Chapter 6 - Life Processes

What are life processes?

Biology is the study of **living things**. All living things are called organisms, both plants and animals are living organisms. But how we decide whether something is living or non-living depends on **7 life processes**. If something is living it will carry out the 7 life processes below.

1. **Movement**

   Both animals and plants have the ability to move. Plants are rooted and move slowly as they grow. Their roots move down into the soil and their stems move up towards the light. Animals on the other hand move quickly and can move their entire bodies. They can move in search of food, shelter or to avoid danger.

2. **Respiration**

   Respiration is the process of extracting energy out of the food we eat. All living things respire because they need energy to grow, to replace worn out parts and to move. Respiration takes place in the mitochondria of the cell.

3. **Sensitivity**

   All living organisms are sensitive; this means that they have an awareness of changes in their environment. Animals respond quickly to stimuli such as heat, light, sound, touch and chemicals which have taste and smell. On the other hand, plants generally appear less sensitive and their response is slower.

4. **Growth**

   All living organisms grow. Plants continue growing throughout their lives. Animals stop growing once they reach adulthood. Even when growth stops, materials within an animal's body are still being replaced from its food.

5. **Excretion**

   All living things make waste products these can be useless or harmful to it and therefore need to be got rid of. Excretion is the process of getting rid of metabolic waste. Plants store waste substances in their leaves, the waste is removed when their leaves fall off. Animals breathe out waste carbon dioxide, other waste substances leave the body in urine and sweat.

   Note: Getting rid of faeces or undigested food is not excretion but egestion.

6. **Reproduction**

   All living things must produce offspring like themselves in order for their species to survive. This is the process known as reproduction. Plants produce seeds that give rise to new plants of the same species. Animals lay eggs or have babies. Reproduction can be of two types, Sexual which involves two parents and the union of two gametes and Asexual where one parent can reproduce itself.

7. **Nutrition**

Nutrition is needed for energy and growth, both plants and animals need food. Plants are able to make their own food by photosynthesis. They use sunlight to turn simple molecules like carbon dioxide and water into more complex carbohydrate molecules. Animals are unable to make their own food so rely on other plants and other animals for their nutrition. Animals take in complex substances and break them down into small, simple, soluble molecules which can be used for energy and growth

Nutrition:

Energy required to carry out different life processes is obtained through the process of nutrition.

Depending on the mode of obtaining nutrition, organisms are classified as autotrophs or heterotrophs.

i. Autotrophs can prepare their own food from simple inorganic sources such as carbon dioxide and water. Examples: Green plants and some bacteria.

ii. Heterotrophs cannot synthesise their own food and are dependent on other organisms for obtaining complex organic substances for nutrition. Example: Animals and fungi

Autotrophic Nutrition:

A type of nutrition in which organisms synthesize the organic materials they require from inorganic sources. Chief sources of carbon and nitrogen are carbon dioxide and nitrates, respectively. All green plants are autotrophic and use light as a source of energy for the synthesis of food through photosynthesis.

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

The following events occur during this process.

(i) Absorption of light energy by chlorophyll

(ii) Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen.

(iii) Reduction of carbon dioxide to carbohydrates.

These green plants absorbs water from the soil by roots. Co_2 enters from the atmosphere through stomata, Sunlight is absorbed by chlorophyll and other green parts of the plants.

Heterotrophic Nutrition:

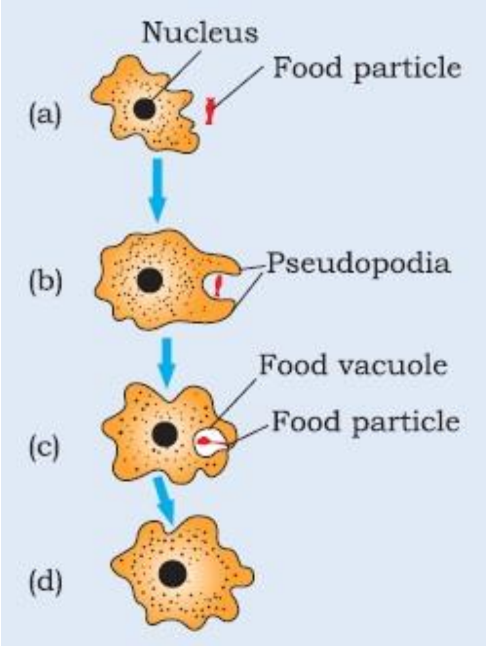
All heterotrophs depend on autotrophs for their nutrition.

