LIFE PROCESSES-1

The activities by which living organisms take in food, derive energy, remove waste from their body and respond to changes in the environment are called **life processes**

WHY DO WE NEED FOOD

Food provides the essential raw material that our body needs to grow and stay healthy. It also provides energy to carry out various life processes.

In other words, **food** serves to :

- **provide energy to carry out life processes, such as respiration, digestion, excretion etc.**
- **help in growth of the body and repair of worn-out and damaged cells and tissues.**
- **help in the production of enzymes and hormones in the body.**

NUTRITION

Nutrition is defined as a process by which living beings obtain food, change food into simple absorbable forms and use it to make substances needed by the body.

Types of Nutrition

There are two main modes of nutrition—autotrophic nutrition and heterotrophic nutrition.

a) Autotrophic nutrition (*autos:* self; *trophos:* food)

The green plants, algae and cetain bacteria manufacture their own food through **photosynthesis**. They are termed **autotrophs** and their mode of nutrition **autotrophic nutrition**. They are the **producers** of the food chain as all organisms depend for food on them.

b) Heterotrophic nutrition (*heteros:* different; *trophos:* food)

The organisms, which depend on other organisms for their food, are called **heterotrophs** and their mode of nutrition is **heterotrophic nutrition.**

Heterotrophic nutrition is of various types

(i) Holozoic nutrition (*Gk: holos* = whole; *zoic* = animal)

Holozoic nutrition includes ingestion, digestion and absorption of food as in *Amoeba*, frogs and human beings.

(ii) Parasitic nutrition: The organisms that live on or inside other living organisms, and derive their food from them are called **parasites** and the nutrition is called parasitic nutrition. *Cuscuta* or Dodder plant (Amar bel) is a parasite on green plants.

(**iii) Saprotrophic nutrition:** Organisms that derive their food from dead and decaying **organisms** are called **saprotrophs.** Saprotrophs help in cleaning the environment by decomposing the dead and decaying organic matter. Some common examples are mushrooms, bread mould, yeast, etc. a white cottony growth developing on your wet leather shoes or belts especially when they get wet during rainy days. This is a fungus. The fungus grows and feeds on substances, which were once part of the living organisms, such as stored food, wood, leather and rotten plant products.

NUTRITION IN PLANTS—PHOTOSYNTHESIS (Photo :light; synthesis : make)

Photosynthesis is 'a biochemical process by which green plants manufacture their own food using carbon dioxide and water as raw materials in the presence of sunlight and chlorophyll'. **Oxygen is released as a by-product in this process.**

Photosynthesis is the only process by which solar (sun's) energy is converted into chemical energy.

The overall equation of photosynthesis is given here.

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

Carbon dioxide Water Glucose Water Oxygen

Essential raw materials for photosynthesis

i. Chlorophyll

To carry out photosynthesis, plants require as raw materials, carbon dioxide (CO_2), water (H_2O), light and chlorophyll. Light gives energy for photosynthesis.

P**hotosynthesis takes place in chloroplasts in the cells of leaves**.

The green colour of plants is due to chlorophyll. Chlorophyll is in the chloroplasts. It can trap light.

ii. Sunlight

Sunlight is absorbed by chlorophyll as solar energy. **iii. Carbon dioxide and water.** Carbon dioxide and water are combined in the chloroplast with the help of a number of enzymes to yield **sugar** which is converted into **starch**. Oxygen formed during photosynthesis diffuses out into the atmosphere through the stomata

The mechanism of photosynthesis

Photosynthesis occurs in two steps— (i) the light reaction and (ii) the dark reaction. In the light reaction, light is captured by chloroplast. The reaction occurs in the chloroplasts. In the dark reaction glucose is formed. Dark reaction occurs in chloroplasts. The dark reaction and light reaction occur simultaneously.

What happens to the end products of photosynthesis?

Glucose is formed in photosynthesis. It is either used up by the cells or is converted and stored in the form of starch. The other end product oxygen is released into the atmosphere. Energy is released during photosynthesis.

Significance of Photosynthesis

i. Photosynthesis is responsible for providing food to all living beings.

ii. Carbon dioxide produced during respiration by all living beings is used up during photosynthesis and does not accumulate in the atmosphere.

iii. Oxygen released during photosynthesis is used for respiration by living beings.

NUTRITION IN HUMANS

The food that we eat, consists of many different items of food. For healthy growth and development of the body, you need to eat food that provides enough of all essential nutrients.

Nutrients are the chemical substances present in our food which nourish our body.

Nutrients are broadly divided into three groups.

(i) Energy-yielding nutrients—carbohydrates and fats

(ii) Body-building nutrients —proteins and

(iii) Growth-regulating nutrients—vitamins and minerals

a) Carbohydrates

Carbohydrates are the main source of energy in our diet. Carbohydrates may be in the form of sugars, starch or cellulose.

Dietary carbohydrates

Types of Carbohydrates	**Source**
Sugar	Fruits, milk, sugarcane
Starch	Potato, wheat, rice, sweet potato
Cellulose (Roughage	Salads and raw vegetables

b) Fats

 Keep the body warm.

 Help in the transport of fat-soluble vitamins

 Some common sources of fats are edible oil, ghee, butter, meat and nuts like groundnuts.

