Biological processes in human body 06

Many different biological processes take place in the human body. We will discuss about those processes and the systems specialized to perform them.

6.1 Digestion of food

Energy is required for different biological processes that take place in human body. Energy is obtained through food that we take into the body. These food contain nutrients such as carbohydrates, lipids and proteins. Carbohydrates, lipids and proteins are complex organic molecules that do not dissolve in water. These compounds cannot be absorbed into the human body. Threfore they should be broken down into small particles.

The process by which the complex organic compounds are converted into simple organic products to be absorbed into the human body is called digestion of food.

Food digestion takes place in two prosesses namely mechanical and chemical processes

During mechanical process the physical nature of the food is altered,

E.g. :- Breaking down of food into small pieces by teeth inside mouth.

During chemical process, the insoluble complex compounds are broken down into simple molecules by the action of enzymes.

E.g. :- Starch is converted into maltose by ptyalin (salivary amylase) enzyme inside mouth.

There are some nutrients, that can be used by the body without any digestion, such as mineral salts, some vitamins, glucose, fructose and galactose.

The organs involved in food digestion, are collectively called as digestive system.

Human digestive system

Human digestive system is a single tube, that runs from mouth to anus. According to the requirement, the structure has changed at different places, and the glands (salivary glands, pancreas, liver) that supply enzymes and other substances (bile) connect at different sites. The functions take place in the digestive system are f**ood digestion, absorption of digested end products** and **removal of undigested materials** from the body.

Let us see the structures that belong to the digestive tract.

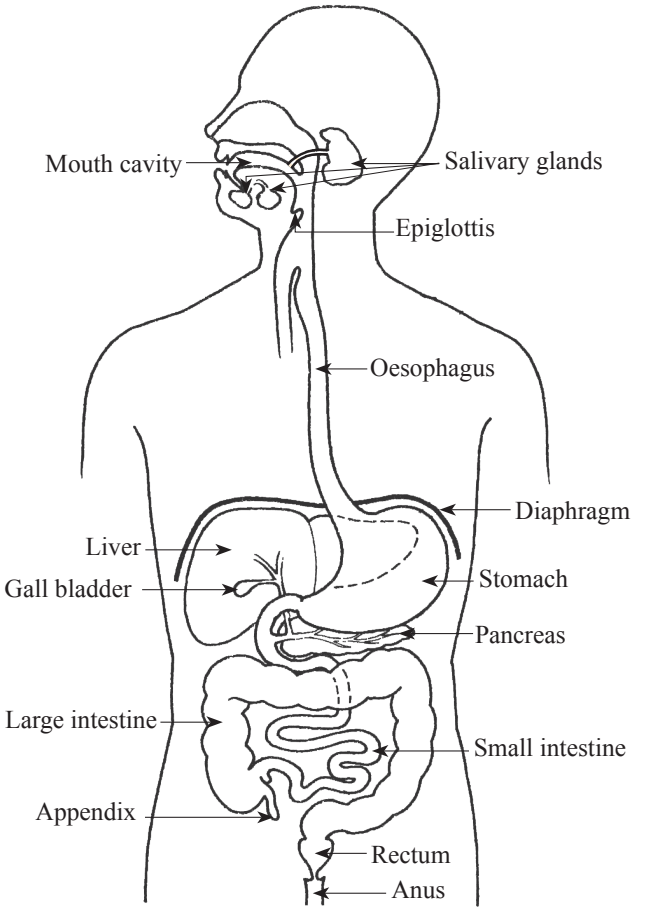
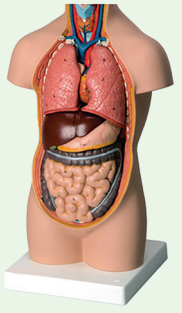


Figure. 6.1 - Human digestive system

Assignment - 6.1



- Identify the parts of the human digestive tract in the human torso
- Concerm about the nature, size and location of those parts

Figure. 6.2 - Human torso

Let us observe the changes that occur in food at first part of the digestive tract, the buccal cavity.

Digestion in the buccal cavity

Mouth opens the buccal cavity to the environment. It is surrounded by muscular lips at the bottom and top. The buccal cavity is made up of upper and lower jaws. Only the lower jaw can be moved. Teeth are present in both jaws. Buccal cavity is surrounded by cheeks. The tongue is attached to the floor of the buccal cavity. Three salivary glands are present and these secrete saliva and the tongue helps in identification of taste, mixing of food with saliva and swallowing.

A sweet taste is sensed when chewing rice or bread for sometime. Let's discuss why it is sweet?

The ptyalin enzyme (salivary amylase), acts on starch in digestion of food. Starch will be partially digested into maltose. Digestion of food is start in the mouth.

$$\text{Starch} \xrightarrow{\text{Ptyalin}} \text{Maltose}$$

When rice or bread is chewed for sometime starch is digested into maltose. As maltose is sweet, we sense the sweet taste.

Initially digested food is formed into a bolus and pushed to the posterior part of the buccal cavity. Next food is pushed into the pharynx.

Pharynx is a common area to both respiratory and digestive systems.

There is a movable organ called epiglottis found just above the opening of trachea. When bolus is swallowed the epiglottis moves down to close the opening of trachea. Then bolus enters into oesophagus without entering into trachea.

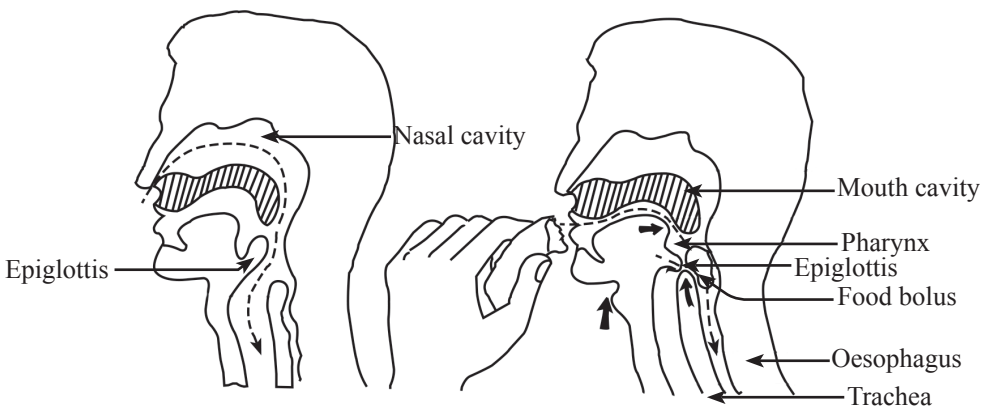


Figure. 6.3 - Trachea is closed with epiglottis when food enter into oesophagus

Epiglottis helps to prevent entering food into the trachea. When food enters to pharynx, respiratory track is blocked by epiglottis. This prolong blockcage of trachea may cause death. If the food is not removed instantly, the person may die due to blockage of respiratory tract.

Oesophagus is a constricted tube. How is food moved along a constricted tubule?

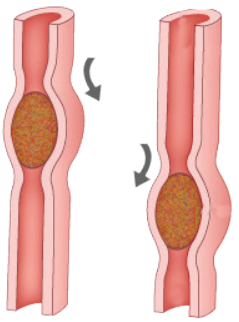


Figure. 6.4 -How the food pass through oesophagus

The bolus passes through the oesophagus by peristaltic movements. As oesophagus is a muscular structure, due to contractions and relaxations of it's wall the peristaltic movements appear as waves. These peristaltic movements provide the force to propel the bolus forward.

Then food is moved into stomach by peristaltic movements.

Digestion in the stomach

The stomach is a dilated sac like organ. Due to the peristaltic activity of muscles in the stomach wall the bolus is broken down and mixed well into a **chyme**. Several secretions ooze out into the stomach. It is collectively called the **gastric juice**.

The gastric juice contains mainly hydrochloric acid (HCl) and pepsin enyme. HCl activates pepsin and pepsin starts the protein digestion to produce polypeptides. Renin present in infants causes coagulation of milk.

Chyme containing partially digested proteins, digested and undigested carbohydrates, undigested lipids, water, minerals and vitamins are released into the proximal part of small intestine, duodenum part by part.

When the stomach is empty, it continues to contract. When the stomach is empty for a longer time period, the rate of contraction is also high. So it causes a pain. It gives a sense about hunger. Hunger is a signal that indicate the need of food.

Digestion in the small intestine

The chemical digestion of food mainly takes place in the small intestine. Pancreatic enzymes as well as intestinal enzymes involve in this digestion.

The small intestine is about 7 m in length. The proximal part of the small intestine is C shaped and known as duodenum.The duct of the pancreas and the gall bladder

opens into the duodenum via a single pore. Pancreatic juice is secreted into the duodenum through pancreatic duct. It contains three main enzymes. They are trypsin, amylase and lipase. The bile carried through the bile duct is added to it. Bile is produced in the liver and stored in the gall bladder.

Bile contains bile pigments, bile salts, bicarbonate ions and water.

Due to mixing of bile with food at duodenum, the lipids in food are broken down into small droplets by the process called emulsification. Due to this action, enzymes get a greater surface area to act on lipid food.

Intestinal juice secreted by the wall of the intestine contains, maltase, sucrase, lactase, peptidase and mucous. Mucous lubricates food and then helps to move along the digestive tract.

Let us summarize food digestion takes place in small intestine (See table 6.1)

Table 6.1 - Enzymes in food digestion in small intestine

Organ	Enzyme	Substrate/food	End products
Pancreas (Pancreatic juice)	trypsin	Protein	Polypeptides
	amylase	Starch	Maltose
	lypase	Lipids	Fatty acids and glycerol
Small intestine (Intestinal juice)	Maltase	Moltose	Glucose
	Sucrase	Sucrose	Glucose and Fructose
	Lactase	Lactose	Glucose and galactose
	Peptidase	Polypeptides	Amino acids

These are the end products of digetion

Carbohydrates ⟶ Monosaccharides (Glucose / Fructose / Galactose)

Protein ⟶ Amino acids

Lipids ⟶ Fatty acids + Glycerol

Proteins in wall of stomach and intestine is protected by the protein digestive enzymes as there is a layer of mucous on the wall.

What happens to the end products of food digestion?

The absorption of digested end products into body takes place mainly in the small intestine. The small intestine is adapted to increase its efficiency of absorption in different ways.

- Being a long tube
- Presence of circular folds in the inner wall
- Presence of finger like projections called villi in the circular folds
- Presence of microvilli in the epithelial cells of villi
- Thin epithelial lining on villi
- Villi are highly vascularised

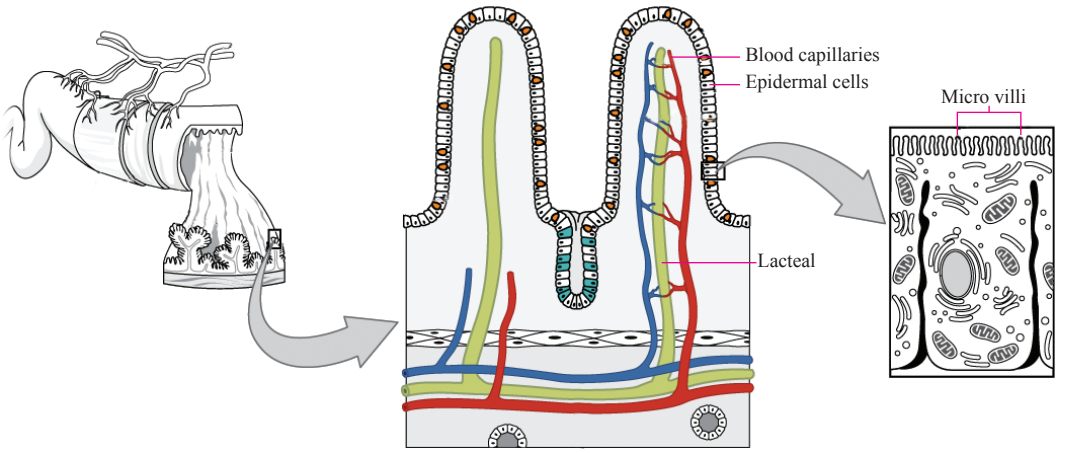


Figure. 6.5 - Structure of villi in small intestine

The digestive end products given below are absorbed into the blood capillaries of villi.

