in the presence of chlorophyll.	It occurs only in living cells.
2. The presence of light is necessary	It occurs all the time.
3. Carbon dioxide and water are used in the process.	Oxygen and glucose are used in the process.
4. Oxygen is released as an end product.	Carbon dioxide is released as an end product.

5. Light energy is converted into chemical energy and stored.	Chemical energy is converted into heat and partly usable energy.
6. Food is synthesised.	Food is broken down to release energy.
7. It is a constructive or anabolic process.	It is a destructive or catabolic process.

Difference between Aerobic and Anaerobic Respiration

Aerobic Respiration	Anaerobic Respiration
1. Aerobic respiration occurs in the presence of oxygen.	Anaerobic respiration occurs in the absence of oxygen.
2. It takes place in the cytoplasm and mitochondria.	The entire process takes place in the cytoplasm.
3. Complete oxidation of food takes place.	Incomplete oxidation of food takes place.
4. 38 ATP molecules are produced by oxidation of one mole of glucose.	2 ATP molecules are produced by oxidation of one mole of glucose.
5. End products formed are CO_2 and H_2O	End products formed are ethyl alcohol or lactic acid and CO_2 .

Respiration through Cell Membrane

Some unicellular organisms such as Amoeba, Paramecium and Euglena exchange respiratory gases by a simple process of diffusion through cell membrane or general body surface. Dissolved oxygen in water keeps on diffusing into the body of these aquatic animals through their cell membrane.

Respiration through Skin

In earthworm and leeches, exchange of gases takes place through skin. Their skin is always moist and is richly supplied with blood capillaries. Oxygen diffuses in and carbon dioxide diffuses out through the cells of the skin.

Respiration through Air Tubes

Respiration through air tubes or trachea is a characteristic feature of insects. This system of respiration is called tracheal system. Tracheal openings are called spiracles which are located on the sides of the body of insects.

Respiration through Gills

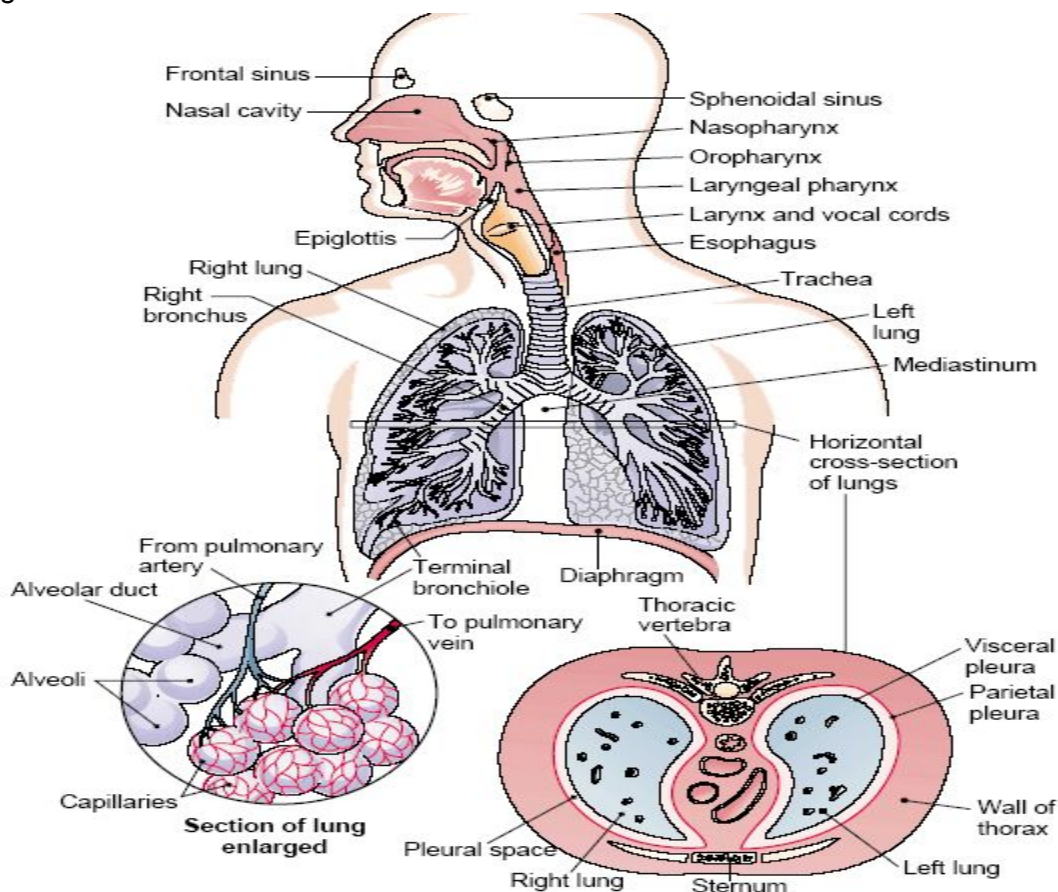
Gills are the respiratory organs in aquatic organisms like fishes, prawns and mussels.

