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22

LIFE PROCESSES-1 NURTRITION, TRANSPORTATION, RESPIRATION AND EXCRETION

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**. In this lesson, you will learn about basic life processes, namely nutrition, respiration, transportation of nutrients and fluids in the body, and excretion.

OBJECTIVES

After completing this lesson, you will be able to:

- *emphasize the need for energy requirement for life processes;*
- *explain the steps in photosynthesis;*
- *appreciate the various modes of heterotrophic nutrition in living organisms;*
- *realize the importance of the process of nutrition in humans, identify nutritional disorders and explain the concept of balanced diet;*
- *outline the need for and steps in the process of respiration;*
- *explain the fundamental aspects of transport of material(food, waste etc.) in plants and animals (e.g. humans);*
- *explain the process of excretion in humans.*

I. NUTRITION

22.1 WHY DO WE NEED FOOD

How do you feel if you do not have food for a day or two? You may feel exhausted and weak. But if you do not get food for a few days, will you survive and grow? You will probably say 'No'. We know that living beings need food to survive. 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.**

22.2 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.

22.2.1 Types of Nutrition

You already know that only plants can make their own food. Animals eat plants or other animals. 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: Have you ever been bitten by a head louse or a bed bug or had worms inside the body? These 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.

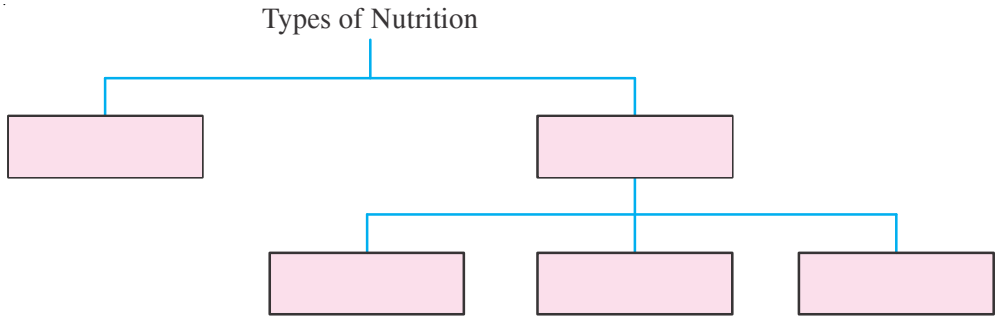
(iii) Saprotrophic nutrition: You must have seen a white cottony growth developing on your wet leather shoes or belts especially when they get wet during rainy days. This is a fungus. The fungus grows and feeds on substances, which were once part of the living organisms, such as stored food, wood, leather and rotten plant products. Some common examples are mushrooms, bread mould, yeast, etc. 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.

INTEXT QUESTIONS 22.1

1. Give two examples of autotrophs. Why do you call them so?

2. Why are autotrophs termed 'producers' of food chain?

3. Fill in the blanks in the flow chart given below:



4. The parasitic and saprotrophic modes of nutrition do not need the three processes required by holozoic animals. Which processes are these?

5. Classify the following as saprotrophs or parasites: leech, yeast, head louse, mushroom

22.3 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.

$$\underset{\text{Carbon dioxide}}{6CO_2} + \underset{\text{Water}}{12H_2O} \longrightarrow \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Water}}{6H_2O} + \underset{\text{Oxygen}}{6O_2}\uparrow$$

22.3.1. 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. **Photosynthesis 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 (Fig.22.1).

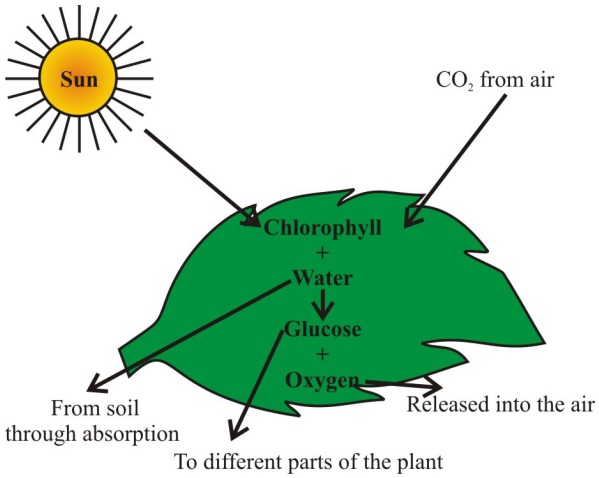


Fig. 22.1 Photosynthesis in a leaf

22.3.2 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?

- As seen in fig.22.1, 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.

22.3.2 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.

INTEXT QUESTIONS 22.2

1. In two sentences, justify the term photosynthesis (photo+ synthesis).

2. What makes plants look green? What does the green pigment of plants do for them?

3. Glucose and starch are two food substances manufactured in the plants. Which one is formed during photosynthesis and in which form is it stored.

4. What role does stomata play in photosynthesis?

22.4 NUTRITION IN HUMANS

The food that we eat, consists of many different items of food. You may prefer to take more of one type of food and less of another. Does your diet fulfil your body's requirement? Does it satisfy your taste buds or body needs? Think.