- Amino acids
- Vitamins
- Mineral salts
- Monosaccharides (Glucose/ Galactose/ Fructose)

Fatty acids and glycerol formed by digestion of lipids are absorbed into lacteals. Finally they enter into blood circulatory system when there is high amount of glucose in blood, they are converted into glycogen and stored in liver. In the same way when the concentration of glucose is dicreased, glycogen breaks down to form glucose and is added to blood. The unabsorbed materials are sent to the large intestine.

Processes in the large intestine

Length of the large intestine is about 1.5 m. It starts with caecum and ends up at anus. The dialated part of the large intestine is the rectum. The opening of it, is the anus. The materials entering into the large intestine contain a very small amount of nutrients. Mainly it contains undigested cellulose and water. A small blind ended tubular structure starts at the end of the caecum. It is known as the appendix. It is very small in humans and it may be infected and become swollen. This disease is known as appendicitis.

The main function is to absorb water from received matter by ileum. Thereby making it into semi solid.

When large intestine fills with faecal matter it passes out from the rectum.

The diseases and disorders associated with digestive system

The chance of getting infections to the digestive tract is high as materials are entered into it from outside frequently. Therefore digestive tract catches many diseases and disorders.

Engage in the following assigment to get knowledge about the diseases and disorders associated with digestive system.

Assignment - 6.2

Prepare a booklet about the diseases and disorders associated with digestive tract and how to prevent them. Discuss with doctors and refer news papers, magazines for information.

Gastritis

Inflammation of inner lining of mucosa is known as gastritis. It is a common disease among people. Generally known as acidity. The symptoms are, regurgitation of acid to mouth, burning feeling and pain in stomach. When the condition becomes worse, ulcers appear in stomach or duodenal wall. Bleeding can take place.
The reasons for this disorder are as follows,

- Skipping of meals
- Consumption of acidic and spicy food
- Excessive smoking and alcohol consumption
- Mental stress

By following healthy food diets and good habits one can avoid the above disease.

Constipation

Difficulty in defaecation due to hardening of faecal matter is known as constipation. Faeces remain in the large intestine for a longer time period and absorption of water takes place excessively, Thereby this condition may occur.

Reasons for constipation are as follows,

- Consumption of food with low dietary fibres
- Not taking required volume of water
- Postponing of defaecation

By avoiding above bad habits one can avoid this disease. Some medicine may cause constipation. Due to forceful defaecation, the anal canal may damage and bleeding can occur.

Typhoid

Typoid is caused by a bacterium. The pathogen is transmitted through food. The bacterium can enter into the body through mouth while swimming and bathing in contaminated water. Pain in arms and legs, headache and fever are main symptoms. It is a disease which gradually becomes worse. Constipation can occur at initial stages. Tongue is covered by a plaque. After sometime stomachache and diarrhoea can occur. Ulcers can form in the small intestine and cause bleeding. Therefore blood is released with faecal matter. Due to ulcers, the wall can be damaged. Disease can be identified by a blood test or stool test.

Diarrhoea

Diarrhoea occurs when the intestines are infected with a virus, bacteria or a parasite. This disease is transmitted by the faeces of an infected person. The main symptom is release of faecal matter in liquid state. Absorption of water in the large intestine will not occur properly. Dehydration may occur due to loss of fluid. due to the difeare spready contaminated food or water.

The above two diseases can be avoided by taking preventive measures given below

- Consumption of boiled water
- Removing fly breeding places and cover is food to prevent entering of flies to food
- Avoid consumption of food which are sold in open places
- Use of water seal latrines
- Wash hands well with soap after using the toilet
- Get a vaccine for typhoid.

If dehydration becomes worse due to diarrhoea, it may be fatal. So it is better to consume more water and consult a doctor.

6.2 Process of respiration

Respiration is a biological process. Inhaling and exhaling can be observed in some animals.

Respiration in a human is a complex process and it occurs in three stages.

1. Gas exchange between external environment and lungs
2. Gas exchange in alveoli
3. Cellular respiration

Intake of oxygen into lungs and removal of gaseouse waste in cells occurs in ventilation.

Engage in the following activity to demonstrate external gas exchange

Activity - 6.1

Demonstration of gas exchange using a model

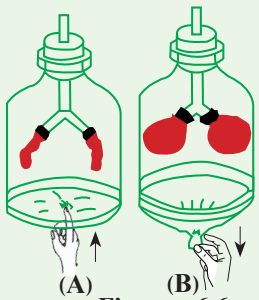


Figure - 6.6

Materials required :- Small bell jar, gas tube, a cork bore, two rubber balloons, balloon membrane or polythene sheath, several rubber bands

Method :- Set the apparatus as shown in the diagram. Push and release the balloon membrane and observe the condition of balloons

According to the above activity when rubber membrane is pulled down the volume inside the bell jar increases. Then external gas enters and balloons get inflated. When rubber sheath is released, gas inside balloons go out as the volume of bell jar decreases. Likewise gas exchange between external environment and lungs occurs due to changes of volume of lungs.

The system involved in entering O_2 into lungs and release of gaseous waste products produced during biological processes is the respiratory system.

The diagram given below shows the human respiratory system.

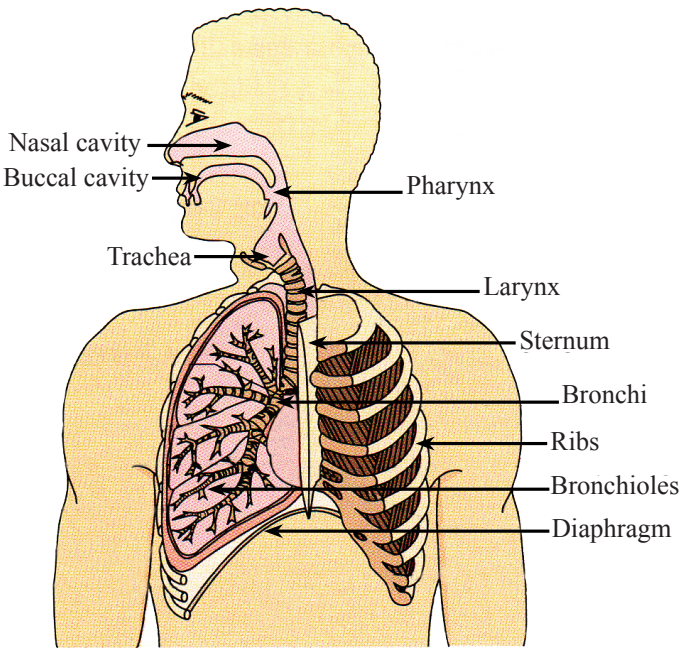


Figure 6.7 - Human respiratory system

Nasal cavity, pharynx, trachea, larynx, bronchi, bronchioles and alveoli are the main parts of respiratory system.

Internal surface of nasal cavity is covered with mucus. Due to the presence of mucus in the nasal cavity, the lining of it is moist. There are numerous cilia present on the lining of the nasal cavity. The bacteria, dust and other wastes found in inhaled air stick onto the mucus. This prevents the entry of them into the lungs. By rhythemic movement of cilia the waste materials are sent out. The materials that are collected at pharynx are removed out with saliva.

The changes that take place when inhaled air passes through the nasal cavity are as follows.

- Moisturizing/ Humidifying inhaled air
- Warming up of inhaled air
- Removal of wastes from inhaled air

Inspiration

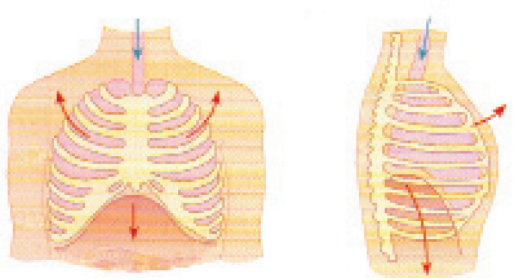


Figure 6.8 - Inspiration

During inspiration, air enters into lungs. For that, the volume of the lungs should increase. To increase the volume of the lungs volume of the thoracic cavity should be increased

Inter-costal muscles contract, therefore ribs move up and sternum moves forward.

At the same time the diaphragm contracts and reduce its curvature.Due to above activities the volume of the thoracic cavity increases and with that volume of lungs increase. So air enter into lungs through the nose.

Expiration

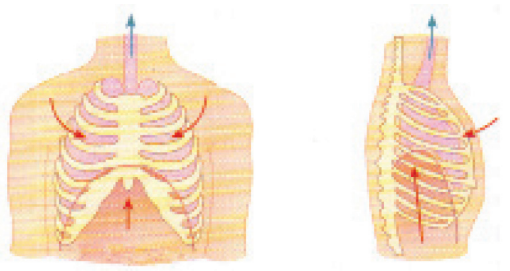


Figure 6.9 - Expiration

For expiration to occur, the volume of the thorasic cavity should decrease to reduce the volume of the lungs.

Inter-costal muscles relax. So the sternum and ribs move into its original position. The diaphragm relax and becomes curved. Due to

these activities the volume of the lungs decreases, thereby gas inside lungs move out through trachea and then nasal cavity.

The gas exchange that takes place in alveoli

The inhaled air finally reach the alveoli, through nasal cavity, trachea, bronchi, and bronchioles. The O_2 concentration in alveoli is greater than that of the blood capillary network around it. Therefore O_2 diffuse out of the alveoli into the blood capillaries. Similarly CO_2 and water vapor concentration is greater in blood capillaries than air inside alveoli, diffuse into the exhaled air.

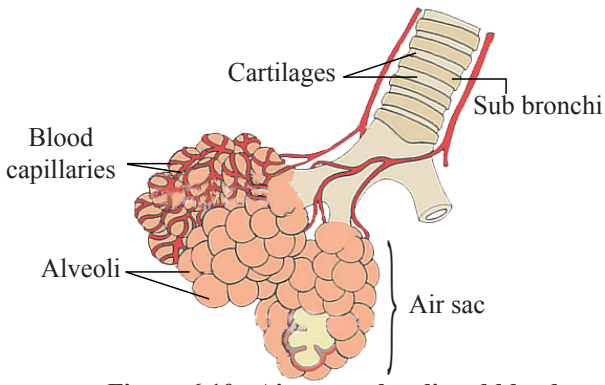


Figure 6.10 - Air, sacs, alveoli and blood capillaries in lungs

Accordingly, the respiratory surface of human is the wall of alveoli. The exchange of gases takes place by diffusion.

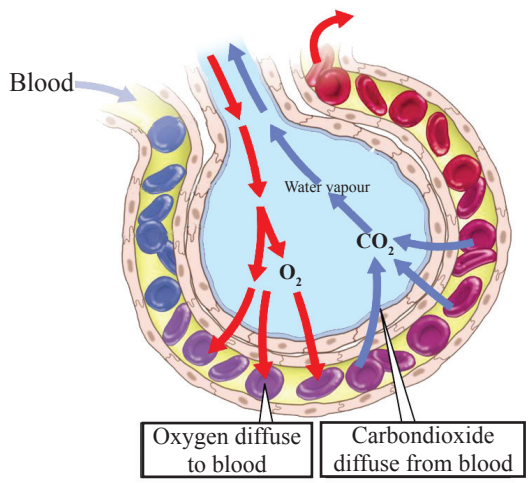


Figure 6.11 - Air exchange between alveoli and blood capillaries

Characteristics of a respiratory surface

The adaptations of the respiratory surfaces for efficient gas exchange are as follows.

- Surface should be moistened and permeable for gas exchange
- Surface should be thin for diffusion of gases
- A larger surface area to exchange large volume of gas according to the needs of animals
- Surface should be highly vascularized

In many animals body cover acts as the respiratory surface and gases exchange through the body cover. The respiratory surface of human is the **wall of alveoli** and the adaptations of the alveoli for efficient gas exchange are as follows.

- Presence of a blood capillary network around alveoli
- Thin alveolar wall
- Moist alveolar surface
- Presence of large number of alveolar sacs

Cellular respiration

Oxygen moved through alveoli reacts with simple organic compounds (glucose) in cells. In this chemical reaction energy is produced, therefore **respiration is the process of oxidation of simple foods within living cells.**

Let us build a word equation for respiration

Glucose + Oxygen ⟶ Carbon dioxide + Water + Energy

The balanced chemical equation for respiration is given below.

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6\,CO_2 + 6\,H_2O +$ Energy

According to the requirement of oxygen two types of respirations can be identified.