 One gram of fat on oxidation given about 37 kilo joules (9 kilocalorie) of energy edible oil, ghee, butter, meat and nuts like groundnuts

c) Proteins

Milk or cooked pulses (dals) or an egg. All these are rich in proteins. Growth of body tissues is the main function of proteins.

d) Vitamins

You have often heard your mother saying 'Eat carrots and your eyesight will improve'. This is because carrots contain vitamin A. What are vitamins? They are necessary for normal growth, and maintenance of the body, and are required in relatively small amounts. Deficiency of a particular vitamin causes disease. Overdose of certain vitamins, such as vitamins A and D, is harmful. Vitamins may be water-soluble or fat-soluble.

Water-soluble: Vitamins B—complex (B1, B2, B4, B12) and C

Fat-soluble: Vitamins A, D, E and K

Types of vitamins, their sources, functions and deficiency diseases

Vitamin	**Sources**	**Functions**	**Deficiency disease**
A	Milk, carrots, tomatoes, egg.	keeps eyes and skin healthy.	Night blindness (Poor vision in dim light)
B1	Milk, peas, cereals, green vegetables, meat	Growth and development	Beri-beri (a disease which affects the nervous system)
B12	Liver, eggs, milk, fish	Form red blood corpuscles	Anaemia (deficiency of red blood corpuscles)
C	Amla, tomatoes, citrus fruits, water chestnut(Singhara)	Healthy growth, strong blood vessels	Scurvy (a disease in which gums swell up and bleed)
D	Sunlight, milk, whole grains and vegetables	Form strong bones and teeth	Rickets (a disease which affects bones in children making them soft and deformed)
E	Vegetable oils, milk, butter, whole grains, vegetables	Protects cell membranes	Affects fertility
K	Green vegetables like spinach and cabbage	Helps in the clotting of blood	Excessive bleeding from wounds

e) Minerals

Minerals such as iron, calcium, sodium, potassium, iodine etc.are required by the body in small quantities. Table 22.2 indicates the sources and functions of some important minerals.

Some important minerals, their sources and functions

Minerals	Sources	Functions
Iron	Green leafy vegetables, turnip, sprouts, yeast, liver, eggs, meat	Forms haemoglobin,
Calcium	Milk and milk products	Forms strong bones and teeth, and needed for muscle movement, clotting of blood
Potassium	Green and yellow vegetables	For growth and keeping osmotic balance of cells and blood
Iodine	Sea food, iodized salt	Body metabolism, development of brain

f) Water

Water is an important part of our diet. It makes 65-70% of our body weight. Water regulates the body temperature, and provides is a medium for biochemical reactions taking place in the body.

g) Raw vegetables

Raw vegetables help in bowel movement. They form the 'roughage' needed to prevent constipation.

Balanced diet

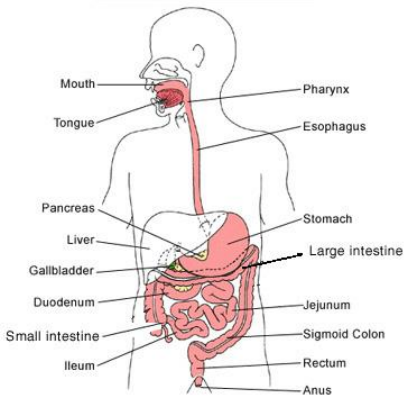
For healthy growth and development, you need to eat foods that provide all the essential nutrients in the correct proportion. **Eating a variety of foods in proper quantity every day constitutes a balanced diet.** A balanced diet contains adequate amounts of essential nutrients such as carbohydrates, fats, proteins, vitamins, minerals and water. The proportion may depend on age, sex, pregnancy etc.

DIGESTION-THE PROCESS OF NUTRITION IN HUMAN BEINGS

The food that we eat cannot be used by the cells in the body in the form in which it is eaten. Conversion of complex food material into smaller substances so that it can be absorbed by the cells is called **digestion**. Taking in of food is termed **ingestion**.

The digestive system

Alimentary canal is a long continuous tube constituted made by mouth, pharynx, oesophagus, stomach, small intestine, large intestine, and rectum. The glandular organs, salivary glands, liver and pancreas and the alimentary canal form the digestive system.



Enzymes

The process of digestion requires enzymes present in the digestive juices secreted by the organs of digestive system. They convert complex substances into simpler ones**. Enzymes are chemicals which speed up chemical reactions taking place in cells**. Almost all enzymes are complex proteins and remain unchanged during the chemical reaction. They can, therefore, be used repeatedly.

Processes involved in nutrition

The entire process of nutrition includes the following steps: ingestion, digestion, absorption, assimilation and egestion.

a) Ingestion and digestion

The process of taking in food through the mouth is called **ing*estio*n**. The digestion of food starts from the mouth and ends in the small intestine.

i. Mouth: Carbohydrates, such as starch, are broken down or digested to form sugar. Saliva contains an enzyme salivary amylase that breaks down starch into sugar. It also helps in lubricating the food and making it easier for swallowing.

ii. Oesophagus: There is no digestion in this part, also called **gullet** .The oesophagus or the food pipe by the contraction of muscles in its wall pushes the food into the stomach. Muscle movement is termed **peristalsis** and helped food travel down the alimentary canal.

iii. Stomach: The stomach is a highly muscular organ. The gastric glands present in its walls secrete gastric juice containing hydrochloric acid (HCl) and enzymes like**pepsinogen**. HCl activates pepsinogen into **pepsin** and kills bacteria. Proteins are broken into smaller fragments called peptones by the enzyme **pepsin**.

iv. Small intestine: The food moves from the stomach to duodenum, which is the upper part of the small intestine. Emulsification of fat (fat is broken into fat droplets) takes place with the help of the bile juice secreted by the live and stored in gall bladder. **Bile does not have any digestive enzymes** but it creates an alkaline medium which is essential for the action of pancreatic enzymes.

