LIFE PROCESSES IN ANIMALS

Life process has four components:

(i) Nutrition
(ii) Respiration
(iii) Transportation
(iv) Excretion

1. The processes which perform maintenance job to prevent damage and break-down in the body are **life processes**.

2. A process to transfer a source of energy from outside the body of the organism, to the inside, is called **nutrition**. Depending on the **complexity** of these carbon food sources, different organisms use different kinds of nutritional processes.

3. **Oxidising-reducing reactions are the most common chemical means to break-down food molecules**. The process of acquiring oxygen from outside the body, and to use it in the process of break-down of food sources for cellular needs, is called **respiration**. In a single-celled organism, exchange of gases or removal of wastes takes place on the **surface of the organism** is in contact with the environment. In multi-cellular organisms, various body parts carry out functions.

4. Food and oxygen are required to be supplied to all parts of the body. Therefore, a **transportation** system for carrying food and oxygen from one place to another in the body is required.

5. Chemical reactions in the body use the carbon source and oxygen for energy generation. The harmful and useless biological waste products formed during chemical reaction of food and oxygen is removed by **excretion**.

We examine these four processes in Animals.

ANIMALS

A - NUTRITION

1. In plants, we have seen autotrophic nutrition. Animals have Heterotrophic mode of nutrition.

Heterotrophic Nutrition

2. Organisms which obtain their food from other organisms are called **heterotrophic** and the process of obtaining the food from other organisms is called **heterotrophic nutrition**.

3. Heterotrophic nutrition are 3 types: -
   (i) **Holozoic nutrition**: Means animals which eat their food whole. Complex food is taken into a specialist digestive system and broken down into small pieces to be absorbed. This consists of **5 stages**, **ingestion, digestion, absorption, assimilation** and **egestion**. Eg. Amoeba, Human

   (ii) **Saprophytic nutrition**: Organisms feed on dead organic remains of other organisms. Eg. decomposers

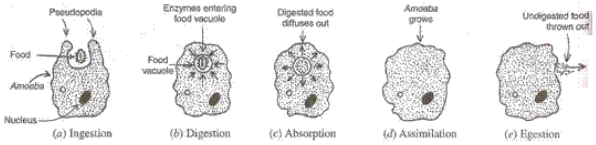
   (iii) **Parasitic nutrition**: Organisms obtain food from other living organisms (the host), with the host receiving no benefit from the parasite. These parasites suck and feed on the blood of the host. E.g. cuscuta (amar-bel), orchids, ticks, lice, leeches and tape-worms.

4. We cover holozoic mode in **Amoeba** and **Humans.**

Nutrition in Amoeba

5. Amoeba is a singled cell organism. Nutrition in amoeba is holozoic. It is an omnivore, feeding on both plants and animals. Its diet includes bacteria, microscopic plants like the diatoms, minute algae, microscopic animals like other protozoa.

6. The mechanism of nutrition takes places in 5 steps:



Different stages in the nutrition (feeding) of *Amoeba*.

   (i) **Ingestion**: The food is ingested at the point where it comes in touch with the cell surface with the help of pseudopodia (false arms).
   (ii) **Digestion**: The food taken-in remains in a food vacuole formed by the cell membrane in the cytoplasm. It is digested by the different enzymes present in the vacuole.
   (iii) **Absorption**: Since the food on digestion is converted into liquid diffusible form, it is readily absorbed by the cytoplasm.
   (iv) **Assimilation**: All the parts of the cell get the nutrients by the cyclic movement of the cytoplasm.
   (v) **Egestion**: Undigested matter is thrown out though a temporary opening.

