1

LIFE PROCESSES

INTRODUCTION

All plants and animals have seven life processes in common. We call these life processes the seven characteristics of living things. Respiration, Sensitivity, Nutrition, Reproduction, Movement, Growth, Excretion. Plants and animals both have important parts called organs that enable them to live. Organs are complex structures that have a specific function.

Respiration : Energy contained in food is 'unlocked' or transferred to the organism by the process of respiration. Respiration takes place in the mitochondria of the cell. Energy is released in a controlled way in a series of reactions. There are two types of respiration, with or without oxygen:
(a) Aerobic respiration uses oxygen, and releases a large amount of energy
(b) Anaerobic respiration does not use oxygen and releases much less energy.
Do not confuse respiration with breathing it is not the same thing.

Sensitivity : Sensitivity is an awareness of changes in the environment. Whereas animals respond more quickly to stimuli such as heat, light, touch and chemicals, plants appear less sensitive and respond more slowly - eg, to the direction of sunlight. Some plants such as the Venus flytrap respond to touch.

Nutrition : Nutrition is the process by which food is taken into and used by the body, and it includes digestion, absorption, transport, and metabolism. Nutrition is also the study of food and drink requirements for normal body function.
Nutrients are the chemicals taken into the body that provide energy and building blocks for new molecules. Some substances in food are not nutrients but provide bulk (fiber) in the diet. Nutrients can be divided into six major classes: carbohydrates, lipids, proteins, vitamins, minerals, and water. Carbohydrates, proteins, and lipids are the major organic nutrients and are broken down by enzymes into their individual subunits during digestion. Subsequently, many of these subunits are broken down further to supply energy, whereas other subunits are used as building blocks for making new carbohydrates, proteins, and lipids. Vitamins, minerals, and water are taken into the body without being broken down. They are essential participants in the chemical reactions necessary to maintain life. Some nutrients are required in fairly substantial quantities, and others called trace elements, are required in only minute amounts.

Reproduction : All animals and plants can reproduce. They multiply in number by producing the next generation of offspring, thus carrying on their genes and ensuring the continuation of the species. Plants do this by producing seeds, which give rise to new plants of the same species. Reproduction can be of two types:
(1) Sexual, involving two parents and the union of two gametes, and
(2) Asexual, where one parent reproduces itself. Examples of this are strawberry plants or spider plants producing runners or offshoots.

Movement : Both animals and plants can move. Animals can move quickly and from place to place in search of food, shelter and favourable conditions; plants on the other hand are rooted to a spot and move much more slowly by growing and responding to external stimuli, such as light.

Growth : Growth is an ongoing increase in size of the organism - as in growing from young to adult animals or from seedlings to mature plants.

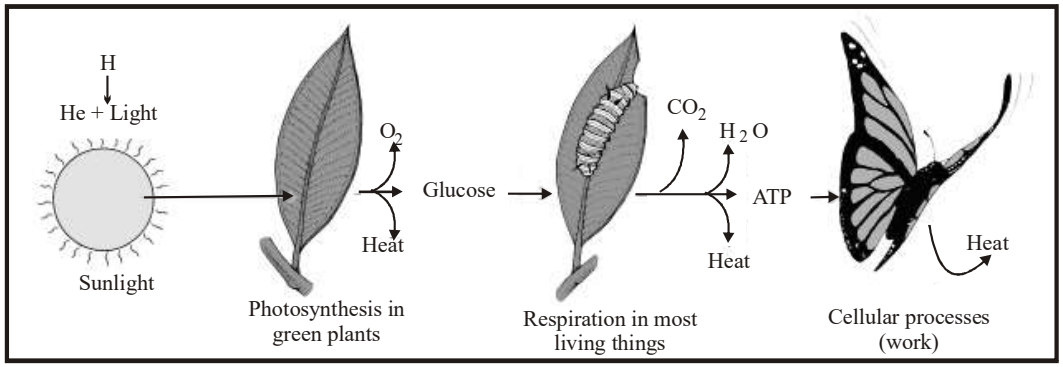
Excretion : Thousands of chemical reactions go on inside body cells producing both useful and waste substances which when allowed to accumulate can be harmful. Excretion is getting rid of metabolic waste, produced by the body, like urine and carbon dioxide. Getting rid of faeces or undigested food is not excretion but egestion.
For all life processes we need energy to obtain energy we eat food.

The food : Food provides energy for all body functions and is also used to form new cells for the body. We eat a variety of food according to our taste, body requirement and availability. Some of us may prefer to eat rice to bread or chapattis. Others may like to have dosas, idlis, burgers, noodles, etc. We may be a vegetarian or a non-vegetarian. All living beings, both plants and animals need food for growth, repair and maintenance. Our food may include a number of items, if it meets your entire body's requirement and is utilized by the body, it is called nutrition (nutrine: to nourish). The process by which, organisms obtain and utilise food for their growth and development (from their environment) is called nutrition.

MODES OF NUTRITION

An organism may be placed into one each of the three pairs of major nutritional groups based on their carbon, energy, and electron sources.
An organism is defined as heterotrophic when using organic substrates to get its carbon for growth and development, whereas it is autotrophic, when its source of carbon is carbon dioxide (CO_2).
An organism is defined as organotrophic when it uses organic compounds as source of electrons, whereas it is defined as lithotrophic when it uses inorganic compounds. Organotrophic organisms are often also heterotrophic, using organic compounds as sources of electrons and carbon at the same time. Similarly, lithotrophic organisms are often also autotrophic, using inorganic sources of electrons and (CO_2) as inorganic carbon source.
An organism is defined phototrophic when it uses light as energy source, whereas it is chemotrophic when it conserves energy from reactions of chemical compounds.

1. **Autotrophic nutrition :** The term autotrophic (from the Greek autos = self and trophe = nutrition 'self-feeding') defines organisms which are able to use external sources of energy in the synthesis of their organic food materials. These organisms make their own food by converting relatively simple inorganic nutrients into more complex, energy-rich, organic forms. Thus, the autotrophs do not need any outside source of organic material. There are two types of autotrophs, divided according to the processes by which they make their food. Photoautotrophs use the process of photosynthesis, while chemoautotrophs use the process of chemosynthesis. Photoautotrophs are far more common, and examples include green plants, algae and some bacteria. This type of autotroph uses photosynthesis to convert the inorganic chemicals, carbon dioxide and water, into the organic sugar glucose, using sunlight as its source of energy.



Glucose is the "food" produced by these photoautotrophs. Chemoautotrophs differ from photoautotrophs because they use chemicals from inorganic chemical reactions, rather than sunlight, as their source of energy to produce organic materials. Certain types of bacteria are chemoautotrophs.

For example, there are chemoautotrophic bacteria at deep sea hydrothermal vents where there is no sunlight. These bacteria support the entire food web at these great ocean depths through chemosynthesis, since photosynthesis cannot occur due to the lack of sunlight. In a food web, the autotrophs are the producers. They are the base of the food web, and all other organisms ultimately depend upon them for their energy and organic material. Autotrophs are consumed by other organisms, the heterotrophs, passing along organic nutrients and energy. Thus, without the autotrophs, other organisms would not be able to obtain the food or energy needed to survive. Autotrophs are a vital part of the food chains of all ecosystems.

Consequences of Autotrophic Nutrition - Motility is no longer required.

One of the main reasons for motility is to obtain food. Since the nutrients required by plants are "omnipotent" there was never an evolutionary pressure for "motility".

Comparison of Plant & Animal Nutrition :

Nutrient	Plant	Animal
form of uptake	inorganic (CO_2, water, ions)	organic (proteins, carbohydrates, fats)
concentration	dilute (i.e., CO_2 = 0.03%)	concentrated
distribution	omnipotent	localized

2. Heterotrophic Nutrition :

Heterotrophic (from Greek heteros = other or different, trophos = feeder 'other-feeding') organisms obtain their energy by breaking down substances obtained from the bodies of other organisms. Heterotrophic organisms include animals, fungi, and some single-celled protozoa (e.g., ameba, paramecia) and bacteria. While autotrophs make their own food by converting inorganic nutrients into organic forms, heterotrophs cannot do this. Heterotrophs require most nutrients in an already produced, organic form. They use these nutrients both as a source of energy and as building blocks to form cell and body parts. In a food web the heterotrophs are the consumers. There are many different types of heterotrophs in a food web, depending on what they consume.

(a) Holozoic nutrition : This literally means 'feeding like an animal'. Holozoic animals feed on solid organic material which is then digested internally to give smaller chemical fragments ready for absorption. Organisms can be split into three sub-groups:

Herbivores : ingest autotrophs (producers). Examples are cattle and sheep – which are also known as ruminants.

Carnivores : eat other heterotrophs. Examples are cats and dogs

Omnivores : eat both autotrophs and other heterotrophs. Example: human

(b) Saprobiontic / saprotrophic nutrition : These organisms feed on dead or decaying organic matter. They include many fungi and bacteria. These organisms release digestive enzymes to break down organic material into their surroundings, they then absorb the soluble digested products – this is called extracellular digestion. Within an ecosystem, saprophytes are important because they act as the decomposers allowing nutrients to be recycled. Example – Rhizopus (bread mould) – a fungus

(c) Parasitic nutrition : A parasite is an organism which obtains food material from the living body of another organism, called the host. The parasite usually harms the host in some way. Example – Taenia – tapeworm. This is an endoparasite (lives inside the host). Heterotrophs can't use inorganic materials to make organic molecules; they must obtain organic precursors for these molecules from the food they ingest.

Given a source of carbon and nitrogen, heterotrophs can fabricate a great variety of organic molecules by using enzymes to rearrange the molecular skeletons of precursors acquired from food.

A single type of amino acid can supply the nitrogen necessary to build other amino acids.

Fats can be synthesized from carbohydrates.

The liver is responsible for most of the conversion of nutrients from one type of organic molecule to another.

An animal's diet also must include essential nutrients, in addition to providing fuel and carbon skeletons.
Essential nutrients – Chemicals an animal requires but can't synthesize
Vary from species to species
An animal is malnourished if its diet is missing one or more essential nutrients
Includes essential amino acids, essential fatty acids, vitamins, and minerals
Essential amino acids are those that must be obtained in the diet in a prefabricated form.
Most animals can synthesize about half of the 20 amino acids need to make proteins.
Human adults can produce 12, leaving eight as essential in the diet (Human infants can only produce 11).
Protein deficiency results when the diet lacks one or more essential amino acids.
The syndrome known as kwashiorkor is a form of protein deficiency in some parts of Africa.
The human body can't store essential amino acids, thus a deficiency retards protein synthesis.
This is most frequent in individuals, who for economic or other reasons, have unbalanced diets.

Essential fatty acids are those unsaturated fatty acids that can't be produced by the body:
An example in humans is linoleic acid, which is required to produce some of the phospholipids necessary for membranes.
Fatty acid deficiencies are rare, as most diets include sufficient quantities.
Vitamins are organic molecules required in the diet in much smaller quantities (0.01 to 100 mg/day) than essential amino acids or fatty acids.
Many serve a catalytic function as coenzymes or parts of coenzymes.
Water-soluble vitamins are not stockpiled in the body tissues; amounts ingested in excess of body needs are excreted in the urine.
Fat-soluble vitamins (vitamins A, D, E, and K) can be held in the body; excess amounts are stored in body fat and may accumulate over time to toxic levels.
If the body of an animal can synthesize a certain compound, it isn't a vitamin.
A compound such as ascorbic acid is a vitamin for humans (vitamin C) and must be included in our diets; it isn't a vitamin in rabbits where the normal intestinal bacteria produce all that is needed.
Minerals are inorganic nutrients required in the diet in small quantities ranging from 1 mg to 2500 mg per day, depending on the mineral. Some minerals serve structural and maintenance roles in the body (calcium, phosphorous) while others serve as parts of enzymes (copper) or other molecules (iron)

PHOTOSYNTHESIS

The term photosynthesis means building up or assembly (synthesis) by/using light (photo). Photosynthesis can be regarded as a process of converting the radiant energy of the sun into chemical energy in plant tissues The major chemical pathway of photosynthesis is the conversion of carbon dioxide (CO_2) and water (H_2O) to carbohydrates $[CH_2O]_n$ and oxygen (O_2). The reaction can be represented by the equation:

$$6CO_2 + 12\,H_2O + \text{Light} \longrightarrow \underset{\text{Glucose}}{C_6H_{12}O_6} + 6H_2O + 6O_2$$

Requirement for photosynthesis:

Efficient light harvesting : Leaves are perfect solar collectors. These organs are broad and flat to allow for efficient light harvest. The leaves are broad to maximize surface area for light harvest and they are thin since light cannot penetrate too deeply into the leaf (the amount of light decreases exponentially with distance). As an aside, although the majority of light is absorbed near the leaf surface, in some situations, plant tissues can act like fiber optic cables to funnel some light deeply into the plant body.
Even within the thin leaf, most chloroplasts are found in the upper layer of cells, the palisade layer or palisade mesophyll, which is a tissue layer just beneath the upper epidermis of the leaf. This makes "sense" since these cells will be receiving the greatest amount of light of any region in the leaf. This is an example of specialization at the tissue and cellular level

An apparatus for gas exchange : Leaves also serve as a means to exchange photosynthetic gases (take up carbon dioxide and get rid of oxygen) with the environment. Leaves have pores in the surface (stomates) that regulate the entry/exit of gases and prevent the loss of excessive water.
The spongy layer (or spongy mesophyll) of the leaf acts like a "lung" increasing the internal surface area and provides for more rapid diffusion within the leaf. Note again that leaves are thin - this avoids the need for lungs or other type of pump to move gases. Since diffusion rates are inversely related to distance, simple diffusion can account for gas movements into/out of a leaf. An added advantage of having large leaves for light harvest is that they provide lots of surface area for absorption of carbon dioxide

A water supply : With the exception of the algae and aquatic plants, plants obtain water through the roots from soil. Essentially the roots "mine" the soil for water. Thus, photosynthesis and the transition to a terrestrial environment stimulated the evolution of a root system to obtain water (specialization at the organ level). And, it required the evolution of specialized transport tissue (xylem) to move the water from the roots to the leaves

A mechanism to transport end products throughout the plant.
Once carbohydrate is produced during photosynthesis there must be a mechanism to transport it to other locations throughout the plant. The evolution of vascular tissue, specifically phloem, permitted movement of photosynthate from leaves to roots, fruits and other tissues where required.