Respiration in Humans

In humans, respiration occurs through lungs and is called pulmonary respiration. The oxygen rich air that we inhale breaks down the food to release energy. The entire process in which energy is released on our body by the oxidation of food is called respiration. The by-products of respiration are carbon dioxide and water.

Respiratory system

The human respiratory tract consists of a series of passages for inhalation and exhalation of air. These include nostrils, nasal cavity, pharynx, larynx, trachea, bronchi, bronchioles, alveoli and lungs.



Nostrils and Nasal Cavity

Nose begins from external nostrils which lead into the nasal cavity or nasal passage. Through the nostrils, the air is drawn into the nasal cavity.

Pharynx

Air moves from nasal cavity into the pharynx which is a common passage to both digestive and respiratory tracts. The mucous lining present in the pharynx filters the air from any contaminant or dust particles. When we swallow food, a cartilaginous flap called epiglottis covers the glottis or tracheal opening to prevent food and water from entering the trachea or windpipe.

Larynx

Larynx or voice box is a cartilaginous box like structure located at the start of windpipe. The larynx contains two ligamentous folds called vocal cords.

Trachea

Trachea or windpipe emerges from the inferior end of the larynx and runs down the neck. It is about 11 cm in length and about 2.5 cm in diameter.

Bronchi and Bronchioles

Bronchi are the main passageway that conducts air into the lungs. The trachea is divided into two main bronchi, i.e., left and right bronchi, which enter into the left and right lung, respectively. A bronchus divides many times into bronchioles. Bronchioles are the smallest tubes, i.e., about 0.5 mm in diameter. By repeated branching, the bronchioles ultimately end in a cluster of tiny, balloon like structures called alveoli or air sacs.

Lungs

Lungs are the pair of highly elastic, hollow, spongy, bag-like structures which lie in the thoracic cavity. These are cone shaped, tapering at the top and broad at the bottom. The broader lower surface of the lungs rests on the sheet of a muscle called diaphragm, which forms the floor of the thoracic cavity. The right lungs is divided into three lobes, whereas the left lung has two lobes. A membrane called pleura membrane or pleura surrounds each lung. The pleural membrane is made up of two layers the inner pleura and outer pleura. A small amount of fluid is present between the two layers or pleural cavity that allows smooth and frictionless movement of the lungs.

Mechanism of Breathing

Breathing is a simple mechanical process and the first step in respiration. The air is passed in and out of the lungs by alternate expansion and contraction of the thoracic cavity.

1. Inhalation or inspiration
2. Exhalation or expiration

Inhalation

The process of breathing in air is called inhalation or inspiration. It occurs mainly due to contraction of diaphragm and intercostal muscles.

Exhalation

The process of breathing out air is called exhalation or expiration. It occurs by the relaxation of intercostal muscles and diaphragm.

Control of breathing rate

Breathing rate in normal human beings is about 15 to 18 times per minute. In case of doing some physical work, it increases up to 20-25 times per minute because of more requirement of oxygen by the body. Our breathing rate is controlled by the respiratory center in the medulla oblongata of the brain.

Transportation

A life process in which substances are carried from one part of the body to another where they are required is called transportation.

Transportation in Humans

In humans, cells/tissues require a regular supply of nutrients, oxygen and other substances for proper functioning of the body and disposing of waste materials. For this, humans have a specialised circulatory system.

The circulatory system has three main parts.