Nutrition in Human Beings

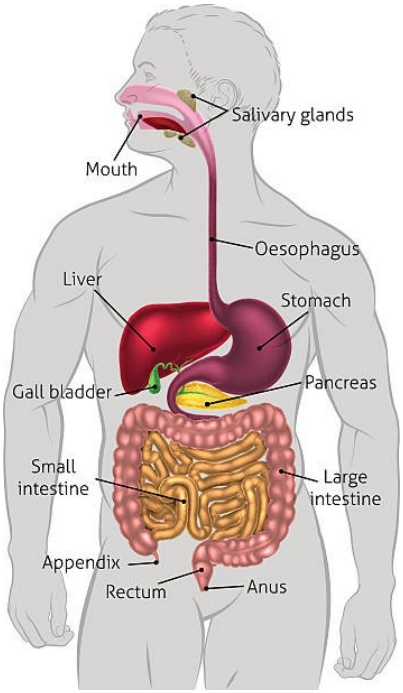
7. Nutrition in Human is carried by the Digestive System. The human digestive system consists of the **gastrointestinal tract**plus the accessory organs of digestion (the tongue, **salivary glands**, **pancreas**, **liver**, and **gallbladder**). In this system, the process of digestion has many stages, the first of which starts in the **mouth**.

8. Once the food is ingested into the **mouth** the action of the upper and the lower jaw crushes and **grinds the food**. The food is also wetted to make its passage smooth by a fluid called saliva secreted by the salivary glands. The saliva contains an enzyme called **salivary amylase** that breaks down starch which is a complex molecule to give sugar.

9. The **alimentary canal** is basically a long tube extending from the mouth to the anus. Various regions are specialised to perform different functions. The lining of canal has muscles that contract rhythmically in order to push the food forward called **peristaltic movements** occur all along the gut.

10. From the mouth, the food is taken to the stomach through the **food-pipe or oesophagus**. The food then moves into the stomach.

LIFE PROCESSES IN ANIMALS



11. The muscular walls of the **stomach** help in mixing the food thoroughly with more digestive juices. Stomach contains gastric glands present in its wall.
    (i) The gastric glands in stomach release hydrochloric acid, a protein digesting enzyme called **pepsin**, and **mucus**. The **hydrochloric acid creates an acidic medium** which facilitates the **action of the enzyme pepsin**.

    (ii) The mucus protects the inner lining of the stomach from the action of the acid under normal conditions. Remember acidity is due excess **hydrochloric acid.**

    (iii) The exit of food from the stomach is regulated by a **sphincter muscle** which releases it in small amounts into the **small intestine**.

12. **Small intestine** is the longest part of the alimentary canal fitted into a compact due to **extensive coiling**.
    (i) In **herbivores** eating grass there is need of a **longer small intestine** to allow the cellulose to be digested.
    (ii) As Meat is easier to digest, **carnivores** like tigers have a **shorter small intestine**.

13. The **small intestine** is the site of the **complete digestion of carbohydrates, proteins and fats**. It receives the secretions of the **liver** and **pancreas** for this purpose.
    (i) The food coming from the stomach is acidic and has to be **made alkaline for the pancreatic enzymes** to act.

    (ii) **Bile juice** from the **liver** accomplishes this in addition to acting on fats. Fats are present in the intestine in the form of large globules which makes it difficult for enzymes to act on them. **Bile salts break** large fat globules into smaller globules increasing the efficiency of enzyme action.

    (iii) The pancreas secretes **pancreatic juice** which contains **enzymes** like **trypsin** for **digesting proteins** and **lipase** for **breaking down emulsified fats**.

    (iv) The walls of the small intestine contain glands which secrete intestinal juice containing enzymes to convert the **proteins to amino acids**, **complex carbohydrates into glucose** and **fats into fatty acids and glycerol**.

14. The digested food is taken up by the walls of the intestine. The **inner lining** of the small intestine has numerous **finger-like projections** called **villi** which increase the surface area for absorption. The villi are **richly supplied with blood vessels** which take the absorbed food to every cell of the body, where it is utilised for obtaining energy, building up new tissues and the repair of old tissues.

15. The **unabsorbed food is sent into the large intestine** where more **villi** will **absorb water**.

16. The rest of the material is **removed from the body via the anus**. The exit of this waste material is **regulated by the anal sphincter**.

