# LIFE PROCESSES

All the plants and animals (including human beings) are alive or living. Now the question is - What criteria do we use to decide whether something is living or not ? The most important criteria to decide whether something is alive (or not) is the **MOVEMENTS**. All the living beings move by themselves without any external help while non living things cannot move by themselves. In some cases the movements of living beings are quite fast (in most of the animals) which can be easily observed by us, while in plants, the movements are very slow and hence observed with difficulty (with the exception of plants like "Touch-me not" plant which shows folding of leaves on being touched).

Animals and plants move in different ways. Animals can move from one place to another or they can move their body parts. While plants are fixed in soil so they can only move parts of their body such as leaves, flowers, shoots and roots.

All the living things (plants and animals) are made up of tiny living units called cells. The cells themselves are made up of small particles called molecules. The movements over very small scale (as those in the molecules of living beings) are invisible to the naked eye, however, these movements are necessary for the existence of life. In fact viruses do not show any molecular movement in them until they infect some cells. That is why viruses are considered as a border line between living and nonliving.

**LIFE PROCESSES** - The basic functions performed by living organisms to maintain their life on this earth are called life processes. They are essential to prevent damage and breakdown and to produce energy. The basic life processes common to all living organisms are –

1. **Nutrition** – involves the taking of food inside the body and converting into small molecules which can be absorbed by the body.
2. **Respiration** – is the process which release energy from the absorbed food.
3. **Transport** – is the process in which a substance absorbed or made in one part of the body is moved to other parts of the body
4. **Excretion** – is the process in which the waste materials produced in the cells are removed from the body.
5. **Control and coordination** – is a process which helps the living organisms to survive in the changing environment around them.
6. **Growth and movements** – The process of growth involves the change from a small organism to a big organism or an adult organism. In movement, the organism either moves from one place to another or moves its body parts while remaining at the same place.
7. **Reproduction** – involves the making of more organisms from the existing ones to maintain the continuity of life on earth.

All living organisms need energy to carry out these life processes. They get this energy from food. Plants obtain their energy from sunlight. In case of single-celled organisms, no specific organs for carrying out various life processes (e.g. taking in food, exchange of gases or removal of wastes etc.) may be needed as the entire surface of the organism is in contact with the environment. While in multi-cellular organisms, all the cells are not in direct contact with the surrounding environment, thus simple diffusion will not meet the requirements of all the cells and they require specific organs for carrying out various life processes.

# NUTRITION

A **NUTRIENT** is defined as any substance which an organism obtains from its surroundings and uses it as a source of energy or for the biosynthesis of its body constituents and the process of intake of nutrients (like carbohydrates, fats, proteins, vitamins etc.) as well as their utilization by an organism is known as **NUTRITION.**

**Modes of nutrition** – depending upon the method of obtaining food, there are mainly two modes of nutrition –

1. **Autotrophic mode of nutrition** – in which an organism makes (or synthesizes) its own food from the simple inorganic substances like carbon dioxide and water present in presence of sunlight and chlorophyll. These organisms are known as **AUTOTROPHS** e.g. green plants and some bacteria.
2. **Heterotrophic mode of nutrition** – *in which an organism cannot make 9or* synthesize) Hits own food from simple inorganic substances. They depend on other organisms for food and are known as **HETEROTROPHS** e.g. animals.

   A heterotrophic organism can obtain its food from other organisms in three ways –

   (a) **Saprophytic nutrition** – in which an organism obtain its food from decaying organic matter of dead plants and animals and these organisms are known as **SAPROPHYTES** e.g. fungi and bacteria, The saprophytes breakdown the complex organic molecules present in dead and decaying matter and convert *them into simpler substances outside their body. These simpler substances* are then absorbed by saprophytes as their food.
   (b) **Parasitic nutrition** – in which an organism derives its food from the body of another living organism (i.e. host) without killing it and organism is called as **PARASITE.** A parasite obtains its food from the host but gives no benefit to the host in return (usually it harms the host) e.g. fungi, bacteria, some flowering plants like *Cuscuta* and some animals like *Plasmodium, Ascaris* etc.
   (c) **Holozoic nutrition** – in which an organism takes the complex food materials into its body by the process of ingestion, the ingested food is digested and absorbed into the body cells of the organism e.g. in human, amoeba etc.

**NUTITION IN PLANTS** – Green plants are autotrophic and synthesize their own food by the process of **PHOTOSYNTHESIS** – The process by which green plants make their own food *(like glucose) from carbon dioxide and water by using sunlight in presence of chlorophyll.* Oxygen gas is released during this process. The process of photosynthesis thus can be represented as –

$$6\,CO_2 + 12\,H_2O \xrightarrow[\text{Chlorophyll}]{\text{sunlight}} C_6H_{12}O_6 + 6\,O_2 + 6\,H_2O$$

The food prepared by the green leaves of a plant is in the form of glucose which is then sent to different parts of the plant. The extra glucose is stored in the form of **STARCH** which serve as the internal energy reserve to be used as and when required by the plant.

The photosynthesis takes place in the following three steps –

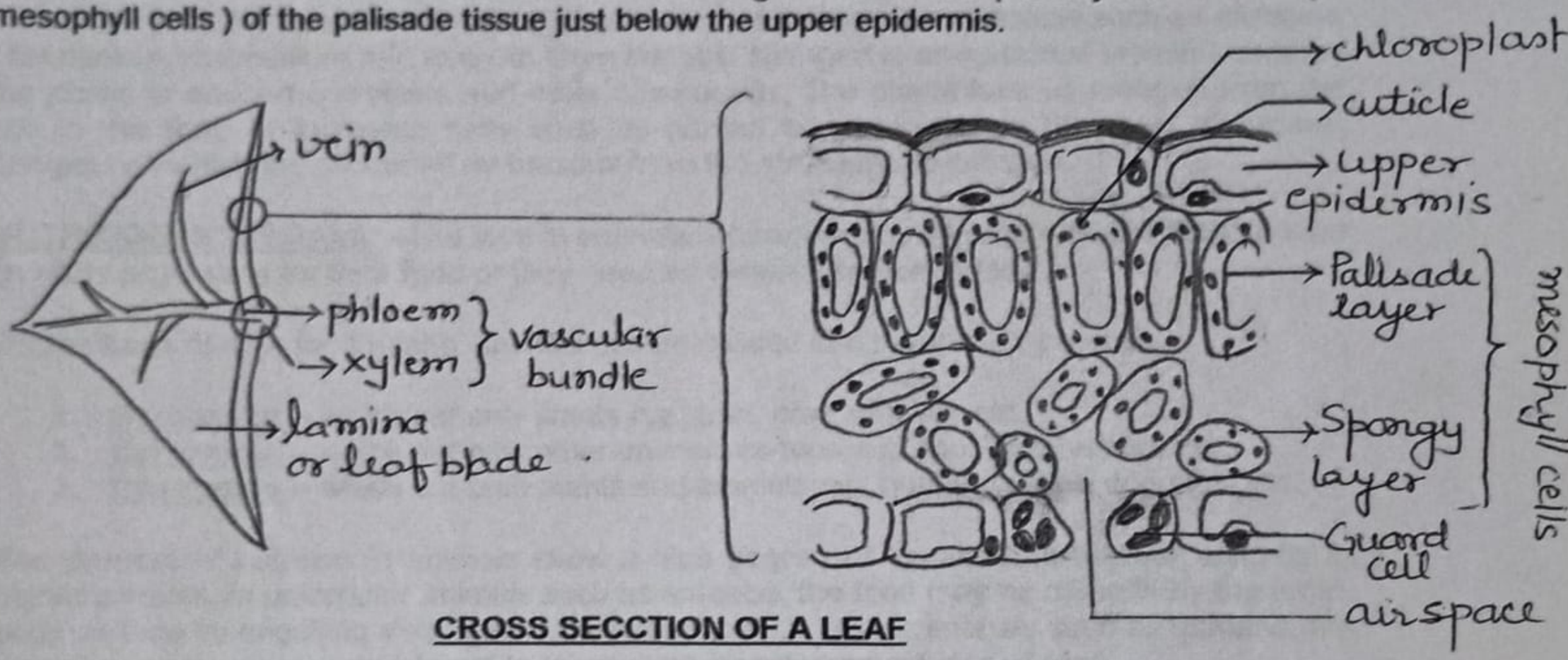
1. Absorption of sunlight energy by chlorophyll
2. Conversion of light energy into chemical energy and splitting of water into hydrogen and oxygen
3. Reduction of carbon dioxide by hydrogen to form carbohydrates

These steps need not take place one after the other immediately. They can take place at different times. For example, desert plants take up carbon dioxide at night and prepare an intermediate product which is acted upon by the sunlight energy absorbed by the chlorophyll during the day time.