For healthy growth and development of the body, you need to eat food that provides enough of all essential nutrients. What does the term nutrient mean?

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

You must have often heard your mother insisting on your having a glass of milk or a bowl of 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? Table 22.1 lists certain 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 (B_1, B_2, B_4, B_{12}) and C

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

Table 22.1: 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)
B_1	Milk, peas, cereals, green vegetables, meat	Growth and development	Beri-beri (a disease which affects the nervous system)
B_{12}	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.

Table 22.2: 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.

22.4.1 Balanced diet

Now that you are aware of the components of diet, try to analyze your own food intake. Do you include all the food components in your 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.

ACTIVITY 22.1

Make a list of food that you consumed in the last seven days. Tabulate as shown below. Discuss with your parents/friends/siblings if your diet is balanced, if not, work towards making it balanced.

Day	Food taken	Nutrients taken	Items containing the nutrients
1 2 3 4 5 6 7	Lunch	Carbohydrates Protein Fats Vitamins Minerals	
1 2 3 4 5 6 7	Dinner	Carbohydrates Protein Fats Vitamins Minerals	

INTEXT QUESTIONS 22.3

1. Why should raw vegetables and fruits be a regular item in lunch/dinner?

2. I ate one gram of starchy food and you ate one gram of fatty food—who shall get more energy you or me?

_____

3. What is common between vitamins A and D and B and C to group them together?

_____

22.5 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**.

22.5.1 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. (Fig.22.2)

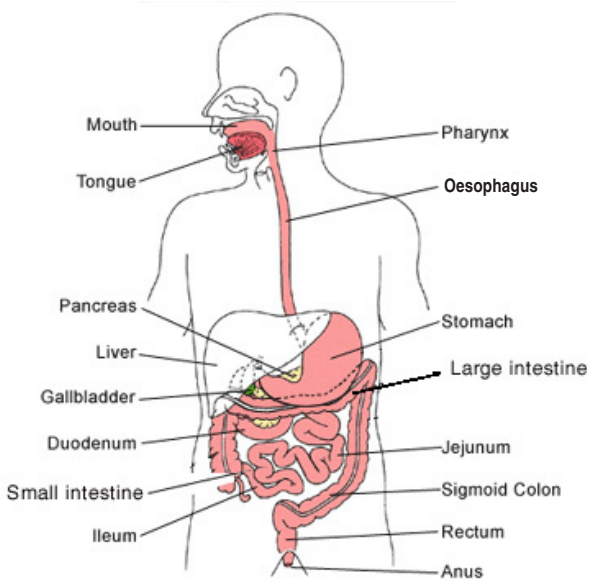


Fig. 22.2 Alimentary canal in human beings

22.5.2 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.

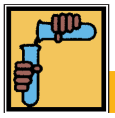
22.5.3 Processes involved in nutrition

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.



ACTIVITY 22.2

Taste a piece of bread or chapatti by biting it. What is the taste? Now chew well with teeth and roll with tongue. What is the taste now and why?

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.

v. 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.

ACTIVITY 22.3

Prepare a chart with the figure of alimentary canal and write down one or two main events of digestion occurring in front of each part. For example, in front of the stomach you can write

$HCl \longrightarrow$ Acidic medium

$\text{Protein} \xrightarrow{\text{Pepsin}} \text{Peptones}$

It will help you understand and remember.

INTEXT QUESTIONS 22.4

1. Name the enzyme secreted by stomach that converts proteins into peptones.

2. What is the movement of muscles of oesophagus that pushes down food called?

_____

3. In which part of the alimentary canal do the pancreas and liver pour their secretions?

_____

4. Name the enzymes present in the pancreatic juice that digests proteins, carbohydrates and fats.

_____

5. Name the acid that takes part in digestion process.

_____

22.6 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** (Fig. 22.3a, b).

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,

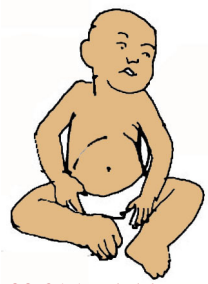


Fig.22.3(a) Child suffering from Marasmus

- 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.

Fig. 22.3(b) Child suffering from Kwashiorkor

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. (see figure 23.11 in the lesson-23, Control and Coordination)

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

You have already studied about vitamins and their deficiency diseases in table 22.1.

22.6.3 Food Adulteration

Why do we prefer to buy food products sold in sealed packets and items made by a standard reliable company? A simple answer is that the manufacturer selling its products in sealed packets or brands ensures delivery of good quality product.

Any attempt to mix items of food with cheaper, sub -standard, edible or inedible substances is called food adulteration. Table 22.3 shows adulterants of different food items

Table22. 3: 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

ACTIVITY 22.4

Food Adulteration

Take any five food items present in your house eg. pulses, rice, channa, black pepper, wheat, coriander seed etc. look for the various adulterants (if any) present in each of the five food items. Now state whether these adulterants are edible or inedible. Record your observations in a tabular form.

INTEXT QUESTIONS 22.5

1. Give the full form of PEM and name the diseases due to PEM.

2. If the diet continuously lacks in vitamin A, which disease may be caused?

3. Why does our government frequently advertise the necessity of consuming iodised salt?

22.7 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.