B – RESPIRATION

1. **Respiration** is the breakdown of organic compounds into simpler compounds accompanied by the release of energy in the form of ATP (Adenosine Triphosphate). The mechanism of taking in oxygen and giving out carbon dioxide is called **breathing**.

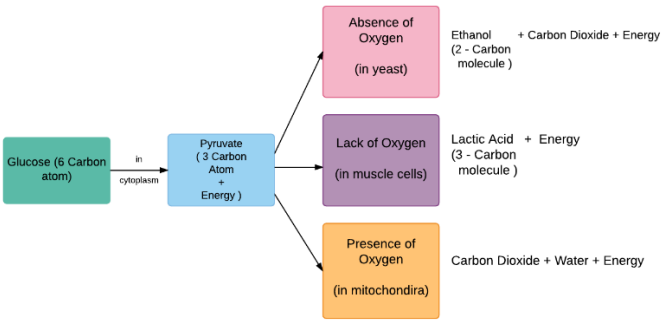
2. Respiration is of two types: - (i) **anaerobic respiration** and (ii) **anaerobic respiration.**

3. In all cases, the first step is the break-down of **glucose(food), a six-carbon molecule, into a three-carbon molecule called pyruvate**. This process takes 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**.

4. Breakdown of pyruvate using oxygen takes place in the **mitochondria**. This process breaks up the three-carbon pyruvate molecule to give three molecules of carbon dioxide. The other product is water. Since this process takes place in the presence of air (oxygen), it is called **aerobic respiration**. The release of energy in this process is a lot greater than in the anaerobic process.

5. Sometimes, when there is a **lack of oxygen in our muscle cells**, another pathway for the break-down of pyruvate is taken. Here the **pyruvate is converted into lactic acid** which is also a three-carbon molecule. **This build-up of lactic acid in our muscles during sudden activity causes cramps**.

LIFE PROCESSES IN ANIMALS



6. The energy released during cellular respiration is immediately used to **synthesise a molecule called ATP** (Adenosine Triphosphate) which is used to fuel all other activities in the cell. In these processes, **ATP is broken down giving rise to a fixed amount of energy** which can drive the endothermic reactions taking place in the cell.

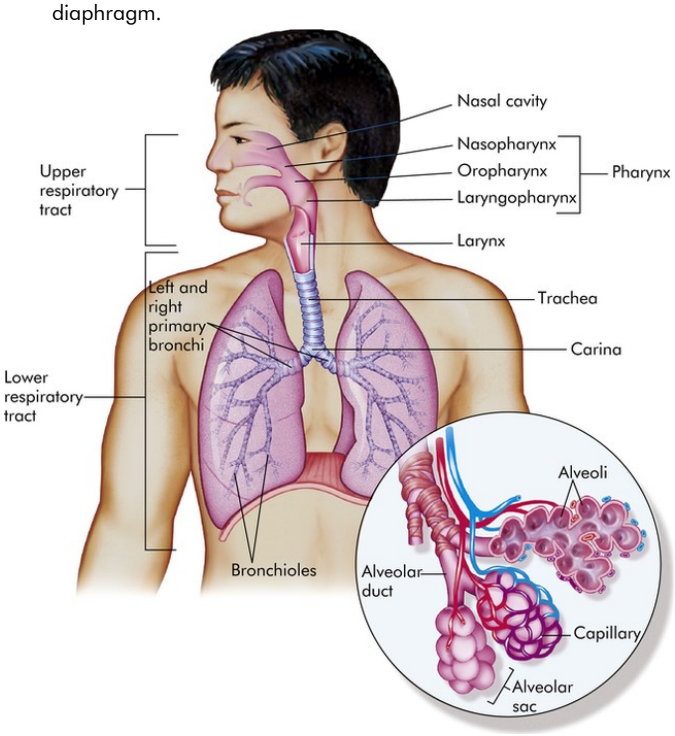
7. Since the aerobic respiration pathway depends on oxygen, aerobic organisms need to ensure that there is sufficient intake of oxygen.