**Conditions necessary for photosynthesis** – The conditions necessary for photosynthesis to take place are –

1. Sunlight
2. Chlorophyll
3. Carbon dioxide
4. Water

**Site of photosynthesis** – The photosynthesis occurs in organelles called chloroplast (present in green plants) which contain chlorophyll pigment. In a cross section of leaf, chloroplast can be seen as numerous disc like organelles in the photosynthetic cells (or mesophyll cells ) of the palisade tissue just below the upper epidermis.

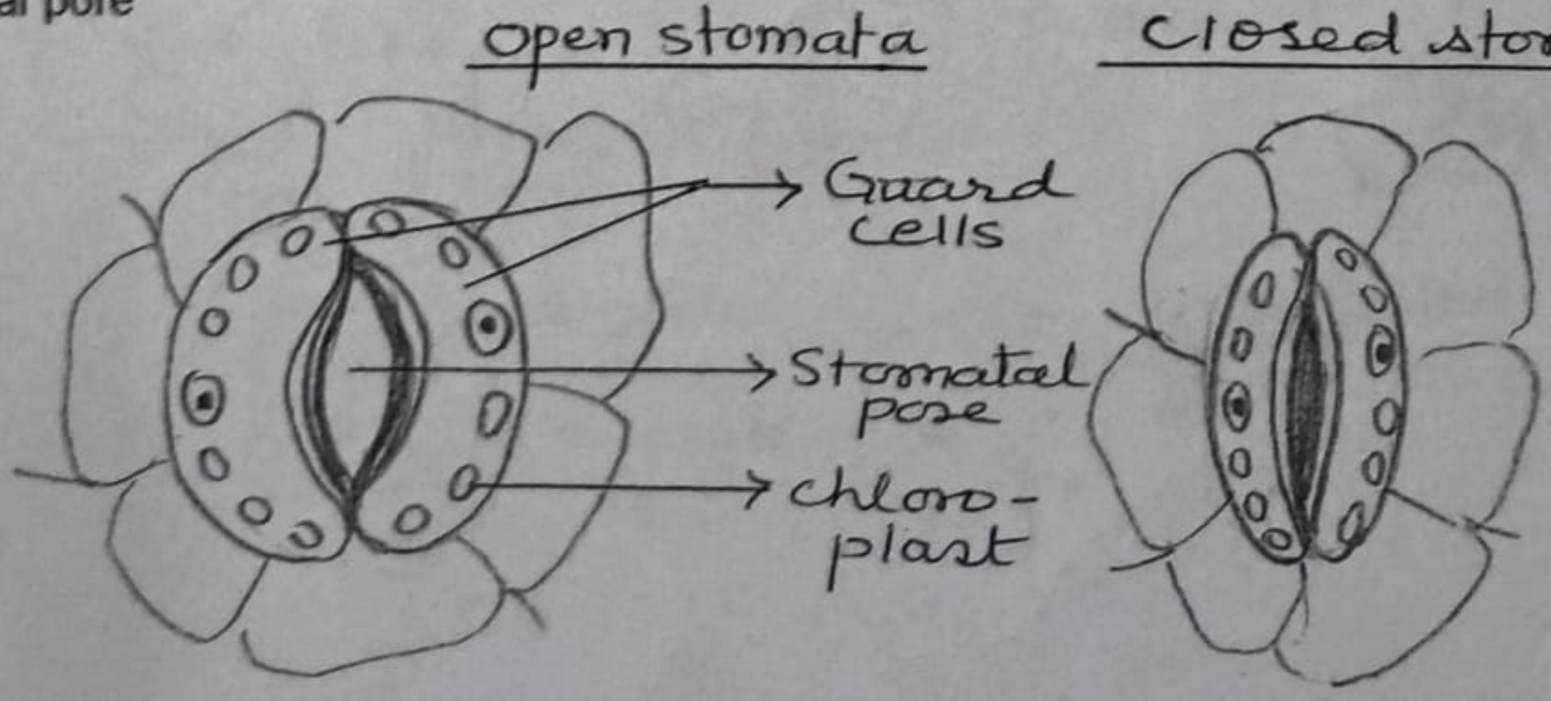



**CROSS SECCTION OF A LEAF**

**Raw materials for photosynthesis** – The raw materials for photosynthesis are –

1. Carbon dioxide
2. Water.

The plants take carbon dioxide from air for photosynthesis. The carbon dioxide enters the leaves of the plant through the **STOMATA** (tiny pores) present on their surface. Each stomatal pore is surrounded by a pair of guard cells. The opening and closing of stomata of stomatal pore is controlled by the guard cells due to uneven thickening of their outer and inner surfaces. The inner wall of the guard cells is thick while the outer wall is thin. When water flows into the guard cells, they swell, become curved and cause the pore to open. On the other hand, when the guard cells lose water, they shrink, become straight and close the stomatal pore




**OPEN AND CLOSED STOMATAL PORE**

A large amount of water is also lost from the cells of the plant leaves through open stomatal pores. So when the plant does not need carbon dioxide and wants to conserve water, the stomatal pores are closed. The oxygen gas produced during photosynthesis also goes out through the stomatal pores of leaves. Aquatic plants used the carbon dioxide gas dissolved in water for carrying out photosynthesis.

The water required by the plants for photosynthesis is absorbed by the roots of the plants from the soil through the process of osmosis. The water absorbed by the roots of the plant is transported upward through the xylem vessels to the leaves where it reaches the photosynthetic cells and utilized in photosynthesis.

In addition to these two raw materials, plants also need other raw materials such as nitrogen, phosphorus, magnesium and iron etc. from the soil. Nitrogen is an essential element used by the plants to make the proteins and other compounds, The plants take up nitrogen from the soil in the form of inorganic salts such as nitrites or nitrates or in the form of organic compounds which are produced by bacteria from the atmospheric nitrogen.

**NUTRITION IN ANIMALS** -- Nutrition in animals is heterotrophic in nature hence they depend on other organisms for their food or they need an external source of food.

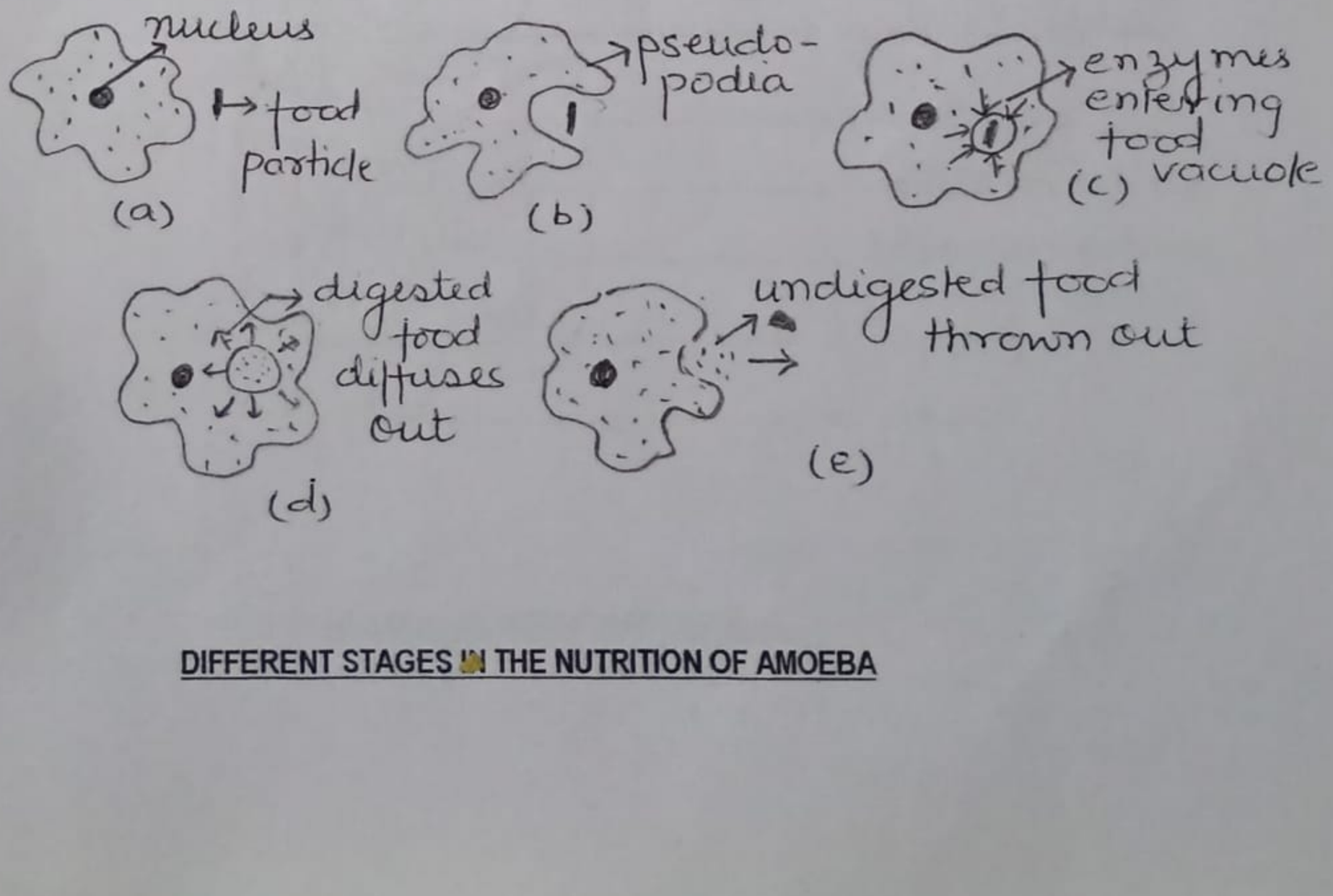
On the basis of their food habits, animals can be divided into three main groups –