The **pancreatic juice** contains three enzymes.

- **Trypsin—**converts peptones and proteoses to smaller peptides.
- **Amylase—**converts starch into maltose.
- **Lipase—**converts fats into fatty acids and glycerol.

The digestion of proteins into the end products amino acids, carbohydrates into glucose, and fats into fatty acids and glycerol is completed in the small intestine.

The inner surface of the small intestine contains thin finger-like projections called **villi**, which increase the surface area for absorption of digested food into the blood capillaries lining the villi. The blood then carries the absorbed food to different parts of the body and undigested food is pushed into the large intestine.

Jaundice is caused by liver infection

When a person suffers from jaundice, the skin looks pale with a yellowish tint due to large amounts of **bilirubin a bile pigment** in the blood. The urine becomes deep yellow. Jaundice is caused by the Hepatitis virus. The virus is of different types and now there is an injection that provides immunity from the virus. The infection usually comes from infected water.

Large intestine: This part of the body absorbs water from the undigested food and solid waste is lubricated to form the faeces. The faeces pass on to the lower part of the large intestine, called the rectum, and are thrown out of the body through the anus.

b) Absorption

Blood capillaries in the villi pick up digested food and take it to all cells.

c) Assimilation

The absorbed food supplied to cells is used to release energy and also to build up the cell components. This is called assimilation.

d) Egestion

The process by which the undigested food material or waste is released from the body is called egestion.

DEFICIENCY DISEASES OR NUTRITIONAL DISORDERS

A disease that occurs due to lack of adequate and balanced diet is called **deficiency disease.**

Intake of improper or inadequate diet in human beings is called **malnutrition**. Malnutrition is harmful for children as it retards their mental and physical growth

Deficiency diseases due to inadequate nutrition are of three types:

a. Protein Energy Malnutrition (PEM)

b. Mineral deficiency diseases

c. Vitamin deficiency diseases

a) Protein Energy Malnutrition (PEM)

Deficiency of proteins in the diet causes PEM. This is the prime reason why your parents insist that you should drink milk; eat pulses and other sources of proteins.

Two diseases caused due to PEM are – **Marasmus** and **Kwashiorkor**

i. Marasmus

It affects children up to one year of age. This occurs in children deprived of mother's milk. The symptoms of this disease include:

- loss or wasting of muscles,
- body develops loose folds of skin,
- ribs become prominent,
- body growth and development slows down.

It can be cured by ensuring mother's milk for infants and by having a diet rich in protein, carbohydrates, fats, vitamins and minerals.

ii. Kwashiorkor

Amongst children of age group 1-5 years, protein deficiency causes kwashiorkor. The symptoms of this disease are:

- enlargement of liver due to water retention,
- darkening of the skin with scaly appearance,
- hair becomes reddish-brown,
- legs become thin, and
- retardation of physical and mental growth.

Eating a protein-rich diet that consists of milk, meat, groundnut, soyabean, jaggery, etc. can cure this disease

b) Mineral deficiency diseases

The two common mineral deficiency diseases are – goitre and anaemia.

i. Goitre: Caused due to prolonged iodine deficiency which causes enlargement of thyroid gland. Iodized salts and seafood are good sources of iodine. **ii. Anaemia:** Iron deficiency causes lesser production of haemoglobin (respiratory pigment), resulting in anaemia. An iron-rich diet consisting of spinach, apple, banana, guava, eggs, groundnuts, etc. can help to cure anaemia.

c) Vitamin deficiency diseases

Food Adulteration: Any attempt to mix items of food with cheaper, sub -standard, edible or inedible substances is called food adulteration.

Some food items and their common adulterants

Food item	Common adulterants
Cereals	Straw, husk, stones, inferior quality grains, infected or insect infested grains
Pulses	Straw, kesari dal, inferior quality grains, infected grains, metanil yellow dye
Milk	Starch, water, milk of other animals, extraction of fats, synthetic milk
Edible oils	Mineral oil, argemone oil, artificial colours
Turmeric (haldi	Starch coloured with chromate or metanil yellow dye
Coriander	Powdered cow/horse dung, saw dust, starch
Black pepper	Dried papaya seeds

TRANSPORTATION

The distribution of food and oxygen to all parts of the body as well as removal of body wastes is performed by a transport system within the body of all living organisms. Our body also secretes many hormones, which have to be carried to their target organs. The flow of fluid (blood or lymph) within the body for transport purposes is termed circulation and the organs for circulation constitute circulatory system.

Transport of Materials in Plants

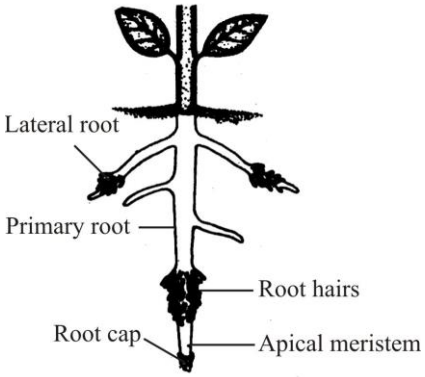
(i) Transport of water

Roots of plants take up water and minerals from the soil. this water move up from roots to leaves for photosynthesis through conducting tissues of plants – **xylem** and **phloem**

Tracheids and vessels, which are non-living cells of xylem, transport water picked up by root hairs from soil to the leaves. The upward movement of water and minerals from soil termed ‘ascent of sap’ is against gravity and is due to transpiration pull. Transpiration is the process in which a lot of water evaporates (as water vapour) from **stomata**. This evaporation creates a vacuum and pulls up water through the xylem. This is transpiration pull.