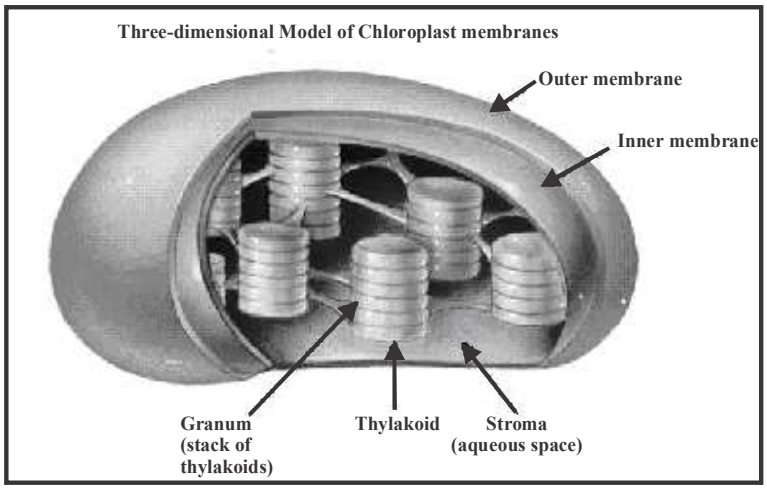
How does photosynthesis work?

* Leaves of plants absorb light from the sun.
* Leaves of plants also absorb the air that people breathe out, called carbon dioxide.
* Leaves of plants also absorb water. They can get water from falling rain or they can get it out of the ground with their roots.
* Leaves of plants use light from the sun to turn the air people breathe out and water into glucose and oxygen. Glucose is a type of sugar that plants use for food help them grow. Oxygen is the gas that people breathe in. So not only do plants make their own food, but they make the air that we breathe in.
  In other words, photosynthesis is:
  sunlight + air people breath out + water = plant food + air people breathe in.
  The process of photosynthesis is completed in two steps – light reaction and dark reaction.

(i) Light reaction : The first step of photosynthesis occurs in the presence of light. During this step, chlorophyll contained in the chloroplast of plant cells absorbs light energy. This energy is converted into another form, which can be supplied for the completion of the dark reaction.

(ii) Dark reaction : This second step of photosynthesis does not require light, and is called dark reaction. It can also carry on in the presence of light. During this step, energy generated during light reaction is used to combine carbon dioxide and water molecules to form energy rich compounds, such as glucose. Oxygen is also released in this process.

The Photosynthetic Machinery : The leaf is the major photosynthetic organ in higher plants. Leaves contain cells that contain chloroplasts. With very few exceptions, chlorophyll is contained within chloroplasts. Internally the chloroplast is composed of a system of lamellae or flattened thylakoids that are arranged on stacks in certain regions known as grana. Each lamella may contain two double layer membranes.
The grana are embedded in a colourless matrix called the stroma and the whole chloroplast is bounded by a double membrane, the chloroplast envelope. Within a chloroplast, the grana are interconnected by a system of loosely arranged membranes called the stroma (or intergranal) lamellae.
The chlorophyll molecules are located on the membrane of the lamellae. The lamellae hold the chlorophyll molecules in a suitable position for trapping the maximum amount of light, a function that it achieves effectively. A chloroplast may contain approximately 60 grana, each consisting of about 50 stacked lamellae (economy of space).



The lamellae function like shelves stacked on top each other and the chlorophyll molecules are on those shelves. This provides a large surface area in a relatively small space. Many proteins and enzymes associated with photosynthesis are also embedded in the lamellae.

The stroma contains, among other things, the enzymes responsible for the reduction of CO_2 in addition to numerous starch granules. From this, it seems that while absorption of light takes place in the lamellae, the subsequent building up of carbohydrates takes place in the stroma

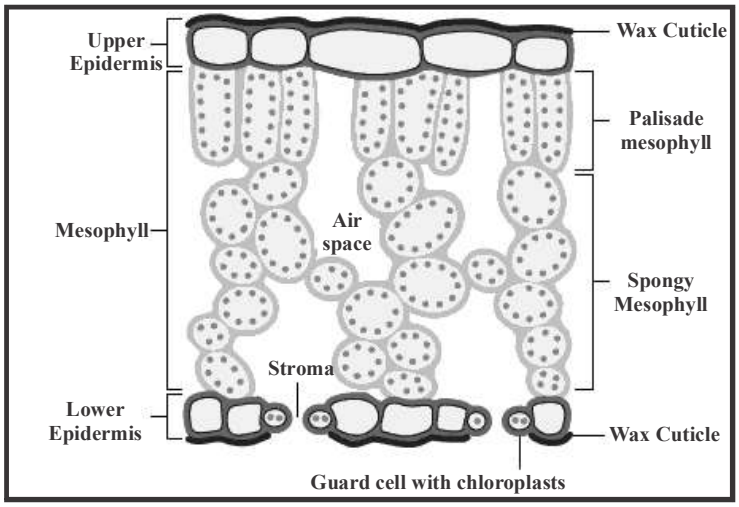


Figure : Cross-section of a leaf

The stomata are the primary control mechanisms that plants use to reduce water loss and they are able to do so quickly. Stomata are sensitive to the environmental cues that trigger the stomata to open or close.

The major role of stomata is to allow carbon dioxide entry to drive photosynthesis and at the same time allow the exit of water as it evaporates, cooling the leaf. Two specialized cells called 'guard cells' make up each stoma (stoma is singular for stomata). Plants have many stomata (up to 400 per mm^2) on their leaf

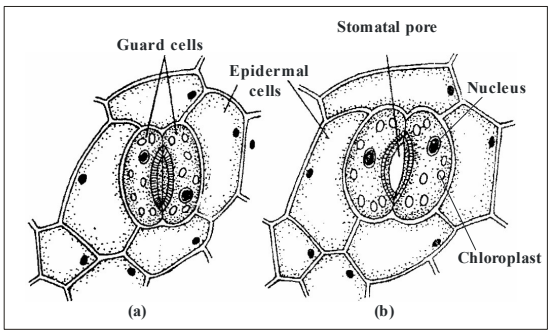


Fig Stomatal apparatus (a) Closed (b) Open

surfaces and they are usually on the lower surface to minimize water loss.Stomata sense environmental cues, like light, to open. These cues start a series of reactions that cause their guard cells to fill with water.

Environmental cues that affect stomata opening and closing are light, water, temperature, and the concentration of CO_2 within the leaf. Stomata will open in the light and close in the dark. However, stomata can close in the middle of the day if water is limiting, CO_2 accumulates in the leaf, or the temperature is too hot.

If the plant lacks water, stomata will close because there will not be enough water to create pressure in the guard cells for stomatal opening; this response helps the plant conserve water.

If the leaf's internal concentration of CO_2 increases, the stomata are signaled to close because respiration is releasing more CO_2 than photosynthesis is using. There is no need to keep the stomata open and lose water if photosynthesis is not functioning. Alternatively, if the leaf's CO_2 concentration is low, the stomata will stay open to continue fueling photosynthesis. High temperatures will also signal stomata to close.

High temperatures will increase the water loss from the leaf. With less water available, guard cells can become flaccid and close. Another effect of high temperatures is that respiration rates rise above photosynthesis rates causing an increase of CO_2 in the leaves; high internal CO_2 will cause stomata to close as well. Remember that some plants may open their stomata under high temperatures so that transpiration will cool the leaves.

Stomata must be open for the plant to photosynthesize; however, open stomata present a risk of losing too much water through transpiration. Stomata close when the guard cells lose water and become flaccid. This occurs because potassium ions move back out of the guard cell, followed by water that lowers the pressure in the guard cell.

Factors Controlling Photosynthesis

Factor	**Effect**
CO_2 concentration	Increasing CO_2 concentration increases the rate of photosynthesis in C_3 plants but not in C_4 plants
Light intensity	The maximum rate of photosynthesis occurs when light is brightest; there is no photosynthesis in the dark
Stage of plant development	Plants in active stages, such as seedlings, require more energy and therefore have higher rates of photosynthesis.
Storage or use	The photosynthetic rate increases when injured plants use carbohydrates for energy; it of decreases photosynthate when carbohydrate use diminishes
Temperature	Photosynthetic rate increases at higher temperatures.
Water availability	Lack of water closes stomata, inhibiting photosynthesis

ACTIVITY 1 :

Testing leaves for starch : Leaves make their own food by the process of photosynthesis. This experiment demonstrates the presence of starch in a leaf. It works particularly well with variegated leaves because the starch will not show up on the white parts of the leaf. This is because plants need chlorophyll to photosynthesis.

Material required : Iodine solution, A leaf geranium is good, A large test tube sometimes called a boiling tube, A 250ml glass beaker, Ethanol (industrial methylated spirits) pair of tweezers, A white tile, A teat pipette

Procedure : Half fill a beaker with boiling water and add a large test tube that is a quarter full of ethanol. Allow the ethanol to come to the boil. Do not heat the ethanol in a bunsen burner flame. This is not safe because ethanol is highly flammable. Take a leaf that has been sitting in good light for at least a few days, and soften on the boiling water for ten seconds or so. Then add to the ethanol and allow to boil for about a minute until all the colour disappears from the leaf. Remove the leaf from the ethanol. Put it back in the hot water to soften for 10 seconds. Spread the leaf out on a white tile and use the iodine solution to test for starch A blue-black colour indicates starch is present. This experiment can be repeated with leaves that have been left in the dark or have been deprived of carbon dioxide.

ACTIVITY 2 :

To demonstrate that carbon dioxide is necessary for plant leaves to carry out photosynthesis

Plants use sunlight and carbon dioxide present in air to produce food for itself; in the absence of either photosynthesis is affected adversely. Food produced is in the form of starch, the presence of which can be tested chemically using Iodine solution – it turns starch black.

Required materials : 2 Potted plants, 2 Bell-jars, A Candle, Dish containing Caustic soda, Petroleum jelly, Glass sheets, Iodine solution to test leaves for starch.

Procedure :

1. Take two young potted plants.
2. Apply petroleum jelly on two glass sheets.
3. Place the potted plants on these glass sheets.
4. On one glass sheet, along with the potted plant place a burning candle.
5. In the other, place a dish containing caustic soda.
6. Cover them with the bell jars.
7. Leave undisturbed for a few hours and test the leaves from each pot for the presence of starch.

Potted plants must ideally have been kept in the dark to make the leaves starch-free before including them in this experiment.

The petroleum jelly makes the bell jars airtight.

On testing leaves from each plant for the presence of starch it is observed that the leaves of the plant that had the lighted candle with it shows the presence of starch, while the other plant had no starch.

The lighted candle used up the oxygen in the sir within the jar by combustion and replaced it with carbon dioxide. This was used by the plant to photosynthesize. The other plant was deprived of carbon dioxide since the dish of caustic soda absorbed all the carbon dioxide in the air under this bell-jar. It was therefore unable to produce starch. Hence carbon dioxide is necessary for photosynthesis.

ACTIVITY 3 :

To show that oxygen gas is released during photosynthesis

Plants use sunlight and carbon dioxide present in air to produce food for itself; one of the by products of this chemical reaction is the formation of oxygen. The fact that oxygen aids combustion makes it easy to identify this gas.

Required materials : Glass beaker, Water-weed, Funnel, Test-tube, Water rich in carbon dioxide, Glowing splinter to test gas generated

Procedure :

1. Fill a glass beaker with water rich in carbon dioxide
2. Place green water-weed (Elodea or Ceratophyllum) in this beaker
3. Place a funnel over the plant (encasing it)
4. Invert a test-tube filled with water over the funnel
5. Leave this set-up undisturbed in bright sunlight

Bubble carbon dioxide gas through water before using it to fill up the glass beaker for best results.

Bubbles of colorless gas are formed on the leaves after some time and are seen to rise and collect in the upper, closed part of the test-tube. On testing the gas by placing a glowing splinter in the tube, it bursts into flames.The splinter caches fire because the gas released by the leaves is oxygen; hence oxygen is released during photosynthesis.

AMOEBA

All living things need nutrition to provide energy and the protist kingdom is no exception.

If we look at the amoeba, it gives us an example of a simple free living protist. The amoeba is a simple animal made up of just one cell. It normally lives in ponds, ditches or slowly moving streams. The amoeba is just visible to the naked eye. It eats, respires, digests food and excretes waste. It moves about, responds to stimuli, grows, is able to repair and reproduces. Amoebas locomote by ways of cytoplasmic movement.

(cytoplasm is the cell content around the nucleus of the cell). The amoeba forms pseudopods (false feet) with which they 'flow' over a surface. The cytoplasm not only flows it also changes from a fluid into a solid state.

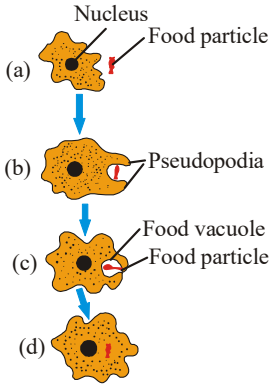


Figure : Nutrition in Amoeba

These pseudopods are also used to capture prey, They simply engulf the food. They can detect the kind of prey and use different 'engulfing tactics'. The habitat of the amoeba is the mud and water of ponds and ditches. In the mud, there are many microscopic plants known as desmids.

When the protoplasm of the amoeba comes into contact with one of these plants, it flows round the plant, forming a cup shaped projection. This is literally a food cup, which completely encloses and ingests the food. In this way a food-vacuole is formed in the endoplasm. An amoeba, however, does not feed entirely on plants it is also carnivorous feeding on tiny ciliates.

In the food vacuole, digestion commences and affected by similar processes to higher animals. Enzymes are secreted into the food vacuoles along with other digestive juices. The digested material is now in a solution that can be absorbed into the surrounding cytoplasm. Once all the digestible material has been absorbed the remainder is excreted by the animal with other digestive juices. The digested material is now in a solution that can be absorbed into the surrounding cytoplasm.

All the oxygen the amoeba needs passes through the outer surface inwards and carbon-dioxide which is a waste product, seeps outwards. This takes place by simple diffusion. As the amoeba uses up oxygen on the inside, the concentrate of oxygen lowers, so there is less on the inside than in the water outside. The oxygen then passes from the outer to the deeper parts of the protoplasm.

NUTRITION IN HUMAN BEINGS

The alimentary canal is a long hollow tube which runs from the mouth to the anus .Together with several other organs, including the liver and the pancreas, it makes up the digestive system.

The total length of the human alimentary canal is between 5 and 6 m, from anus to mouth. To fit this considerable length into body, parts of the canal are folded and coiled inside the abdomen .The mucus is a substance secreted along the tube by cells lining its walls .Mucus helps food to slide through the canal without doing too much damage to the lining. It also forms a protective covering which keeps the digestive juices, which are inside the lumen of the canal, from coming into contact with the living cells of the walls. Along the whole length of the alimentary canal there are muscles in the walls.