1. **Herbivores** – which eat only plants e.g. goat, cow, monkey etc.
2. **Carnivores** – which eat only other animals as food e.g. lion, tiger, vulture etc.
3. **Omnivores** – which eat both plants and animals e.g. human beings, dog crow etc.

The process of nutrition in animals show a high degree of variation from lower animals to higher animals. In unicellular animals such as amoeba, the food may be taken in by the entire body surface by engulfing and digested subsequently. In higher animals such as humans, the digestive system is well developed to take in and digest various types of food.

**Nutrition in amoeba** - The mode of nutrition in amoeba is **HOLOZOIC** and the process of obtaining food by amoeba is called **PHAGOCYTOSIS**. The various steps involved in nutrition of amoeba are – ingestion, digestion, absorption, assimilation and egestion.

1. **Ingestion** – Amoeba has no mouth or a fixed place for the ingestion of food. When a food particle comes near amoeba, then amoeba ingests this food particle by forming temporary finger like projections called **PSEUDOPODIA** around it. The food is engulfed with a little surrounding water to form a food vacuole inside the amoeba.
2. **Digestion** – In amoeba the food is digested in food vacuole by digestive enzymes.




**DIFFERENT STAGES IN THE NUTRITION OF AMOEBA**

The enzymes from surrounding cytoplasm enter into the food vacuole and break down the food into small and soluble molecules by chemical reactions.

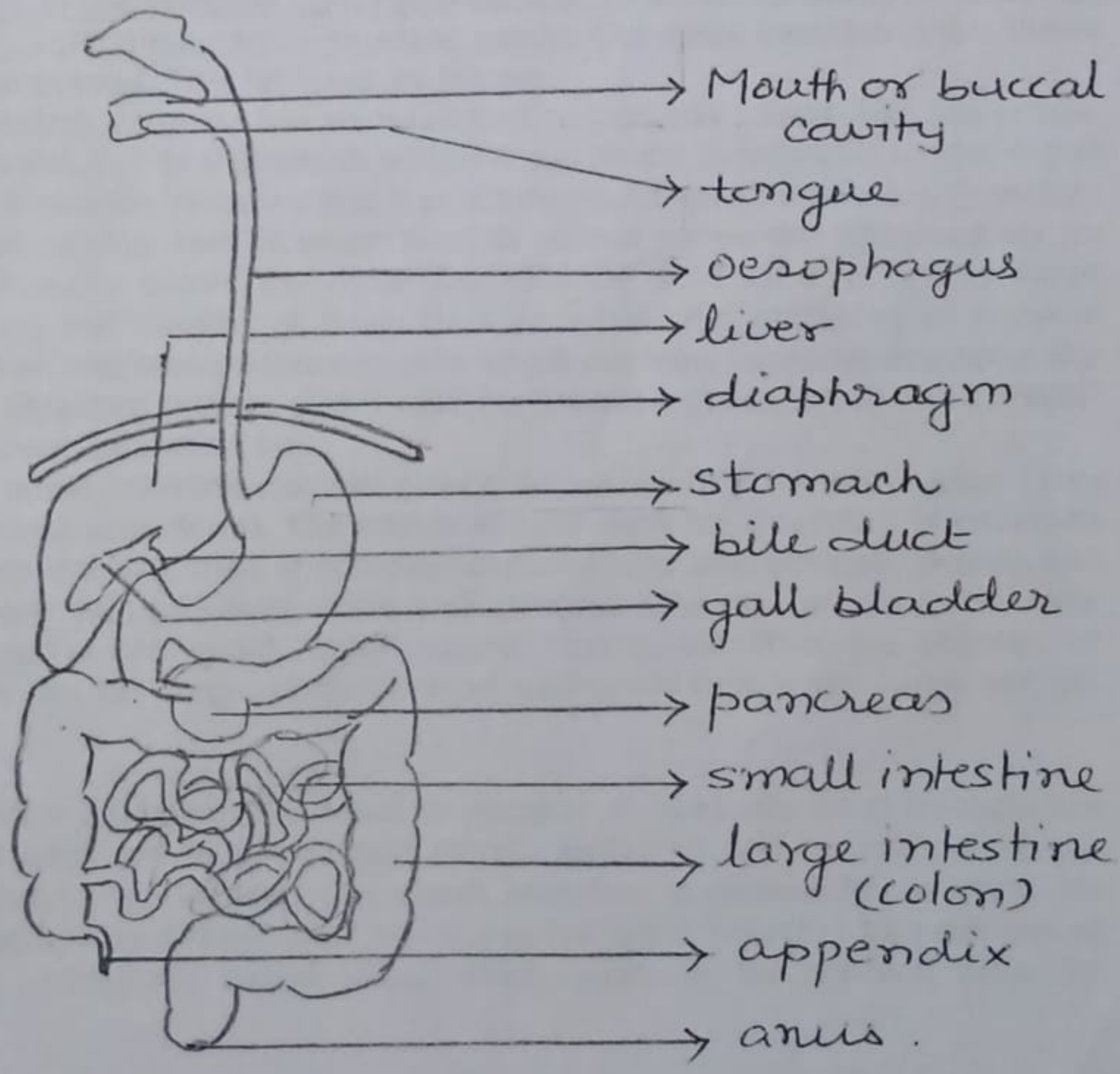
3. **Absorption** – The digested food present in the food vacuole is absorbed directly into the cytoplasm of the cell by diffusion. After absorption of food, the food vacuole *disappears*.
4. **Assimilation** – A part of the food absorbed in amoeba is used to obtain energy through respiration. The remaining part of the absorbed food is used to make parts of amoeba which lead to its growth.
5. **Egestion** – When a considerable amount of undigested food collects inside amoeba, then its cell membrane suddenly ruptures at any place and the undigested food is thrown out of the body.

In ***Paramaecium***, a unicellular organism with a specific shape, the food is taken at a specific spot. Food is moved to tis spot by the movement of cilia which cover the entire surface of the cell,

**Nutrition in human beings** – takes place through **DIGESTIVE SYSTEM** which consists of **ALIMENTARY CANAL AND ASSOCIATED GLANDS**. The alimentary canal is long tube extending from the mouth to the anus. In humans, the various organs forming the alimentary canal in sequence are – Mouth, Oesophagus, Stomach, Small intestine and large intestine. The glands that are associated with the human digestive system are – salivary glands, Liver and Pancreas.

The various steps of nutrition in human beings are –

1. **Ingestion** – The food is ingested through the mouth.




**HUMAN ALIMENTARY CANAL**

2. <u>Digestion</u> – In humans, the digestion begins in mouth itself. The **mouth cavity** contains **TEETH, TONGUE AND SALIVARY GLANDS**. The teeth cut the food into small pieces, chew and grind it. Our tongue helps in mixing food with saliva. Saliva is a watery liquid salivary glands. It wets the food in our mouth so that food can be *swallowed more easily. The saliva also contains an enzyme called* **SALIVARY AMYLASE**. Which break down starch (a complex molecule) into sugar.

From the mouth, slightly digested food is taken to the stomach through the **food pipe or oesophagus.** The walls of food pipe have muscles which can contract and expand alternatively and thus pushes the food into the stomach. The movement of the walls of food pipe is called **PERISTALTIC MOVEMENT**. In fact these peristaltic movements occur all along the alimentary canal.

