LIFE-PROCESS

All the living organisms including human beings perform a number of activities such as nutrition, respiration, excretion, growth and reproduction. These activities are characteristics of living organisms, and through such activities they maintain their lives.

These maintenance functions of living organisms are known as life processes.

Chemical reactions which take place within cells or organisms during various vital activities are called biochemical reactions.

Metabolism is a word used to describe the sum total of all the chemical and physical changes that are constantly taking place in living matter and are necessary for life. The word metabolite refers to a substance which undergoes various changes during metabolism. For example, carbon dioxide and water are metabolites used in the process of photosynthesis.

The metabolic pathways are of two types:

(i) Anabolic pathways or biosynthetic pathways in which biosynthesis of organic compounds occurs, or in other words, complex substances are synthesized from simpler ones. For example photosynthesis.

(ii) Catabolic pathways in which the breakdown of complex organic substances into simpler ones occurs (as in respiration).

In anabolic pathways or processes of anabolism energy is used (endothermic reactions), while in catabolic pathways or catabolism, energy is released (exothermic reactions).

Criteria to define something is alive:

1. Nutrition: The processes by which organisms obtain and utilise the nutrients (food).

2. Respiration: The process that involves breakdown of respiratory substrates through oxidation and release of usable energy.

3. Transport: The process in which the substances absorbed or synthesized in one part of the body is carried to other parts of the body.

4. Excretion: The process involved in removal of the excess or toxic wastes from the body.

5. Control & coordination: The process which helps the living organisms to receive information from the surroundings and behave accordingly in order to survive in the changing environment around them.

6. Growth&development: Permanent increase in the size of the organisms is called growth. The whole series of changes which an organism goes through during its life cycle, is called **development**.

7. Movement and Locomotion: Movement is the temporary or permanent displacement of a body or its parts from its original position. Living beings and parts there of **move** in response to stimulus from outside or from within the body.

Locomotion, on the other hand, is the displacement of the entire body from one place to another.

Nutrition

Nutrients are inorganic as well as organic substances which the organisms obtain from their surroundings in order to synthesize their body constituents and use them as a source of energy. The process of intake of nutrients and its utilization by an organism in various biological activities.

Energy foods: Carbohydrates and fats.

Body building foods: Proteins and mineral salts, synthesis skin and blood.

Regulating foods: Vitamins and minerals.

Modes of nutrition: Method of obtaining food by the organism is called **mode of nutrition.**

(A) Autotrophic nutrition: The mode of nutrition in which the organisms prepare (or synthesize) their own organic food by using inorganic raw material (CO_2 & H_2O). They are also called **autotrophs.**

example: Plants, Photosynthetic and chemosynthetic bacteria and cyanobacteria etc.

(B) Heterotrophic nutrition: The mode of nutrition in which the organisms derive their nutrition from other organisms. They take ready made organic food from other dead or living plants or animals. The living organisms showing heterotrophic nutrition, are called **heterotrophs.**

example: All animals, fungi, many bacteria and some non-green plants (insectivorous plants) and man.

Types of heterotrophic nutrition:

(i) Holozoic nutrition-

The mode of nutrition in which all animals take in complex solid food material is called holozoic nutrition.

It contains the following steps:

- Ingestion: Taking in complex organic food through mouth opening.

- Digestion: Change of complex food into simple diffusible form by the action of enzymes.

- Absorption: Passing of simple, soluble nutrients into blood or lymph.

- **Assimilation:** Utilization of absorbed food for various metabolic processes.
- **Egestion:** Expelling out the undigested food.

For example: All animals including vertebrates and Invertebrates.

Depending upon the **type of food habit**, animals are divided into three categories:-

(a) Herbivores: Animals that depend upon green plants are known as herbivores.

For example: Goat, Cow, Deer, Rabbit.

(b) Carnivores: Animals which eat flesh of other animals as food are called carnivores.

For example: Lion, Tiger.

(c) Omnivores: Animals which eat both plants and animals as food are known as omnivores.

For example: Rat, Pigs, Crows, Cockroaches and Humans.

(ii) Saprotrophic (Sapro - Rotten; Trophos - Feeder) Nutrition: In this type of nutrition the organisms obtain their food from decaying organic substances. Organisms are also called **saprotrophs**.

example: Bacteria, Fungi.

(iii) Parasitic nutrition (para-other):

The mode of nutrition in which one organism (called parasite) derives its food from other living organisms (Host) without killing it is called parasitic nutrition. Parasite gives no benefit to host.

example: Tapeworm, Ascaris,leech,ticks,roundworm Plasmodium, Liver flukes, Cuscuta etc.

Characters	**Autotrophic Nutrition**	**Heterotrophic nutrition**
(1) Source of Energy	Sunlight or chemical energy	Readymade food
(2) Mode of Nutrition	Photosynthesis or Chemosynthesis or animals	Feeding upon dead or living plants
(3)Occurrence	Found in green plants, Blue-green algae, certain Bacteria	Found in Animals, fungi, Most of the bacteria

Animals which depend upon the blood of other animals known as **sanguines** / **sanguivorous.**

example: Mosquito, Leech

(iv) Mutualistic/ Symbiotic nutrition: The mutualistic nutrition can be defined as the interdependent nutrition in which each organism is dependent mutually on the other.

example: The lichens share mutualistic nutrition between a fungus and an Algae.

Fungus provide water and mineral to algae while algae provides food to fungi

•Rhizobium present in leguminous plants

• Mycorrhiza – fungus + roots of higher plants

(v) Chemosynthetic nutrition: organism manufacture food by utilizing energy released by oxidation of inorganic materials

Eg – sulphur bacteria, nitrosomonas bacteria found in lakes and streams oxidise ammonia into nitrite.

Nutrition in unicellular organisms Amoeba:

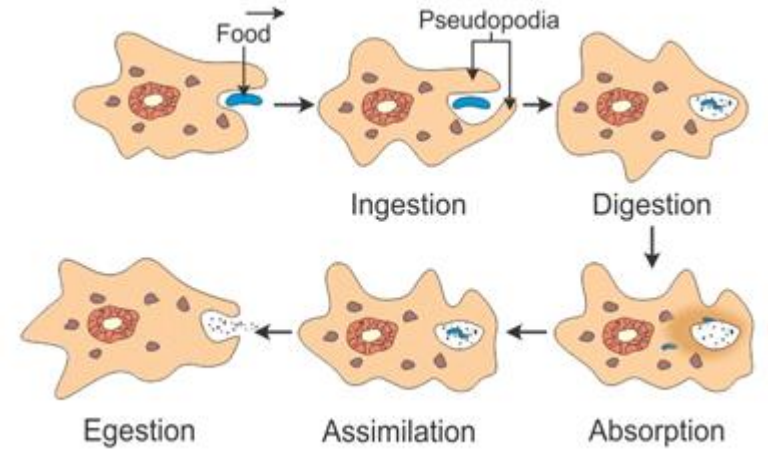
Food: Amoeba is a holozoic and omnivorous animal. It feeds upon microscopic organisms like bacteria, Paramecium, Diatoms, Algae and dead organic matter.

Mechanisms: Nutrition in Amoeba involves the following steps:

(i) Ingestion: Amoeba has no mouth, so ingestion may occur at any point of body surface but generally it occurs at the advancing end of the body. Ingestion occurs with the help of pseudopodia. The opening of food cup gradually becomes narrower and narrower, and finally closes. So the food is finally enveloped and taken inside a **food-vacuole** (called **phagosome**) along with a drop of water.

(ii) Digestion: Amoeba shows **intracellular** and **vacuolar digestion**. In the cytoplasm, food vacuole fuses with lysosomes containing digestive enzymes. In this, the complex and non-diffusible nutrients are changed into simple and diffusible nutrients. Medium inside the food vacuole is **first acidic but later becomes alkaline** (as in the alimentary canal of man).

(iii) Absorption and assimilation: In absorption, the diffusible nutrients pass through vacuolar membrane into the cytoplasm by diffusion and are then distributed to all the body Due to this, the size of food vacuole gradually decreases.
In the cytoplasm, a part of the absorbed food is oxidised to produce energy, most of simple nutrients are combined to synthesize complex compounds.
(iv) Egestion: Amoeba has no anus, so egestion may occur at any point on the body surface.



Paracmecium –
It is a tiny unicellular animal who lives in water. It has. definite shape and food is taken in at a specific spot.
It uses hair like projections, cilia to sweet the food particle from water and put them into its mouth. This is the first step of nutrition called ingestion.
Remaining steps are same as in amoeba.

Photosynthesis can be defined as the synthesis of organic compound (carbohydrates) from CO_2 and H_2O using solar energy by chlorophyll molecules.

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

Food prepared by plant is in the form of simple sugar called glucose. Extra glucose is changed into another form called starch, stored in the leaves of the plant.

The process of photosynthesis involves two phases: Light Reaction and Dark Reaction.
Light reaction – It usually takes place in the grana of chloroplasts.

The energy from the sun is absorbed by the chlorophyll in the chloroplasts. The energy is then transferred to ATP (adenosine triphosphate)and NADPH (nicotimeamide adenine dinucleotide phosphate). Water is used and oxygen is released during the process.

Dark reaction – It is a light-independent process in which sugar molecules are formed from the carbon dioxide and water molecules.

The dark reaction occurs in the stroma of the chloroplast where they utilize the products of the light reaction.