Aerobic respiration and Anaerobic respiration

We discussed the respiration that takes place inside cells in the presence of oxygen. It is called **aerobic respiration.**

Organisms can respire without O_2. Respiration carried out by organisms without O_2 is known as **anaerobic respiration**.

Anaerobic respiration that takes place in plants is known as **alcohol fermentation.** The anaerobic respiration that takes place inside plant cells can be given by the following word equation.

Glucose ⟶ Ethyl alcohol + Carbon dioxide + Energy

When Yeast carries out anaerobic respiration during fermentation, CO_2 and Ethyl alcohol is produced. This process is an example for alcohol fermentation.

Animals including human cells also perform anaerobic respiration. The anaerobic respiration that takes place within animal cells is referred to as **lactic acid fermentation.** The products of that is given in the equation given below.

Glucose ⟶ Lactic acid + Energy

Have you faced an incident of muscle pain and cramp due to an instant activity like 100m race. That is due to lactic acid, collected in muscles. That is a result of anaerobic respiration.

Energy produced during aerobic respiration is higher than energy produced during anerobic respiration. This is because of the incomplete break down of glucose in anerobic respiration and complete break down of glucose in aerobic respiration.

Energy is produced during anaerobic respiration as well as in aerobic respiration and part of this energy is lost as heat and rest will be deposited in ATP (Adenosine Tri - Phosphate) as chemical energy.

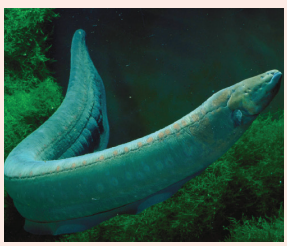
The energy needed for biological processes is produced during formation or break down of ATP

Functions of ATP

- Storage of energy
- Release of energy
- Act as an energy carrier

Extra knowledge

The energy stored in ATP is used for the following requirements



- Movement of muscles
- Active transportation
- Chemical reactions that take place within organisms
- Synthesis of complex compounds from simple compounds (E.g.:- Amino acids ⟶ Proteins)
- Production of new cells
- Illumination of some organisms. (E.g.:- firefly)
- Generation of electricity in some organisms (E.g. :- Electric eel)

Diseases associated with respiratory system

Assignment - 6.3

Collect information about diseases associated with respiratory system and preventive measures to prepare a small booklet.

- **Common cold**

Causative agent is a virus. Headache, sneezing, running nose, cough are the symptoms. There is no medical treatment as it is a viral infection. But can treat for symptoms. By avoiding dust and mist like conditions which are good for viral growth can recover quickly.

- **Pneumonia**

This disease occurs due to a bacterium or a virus. The lungs are infected and a fluid may accumulate in the lungs. Prolong cold and cough are the main symptoms for pneumonia.

- **Asthma**

Asthma is an inflammation that occurs in the body. Dust, pollen, saw dust, fur, smoke are some causative agents. Due to those substances, the bronchioles get inflammated and the cross area of them are reduced causing difficulty in breathing.

- **Bronchitis or bronchiolar inflammation**

The bronchioles swell up due to inflammations that occur by viral or bacterial infections. Heavy cough and difficulty in breathing are symptoms. Other than bronchioles, larynx may get infected. As a result, voice may not exit properly.

- **Tuberculosis**

Tuberculosis is caused by a bacterium. Due to multiplication of the particular bacterium within the lungs, the tissues are damaged. Mainly, the lungs are infected. But it may affect other parts in the body too. Parts of tissue can be released with phlegm. The lungs are deteriorated and get perforated. Blood release with phlegm due to breakdown of blood vessels.

Symptoms of tuberculosis

- Tiredness
- Loss of apetite
- Fever
- Release of blood during coughing
- Weight loss

Tuberculosis can be prevented by vaccines and proper treatment

Diseases associated with smoking

Smoking cause, lung cancer, bronchitis and some other diseases. Sometimes it may cause death.

Carbon monoxide (CO) in cigarette smoke is absorbed into blood. CO readily binds with haemoglobin and avoid binding of O_2 with haemoglobin. Therefore O_2 carrying capacity of blood reduces.

Nicotine found in cigarette smoke increases the heart rate temporally.

Due to destruction of cilia in the respiratory tract, bronchioles may swell up due and get inflammations, and it may cause difficulty in breathing. As these epithelial cells expose to cigarette smoke, they may form abnormal cells which develop into cancers.

Passive smokers also get same ill effects due to cigarette smoke.

Silicosis

Workers work in quarries, coal mines and glass industry expose to silicon containing componds. When these people inhale air with those componds, they accumalate in alveoli. So lung tissues get deteriorated gradually

Asbestosis

This disorder occurs due to inhalation of air containing asbestos particles and fibres. Due to accumulation of these particles tissues of respiratory tract get destroyed.

6.3 Process of excretion

Summation of bio chemical reactions that take place in the living body is known as **metabolism**

Examples for several metabolic activities are given below

- Production of carbondioxide, water and energy during cellular respiration
- Production of urea, uric acid in protein catabolism in liver

When metabolic processes occur in the cells, necessary as well as unnecessary materials are produced. These unnecessary materials should be removed from the body.

The waste products that are produced during metabolic process are called excretory materials. **Removal of excretory products produced during metabolism from the body is called excretion.**

Different excretory materials, organs through which the excretory materials are excreted and the form of excretion is shown in the table below.

Table 6.2 - Different excretory materials

Excretory material	Excretory organ	Form of Excretion
CO_2, water vapour	Lungs	Exhale air
Urea, uric acid, Salts, water	Kidney	Urine
Urea, uric acid, NaCl, water	Skin	Sweat

Why faecal matter is not an excretory substance?

Faeces is the undigested materials of the digestion process. Digestion takes place within the digestive system. Digestion of food is not a bio chemical reaction that takes place in the cells. So faeces is not considered as an excretory material. The bile pigments that is released with faeces is an excretory substances.

Urinary System

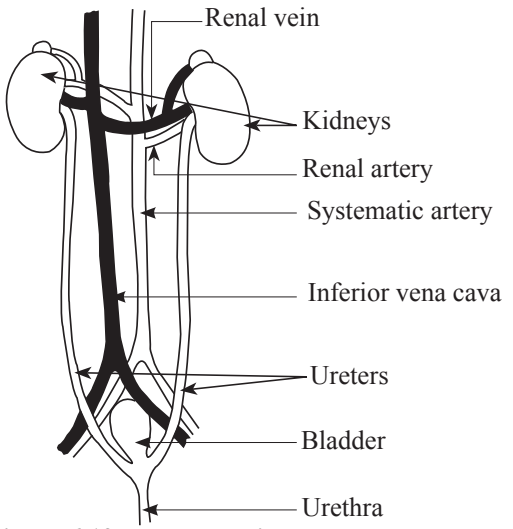


Figure 6.12 - Human urinary system

The main organ that carries out nitrogenous excretion is the kidney.

A pair of kidneys and other organs are organized to form urinary system.

The main parts of the urinary system are as follows

- Pair of kidneys
- Pair of ureters
- Urinary bladder
- Urethra

The waste materials in blood enter through renal arteries are filltered inside the kidney. This filterate is known as urine and it is transported through ureters and released out of the body through urethra.

Activity - 6.2

Observation of internal structure of a kidney

Required materials :- A specimen or a model of a kidney of a goat or a cow

Method :-
- Observe the above specimem carefully (get the assistance from your science techaer)
- Use the diagram below to identify the parts of kidny

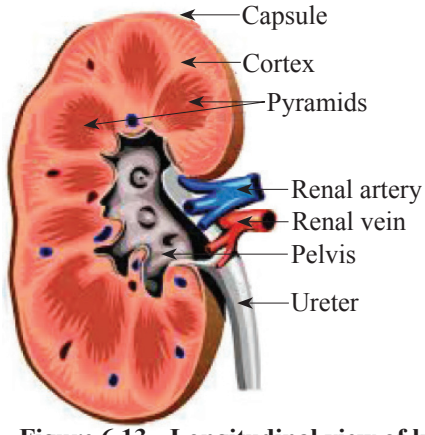


Figure 6.13 - Longitudinal view of kidney

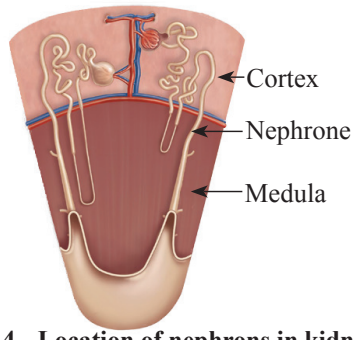


Figure 6.14 - Location of nephrons in kidnay

The structural and functional unit of kindney is nephron. Nephron is microscopic and there are about one million of them in a kidney. The parts of a nephron can be identified as in the diagram given below.

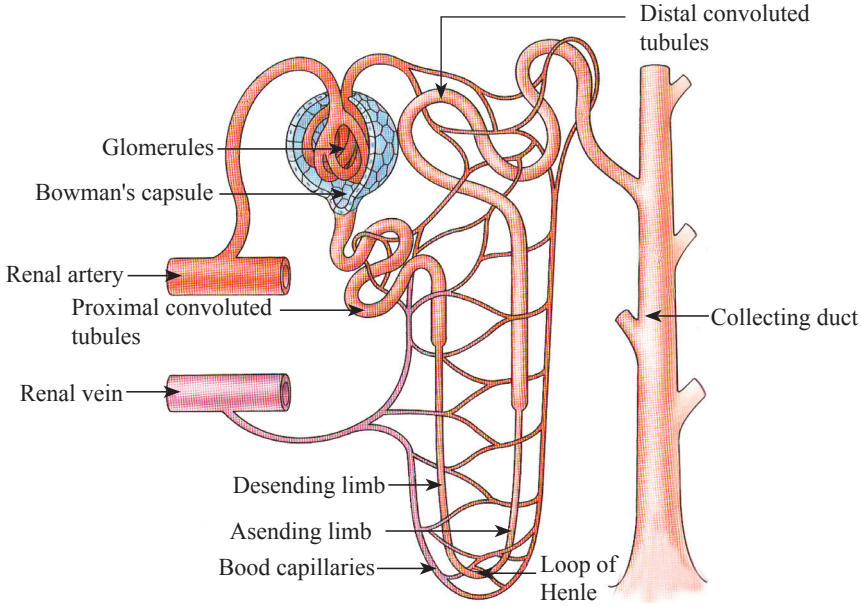


Figure 6.15 - Structure of a nephron

Process of urine formation

Urine formation in kidney follows three main processes,

1. Ultra filtration
2. Selective reabsorption
3. Secretion

Ultrafiltration

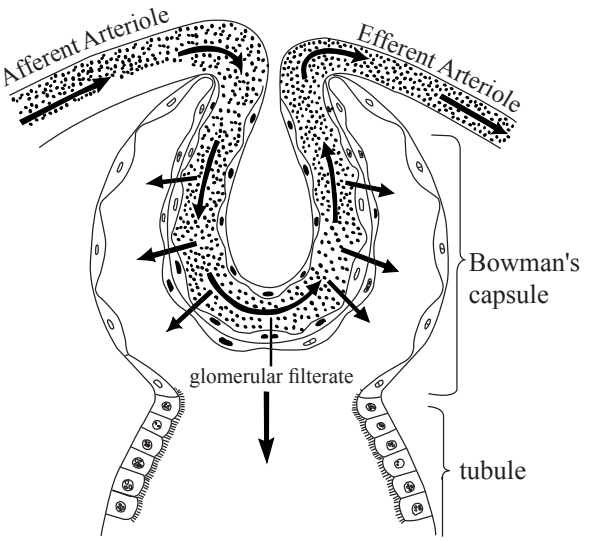


Figure 6.16 - Glomerular filterate collected into the cavity of bowman's capsule

Each afferent arteriole enters into each Bowman's capsule, where they further divide forming a dense network of capillaries. It is known as **glomerulus**.The blood flow through the glomerulus is having a high blood pressure because the diameter of efferent arteriole is smaller than diameter of afferent arteriols. So blood gets filtered through the wall of glomerulus and the inner wall of the bowman's capsule and collected into the cavity of Bowman's capsule. This process is known as **ultrafiltration.** This filtered fluid is referred to as glomerular filterate. Large molecules like plasma proteins and blood cells are not filtered into the glomerular filterate. Glomerular filterate is as same as blood plasma. The constituents of glomerulur filterate are water, glucose, amino acids, vitamins, medicine, various ions, hormones and urea.