The **stomach** is a J – shaped organ present on the left side of the abdomen. The glands present in the wall of the stomach secrete **GASTRIC JUICE**. It contains three substance **HYDROCHLORIC ACID, ENZYME PEPSIN AND MUCUS**. The hydrochloric acid creates an acidic medium so that enzyme, pepsin can act on protein. Another function of acid is that it kills any bacteria which may enter the stomach with food. The enzyme pepsin begins the digestion of proteins present in to food to convert into smaller molecules. The mucus protects the inner lining of the stomach from the action of acid under normal conditions. From stomach the food enters into small intestine. The exit of food from the stomach is regulated by a *sphincter muscle which releases it in small amounts into small intestine.*

The **small intestine** is the longest part of the alimentary canal which is fitted into a compact space because of extensive coiling. The length of the small intestine differs in various animals depending on the food they eat. <u>The length of small intestine is more in herbivores as compared to carnivores</u> because it is difficult to digest cellulose (present in grass ) while meat can be digested easily. The small intestine is the site of complete digestion of food. This happens as follows –

(a) The small intestine receives the secretions of two glands : **liver and pancreas**. Liver secretes ***BILE***. *It is a greenish yellow liquid which is normally stored in gall* bladder. Bile is alkaline in nature and it performs mainly two functions – (i) makes the acidic food coming from stomach alkaline so that pancreatic enzymes act on it and (ii) bile salts cause **EMULSIFICATION OF FATS** i.e. it breaks large *globules of fats into smaller globules thus increases the efficiency of enzyme* action. Pancreas secretes pancreatic juice which contains digestive enzymes like **TRYPSIN** for digesting protein, **AMYLASE** for breaking down starch and **LIPASE** for breaking down emulsified fats.

(b) The walls of small intestine contain glands which secrete intestinal juice (also known as **Succus entericus**). The intestinal juice contains a number of enzymes which complete the digestion of complex carbohydrate into glucose, protein into amino acids and fats into fatty acids and glycerol. Glucose, amino acids, fatty acids and glycerol are small, water soluble molecules. Thus the process of *digestion converts the large insoluble food molecules into small water soluble* molecules.

3. **<u>Absorption</u>** - After digestion, the small molecules of food can pass through the walls of the small intestine (which contain blood capillaries) and go into our blood. *This is called* absorption. In fact, the small intestine is especially adapted for absorbing the digested food. The inner surface of the small intestine has millions of tiny, fingers like projections called **VILLI** which increase the surface area for absorption.

4. **<u>Assimilation</u>** – The blood carries absorbed food to each and every cell of the body, where it is utilized for obtaining energy, building up new tissues and the repair of old tissues. The digested food which is not used by our body immediately is stored in the liver in the form of carbohydrate called **GLYCOGEN**. This stored food can be used as *a source of energy by the body as and when required.*

5. **Egestion** – The undigested or unabsorbed food is sent into the large intestine. The walls of large intestine absorb most of the water from the undigested food with the help of villi. The rest of the material is removed from the body via anus as faeces. The exit of faeces is regulated by anal sphincter.

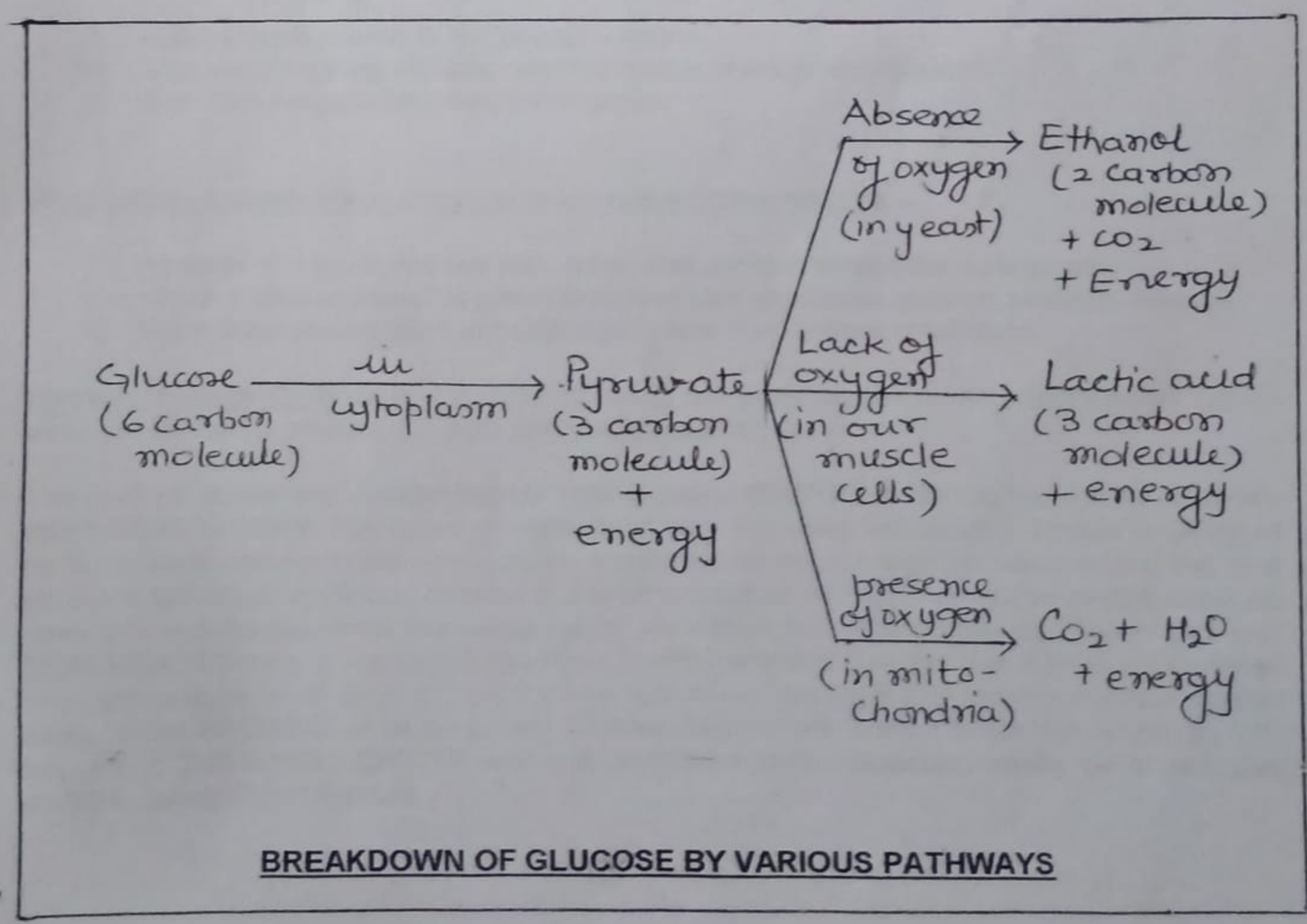
# RESPIRATION

The process of releasing energy from food is called **RESPIRATION.** It involves oxidation of glucose to give energy which is stored in our body in the form of ATP. The oxidation of food to obtain energy occurs in presence or absence of oxygen. Based on this, respiration is of two types – **AEROBIC RESPIRATION (**in presence of oxygen) and **ANAEROBIC RESPIRATION** (in absence of oxygen).

In both cases, the first step is breakdown of glucose, a six carbon molecule, into a three carbon molecule called **PYRUVATE.** This process takes place in the cytoplasm. Further breakdown of pyruvate can occur in three different ways –

**(1)** In yeast, anaerobic respiration takes place and pyruvate is converted into **ethanol and carbon dioxide.** This process is known as **FERMENTATION.**
**(2)** In presence of oxygen (e.g.in human or in plants) the breakdown of pyruvate takes place in mitochondria and gives **carbon dioxide and water.**
**(3)** Sometimes, when there is lack of oxygen in our muscle cells (e.g. during vigorous physical exercise), another pathway for breakdown of pyruvate is taken. Here the pyruvate is converted into **lactic acid** which is also a three carbon molecule. The sudden build up of lactic acid in in our muscles causes **CRAMPS.**

Breakdown of glucose by different pathways is summarized as follows.--




**BREAKDOWN OF GLUCOSE BY VARIOUS PATHWAYS**

**Difference between aerobic and anaerobic respiration -**

| ANAEROBIC RESPIRATION | AEROBIC RESPIRATION |
|---|---|
| 1. Takes place in absence of oxygen.<br>2. Partial breakdown of food occurs.<br>3. End products may be alcohol or lactic acid.<br>4. Less energy is released. | 1. Utilizes oxygen.<br>2. Complete breakdown of food occurs.<br>3. End products are carbon dioxide and water.<br>4. Considerable amount of energy is released. |

Since the aerobic respiration pathways depends on oxygen, aerobic organism need to ensure that there is sufficient intake of oxygen. Plants exchange gases through stomata and large intercellular spaces in the leaves by diffusion. In woody plants, the exchange of gases takes place through lenticels.