22.7.1 Transport of Materials in Plants

(i) Transport of water

Roots of plants take up water and minerals from the soil. How does this water move up from roots to leaves for photosynthesis? You have already learnt about conducting tissues of plants – **xylem** and **phloem** in lesson 21.

Tracheids and vessels, which are non-living cells of xylem, transport water picked up by root hairs (Fig.22.4) 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 (Fig.22.5). 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.

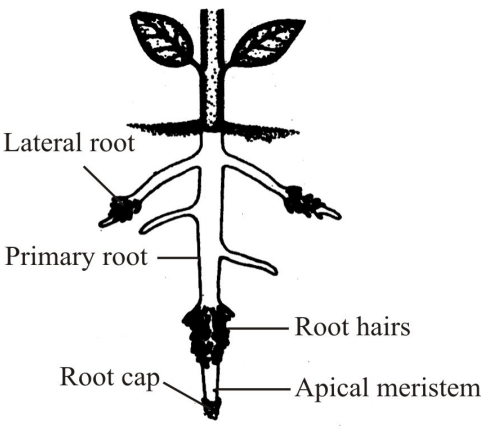


Fig.22.4 Root hairs

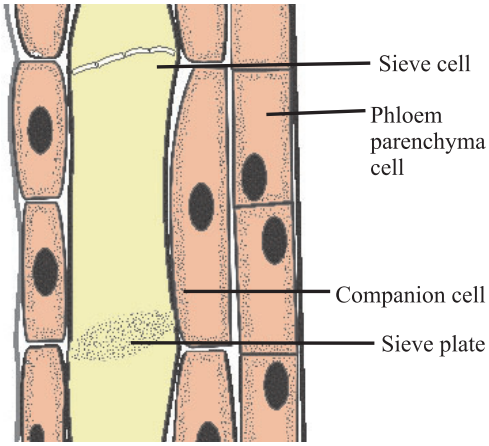


Fig.22.5 Sieve tubes in phloem

22.8 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 (Fig.22.6).

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.

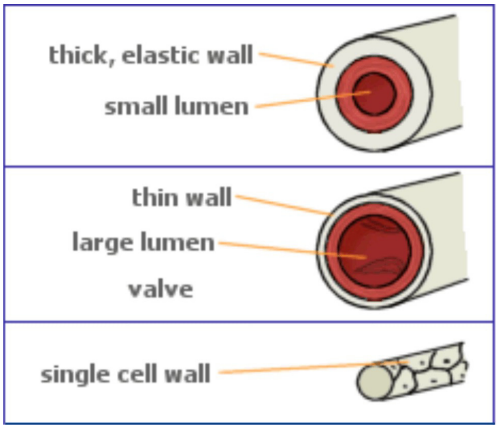


Fig. 22.6 Arteries, veins and capallaries

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

22.8.1 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. (Fig. 22.7a).

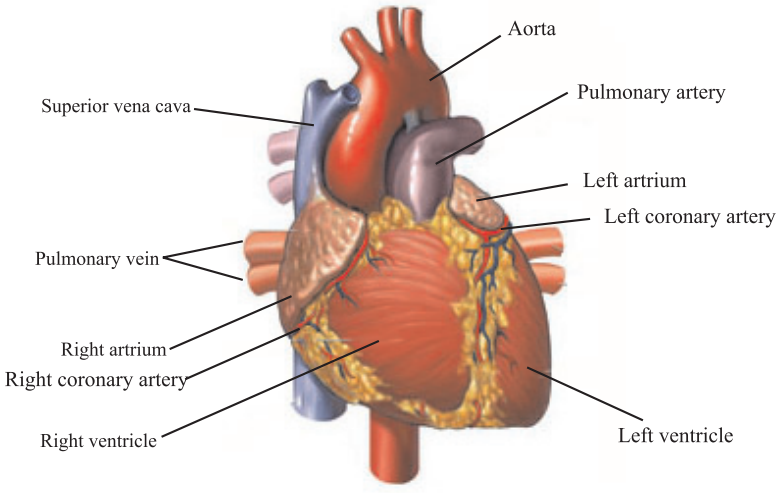


Fig. 22.7(a) The human heart

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 and

relaxation 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** (Fig. 22.7b).

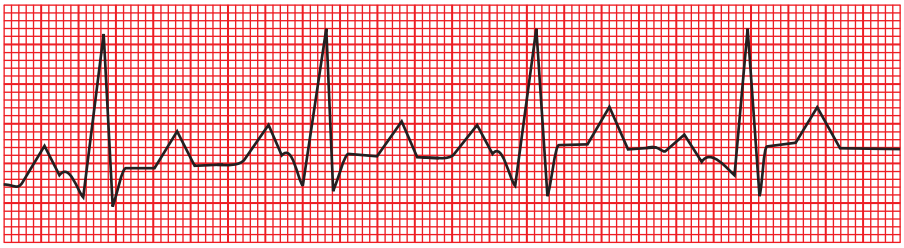


Fig. 22.7ECG or Electrocardiogram

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

ACTIVITY: 22.5

Find out the addresses of three hospitals/ clinics/nursing home nearest your house where treatment for heart diseases is taken up.