Functions of the Digestive system :

The functions of the digestive system are to

1. **Take in food :** Food and water are taken into the body through the mouth.
2. **Break down the food :** The food that is taken into the body is broken down during the process of digestion from complex molecules to smaller molecules that can be absorbed.
3. **Absorb digested molecules :** The small molecules that result from digestion are absorbed through the walls of the intestine for use in the body.
4. **Provide nutrients :** The process of digestion and absorption provides the body with water, electrolytes, and other nutrients such as vitamins and minerals.

5. **Eliminate wastes :** Undigested material, such as fiber from food, plus waste products excreted into the digestive tract are eliminated in the feces.

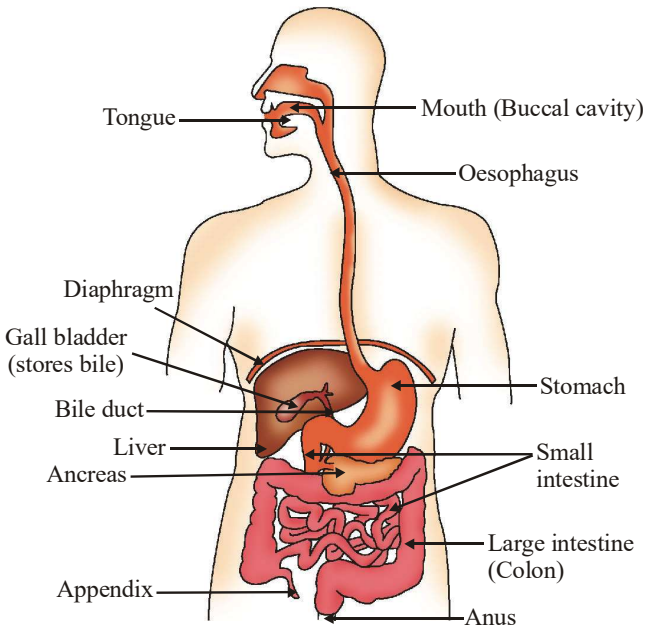


Figure : Human alimentary canal

Mouth/Buccal Cavity : Taking food into the mouth is called ingestion. We use lips, tongue and teeth. The tongue is also important in tasting food, to tell you whether it is good to eat; if not it will be ejected from the mouth rather than swallowed.
The main purpose of the human teeth is to break up large pieces of food, thus beginning the process of the mechanical digestion. This is done by chewing, or mastication. Strong muscle is the jaws move the lower jaw up and down from side to side, grinding the teeth in the lower jaw against those in the upper jaw.
The premolar and molar teeth have ridges and grooves, which trap food between them and crush it as chew. Mastication greatly increases the surface area of the food, bringing more of it into direct contact with enzymes in the digestive juice and so speeding up chemical digestion.
Three pairs of salivary glands secrete watery liquid saliva, which pours along ducts into the mouth. Like all secretions along the alimentary canal, saliva is mostly water. It contains mucus, which mixes with the food as it is chewed, helping to glue it loosely together into a ball called a bolus. The mucus also makes the bolus slippery, so that is easier to swallow.
Saliva contains the enzyme amylase, which catalyses the hydrolysis of starch.
Thus, digestion by amylase produces maltose and small chain made up of three, four or more glucose molecules on the end of a chain . Thus, digestion by amylase produces maltose and small chains made up three, four or more glucose molecules linked together, but it does not produce individual glucose molecules.
Saliva also contains an enzyme called lysozyme. This enzyme, which is also found in tears, can destroy several types of bacteria which can cause infection in the mouth and throat, including Staphylococcus and Streptococcus. The lysozyme, together with a general 'washing' action of saliva, and a small amount of hydrogen carbonate ions in it (which partly neutralizes acids on teeth) appear to help reduce the incidence of tooth decay.

Oesophagus : Swallowing is an initially voluntary process that becomes a reflex reaction once food has come in contact with the pharynx. The bolus is directed across the laryngeal orifice by the epiglottis (the tracheal circular muscle also constricts) and is passed to the gut by peristalsis.

The stomach : When a bolus of food is swallowed ,it is moved swiftly down to the esophagus by peristalsis and into stomach.The stomach is a muscular sac. In some parts of the stomach the muscle layers of the muscularis externa are thicker than in most other parts of the alimentary canal. They produce strong, rhythmic, churning movements when there is food in the stomach.
This not only mixes the food with the juices secreted in the stomach, but also helps to continue the process of mechanical breakdown begun by chewing in the mouth.
The inner layer of the stomach wall, the mucosa, is specialized to produce large quantities of gastric juice. Gastric juice contains protease and lipase, as well as hydrochloric acid (HCL).To protect the cells in the wall from damage by the acid and proteases, they are covered with a slimy coat of mucus containing hydrogen carbonate ions which neutralize the acid.

The esophagus is at the left. In the fundus can be seen the lesser curvature. Just beyond the antrum is the pylorus emptying into the first portion of duodenum is at the lower right.
The protease secrete in gastric juice is pepsin. Pepsin is secreted from large cells in the gastric glands called chief cells .It is secreted in an inactive form, as pepsinogen ,to prevent it from digesting proteins in the cells which produce it. Pepsinogen is a larger molecule than pepsin, and it is activated by removing a strip of several amino acids from it. This happens automatically when it is exposed to the acidic conditions inside the stomach. It is also achieved by pepsin molecules which have already been activated; they 'digest' pepsinogen molecules to convert them into more pepsin.
Pepsin catalyses the hydrolysis of peptide bonds within protein molecules; it does not break the bonds holding the 'end' amino acids of the polypeptide chains. Proteases which do this are called endopeptidases ('endo' means 'within').Pepsin therefore breaks protein molecules into short chains of amino acids called peptides, but produces almost no individual amino acid molecules. Pepsin molecules are unusual proteins in that they are only stable in acidic conditions. The optimum pH for the pepsin found in the human stomach is about 2 or 3.This is, of course the pH which is found in the stomach when gastric juice has been secreted because this juice contains large amounts of hydrochloric acid. Hydrochloric acid helps to destroy many potentially harmful microorganisms which might be present in food. It is secreted from parietal cells in the gastric glands.
The lipase in gastric juice begins to hydrolyze triglycerides into fatty acids and glycerol. However, the majority of the digestion of triglycerides and other lipids happens later, in the small intestine.
Gastric juice also contains a substance called intrinsic factor. This is a glycoprotein which binds to vitamin B and protects it from begin digested. Later, in the ileum, the intrinsic factor-vitamin B complex sticks to the surfaces of the cells of the ileum wall, which adsorb it. People who don't secrete intrinsic factor cannot absorb vitamin B ,however much the eat in their diet. They suffer from pernicious anaemia, an illness in which not enough red blood cells are formed. Food may be kept in the stomach for several hours. The acidic mixture of partly digested food and water, called chyme, cannot pass on the next part of the alimentary canal, the duodenum, until a band muscle called the pyloric sphincter relaxes. When this happens depends on many factors which seem to relate to how quickly the duodenum will be able to deal with what is being sent into it.

The small intestine : The duodenum (main site of digestion) and the ileum together make up the small intestine. (The first part of the ileum is sometimes known as the jejunum.) The overall length of the small intestine is about 5m, of which the duodenum makes up the first 25m.
The mucosa of the whole of the small intestine is greatly folded, forming tiny projections called villi. In the duodenum, these are flattened with a rather leaf-like shape, while in the ileum the are more finger-like. A villus is about 0.5mm to 1.0mm long; villi are very thin and make the inner surface of the small intestine look rather like velvet.
The cells which make up the epithelium of the villi have a very folded cell surface membrane on the side nearest to the lumen of the small intestine; these little folds are called microvilli. Seen under the microscope, the surface of the cells looks like the bristles of a burst and it is called a bursh border. The villi and the microvilli produce an enormous surface area within the small intestine, which greatly increase the rate at which absorption can take place.
Bile is a green watery alkaline fluid containing cholesterol, bile pigments and sodium and potassium salts of the so-called bile acids. It is produced continually in the liver approximately 5000-1,000 cm^3 per day and passes through a series of ducts to the gall bladder where it is stored (approximately 30 cms^3). Water re-absorption here concentrates the bile. The bile is pumped into the duodenum where it is involved in the digestion of fats. The bile salts emulsify the fats thus increasing the surface areas so that lipase digestion is more rapid.
The color is brown and the surface is smooth. A normal liver is about 1200 to 1600 grams.
Enzymes discharged into the lumen of the duodenum are responsible for the digestion of polypeptides, carbohydrates, lipids and nucleic acids. The pancreas, a large gland lying just below the stomach, plays a very significant role here. The pancreas secretes pancreatic juice. This flows into the duodenum along the pancreatic duct. The pancreas has another role as part of the endocrine system, where it helps in the regulation of blood glucose levels.

Pancreatic juice contains hydrogen-carbonate ions and a number of enzymes, especially amylase, the three proteases trypsin, chymotrypsin and carboxypeptidase and lipase. The enzyme in pancreatic juice continue to digest the partly digested substances which flow into the small intestine from the stomach. Digestion is completed by enzymes which are produced by the cells on the surface of the villi and remain on their surfaces. Indeed , some of the pancreatic enzymes become absorbed onto these surfaces, so that much of the digestion in the small intestine takes place on the brush border of the villi. This is useful because it means that the products of digestion are right next to the surface across which they can be absorbed, which probably increases the speed at which they are taken up into the cells.

Process of absorption : The process of absorption occurs through the absorptive cells on the villus epithelium. Food molecules pass through these cells by phagocytosis and pinocytosis.
The microvilli posses a wide range of specific enzymes (e.g. maltase, sucrase, lactase) to digest a wide range of molecules. They also posses active transport systems to rapidly transport the more useful food molecules into the cell cytoplasm where they are further modified by other enzymes prior to moving into the blood vessel of the villus. Less important food molecules are absorbed passively and therefore much more slowly.
Lipids are absorbed as glycerol and fatty acids or in some cases as small monoglcerides. The small ones pass straight into the blood whereas larger fatty acids are re-synthesised into fats by the absorptive cell membranes prior to being transported away through the lacteal into the lymphatic system.
The small intestine is also responsible for the re-absorption of large amounts of water, largely from internal secretions. Nine litres pass through the small intestine every day and approximately 80% is reabsorbed here. (This is greater than the volume of the blood). Food takes about three hours to pass through the small intestine before passing into the large intestine.
Glucose, Amino-acids, Fatty acids and glycerol, inorganic ions, Vitamins etc. are absorbed in small intestine.

The colon and rectum:
By the time the food has reached the end of the small intestine, virtually everything which could be absorbed has entered the villi. What is left ? The undigested, unabsorbed remains are mostly fibre; humans cannot digest cellulose or lignin.
At the entrance of the colon from the small intestine, there is a blind-ending side branch-the caecum and appendix. The appendix has no function in humans. The colon however is very important indeed as it is here that much of the remaining water is absorbed into the blood, together with sodium and chloride ions. These processes also occur in the caecum. The colon has no villi but it does have a large surface area produced by many folds in its wall, to increase the efficiency of a absorption. The rectum is a short straight section of the alimentary canal, which leads from the colon to the anus and thus to the outside world. It is usually empty only receiving the contents of the colon now called faeces when they are ready to be passed out of the anus.

Function of Digestive secretions

Fluid or Enzyme	**Source**	**Function**
Mouth		
Saliva	Salivary glands	Moistens and lubricates food
Salivary amylase	Salivary glands	Digests starch
Stomach		
Hydrochloric acid	Gastric glands	Kills bacteria, activates pepsin
Pepsinogen	Gastric glands	Active form, pepsin, digests protein
Mucus	Mucous cells	Protects stomach lining
Intrinsic factor	Gastric glands	Binds to vitamin B_{12}, aiding in its absorption
Gastrin	Gastric glands	Increases stomach secretions

Small Intestine and Associated Glands

Bile salts	Liver	Emulsify fats
Bicarbonate ions	Pancreas	Neutralize stomach acid
Trypsin, chymotrypsin	Pancreas	Digest protein
Pancreatic amylase	Pancreas	Digests starch
Pancreatic lipase	Pancreas	Digests lipid
Nucleases	Pancreas	Digest nucleic acid
Mucus	Duodenal glands and goblet cells	Protects duodenum from stomach acid and digestive enzymes
Secretin	Duodenum	Inhibits gastric secretions Stimulates sodium bicarbonate secretion from the pancreas and bile secretion from the liver
Cholecystokinin	Duodenum	Inhibits gastric secretion, stimulates gallbladder contraction and pancreas secretion (enzymes)
Gastric inhibitory polypeptide	Duodenum	Inhibits gastric motility & secretion,stimulates gallbladder contraction
Peptidases	Small intestine	Digest polypeptide
Amylase	Small intestine	Digests starch
Lipase	Small intestine	Digests lipid
Sucrase	Small intestine	Digests sucrose
Lactase	Small intestine	Digests lactose
Maltase	Small intestine	Digests maltose

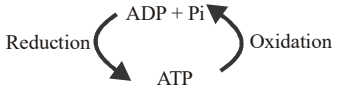
INTERESTING FACTS

1. For every 2 weeks, the human stomach produces a new layer of mucous lining, otherwise the stomach will digest itself.
2. The human liver performs 500 different functions.
3. Liver is the largest and heaviest internal organ of the body and weighs about 1.6 kilos.
4. The Liver is the only organ of the body, which has the capacity to regenerate itself completely even after being removed almost completely.
5. Liver cells take several years to replace themselves.
6. A healthy liver processes 720 liters of blood per day.
7. The human stomach contains about 35 million small digestive glands.
8. The human stomach produces about 2.5 liters of gastric juice everyday.
9. In an average person, it takes 8 seconds for food to travel down the food pipe, 3-5 hours in small intestine and 3-4 days in the large intestine.
10. The human body takes 6 hours to digest a high fat meal and takes 2 hours for a carbohydrate meal.

RESPIRATION

The word "respiration" to most people means "breathing" as in "artificial respiration" or "the respiratory system." Respiration at the cellular level, though, has a different meaning. Cellular respiration refers to the biochemical pathways that extract energy from the bonds of nutrient molecules, in the presence of oxygen. Yet cellular respiration and the familiar, whole-body respiration are very much related. Both processes take in oxygen and release carbon dioxide (CO_2), which is called gas exchange.

Cell respiration is the controlled release of energy from organic compounds in cells to form ATP.



ATP or Adenosine triphosphate is the molecule which directly fuels the majority of biological reactions. Everyday each person will hydrolyse (reduce) 1025 ATP molecules to ADP. The ADP is reduced back to ATP using the free energy from the oxidation of organic molecules.

HUMAN CELLULAR RESPIRATION

(a) Glucose transported to the cell diffuses into the cytoplasm. This is the substrate for respiration.