The direction of diffusion depends upon the environmental conditions and requirements of the plant. At night, when there is no photosynthesis occurring, carbon dioxide elimination is the major exchange activity going on. During the day, carbon dioxide generated during respiration is used up for photosynthesis, hence there is no carbon dioxide release. Instead oxygen release is the major event at this time.

In simple unicellular animals like amoeba, paramecium etc. respiration takes place by the diffusion of gases through the cell membrane. Most of the animals have however, specialized organs for respiration. Terrestrial animals can breathe the oxygen in the atmosphere but animals that live in water need to use oxygen dissolved in water. Since the amount of dissolved oxygen is fairly low compared to the amount of oxygen in air, the rate of breathing in aquatic organisms is much faster than that seen in terrestrial organisms. The aquatic organisms like fish, prawn etc. have **GILLS** as the respiratory organs. Fishes take in water through their mouths and force it to pass through the gills where the dissolved oxygen is taken up by the blood.

All respiratory organs, whether gills, lungs,or skin have three common features –

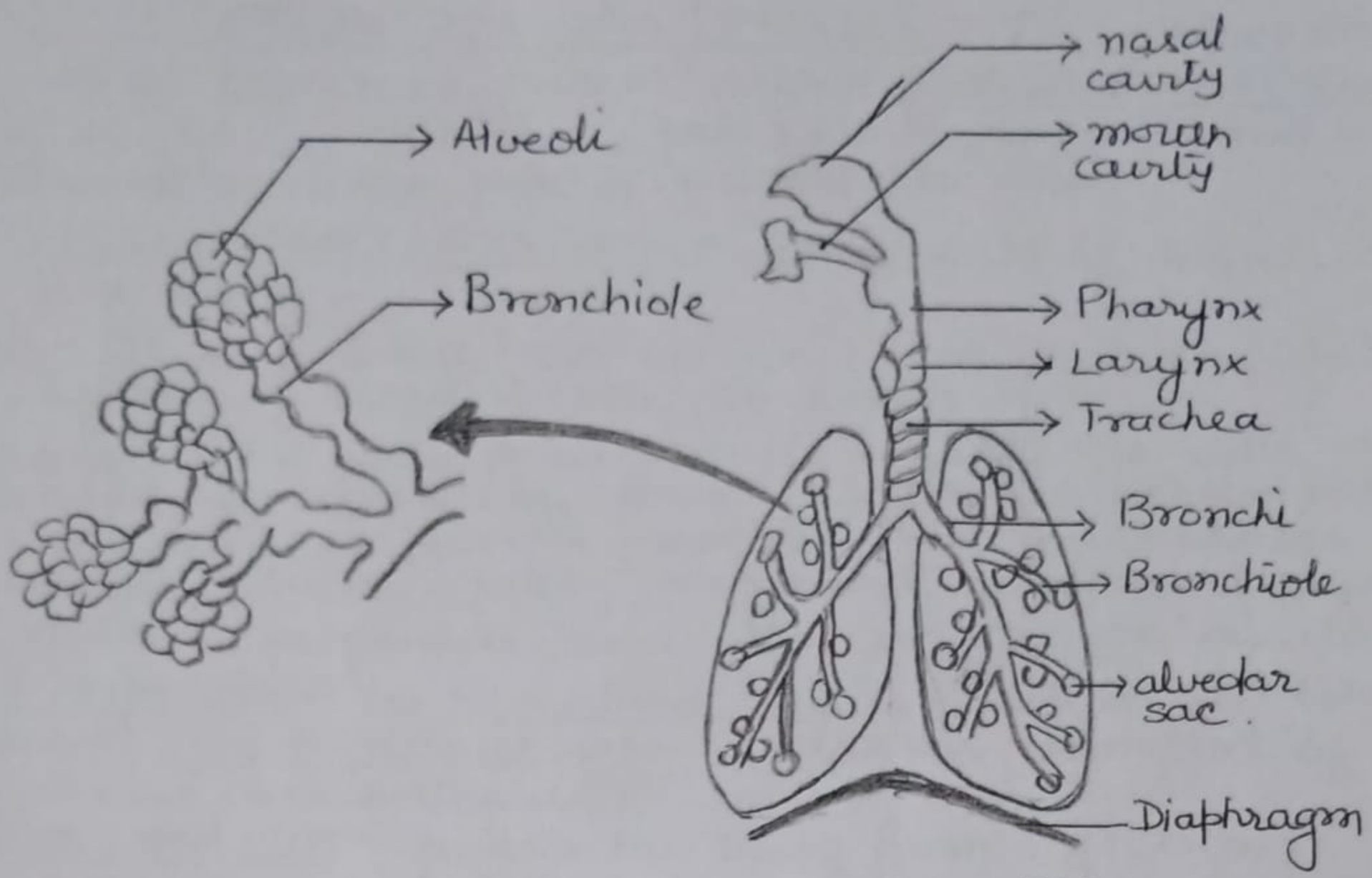
1. A large surface area to get enough oxygen.
2. Thin walls for easy diffusion and exchange of respiratory gases.
3. *Rich blood supply for transport of gases.*

Respiration in plants differs from that in animals in three respects –

1. All parts of a plant, like the root, stem, leaf perform respiration individually.
2. There is little transport of gases from one part of plant to another, unlike in animals.
3. Plant respiration occurs at much slower rate than animal respiration.

**Human respiratory system** – In human being, the main organs of respiratory system are – nose, nasal cavity, trachea, bronchi, lungs and diaphragm.

The human respiratory system begins from external **NOSTRILS**, through which air is drawn into **NASAL CAVITY**. The nasal cavity is lined with fine hairs and mucus. Mucus is secreted by the glands present in the nasal cavity. When the air passes through nasal cavity, the dust particles and other impurities present in the air is trapped by hair and mucus so that clean air goes into the lungs. From the nasal cavity air enters into **PHARYNX** and then goes into **TRACHEA**. Trachea is supported by rings of cartilage which ensures that it does not collapse *even when there is no air in it. The trachea runs down the neck and divides into two smaller* tubes called **BRONCHI** at its lower end. The two bronchi are connected to the two lungs. The lung lie in **THORACIC CAVITY** which is separated from abdominal cavity by a muscular partition called **DIAPHRAGM.**




HUMAN RESPIRATORY SYSTEM

Within lungs bronchi branch into many **BRONCHIOLES.** Each bronchiole terminates in a sac called **ALVEOLI.** The walls of the alveoli are very thin and surrounded by very thin blood capillaries so that gaseous exchange can takes place very easily. There are millions of alveoli in the lungs thus provides a large surface area for exchange of gases.

**Mechanism of breathing** – When we breathe in, air from outside rushes into the alveoli of the lungs. This is called **INHALATION**. and occurs when the thoracic cavity expands. Thoracic cavity expands when the diaphragm and muscles attached to ribs contract. This makes the thorax moves upwards and outwards, thereby increasing the volume inside the *thoracic cavity. Thus, air pressure decreases inside and air from outside rushes into alveoli of* the lungs through nostrils, trachea and bronchi. From alveoli, oxygen diffuses into blood and is supplied to the tissues. Carbon dioxide is absorbed by blood from the tissue and is carried to the alveoli for its removal. Carbon dioxide is subsequently pushed out of lungs through trachea and nostrils. This happens when thoracic cavity comes back to its original size as diaphragm and rib muscles relax. Breathing out carbon dioxide is called **EXHALATION.** Thus breathing has two events : inhalation and exhalation.

During the breathing cycle, when air is taken in and let out, the lung always contain a residual volume of air so that there is sufficient time for oxygen to be absorbed and for the carbon dioxide to be released.

Oxygen is carried by blood to all parts of the body with the help of red pigment called **HAEMOGLOBIN** present in RBCs. Carbon dioxide is more soluble in water than oxygen is and hence transported in the dissolved form in our blood.

**Exchange of gases in tissues** – After breathing, the next step is the exchange of respiratory gases between the blood and tissues. In the tissues, oxygen gets used up and carbon dioxide is released. The blood which brings oxygen from lungs and carries it to tissues, has a higher concentration of carbon dioxide. Due to the difference in concentration, the gases get exchanged between tissue and blood capillaries.