How plants obtain Carbon dioxide – enters through stomata. Each stomatal pore is surrounded by a pair of guard cells. When water flows into guard cells, they swell and open the pore and when guard cells loose water, shrink become straight and close the stomatal pore. Water is lost through transpiration. Released oxygen goes out through stomatal pore of the leaves.

How plants obtain water – absorbed by roots, transported upward through xylem vessels to the leaves.

Chloroplast – numerous disc like organelles below epidermis of leaves present in middle layer called mesophyll cells, green due to chlorophyll pigment.

Events occur during the photosynthesis :
(i) Absorption of light energy by chlorophyll.

(ii) Conversion of light energy to chemical energy as well as splitting of water molecules into hydrogen and oxygen.
(iii) Reduction of carbon dioxide to carbohydrates.

Significance – Maintains level of atmospheric oxygen which is consumed by plants and animals

• oxygen is utilised in making outer layer of atmosphere i.e ozone

• Consumes carbon dioxide, added by the respiration of organisms and burning of fuel.

Experiment 1 – To show that Carbon dioxide is necessary for photosynthesis

•Take 2 healthy potted plants, keep them in dark room for 3 days.

•Place a watch glass containing potassium hydroxide (KOH) by the side of one of the plant. KOH absorbs carbon dioxide

•Cover both plants with bell jars

•Keep plants in sunlight for 2 hours.

•Pluck a leaf from each plant and check the presence of starch with iodine solution

•Remove chlorophyll from leaf by boiling it with alcohol, decolorize leaf

•Pour iodine solution over the colourless leaf

•leaf from plant which was kept without KOH will show blue black colour, as carbon dioxide has not been absorbed.

Experiment 2 – To show that sunlight is necessary for photosynthesis

• Take a potted plant and destarch its leaves by keeping it in dark for 2-3 days

•Take a thin strip of Al foil and wrap it in the centre of one attached leaf to the plant, on both the sides to prevent entry of sunlight

•Place the plant in sunlight for 3-4 days and test for starch

•Positive starch test – leaf exposed to sunlight Negative starch test – leaf part covered with All foil

Experiment 3 – To show that chlorophyll is necessary for photosynthesis

•Take a potted plant like croton plant or variegated leaves whose leaves are partially green and white. Green part has chlorophyll while white part doesn't have it

•Place the plant in a dark room for 4 days to destarch its leaves

•Take out the potted plant from dark place and keep it in bright sunshine for 4 days

•Remove chlorophyll by boiling it in alcohol

•Pour iodine solution over the colourless leaf and observe the change in color of leaf

•Outer part of leaf that was white doesn't turn blue black on adding iodine solution

•Inner part turns blue black on adding iodine solution showing the presence of starch.

Digestive system of human :
Human digestive system consists of the alimentary canal and digestive glands and it involves mastication, swallowing, digestion of food and elimination of undigested matter.
Alimentary canal: The alimentary canal is basically a long tube 9 m long extending from the mouth to the anus.

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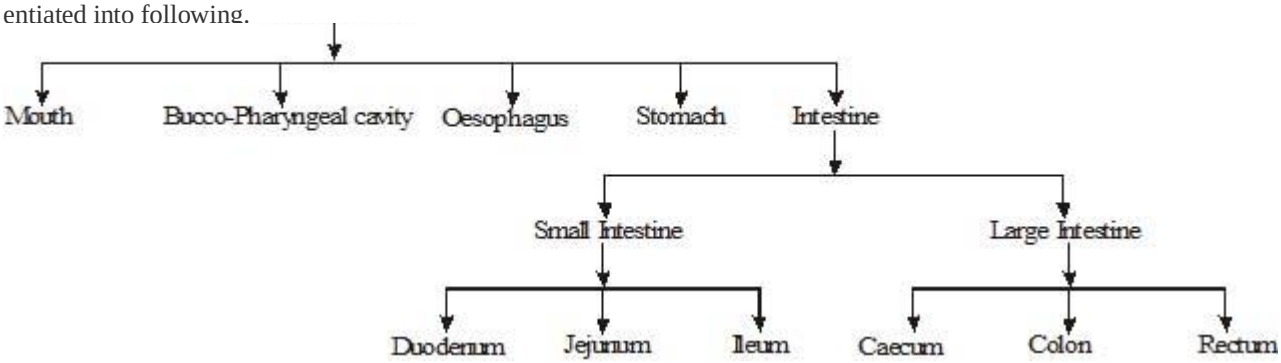
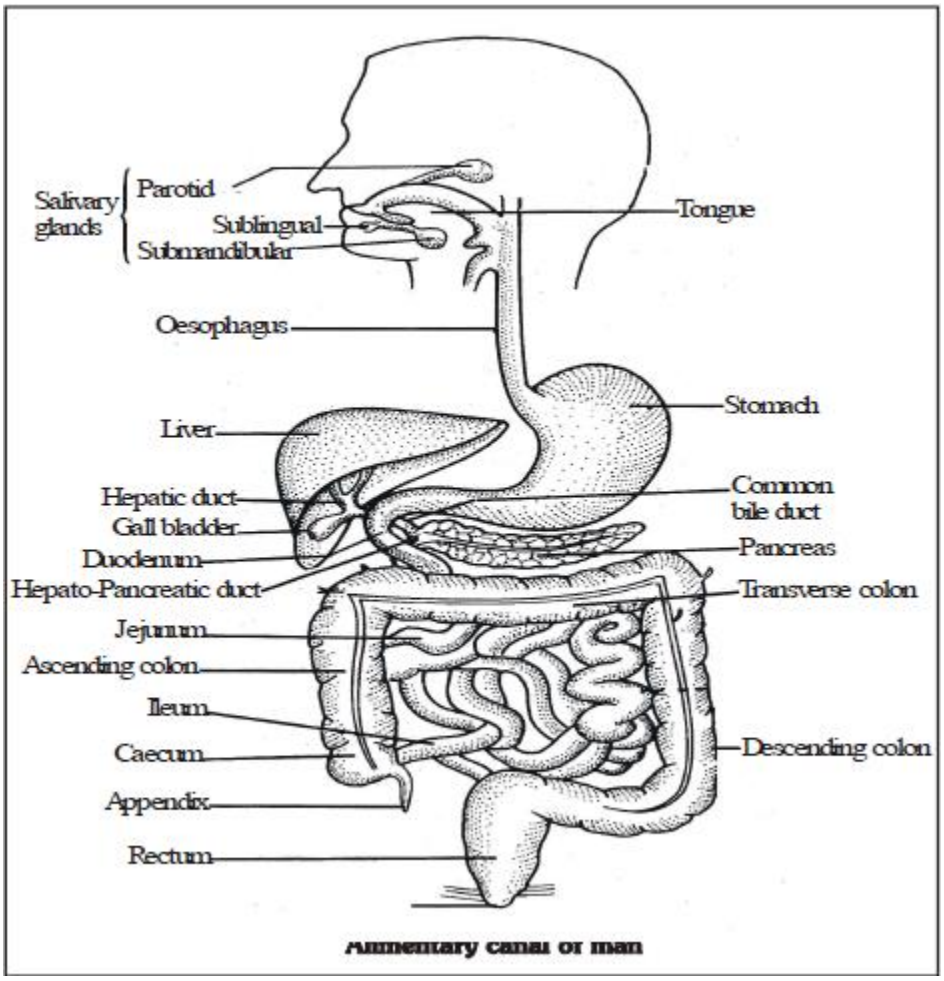




Alimentary canal of man

(1)Mouth :- It is a transverse slit bounded by movable lips. The lips serve to close and open mouth, holding the food in between and also help in speaking. Food is ingested through it. It is lines by stratified squamous epithelium.

(2) Buccopharyngeal cavity / Mouth cavity : Mouth leads into the **mouth cavity** or **oral** or **buccal cavity**. The roof of mouth cavity is formed by palates i.e., **hard** and **soft palate**, the floor by **tongue** and the sides by the **cheeks**. The other conspicuous structures are the **teeth** and **salivary glands**. Saliva contains an enzyme called salivary amylase that breaks down starch into simple sugar.

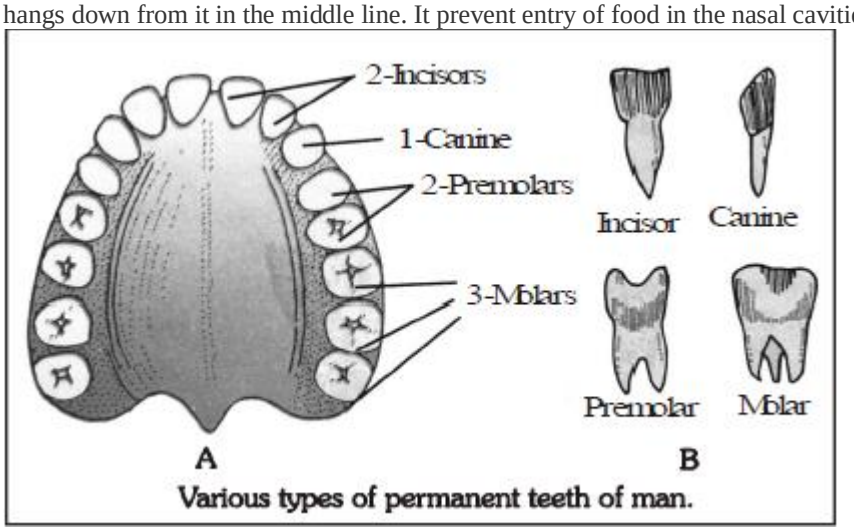
$$\text{Starch} \xrightarrow[6.8\ \text{PH},Cl^-]{\text{Salivary amylase}} \text{Maltose}$$

Salivary glands :- In man, there are three pairs of salivary glands. These secrete saliva which contains a digestive enzyme called **Ptyalin or Salivary amylase**.