(ii) Transport of food material

Sugars and other food molecules synthesized in the leaves are transported to other parts of the plant through phloem. Sieve tubes are living cells of the phloem, which transport food Transport of food material from leaves to other parts of the plant is called **translocation**. This food may then be stored in fruits, stem or roots



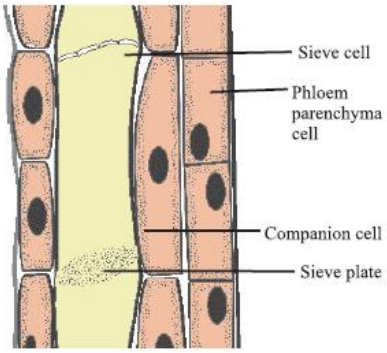


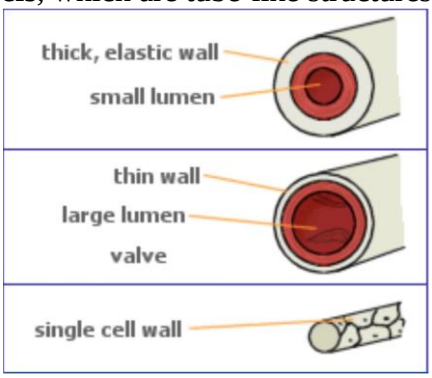
Fig.22.5 Sieve tubes in phloem

TRANSPORTATION IN HUMAN BEINGS

Human circulatory system consists of

(i) Centrally located muscular pump called **heart**, and

(ii) **Blood vessels**, which are tube-like structures, connected to the heart



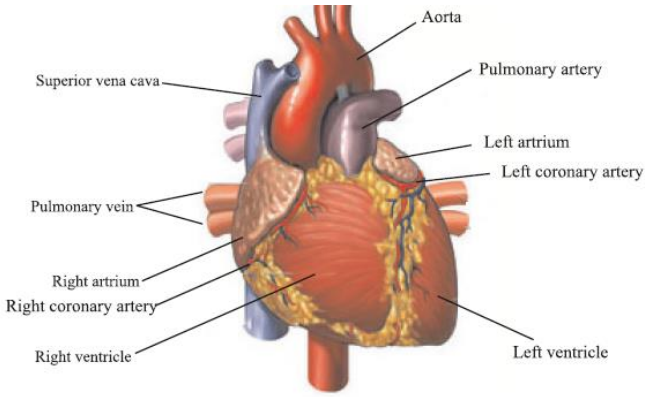
Blood vessels are of three kinds:

- **Arteries:** Carry blood from heart to various parts of body.
- **Veins:** Bring blood from various parts of body to the heart.
- **Capillaries:** Thin vessels between the artery and the vein. The capillaries allow the exchange of materials between blood and tissues.

(iii) Circulating fluid—blood, tissue fluid and lymph

Heart

Heart is a powerful muscular organ lying between lung. It is four-chambered- two (right and left) atria (*sing.* atrium, also called auricles), and two (right and left) ventricles



The heart is made of specialised muscle cells, also called cardiac muscle fibers, which contract and relax all the time without getting tired. The contraction andrelaxation follows a rhythm called **heartbeat.** Heart pumps blood into the blood vessels.Rhythmic heart beat results in the proper transport of substances to the various organs by means of blood. In one minute, normal human heart beats about 72 times. Abnormalities in heartbeat can be seen by taking **ECG** or **Electrocardiogram** The oxygen laden blood from the left ventricle gets pumped into a large artery called **aorta**. It carries oxygenated blood to all parts of the body. The general plan of human circulatory system is given in

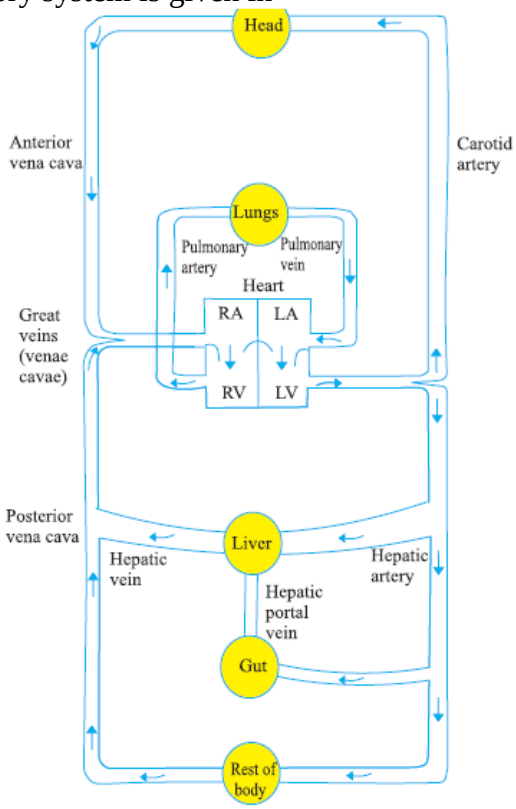


Fig.22.8 General plan of the human circulatory system

Blood Pressure

It is the force with which blood pushes against the walls of the arteries. It is generally measured in terms of how high it can push a column of mercury. When ventricles contract, pressure of blood inside the arteries is highest. In a healthy young human being, it is about 120 millimetres of mercury (120 mm Hg). When the

ventricles relax, pressure of blood inside the arteries is comparatively less. It is about 80 millimetres of Hg (80 mm Hg) in a healthy young man. Thus, a healthy young man has a normal blood pressure of 120 / 80 mm of Hg. The instrument used to measure blood pressure is called **sphygmomanometer.**