You must have noticed that veins bring oxygen depleted and carbon dioxide laden blood to the heart and arteries take oxygen laden blood away from the heart. But here are two exceptions – the pulmonary artery carries carbon dioxide laden blood and the pulmonary vein carries oxygen laden blood.

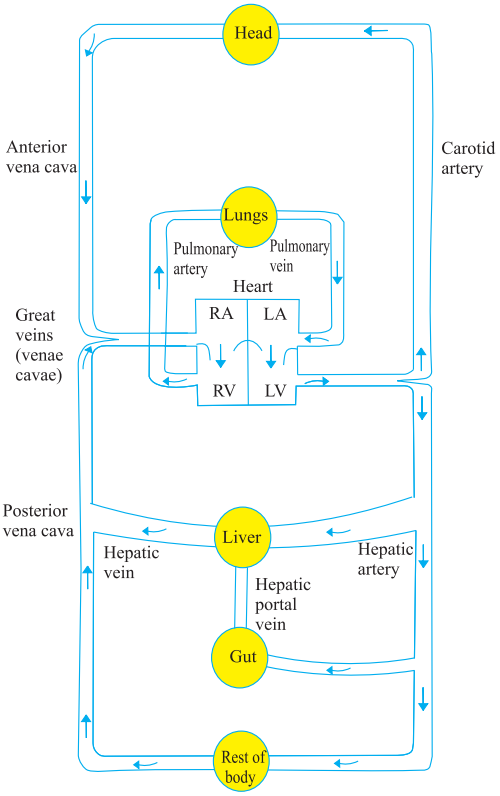


Fig.22.8 General plan of the human circulatory system

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.**

ACTIVITY 22. 6

Locate and hold the radial artery present in your wrist. Try and count the number of beats in a specified time. It is called 'pulse' and will give you an idea of the number of times your heart beats in a minute.

ACTIVITY 22. 7

Visit the local medical centre and get your pulse rate and blood pressure checked and also that of your family members. Do you find any difference in blood pressure and pulse rate of your family members?

INTEXT QUESTIONS 22.6

1. Why is a system of transportation/circulation necessary for organisms?

   _____

2. Which kind of blood vessels are responsible for the exchange of nutrients and respiratory gases between blood and tissues?

   _____

3. What is so special about heart that it continues beating without getting fatigued?

   _____

22.8.2 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. (Fig.22.9)

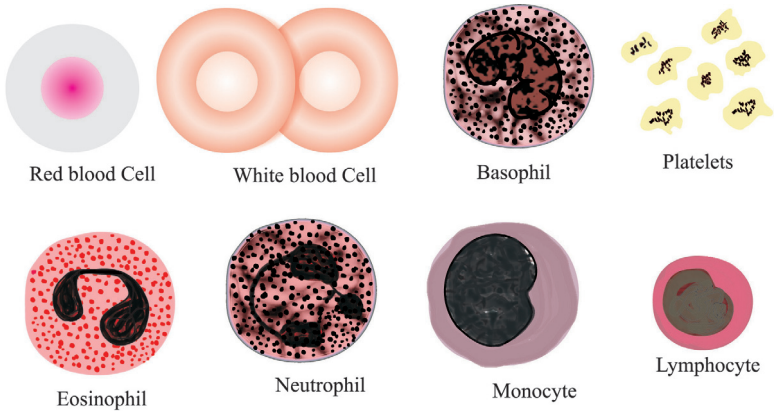


Fig22.9. Types of blood cells

(a) 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.

22.8.3 Blood groups and 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. Injecting blood into the body from outside is called **blood transfusion**. 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 (Table22.4). **Antigens** present on membrane of RBC of transfused blood is counteracted by **antibodies** present in the plasma of recipient.

Table 22. 4: 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**. Can you say why?

22.8.4 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.

22.8.5 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.

INTEXT QUESTIONS 22.7

1. Which blood cells would you categorise as (i) transporters of oxygen and carbon-dioxide (ii) enemies of germs that enter the body.

_____

2. Sheena has blood group O+ and Veena has AB+. Whose blood would be useful if it has to be transfused into an accident victim of unknown blood group and why?

_____

3. What makes RBC s look red? What is the role of this pigment?

_____

4. In which function is lymph similar to blood?

_____

22.9 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.

22.9.1 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.

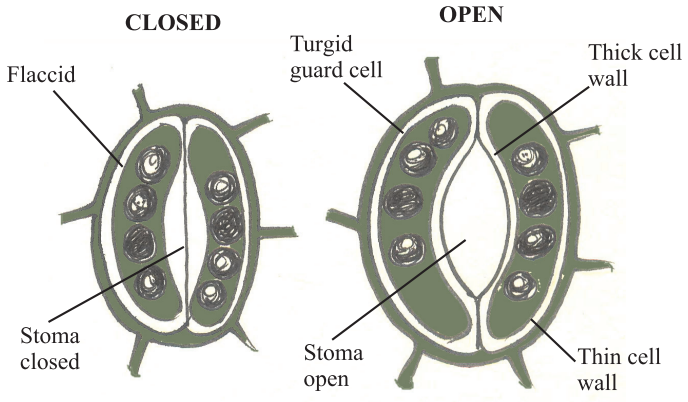


Fig22.10 Opening and closing of stomata (showing inner and outer surface)

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.