8. **Terrestrial animals** can breathe the oxygen in the atmosphere, but animals that live in water need to use the oxygen dissolved in water.

9. Since the amount of dissolved oxygen is low compared to the amount of oxygen in the air**, the rate of breathing in aquatic organisms is much faster than that seen in terrestrial organisms**. Fishes take in water through their mouths and force it past **the gills where the dissolved oxygen is taken up by blood**.

Respiration in Humans

10. It's the **respiratory system** (also called **Pulmonary System**) which carries out Respiration. The **pulmonary system** includes the lungs, larynx, trachea, bronchi, bronchioles, alveoli and thoracic diaphragm.



11. **In human beings**, air 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 which ensure that the air-passage does not collapse.
12. Breathing Process: -
    (i) When we **breathe in**, we lift our ribs and **flatten our diaphragm**, and the **chest cavity becomes larger** as a result. As a result, air is sucked into the lungs and fills the expanded alveoli.

    (ii) 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.

    (iii) 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.

13. In human beings, the **respiratory organs are the lungs**.

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

    (i) The **alveoli provide a surface where the exchange of gases can take place**.

    (ii) This oxygen-rich air is taken in by the nostrils. The walls of the alveoli contain an extensive network of blood-vessels.

    (iii) The capillaries lining the alveoli have impure blood which has low concentration of oxygen. So, the oxygen from the air easily diffuses into the blood through the thin barrier of the alveolus wall. Similarly, since the concentration of carbon dioxide is quite high in the blood, the gas easily diffuses out into the alveolar space. From here, the air that has comparatively more concentration of carbon dioxide than the air that entered it, leaves the lungs.

15. When the body size of animals is large, the diffusion pressure alone cannot take care of oxygen delivery to all parts of the body. Instead, respiratory pigments take up oxygen from the air in the lungs and carry it to tissues which are deficient in oxygen before releasing it. **In human beings, the respiratory pigment is haemoglobin which has a very high affinity for oxygen**. This pigment is present in the red blood corpuscles. Carbon dioxide is more soluble in water than oxygen is and hence is mostly transported in the dissolved form in our blood.

C –TRANSPORTATION

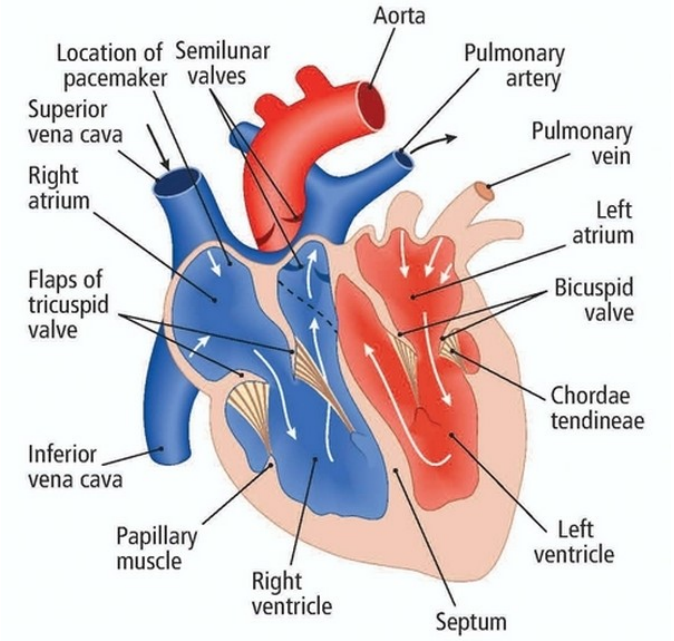
1. The transport system in animals is called the **circulatory system**. The circulatory system consists of three independent systems that work together: the **heart** (cardiovascular), **lungs** (pulmonary), and **arteries, veins, coronary and portal vessels** (systemic). The system is responsible for the flow of blood, nutrients, oxygen and other gases, and as well as hormones to and from cells.