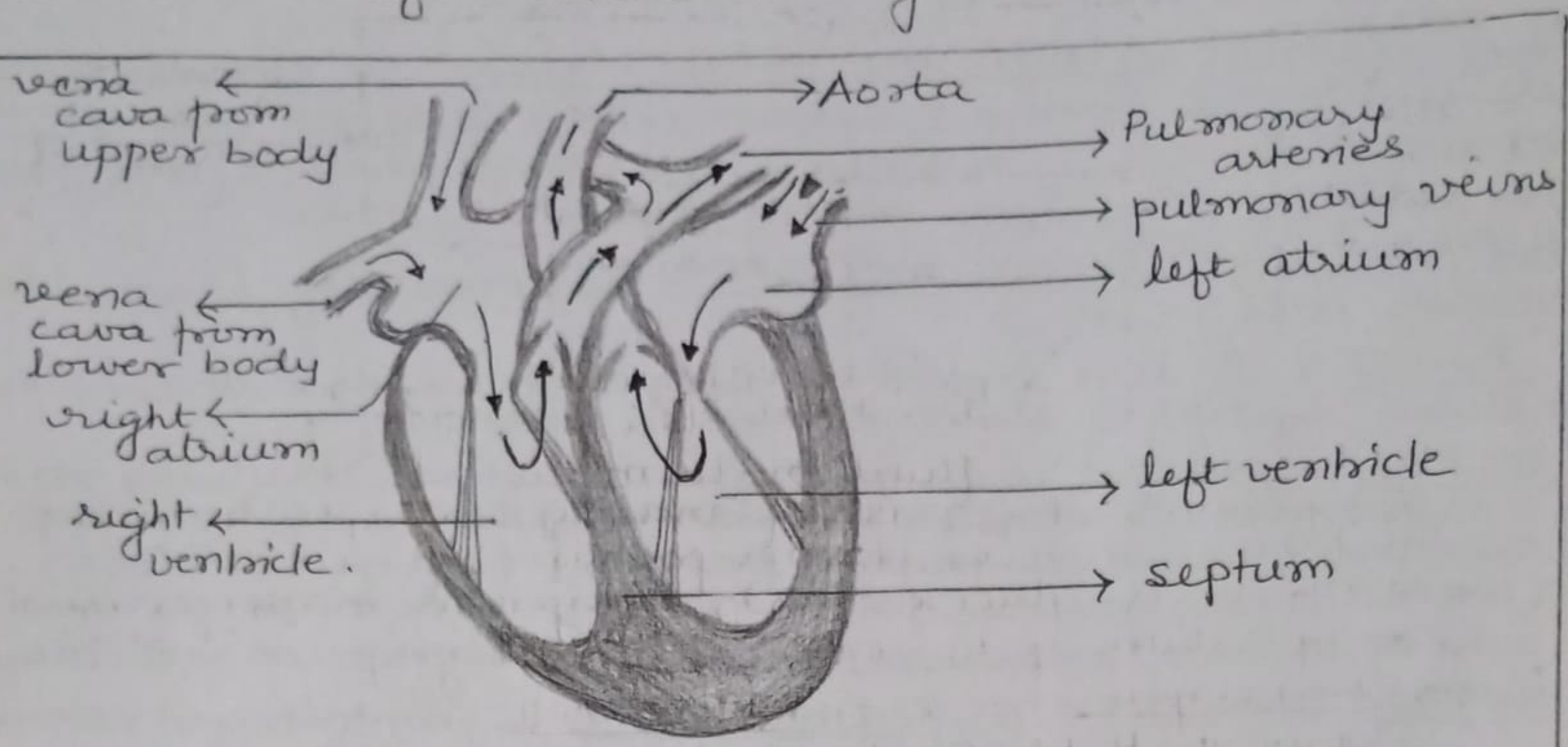
# TRANSPORTATION

(A) TRANSPORTATION IN ANIMALS – In complex animals there is a special transport system called CIRCULATORY SYSTEM that carries $O_2$, $CO_2$, nutrients, food, waste products and various other substances from one part of the body to other.

HUMAN CIRCULATORY SYSTEM – It consists of blood, blood vessels and heart.

1. BLOOD – It is a liquid connective tissue that circulates in a closed system of blood vessels. It consists of –
   (a) Plasma – is a fluid medium in which the cells are suspended. It consists of mainly water in which various substances such as plasma proteins, food substances (amino acids, glucose, fats), nitrogenous compounds and ions of sodium, potassium, calcium & magnesium are dissolved.
   (b) Blood corpuscles – (i) Red blood cells – contain red colour pigment, HAEMOGLOBIN which helps in transport of oxygen and carbondioxide.
   (ii) White blood cells – protect the body from infection.
   (iii) Platelets – help in clotting of blood.
   – Blood also plays an important role in temperature regulation of the body.
2. BLOOD VESSELS – Three types of blood vessels namely arteries, veins and capillaries are involved in blood circulation –
   (a) Arteries – are thick walled and carry blood away from the heart or carry oxygenated blood with the exception of pulmonary artery
   – deeply situated in our body
   – don't have valves to prevent backflow of blood (as in arteries the blood flow with pressure).
   (b) Veins – are thin walled and carry blood to the heart from different organs or carry deoxygenated blood with the exception of pulmonary vein.
   – superficially situated
   – have valves to prevent backflow of blood.
   (c) Capillaries – thin vessels having only one cell thick wall and connecting arteries to veins.
   – flow of blood in capillaries is very slow.
   – the exchange of various materials like $O_2$, food, $CO_2$ etc. between blood and body takes through capillaries.
3. HEART – is a muscular organ (as big as our fist) and is made up of cardiac muscles. It has four chambers separated by septum. The upper two chambers are called AURICLES or auricles and the lower two chambers are called VENTRICLES. The two auricles receive blood from two main veins and the two ventricles

transport blood to the entire body and lung. The left auricle is connected to left ventricle through a valve. Similarly




CROSS - SECTION OF THE HUMAN HEART.

right atrium is connected to right ventricle through value. These values prevent the backflow of blood into atrium when the ventricles contract to pump blood out of the heart to rest of body. Ventricles have thick walls as compare to auricles as ventricles have to pump blood into various organs with high pressure while on contraction auricles have to pour blood into ventricles only.

Circulation of blood - When the muscles of all the four chambers of the heart are relaxed PULMONARY VEIN brings oxygenated blood from the lung into left atrium of the heart. At the same time, deoxygenated blood from body organs enters into the right atrium through the main vein called VENA CAVA.

- On contraction left atrium pour its blood into left ventricle. When the left ventricle contracts in its turn, the oxygenated blood is pumped into the main artery DORSAL AORTA. This main artery branches into smaller arteries which go into different body organs.

- From the right atrium the blood is transferred to right ventricle which in turn pumps the blood to lungs (by PULMONARY ARTERY) for oxygenation.

Thus in one complete cycle, blood travels twice through the heart, it is called DOUBLE CIRCULATION.

The animals such as mammals (including human beings) and birds have four chambered heart. The left side and right side of the heart are completely separated to prevent the mixing of oxygenated and deoxygenated blood. Such a separation allows a highly efficient supply