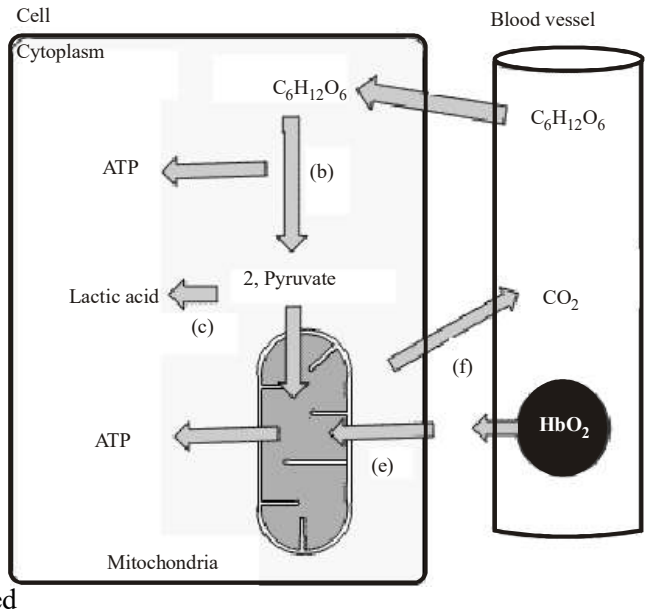
(b) Glycolysis in which glucose with sic carbons is broken down into two Pyruvate each with 3 carbons. This yields a small amount of ATP.

(c) Anaerobic respiration in which lactic acid is produced, oxidation from glucose yields a small amount of ATP. Remember this stage can accompany the next stage.

(d) Aerobic respiration in which pyruvate is broken down, oxidised, further in the mitochondria a lot of ATP is produced.

(e) Oxygen is required for step (d)to be completed. This is transported to the cell on the haemoglobin inside red blood cells.

(f) Carbon dioxide is produced as waste from aerobic respiration it diffuses into the blood and is transported to the lungs where it is excreted in exhaled air.



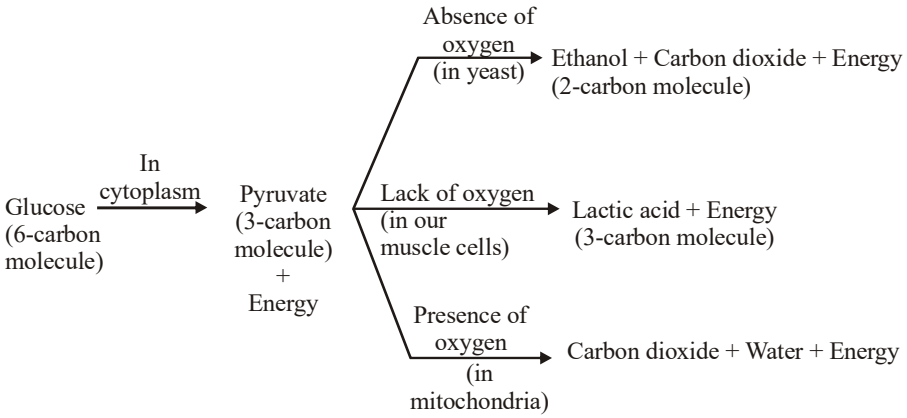


Figure : Break-down of glucose by various pathways

HUMAN RESPIRATORY SYSTEM

Human beings like other land animals breathe though their nostrils in noses and with the help of lungs. A pair of lungs are located in the airtight thoracic cavity that is bounded by a convex muscular and elastic sheet called diaphragm.. The right lung has three lobes and the left lung two. A bronchus, an artery, and a vein enter each lung medially at the hilum; each branches again and again as it enters the lobules and smaller divisions of the lungs. The terminal airways or bronchioles expand into small clusters of grapelike air cells, the alveoli. The alveolar walls consist of a single layer of epithelium and collectively present a huge surface. A small network of blood capillaries in the walls of the alveoli affords surfaces for the actual exchange of gases

Functions of the Respiratory system :

Respiration is necessary because all living cells of the body require oxygen and produce carbon dioxide. The respiratory system assists in gas exchange and performs other functions as well.

1. **Gas exchange :** The respiratory system allows oxygen from the air to enter the blood and carbon dioxide to leave the blood and enter the air. The cardiovascular system transports oxygen from the lungs to the cells of the body and carbon dioxide from the cells of the body to the lungs. Thus the respiratory and cardiovascular systems work together to supply oxygen to all cells and to remove carbon dioxide. Without healthy respiratory and cardiovascular systems, the capacity to carry out normal activity is reduced, and without adequate respiratory and cardiovascular system functions, life itself is impossible.
2. **Regulation of blood pH :** The respiratory system can alter blood pH by changing blood carbon dioxide levels.
3. **Voice production :** Air movement past the vocal cords makes sound and speech possible.
4. **Olfaction :** The sensation of smell occurs when airborne molecules are drawn into the nasal cavity.
5. **Innate immunity :** The respiratory system provides protection against some microorganisms by preventing their entry into the body and by removing them from respiratory surfaces.

Functionally, the lungs are elastic bags resembling rubber balloons. They lack any muscle, which may allow them to expand or contract by themselves.

The airways below the larynx consist of (i) the trachea, a tube that extends almost to the middle of the chest; (ii) the bronchi (bronchial tree), formed by the trachea splitting into two and then each branch dividing again; (iii) the bronchioles — thin and short distensible airways that again divide many times to form (iv) the alveolar ducts from which (v) the alveoli arise. This multiple division results in about 23-5 generations of airway, with geometrically increasing numbers and total cross-sectional areas, and decreasing diameters. For example, from one trachea with a diameter of about 180 mm in an adult, by the tenth generation we have 1000 bronchi, each with a diameter of about 1.3 mm; by the twentieth generation we have 1 million bronchioles, each with a diameter of about 0.5 mm; and right at the end there are about 300 million alveoli. The diameter of the alveoli, like that of the bronchi and bronchioles, varies with the degree of lung inflation, in the range 0.1-0.3 mm. The alveolar surface area may be 30-100 m^2 often described as the size of a tennis court.

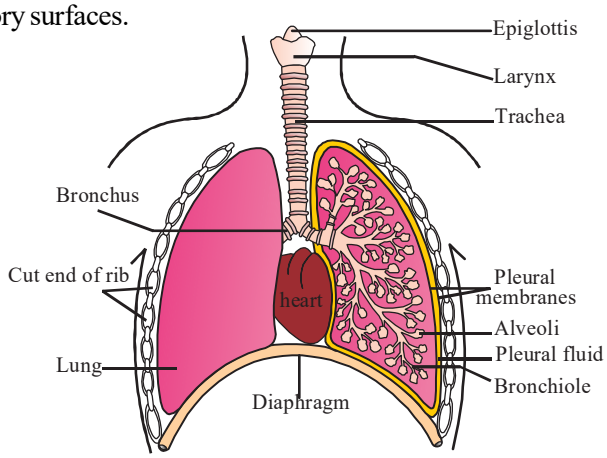


Figure : Diagrammatic view of human respiratory system (Sectional view of the left lung is also shown)

These are the conducting airways, and do not take part in gas exchange. Their function is to condition the air we breathe in and to conduct it to the alveoli. If inspired air reached the alveoli directly, if it were cold it would cool the tissue, if hot it would heat it, and if dry it would parch and destroy the alveolar walls. Only if we breathed air at 37°C and 100% humidity a rare occurrence would we avoid tissue damage. When we breathe through the mouth, as in exercise or with nasal blockage, we have eliminated the air conditioning role of the nose, and the mouth is much less efficient for this purpose. If the inspired air is cold and dry it will be raised to body temperature and full humidity by the first few generations of bronchi. This makes the airway lining itself (the mucosa) cold and dry, but protects the alveoli. On breathing out the mucosa will take up heat and water vapour from the expired air, restoring it to normal. Not only are the alveoli protected, but loss of heat and water from the body as a whole is minimized. The walls of the trachea and bronchi have several layers. On the inner lining surface, the 'luminal' side, there is a layer of epithelium as a kind of skin. Most of the epithelial cells are ciliated, with microscopic 'hairs' (cilia) that continuously sweep any surface material towards the larynx, where it is coughed up or swallowed. This is the 'ciliary escalator'. Other cells secrete mucus, the slimy liquid that constitutes phlegm and lies on the cilia. Just under the epithelium is a dense blood capillary network that provides nutrition for the epithelium and glands, and may be the site of uptake of inhaled pollutants and drugs.

Deeper in the wall are the submucosal glands, the main source of the mucus that lines the airways. The glands are stimulated to secrete by many factors, the most important being pollutants, including cigarette smoke, and viral or bacterial infections of the airways. Smoker's cough brings up the mucus thus secreted, and in chronic bronchitis there is the overproduction of mucus that characterizes the disease and is due to local pathological changes. The secreted mucus normally has several important defensive effects. It will create a barrier and take up soluble pollutants and smoke particles, slowing down their entry into the body and protecting the epithelium from their harmful effects, and eliminating them via the ciliary escalator. It will stimulate cough as an even more rapid means of their removal. In health the mucus sheet is very thin and difficult to measure; it is probably about 0.02-0.05 mm thick. Even in disease when the output of mucus is greatly increased, it remains too thin to block the airways, unless there is associated inflammation.

Deeper in the airway wall there is cartilage and smooth muscle. The cartilage stabilizes the airways and prevents their collapse during vigorous acts of breathing, such as coughing. The smooth muscle has not been shown to have a physiological role, unlike that in the intestines, which is responsible for the squeezing movement of peristalsis, but possibly it adjusts the diameter of the airways to make them optimally efficient for conducting gas to the alveoli.

The trachea and bronchi contain many sensory nerves, in general of two types. In the smooth muscle are receptors that signal the degree of stretch and therefore of inflation of the airways and lungs, and control the pattern of breathing its rate and depth, probably to make it as efficient as possible. If the vagus nerves that carry sensory information from the bronchi are cut, in most animals the breathing becomes slow, deep and mechanically inefficient. Secondly, in the epithelium there is a network of fine nerve fibres, with finger-like projections reaching almost to the airway lumen, that respond to inhaled pollutants and inflammatory mediators and set up a range of reflex responses. The most striking is the cough, but there is also reflex mucus secretion and smooth muscle contraction. The nerves look like, and act as, tripwires and sensing rods just under the surface, ready to respond to any adverse intruder.

The smallest air-conducting vessels, the bronchioles, are distinguished by having no cartilage in their walls, no mucus cells in their epithelium, and few or no submucosal glands. When the lungs inflate they probably distend equally with the alveoli, but there is little gas exchange in them. If they are inflamed, as in bronchiolitis, the alveoli they supply collapse, with a stiffening of the lungs and a failure of gas exchange.

Because the airways take no part in gas exchange, they are sometimes referred to as the 'anatomical deadspace'. At rest their volume is about 150 ml in a healthy adult. If an average tidal volume of 500 ml is inhaled, at the end of inspiration only 350 ml will have entered the alveoli, and 150 ml will remain in the airways. The ventilation used for gas exchange will be only 350/500ths or 70% of the total ventilation. The rest could be called wasted ventilation but, as described earlier, it has an essential function in conditioning the inspired air. When we breathe out, the first 150 ml is unchanged 'fresh' air, followed by 350 ml of air from the alveoli, rich in carbon dioxide and partly depleted of oxygen.

In normal breathing, through the nose, air travels through the nasal passages here it is cleaned and warmed. Sensory cells detect odours. As air continues through the pharynx or throat, it crosses the path of food. This is why we can breathe through the mouth. Then, air passes the epiglottis, enters the larynx or voice box, and goes down the trachea or windpipe. A bronchus runs to each lung, divides in a tree like manner to give smaller bronchioles and finally deposits the air in the microscopic thin walled air sacs or alveoli (singular alveolus). A group of alveoli appears like a cluster of grapes and gives the lungs, a sponge like structure. There are about 150 million alveoli in each lung and altogether they cover a very large surface area (approximately 70 square metres).

The alveoli are lined by a layer of moist flat epithelial cells and surrounded by networks of blood capillaries. The blood, which flows to the lungs by pulmonary artery, contains little oxygen and much carbon dioxide. On the other hand, the air in the alveoli has a high concentration of oxygen and relatively less carbon dioxide. Thus a 2-way diffusion takes place through the cells of the capillaries. Oxygen enters the blood and CO_2 leaves it. Since enormous breathing surface of lungs is exposed to the external environment the exchange of gases is computed within a few seconds.

The cut surface of this lung demonstrates the typical appearance of a bronchopneumonia with areas of tan-yellow consolidation. Remaining lung is dark red because of marked pulmonary congestion. Bronchopneumonia (lobular pneumonia) is characterized by patchy areas of pulmonary consolidation. The areas of consolidation are firmer than the surrounding lung.

In addition to gas exchange, our lungs and the other parts of your respiratory system have other important jobs related to breathing. These include:

- Bringing all air to the proper body temperature.
- Moisturizing the inhaled air for necessary humidity.
- Protecting the body from harmful substances by coughing, sneezing or filtering them, or by alerting the body through your sense of smell.

Defending the lungs with cilia (tiny hair-like structures) and mucus, which act to remove harmful substances deposited in the respiratory system.

TRANSPORTATION

Transportation in animals :

There are two types of circulatory systems found in animals

(1) open circulatory system (2) closed circulatory system

In an open circulatory system, the fluid is not contained in vessels. Most mollusks and arthropods have open circulatory systems. These systems consist of a heart and blood vessels that lead to spaces where the fluid, hemolymph, directly bathes cells before returning to the heart. Invertebrates with open circulatory systems can be fairly active because their respiratory systems branch in a way that allows the outside environment to come close to internal tissues. Insects, for example, are among the most active animals, and their respiratory systems operate independent of their open circulatory systems. Example : Cockroach, Paleomon, Pilia, Unio, etc.

In a closed circulatory system, blood remains within vessels. Large vessels called arteries conduct blood away from the heart and branch into smaller vessels, called arterioles, which then diverge into a network of very tiny, thin vessels called capillaries. Materials diffuse between cells and blood across the walls of capillaries. Blood then collects into slightly larger vessels, called venules, which unite to form still larger vessels, the veins, which carry blood back to the heart. Annelids are the simplest animal with a closed circulatory system. Example : Earthworm, fish, frog, human beings etc.

Squids, which are mollusks, have an interesting variation on a closed circulatory system. They have two extra hearts in their extensive network of gills, which boost blood circulation through the dense vessels in that region. The extra pumping action and very large gills help the animal to move very quickly.

The cells of small organisms such as protozoa (a), cnidaria such as the hydra (b), flatworms (c), and starfishes (d) maintain close enough contact with the environment that the animals do not require a circulatory system. In them exchange of material take place by diffusion across the body surface.