1. Circulatory medium - Blood and lymph
2. Blood vessels - Arteries, veins and capillaries
3. A pumping organ - Heart

Blood

A red coloured mobile fluid connective tissue that flows within the blood vessels is known as blood. An average human adult has about 5.5 litres of blood in his body.

1. Plasma: It is a straw colored, aqueous, slightly alkaline fluid part of blood.
2. Blood corpuscles: in humans, three types of blood corpuscles are found suspended in the plasma. These are red blood corpuscles, white blood corpuscles and platelets.

Red blood corpuscles: the red blood corpuscles are biconcave, non-nucleated and disc-like structures. They contain a red coloured iron pigment called haemoglobin. Haemoglobin is a respiratory pigment which is formed of an iron containing part known as haem and a protein part called globin.

RBCs are produced in the bone marrow of bones. The process by which red blood cells are formed is called erythropoiesis.

White blood corpuscles: the white blood corpuscles are colourless, nucleated, rounded to irregular shaped cells and their size ranges from 8-20 microns. They lack haemoglobin. The process by which WBCs are formed is called leukopoiesis.

The main types of white blood corpuscles are granulocytes and agranulocytes.

1. Granulocytes: They are spherical in shape, have a lobed nucleus and a cytoplasm contains granules. The three main types of granulocytes are neutrophils, basophils, and eosinophils.
2. Agranulocytes: Their nucleus is typically spherical or kidney-shaped. Their cytoplasm lacks granules. The two types of agranulocytes are lymphocytes and monocytes.

Platelets : The blood platelets or thrombocytes are small in size about 2-4 μm . They are fragments of cells of various shapes formed in bone marrow.

Function of blood : the blood performs several functions in the body.

1. Digested food substances are absorbed at the site of absorption by blood and transported to the different organs of the body.
2. Oxygen is transported by blood from the lungs to the tissues and carbon dioxide from tissues to the respiratory surface.

Blood Vessels

1. Arteries : The blood vessels that carry blood from the heart to various parts of the body are called arteries.
2. Veins : The blood vessels that collect blood from various parts of the body and bring it back to the heart are called veins.

Difference between Arteries and Veins

Arteries	Veins
----------	-------

1. Arteries carry blood away from the heart.	2. It carry blood towards the heart.
2. These carry oxygenated blood	These carry deoxygenated blood
3. Arterial walls are thick	Walls of veins are thin
4. These are highly elastic in nature.	These are less elastic when empty.
5. These do not collapse when empty.	These collapse easily when empty.
6. These do not have any valves	These have a series of valves that prevent backflow of blood.

External Structure

The heart is a hollow muscular organ which is about the size of our fist. It measures about 12 cm in length and 9 cm in breadth. It is shaped somewhat like a cone and weighs about 300g in an adult. The heart is located centrally between the lungs with nearly $\frac{2}{3}$ rd of its mass towards the left of the midline.