22.9.2 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.

22.9.3 Respiratory system in Humans

Respiratory system

Respiratory system of human beings has the following parts (Fig22.11).

- 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.

See figure 22.11 and locate the trachea, the windpipe

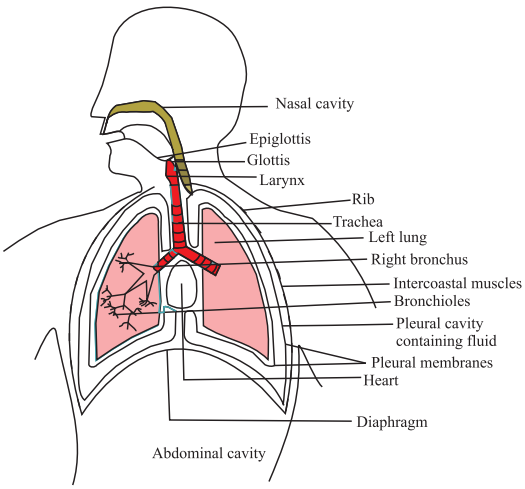


Fig. 22.11 Respiratory system in human beings

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). See the figure of respiratory system.

The voice box or **larynx** is present on the trachea

22.9.4 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 (see figure22.11). 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** (Fig 22.12b) 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.

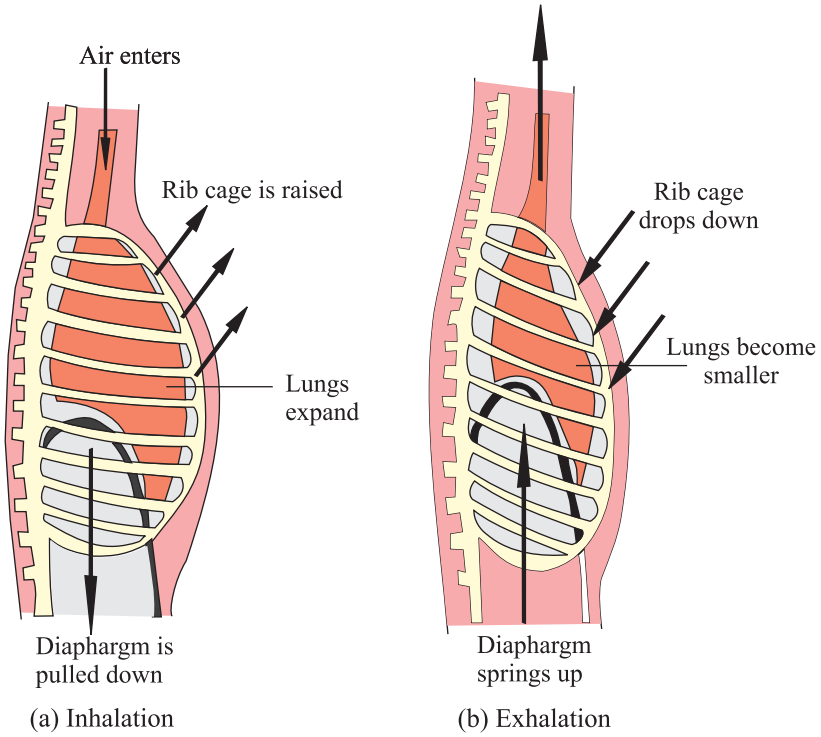


Fig22.12. How the thorax changes shape during breathing

22.9.5 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.

ACTIVITY 22.8

Check your breathing rate at rest. Now run for 5 minutes or climb 15 stairs and then check breathing rate. Do you find any difference? You will observe that you start panting and your rate of breathing increases as you run or climb the stairs.

22.9.6 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 (Fig22.17) 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.

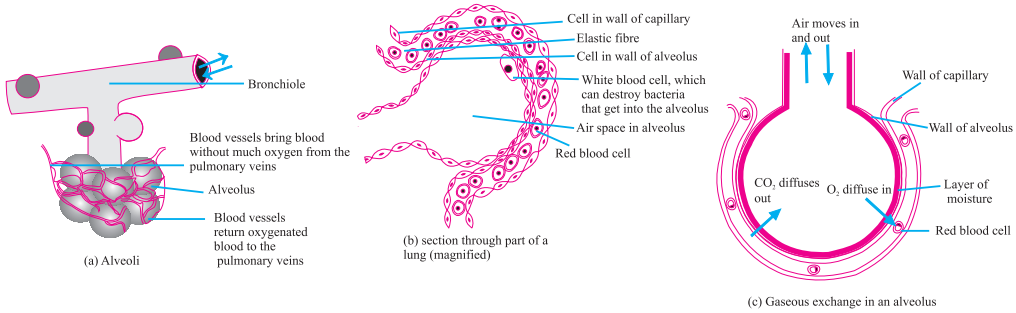


Fig.22.13 Exchange of gases between blood and alveoli

22.9.7 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.

INTEXT QUESTIONS 22.8

1. Why does the trachea not deflate (collapse) during exhalation?

2. The sequence of parts of human respiratory are jumbled. Place them in the right order. Nasal cavity, trachea, pharynx, internal nostrils, bronchi, lungs.