CIRCULATORY SYSTEM

The purpose of the circulatory system is to provide mass flow of materials from one part of the body to another, i.e. it is an internal transport system. It has three basic characteristics: Circulatory fluid, i.e. blood which transports the materials. A pump, e.g. the heart.

Functions of the Heart :

1. **Generating blood pressure :** Contractions of the heart generate blood pressure, which is responsible for blood movement through the blood vessels.
2. **Routing blood :** The heart separates the pulmonary and systemic circulations and ensures better oxygenation of blood flowing to tissues.
3. **Ensuring one-way blood flow** : The valves of the heart ensure a one-way flow of blood through the heart and blood vessels.

4. **Regulating blood supply :** Changes in the rate and force of contraction match blood delivery to the changing metabolic needs of the tissues, such as during rest, exercise and changes in body position.
The epicardial surface is smooth and glistening.The amount of epicardial fat is usual.The left anterior descending coronary artery extends down from the aortic root to the apex.
Tubes through which the blood can circulate, i.e. blood vessels (vascular).
The human blood circulatory system is a double circulation which means that the blood passes through the heart twice during every full circulation, thus we can consider:
   - Pulmonary circulation system.
   - Systemic circulation system.

Functions of the Peripheral Circulation : Although the heart provides the major force that causes blood to circulate, the peripheral circulation functions to

1. **Carry blood :** Blood vessels carry blood to all tissues of the body and back to the heart.
2. **Exchange nutrients, waste products, and gases :** Nutrients and oxygen diffuse from blood vessels to cells in essentially all areas of the body. Waste products and carbon dioxide diffuse from the cells where they are produced to blood vessels.
3. **Transport :** Hormones, components of the immune system, molecules required for coagulation, enzymes, nutrients, gases, waste products, and other substances are transported in the blood to all areas of the body.
4. **Regulate blood pressure :** The peripheral circulatory system and the heart work together to regulate blood pressure within a normal range of values.
5. **Direct blood flow :** The peripheral circulatory system directs blood to tissues when increased blood flow is required to maintain homeostasis.
Blood is pumped by the heart simultaneously into two circuits. The pulmonary system takes blood through the lungs where gas exchange occurs and the systemic system transports blood to all parts of the body where exchange with tissue fluid takes place.
In practical terms, we can think of the systemic circuit as a means to conduct blood to and away from the capillaries, because only here does exchange with tissue fluid take place. Nutrient molecules leave the capillaries to be taken up by the cells, and waste molecules given off by the cells are received by the capillaries to be transported away. Capillaries abound in all parts of the body, and no cell is more than a few micrometers from a capillary.
In both of the systems, there are principally three types of blood vessel:

Arteries - transport oxygenated blood from the heart to areas of the body.

Veins - transport blood to the heart to be reoxygenated.

Capillaries - transport blood to different areas of tissue

During blood circulation, the arteries carry blood away from the heart. The capillaries connect the arteries to veins. Finally, the veins carry the blood back to the heart. If you took all of the blood vessels out of an average child, and laid them out in one line, the line would be over 60,000 miles long! An adult's vessels would be closer to 100,000 miles long.
Besides circulating blood, the blood vessels provide two important means of measuring vital health statistics: pulse and blood pressure. We measure heart rate, or pulse, by touching an artery. The rhythmic contraction of the artery keeps pace with the beat of the heart. Since an artery is near the surface of the skin, while the heart is deeply protected, we can easily touch the artery and get an accurate measure of the heart's pulse. When we measure blood pressure, we use the blood flowing through the arteries because it has a higher pressure than the blood in the veins. Your blood pressure is measured using two numbers.

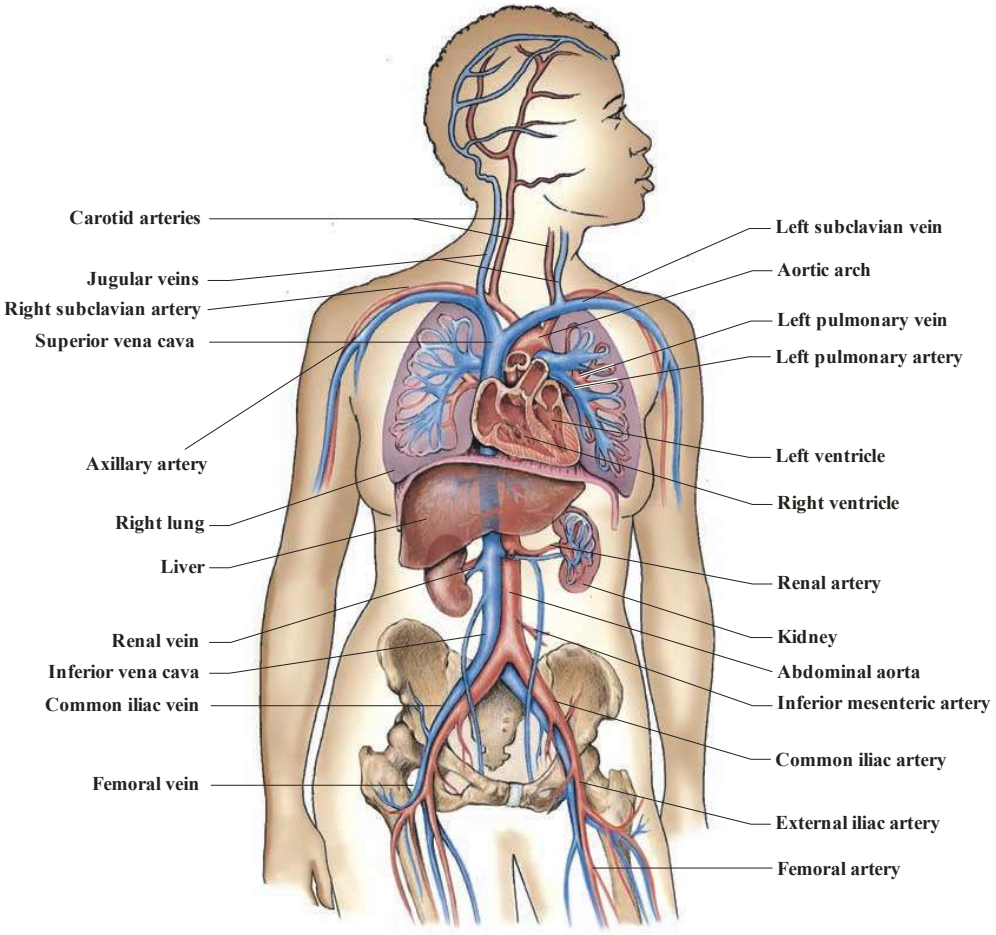


FIGURE : Blood circulation through some of the principal arteries and veins of the human body

The first number, which is higher, is taken when the heart beats during the systole phase. The second number is taken when the heart relaxes during the diastole phase. Those two numbers stand for millimeters. A column of mercury rises and falls with the beat of the heart. The height of the column is measured in millimeters. Normal blood pressure ranges from 110 to 150 millimeters (as the heart beats) over 60 to 80 millimeters (as the heart relaxes). It is normal for your blood pressure to increase when you are exercising and to decrease when you are sleeping. If your blood pressure stays too high or too low, however, you may be at risk of heart disease.

Arteries: Arteries Carry Away

The heart pumps blood out through one main artery called the dorsal aorta. The main artery then divides and branches out into many smaller arteries so that each region of your body has its own system of arteries supplying it with fresh, oxygen-rich blood.

Arteries are tough on the outside and smooth on the inside. An artery actually has three layers: an outer layer of tissue, a muscular middle, and an inner layer of epithelial cells. The muscle in the middle is elastic and very strong. The inner layer is very smooth so that the blood can flow easily with no obstacles in its path. The muscular wall of the artery helps the heart pump the blood. When the heart beats, the artery expands as it fills with blood. When the heart relaxes, the artery contracts, exerting a force that is strong enough to push the blood along. This rhythm between the heart and the artery results in an efficient circulation system.

Veins: All in Vein

Veins are similar to arteries but, because they transport blood at a lower pressure, they are not as strong as arteries. Like arteries, veins have three layers: an outer layer of tissue, muscle in the middle, and a smooth inner layer of epithelial cells. However, the layers are thinner, containing less tissue. Veins receive blood from the capillaries after the exchange of oxygen and carbon dioxide has taken place. Therefore, the veins transport waste-rich blood back to the lungs and heart. It is important that the waste-rich blood keeps moving in the proper direction and not be allowed to flow backward. This is accomplished by valves that are located inside the veins. The valves are like gates that only allow traffic to move in one direction.

The vein valves are necessary to keep blood flowing toward the heart, but they are also necessary to allow blood to flow against the force of gravity. For example, blood that is returning to the heart from the foot has to be able to flow up the leg. Generally, the force of gravity would discourage that from happening. The vein valves, however, provide footholds for the blood as it climbs its way up.

Blood that flows up to the brain faces the same problem. If the blood is having a hard time climbing up, you will feel light-headed and possibly even faint. Fainting is your brain's natural request for more oxygen-rich blood. When you faint, your head comes down to the same level as your heart, making it easy for the blood to quickly reach the brain.

Because it lacks oxygen, the waste-rich blood that flows through the veins has a deep red color, almost like maroon. Because the walls of the veins are rather thin, the waste-rich blood is visible through the skin on some parts of the body. Look at your wrist, or hands, or ankles. You can probably see your veins carrying your blood back to your heart. Your skin refracts light, though, so that deep red color actually appears a little blue from outside the skin

Capillaries: Connecting Arteries and Veins

Unlike the arteries and veins, capillaries are very thin and fragile. The capillaries are actually only one epithelial cell thick. They are so thin that blood cells can only pass through them in single file. The exchange of oxygen and carbon dioxide takes place through the thin capillary wall. The red blood cells inside the capillary release their oxygen which passes through the wall and into the surrounding tissue. The tissue releases its waste products, like carbon dioxide, which passes through the wall and into the red blood cells.

Arteries and veins run parallel throughout the body with a web-like network of capillaries, embedded in tissue, connecting them. The arteries pass their oxygen-rich blood to the capillaries which allow the exchange of gases within the tissue. The capillaries then pass their waste-rich blood to the veins for transport back to the heart.

Capillaries are also involved in the body's release of excess heat. During exercise, for example, your body and blood temperature rises. To help release this excess heat, the blood delivers the heat to the capillaries which then rapidly release it to the tissue. The result is that your skin takes on a flushed, red appearance. If you hold your hand, for example, under hot water, your hand will quickly turn red for the same reason. Your arm, however, is not likely to change color because it is not actually feeling an increase in temperature.

How The Circulatory System Functions:

The heart is the muscular pump like organ that circulates blood through the body heart is made up of four different blood-filled chambers (areas). There are two chambers on each side of your heart; one on top and one on bottom. The two chambers on top are the left and right atrium; they fill with blood returning to your heart from your body and lungs. The chambers on the bottom are called the ventricles. They squirt out the blood to the body and lungs. .The muscles of the heart contract periodically and cause the heart to pump blood. The heart contracts about 72 times a minute when an adult person is at rest, but this rate increases to 100 or more during activity or excitement. The total volume of blood in the system is about 5 to 6 litres. The heart pumps approximately 5 litres of blood out every minute.

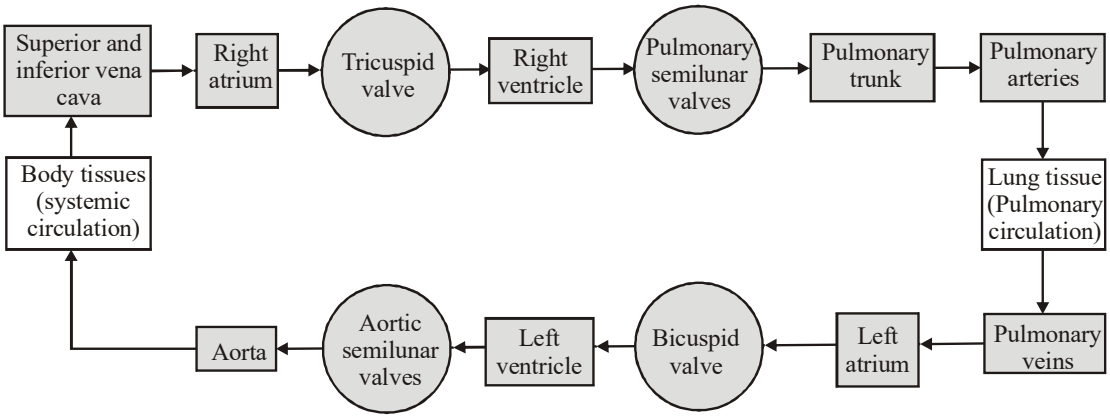


Figure : Diagram listing in order the structures through which blood flows in the systemic and pulmonary circulations

Arteries take blood from the heart and supply it to various tissues via the capillaries and veins return blood from the tissue to the heart. For maintaining such a unidirectional flow of blood, large veins have valves in them. The pressure of blood flow opens them in the directional of flow and closes them otherwise.

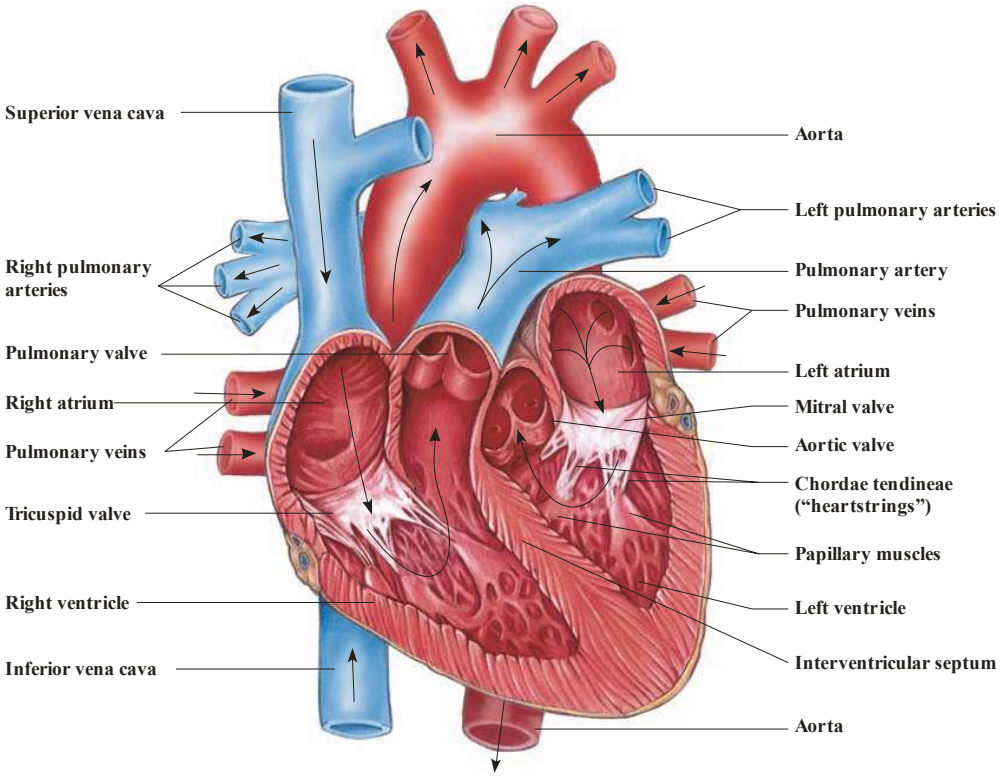


Figure : Section through the human heart showing the valves
Note the right and left atria, which receive blood, and the right and left ventricles, which pump blood into the arteries. Arrows indicate the direction of blood flow.