Pulse rate

The systemic contraction of the heart can be felt as a jerk in certain arteries like the radial artery in the wrist and neck artery below the jaw which are superficial in position. This is called **arterial pulse. Pulse rate is the same as the rate of heartbeat.**

Circulatory Medium

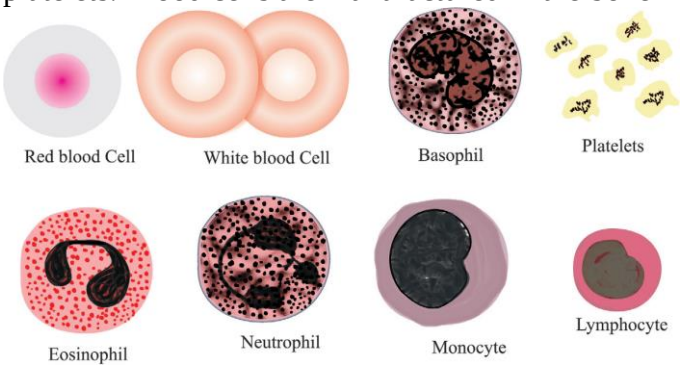
Our body has three different types of fluids

 Blood—found in heart and blood vessels (arteries, veins and capillaries) Tissue fluid—found in spaces between cells in organs

 Lymph—found in lymph vessels and lymphatic organs (e.g. spleen and tonsils)

Blood

Blood is a connective tissue that circulates throughout the body. It is made up of a fluid medium called **plasma** in which float two types of **blood cells**, called red blood cells, white blood cells and cell fragments called blood platelets. Blood cells are manufactured in the bone marrow.



Red blood cells (RBC or Erythrocytes)

 These are circular in shape, and contain a red coloured pigment called haemoglobin

 No nucleus is present in RBC

 RBC carry oxygen to tissues and bring back carbon dioxide from tissues

(b) **White blood cells (WBC or Leucocytes)**

 Since they carry no pigments, they are colourless

 They have irregular shape

 They prevent body from infections by eating up germs or by producing antibodies to fight antigens.

(c) **Blood platelets (Thrombocytes)**

 These are very small fragments of cells

 They have no nuclei

 They participate in clotting of blood

Functions of blood: Blood carries nutrients, oxygen, carbon dioxide, hormones and waste material to the relevant parts of the body. Some medicines when taken in the body are also distributed through blood.

Blood groups and blood transfusion

Injecting blood into the body from outside is called **blood transfusion**. You must have heard that blood has to be arranged for a person undergoing a surgery (operation) or in the case of an accident or in case of persons suffering from thallasemia. This arrangement is to replace blood lost from the patient. Blood transfusion is

successful only when the blood of **donor** (who gives blood) and of the **recipient** (who receives blood) match. Unmatched blood transfusion causes agglutination (clumping together) of red cells due to which the recipient may even die. On the basis of types of proteins present in the blood, a system of blood groups known as **ABO system** having four blood groups named A, B, AB and O is recognized in human blood. **Antigens** present on membrane of RBC of transfused blood is counteracted by **antibodies** present in the plasma of recipient.

Human blood groups and their compatibility

Blood group	Antigens on RBC	Antibodies in plasma	Can donate blood to	Can receive blood from
A	A	b	A, AB	A, O
B	B	a	B, AB	B, O
AB	AB	None	AB	A, B, AB,O
O	None	a, b	A, B, AB, O	O

The persons with blood group O can donate blood to all and so 'O' group is called **universal donor** and AB group can receive blood from donors of all blood groups and is called **universal recipient**.

Lympthatic system

Lymph is also a circulatory fluid and flows in the lymph vessels.

- It is light yellow in colour.
- It always flows only in one direction from tissues to heart.
- Cells called lymphocytes present in lymph eat up germs and prevent body from infections.
- It returns proteins and fluids from circulation to tissues.

Disorders related to circulatory system

1. Heart attack: Like all other organs, heart also needs nutrients and oxygen.When arteries supplying the heart become thick due to age or faulty diet consisting of excessive fatty food, muscle cells of the heart cannot beat in the proper rhythm. Heart attack occurs which can be detected in an abnormal ECG. Immediate medical attention is then required.

2. Anemia: When haemoglobin level falls below a certain point, the condition is called anemia. It makes the person weak and look pale and inactive. Iron in the diet helps remove anemia.

3. Leukemia: This is blood cancer. The bone narrow makes excessive WBCs and few RBCs.

4. Hypertension: It is another term for high blood pressure and leads to headache, dizziness and fatigue. Normal blood pressure is 120/80. Proper diet, exercise, medicines and tension free mind helps to cure high blood pressure.