3. You have learnt in Physics that when volume increases, pressure decreases. How does this principle find a place in the process of breathing?

4. Once oxygen reaches cells, which of its organelles takes over respiration?

5. Why are the alveoli supplied with capillaries?

IV 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**.

22.10 HUMAN EXCRETORY SYSTEM

In human beings, excretion is carried out by an organ system known as the urinary system or the excretory system. See the figure (Fig 22.14) 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.

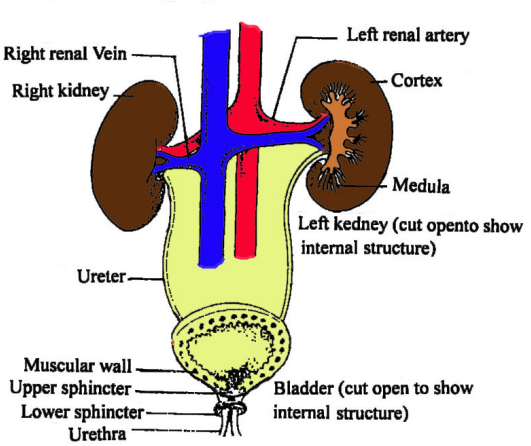


Fig.22.14 Human excretory system

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

22.10.1 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 capusle 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) (Fig. 22.15). Blood capillaries surround these tubules.

22.10.2 Mechanism of excretion

Filtration and reabsorption are two important processes of excretion.

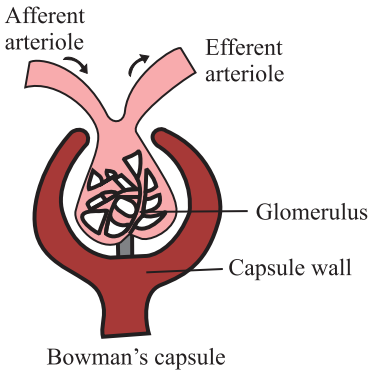


Fig.22.15(a) Bowman's capsule

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. (Fig 22.15a) .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.

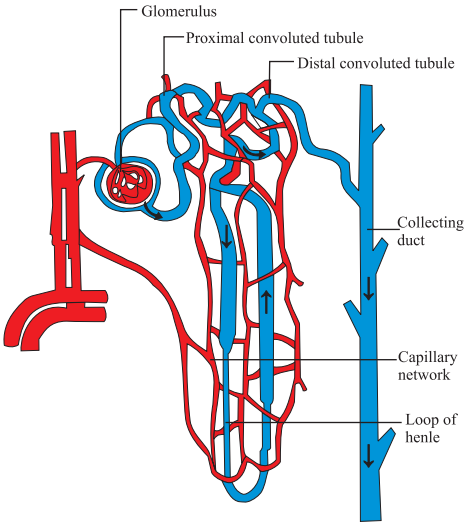


Fig.22.15 (b) Structural and functional unit of the kidney— Nephron

Functions of kidneys

- Kidneys not only excrete nitrogenous wastes but also regulate the water content of the body (osmoregulation), and

- Keep the normal mineral balance in the blood. When this balance is upset, a person can fall sick.

22.10.3 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 Fig. 22.16.

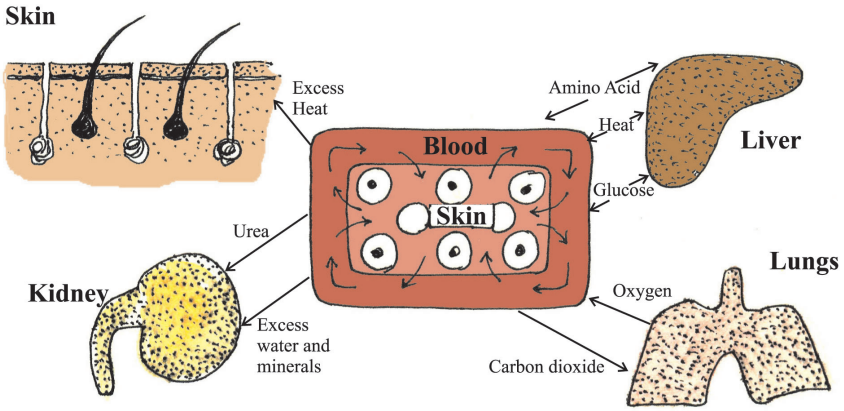


Fig. 22.16 other excretory organs

22.10.4 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**.

22.12.5 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.