Selective reabsorption

When glomerular filterate moves along the nephron most of the constituents absorb again into the blood capillaries associated with nephron. This is called **Selective reabsorption**. 90% of the water, all glucose, part of amino acids, vitamins, salts, urea and uric acid and medicine reabsorb into blood. The composition of glomerular filtrate change with selecteve reabsorption and then the glomerular filterate is referred to as urine.

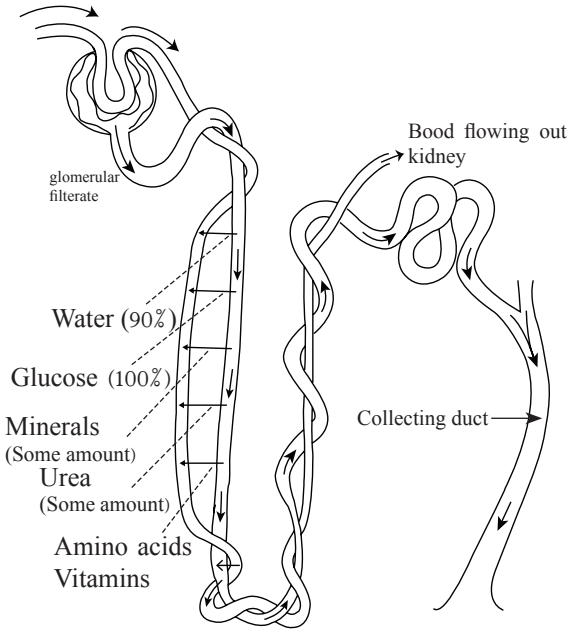


Figure 6.17 - Materials reaborsobed during urine formation

Urine is released into collecting ducts and then to the pelvis. The volume of glomerular filterate formed during one minute in a healthy adult is about 120 cm^3. But 95% of the glomerular filterate reabsorb when it moves along the nephrone.

100% of glucose is reabsorbed in a healthy adult. But in diabetes patients glucose is not totally reabsorbed. The remaining glucose is released with urine.

Secretion

Some of the materials in the blood capillaries associated with nephrone, are secreted into the tubules of nephron.

E.g :- Hydrogen ions (H^+), Potasium ions (K^+), Ammonium ions (NH_4^+), Creatinine, Medicine, Vitamin B

Removal of urine from the body

Urine released into the pelvis is transported along ureters into bladder and is temporally stored in bladder. Release of urine takes place according to the need of urination.

The composition of urine in a healthy person is given below in the table 6.3

Table **6.3 - Composition of urine in a healthy person**

Constituent	Composition
Water	About 96%
Salts	About 0.2%
Urea	About 0.2%
Uric acid	Trace
Creatinine	Trace

Diseases associated with urinary system

Assignment 6.4

Write a report on diseases associated with urinary system to make aware the society about them.

Let us discuss some of the diseases associated with urinary system.

Renal failure

The weakening of urine filteration process in nephrons is renal failure. Infections by micro oganisums, heavy metals (mercury, arseric) various medicine and carbon tetrachloride (CCl_4) may cause renal failure. The basic symptom is oedema and increase of blood pressure due to accumulation of water and salts. pH of blood decreases due to accumulation of urea and other excretory materials. By taking immediate treatments and healthy life style one can maintain a healthy kidney. If treatments are not taken immediately after the symptoms, **acute renal failure** may occur within 8-14 days. Then blood is filtered by a machine in a process called **dialysis**. When both kidneys are failed, a healthy kidney from a donor should be transplanted.

Nephritis

Nephritis or swelling of kidney occurs due to infections and toxins. Infections in ureters and other changes that occur in the body are reasons for nephritis. During nephritis, it affects glomerulus and also uriniferous tubules. Due to damages occur in glomerulus the volume of blood flow through it reduces. So the amount of urine formed also reduces. Therefore the waste materials remaining within the body become high. Sometimes due to damages that occur in glomerules, filtering process is affected and as a result red blood cells can be passed into the glomerular filtrate. Similarly proteins also can be filtered and due to loss of these essential proteins, strokes may occur. Medical advice should be taken immediately for this condition.

Calculi in kidney and bladder

Crystalization of calcium oxalate in kidney and bladder is the reason for this condition. When these stones block ureters, a terrible pain would occur. The removal of these stones can be done by drugs or a surgery.

These stones can be crushed by applying laser rays, and this technique is called Lithotrypsy technology.

The feeding habit of a person is also a reason for these stones. Postponing of urination is also a reason for the above disorder.

6.4 Process of blood circulation

Glucose and oxygen are the main components to produce energy in the body. Blood is the transport medium of both the above components to the cells and the waste out of the cells.

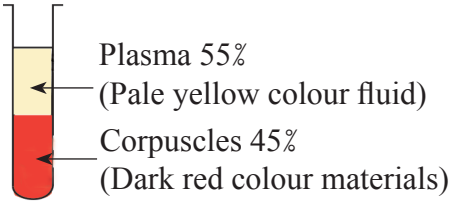
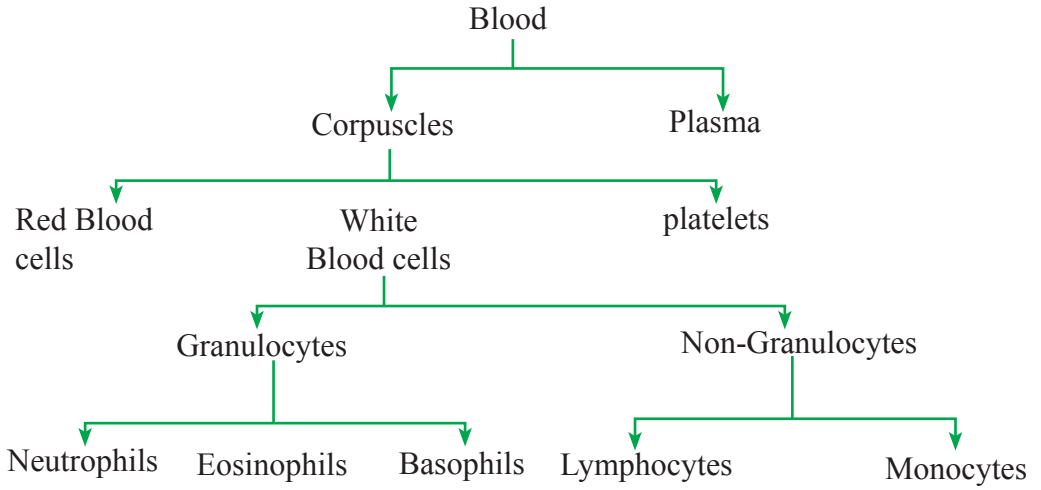


Figure 6.18 - Blood corpuscles and plasma

Blood is a special connective tissue. It is a red colour fluid. When blood is centrifuged and kept aside, there will be two different layers. The dark red layer consists of blood corpuscles while the pale yellow layer contains the plasma. On this basis, blood which is seen as a homogenous fluid, contains a plasma and a suspension of corpuscles. When a slide with a blood smear observed under the microscope there will be several types of corpuscles in it.



Red Blood cells (Erythrocytes)

Figure 6.19 - Red blood cells under electron microswpe

One cubic milimetre of human blood contain about five million of red blood cells. These red coloured and biconcave disc-like cells are clearly visible among the other corpuscles. They form in red bone marrow.The life span of RBC is about four months. Absence of nucleus in red blood cells provides a large surface area to absorb more oxygen. A pigment called haemoglobin is present in red blood cells. Haemoglobin absorbs oxygen and form oxyhaemoglobin to transport oxygen to cells.

White Blood cells (WBC)

A type of corpuscle, larger than the size of red blood cells, but smaller in number is present in blood. They are with nuclei and form in bone marrow. They are colourless and known as white blood cells. The ratio between red blood cells to white blood cells is 600:1

Two Types of WBC present in blood

- Granulocytes
- Non-granulocytes

Granulocytes are further divided into three types,

- Neutrophils
- Eosinophils
- Basophils

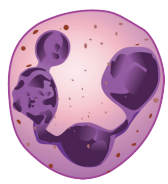
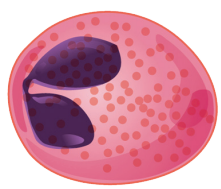
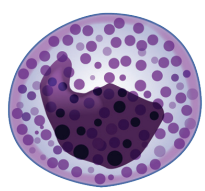
Non-Granulocytes are in two types,

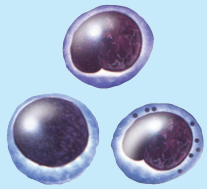
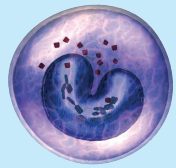
- Lymphocytes
- Monocytes

One cubic milimeter (1 mm^3) of human blood contains 4 000-11 000 number of WBC.

The following table shows the percentages of WBC in a healthy person.

Table **6.4 - Percentages of WBC in a healthy person**

Types of corpuscle	Variety and morphology	Percentage %
Granulocytes	Neutrophils 	50 - 70
	Eosinophils 	1 - 4
	Basophils 	0 - 1

Non-granulocytes	Lymphocytes 	20 - 40
	Monocytes 	2 - 8

WBC destroy infectious particles that entered the body by phagocytosis. Therefore percentages of WBC increase above normal levels. Invertigation of WBC counts in blood helps to diagnose diseases.

The function of WBC is to protect the body from infectious particles entered the body. This is done by phagocytosis and by producing antibodies.

Platelets

In addtion to RBC and WBC there are fragments of cells that cannot be considered as cells in human blood. These corpuscles without nuclei are known as platelels. One cubic milimeter of blood contains 150 000-400 000 platelels. They form in marrow bone. Life span of platelets is approximately 5-7 days. Due to diseases like Dengue and Leptospirosis, platelet count drops drastically. Platelels contain thromboplastin which help in coagulation of blood.

Blood plasma

92% of blood plasma is water. Other than it the second most abundant compound is protein. Nutrients, nitrogenous waste, hormones, enzymes, gases and ions are present in blood plasma.

Blood Plasma

- Water
- **protein**
  - Albumen
  - Globulin
  - Fibrinogen
- **Nutrients**
  - Monosaccharides
  - Amino acids
  - Fatty acids
  - Glycerol
  - Vitamin
- **Ions**
  - Na^+
  - K^+
  - Ca^{2+}
  - Mg^{2+}
  - Cl^-
  - PO_4^{3-}
  - SO_4^{2-}
  - HCO_3^-
- **Nitrogenous byproducts**
  - Urea
  - Uric acid
  - Creatinine
- **Gases**
  - O_2
  - CO_2
  - N_2
- Hormones
- Anibiotics
- Antigens

Function of blood

- Transportation of materials (digested end products respiratory gases, excretory byproducts, hormones, platelets, mineral ions and proteins)
- Protect body against pathogenic microbes
- Maintenance of chemical coordination and homeostatis among tissues and organs

Blood Circulation

Do the following activity to observe blood circulation of cappillaries.

Activity - 6.3

Observation of blood circulation in blood cappillaries

Materials required:- A small live fish or tadpole, A glass slide, Wet cotton, A microscope

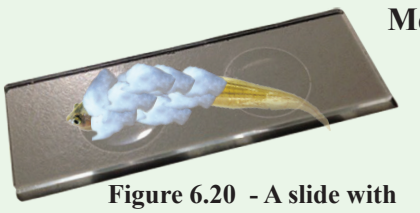


Figure 6.20 - A slide with a tadpole

Method :-

- Place the small live fish or tadpole on the slide and cover the gills with wet cotton
- Observe the blood capillaries in tail area under light microscope
- Change the specimen in 10 minutes time to keep it live

You have observed the flow of blood within the blood vessels in the above activity. The force generated by the heart helps to distribute blood through the body. Carry out the activity below to understand the structure of the heart.

Activity - 6.4

Observe the structure of the heart

Materials required:- A specimen or a model of a heart

Method :-

- Observe the external struture of the heart
- Observe it's internal chambers, connected arteries and veins, bicuspid and tricuspid valves.
- Observe that the atrial walls are thinner than vetricular walls and the thickest wall in the left ventricle.
- Use the diagram 6.21 to identify the parts.