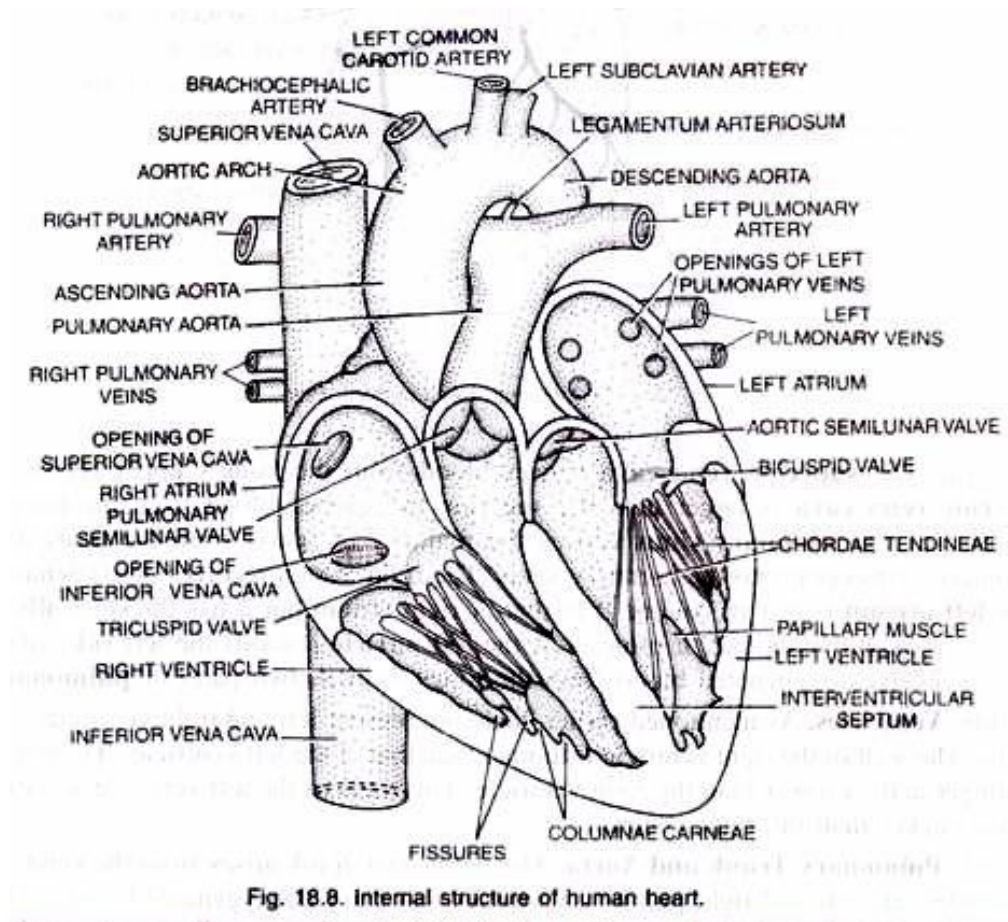
The human heart is four chambered, i.e., it has upper two small sized auricles or atriums and the lower two large sized ventricles.

An outer double membrane that encloses the heart is known as pericardium. It protects the heart from any mechanical injury. The space between the two pericardial membranes is called pericardial space. This space is filled with pericardial fluid. The pericardial fluid keeps the heart moist and reduces friction between the wall of heart and the surrounding tissues.

Internal Structure

The internal structure of the heart consists of two auricles, two ventricles, blood vessels and various valves.

1. Auricles : the auricles or atriums are upper two chambers.
2. Ventricles: these are two lower, thick-walled chambers and are separated from each other by an interventricular septum.
3. Blood vessels entering the heart: the right auricle receives two large vessels - anterior vena cava and posterior vena cava.
4. Blood vessels leaving the heart: from the right ventricle, a large pulmonary artery arises and takes venous blood to the lungs for oxygenation.
5. Valves in the heart
 - A. Bicuspid valve or mitral valve or left auriculoventricular valve
 - B. Tricuspid valve or right auriculoventricular valve



HeartBeat

The rhythmic contraction and relaxation of the heart that occurs at an average rate of 72 times per minute is called heartbeat.

Heart Sounds

When a heart beats, two sounds can be heard- 'lubb' and 'dup'. The closing of valves present in the outlet and inlet of ventricles cause these sounds. These can be heard by doctors using stethoscope that magnifies sounds and conducts them to the ear.

Blood Pressure

The pressure exerted by blood against the walls of the arteries due to pumping of heart is called blood pressure.

Difference between Blood and Lymph

Blood	Lymph
Blood is a red colour fluid which passes through blood vessels	Lymph is a colourless or pale yellow fluid which passes through lymphatic vessels.
It consists of plasma, RBCs, WBCs, platelets and some proteins.	It consists of plasma, WBCs and some proteins.
The flow of blood is bidirectional.	The flow of lymph is unidirectional.
The blood flows fast.	The lymph flows slowly.
It transports different materials in the body.	It acts as a middle man between blood and tissue.

Excretion

The biological process of removal of harmful toxic substances or metabolic waste products from the body is called excretion.

Excretion in Unicellular Organisms

The unicellular organisms like Amoeba and paramecium lack special excretory organs for the removal of metabolic waste products such as carbon dioxide and ammonia.

Excretion in Multicellular Animals

The complex multicellular animals perform excretion process through various excretory organs. In sponges, hydra and other cnidarians, no special excretory organs are present. Their body cells remain in water all the time.