•Saliva is an antiseptic as it kills germs and bacteria due to presence of an enzyme called **Lysozyme**.

•Saliva makes the food soft, slippery and helps in digestion of starch due to presence of salivary amylase enzyme.

Tongue :- The floor of the mouth cavity is occupied by muscular, large, mobile tongue. It remains attached on its under surface to the floor by fold of mucous membrane.
Taste buds :- The taste buds for **sweet taste** are located on the anterior end of the tongue, for **bitter taste** at the posterior end, for **sour taste** on its sides and for **salty taste** on a small part just behind the anterior end of the tongue.
Functions of tongue :-
(i) It acts like a spoon during ingestion of food.
(ii) It brings food under teeth for mastication
(iii) It moves food in buccal cavity for mixing of saliva.
(iv) It helps in swallowing food.
(v) It cleans teeth by removing small food particles from their surface.
(vi) It helps in speaking.
(vii) It is the main organ of taste.
(viii) It keeps the mouth moist by the secretion of both mucus and serous or water like fluid.
(ix) In dogs during panting it helps in thermoregulation by quick evaporation of water of saliva.
(x) In some mammals tongue is used to clean skin by licking.
Teeth :- Thecodont (Teeth present in bony socket), Heterodont (Teeth are of four types) and diphyodont (Teeth that come two time in life).
Teeth are of following types :
(i) Incisors Biting and cutting the food.
(ii) Canines Wearing and tearing of food.
(iii) Premolars Crushing and grinding the food.
(ii) Molars Crushing and grinding the food.
How can the dental caries be prevented ?
(i) Avoid sugar rich eatable.
(ii) Regular brushing of teeth after meals.
(iii) Vigorous chewing of fibrous food.
(iv) Consumption of water containing 1 ppm of fluoride. Eg: Listerine mouth wash
Palate :- The septum like structure which separates nasal path from oral path. The hard palate is the anterior part of the roof of mouth cavity. The lower surface of hard palate covered with mucous membrane is raised into Soft palate, is the posterior muscular part having no skeletal support. It carries a fleshy cone shaped projection called **uvula** which hangs down from it in the middle line. It prevent entry of food in the nasal cavities.



Various types of permanent teeth of man.

(iii) Pharynx :
The buccal cavity opens into a short narrow chamber called **pharynx or throat**. The pharynx communicates with oesophagus and with larynx through glottis. The glottis is guarded by an elastic and muscular flap called epiglottis which closes glottis during swallowing to prevent food from entering into wind pipe. Thus pharynx serves two ways (i) as a passage between nose and wind pipe (ii) as food passage between mouth cavity and oesophagus.
(iv) Oesophagus (food pipe) :- It conducts the food by **peristalsis**.
The oesophagus is a collapsible muscular tube 25-30 cm long and about 25-30 mm thick, leading from the pharynx to

stomach. It is also lined by stratified squamous epithelium. It runs down the neck, behind trachea and through thorax, finally piercing the diaphragm to open into stomach. The upper 1/3rd part is composed of voluntary muscles and the lower 2/3rd of involuntary muscles. There are no digestive glands but only mucous glands in oesophagus.
•When we swallow the food (bolus), it is further pushed forward by rhythmic contraction and relaxation of muscles present in lining of alimentary canal. These movements are called peristaltic movements. Thus, the food is carried to stomach through food-pipe or oesophagus.
(v) Stomach :- It is a thick, muscular, 30 cm long and 15 cm wide and J-shaped sac present on the left side of upper part of abdomen. It is the widest part of alimentary canal, size and shape of which varies according to the contents and sex. The stomach of a woman in general is more slender and smaller than that of a man.
Food is churned here for 3 hours. The partly digested food is forced into intestine through **gastric/pyloric sphincter,** due to peristaltic waves of stomach.
Functions of Stomach :-
(1) Temporary storage of food.
(2) Partial digestion of food by gastric juice.
(3) Churning of food.
(4) The stomach regulates the flow of partially digested food into the small intestine.
1.The gastric glands present in the wall of the stomach secrete hydrochloric acid, a protein digesting enzyme called pepsin and mucus.
2.Hydrochloric acid
(i) Stops the action of salivary amylase in stomach.
(ii) Kills the bacteria present in the food.
(iii) Activates pepsin.
(iv) Provides acidic medium, pH – 1.5 to 2.5
3.Pepsin hydrolyses proteins into proteases and peptones.(Protein into peptide)
4. Mucus, lubricates the food and protects the inner lining of the stomach from the action of acids.
(vi)Intestine :- It is distinguished into two parts
(a) Small Intestine (b) Large Intestine
(a) Small intestine :- It is a long (about 6 meter) narrow (average diameter 4 cm), tubular and coiled part. It is differentiated into anterior duodenum, middle jejunum and posterior ileum. It is mainly concerned with completion of digestion and absorption of food.
(i) Duodenum : This proximal part starts after pyloric end of stomach. It is about 25 cm long It is curved like 'C'. A common bile duct and a pancreatic duct opens in middle of 'C' of duodenum
(ii) Jejunum : The Jejunum (a latin word meaning empty) is so called because it is always found empty after death.It is more coiled part.
(iii) Ileum : It is the last part of small intestine.

•From stomach, the partially digested food (chyme) enters the small intestine. The exit of food from the stomach is regulated by a sphincter muscle which releases it in small amounts into the small intestine.
•The length of the small intestine differs in various animals depending on the feeding habit. Herbivores have longer small intestine (due to high bulk of vegetal matter and cellulose) as compared to carnivores (due to smaller bulk of animal food).
•The small intestine is the site of complete digestion of carbohydrates, proteins and fats. The proximal part of small intestine referred as duodenum receives partially digested acidified food from stomach. Duodenal glands secrete an alkaline mucus containing juice that helps in neutralising the chyme and protects the duodenal wall from corrosion.
•A common bile duct from liver and gall bladder as well as a pancreatic duct from pancreas open into duodenum.
Liver :- It is lobed and reddish-brown coloured largest gland of body present in the right side of upper part of the abdomen. It synthesizes and secretes greenish yellow bile juice. Gall bladder is present below the right lobe of liver. It stores and secretes bile.
Bile juice from the liver contains bile pigments and bile salts. Bile salts break fats into small globules by a process called emulsification and thus increases the efficiency of enzyme action (lipase).
Bile juice provide **alkaline medium.**
Pancreas :- It is yellow- coloured gland present just behind the stomach. It secretes pancreatic juice. Pancreatic duct carries pancreatic juice to small intestine.
Pancreas secretes slightly alkaline pancreatic juice which contains three major following enzymes :
(i) Trypsin which digests proteins.

(ii) Lipase which digests fats.
(iii) Amylase which digests carbohydrates.
Intestinal glands :- These lie in the wall of small intestine and secrete intestinal juice.
The walls of the small intestine contain glands which secrete intestinal juice. The enzymes present in it, finally convert
1.Proteins into amino acids,
2.Complexcarbohydrates into glucose
3.Fats into fatty acids and glycerol.
•The inner lining of the small intestine has numerous finger-like projections called villi which increase the surface area for absorption of digested food. The villi are richly supplied with blood vessels which take the absorbed food to each and every cell of the body, where it is utilised for obtaining energy, building up new tissues and the repair of the old ones.
The unused digested food is stored in liver in the form of carbohydrate called GLYCOGEN
(b) Large intestine :- It is shorter (about 1.5 meter) and wider (Average diameter 6 cm) than small intestine. It is differentiated into caecum, colon and rectum. It is the site of absorption of water from undigested food. It helps in formation and temporary storage of faeces.
Rectum stores undigested food i.e faeces.
Anus :- It lies at the base of trunk and is for egestion. The exit of this waste material is regulated by the anal sphincter.

Breathing:
The process involving intake of air or oxygen [inspiration] and removal of air or carbon dioxide [expiration] is called breathing. No enzymes are involved in this process.
Respiration:
The process of respiration involves taking in oxygen (of air) into the cells, using it for releasing energy by burning food, and then eliminating the waste products (carbon dioxide and water) from the body.
$C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2 +$ Energy (ATP)

Breathing	**Respiration**
1 . It is a physical process. It involves inhalation of fresh air and exhalation of foul air.	1. It is a biochemical process. It involves exchange of respiratory gases and also oxidation of food.
2 . It is an extracellular process.	2. It is both an extracellular as well as intracellular process.
3 . It does not involve enzyme action.	3. It involves a number of enzymes required for oxidation of food.
4 . It does not release energy, rather it consumes energy.	4. It releases energy.
5 . It is confined to certain organs only like lungs	5. It occurs in all the cells of the body like mitochondria

Types of respiration: Process of respiration can be divided into the following two categories:

AEROBIC RESPIRATION: When oxygen is used for respiration it is called aerobic respiration.

$$\underset{\text{(1 molecules)}}{\text{Glucose}} \xrightarrow[\text{(in cytoplasm)}]{\text{Glycolysis}} \underset{\text{(2 molecules)}}{\text{Pyruvate or Pyruvic acid}}$$

$$\xrightarrow[\text{(in Mitochondria)}]{\text{Oxygen}} 6CO_2 + 6H_2O + \text{Energy [38 ATP]}$$

Under aerobic conditions, the products of glycolysis are completely oxidised and CO_2 and H_2O are formed as the end products, and under anaerobic conditions, alcohol or lactic acid, CO_2 are produced.