LIFE PROCESSES IN ANIMALS

2. There are two circulatory systems: (i) **Blood circulatory system** ; and (ii) **Lymphatic circulatory system**

3. Blood transports food, oxygen and waste materials in our bodies. Blood being a **fluid connective tissue**. **Blood consists of a fluid medium called plasma in which the cells are suspended. Plasma transports food, carbon dioxide and nitrogenous wastes in dissolved form. Oxygen is carried by the red blood cells.** Many other substances like salts, are also transported by the blood.

4. The **heart** is a muscular organ which is as big as our fist.
   (i) The human heart is **four-chambered**.



   (ii) The **upper chambers are called the atria** or the auricles and the **lower two chambers are called the ventricles**. The two atria are separated by the interatrial septum. The two ventricles are separated from each other by the interventricular septum. The ventricles have more muscular walls than the auricles.
   (iii) The **right side of the heart is concerned with deoxygenated blood** and the **left side of the heart with the oxygenated blood**.
   (iv) The right auricle opens into the lower right ventricle. The left auricle opens into the lower left ventricle.
   (v) The deoxygenated blood from the different parts of the body are collected by the **veins called the vena cava** (superior vena cava collecting from the upper body and the inferior vena cava collecting from the lower body). The blood from the vena cava is poured into the right auricle.
   (vi) The right ventricle opens to a major artery called the **pulmonary artery** which takes the deoxygenated blood to the lungs.
   (vii) The left auricle receives oxygenated blood from the **left and right pulmonary veins** coming from the left and right lung respectively. The left ventricle opens into a major artery called the **aorta**.

5. As both oxygen and carbon dioxide have to be transported by the blood, the heart has different chambers to prevent the oxygen-rich blood from mixing with the blood containing carbon dioxide.

6. 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**. We can follow this process step by step.

   (i) Oxygen-rich blood from the lungs comes to the **thin-walled upper chamber of the heart on the left, the left atrium**.
   (ii) The left atrium relaxes when it is collecting this blood. It then contracts, while the next chamber, the **left ventricle,** expands, so that the blood is transferred to it. When the muscular left ventricle contracts in its turn, the blood is pumped out to the body.

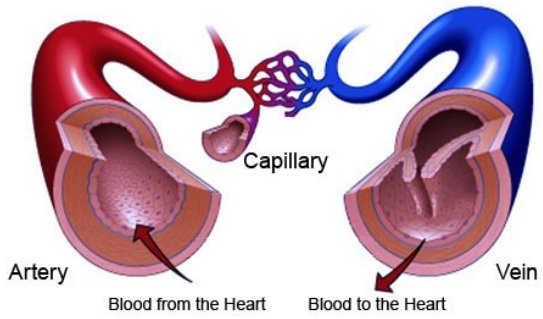
   (iii) **De-oxygenated blood comes** from the body to the upper chamber on the right**, the right atrium**, as it expands. As the right atrium contracts, the corresponding lower chamber, the right ventricle, dilates. This **transfers blood to the right ventricle**, which in turn pumps it to the lungs for oxygenation.

   (iv) Since ventricles have to pump blood into various organs, they have thicker muscular walls than the atria do. **Valves** ensure that blood does not flow backwards when the atria or ventricles contract.

   (v) The **separation** of the right side and the left side of the heart is useful to keep oxygenated and deoxygenated blood from mixing. Such separation allows a highly efficient supply of oxygen to the body.

   (vi) Thus, blood goes through the heart twice during each cycle in other vertebrates. This is known as **double circulation**.

7. **Arteries are the vessels which carry blood away from the heart to various organs of the body**. Since the blood emerges from the heart under high pressure, the arteries have thick, elastic walls. **Veins collect the blood from different organs and bring it back to the heart**. They do not need thick walls because the blood is no longer under pressure, **instead they have valves** that ensure that the blood flows only in one direction. On reaching an organ or tissue, the **artery divides into smaller and smaller vessels** to bring the blood in contact with all the individual cells. The smallest vessels have walls which are one-cell thick and are called **capillaries**. Exchange of material between the blood and surrounding cells takes place across this thin wall. **The capillaries then join to form veins that convey the blood away from the organ or tissue**.