Excretory Organs of some animal groups

Animals	Excretory organs
Platyhelminthes (flatworms)	Flame cells
Nematodes (roundworms)	Renette or giant cell
Annelids (earthworm)	Nephridia and moist skin

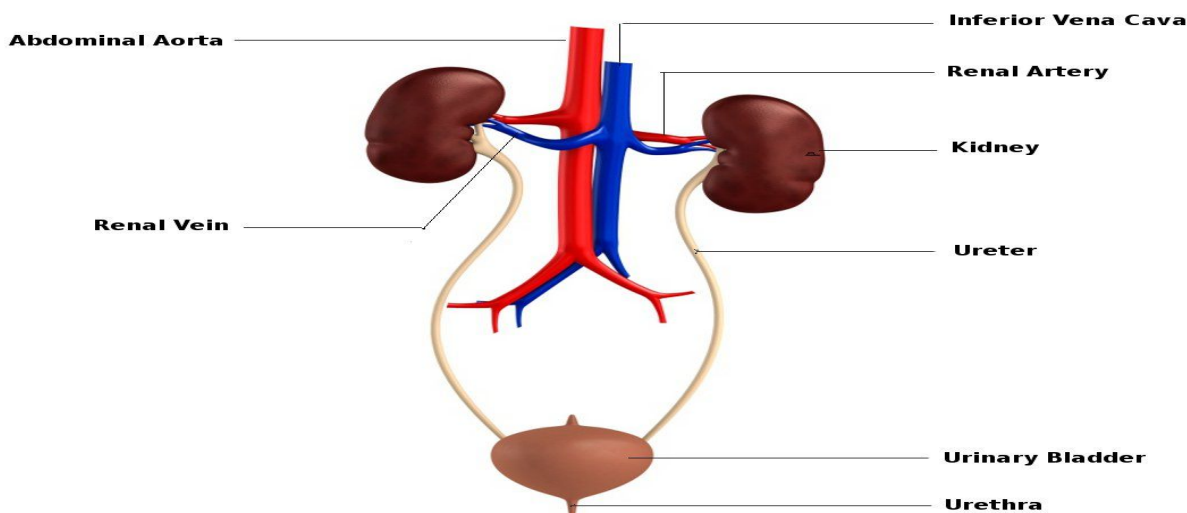
Arthropods (insects)	Malpighian tubules, green glands
Mollusca (snails)	Kidneys
Vertebrates (humans)	Kidneys

Excretion in Humans

In humans, the nitrogenous waste products, i.e., Urea, is excreted through a well established system called urinary system or excretory system. It consists of a pair of kidneys and ureters, a urinary bladder and urethra.

Kidneys

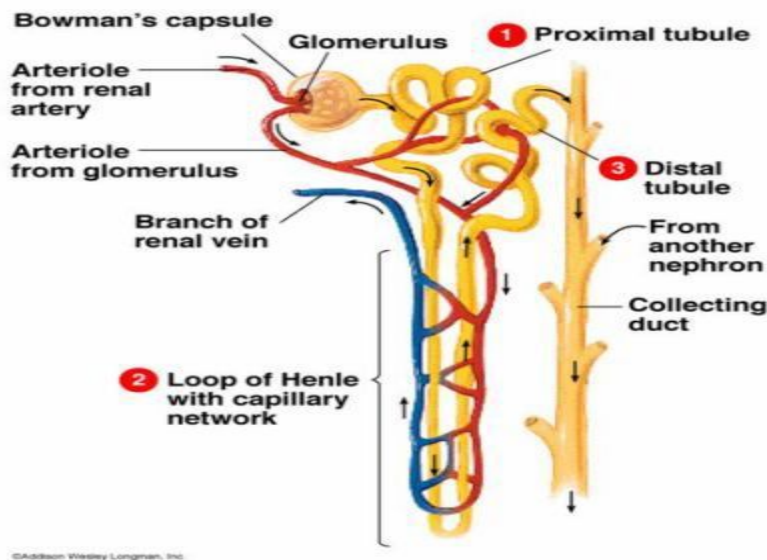
Kidneys are reddish brown, bean shaped paired organs and are about 10 cm long and 6cm wide. These lie along the posterior abdominal wall on either side of the backbone. They are protected by last two pairs of ribs. The right kidney is located at a slightly lower level than the left one as the right side of the abdominal cavity is occupied by the liver. In the median surface of each kidneys, a notch called hilum is present. Hilum acts as a route of entry and exit for the blood vessels, lymph vessels nerves and ureters of the kidney.