The three main types of heterotrophic nutrition are:

1. Holozoic nutrition: Complex food is taken into a specialist digestive system and broken down into small pieces to be absorbed. Eg: Ameoba, Humans

2. <u>Saprophytic nutrition</u>: Organisms feed on dead organic remains of other organisms. Eg: Fungi like bread moulds yeast and mushrooms.
3. <u>Parasitic nutrition</u>: Organisms obtain food from other living organisms (the host), with the host receiving no benefit from the parasite. Eg: cascuta, ticks, lice, leeches and tape worms.

How do Organisms Obtain Their Utrition?



In single celled organisms, the food may be taken in by the entire surface.
Eg: Amoeba takes in food using temporary finger-like extensions of the cell surface which fuse over the food particle forming a food-vacuole. Inside the food vacuole, complex substances are broken down into simpler ones which then diffuse into the cytoplasm. The remaining undigested material is moved to the surface of the cell and thrown out.

Nutrition in Human Beings:
In humans, digestion of food takes place in the alimentary canal, made up of various organs and glands.

In the mouth, food is crushed into small particles through chewing and mixed with saliva, which contains amylase for digesting starch.

On swallowing, food passes through the pharynx and oesophagus to reach the stomach. Gastric juice contains pepsin (for digesting proteins), HCl and mucus.

The hydrochloric acid creates an acidic medium which facilitates the action of the enzyme pepsin. The mucus protects the inner lining of the stomach from the action of the acid under normal conditions.

From the stomach, the food now enters the small intestine. The small intestine is the site of the complete digestion of carbohydrates, proteins and fats.
The liver secretes bile which emulsifies fat.
The pancreas secretes pancreatic juice which contains the enzymes amylase, trypsin and lipase for digesting starch, proteins and fats, respectively.

In the small intestine, carbohydrates, proteins and fats are completely digested into glucose, aminoacids, fatty acids and glycerol.

The villi of the small intestine absorb the digested food and supply it to every cell of the body.

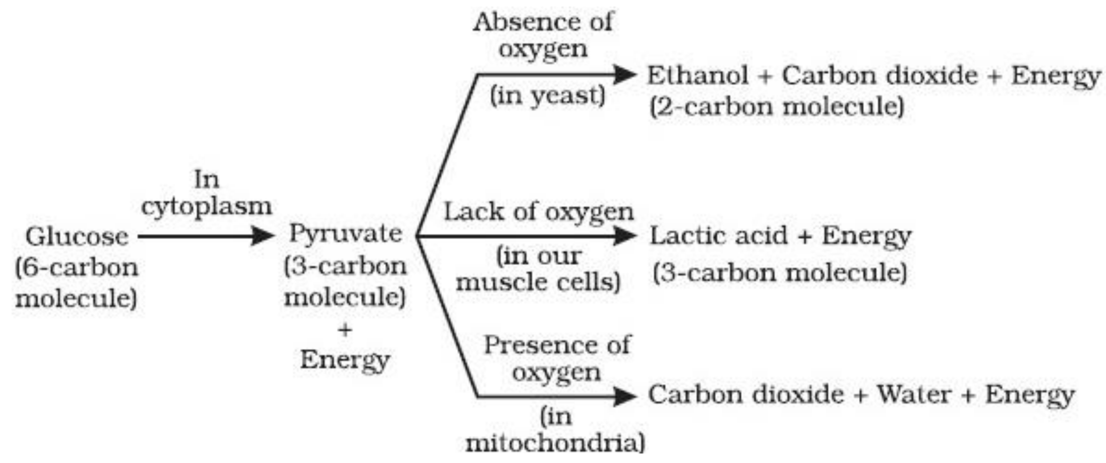
The unabsorbed food is sent into the large intestine where more villi absorb water from this material. The rest of the material is removed from the body via the anus.