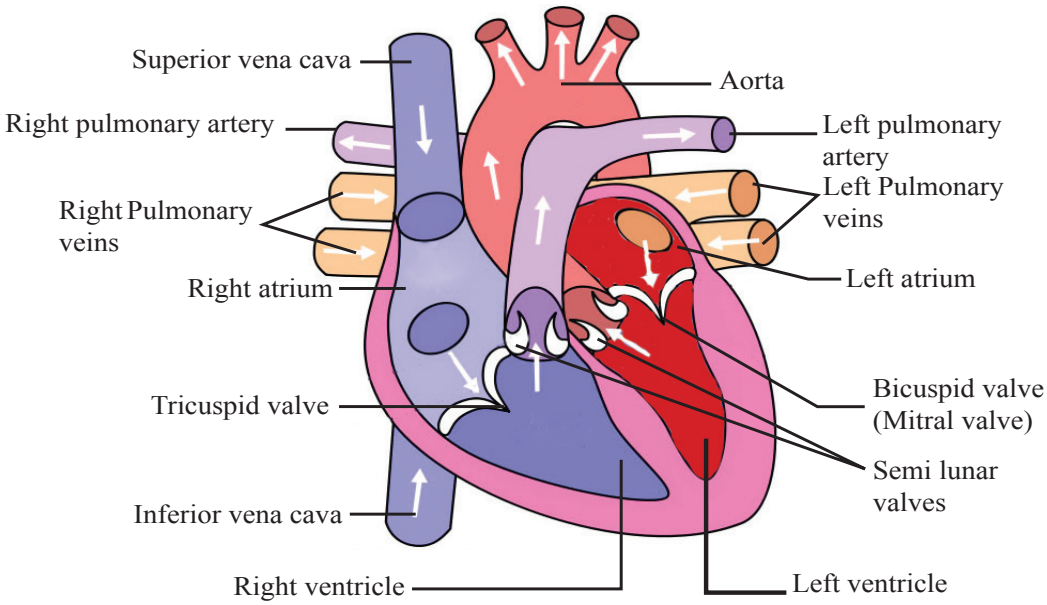


Figure 6.21 - A longitudinal section of the human heart

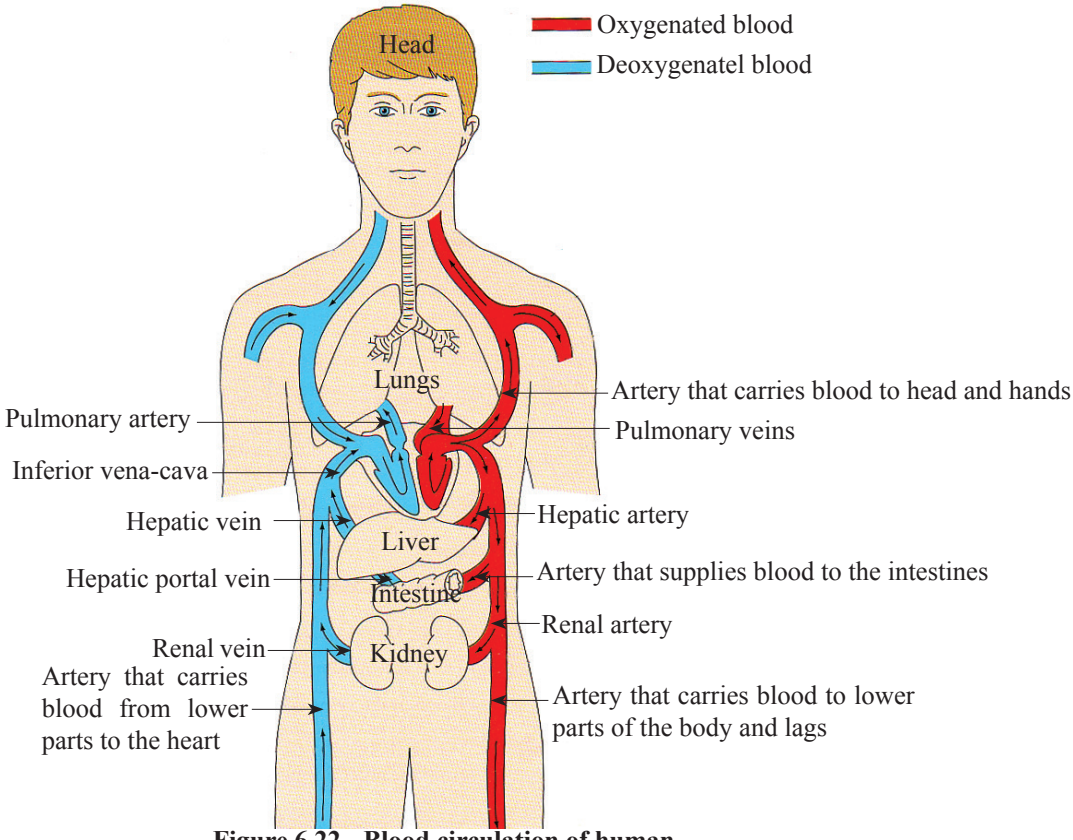


Figure 6.22 - Blood circulation of human

Double blood circulation

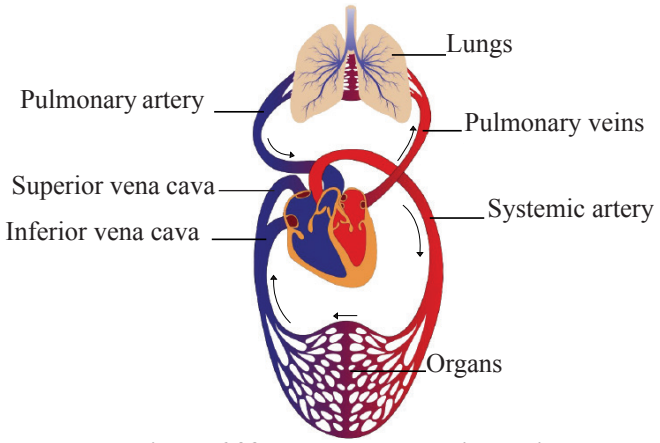


Figure 6.23 - Double blood circulation

The circulation where blood flows through lungs is known as **pulmonary circulation.** The circulation where blood flows through the rest of other organs is known as **Systemic circulation.** Right ventricle of the heart acts as the pump for the pulmonary circulation, and left ventricle for the systemic circulation. So it is clear that blood flows twice through heart before entering into systemic artery. In human, when the blood circulates once through the body it flows twice through the heart. This is called as **double blood circulation.**

Heart beat and Cardiac cycle

Atria and Ventricles of heart contract to pump blood out of the heart. These contractions and dialations of heart muscle are known as **heart beat**. The heart beat rate of a healthy person at rest, is 72 beats per minute. Pulse rate is also similar to heart beat rate. In one heart beat atria contract when ventricles dialate. Next ventricles contract, atria dialate. Contraction of atria is known as **diostole** whereas contracion of ventricles is known as **systole**. After that atria and ventricles are in relax mode and it is known as **intervening**.

Cardicac cycle refers to a complete heart beat from its generation to the beginning of the next beat. The stages of cardiac cycle are as follows;

1) Diastole - Atrial contraction
2) Systole - Ventricular contraction
3) Intervening - Atrial and Ventricular relaxation (complete cardiac diastole)

Electro cardio gram (E .C .G) is used to get information about heart function. This tracing denote the potential changes take place in cardiac muscle cells during heart funtion. Three stages of cardiac cycle can be identified in ECG

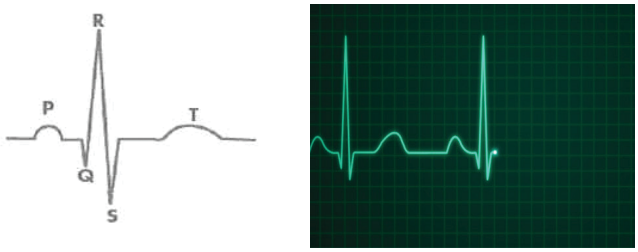


Figure 6.24 - Electro cardio gram of a healthy person

P - Atrial contraction
QRS - Ventricular contraction
T - Intervening

ECG wave patterns deviate from normal patterns due to disfunction of heart. **Lub - Dup** sound in heart beat can be heard by keeping ear or stethescope on chest. Lub sound is longer than Dup sound. Lub sound is produced when bicuspid and tricuspid valves close in atrial contraction. Next produce lup sound and it is shorter. This lub sound is resulted when semi lunar valves close.

Blood pressure

When heart beats, it contracts and pushes blood through the arteries to the rest of the body. This force creates pressure on the ateries. This is called **systolic blood pressure.**

Figure 6.25 - Measuring of blood pressure

A normal systolic blood pressure is 110-120 mmHg. **Diastolic blood pressure** is the pressure in the arteries when heart rests between beats. A normal diastolic blood pressure is between 70-80 mmHg. Blood presure is measured in millimeters of mercury (mmHg).

Normal resting blood pressure is mentioned as follows

Blood presure (B.P) = 120/80 mm Hg

Ageing, stressful mentality, sex, diseases of a human are the factors that can increase blood pressure.

Another transportation system closely linked with blood circulatory system is present in human body and it is known as Lymphatic system.

Lymphatic system

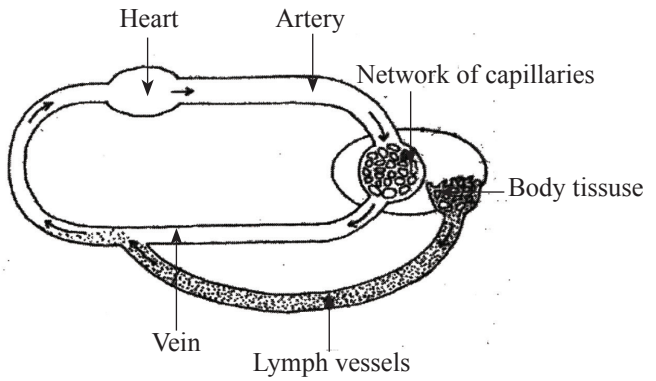


Figure 6.26 - Relationship between blood circulation and lymph circulation

Blood capillaries transport blood through cells in the tissues. Blood capillary cell walls are very thin but only WBC and blood plasma can move through the capillary wall. RBC and some plasma proteins cannot move through capillary wall. This fluid moved to tissue is known as **tissue fluid**. Materials exchanged within body cells and blood occurs through this tissue fluid.

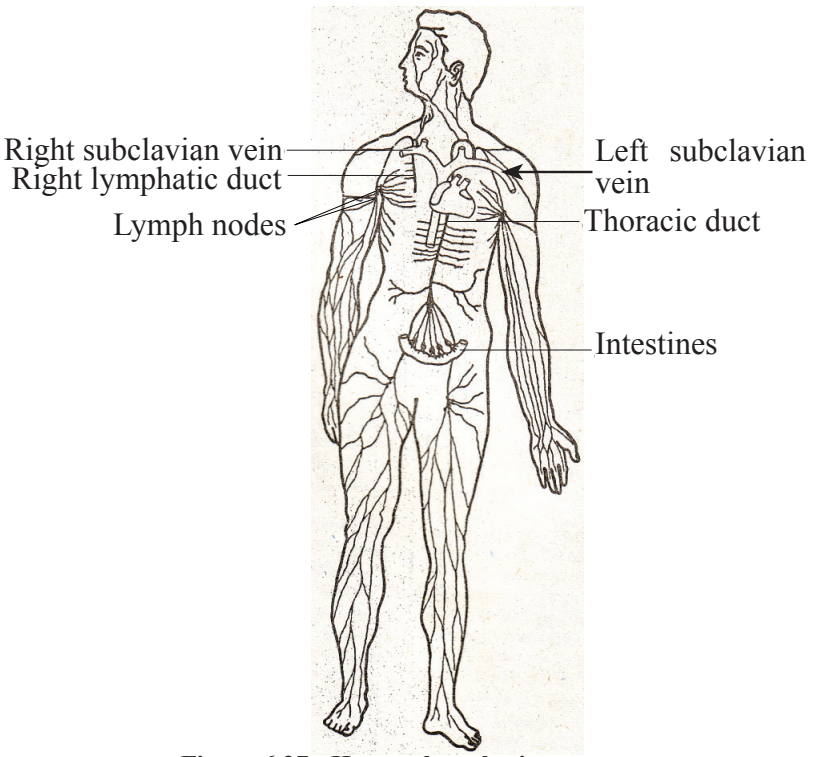


Figure 6.27 - Human lymphatic system

Tissue fluid is absorbed back to capillaries while 1/10 th of it remain within intercellular spaces. This remaining tissue fluid connect with blood circulatory system through a special tubular system known as **lymphatic system**.