Structure of nephron:

The structural and functional unit of kidney is nephron. Each nephron is a tubular structure closed at one end and open at the other.

The Bowman's capsule and the glomerulus together are called Malpighian capsule or just renal capsule. Bowman's capsule is a thin walled cup shaped structure. It forms the dilated blind end of the nephron. Glomerulus is a dense knot of capillary network found within the Bowman's capsule.



Nephric Tubule

It is long, coiled tubule and can be divided into three major regions - the proximal convoluted tubule, the loop of Henle and the distal convoluted tubule. (DCT).

1. Proximal convoluted tubule is the first region nephric tubule. It is highly coiled and about 12-24 mm in length. It has several microvilli on its inner lining. It leads to the loop of Henle.
2. Loop of Henle is the mid part of the nephric tubule. It is a U shaped loop formed by a thin descending limb and a thick ascending limb. The descending limb is lined with flattened epithelial cells where's the ascending limb is lined with cuboidal epithelium.

Collecting Tubules

The collecting tubules are larger tubes which receive filtrate from distal convoluted structure and is present in the collecting tubules pass through the medulla and join with each other to form larger ducts of Bellini. The ducts of Bellini drain the urine collected from the nephrons into the pelvis which leads to ureters.

Functions of kidneys

The kidneys are vital organs that perform the following important functions in the body

1. Kidneys excrete nitrogenous wastes and other waste products from the body.
2. They play an important role in osmoregulation of the body.
3. They maintain the pH of the body fluids.

4. They maintain the normal mineral balance in the body.
5. They regulate the blood pressure by controlling fluids of the body.

Ureters

The ureters are two tubes about 30 cm long, one emerging from each kidney.

Urinary Bladder

It is a bag like structure in which urine is stored.

Urethra

Urethra is a tube like structure that arises from the urinary bladder. The opening of urinary bladder into urethra is guarded by sphincter muscles. Urine and sperms are transported through urethra to the outside.

Mechanism of Urine Formation

1. Glomerular filtration or Ultrafiltration: the walls of glomerular capillaries and Bowman's capsule are very thin and semipermeable. The blood from all these sources is filtrate consists of water, urea, salts, glucose and other plasma solutes. This process of filtration of blood in glomerulus under high pressure is called ultrafiltration.
2. Tubular reabsorption: The glomerular filtrate passes into the proximal convoluted tubule. Now the filtrate moves along the tubules and is called tubular fluid. Some substances in the tubular fluid like glucose, amino acids, salts and a major amount of water, are selectively reabsorbed as the tubular fluid flows along PCT but this reabsorption is only to the extent that the normal concentration of the blood is not disturbed. Due to this it is also called selective absorption.
3. Tubular secretion: this process is opposite to the tubular reabsorption. In tubular secretion, the additional waste like creatinine and drugs from the blood is secreted into the tubular fluid in the distal convoluted tubule or collecting duct. This process involves the activity of the cells of the tubular walls, hence the process is known as tubular secretion.

Summary of Urine Formation in different Components of Nephron

Part of Nephron	Activity
Glomerulus	Ultrafiltration occurs

Bowman's capsule	Receives glomerular filtrate.
Proximal convoluted tubule	Reabsorbs most of the water along with glucose and ions, like sodium and chloride.
Loop of henle	Some absorption of water and sodium ions takes place.
Distal convoluted tubule	Reabsorbs remaining chlorides and some water.

Haemodialysis

Artificial kidney is an apparatus used for removing accumulated nitrogenous waste products like urea from the blood of a patient through the technique of dialysis.

Some Important Question

1. Write any two function of stomata
2. List any two rules of HCL in the stomach?
3. What are ureters?
4. Explain the process breathing in humans.
5. What is osmoregulation? Why is it necessary in our body define double circulation.
6. Digestion in small intestine?
7. List any two vital functions of kidney
8. Draw a well labeled diagram of human heart?