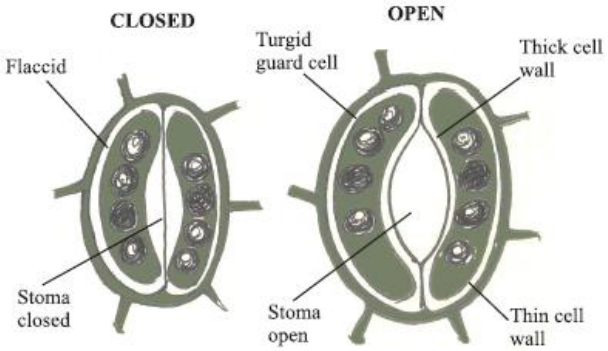
RESPIRATION

We can live without food for s everal days but we cannot live without breathing even for a short while. Breathing provides oxygen to the cells of our body for oxidation of food in order to generate energy for various activities.

Respiration in Plants

Plants do not have any special respiratory organs. Roots take up oxygen from air trapped in the soil by means of root hairs. Root hairs are embedded in the soil. Oxygen in the air surrounding them diffuses into the root hair and from there into the roots. Carbon dioxide given out, similarly, diffuses out through roots. Stomata in

leaves opens to let in oxygen and release carbon dioxide. In the older parts of roots or bark of woody plants, tiny openings called **lenticels** are present. It is through these lenticels that oxygen reaches the inner living tissues and carbon dioxide moves out.



Guard cells help in the opening and closing of stomata. When guard cells get filled up with water, they swell and become turgid. The two guard cells curve away from each other opening the stomata. When guard cells become flaccid, stoma closes. Minerals also play a role in making guard cells turgid or flaccid.

Breathing and Respiration in humans

Respiration may be divided into two steps.

 Breathing involves inhalation of air containing oxygen and exhalation of carbon dioxide.

 Cellular respiration is responsible for release of energy by oxidation of food (glucose), and its conversion into ATP (adenosine triphosphate)—The energy module.

***Respiration* is different from breathing**.

Breathing is the physical process of respiratory gaseous exchange between the organism and the environment by diffusion. It takes place in the lungs. On the other hand, **respiration** involves oxidation of food and release of energy which takes place in the cells along with respiratory gaseous exchange.

Respiratory system in Humans

Respiratory system

Respiratory system of human beings has the following parts

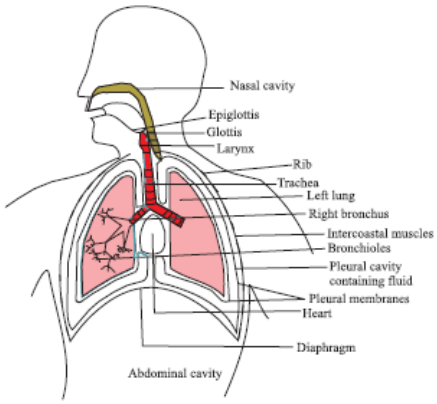
External nares or nostrils.

 Nasal cavities inside the nose.

 Internal nostrils opening into pharynx.

 Pharynx that leads into the wind pipe or trachea.

 Trachea divides into two bronchi (one bronchus) which lead into the two lungs.



The **opening** of the pharynx into the trachea is called **glottis**. Trachea is thin walled but its walls do not collapse even when there is not enough air in it as it is supported by rings of cartilage. Trachea bifurcates into **bronchi.** Lungs enclose within them branches of bronchi called **bronchioles** which branch further and end in very thin walled sac-like structures called **air sacs or alveoli** (sing. alveolus).

The voice box or **larynx** is present on the trachea **Mechanism of breathing or ventilation of lungs.** Lungs are located in the chest cavity or the thoracic cavity. Below the chest cavity is the abdominal cavity. These two cavities are separated from each other by a dome-shaped (upwardly arched) muscular sheet called diaphragm. The movement of diaphragm helps in breathing. Breathing, also called ventilation involves two processes:

(i) Inhalation (drawing the air inwards) (Fig.22.12a) is the result of increase in the volume of the thoracic cavity. This increase is caused by the changes that take place in the position of diaphragm and ribs.

 Diaphragm straightens out due to contraction of its muscles.

 Ribs are raised upward and outward and volume of chest cavity enlarges by contraction of rib muscles.. As volume of chest increases pressure of air in it decreases.

 Atmosphereic air rushes in and reaches the alveoli. It brings in oxygen which diffuses into the capillaries from the alveoli.

(ii) **Exhalation** is the result of decrease in the volume of the thoracic cavity. This decrease in the volume is caused when:

 Diaphragm relaxes and resumes its dome shape, arching upwards.

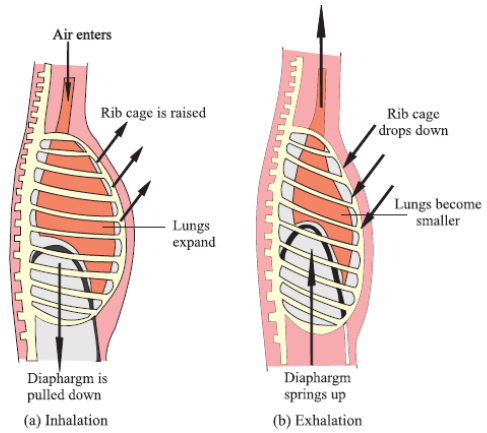
 Ribs are lowered downwards and inwards.

 Thoracic cavity is compressed and the pressure inside the lungs is increased.

 The alveolar carbon dioxide diffuses out and is pushed out through the trachea and nose.

 This breathing out of carbon dioxide laden air is called exhalation.

If you take long breaths, you can feel your chest go up and down.