ANAEROBIC RESPIRATION:

When food is oxidised without using molecular oxygen, the respiration is called anaerobic respiration. In this type of respiration incomplete oxidation of food takes place.

During this process one molecule of glucose is degraded into two molecules of pyruvic acid (pyruvate) and little energy (2 ATP).

The Pyruvic acid is further oxidised into ethyl alcohol (ethanol) or lactic acid.

Differences between aerobic and anaerobic respiration:

S. no.	Features	Aerobic Respiration	Anaerobic Respiration
1	O_2 requirement	O_2 Required	Not Required
2	Occurs in	Cytoplasm and Mitochondria	Cytoplasm
3	Breakdown	Complete breakdown of glucose takes place.	Incomplete breakdown of glucose takes place.
4	End Products	CO_2 and H_2O	CO_2 and ethyl alcohol or lactic acid
5	Energy produced from one glucose molecule	38 ATP It occurs in plants and animals	2 ATP It occurs in yeast and bacteria

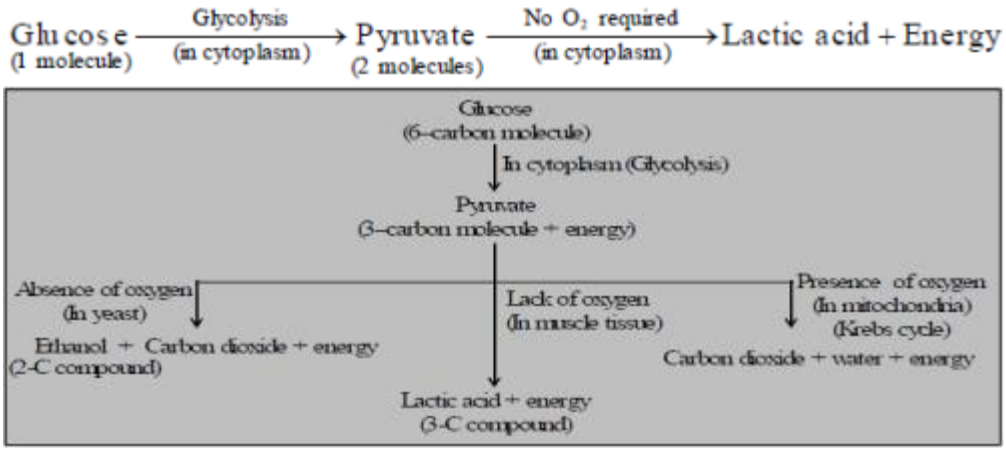
Fermentation: Fermentation is a kind of anaerobic respiration, carried out primarily by fungi and bacteria.

In fermentation anaerobic breakdown of carbohydrates and other organic compounds occur and form alcohol, organic acids, gases, etc.

$$\text{Glucose} \xrightarrow[\text{(in cytoplasm)}]{\text{Glycolysis}} \underset{\text{(2 molecules)}}{\text{Pyruvate}} \xrightarrow[\text{(yeast)}]{\text{No } O_2 \text{ required}} \text{Ethanol} + CO_2 + \underset{\text{(2 ATP)}}{\text{Energy}}$$

In certain bacteria and parasitic worms (Ascaris, tapeworm) glucose is metabolized to lactic acid without the use of O_2 and without the formation of CO_2.

In human beings, anaerobic respiration occurs in certain tissues such as RBC's of mammals and skeletal muscles. The accumulation of lactic acid in the muscles causes cramps.We can get relief from cramps by taking a hot water bath or a massage, improves circulation of blood and supply oxygen to muscles increases. This oxygen breaks down lactic acid into water and carbon dioxide.



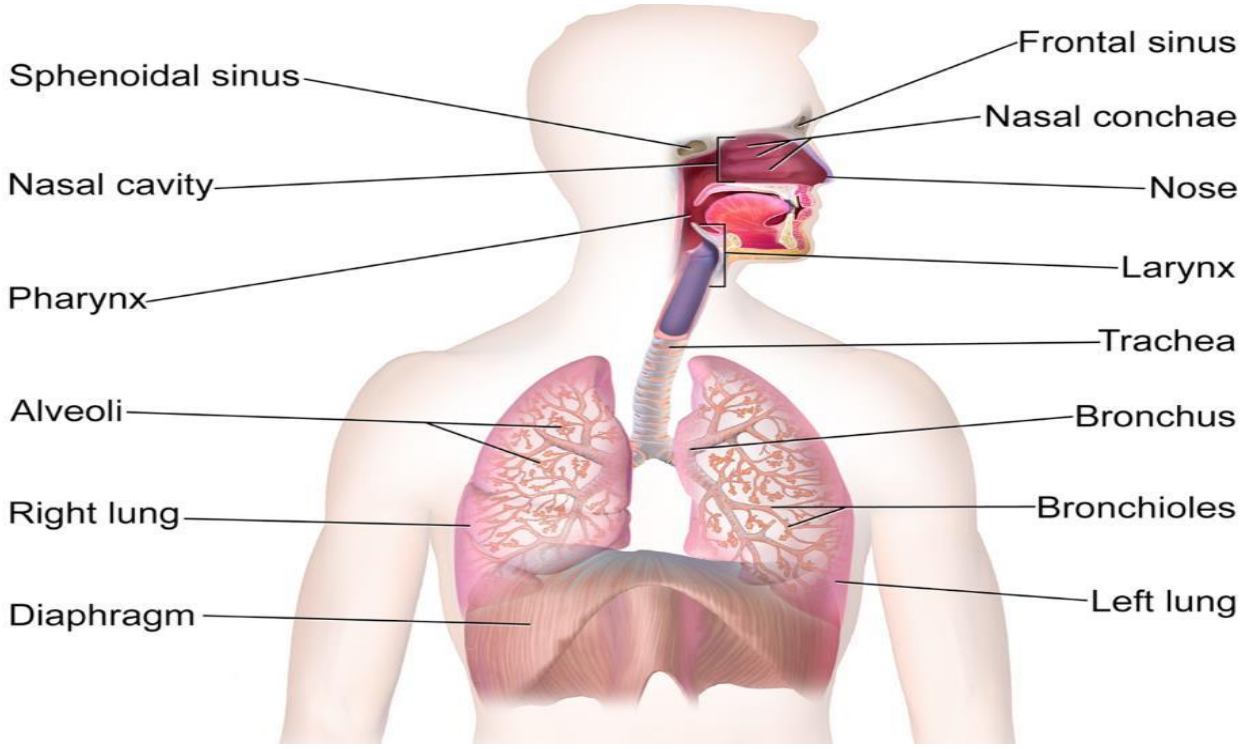
Organs of Respiration:
1.Skin or general body surface, as in earthworm.
2. Air tubes or trachea, as in insects (grasshopper, cockroach, housefly)
3. Gills as in aquatic animals like fish and prawn.
4. Lungs as in land animals like frog, lizard, birds, rat, humans.
5.Frog respires through skin as well as lungs (being amphibious).
It is worth noting that all respiratory organs whether skin, trachea, gills or lungs have **three common features.**
1.All the respiratory organs have a large surface area so as to get enough oxygen.
2. All have thin walls for easy diffusion and exchange of respiratory gases.
3. The respiratory organs like the skin, gills and lungs have a rich blood supply for transport of gases. In the tracheal system, air reaches cells directly and blood plays no role in the transport of gases.
Rate of breathing in aquatic organisms is much faster than terrestrial animals:
•Water is less suitable for respiration in comparison to air. Water is more dense (about 1000 times) than air and thus more energy is needed in passing it over the respiratory surface.
•Also since solubility of oxygen is very low in water, under similar conditions a given volume of water contains less amount of oxygen in comparison to same volume of air which contains more oxygen.
•Another problem faced in aquatic environments is that less oxygen is available in water as the temperature increases. Warm water contains less oxygen. However, as the temperature increases the rate of respiration increases and the animal requires more oxygen to meet with the metabolic demand.
Respiration in Fish: Fish has gills on both sides of its head. Gills are cover by gill covers. Fish breathe by taking water through mouth and send it to gills, gills extract dissolved oxygen from water. Extracted oxygen is absorbed by the blood and carried to other parts of fish. Carbon dioxide produced by respiration is brought back by the blood into the gills for expelling into water.

S.No.	**Respiration in plants**	**Respiration in animals**
1	Respiration is carried out by all parts of the plant i.e ., roots, stem, leaves.	Respiration occurs only in the respiratory organs.
2	It occurs at slower rate.	It is faster in animals.
3	In plants, there is little transport of gases to various part of the plant.	Transport of gases to various parts is more .

4	Products of anaerobic respiration of glucose in plants are ethanol and CO_2 .	Products of anaerobic respiration of glucose is lactic acid and CO_2 .
5	There is no special gas transport system.	Blood transports oxygen.
6	Green plants have additional oxygen source from photosynthesis.	Animals do not have any additional source of oxygen.

S .NO	Characters	**Photosynthesis**	**Respiration**
1	Site	It takes place in green cells of plants.	It takes place in all living beings.
2	Time	It occurs during day time	It occurs throughout the life of an organism.
3	Energy	Stored	Released
4	CO_2 and H_2O	Used up	Released
5	Food and oxygen	Produced	Used up
6	Dry weight	Increased	Decreased
7	Metabolism	Anabolic process	Catabolic process

Respiration in Human:



External nostrils →Nasal cavity →Pharynx →Larynx →Trachea →Bronchi →Bronchioles →Alveolar sacs.