The tissue fluid flowing in the lymphatics is called **lymph.**

Lymphatic system consists of **lacteals**, **Lumph capillaries** and **lymph nodes**. Lymph is flowing due to pressure caused by muscles around lymph vessels. All the lymph vessels in the body form two main vessels. They are,**Thoracic duct** and **right lymphatic duct**. Lymph empties into venous circulation at the junction of internal jugular vein and sub clavian vein.

Main function of lymphatic system is destruction of infectious organisms like bacteria. WBC in lymph nodes destroy them by phagocytosis. Then these lymph nodes become more active and swollen. These swollen lymph nodes are known as **kuddeti.** Lymph nodes can be found mostly around lungs, heart like organs, skin, arm pits and throat.

Diseases associted with blood circulatory system

Assignment 6.5

Prepare a booklet about diseases associated with blood circulatory system and preventive measures to control them. Collect information about following disorders and compare them with given facts.

- Artherosclerosis
- Heart attack
- Hypertension
- Thrombosis

Artherosclerosis

Cholesterol is an essential lipid compound produced by the liver. As cholesterol is insoluble in water it is transported as lipo proteins by combining with proteins. Lipo proteins are of two types. Low density lipo proteins (**LDL**) and High density lipo proteins (**HDL**). Excessive amount of low density lipo proteins deposit in coronary arteries and other arteries. Thereby the size of the lumen in arteries reduces. The lipid deposits like this in arteries are called Arthero and the condition that occur is called Artherosclerosis.

Due to blocking of coronary arteries, the blood supply to heart is affected. Some parts of the cardiac muscle will be failed to function causing **angina** (Chest pain). Due to blockage of coronary arteries the region of the cardiac muscle will not recieve blood and that region is failed. This condition is called heart failure.

The reason to increase LDL is consumption of food containg high amount of saturated fatty acids (beef, pork, mutton, full cream milk, egg yolk, prawns, and liver). By controlling such food types and regular exercises can control artherosclerosis.

Hypertention and hypotention

Due to deposition of cholesterol inside arteries, the size of the lumen reduces. Therefore blood supply to different organs get lowered. So to supply required amount of blood, heart has to excert more pressure. The higher pressure excerted onto the arterial wall is called hypertention pressure. Reduction of elasticity of the artery or arterile wall also a reason for hypertention.

Reduction of consumption of saturated fatty acid is important to control this condition. One has to avoid smoking, consumption of alcohol, mental stress, obesity to control hypertension.

Hypotension is the low blood pressure. The blood become less than the normal. Low blood pressure occurs mostly due to nurient deficiencies. During this condition one has to get treatments to increase blood pressure to normal quickly.

Thrombosis

When blood supply to a certain organ is affected due to a blood clot in a blood vessel is called thrombosis. If blood supply to a part of the brain is affected due to a blood clot, the organs that are controlled by that part of the brain fail. This condition is normally called **paralysis**. If the function of heart is affected due to a blood clot in the coronary artery it is called **coronary thrombosis**. Due to this, **heart attack** may occur.

Thrombosis can be controlled by steps taken from child hood. They are as follows,

- Avoiding alcohol and smoking
- Reduction of consumption of food containing saturated fatty acids.
- Consumption of food with more fibre
- Reduce salt consumption
- Control of diabetes
- Reduce body weight by proper food habits
- Regular physical excercises
- Peaceful mental status

If there is a record about heart attacks, hypertension, diabetes in family history, one has to be more careful about this condition.

6.5 Coordination and homeostasis in human

Do you remember taking away your leg, when a thorn pricks your foot? This action has taken place as living beings have the ability to respond to stimuli coming from external and internal environments. That is known as irritability. Above response is due to adaptation of body according to the changes of external and internal environments. That is called coordination. The change that takes place in the external environment which is detectable by the sensory organs is called a stimulus. The organs that can detect (sense) the **stimuli** are called sensory organs (receptors). Eye, nose, ear, tongue and skin act as sensory organs.

Assignment - 6.6

Complete the table using different receptor organs and the stimulus that can be detected.

Sensory organ	Stimulus that is detected
Eye	Light energy
Ear	.....
Nose	.....
Tongue	.....
Skin	.....

The reaction for a stimulus is known as a **response**. The response is done by effectors. Muscles or glands act as effectors.

Recall the incident about the thorn prick. The pain due to thorn prick is the stimulus. The receptor of that stimulus is the skin. Taking the foot away is the response to that stimulus. Responding is done using muscles of the foot and that is the effector.

Assignment - 6.7

When you sense smell of tasty food saliva is secreted into the mouth. State the stimulus, sensory organ, response and effector in this action.

You will understand that there should be a proper communication between organs/ tissues to carry out body functions smoothly. Identification of the changes in the external and internal environments and responding accordingly is done by the coordination.

For coordination, two inter connected but different systems present in the human body.

- Nervous system
- Endocrine system

The coordination done by nervous system, is called nervous cordination, and coordination by endocrine system is called chemical coordination

Nervous coordination

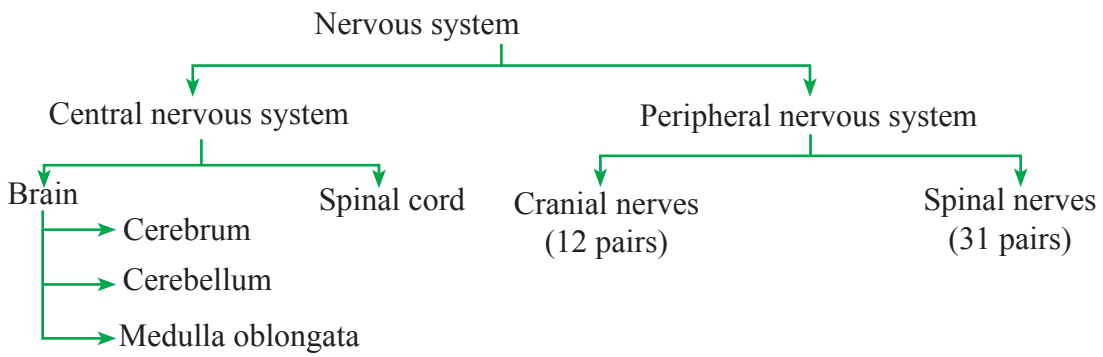
Due to an electro chemical change in the nerves, impulses are transmitted through nerves. A proper coordination is maintained between the receptor and the effector.

The nervous coordination takes place with the involvement of the nervous system.

The structural unit of the nervous system is the neuron. There are three types of neurons in the nervous system.

- Sensory neuron
- Motor neuron
- Inter neuron

The nervous system is mainly composed of two components. They are the central nervous system and peripheral nervous system. The structure of it can be shown by the following simplified diagram.



Central nervous system

Central nervous system is very important in controlling of activites and coordination. Brain and spinal cord belong to central nervous system. Skull provides protection to the brain and vertebral column to the spinal cord.

Brain and spinal cord covered by meninges. There is a special fluid found within the cavities of brain and between meninges. It is known as cerebro spinal fluid. The functions of cerebro spinal fluid are given below,

- Support brain and spinal cord
- Absorption of shocks and jerks
- Protection against microbial infections and dessication
- Nourishing tissues

Brain

Brain is protected by the cranium and surrounded by three linings called meninges. The brain is about 1/50 of the body weight. There are about hundred billion of neurons. Other than neurons another accessory cells called neurogloea are present in brain. The brain is composed of three main parts.

- Cerebrum
- Cerebellum
- Medulla oblongata

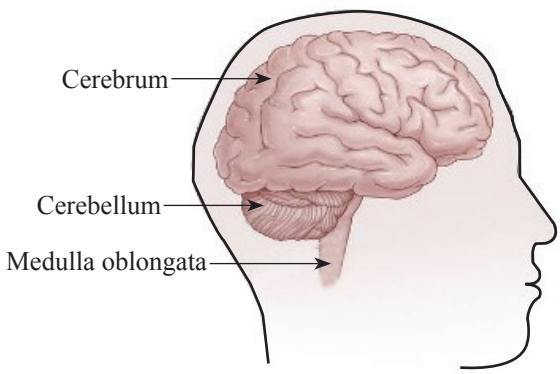


Figure 6.28 - External view of human brain

The peripheral region of the brain is composed of grey matter made up of cell bodies and the interior with white matter made up of nerve fibres.

Assignment - 6.5

Take a model / live specimen of a mammalian brain and identify the parts of it with the guidance of the teacher.

Cerebrum

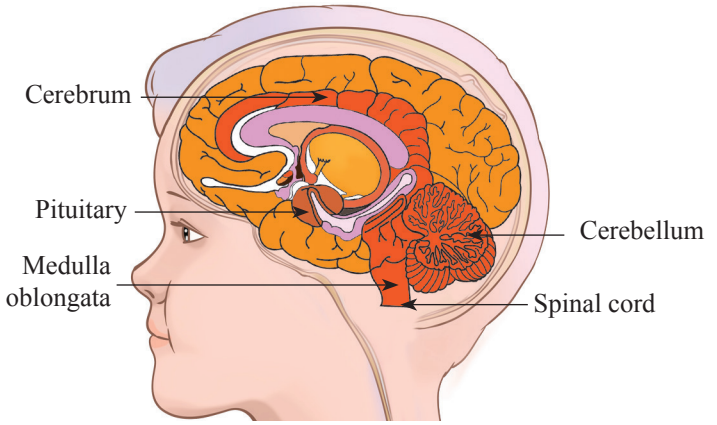


Figure 6.29 - Longitudinal section of human brain

Cerebrum is the largest and most highly developed part of the brain. It is divided into left and right hemispheres. The cortex of the cerebrum is highly convoluted to increase the surface area. The left cerebral hemisphere controls the right half of the body and the right cerebral hemisphere controls the left part of the body.

Functions of cerebrum

- Perception of impulses from receptors, identification of received sensory information and storage of those information.
- Perception of senses about pain, vision, temperature, taste and smell.
- Perform high mental activities such as learning, intelligence and thinking.
- Controlling of voluntary muscle contraction.

Cerebellum

This is located just below the latter part of the cerebrum. It consists of two hemispheres. It is of grey matter in the outer layer and white matter in the interior layer.

Functions of cerebellum

- Maintenance of body balance
- Control of voluntary muscle activity
- Involve in maintenance of body movement

Medulla Oblongata

It is located anteriorly interior to cerebellum. It is an important centre in controlling many life processes (all reflex actions and involuntary actions).

Functions of medulla oblongata

- Control the rate of heart beat
- Control the rate of respiration
- Control reflex actions such as vomitting, caughing and swallowing.

Spinal cord

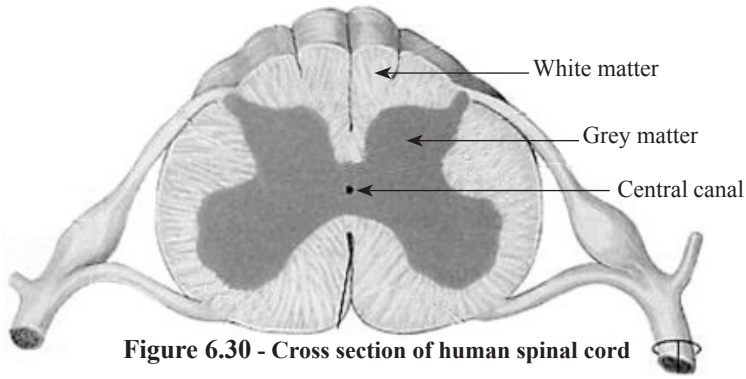


Figure 6.30 - Cross section of human spinal cord

It is a tubular structure starting from medulla oblongata inferiorly and runs through vertebral column. Peripherally white matter and interiorly grey matter is present in the spinal cord. The spinal nerves start symmetrically at either side of the spinal cord.