Respiration:

During respiration, the digested food materials are broken down to release energy in the form of ATP.
Depending on the requirement of oxygen, respiration may be of two types:

i. Aerobic respiration: It occurs in the presence of air (oxygen).
ii. Anaerobic respiration: It occurs in the absence of (air) oxygen.

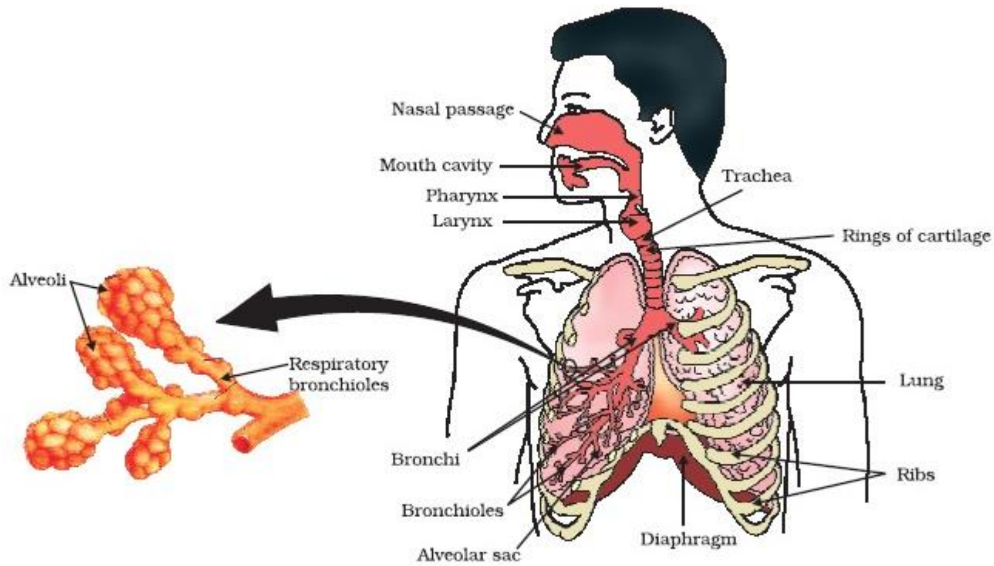
In all cases the first step is the break-down of glucose, a six-carbon molecule, into a three-caron molecule called pyruvate. This process taken place in the cytoplasm. Further, the pyruvate may be converted into ethanol and carbon dioxide. This process takes place in yeast during fermentation. Since this process takes place in the absence of air (oxygen), it is called anaerobic respiration. Break-down of pyruvate using oxygen takes place in the mitochondria.
A large amount of energy is released in aerobic respiration as compared to anaerobic respiration.
Some times when there is a lack of oxygen in our muscle cells, the pyruvate is converted into lactic acid. This build up of lactic acid in our muscles during sudden activity causes cramps.



Terrestrial organisms use atmospheric oxygen for respiration, whereas aquatic organisms use oxygen dissolved in water.

In humans, inhalation of air occurs through the following pathway:

Nostrils _ Nasal passage _ Pharynx _ Larynx _ Trachea _ Bronchus _ Bronchiole _ Alveolus (please put arrow marks ------→)



In human beings are is taken into the body through the nostrils. The air passing through the nostrils is filtered by fine hairs that line the passage. The passage is also lined with mucus which helps in this process. From here, the air passes through the throat and into the lungs. Rings of cartilage are present in the throat. These ensure that the air-passage does not collapse.

Within the lungs the passage divides into smaller and smaller tubes which finally terminate in balloon-line structures which are called alveoli.

The alveoli of lungs are richly supplied with blood and are the sites where exchange of gases (O_2 and CO_2) occurs between blood and the atmosphere.