The respiratory tract: The respiratory tract of human respiratory system begins from a pair of external nostrils situated at the lower end of the nose.
1.The air enters through the nostrils and reaches into a pair of nasal cavities.
2.The two nasal cavities are separated from each other by a nasal septum. The nasal cavities are separated from the oral cavity by a bony palate. It is due to this reason we can breathe in air while we eat.
3.The nasal passages are linked by ciliated epithelium and mucus secreting cells, so that the inspired air gets warmed, moistened and becomes dust free. The dust particles are entrapped in the mucus secreted by mucus cells.
4.Nasal cavity is also lined with olfactory epithelium which acts as organ of smell. The nasal chambers open into pharynx.
5.The pharynx is a short vertical tube located at the back of the buccal cavity. It provides passage into which the nasal cavity and buccal cavity both open to pass the air into it.
6.The pharynx provides passage into trachea or wind pipe through a slit like aperture, called glottis. The glottis always remains open except during swallowing. The glottis bears a leaf like cartilaginous flap, the epiglottis.
7.During swallowing, the epiglottis closes the glottis to check the entry of food into it. Entry of food into the respiratory tract can be fatal.
8.Trachea is about 11 cm in length and 2.5 cm in diameter. Its wall has incomplete C-shaped cartilaginous rings,which prevents it from collapsing even if there is not much air in it.
9.Trachea is lined internally by ciliated epithelium and mucus secreting cells. The mucus and cilia both prevent the entry of dust particles and microbes. Trachea runs down the neck and extends into thoracic cavity.
10.On entering the thoracic cavity, trachea divides into bronchi (singular: bronchus). On entering the lungs, the right bronchus enter into right lung and left bronchus enters into left lung.
The voice box: The voice box is also called larynx. It is an enlarged upper part of trachea.
• Before puberty, the larynx is inconspicuous and similar in both sexes. In males, it often becomes prominent and protrudes out and often called "Adam's apple".
•Inside the larynx, are the two vocal cords.
•Vibration in the vocal cords results in the production of sound which is altered and converted into speech with the help of buccal cavity, soft palate, tongue and lips.
Lungs: The lungs are a pair of spongy, highly elastic, solid and bag-like organs. They are situated in the thoracic cavity, separated from abdominal cavity by diaphragm. Lungs are enclosed in a rib cage made of bones.

•Within the lung, each bronchus divides and redivides to form finer branches called bronchioles.
•After repeated divisions each bronchiole ends into a cluster of tiny air chambers called air sacs or alveoli.
•Alveoli are functional units of lungs as these are the actual sites of respiratory exchange.
•There are about 750 million of alveoli present in lungs. Alveoli are covered with a network of capillaries.

Mechanism of Breathing: Lungs cannot expand or contract of their own. The contraction and expansion of lungs is brought about by diaphragm muscles and external intercostal muscles.

(a) **Inhalation (Inspiration):-** Inhalation is intake of fresh air from outside into the alveoli of the lungs. It occurs by expansion of lungs which is brought about by enlargement of thoracic cavity.

1. The diaphragm (a sheet of tissue that separates thoracic cavity from abdominal chamber) muscle contracts so that the diaphragm lowers down and becomes flat.
2. Lowering of diaphragm pushes the abdominal viscera downward resulting in the enlargement of thoracic cavity vertically.
3. External muscles contract so that the ribs and sternum are pulled upward and outward. This causes enlargement of thoracic cavity.
4. Enlargement of thoracic cavity results in the expansion of lungs.
5. Expansion of lungs reduces the pressure of air inside so that the fresh air is pulled from outside into the lungs passing through nostrils, trachea and bronchi.
6. Fresh air has a rich supply of O_2 which goes into the blood passing through thin membranes of alveoli and blood capillaries. As a result the blood in the capillaries becomes loaded with oxygen and expels carbon dioxide into the alveoli for exhalation.

(b) **Exhalation [Expiration]:-** The mechanism of breathing out of carbon dioxide is called exhalation.

1. During exhalation, the muscle of the diaphragm relaxes so that the abdominal viscera pushes the diaphragm upward.
2. The external muscles also relax, resulting in reduced size of the thoracic cavity and lungs also contract.
3. Contraction of lungs raises the air pressure so that the foul air moves out. An average rate of breathing in a normal adult man is 15 to 18 times per minute.

Rate of Breathing: Average breathing rate in an adult at rest is 15 to 18 times per minute.

Rate of breathing increases when we do physical exercise.

Deficiency of haemoglobin in blood reduces oxygen carrying capacity results in breathing problems, tiredness and lack of energy.

If carbon monoxide is inhaled by a person, CO binds strongly with haemoglobin and prevents it from carrying oxygen to the brain causes unconsciousness and death.

CO is produced when fuel burns in an insufficient supply of air.

EXCHANGE OF GASES

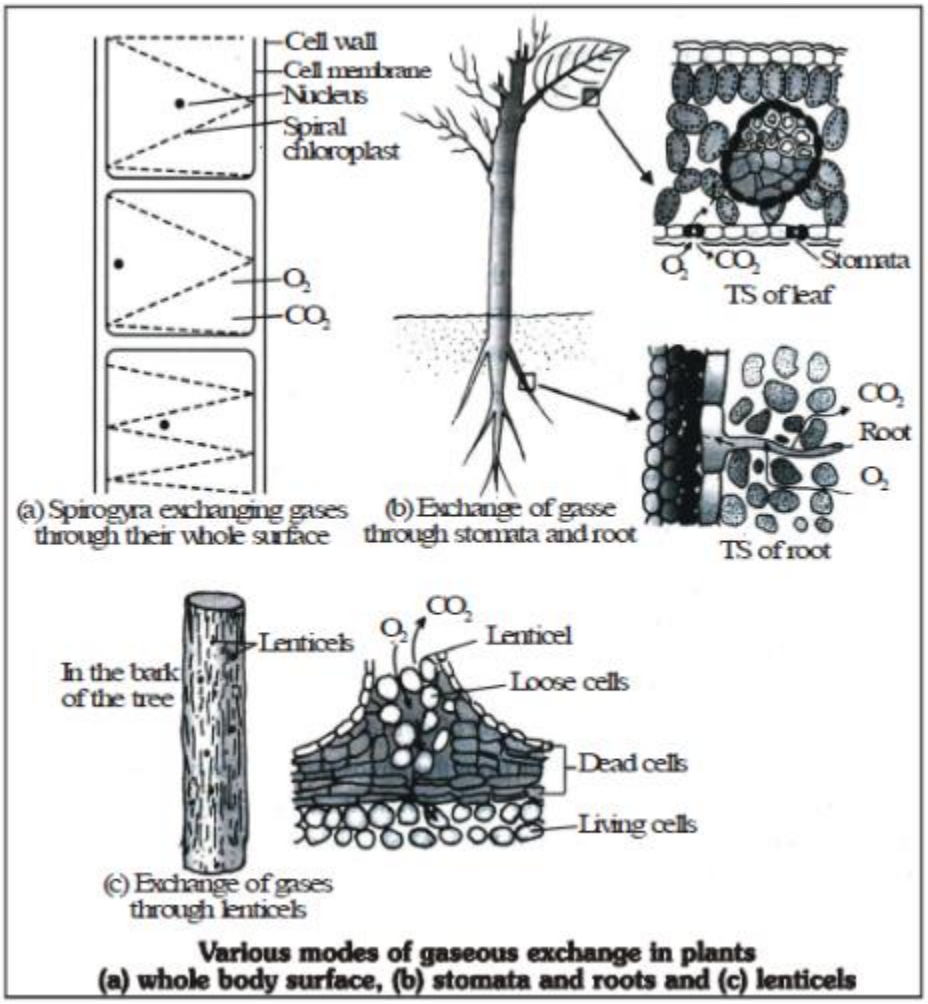
The aerobic respiration occurs partly in the cytosol and partly in the mitochondria of cells. This catabolic process is called cellular respiration.

The concentration of O_2 is more in the blood and less in the tissue cells. So, the O_2 moves from blood to the tissues by diffusion. Similarly, CO_2 concentration is more in tissues and less in the blood. So, the CO_2 moves from tissues to the blood. The oxygenated blood now becomes deoxygenated.

RESPIRATION IN PLANTS:

The plants do not have any special respiratory system so they have to respire in all of their individual parts like leaf, stem and root. The plants also have to exchange gases with the atmosphere by simple diffusion process. Mode of gaseous exchange (oxygen and carbon dioxide) in plants. In terrestrial plants gaseous exchange occurs through:

(a) Stomata – In leaves and green stem.
(b) Lenticels – In woody stem and roots.
(c) Root hairs – In young roots.



Various modes of gaseous exchange in plants
(a) whole body surface, (b) stomata and roots and (c) lenticels

Respiration through stomata:

Stomata are small apertures found on the surface of leaf. For the process of respiration, oxygen enters stomata by the process of diffusion and then into other cells of the leaf. When concentration of CO_2 increases inside the cells it is diffused out through stomata.

Respiration through lenticels:

Lenticels are the opening in the bark of woody stems. They also serve as a place of gaseous exchange.

Respiration through general surface of the roots:

Ploughing or tilling of the soil creates small air spaces around soil particles which provides the sources of oxygen for the roots.