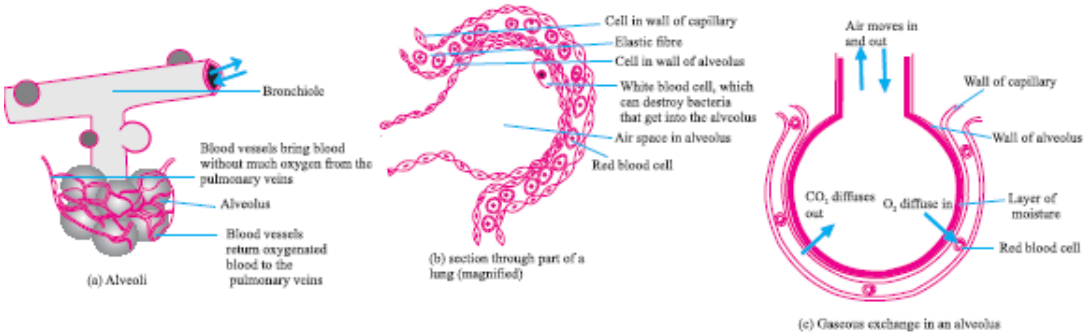
Breathing Rate

When at rest, an adult human breathes about 16 to 18 times per minute. Breathing rate increases during physical exercise, disease, fever, pain and under stress.

Exchange of gases between blood and tissues

Inhalation fills in the alveoli of lungs with oxygenated air. This oxygen has to reach the various tissues of the body. Thus as the first step, blood capillaries on alveoli pick up oxygen from alveoli and carbon dioxide brought by the capillaries from the tissues is exchanged for oxygen. Oxygen diffuses into alveoli. In the tissues,

oxygen gets used up and carbon dioxide is accumulated which is now exchanged for oxygen in blood. The carbon dioxide picked up by blood from tissues is carried to the heart by veins.



Cellular Respiration

Once inside the tissues, oxygen acts upon the digested food (glucose) which has reached the cells of the tissues. As a result energy and carbon dioxide are released. This occurs in the **mitochondria** of the cells and is called **cellular respiration**.

Do you know why mountaineers and sea divers carry oxygen cylinders and wear oxygen masks? As we climb higher and higher altitudes, the air pressure becomes lower and lower. Reduced oxygen supply causes breathing troubles and oxygen masks facilitate breathing. People living in hilly areas have evolved adaptation such as increased number of red blood corpuscles and large thoracic cavity. Divers carry oxygen masks because we derive our respiratory oxygen from air and not water.

Artificial respiration

A victim of an accident like drowning, electric shock or inhalation of poisonous gas suffers from “asphyxia” or lack of oxygen. The symptoms are blueing of lips, fingernails, tongues and stoppage of breathing. In such cases mouth-to mouth respiration is given. You must have realised how important respiration is for survival. Medical technology has introduced certain gadgets like the “oxygen mask” and “ventilators” which assist the patient in respiration during breathing problems. Often these help the patient to overcome such problems.

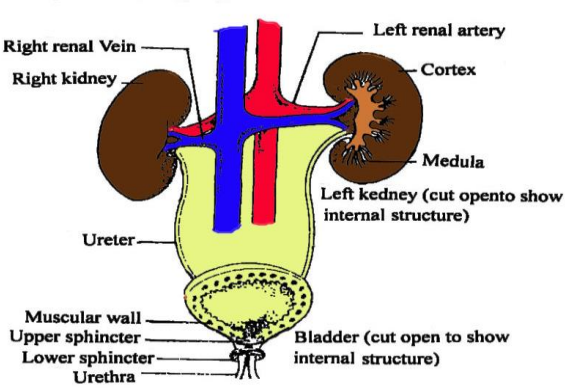
EXCRETION

Many chemical reactions take place inside body cells. Some products of these chemical reactions are not needed by the body. They may even be harmful if they accumulate in the body. Their removal from the body is called **excretion**.

HUMAN EXCRETORY SYSTEM

In human beings, excretion is carried out by an organ system known as the urinary system or the excretory system and locate the following parts:

- Two bean shaped kidneys, located below the diaphragm in the abdomen and towards the back.
- Two excretory tubes or ureters,(one from each kidney).
- One urinary bladder, ureters open into it.



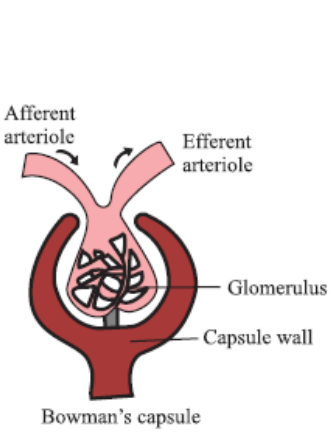
A muscular tube called urethra arises from the bladder. The urinary opening is at the end of urethra.

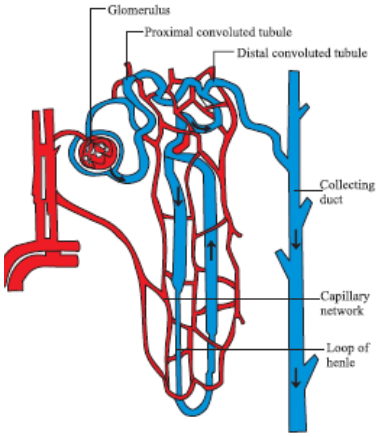
Structural and functional unit of the kidney — Nephron

Each kidney is made of tube like structures called nephrons (renal tubules). A nephron is the structural and functional unit of the kidney. The cup-shaped upper end of nephron is called Bowman's capsule, has a network of capillaries within it called **glomerulus**. Glomerulus is a knot of capillaries formed from the artery which brings blood containing wastes and excess of water to the kidney. Bowman's capsule leads into a tubular structure. The tubular part of the nephron or renal tubule has three sub-parts, the proximal convoluted tubule (PCT), a thinner tube called loop of Henle and the distal convoluted tubule (DCT). Blood capillaries surround these tubules.