The blood brings carbon dioxide from the rest of the body for release into the alveoli, and the oxygen in the alveolar air is taken up by blood in the alveolar blood vessels to be transported to all

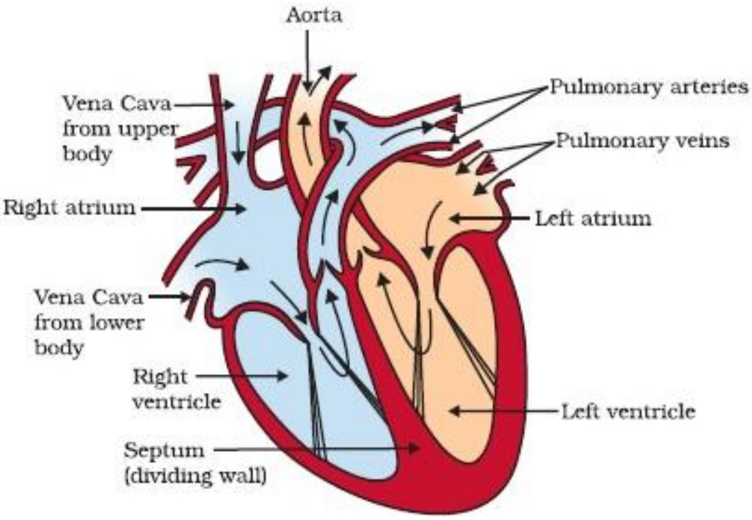
the cells in the body. During the breathing cycle, when air is taken in and let out, the lungs always contain a residual volume of air so that there is sufficient time for oxygen to be absorbed and for the carbon dioxide to be released.
In humans, the respiratory pigment haemoglobin carries oxygen from the lungs to the different tissues of the body. This pigment in present in the red blood cells.

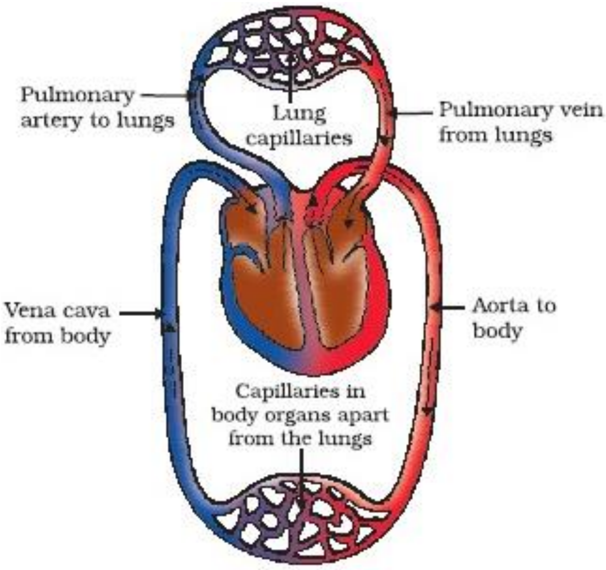
Transportation:

Transportation in Human Beings:

The circulatory system is composed of the heart, blood and blood vessels which transport various materials throughout the body.

The heart:





The human heart has four chambers—two atria (right and left) and two ventricles (right and left). These chambers prevent the oxygen rich blood from mixing with the blood containing carbon dioxide. The right half of the heart receives deoxygenated blood, whereas the left half receives oxygenated blood.
The carbon dioxide –rich blood has to reach the lungs for the carbon dioxide to be removed, and the oxygenated blood from the lungs has to be brought back to the heart. This oxygen-rich blood is then pumped to the rest of the body.
Ventricular walls are much thicker than atrial walls.
Humans show double circulation i.e. blood goes through the heart twice and complete separation of oxygenated and deoxygenated blood.
Arteries carry blood from the heart to different parts of the body, whereas veins deliver the blood back to the heart. Arteries are connected to veins by thin capillaries, wherein materials are exchanged between the blood and cells.
Blood has platelet cells which circulates around the body and prevent the blood loss at the site of injury.
Lymph is also involved in transportation. It is similar to the plasma of blood but colourless and contains less protein. It drains into lymphatic capillaries from the intercellular spaces which join to from large lymph vessels that finally open into larger veins. It carries digested and absorbed fat from intestine and drains excess fluid from extra cellular space back into the blood.