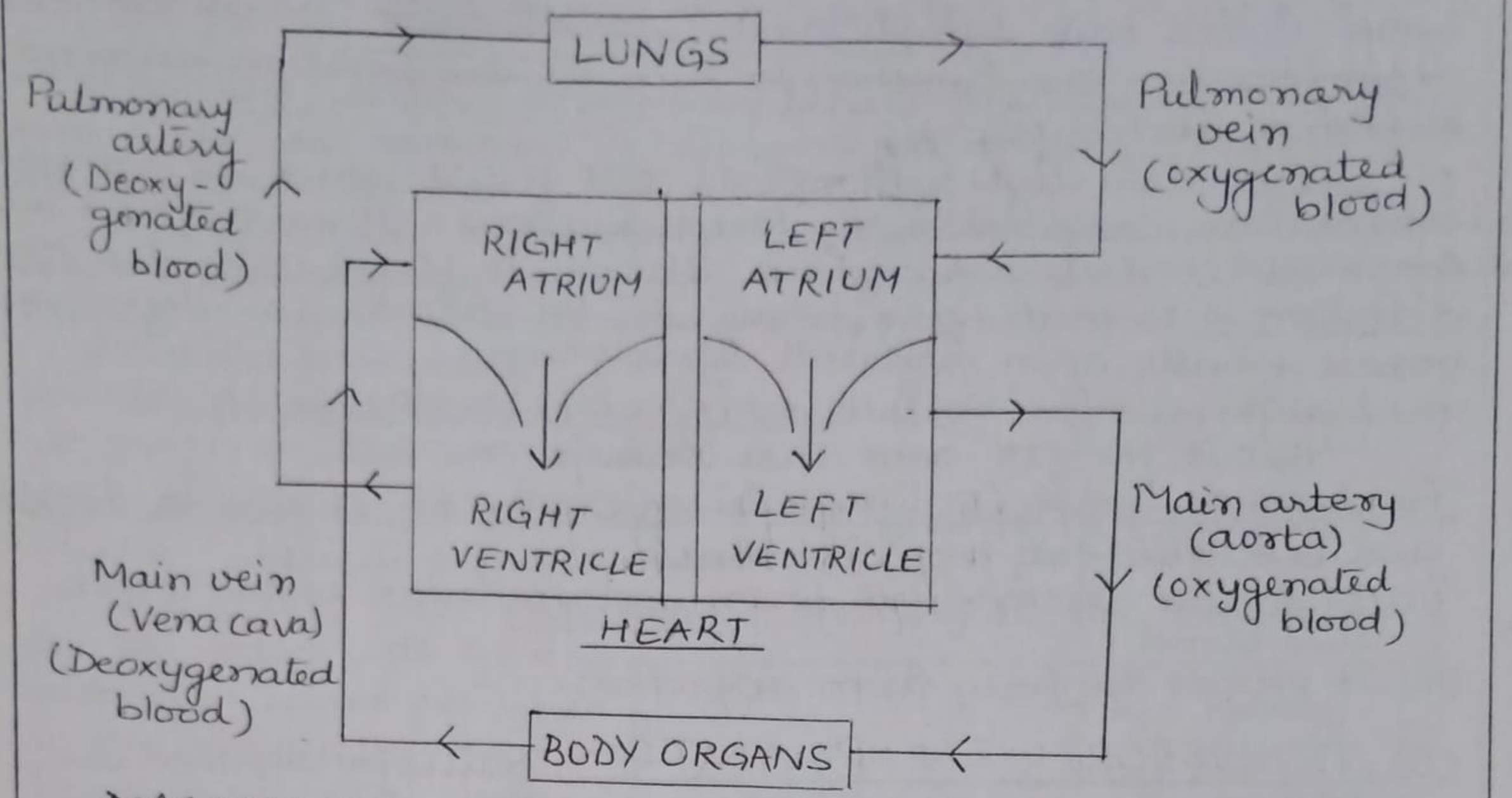



DIAGRAM TO SHOW BLOOD CIRCULATION IN HUMAN BODY

of oxygen to the body cells which is necessary for producing a lot of energy. This energy is useful in warm blooded animals as they require more energy to maintain their body temperature..

- The cold blooded animals like amphibians or many reptiles whose body temperature depends on the temperature of environment do not require energy to maintain their body temperature and hence their requirement of energy is less. Thus they have three chambered heart and tolerate some mixing of oxygenated and deoxygenated blood.

- The fish has a two chambered heart. The blood from the heart is pumped to the gills, where it gets oxygenated and then passes directly to rest of the body. Thus the blood flows only once through the heart in one cycle.

LYMPHATIC SYSTEM - It consists of -

(i) lymph vessels (large vessels & capillaries)
(ii) lymph nodes.
(iii) Lymph.

Lymph capillaries are small tubes which are present in whole body. They differ from blood capillaries in two ways -.

(a) they are closed ended.
(b) pores in their walls are bigger in size.

Since the ends of the lymph capillaries in the body tissue are closed, so the tissue fluid can only seep into the walls of lymph capillaries present in the body tissue. Due to large pore size, proteins and blood cells can also escape intercellular spaces in the tissue to form tissue fluid or lymph

The lymph capillaries join to form larger lymph vessels. The lymph vessels have lymph nodes at intervals which contain lymphocytes. The lymphocytes help us in fighting against infection and disease.

- Lymph is a light yellow coloured fluid which is somewhat similar in composition to blood plasma. It is not red in colour as it does not contain RBCs. It flows only in one direction i.e. from body tissue to the heart. (as lymph vessels finally open into into large veins).
- lymph is also called EXTRACELLULAR FLUID as it bathes the cell and lies outside the cell.

Functions of lymph (or lymphatic system) - (i) It carries digested and absorbed fat from intestine.
(ii) It drains excess fluid from extracellular space back into blood.
(iii) It protects the body from infection.

(B) TRANSPORT IN PLANTS - Transport system in plants is less elaborate than in animals. Some materials pass in and out of the plant through diffusion. For diffusion to occur plants possess stomata and lenticels. During day time, the photosynthetic organs obtain carbon dioxide from outside by diffusion which is used to synthesize food. Oxygen is formed as a by product in this process and it also passes out of the plant by diffusion. Other materials required for building plant body will also have to be taken up separately. For plants, the soil is the nearest and richest source of raw materials like nitrogen, phosphorous etc. The absorption of these substances occur through roots. If the distances between the roots and chlorophyll containing organs are small, energy and raw materials can easily diffuse to all parts of the plant body. But if these distances become large, diffusion proves will not be sufficient to provide raw materials in leaves and energy in roots. Thus a proper system of transportation is required in such situations.

- Plant transport system is slow as compared to animals because plants have low energy needs as they don't have to move and have large proportion of dead cells in many tissues.
- Plant transport system have two types of conducting tissues - XYLEM and PHLOEM. Xylem tissue transports water and minerals from soil (or roots) to leaves and phloem tissue transports food material from leaves to different parts of the plant.

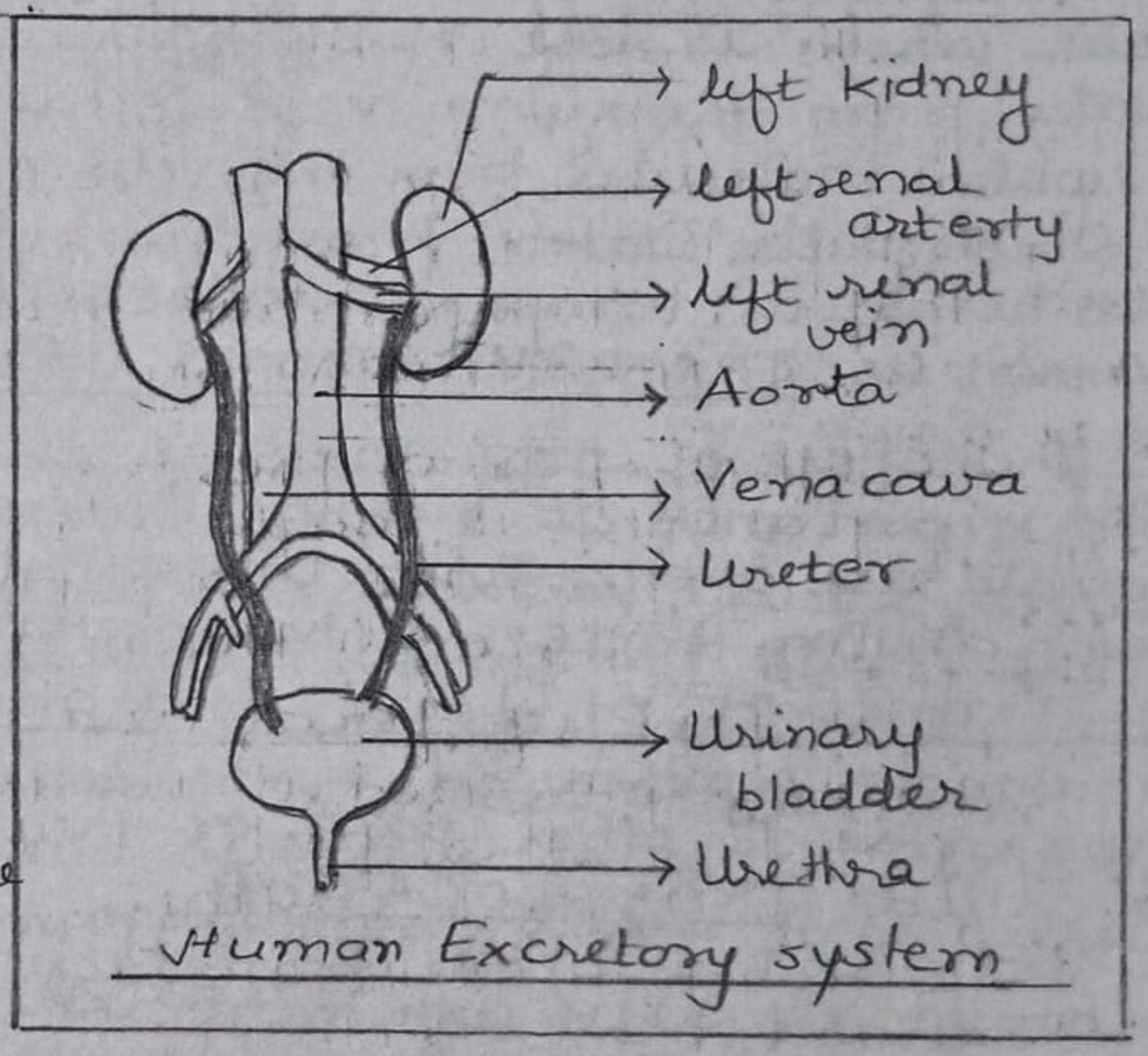
# EXCRETION

EXCRETION is the process by which metabolic wastes from body is removed. Different organisms use varied strategies to do this.