Reflex arc

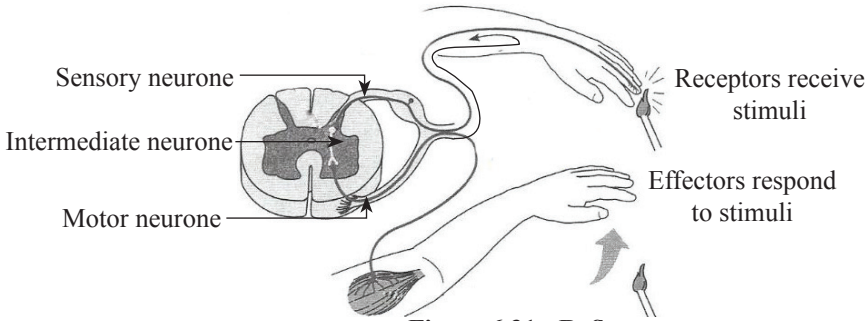


Figure 6.31 - Reflex arc

Stimualtion of the pain receptors in the skin → Sensory Neurone → Spinal cord (Intermediate neurone) → Motor Neurone → Effector (Muscles of leg)

We know that there is a proper co-ordination maintained by nervous system between the receptors and effectors in the body. The impulses are sent from receptors to the central nervous system and from central nervous system into the effectors. The functional unit of the nervous system that maintains the coordination is called the **reflex arc**.

Three types of nerve cells involve in a reflex arc. They are sensory neuron, inter neuron and motor neuron. The reflex actions take place with the involvement of the reflex arc.

Reflex actions

A sudden, involuntary response to a particular stimulus is called a **reflex action**. They take place without the conciousness of the involvement of the brain.
The reflex actions are of two types, as spinal reflexes and cranial reflexes.

Examples for spinal reflexes

- Moving the hand away when it contacts with a hot surface
- Lifting the leg when you step on a thporn

Examples for cranial reflexes

- Sneezing
- Salivation
- Blinking eyelids

Assignment - 6.8

State the reflexes you encounter in day today life

Autonomic Nervous System

The nervous supply from the autonomous nervous system is to the internal organs of the body which are involuntarily controlled. This nervous system coordinates involuntary activities in the body.

The coordinating centres of the autonomous nervous system are hypothalamus and medulla oblongata. The autonomous nervous system is composed of two parts.

- Sympathetic nervous system
- Parasympathetic nervous system

The sympathetic and parasympathetic nervous systems cause opposite effects. The sympathetic system activates when a person is at emergency. It causes fight or flight effects.

Figure 6.32 - Fight or flight effect caused by sympathetic system

The changes that occur due to the activities of sympathetic system, will be neutralised by the parasympathetic system.

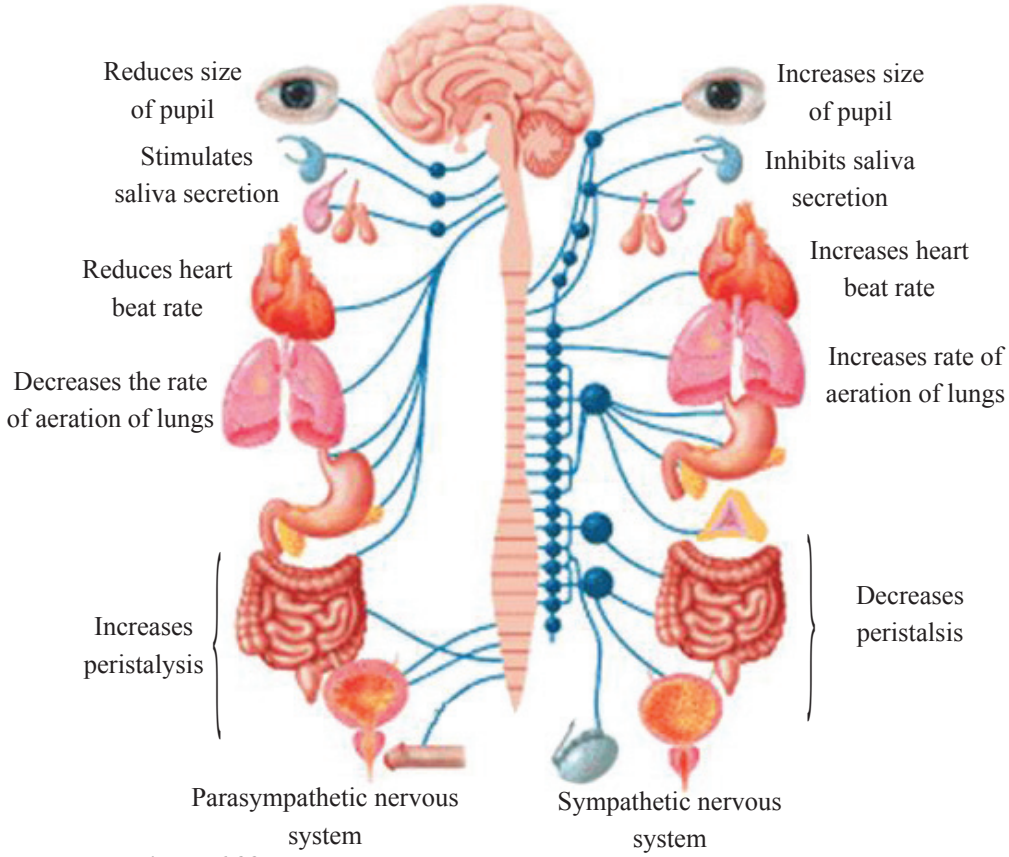


Figure 6.33 - Parasympathetic and sympathetic nervous supply on body organs

Chemical co-ordination

Chemical co-ordination is also important as nervous co-ordination to the survival of organism. Hormones secreted by endocrine glands are important in chemical co-ordination. Endocrine glands or ductless glands secrete hormones, directly into blood stream. So hormones are transported through blood.

Features of hormones

- Hormones are oraganic compounds
- They are transproted through blood
- Produced at one site and act on another site
- Stimulate target organs or target cells
- Small concetration is required

The endocrine glands of human body

There are several endocrine glands located in human body. The main endocrine glands are mentioned below.

- Pituitary
- Thyroid
- Hpothalamus
- Pancreas
- Adrenal gland
- Gonads (testes and ovaries)

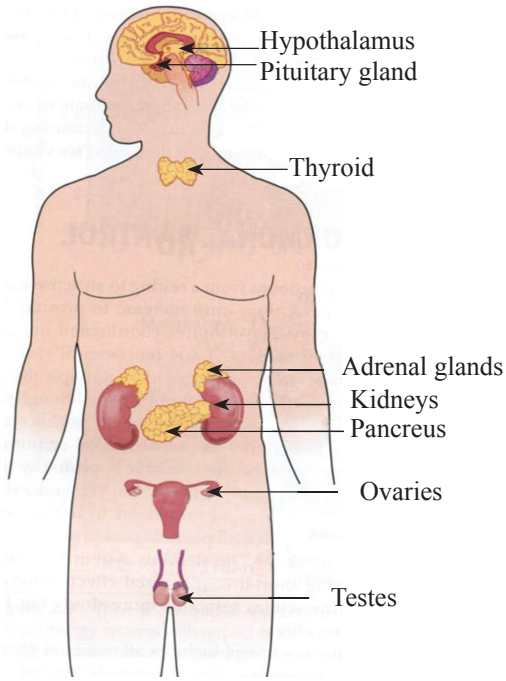


Figure 6.34 - Location of endocrine glands in human body

Table 6.5 - Several hormones secreted by endocrine glands of human

Gland	Location of gland	Hormone	Utility
Pituitary	Below the hypothalamus	Growth hormone	Increase protein synthesis. Growth of ordinary body tissues. Growth of long bones.
Thyroid	Posterior to tracheal and dorsal part of neck	Calcitonin Thyroxin	Reduce calcium level in blood. Control metabolic rate

Pancreas	In the bend of duodenum between stomach and large intestine	Insulin Glucogen	Canvert glucose into glycogen Convert glycogen into glucose
Adrenal glands	Above the kidneys	Adrenaline	Prepare body to activate in an emergency
Testes	Outside the abdominal region	Testosterone	Development of secondary sexcual Characteristics in boys Induces Spermatogenesis
Ovaries	Below the kidneys	Oestrogen Progesterone	Development of secondary sexual Characteristics in girls Maintenance of pregnancy

Homeostasis

Maintenance of constant internal environment is called **homeostasis**.

The internal environment is the immediate surrounding of the cell which provides medium for the cell to survive. The tissue fluid around cells, the plasma around blood cells and lymph are included into the internal environment.

When internal environment is constant, the conditions inside cells is also constant. If there is a small change in the internal environment it highly affects the cellular activities. Therefore the internal environment should maintain stable conditions or within a narrow range, which can be tolerated by the cells. If not, automatic control system will be active with feedback mechanisms.

The factors in the internal environment that has to be regulated

- Blood glucose level
- Body temprature
- Water balance

Regulation of blood glucose level

The blood glucose level of a healthy adult is 80-120 mg/100 ml of blood. When blood glucose level is greater than the normal level beta cells in islets of langerhans in pancreas secrete more insulin. This hormone converts glucose into glycogen and then glycogen store in liver. Further excess glucose is converted to fat and stored in adipose tissue.

When blood glucose level is less than normal (when a person is starving) alpha cells in islets of langerhans in pancreas are stimulated to secrete more glucogen. This glucogen acts on glycogen stored in liver to convert it into glucose and release into blood. The blood glucose level will be increased to normal level.

Due to the activities of insulin and glucogen. The blood glucose level is regulated. Due to absence of beta cells or secretion of insulin will cause diabetes.

Regulation of body temperature

Human is a homoithermic organism. Homoithermic means maintenance of constant body temperature irrespective to the fluctuations of temperature in the environment. Normal body temperature of human is 37 ^{0}C. But it can vary from 36 ^{0}C to 37.5 ^{0}C.

The thermo regulatory centre of the human is present in the hypothalamus of the brain. When environmental temperature drops to avoid the decrease of body temperature, hypothalamus stimulates and carries out the activities below.

- Reduce blood supply to skin to reduce heat loss, by contracting blood capillaries in the skin.
- Reduce production of sweat in sweat glands and reduce heat loss.
- The hairs become erect and trap an air layer to act as a heat insulating layer.
- If the heat loss is high, heat is generated by shivering.

When temperature of the internal environment increases, to prevent the increase of body temperature, the hypothalamus stimulates to activate the processes as follows,

- Dialate blood vessels in the skin and thereby increase blood supply to skin and increase heat loss.
- Increase sweat production by sweat glands. When sweat is evaporated heat is absorbed by body and decrease body temperature.

Regulation of body temperature is done by the hypothalamus.

Regulation of water balance

When the water level of blood drops, pituitary secretes ADH (Antidiuresis hormone). This ADH acts on kidney to increase reabsorption of water, thereby reduce the amount of water released with urine.

When water level in blood is high, the reabsorption of water decreases and the amount of water released with urine increases. Accordingly water balance in the body is regulated.

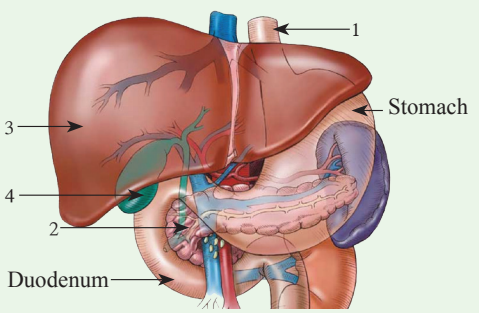
Summary

- Digestion, respiration, blood circulation, excretion and coordination are several biological processes that take place in human body.
- Food digestion is the prossess by which the complex organic compounds are converted into simple organic products which absorbs into the human body.
- Enzymes are important in food digestion. Glucose from carbohydrates, fatty acids and glycerol from lipids and amino acids from protein are the end products of food digestion.
- Bile helps to emulsify lipids in lipid digestion.
- Several medicine, vitamins, alcohol and glucose are some of the materials absorbed directly into blood, without digestion.
- Respiration is the prosses of oxidation of simple foods within living cells.
- Respiratory system involves in taking oxygen into lungs and release of gaseous waste products out of lungs.
- Part of energy produced during anaerobic and aerobic respiration is lost and rest will be deposited in ATP as chemical energy.
- Excretion is the removal of excretory products, produced during metabolism. kidneys, skin and lungs are the organs which carry out excretion of human.
- The functional and the structural unit of kidney is nephon. The excretory materials produced in nephrons is referred to as urine.
- Urinary system is the anatomical system which involves in the production and removal of urine from the body.
- Circulating substances in the body and protecting the body from micro orgamisms are the function of the blood circulatory system.
- Blood is composed of blood cells and plasma
- Heart functions as a pumping machine of the blood circulatory system. It is a double blood circulation which consists of the systematic and pulmonary circulation.
- The diastole, the systole and the intervening phase are the three major stages of a cardiac cycle.