This oxygen present between the soil particles diffuses into root hairs (these are the extensions of epidermal cell of the root), by the process of diffusion.

From the root hairs, oxygen diffuses into other cells of the root. After utilisation of oxygen, CO_2 is diffused out into the soil.

In older roots there are no root hairs present. Instead they have layer of dead cells which is protective in nature and encloses small opening (lenticels). These are used for gaseous exchange between soil and inner living cells.

Aquatic plants can carry out gaseous exchange by diffusion over their whole surfaces.

During the day time O_2 release is the major event.

During night CO_2 release is the major event because there is no photosynthesis.

TRANSPORTATION:

Transportation : The transport of water, food, minerals, hormones and other substances from one part to another part inside the body of an organism is known as transportation.

Plants take in CO_2, nitrogen, phosphorous etc.

Diffusion : The movement of molecules is in the direction of concentration gradient i.e., from a region of higher concentration to that of lower concentration.
Osmosis : Osmosis is the flow of water molecules from the region of higher water potential to the region of lower water potential through a semi-permeable membrane.

If the distance between roots and leaves is small, then these raw materials can reach to the leaves easily by the process of diffusion.
Specialized vascular system is present in the root, stem and leaves.
Vascular system is made up of two types of vascular tissues:
1. Xylem
2. Phloem

Transport of water and minerals [Ascent of sap].

The plants require water and minerals for making food and performing other functions.
The upward movement of water and minerals from the roots to various parts of the plant is known as ascent of sap.
Ascent of sap is carried out by xylem tissue which consists of :-
1. Xylem vessels
2. Xylem tracheids
3. Xylem fibre
4. Xylem parenchyma.

In flowering plants, xylem vessels and tracheids conduct water and minerals upward.
In non-flowering plants, tracheids are the only conducting cells.
Xylem vessels: non living tube, made up of cellulose and lignin provide strength.
Xylem tracheids: long, spindle cells with tapering ends and dead cells with lignified wall
Mechanism of ascent of sap :-

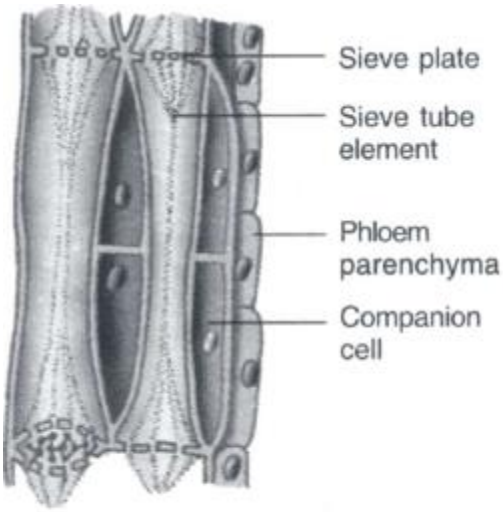
Absorption of water and minerals :- The water and minerals are absorbed by land plants from the soil where it is present in the form of soil solution.
The main water and minerals absorbing organs are root hairs. The water is absorbed actively due to the water potential difference between soil solution and root hairs.
Water molecules move from higher water potential to lower water potential and then migrate from cell to cell passing from root hair to root xylem, from root xylem to stem xylem and then reach the leaves. Only 1-2% of water is utilised by plant, rest if water is lost through transpiration.

Transpiration pull:-

According to this theory, the main force responsible for upward movement of water is transpiration pull generated in the leaves which pulls the water column filled in the xylem tracheids and vessels.
During day period, Transpiration pull help in the upward movement of sap from roots to leaves.
•The loss of water in the form of water vapours from the aerial part of a plant is known as transpiration.
•Transpiration mainly occurs through stomata, (about 80% to 90%) but it may also occur through cuticle (9%) and lenticels (1%•Transpiration helps in absorption and upward movement of water.The pressure at top of xylem vessel is reduced so water from root xylem vessels travel by osmosis to make up the loss of water.
•Transpiration helps in temperature regulation. The plants are protected from the burning due to transpiration. Evaporation of water produces cooling effect.

Transportation of food

Sugar, amino acid are translocated from site of synthesis to site of storage through the phloem.
Transport of food from leaves to different parts of plant is termed as translocation.
Translocation may be in upward or downward direction.
Translocation of food takes place in the sieve tubes with the help of adjacent companion cells by phloem tissue.
Phloem tissue consist of four components:
1. Sieve tubes
2. Companion cells
3. Phloem parenchyma
4. Phloem fibre



A part of the phloem tissue

Mechanism of translocation

•Translocation takes place through energy in the form of ATP. Sieve plates have holes to pass food along phloem tube.

•Sugar (sucrose) made in leaves are loaded into the sieve tubes by using energy from ATP.

•It increases the osmotic pressure of the sieve tubes.

•Water enters into sieve tubes by the process of osmosis, rises the pressure.

•Soluble material is then transferred from phloem tissue to other tissues which have less pressure than in the phloem.

CIRCULATORY SYSTEM

Circulation :

The process of transporting the absorbed food, water and waste products from one place to another in the body is called circulation.

Open Circulatory System : In this type of circulatory system, the main blood vessels arise from heart and pour the blood into tissue spaces ***e.g.*** *Arthropoda , Echinodermata.*

Closed Circulatory System : In this type of circulatory system, the blood remains only in the blood vessels and is carried to various organ through vessels and capillaries. ***e.g.*** *Human beings,* Earthworm

In human beings, the circulatory (transport) system is divided into two system :

Blood circulatory system

Blood is an important fluid conducting tissue, which transport the materials to different body parts.

Composition of Blood :

Liquid part - (Matrix) - Blood plasma

Solid part - Blood corpuscles - (RBC, WBC and Platelets)

Plasma : It composes 55% of blood.

•The plasma has 90-92% water and remaining 8% -10% are other materials.

•The plasma is a faint yellow viscous fluid.

•Plasma contains some soluble proteins, inorganic salts, food materials, waste products, dissolved gases and antibodies.

Function of Plasma :

(i) Transportation of nutrients, respiratory gases, excretion of wastes and hormones of endocrine glands.

(iii) Plasma proteins help in blood clotting at injuries.

(iv) provide immunity (disease resistance) to body.

(v) Plasma also helps in transportation of minerals like iron, copper etc.

Blood Corpuscles : They form 45% part of blood.

•Erythrocytes or Red Blood Corpuscles (RBC)

•Leucocytes or White Blood Corpuscles (WBC)

•Platelets.

Functions of Blood :

1. Transportation of oxygen from lungs to tissues.
2. Transportation of carbon dioxide from the tissues to the lungs.
3. Transportation of excretory material from the tissues to the kidneys
4. Transportation of digested food from the small intestine to the tissue.
5. Distribution of hormones and enzymes.
6. Formation of clots to prevent blood loss.
7. Distribution of heat and temperature control : Muscular and chemical activities release heat. The heat so produced is distributed locally all around the body by the blood and in this way an even temperature is maintained in all body regions.
8. Prevention of infection and wound healing **:** WBCs in the blood help in wound healing. Bacteria are destroyed by the WBCs before they can enter the general circulation. Also, the WBCs provide defence to the body against disease germs and foreign substances.

•Blood by volume - 5-6 litres in male and 4-5 litres in female

•Blood red in colour due to red coloured respiratory pigment **haemoglobin** present in RBC .Iron (Fe^{+2})element found in haemoglobin

Maintenance by platelets:

When we are injured and start bleeding, the loss of blood from the system has to be minimised. Platelets avoid the loss of pressure which would reduce the efficiency of the pumping system and help in blood clotting.

Blood vessels:

1. Arteries : The vessels which carry blood from heart to various organs of the body.
2. Veins : They collect the blood from different parts of the body and pour it into the heart.
3. Capillaries : These are smallest blood vessels and one-cell thick.

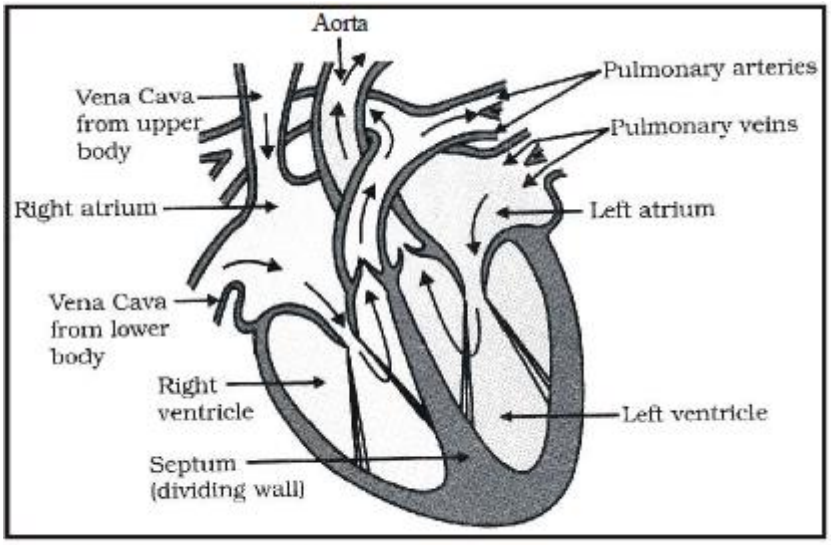
Arteries	Veins	Capillaries
Take the blood away from heart to different parts of body.	Bring the blood towards the heart from various body parts.	Blood flows from arterioles (capillaries) to venules.
Oxygenated blood except in pulmonary artery.	Deoxygenated blood except in pulmonary vein.	Blood changes from oxygenated to deoxygenated.
Pressure is high	Pressure is low.	Pressure is extremely low
Valves - Absent	Present	Absent
Mostly deep seated.	Mostly superficial.	Form a network all over the body and in the organs.