Arterial blood is rich in oxygen and dissolved food, while venous blood carries CO_2 and waste material. However, pulmonary artery and pulmonary vein form two important exceptions to it. Pulmonary artery supplies lungs CO_2 rich blood and pulmonary vein collects oxygen - rich blood from lungs and sends it to heart.

Functions of human circulatory system :

The circulatory system is critical to the internal environment in that tissue fluid is nourished and purified by the movement of small molecules across capillary walls. The digestive system contributes nutrients to the blood, while the excretory system removes wastes. The respiratory system takes in oxygen and excretes carbon dioxide. Oxygen is used during cellular respiration and carbon dioxide is a waste product of cellular respiration. The nervous and endocrine systems exert the ultimate control over homeostasis because they coordinate the functions of the body's systems.

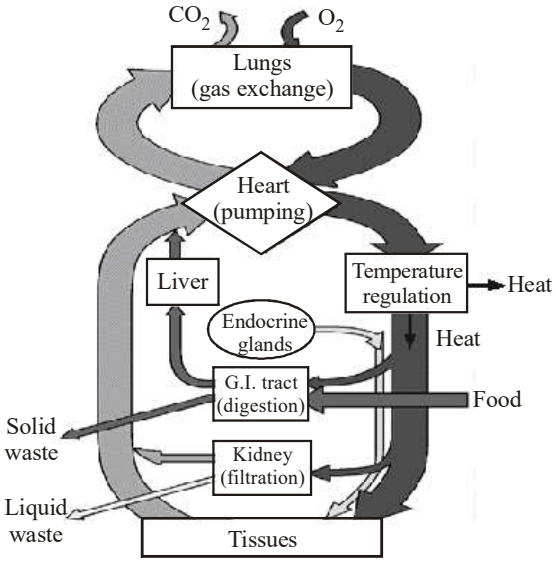
Regulation of body temperature, blood pressure, pH, and glucose concentration are four examples of how the body maintains homeostasis. The hypothalamus is involved to a degree in each of these regulations. The hypothalamus contains a regulatory center for body temperature but is also involved in regulation of blood pressure and breathing rate through its control over the medulla oblongata. Through the production of hypothalamic-releasing factors and release-inhibiting factors, the hypothalamus directly controls the pituitary gland and indirectly controls the secretions of other glands, such as the thyroid and the adrenal cortex.

The body has both short-term and long-term measures to control bodily conditions. In regard to temperature control, the short-term measures include shivering and constriction of arteries to conserve body heat, and dilation of arteries along with sweating to lose body heat. A significant long-term measure to increase body temperature is an increase in thyroxin.

Thyroxin raises the metabolic rate.

A rapid elevation in blood pressure occurs when the vasomotor center stimulates the constriction of abdominal blood vessels and increases the heartbeat. A longer lasting effect occurs when the kidneys secrete renin leading to a reabsorption of sodium and water. The resulting increase in blood volume increases blood pressure.

The pH of the body is immediately regulated by chemical buffers, while the excretion of carbon dioxide must wait until blood moves through the lungs. The kidneys are also involved in regulating blood pH, but the effect may not noticed for up to twenty hours. The blood glucose level is usually regulated by insulin and glucagon.



BLOOD

The average adult has about five liters of blood living inside of their body, coursing through their vessels, delivering essential elements, and removing harmful wastes. Without blood, the human body would stop working.

Blood is the fluid of life, transporting oxygen from the lungs to body tissue and carbon dioxide from body tissue to the lungs. Blood is the fluid of growth, transporting nourishment from digestion and hormones from glands throughout the body. Blood is the fluid of health, transporting disease fighting substances to the tissue and waste to the kidney

Blood is composed of two parts: formed elements and plasma.

Formed Elements

Name	**Function**
Red blood cells	Transport oxygen and hydrogen ions
White blood cells	Fight infection
Platelets	Assist blood clotting

Red Blood Cells: Red blood cells perform the most important blood duty. A single drop of blood contains millions of red blood cells which are constantly traveling through your body delivering oxygen and removing waste. If they weren't, your body would slowly die.

Red blood cells are red only because they contain a protein chemical called hemoglobin which is bright red in color. Hemoglobin contains the element Iron, making it an excellent vehicle for transporting oxygen and carbon dioxide. As blood passes through the lungs, oxygen molecules attach to the hemoglobin. As the blood passes through the body's tissue, the hemoglobin releases the oxygen to the cells. The empty hemoglobin molecules then bond with the tissue's carbon dioxide or other waste gases, transporting it away.
Over time, the red blood cells get worn out and eventually die. The average life cycle of a red blood cell is 120 days. Your bones are continually producing new blood cells, replenishing your supply. The blood itself, however, is re-circulated throughout your body, not being remade all of the time.
Since the human body is continually making more blood, it is safe for healthy adults to donate blood. The blood is then stored for use in emergency situations. Initially after giving blood, the donor may feel some momentary lightheadedness due to the loss of oxygen-rich red blood cells and blood sugar. The body quickly stabilizes itself.

White Blood Cells: Battling Blood Cells : Whenever a germ or infection enters the body, the white blood cells snap to attention and race toward the scene of the crime. The white blood cells are continually on the lookout for signs of disease. When a germ does appear, the white blood cells have a variety of ways by which they can attack. Some will produce protective antibodies that will overpower the germ. Others will surround and devour the bacteria.
The white blood cells have a rather short life cycle, living from a few days to a few weeks. A drop of blood can contain anywhere from 7,000 to 25,000 white blood cells at a time. If an invading infection fights back and persists, that number will significantly increase.
A consistently high number of white blood cells is a symptom of Leukemia, a cancer of the blood. A Leukemia patient may have as many as 50,000 white blood cells in a single drop of blood.

Platelets: Sticky Situations
The human body does not handle excessive blood loss well. Therefore, the body has ways of protecting itself. When, for some unexpected reason, sudden blood loss occurs, the blood platelets kick into action.
Platelets are irregularly-shaped, colorless bodies that are present in blood. Their sticky surface lets them, along with other substances, form clots to stop bleeding.
When bleeding from a wound suddenly occurs, the platelets gather at the wound and attempt to block the blood flow. The mineral calcium, vitamin K, and a protein called fibrinogen help the platelets form a clot.
A clot begins to form when the blood is exposed to air. The platelets sense the presence of air and begin to break apart. They react with the fibrinogen to begin forming fibrin, which resembles tiny threads. The fibrin threads then begin to form a web-like mesh that traps the blood cells within it. This mesh of blood cells hardens as it dries, forming a clot, or "scab."
Calcium and vitamin K must be present in blood to support the formation of clots. If your blood is lacking these nutrients, it will take longer than normal for your blood to clot. If these nutrients are missing, you could bleed to death. A healthy diet provides most people with enough vitamins and minerals, but vitamin supplements are sometimes needed.
A scab is an external blood clot that we can easily see, but there are also internal blood clots. A bruise, or black-and-blue mark, is the result of a blood clot. Both scabs and bruises are clots that lead to healing. Some clots can be extremely dangerous. A blood clot that forms inside of a blood vessel can be deadly because it blocks the flow of blood, cutting off the supply of oxygen. A stroke is the result of a clot in an artery of the brain. Without a steady supply of oxygen, the brain cannot function normally. If the oxygen flow is broken, paralysis, brain damage, loss of sensory perceptions, or even death may occur

Plasma :

It's a straw-colored, clear liquid that is 90 percent water, and it is an essential ingredient for human survival.

It might seem like plasma is less important than the blood cells it carries. But that would be like saying that the stream is less important than the fish that swims in it. You can't have one without the other.

Besides water, plasma also contains dissolved salts and minerals like calcium, sodium, magnesium, and potassium. Microbe-fighting antibodies travel to the battlefields of disease by hitching a ride in the plasma.

Component	Function
Water	Provides fluid environment
Proteins	Create osmotic pressure, aid clotting, and help buffer blood
Nutrients	Required for cellular metabolism
Wastes	Produced by cellular metabolism
Salts	Aid metabolic activity and help buffer blood
Hormones	Chemical messengers

Without plasma, the life-giving blood cells would be left floundering without transportation. Never underestimate the importance of plasma.

Lymph : Blood plasma that escapes from the blood vessels is absorbed into the surrounding tissue. This tissue fluid collects in tubes throughout the body and is known as lymph. From the lymph tubes, it returns to the blood after passing through a lymph node. It's a colorless, slightly sticky liquid.

Lymph is an important part of the circulatory system. It aids the body's absorption of nutrients and helps to remove waste from the tissue. The lymph collects the body's waste and then deposits it in a lymph node as it passes through. Lymph nodes are clumps of tissue that collect the waste deposits. Your tonsils and adenoids are two examples of lymph nodes.

The lymph nodes also assist the spleen and the bones in producing new white blood cells

Blood Types: In some ways, every person's blood is the same. But, when analyzed under a microscope, distinct differences are visible. In the early 20th century, an Austrian scientist named Karl Landsteiner classified blood according to those differences. He was awarded the Nobel Prize for his achievements.

Landsteiner observed two distinct chemical molecules present on the surface of the red blood cells. He labeled one molecule "A" and the other molecule "B." If the red blood cell had only "A" molecules on it, that blood was called type A. If the red blood cell had only "B" molecules on it, that blood was called type B. If the red blood cell had a mixture of both molecules, that blood was called type AB. If the red blood cell had neither molecule, that blood was called type O.

If two different blood types are mixed together, the blood cells may begin to clump together in the blood vessels, causing a potentially fatal situation. Therefore, it is important that blood types be matched before blood transfusions take place. In an emergency, type O blood can be given because it is most likely to be accepted by all blood types. However, there is still a risk involved.

A person with type A blood can donate blood to a person with type A or type AB. A person with type B blood can donate blood to a person with type B or type AB. A person with type AB blood can donate blood to a person with type AB only. A person with type O blood can donate to anyone.

A person with type A blood can receive blood from a person with type A or type O. A person with type B blood can receive blood from a person with type B or type O. A person with type AB blood can receive blood from anyone. A person with type O blood can receive blood from a person with type O.

Because of these patterns, a person with type O blood is said to be a universal donor. A person with type AB blood is said to be a universal receiver. In general, however, it is still best to mix blood of matching types and Rh factors.

Blood type inheritance possibilities Based on Parents:

Types Possible interitances	PARENTAL COMBINATIONS AB/ABAB/BAB/AAB/OB/BA/BA/AO/BO/AO/O
O	no no no no yes yes yes yes yes yes
A	yes yes yes yes no yes yes no yes no
B	yes yes yes yes yes yes no yes no no
AB	yes yes yes no no yes no no no no

Rh Factors : Scientists sometimes study Rhesus monkeys to learn more about the human anatomy because there are certain similarities between the two species. While studying Rhesus monkeys, a certain blood protein was discovered. This protein is also present in the blood of some people. Other people, however, do not have the protein. The presence of the protein, or lack of it, is referred to as the Rh (for Rhesus) factor.

If your blood does contain the protein, your blood is said to be Rh positive (Rh^+). If your blood does not contain the protein, your blood is said to be Rh negative (Rh^-).

This Rh factor is connected to your blood type. For example, your blood may be AB^+ which means that you have type AB blood with a positive Rh factor. Or, you might have O^- blood which means that you have type O blood with a negative Rh factor.

It is particularly important for expectant mothers to know their blood's Rh factor. Occasionally, a baby will inherit an Rh positive blood type from its father while the mother has an Rh negative blood type. The baby's life could be in great danger if the mother's Rh negative blood attacks the baby's Rh positive blood. If this happens, an exchange transfusion may save the baby's life. The baby's blood can be exchanged for new blood that matches the mother's

Electrocardiogram : Action potentials conducted through the heart during the cardiac cycle produce electrical currents that can be measured at the surface of the body. Electrodes placed on the surface of the body and attached to a recording device can detect the small electrical changes resulting from the action potentials in all of the cardiac muscle cells. The record of these electrical events is an electrocardiogram (ECG or EKG). The normal ECG consists of a P wave, a QRS complex, and a T wave.

The P wave results from depolarization of the atrial myocardium, and the beginning of the P wave precedes the onset of atrial contraction. The QRS complex consists of three individual waves: the Q, R, and S waves. The QRS complex results from depolarization of the ventricles, and the beginning of the QRS complex precedes ventricular contraction. The T wave represents repolarization of the ventricles, and the beginning of the T wave precedes ventricular relaxation. A wave representing repolarization of the atria cannot be seen because it occurs during the QRS complex.

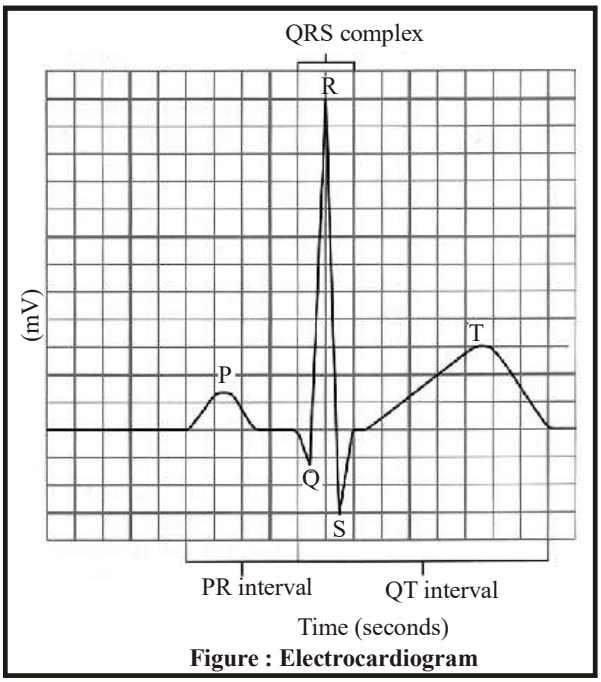


Figure : Electrocardiogram

Lymphatic System : This is a second transport system comprising a series of vessels, nodes and three organs viz. tonsils, thymus and spleen. The lymphatic system has 3 functions:

(i) Principally concerned with the transport & return of large molecules e.g. proteins which escape from the blood capillaries in the tissue fluids.