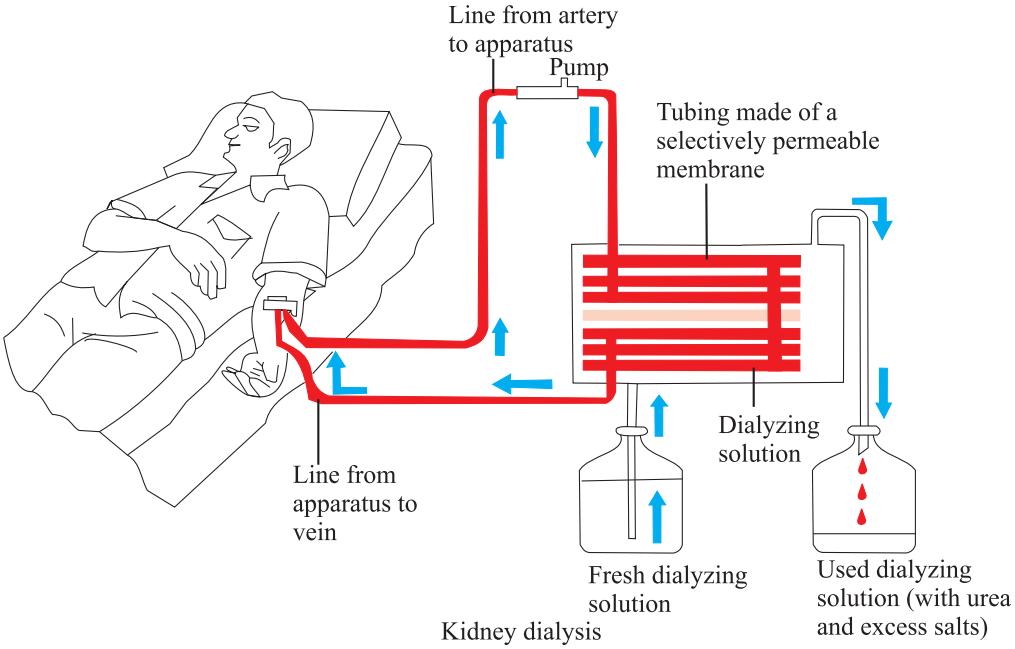


Fig22.17 Artificial Kidney

INTEXT QUESTIONS 22.9

1. Name the organ of the excretory system, which stores urine before its removal from the body.

_____

2. Draw a rough diagram of the nephron and label only the part where filtration occurs?

_____

3. What happens to the useful substances that move into the glomerulus along with nitrogeneous waste?

_____

WHAT YOU HAVE LEARNT

- Nutrition is a process by which living beings procure food or synthesize it and change it into simple absorbable form by a series of biochemical processes in the body.

- The photosynthesis provides food for all. It is the ultimate source of energy for all living organisms. It is essential for sustaining life.
- A balanced diet contains adequate amount of essential nutrients such as carbohydrates, fats, proteins, vitamins, minerals and water. The amount of these nutrients in diet depends upon a number of factors, such as age, sex and nature of work an individual performs.
- Conversion of complex food material into smaller substances so that it can be absorbed by the cells is called digestion. The digestive system enables conversion of ingested food into its simpler form. The process of digestion requires a number of enzymes.
- The absorption of food occurs mainly in the small intestine. The simple soluble food molecules are absorbed from the small intestine into the blood which takes them to all the cells of the body.
- A disease that occurs due to lack of adequate and balanced diet is called deficiency disease. Deficiency diseases caused due to malnutrition are of three types: protein energy malnutrition (marasmus and kwashiorkor); mineral deficiency diseases (goitre and anaemia); and vitamin deficiency diseases (xerophthalmia, rickets, beri-beri, pellagra).
- The distribution of food and oxygen to all parts of the body as well as the removal of body wastes is performed by a transport system within the body of all living organisms.
- Heart in humans is four-chambered, two upper chambers are called atria and lower chambers are ventricles. Heart is made of cardiac muscle fibres.
- Every human being belongs to one of four blood groups: A, B, AB and O. Blood transfusion can be between matching blood groups. The persons with blood group O can donate blood to all and 'O' group is called universal donor and AB group can receive blood from all and is called universal recipient.
- Breathing is the physical process of respiratory gaseous exchange between the organism and the environment by diffusion. On the other hand, respiration involves oxidation of food and release of energy along with respiratory gaseous exchange.
- In human beings, excretion is carried out by an organ system known as the urinary system or the excretory system.
- A nephron is the structural and functional unit of the kidney.

TERMINAL EXERCISES

1. Multiple choice type questions.

i. Rickets is caused due to deficiency of:
   a) Iron
   b) Vitamin D
   c) Proteins
   d) Carbohydrates

ii. One gram of a substance was oxidized. The energy released amounted to 9.0Kcal. The substance was of the type:
   a) Carbohydrates
   b) Fats
   c) Vitamins
   d) Proteins

iii. A person living in the hilly regions of Shimla developed swelling in his neck region. The doctor said his thyroid gland got swelled up. Name the nutrient deficient in his diet.
   a) Calcium
   b) Iron
   c) Phosphorus
   d) Iodine

iv. The vitamin that helps in the clotting of blood is:
   a) Vitamin A
   b) Vitamin D
   c) Vitamin E
   d) Vitamin K

v. In human beings, gas exchange between the environment and the body takes place in the :
   a) larynx
   b) bronchi
   c) alveoli
   d) trachea

vi. RBCs of human beings who live in high altitude regions:
   a) increase in number
   b) decrease in number
   c) decrease in size
   d) increase in size.

vii. Lungs have a large number of alveoli for:
   a) maintaining a spongy texture and proper shape.
   b) more surface area for diffusion of gases.
   c) more nerve supply.
   d) more space to increase volume of inspired air.

viii. The main function of lymph is to:
   a) transport O_2 to the brain.
   b) transport CO_2 to lungs.
   c) return interstitial fluid to blood.
   d) return RBCs and WBCs to lymph vessels.