Heart

• It is situated in thoracic cavity, between the lungs slightly on the ventral surface.
• Its triangular, superior-broad portion is tilted slightly towards right (dorsal) side, its lower narrow portion is tilted towards left side.
• Heart is enclosed from all the sides by an envelope of two membranes called pericardial membranes (pericardium).
• Pericardial prevents the heart from external jerks.
• The human heart is divisible into four chambers.
• The upper two chambers are **auricles** (atria) while the lower two chambers are called **ventricles.**

External structure of Heart :

• Auricular part of heart is smaller and its walls are thin.
• It is divided into right and left auricles.
• Ventricular part is broad and muscular.
• Ventricles have thicker wall than auricles.



Heart : Internal Structure

Internal structure of Heart :

• Partition between right and left auricle is known as **inter-auricular septum** while partition between the two ventricles is known as **inter- ventricular septum**.

Right Auricle (Atrium) :

• The right auricle has the openings of the **superior vena cava**, **inferior vena cava.**

• Deoxygenated blood from the veins of the head, neck and upper limbs enters the right auricle by superior vena cava and from the rest of the body and lower limbs by the inferior vena cava.

•From the right auricle blood passes into the right ventricle through a **tricuspid valve**, (so called because it has three cusps.)

Right Ventricle :

• Blood leaves the right ventricle through the **pulmonary artery**.

• This artery further divides into right and left pulmonary arteries entering into the two lungs where they further branch into pulmonary capillaries.

Left Auricle (Atrium) :

• This chamber receives four pulmonary veins, two from each lung from where they bring oxygenated blood.

• The left auricle empties its blood into the left ventricle through a **bicuspid valve.**

Left Ventricle :

• Blood leaves the left ventricle by the large, main artery of the body called the **aorta.**

Working of the heart

• The heart of the human works like a pump.

• Pure oxygenated blood enters the left auricle from lungs through pulmonary veins when heart is relaxed.

• The deoxygenated blood from various part of the body enters right auricle through veins and capillaries.

• The two auricles contract simultaneously so the oxygenated blood from left auricle to left ventricle and deoxygenated blood from right auricle is pumped into right ventricle.

• Now both the ventricles contract simultaneously so the pressure is created on the blood and the valves between auricle and ventricle close and the blood does not go back into auricle.

• Due to this pressure, aorta valve opens and the blood comes in aorta, from here, blood is sent to different parts of the body with the help of various arteries.

• By the contraction of right ventricle, blood reaches the lungs through pulmonary arteries where it gets reoxygenated.

Double circulation:

In double circulation, the blood passes twice through the heart to supply once to the body.

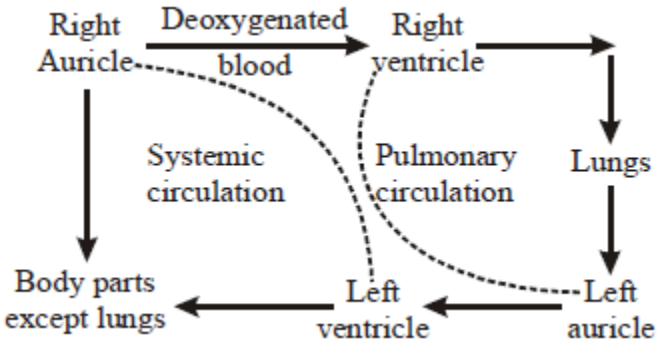
(i) Systemic circulation:

In this, blood completes its circulation from left ventricle to right auricle through the body organs. Pathway from heart to rest of the body and back to the heart.

(ii) Pulmonary circulation:

In this, blood completes its circulation from right ventricle to left auricle through the lungs.

Pathway from heart to the lungs and back to the heart.



The separation of the right side and the left side of the heart is useful to keep oxygenated and de-oxygenated blood from mixing.

This is useful in animals who have high energy needs (e.g. birds and mammals) which constantly use energy to maintain their body temperature. In animals who do not use energy for this purpose, the body temperature depends on the temperature of environment. (e.g. fishes, frogs)

Three chambered heart: Amphibians and reptiles. 2 atria and 1 ventricle. Cold blooded.

Two changed heart: fish 1 atria and 1 ventricle

Single circulation:

In this, the blood passes once through the heart to supply once to the body.

It is found in fishes which have two-chambered heart, one auricle and one ventricle. The heart receives only deoxygenated blood, which is first pumped to the gills for oxygenation and then oxygenated blood is supplied to rest of the body parts by various arteries.

Heart beat:

• Rhythmic contraction and expansion of heart is called heart beat. Contraction and expansion occurs separately in atria and ventricles.

• Heart beat in human is 72 times in one minute.

• Each heart beat has two components, **systole** and **diastole**. Systole represents contraction while diastole represents expansion or distension of heart chambers.

Blood pressure:

• Blood pressure is the pressure exerted by the flowing blood on the walls of blood vessel.

(i) Systolic blood pressure (ii) Diastolic blood pressure

Systolic blood pressure	Diastolic blood pressure
Blood pressure at the time of maximum contraction of ventricles	Blood pressure at the time of maximum relaxation of ventricles/ Minimum pressure in arteries.
120 mm Hg. Lubb sound	80 mm Hg. Dup sound

• Hypertension: A persistent increase in blood pressure. It is caused by narrowing of artery and reduced elasticity of arterial walls.

• The instrument by which we can measure B.P. is called "*sphygmomanometer*".

• Normal B.P. of a healthy person is *120/80 mm Hg.*

• **Cardiac Cycle :-** The sequence of events which takes place during the completion of one heart beat.

Pulse

• Blood is forced into artery, artery expand a little, called pulse.

• It is generally felt by placing fingers over the artery at the wrist.

• The pulse rate is same as heart beat rate.
•These "Lubb" and "Dup" sounds of the heart can be heard with the help of an instrument called **" Stethoscope."**

Electrocardiogram (ECG)

• The functioning of heart can be graphically recorded by an instrument called **electrocardiograph**.

Lymphatic system:

It consists of lymph, lymphatic capillaries, lymph vessels, lymph nodes and lymphoid organs (spleen thymus and tonsils).

Lymph capillaries: Tiny tubes present in the whole body. They are closed ended and have large pores so large protein can enter into it.

Lymph vessels: Lymph capillaries join to form lymph vessels. Fats are absorbed in the intestine. They are connected to veins, carry fat and protein to the heart.

Lymph nodes: Lymph vessels have lymph nodes at intervals. They carry lymphocytes, clean the lymph from pathogens.

Lymph: When blood flows into thin capillaries some amount of plasma filters out of thin capillaries. This fluid is called interstitial fluid or tissue fluid or lymph. Lymph is also called extracellular fluid.

•It is colourless and contains lymphocyte cells. •Lymph contains less large plasma protein and digested fat

•Lymph flows only in one direction, that is from tissues to heart.

The functions of lymph- •Transports fatty acids and glycerols from small intestine to blood.

•Lymphocytes present in it which destroy harmful pathogens.

•It drains excess tissue fluid from intercellular spaces back into the blood.

• It removes the waste like dead cells

•Lymph nodes localize the infection and prevent it from spreading to other body parts.

Blood	Lymph
It forms circulatory system.	It forms lymphatic system.
Red in colour due to presence of haemoglobin	Colourless as haemoglobin is absent
Contains plasma, RBC, WBC and platelets	Contains plasma and WBC
Flows inside arteries, veins and blood capillaries	Flows inside vessels and lymph capillaries
Its flow is rapid	Its flow is slow
It mainly transports materials from one organ to another in the body	It mainly conveys materials from the tissue cells into the blood.

EXCRETION :

The biological process of removal of harmful nitrogenous wastes from the body is called excretion.

The waste products in animals include :

(i) Nitrogenous compounds like ammonia, urea and uric acid.

(ii) Carbon dioxide and water.

(iii) Excess salts and vitamins.

(iv) Unwanted medicines.