(ii) Transports (large) lipids away from the intestine after digestion and into the blood system. These are too large to enter the small pores in the capillaries.

(iii) Digests foreign material from the blood and produces lymphocytes and antibodies.

Lymphatic vessels are a network of blindly-ending thin-walled vessels called lymph capillaries which are found between the cells. These join up to form larger vessels, lymphatics, which eventually unite into two main ducts, right lymphatic duct & thoracic duct. These empty their contents into the large veins entering the right atrium.

Lymph transport is uni-directional and very slow and is brought about by:

(a) Pressure of lymph that accumulates in the tissues.

(b) Muscular movement in conjunction with numerous one way valves.

(c) Current evidence suggests that some larger lymph vessels contain autonomous pumps.

Lymph nodes are swellings covered by a capsule of connective tissue and found at various locations along the lymphatics. They are scattered throughout the body, usually in groups. Typically, these groups are arranged in two sets - superficial & deep. Lymph nodes are lined by macrophages which remove bacteria, foreign bodies & cell debris from the lymph as it passes through. During infection, they are the site of lymphocyte production and various plasma cells which produce antibodies.

INTERESTING FACTS

1. Every second, 15 million blood cells are destroyed in the human body.
2. Platelets, which form a part of the blood cell component are produced at the rate of 200 billion per day.
3. An adult human body contains five to six liters of blood and an infant has about one liter of blood.
4. Except the heart and lungs, all the other parts of the body receive their blood supply from the largest artery of the body, the aorta.
5. The Pulmonary vein is the only vein in the human body that carries oxygenated blood while all the other veins of the body carries de-oxygenated blood.
6. Human blood is colorless. It is the hemoglobin; a pigment present in the red blood cells that is responsible for the red color of the blood.
7. Heartbeat is nothing but the sound produced by the closure of valves of the heart when the blood is pushed through its chamber.
8. A women's heart beat is faster than that of a man's.
9. The human heart continues to beat even after it is taken out of the body or cut in to pieces.
10. **Milestones in Heart study :**

1628	William Harvey, an English Physician, first describes blood circulation.
1706	Raymond de Vieussens, a French anatomy professor, first describes the structure of the heart's chambers and vessels.
1733	Stephen Hales, an English clergyman and scientist, first measures blood pressure.
1816	Rene T. H. Laennec, a French physician, invents the stethoscope.
1903	Willem Einthoven, a Dutch physiologist, develops the electrocardiograph.
1912	James B. Herrick, an American physician, first describes heart disease resulting from hardening of the arteries.
1938	Robert E. Gross, an American surgeon, performs first heart surgery.
1951	Charles Hufnagel, an American surgeon, develops a plastic valve to repair an aortic valve.
1952	F. John Lewis, an American surgeon, performs first successful open heart surgery.
1953	John H. Gibbon, an American surgeon, first uses a mechanical heart and blood purifier.
1961	J. R. Jude, an American cardiologist, leads a team performing the first external cardiac massage to restart a heart.
1965	Michael DeBakey and Adrian Kantrowitz, American surgeons, implant mechanical devices to help a diseased heart.

1967 Christiaan Barnard, a South African surgeon, performs the first whole heart transplant from one person to another.

1982 Willem DeVries, an American surgeon, implants a permanent artificial heart, designed by Robert Jarvik, an American physician, into a patient.

11. The average pulse rate of a newborn is up to 140 beats per minute, and the average pulse rate of an elderly person is 50 to 65 beats per minute.

12. At least eight out of every 1,000 infants born each year have a heart defect.

13. The first open heart surgery patient was cooled by a special blanket until her body reached 81 degrees F; at this temperature, she could survive without a pumping heart for 10 minutes.

14. High blood pressure has no symptoms

15. It only takes about 20 seconds to pump blood to every cell in your body.

16. If you listen to your heart beat, you'll hear a "lub" and a "dub." These sounds are made by the heart valves as they open and close.

17. Your body has about six quarts of blood. In one day, the blood travels about 12,000 miles.

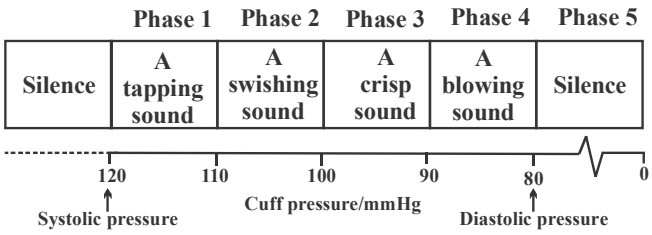
18. Humans' blood is red, octopus' blood is blue; caterpillars' blood is green.

BLOOD PRESSURE

Blood pressure is the pressure in the blood due to the beating heart. There are two types of blood pressure: systolic and diastolic. The systolic blood pressure corresponds to the pressure of the blood when the heart has imparted the maximum pressure. The diastolic blood pressure is the pressure when the heart is in the resting phase.

How To Measure Blood Pressure :

A sphygmomanometer cuff is wrapped around the subject's upper arm, just above the elbow and a stethoscope is placed on the hollow of the elbow, over the brachial artery.
Inflate the sphygmomanometer (blood pressure cuff) to a little above 180 mm Hg.
This collapses the major arteries to the arm (that's why it is uncomfortable).
Then slowly release air by gently turning the air valve, and watch the pressure drop.
When you first hear a sound, that will be the Systolic blood pressure.
(the maximum pressure exerted by the blood against the wall of the brachial artery when the heart beats)
The sound you hear is the blood now flowing in the artery of the arm.
Sound heard are called Korotkoff sounds (named after their discoverer).
This means that the systolic pressure is now greater than the pressure in the blood pressure cuff.
As you continue to watch the pressure drop, when you no longer hear any sounds, that will be the Diastolic blood pressure. It is generally accepted that there are five phases of Korotkoff sounds. Each phase is characterised by the volume and quality of sound heard. The figure below illustrates these phases. In this example, the systolic and diastolic pressures are 120mm Hg and 80mm Hg respectively.



Phase 1 :

With the pressure cuff inflated to beyond the systolic pressure, the artery is completely occluded and no blood can flow through it. Consequently, no sounds are heard above the systolic pressure. At the point where cuff pressure equals the systolic pressure, a sharp tapping sound is heard. We recall that the blood pressure oscillates between systolic and diastolic pressure. At systolic, the pressure is great enough to force the artery walls open and for blood

to spurt through. As the pressure dips to diastolic, however, the artery walls bang shut again. It is the closing shut of the artery walls that results in the tapping sound.

Phase 2 : This phase is characterised by a swishing sound, caused by the swirling currents in the blood as the flow through the artery increases. Sometimes, if the cuff is deflated too slowly, the sounds vanish temporarily. This happens when the blood vessels beneath the cuff become congested, and is often a sign of hypertension. The congestion eventually clears, and sounds resume. The intervening period is called the auscultatory gap.

Phase 3 : In this phase, there is a resumption of crisp tapping sounds, similar to those heard in phase 1. At this stage, the increased flow of blood is pounding against the artery walls.

Phase 4 : At this point, there is an abrupt muffling of sound. The blood flow is becoming less turbulent. Some medical practitioners choose to record this point as the diastolic pressure.

Phase 5 : This is the point at which sounds cease to be heard all together. The blood flow has returned to normal and is now laminar. The pressure cuff is deflated entirely and removed.

TRANSPORTATION IN PLANTS

Xylem and Phloem : Xylem and phloem are the building blocks of plant life. Without these essential vascular tissues, plants would cease to exist as we know them. Xylem conducts water and dissolved minerals from the roots to all other parts of the plant. In addition to its critical transportation function, xylem also provides support for the plant. Xylem can be seen by the unaided human eye by examining a tree trunk. When sliced horizontally, tree trunks reveal a set of rings. These rings are the remains of old xylem tissue. Because xylem dies after one year and then renews itself, each ring represents a year in the treelife.

The process of photosynthesis uses the energy of sunlight to convert water and carbon dioxide into carbohydrates and oxygen. These vital plant nutrients are then transported from the leaves to other parts of the plant by the vascular tissue known as phloem

Transpiration : Trees absorb water primarily through their roots. They evaporate water through openings in their leaves in a process called transpiration.

As with human respiration, trees tend to transpire more with increased temperatures, sunlight intensity, water supply, and size. When it gets too hot, though, transpiration will shut down. In actively growing plants, water is continuously evaporating from the surface of leaf cells exposed to air. This water is replaced by additional absorption of water from the soil.

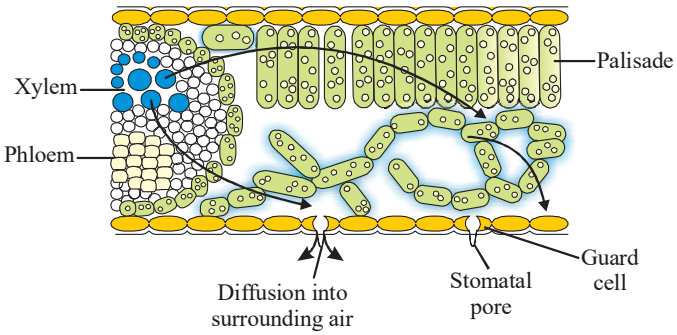


Figure : Water movement in the leaf.

Liquid water extends through the plant from the soil water to the leaf surface where it is converted from a liquid into a gas through the process of evaporation. The cohesive properties of water (hydrogen bonding between adjacent water molecules) allow the column of water to be 'pulled' up through the plant as water molecules are evaporating at the surfaces of leaf cells. This process has been termed the Cohesion Theory of Sap Ascent in plants.

Why do plants transpire ?

Evaporative cooling: As water evaporates or converts from a liquid to a gas at the leaf cell and atmosphere interface, energy is released. This exothermic process uses energy to break the strong hydrogen bonds between

liquid water molecules; the energy used to do so is taken from the leaf and given to the water molecules that have converted to highly energetic gas molecules. These gas molecules and their associated energy are released into the atmosphere, cooling the plant.

Accessing nutrients from the soil: The water that enters the root contains dissolved nutrients vital to plant growth. It is thought that transpiration enhances nutrient uptake into plants.

Carbon dioxide entry: When a plant is transpiring, its stomata are open, allowing gas exchange between the atmosphere and the leaf. Open stomata allow water vapor to leave the leaf but also allow carbon dioxide (CO_2) to enter. Carbon dioxide is needed for photosynthesis to operate. Unfortunately, much more water leaves the leaf than CO_2 enters for three reasons:

1. H_2O molecules are smaller than CO_2 molecules and so they move to their destination faster.
2. CO_2 is only about 0.036% of the atmosphere (and rising) so the gradient for its entry into the plant is much smaller than the gradient for H_2O moving from a hydrated leaf into a dry atmosphere.
3. CO_2 has a much longer distance to travel to reach its destination in the chloroplast from the atmosphere compared to H_2O which only has to move from the leaf cell surface to the atmosphere.

This disproportionate exchange of CO_2 and H_2O leads to a paradox. The larger the stomatal opening, the easier it is for carbon dioxide to enter the leaf to drive photosynthesis; however, this large opening will also allow the leaf to lose large quantities of water and face the risk of dehydration or water-deficit stress. Plants that are able to keep their stomata slightly open, will lose fewer water molecules for every CO_2 molecule that enters and thus will have greater water use efficiency (water lost/CO_2 gained). Plants with greater water use efficiencies are better able to withstand periods when water in the soil is low.

Water uptake: Although only less than 5% of the water taken up by roots remains in the plant, that water is vital for plant structure and function. The water is important for driving biochemical processes, but also it creates turgor so that the plant can stand without bones.

How Transpiration Works :

- Transpiration is the flow of water vapour from leaves into the atmosphere.
- The driving force of transpiration is radiation from the sun heating the interior of leaves. Evaporation occurs at the surface of cells and water vapour flows through stomates into the drier atmosphere.
  The loss of water at the leaf surface creates a suction pulling water up through the xylem tubes in the stem and roots and water is sucked out of the soil through root hairs Water movement by transpiration pull is assisted by osmotic pressure and capillary rise
- The major factors affecting the rate of transpiration is the strength of solar radiation and the presence of available soil water. Transpiration is greatest in the middle of the day when maximum solar radiation occurs and nearly ceases during the middle of the night.
- The rate of transpiration is increased by winds, low relative humidity and low atmospheric pressure.
- Photosynthesis requires, carbon dioxide to enter through open stomates and oxygen to flow out. Water vapour also flows out through open stomates into the atmosphere. Stomates are small breathing pores mainly found in the lower leaf surface. Plants regulate water loss through transpiration by opening and closing stomates.
- Normally stomates are open in the day and closed in night. Cacti and some desert plants conserve water by closing stomates in day and opening them in the night.
- In different plant species the number, size and location of stomates helps to control transpiration rate. Often plants close their stomates during high temperatures and water shortages.
- In the winter transpiration is slow and when deciduous
  trees lose their leaves nearly stops.

- Higher leaf area in plants increases transpiration and at the top of a canopy, transpiration is greater than close to ground level. An open canopy facilates transpiration compared to a dense, closed canopy. A tree standing alone has a higher transpiration rate than a tree in a forest surrounded by many tall trees.

- There needs to be sufficient available soil water for transpiration. When a water shortage occurs, leaves will droop and wilting occurs.
- Normally transpiration can not exceed evaporation and under ideal cond ions transpiration may reach 95% of evaporation. In the middle of winter transpiration from deciduous trees when they have lost their leaves is less than 15% of evaporation.
- Evapotranspiration is the sum of evaporation from the soil surface plus transpiration from plants.

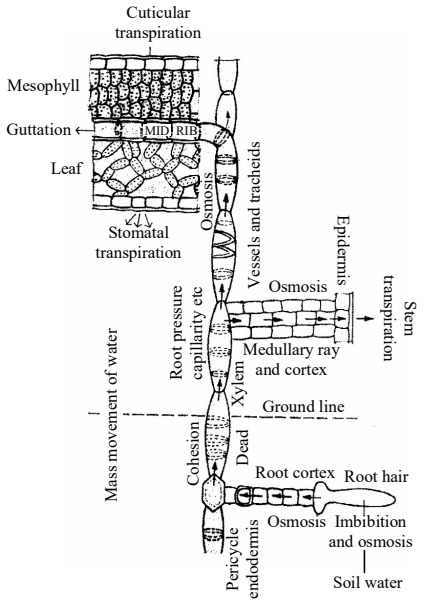


Figure : Path of ascent of sap showing transpiration pull

Transport of water : Xylem is the water transporting tissue in plants that is dead when it reaches functional maturity. Tracheids are long, tapered cells of xylem that have end plates on the cells that contain a great many crossbars. Tracheid walls are festooned with pits. Vessels, an improved form of tracheid, have no (or very few) obstructions (crossbars) on the top or bottom of the cell. The functional diameter of vessels is greater than that of tracheids.