- In unicellular animals e.g. amoeba, the waste material $CO_2$ is removed by diffusion through cell membrane while nitrogenous waste and excess water are removed by the contractile vacuole.
- Complex multicellular organisms use specialized organs to perform the same function.

HUMAN EXCRETORY SYSTEM - It consists of kidney, ureter, urinary bladder and urethra.

- There are two KIDNEYS located in the abdomen one on either side of the backbone. Urine produced in the kidney passes through URETER into URINARY BLADDER, where it is stored until it is released through URETHRA.



Human Excretory system

- Each kidney is made up of large number of excretory units called NEPHRON. The nephron has a cup shaped structure at its upper end which is called BOWMAN'S CAPSULE. The lower end of the Bowman's capsule is is tube shaped and is called TUBULE. One end of the tubule is connected to Bowman's capsule and its other end is connected to a urine collecting duct of kidney. The Bowman's capsule contains a bundle of blood capillaries which is called GLOMERULUS. One end of the glomerulus is attached to the renal artery which brings the blood containing nitrogenous wastes like UREA and URIC ACID into it. The other end of the glomerulus comes out of Bowman's capsule as a blood capillary, surround the tubule of nephron and finally joins a renal vein.
- The function of glomerulus is to filter the blood passing through it. During filtration, the substances like glucose, amino acids, salts, water, urea etc, present in the blood pass into Bowman's capsule and then enter the tubular part of the nephron.

(a) Transport of water and minerals — . In xylem tissue, vessels and tracheids of the roots, stems and leaves are interconnected to form a continuous system of water conducting channels reaching all parts of the plant. At the roots, cells in contact with the soil actively take up ions. which creates a difference in the concentration of these ions between the root and the soil. Water, therefore, moves into the root from the soil to eliminate this difference. Thus, there is steady movement of water into root xylem, creating a column of water which is steadily pushed upwards. This is known as ROOT PRESSURE THEORY.

— Another strategy which plant use to move water in the xylem upwards to the highest point is by transpiration pull. TRANSPIRATION is the loss of water in the form of vapours from the aerial parts of the plant. The water which is lost through the stomata is replaced by water from the xylem vessels in the leaf. Thus evaporation of water molecules from the cells of a leaf creates a suction which pulls water from the xylem cells of roots. (It also helps in temperature regulation). This is known as TRANSPIRATION PULL THEORY.

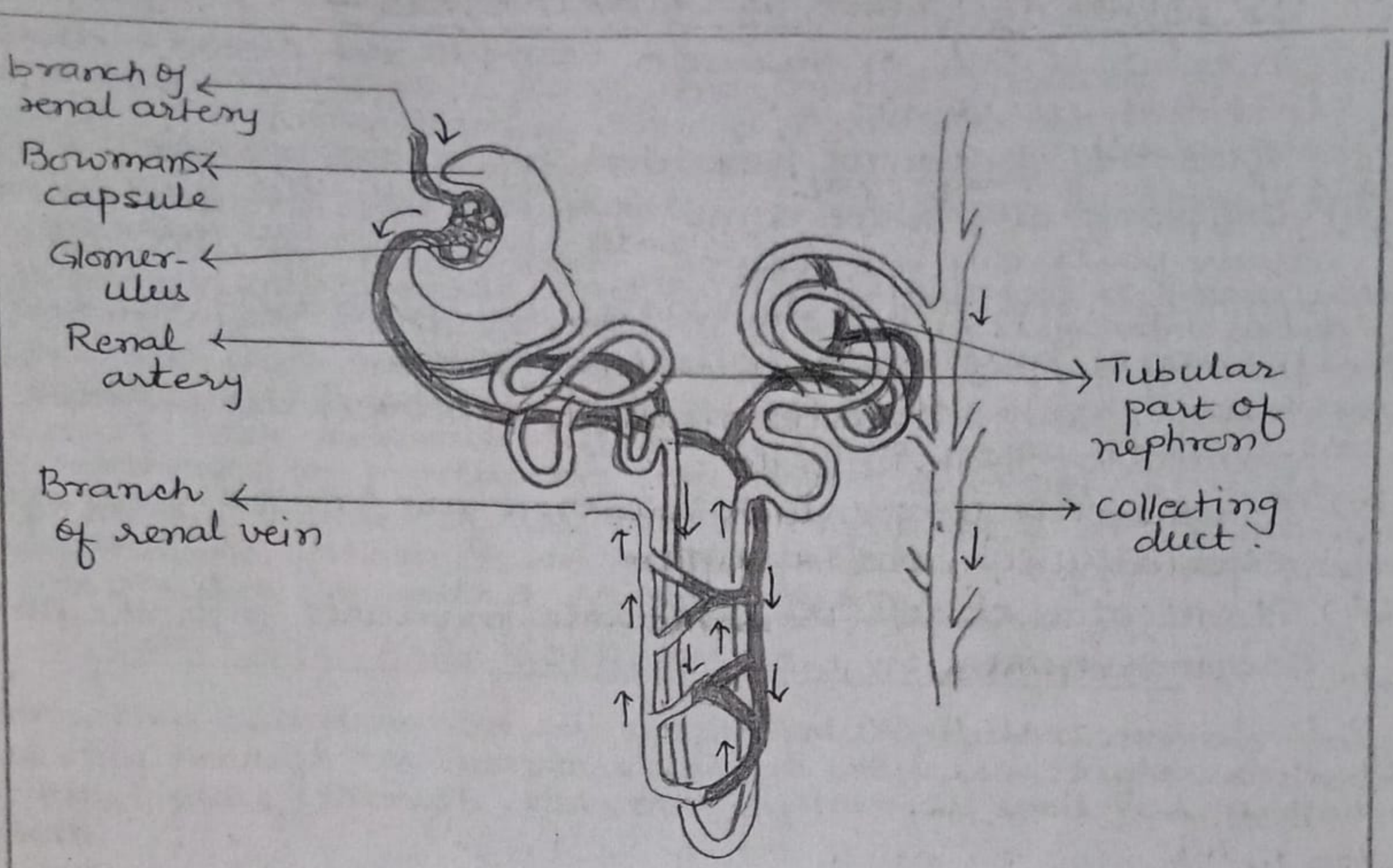
— The effect of root pressure in transport of water is more important at night. During the day time, when the Stomata are open, the transpiration pull becomes the major driving force in the movement of water in xylem.

(b) Transport of food and other substances — . Food materials synthesized in the leaves of plant has to be transported to other parts of the plant. and this process is called TRANSLOCATION.

— The direction of the translocation can be upward, downward or both.

— Translocation occurs through phloem. The channels of transport are sieve tubes. while the force required for translocation is produced by companion cells which lie adjacent to sieve tubes.

— The transport of organic solutes or nutrients occurs through a physical process but entry and exit of nutrients from the phloem can occur only through an active process which utilizes energy from ATP. Materials like sucrose is transferred into the phloem (sieve tubes) using energy from ATP. This increases the osmotic pressure of the tissue causing water to move into it. A high turgor pressure develops. It forces the nutrients to pass towards the region which has low pressure. This allows the phloem to move material according to plant's needs. e.g. in the spring, sugar stored in the root or stem would be transported to the buds which need energy to grow.




STRUCTURE OF NEPHRON

Some molecules in the filtrate such as water, glucose, amino and salts are selectively reabsorbed into the blood. The filterate now contains mainly urea, salts and water and constitutes URINE. The amount of water reabsorbed depends on — (i) the amount of excess water in the body.
(ii) the quantity of dissolved waste to be excreted.
This reabsorption of water from the filterate to maintain the water balance of body fluid is known as OSMOREGULATION.

- The urine formed in each kidney eventually enters a long tube, the ureter, which connects the kidney with urinary bladder. Urine is stored in the bladder. As the bladder expands, its pressure creates an urge to pass the urine through urethra. As the bladder is muscular, the urge to urinate is under voluntary nervous control.

EXCRETION IN PLANTS- Like animals, plants also produce a number of waste products during their life processes. As compared to animals, the plants produce waste products very slowly and in very small amounts. The plants have no special organs for waste removal like the animals. They remove their waste products by different methods. Some of the important methods are

(i) The plants get rid of gaseous waste products (like $O_2$ & $CO_2$) through stomata in leaves and lenticels in stems.
(ii) Excess of water is removed by transpiration.
(iii) The plants also store some of the waste products in their body parts e.g in leaves, bark and fruits. The plants get rid of these wastes by shedding of leaves, peeling of bark and falling of fruits.
(iv) Many plant waste products are stored in central vacuoles of their cells.
(v) Other waste products are stored as resins and gums, especially in old xylem.
(vi) Plants also excrete some waste products into the soil around them.