Transportation in plants:
Plant transport systems will move energy stores from leaves and raw materials from roots. These two pathways are constructed as independently organized conducting tubes. One, the xylem moves water and minerals obtained from the soil. The other, phloem transports products of photosynthesis from the leaves where they are synthesised to other parts of the plant.

The component of xylem tissue (tracheids and vessesls) of roots, stems, leaves are interconnected to form a continuous system of water conducting channels that reaches all parts of the plant.
Transpiration creates a suction pressure, as a result of which water is forced into the xylem cells of the roots. Then there is a steady movement of water from the root xylem to all parts of the plant parts through the interconnected water conducting channels.

The loss of water in the form of vapour from the aerial parts of the plant is known as **transpiration**. Thus it helps in the absorption and upward movement of water and minerals dissolved in it from roots to the leaves. It also regulates temperature.
The transport of soluble products of photosynthesis is called translocation and it occurs in phloem. It transports amino acids and other substances. The translocation of food and other substances takes place in the sieve tubes with the help of adjacent companion cells both in upward and down ward directions.

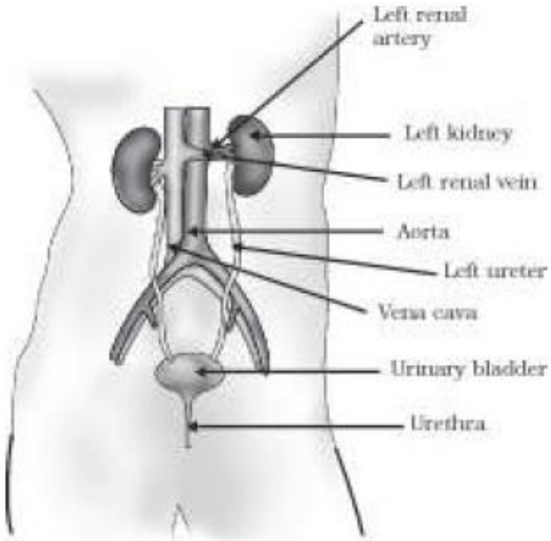
The translocation in phloem is achieved by utilising energy. Material like sucrose is transferred into phloem tissue using energy from ATP. This increases the osmotic pressure of the tissue causing water to move into it. This pressure. This allows the phloem to move material according to the plant's needs. For example, in the spring, sugar stored in root or stem tissue would be transported to the buds which need energy to grow.

Excretion:

During excretion, the harmful metabolic nitrogenous wastes generated are removed from the body

Excretion in Human Beings:

In humans, a pair of kidneys, a pair of ureters, the urinary bladder and the urethra constitute the excretory system. Kidneys are located in the addomen, one on either side of the backbone. Urine produced in the kidneys passes through the ureters into the urinary bladder where it is stored until it is released through the urethra.



Each kidney has large numbers of basic filtration units called nephrons. Some substances in the initial filtrate, such as glucose, amino acids, salts and a major amount of water, are selectively re-absorbed as the urine flows along the tube. The amount of water re-absorbed depends on how much excess water there is in the body, and on how much of dissolved waste there is to be excreted. The urine forming in each kidney eventually enters a long tube, the ureter, which connects the kidneys with the urinary bladder until the pressure of the expanded bladder leads to the urge to pass it out through the urethra. The bladder is muscular so it is under nervous control. As a result we can control the urge to urinate.

Excretion in plants:

Plants do not have an excretory system and carry out excretion in various ways such as transpiration, releasing wastes into the surrounding soil, losing their leaves and storing waste materials in cell vacuoles. Other waste products are stored as resins and gums in old xylem.