Excretory Organs/Structures in Animals :-

Animals	Hydra	Flatworm/ aquatic animals	Earthworm	Insects e.g. cockroach	All chordates
Excretory Structures	Body surface	Protonephridia (flame cells)	Nephridia	Malpighian tubules	Kidneys
Waste products	CO_2 and ammonia	Mainly ammonia	ammonia and urea	Uric acid	Urea

		Plenty of water for excretion		Need little water for excretion	Need less water for excretion

HUMAN EXCRETORY SYSTEM :

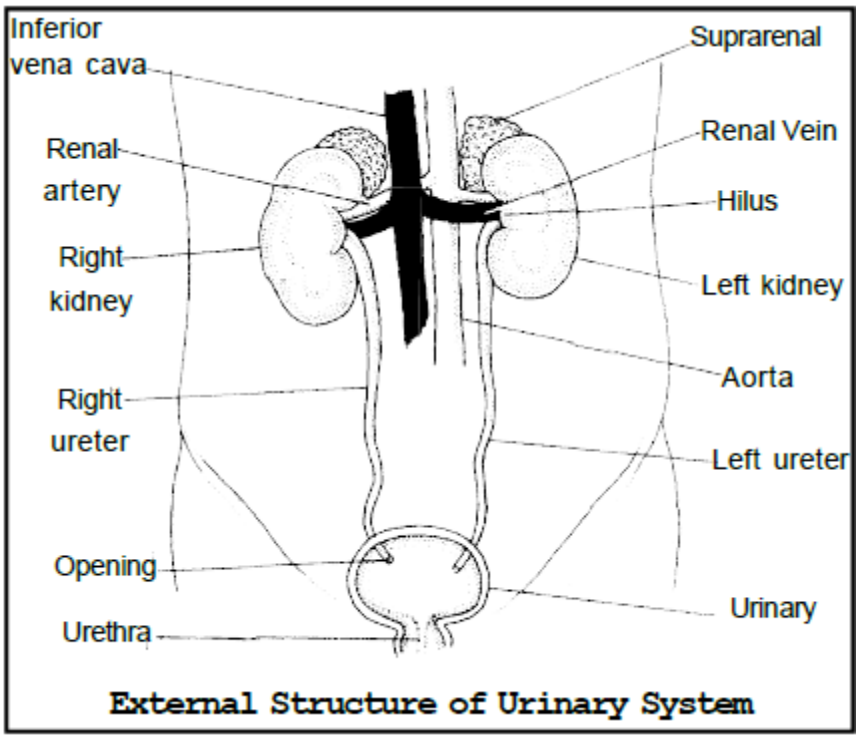
Human excretory system consists of :-

– A pair of kidneys

– A pair of ureters.

– Urinary bladder.

– Urethra.



External Structure of Urinary System

KIDNEY :

The main excretory organ of our body are **kidneys**.

Colour – Dark red **Shape** – Bean shaped **Weight** – 125–170 gms.

Size – 10 cm length, 5 cm breadth, 3 cm thickness. **Position –** Located lateraly either sides of **vertebral column.**

External Structure :-

• Each kidney is surrounded and covered by a tough, fibrous, capsule of connective tissues. This capsule is called renal capsule.

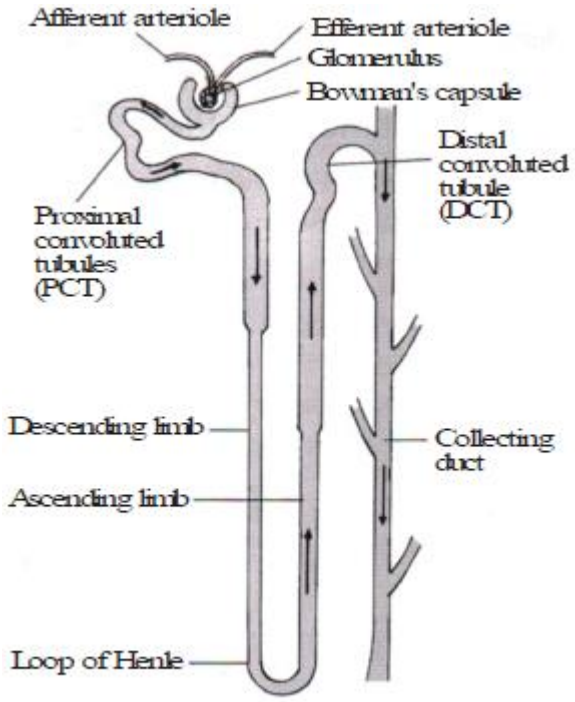
• Lateral surfaces of kidney are convex while medial surfaces are concave.

• On the inner border of each kidney is a depression called hilum/hilus.

The human kidney are not located at similar positions due to presence of liver above right kidney, so the right kidney get slightly lower position.

Internal Structure :

•Nephron is the structural and functional unit of excretion.



Structure of a nephron

Functions of Kidney :

– Regulation of water and electrolyte balance. (Osmoregulation)
– Regulation of acid base balance.
– Regulation of blood pressure.
– Excretion of metabolic waste and foreign chemicals.

Structure of Nephron :-

Nephron is the structural and functional unit of kidney, which is about 3 cm long and 20-60 μm in diameter.
Each kidney has about one million nephrons in humans.
At the proximal end of the nephron, a double walled cup-shaped structure is present called **Bowman's capsule.**
• It consists of network of capillaries called **glomerulus.**
Glomerulus and Bowman capsule are collectively called **Malpighian body**
•One end of the **glomerulus** is attached to renal artery and the other end to the renal vein.
• The impure blood enters to each kidney through **renal artery.**
• The **afferent arterioles** which is branch of renal artery provides blood to the glomerulus.
• Glomerulus is a group of blood capillaries formed by division of afferent arterioles located in Bowman capsule.
• Walls of glomerulus and Bowman's capsule are thin and semipermeable membrane. In the glomerulus there are many minute pores present.
• The arterioles which carry blood away from glomerulus are called **efferent arterioles.**
• The radius of afferent arterioles is greater than that of efferent arterioles so the pressure in glomerulus increases which is necessary for **ultrafiltration.**
• Due to the blood pressure, water, glucose, urea, uric acid and some salt from the blood of afferent arteriole filter in Bowman capsule through ultra-filtration.
• This liquid from the Bowman capsule moves through the glandular part of the nephron.
• From liquid glucose, useful salt and some part of water is reabsorbed and they enter into the surroundings blood capillaries.
• The amount of water reabsorbed depends on how much excess water there is in the body and on how much of dissolved waste there is to be excreted.
• The remaining liquid now contain only waste material is called urine.
• The collecting ducts open into the ureter.
• Each ureter originate from interior part of kidney.
• The anterior part of the ureter is broad, like a funnel and called pelvis and its posterior part is in the form of long tubule.

•Each ureter opens into the urinary bladder.
• The structure of urinary bladder is muscular sac like and pear shaped.
• It extends from the urinary bladder to the urethra. It carries the urine to the outside.
• The urine from the nephron is collected in urinary bladder through ureter.
• Urine is stored in the urinary bladder until the pressure of the expanded bladder leads to the urge to pass it out through the urethra.
• By the contraction of muscles of urinary bladder, the urine passes out of the body when necessary.
• They not only excrete out salts and nitrogenous waste products but also perform important role of water balance.

The process of maintaining the right amount of water and proper ionic balance in the body is called osmoregulation.

Urea is always formed in liver

Chemical composition of urine :

• Urine is slightly acidic liquid, light yellow in colour.
• The healthy human being has 95% water, 5% urea, uric acid and salts of phosphoric acid.
• A young and healthy person excretes 1.5-1.8 litres urine per day.
• This quantity may increase due to intake of tea, coffee, wine etc.

Regulation of excretion

Vasopressin: hu
It is secreted by pituitary gland, it promotes the reabsorption of water through nephrons.

Role of lungs in excretion:

Human lungs eliminate around 18L of CO_2 per hour and about 400ml of water per day in normal resting condition. Water loss via the lungs is small in hot humid climate and large in cold dry climates.

Role of skin in excretion :

Human possess two types of glands :
(1) Sweat glands : These excrete sweat, Sweat contain 99.5% Water, NaCl, Lactic acid, Urea, Amino acid and glucose.
(2) Sebaceous glands : These secrete waxes, lipids, hydrocarbons and fatty acids.

Role of liver in excretion :

Liver is the main site for elimination of cholesterol, bile pigments (bilirubin & biliverdin) inactivated products of steroid hormones, some vitamins and many drugs. Bile carries these materials to the intestine from where they are excreted with the faeces.

ARTIFICIAL KIDNEY OR HAEMODIALYSIS

Kidney dialysis also known as haemodialysis or renal dialysis, is a medical treatment used to remove nitrogenous waste materials from the blood of patients lacking kidney function or kidney failure, due to infections, injury or restricted blood flow to kidneys.
•In this procedure, the blood is circulated through a machine known as artificial kidney or dialyser that removes wastes and excess fluid from the bloodstream.
•The blood from an artery is pumped through a dialyser or artificial kidney, where it flows through a semipermeable membrane which are made up of tubes.
•The tubes remain suspended in a tank filled with dialysing fluid which has same osmotic pressure as blood, and has the same composition as that of blood plasma but it lacks nitrogenous wastes.
•When the blood of the patient is passed through the tubes, the dialysis fluid passing on the other side of the membrane removes unwanted elements in the blood by diffusion. The blood is then returned to the body through a vein. Main difference of kidney & dialysis is that there is no reabsorption in dialysis. In kidney, initial filtrate is about 180L daily but actual excretion is only a litre or two a day.

EXCRETION IN PLANTS

•The main waste products produced by plants are carbon dioxide, water vapour and oxygen.
•The gaseous wastes of respiration and photosynthesis in plants are removed through the stomata in leaves and **lenticels** in woody stem and released to the air.
•**Oxygen** is produced as a waste during **photosynthesis.**
•Plants get rid of excess water by **transpiration.**
•Many plant waste products are stored in cellular vacuoles.
•Plants also store some of the waste products in their body parts (leaves, bark and fruits). e.g. Tannins, essential oils, latex, gums, resins.
•Tea leaves, amla, betal nut and bark of tree contain tannins.
•The plants excrete carbon dioxide produced as a waste during respiration in night time.

•Aquatic plants lose most of their metabolic wastes by direct diffusion into the water surrounding them.
•Terrestrial plants excrete some waste into the soil around them.
•The plant get rid of stored solid and liquid wastes by the shedding of leaves, pealing of bark and felling of fruits.
•Gums are found in babul tree.
•**Resins** are found in stem of conifers.