- In the lymphatic system, places where lymphatic vessels aggregate are called lymph nodes. Germs that enter the body are distroyed within the lymph nodes.
- Maintaining proper balance between stimulus and response is called as coordination.
- The nervous system and the endocrine system involve in maintaining coordination.
- The structural unit of the nervous system is the neuron where as the functional unit of nervous system is reflex arc.
- Brain and spinal cord belong to central nervous system.
- Reflex arc consists of motor neuron, sensory neuron and inter neuron.
- Autonomous nervous system is important to control involuntary body functions.
- Autonomic nervous system is organized to control opposite actions via sympathetic and parasympathetic nervous systems.
- Hormones which are secreted to the blood from the glands regulate the chemical coordination of the body.
- Homeostasis is the maintenance of a constant internal enviroment free from the changes in the external enviroment.
- Regulating blood glucose, body temperature and water balance is important in homeostasis.

Excercise

(1)



A part of the human digestive system is shown in the figure. Answer the questions raised on it.

I. Name the parts 1, 2, 3, 4

II. In the food that reaches stomach

a) Name one enzyme that could be present in it.

b) Name two products of digestion that could be present in it.

III. a) Name two enzymes which are added to the food in the stomach.

b) Proteins are digested partially in the stomach. Explain this using the changes that occur in proteins.

IV. a) Name the enzymes which are in the digestive juice/ fluid secreted by the organ No 2 to duodenum.

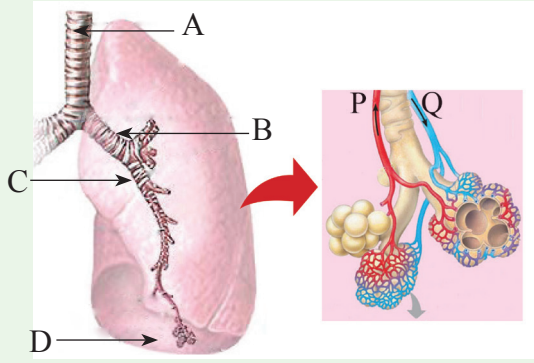
b) Name two secretions that influence lipid digestion.

c) Name the organs from which they are secreted.

V. Gastritis is a common disease of the digestive system. State three reasons for this disease

VI. Why protein digestive enzymes do not digest the wall of the digestive system.

(2)



An organ which is related to the respiratory process and its internal structure is shown in the figures.

a) Answer the following questions.

i). Name the parts A, B, C, D

ii). What is the respiratory surface shown in the diagram.

iii). Write two adaptations of that respiratory surface for the efficient gas exchange.

iv). What are the differences in blood composition of the vessels P and Q?

v). To which chamber does the blood flow through Q?

vi). What is the illness which shows symtom, swelling of B, C parts due to bacteria or virus infections?

b) Choose the correct answer

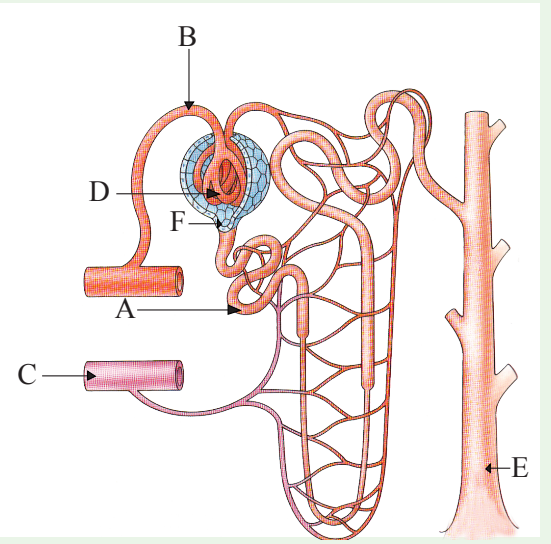
i) What is the respiratory product produced only in animals?

1) Energy 2) CO_2 3) Ethyl alchohol 4) Lactic acid

ii)Which of the following is not produced using anaerobic respiration

1) Alchohol 2) Biogas 3) Bread 4) Yogurt

(3) A figure of the structural and functional unit of the kidney is shown below.



i) What is this unit called?

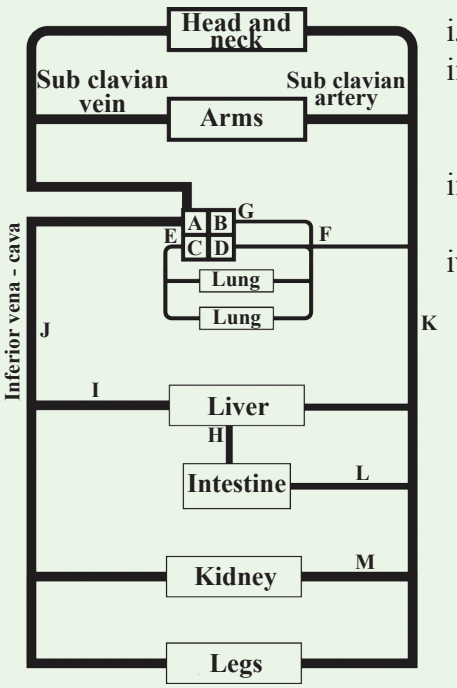
ii) Name the parts A, B, C, D, E.

iii) Briefly explain the functions that occur in D.

iv) Name two substances absorbed into blood capillaries from the fluid that flows through tube F.

v) A urine test of a person revealed that urine had sugar in it. What is the disease that person is having. What are the reasons for it?

(4) Following is a diagram of a model of the human blood circulatory system. Answer the following questions regarding that.



i. Name the chambers A to D.

ii Name the following blood vessels

a) E (c) G

b) F (d) H

iii In which form part of glucose is stored in liver?

iv Write the path of a glucose molecule in blood from the liver to the kidney. Use symbols.

v How many times does the glucose molecule pass through the heart when transporting to the liver?

vi Write two differences in blood at E and F.

(5) i) Name the nurone which involve in the peripheral nervous system
   a. Higher mental cognitive activities meta
   b. Controlling the heart beat rate
   c. Controlling swallowing
   d. Controlling functions of the voluntary muscles
(ii) Name the nurons which involve in the peripheral nervous system.
(iii) What is the sub system of the autonomous nervous system that functions mainly in an emergency.

Technical terms

Digestive system	ආහාර ජීරණ පද්ධතිය	சமிபாட்டுத் தொகுதி
Digestion	ජීරණය	சமிபாடு
Pharynx	ග්‍රසනිකාව	தொண்டை
Oesophagus	අන්නස්‍රෝතය	களம்
Salivary glands	ඛේට ග්‍රන්ථි	உமிழ் நீர்
Epiglottis	අපිජිහ්විකාව	மூச்சுக்குழல்வாய் மூடி
Bile	පිත	பித்தம்
Emulsification	තෛලෝදකරණය	குழம்பாக்குதல்
Peristalsis	ක්‍රමාකුංචනය	சுற்றுச் சுருங்கல் அசைவு
Chyme	ආමලසය	இரைப்பைப் பாகு
Appendix	උණ්ඩුක පුච්ඡය	குடல் வளரி
Anus	ගුද මාර්ගය	குதவழி
Faeces	මල	மலம்
Constipation	මල බද්ධය	மலச்சிக்கல்
Diaphragm	මහා ප්‍රාචීරය	வயிற்றோட்டம்
Respiratory system	ශ්වසන පද්ධතිය	சுவாசத் தொகுதி
Respiration	ශ්වසනය	சுவாசம்
Lungs	පෙනහැලි	நுரையீரல்
Ribs	පර්ශු	விலாவென்பு
Intercostal muscles	අන්තර් පර්ශුක පේශි	பழுவுக்கிடை தசைகள்

Aerobic respiration	සවායු ශ්වසනය	காற்றுச் சுவாசம்
Anaerobic respiration	නිර්වායු ශ්වසනය	காற்றின்றிய சுவாசம்
Nitrogenous excretory products	නයිට්‍රජනීය බහිස්ස්‍රාවී ද්‍රව්‍ය	நைதரசன் கழிவுப் பொருள்
Excretory system	බහිස්ස්‍රාවී පද්ධතිය	கழிவகற்றல் தொகுதி
Excretion	බහිස්ස්‍රාවය	கழிவகற்றல்
Kidney	වෘක්කය	சிறுநீரகம்
Ureter	මූත්‍රවාහිනිය	சிறுநீர்
Renal vein	වෘක්කීය ශිරාව	சிறுநீரக நாளம்
Renal artery	වෘක්කීය ධමනිය	சிறுநீரக நாடி
Bladder	මූත්‍රාශය	சிறுநீர்ப்பை
Urethra	මූත්‍ර මාර්ගය	சிறுநீர் வழி
Nephron	වෘක්කාණුව	சிறுநீரகத்தி
Glomerulus	ගුච්ඡිකාව	கோளவுருவானவை
Reabsorption	ප්‍රතිශෝෂණය	மீள் அகத்துறிஞ்சல்
Glomeular filtrate	ගුච්ඡිකා පෙරණය	மயிர்துளை
Afferent arteriole	අභිවාහි ධමනිකාව	உட்காவுநாடி
Efferent arteriole	අපවහි ධමනිකාව	வெளிக்காவு நாடி
Bowman capsule	බෝමන් ප්‍රාවරය	மோமனின் உறை
Collecting duct	සංග්‍රාහක නාලිකාව	சேகரிக்கும் குழாய்
Blood circulation	රුධිර සංසරණය	சுருதி சுற்றோட்டம்
Blood corpuscles	දේහාණු	குருதிக் கலங்கள்
Blood plasma	රුධිර ප්ලාස්මය	குருதி திரவவிழையம்
Red blood corpucle	රතු රුධිරාණු	செங்குருதிக் கலம்
Granulocytes	කණිකාමය සුදු රුධිරාණු	சிறுமணி கொண்ட வெண்குழியம்
Non- granulocycts	කණිකාමය නොවන සුදු රුධිරාණු	சிறுமணியற்ற வெண் குழியம்
Atrium	කර්ණිකාව	இதயவறை
Ventricle	කෝෂිකාව	சோணையறை
Bicuspid valve	ද්විතුණ්ඩ කපාටය	இருகூர் வால்வு

Pulmonary vein	පුප්ඵුශීය ශිරාව	நுரையீரல் நாளம்
Pulmonary cirulation	පුප්පුශීය සංසරණය	நுரையீரல் சுற்றோட்டம்
Lymphatic system	වසා පද්ධතිය	நிணநீர்த் தொகுதி
Systemic cirulation	සංස්ථානික සංසරණය	தொகுதி சுற்றோட்டம்
Blood capillaries	රුධිර කේශනාලිකා	குருதி மயிர்துளைக் குழாய்
Systemic artery	සංස්ථානික ධමනිය	தொகுதிப் பெருநாடி
Arterial system	ධමනි පද්ධතිය	நாடித் தொகுதி
Venous system	ශිරා පද්ධතිය	நாளத்தொகுதி
Coronary thrombosis	කිරීටක ත්‍රොම්බෝසිය	முடியுரு துரொம்போசிஸ்
Co-ordination	සමායෝජනය	இயைபாக்கம்
Homeostasis	සමස්ථිතිය	ஒருசீர்த்திடநிலை
Reflex arc	ප්‍රතීක චාපය	தெறிப்பு வில்
Reflex actions	ප්‍රතීක ක්‍රියා	தெறிவினை
Central nervous system	මධ්‍ය ස්නායු පද්ධතිය	மைய நரம்புத் தொகுதி
Autonomic nervous system	ස්වයං සාධක ස්නායු පද්ධතිය	தன்னாட்சி நரம்புத் தொகுதி
Parasympathetic system	ප්‍රත්‍යානුවේගී ස්නායු පද්ධතිය	பராபரிவு நரம்புத் தொகுதி
Sympathetic system	අනුවේගී ස්නායු පද්ධතිය	பரிவு நரம்புத் தொகுதி
Endocrine system	අන්තරාසර්ග පද්ධතිය	அகஞ்சுரக்குந் தொகுதி