Mechanism of excretion

Filtration and reabsorption are two important processes of excretion. Blood entering the glomerulus gets **filtered** in the Bowman's capsule and is called the nephric filtrate. The red blood corpuscles and proteins do not filter out.They remain in the blood stream. The filtrate entering the renal tubule not only contains waste but also useful substances. The useful substances get **reabsorbed** from the tubule into the blood capillaries surrounding the tubule. Excess water and salts like sodium and chloride also get reabsorbed into the blood from the renal tubule. Thus, waste alone which is primarily in the form of urea enters into collecting tubules from various renal tubules. It is the urine. From the kidneys, the urine enters the ureters to reach the urinary bladder where it is temporarily stored. Urine is thrown out periodically through the urinary opening.



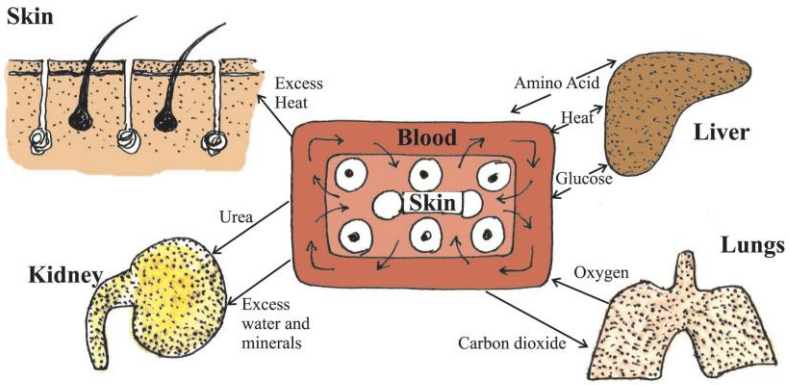


Functions of kidneys

- Kidneys not only excrete nitrogenous wastes but also regulate the water content of the body (osmoregulation),
- Keep the normal mineral balance in the blood. When this balance is upset, a person can fall sick.

Other organs that remove waste from our body

Apart from kidneys, lungs, skin and liver also remove wastes. Sweat glands in the skin remove excess salts when we perspire. Lungs remove carbon dioxide



Maintenance of the internal environment

A person gets sick if the balance of substances such as mineral ions, water or even hormones inside the body is upset. Maintenance of the correct amount of water and mineral ions in the blood is termed **osmoregulation**.

Kidney failure, dialysis and kidney transplant

Certain diseases or sometimes an accident may lead to kidney failure. Since the number of nephrons is as large as almost one million in each kidney, a person can survive even with one kidney. However, in case both the kidneys are damaged, it is difficult to remain alive. Modern technology can now save such patients with the help of new techniques like dialysis and kidney transplant. Fig. 22.17 shows the set up of an artificial kidney. A tube is inserted in an artery in the patient's arm or leg. The tube is connected to the kidney machine. This plastic tube has two membranes so as to form one tube within the other. In the inner tube flows blood from patient's artery. This blood is surrounded by fluid (dialysis fluid) in the outer tube, separated from it by the membrane of the inner tube. Wastes move out of blood into the fluid. The blood cleaned of its waste goes back from the kidney machine into the vein in the arm or leg and back into the body. The dialysis fluid carrying waste is removed from the machine. This technique is termed **dialysis**. Nowadays, a surgeon may sometimes remove a non-functioning kidney from a patient and replace it with a kidney donated by another person. Care, however, has to be taken so that a foreign kidney gets accepted by the body of the recepient.

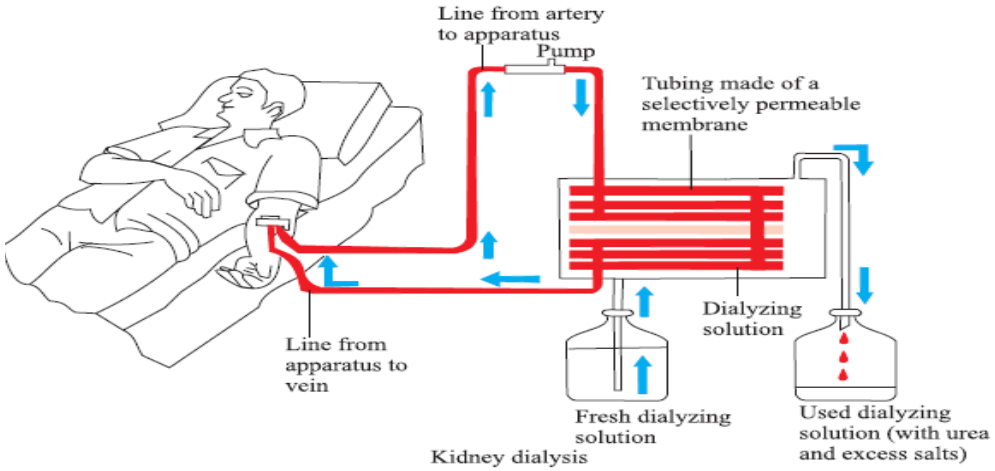


Fig22.17 Artificial Kidney