8. To avoid leakages and loss of pressure, the blood has **platelet** cells which circulate around the body and plug these leaks by helping to clot the blood at these points of injury.

9. At the capillary end of the arteries, the walls are only one-cell thick. The pressure in the arterial capillaries is also quite high. These leads the plasma to leak into the interstitial space. The interstitial space is the space between the cells of the tissue. The fluid then enters the closed vessels called the **lymph vessels**. It is like the plasma of blood but colourless and contains less protein. **Lymph carries digested and absorbed fat from intestine and drains excess fluid from extra cellular space back into the blood**.

D – EXCRETION

1. The removal of harmful and unwanted toxic waste products of **metabolism** is known as excretion. It is the **urinary system** in Humans. The urinary system, also known as the renal system, consists of the **kidneys, ureters**, **bladder**, and the **urethra**.

2. **Egestion** is expelling the undigested wastes from the body. Food which is not digested and thus is not assimilated by the body is passed to the last part of the alimentary canal called the rectum and egested out in the form of faeces or excreta.

3. Organisms need to get rid of gaseous wastes generated during photosynthesis or respiration. **Other metabolic activities generate nitrogenous materials such as urea or uric acid which need to be removed**. The biological process involved in the removal of these harmful metabolic wastes from the body is called **excretion**.

4. Different organisms use varied strategies to do this. Many unicellular organisms remove these wastes by simple diffusion from the body surface into the surrounding water. Complex multi-cellular organisms use specialised organs to perform the same function.

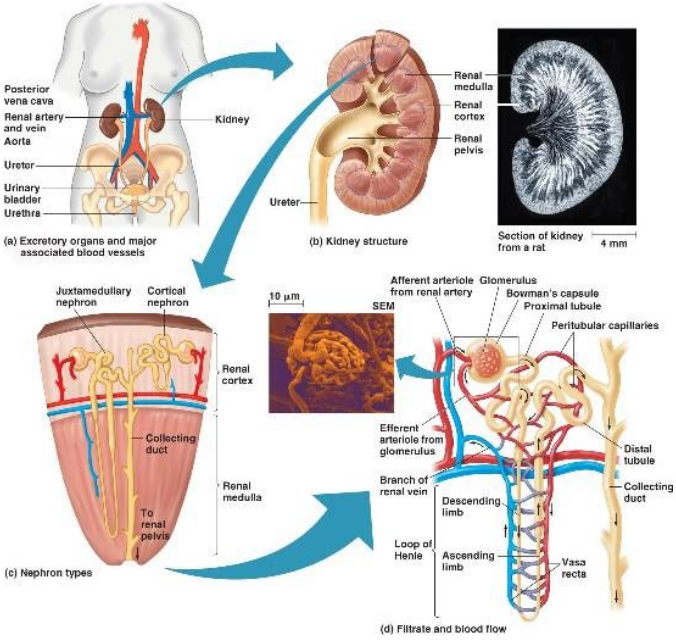
5. **The excretory system of human beings includes a pair of kidneys, a pair of ureters, a urinary bladder and a urethra**.

6. The kidneys are the principal excretory organs in man through which the nitrogenous metabolic wastes are eliminated in the form of urine. Kidneys are in the abdomen, one on either side of the backbone.

7. The **renal artery** brings oxygenated blood carrying toxic nitrogenous wastes into the kidneys. The **renal vein** drains away deoxygenated blood which is free of toxic substances into the inferior vena cava.

8. Each kidney has large numbers of these filtration units called **nephrons** packed close together. The nephron is the structural and functional unit of the kidney.

9. **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 reabsorbed depends on how much excess water there is in the body, and on how much of dissolved waste there is to be excreted.



10. **Urine** produced in the kidneys passes through the ureters into the **urinary bladder** where it is stored until it is released through the **urethra**. The bladder is muscular, so it is under nervous control. As a result, we can usually control the urge to urinate.