2. Name the following.
   i. A fluid that transports fatty acid and glycerol.
   ii. The valve present in between the chambers on the right side of the human heart.
   iii. The respiratory pigment present in RBCs.
   iv. The iron containing pigment in RBCs.
   v. The phase of cardiac cycle in which the auricles contract.

3. Give on epoint of difference between the following.
   1. Autotrophic and heterotrophic nutrition
   2. Breathing and respiration
   3. Arteries and veins
   4. Blood and lymph
   5. Auricular systole and ventricular systole

4. Match the columns A and B.

COLUMN A	COLUMN B
1. Sponge-like organs located in the chest cavity	a. trachea
2. Chamber acting as a common passage for food and air	b. bronchioles
3. Elastic tissue that forms a flap over the top of the larynx	c. epiglottis
4. Main passageway to the lungs	d. pharynx
5. Small tubes that branch from the bronchi	e. bronchi
6. Small air sacs in the lungs	f. lungs
	g. alveoli
	h. larynx

5. Given below is an example of a certain structure and its function.

   'Kidney and excretion'

   Fill in the blanks on a similar pattern.

   1. Alveoli and _____
   2. Diaphragm and _____
   3. 'C'-shaped cartilage rings and _____
   4. Erythrocyte and _____
   5. Left ventricle and _____
   6. Pacemaker and _____

6. What is a balanced diet? Name three items of a diet that provide three different nutrients?

7. What are the main steps of photosynthesis? Is sunlight essential for photosynthesis and why?

8. A patient complains of lack of appetite, exhaustion and is losing weight. Diagnose the deficiency. What kind of diet would you suggest for the patient?

9. Deficiency of which vitamin causes night blindness. What would you suggest to prevent this deficiency?

10. Where does the digestion of starch, proteins and fats take place and what is the role played in digestion by liver and pancreas?

11. Which component in your diet will not be digested if the enzyme lipase is not secreted?

12. Explain how oxygen leaves the blood from the tissue capillaries and carbon dioxide enters the blood in the tissue capillaries.

13. Explain the usefulness of large surface area provided by alveoli for respiration in human beings.

14. Why do arteries have a thick or elastic wall?

15. What are the four types of blood groups present in humans? Prepare a table with two columns to show the different human blood groups and names of compatible blood groups in the other column.

ANSWER TO INTEXT QUESTIONS

22.1

1. Green plants, algae and bacteria (any two); they undertake photosynthesis to manufacture their own food.

2. They are the food for all the oorganisms in a food chain
3. Types of nutrition: Autotrophic, Heterotrophic:—Holozoic, Parasitic, Saprophytic/ saprotrophic
4. Digestion of the ingested food.
5. Parasitic: leech, head louse; saprophytic: Yeast, mushroom.

22.2

1. Photo means light and synthesis means manufacture. Plants manufacture food in presence of light.
2. Chlorophyll; necessary for photosynthesis.
3. Glucose during photosynthesis stored as starch.
4. Let in CO_2, from the atmosphere let out O_2 is to the atmosphere.

22.3

1. Easy bowel movement / prevents constipation/, forms roughage.
2. You
3. Vitamin B and C.—Water soluble vitamin

   Vitamin A, D, E and K.Fat soluble:-

22.4

1. Pepsin
2. Peristalsis/ peristaltic movement
3. Small intestine
4. Trypsin digests proteins, Amylase digest carbohydrates, Lipase digests fats
5. HCl (Hydrochloric acid)

22.5

1. Protein Energy Malnutrition; Marasmus and Kwashiorkor
2. Night blindness; Beri Beri, Pellagra; Anaemia, Scurvy; Rickets; Excessive bleeding from wounds (any two)
3. Because it contains Iodine which is necessary for formation of thyroid hormones/ prevention of diseases due to deficiency of thyroid hormone/prevention of goitre.

22.6

1. To circulate O_2 / products of digestion of food/ removal of waste
2. Capillaries
3. Valves prevent mixing of oxygen laden blood with carbon dioxide laden blood.

22.7

1. (i) RBC
   (ii) WBC
2. Sheena's blood because O group is universal donor.
3. Haemoglobin; carries oxygen to tissues and brings back carbondioxide from tissues.
4. Prevent body from infections; returns proteins and fluid from circulation to tissues.

22.8

1. It is supported by rings of cartilage.
2. Nasal Cavities; Internal nostrils; Pharynx; Trachea; Bronchi; Lungs.
3. During inhalation, chest cavity enlarges and air pressure in it decreases so air from outside rushes in.
   - Diaphragm straightens out.
   - Ribs are raised upward and outward
   - Volume of chest cavity increases;pressure of air is it decreases
   - Air rushes into the alveoli
4. Mitochondria
5. For the exchange of gases (O_2 and CO_2)

22.9

1. Urinary bladder
2. Bowman's capsule labeled in the figure of nephron.
3. Get reabsorbed into the blood capillaries surrounding the tubule.