Water is pulled up the xylem by the force of transpiration, water loss from leaves. Mature corn plants can each transpire four gallons of water per week. Transpiration rates in arid-region plants can be even higher. Water molecules are hydrogen bonded to each other. Water lost from the leaves causes diffusion of additional water molecules out of the leaf vein xylem, creating a tug on water molecules along the water columns within the xylem. This "tug" causes water molecules to rise up from the roots to eventually the leaves. The loss of water from the root xylem allows additional water to pass through the endodermis into the root xylem.

Transpiration exerts a pull on the water column within the xylem. The lost water molecules are replaced by water from the xylem of the leaf veins, causing a tug on water in the xylem. Adhesion of water to the cell walls of the xylem facilitates movement of water upward within the xylem.

In most environments, the water concentration outside the leaf is less than that inside the leaf, causing a loss of water through openings in the leaf known as stomata (singular = stoma). Guard cells are crescent-shaped cells of the epidermis that flank the stoma and regulate the size of the opening. Together, the guard cells and stoma comprise the stomatal apparatus. The inner wall of the guard cell is thicker than the rest of the wall. When a guard cell takes up potassium ions, water moves into the cell, causing the cell to become turgid and swell, opening the stoma. When the potassium leaves the guard cell, the water also leaves, causing plasmolysis of the cells, and a closing of the stoma. Stomata occupy 1% of the leaf surface, but account for 90% of the water lost in transpiration.

Transportation of food and other substances :

Plants make sugar by photosynthesis, usually in their leaves. Some of this sugar is directly used for the metabolism of the plant, some for the synthesis of proteins and lipids, some stored as starch. Other parts of the plant also need energy but are not photosynthetic, such as the roots. Food must therefore be transported in from a source, an action accomplished by the phloem tissue.

Phloem consists of several types of cells: sieve tube cells (aka sieve elements), companion cells, and the vascular parenchyma. Sieve cells are tubular cells with endwalls known as sieve plates. Most lose their nuclei but remain alive, leaving an empty cell with a functioning plasma membrane.

Companion cells load sugar into the sieve element (sieve elements are connected into sieve tubes). Fluids can move up or down within the phloem, and are translocated from one place to another. Sources are places where sugars are being produced. Sinks are places where sugar is being consumed or stored.

Food moves through the phloem by a Pressure-Flow Mechanism. Sugar moves (by an energy-requiring step) from a source (usually leaves) to a sink (usually roots) by osmotic pressure. Translocation of sugar into a sieve element causes water to enter that cell, increasing the pressure of the sugar/water mix (phloem sap). The pressure causes the sap to flow toward an area of lower pressure, the sink. In the sink, the sugar is removed from the phloem by another energy-requiring step and usually converted into starch or metabolized.

EXCRETION

Excretion can be defined as the removal of toxic waste products of metabolism from the body. These wastes can be either solid, liquid or in the gaseous state. The liquid wastes are ammonia and urea, which exist in the blood along with the nutrients and other useful substances. So there is a need of complex organ that may separate or filter out the dissolved excretory wastes from blood while retaining the nutrients in the latter.

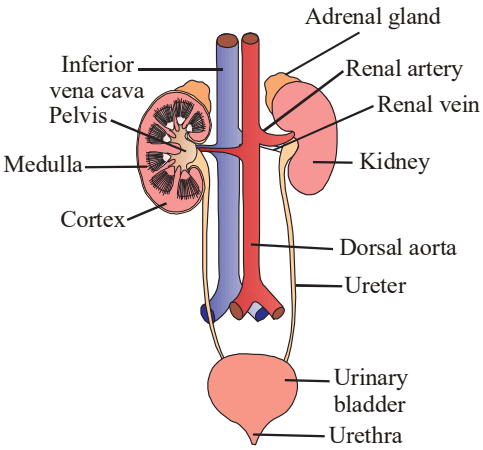


Figure : Human Urinary system

The main organ of the excretory system is the kidney (two kidney in human). There is a distinct advantage of the two kidneys in our body. If one kidney fails, the other can still deal with functions of excretion and regulation. The kidneys have a remarkable operating capacity—a single kidney, working at just 20% of its capacity, can still provide all needed renal filtration and regulation. And, the kidneys are capable of altering their activities from day to day, constantly adjusting to the variety and amounts of foods and liquids that are consumed. As we fast one day, or overindulge the next, the kidneys compensate to keep the body's tissues from bloating with fluids or dehydrating.

The kidneys are solid; bean shaped, reddish brown-paired structure, which lie in the abdominal cavity one on either side of the vertebral column. A section through a kidney shows a darker outer region, the cortex and a lighter inner zone, the medulla, where the ureter leaves the kidneys is a space called the pelvis.

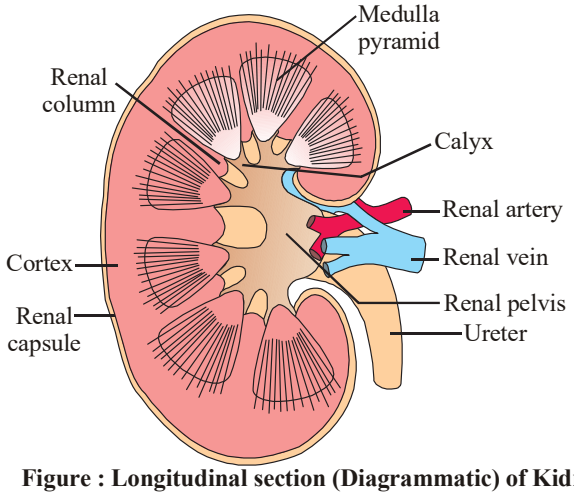


Figure : Longitudinal section (Diagrammatic) of Kidney

Kidney is built of billions of little tubes called the nephrons. Actual filtering occurs in it.At the beginning of each nephron, a web of capillaries releases much water and other molecules into the nephron. Then, along the length of the nephron, there is exchange between the nephron, the neighboring capillaries and the space between them. Some substances, e.g, glucose, get completely reasborbed out of the nephron and back into the bloodstream. Toxic and waste materials are actively secreted from the blood into the nephron. Many ions are also exchanged, leading to regulated changes in pH. Finally, most of the water gets reabsorbed as well, under control of antidiuretic hormone and aldosterone. Control of how much water gets excreted in the urine and how much is reabsorbed back into the bloodstream is important not just for preventing water loss, but also in controlling blood pressure. The urine is collected in the urinary bladder and, when it fills up, it is excreted via urethra into the outside environment.

The kidneys also regulate the body's levels of sodium, potassium, calcium, and other chemicals which can become toxic if left to build up. In addition, the kidneys function as glands, producing hormones to help maintain normal blood pressure, enable the production of red blood cells, and aid the formation of bone.

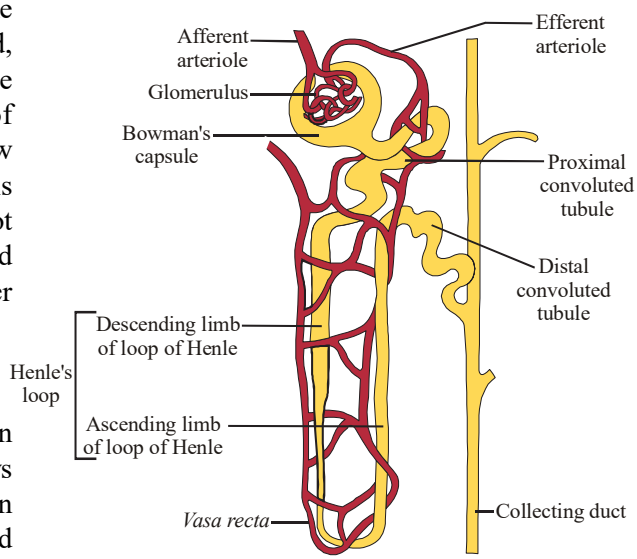


Figure : A diagrammatic representation of a nephron showing blood vessels, duct and tubule.

Functions of the Urinary system : The major functions of the urinary system are performed by the kidneys, and the kidneys play the following essential roles in controlling the composition and volume of body fluids:

1. **Excretion :** The kidneys are the major excretory organs of the body. They remove waste products, many of which are toxic, from the blood. Most waste products are metabolic by-products of cells and substances absorbed from the intestine. The skin, liver, lungs, and intestines eliminate some of these waste products, but they cannot compensate if the kidneys fail to function.
2. **Blood volume control :**The kidneys play an essential role in controlling blood volume by regulating the volume of urine produced.
3. **Ion concentration regulation :** The kidneys help regulate the concentration of the major ions in the body fluids.
4. **pH regulation :** The kidneys help regulate the pH of the body fluids. Buffers in the blood and the respiratory system also play important roles in the regulation of pH.
5. **Red blood cell concentration :** The kidneys participate in the regulation of red blood cell production and, therefore, in controlling the concentration of red blood cells in the blood.
6. **Vitamin D synthesis.** The kidneys, along with the skin and the liver, participate in the synthesis of vitamin D.

Functions of Each Part of the Renal Tubule

Part	Site in Kidney	Function
Glomerular capsule	Cortex	Filtration
Proximal convoluted tubule	Cortex	Selective reabsorption of water, amino acids,electrolytes
Nephron loop	Medulla	Water conservation;urine concentration
Distal convoluted tubule	Cortex	Secretion of large molecules
Collecting duct	Medulla	Further reabsorption of water

Why do kidney fail :

Most kidney diseases attack the nephrons, causing them to lose their filtering capacity. Damage to the nephrons may happen quickly, often as the result of injury or poisoning. But most kidney diseases destroy the nephrons

slowly and silently. Only after years or even decades will the damage become apparent. Most kidney diseases attack both kidneys simultaneously.

The two most common causes of kidney disease are diabetes and high blood pressure. If your family has a history of any kind of kidney problems, you may be at risk for kidney disease.

Diabetic Nephropathy : Diabetes is a disease that keeps the body from using glucose (sugar) as it should. If glucose stays in your blood instead of breaking down, it can act like a poison. Damage to the nephrons from unused glucose in the blood is called diabetic nephropathy. If you keep your blood glucose levels down, you can delay or prevent diabetic nephropathy.

High Blood Pressure : High blood pressure can damage the small blood vessels in your kidneys. The damaged vessels cannot filter wastes from your blood as they are supposed to.

Glomerular Diseases : Several different types of kidney disease are grouped together under this category, including autoimmune diseases, infection-related diseases, and sclerotic diseases. As the name indicates, glomerular diseases attack the tiny blood vessels (glomeruli) within the kidney. The most common primary glomerular diseases include membranous nephropathy, IgA nephropathy, and focal segmental glomerulosclerosis. Protein, blood, or both in the urine are often the first signs of these diseases. They can slowly destroy kidney function. Blood pressure control is important with any kidney disease. Treatments for glomerular diseases may include immunosuppressive drugs or steroids to reduce inflammation and proteinuria, depending on the specific disease.

Inherited and Congenital Kidney Diseases : Some kidney diseases result from hereditary factors. Polycystic kidney disease (PKD), for example, is a genetic disorder in which many cysts grow in the kidneys. PKD cysts can slowly replace much of the mass of the kidneys, reducing kidney function and leading to kidney failure.

Some kidney problems may show up when a child is still developing in the womb. Examples include autosomal recessive PKD, a rare form of PKD, and other developmental problems that interfere with the normal formation of the nephrons. The signs of kidney disease in children vary. A child may grow unusually slowly, may vomit often, or may have back or side pain. Some kidney diseases may be "silent" for months or even years.

The capsule has been removed and a pattern of fetal lobulations still persists, as it sometimes does. The hilum at the mid left contains some adipose tissue. At the lower right is a smooth-surfaced, small, clear fluid-filled simple renal cyst. Such cysts occur either singly or scattered around the renal parenchyma and are not uncommon in adults.

Other Causes of Kidney Disease : Poisons and trauma, for example a direct and forceful blow to your kidneys, can lead to kidney disease. Some over-the-counter medicines can be poisonous to your kidneys if taken regularly over a long period of time. Products that combine aspirin, acetaminophen, and other medicines such as ibuprofen have been found to be the most dangerous to the kidneys. If you take painkillers regularly, check with your doctor to make sure you are not putting your kidneys at risk.

What happens if my kidneys fail completely ?

Complete and irreversible kidney failure is sometimes called end-stage renal disease, or ESRD. If kidneys stop working completely, body fills with extra water and waste products. This condition is called uremia. Hands or feet may swell, body will feel tired and weak because your body needs clean blood to function properly. Untreated uremia may lead to seizures or coma and will ultimately result in death. If kidneys stop working completely, person will need to undergo dialysis or kidney transplantation.

Dialysis : Dialysis is a treatment for people in the later stage of chronic kidney disease (kidney failure). This treatment cleans the blood and removes wastes and excess water from the body. Normally, this work is done by healthy kidneys. Sometimes dialysis is a temporary treatment. However, when the loss of kidney function is permanent (as in end-stage kidney failure), you must continue to have dialysis on a regular basis. The only other treatment for kidney failure is a kidney transplant.

The two major forms of dialysis are hemodialysis and peritoneal dialysis. In hemodialysis, blood is sent through a filter that removes waste products. The clean blood is returned to the body. Hemodialysis is usually performed at a dialysis center three times per week for 3 to 4 hours. In peritoneal dialysis, a fluid is put into your abdomen.

This fluid captures the waste products from blood. After a few hours, the fluid containing body's wastes is drained away. Then, a fresh bag of fluid is dripped into the abdomen. Patients can perform peritoneal dialysis themselves. Patients using continuous ambulatory peritoneal dialysis (CAPD) change fluid four times a day. Another form of peritoneal dialysis, called continuous cycling peritoneal dialysis (CCPD), can be performed at night with a machine that drains and refills the abdomen automatically.

Transplantation : A donated kidney may come from an anonymous donor who has recently died or from a living person, usually a relative. The kidney that you receive must be a good match for body. The more the new kidney is like person, the less likely immune system is to reject it immune system protects from disease by attacking anything that is not recognized as a normal part of body. So immune system will attack a kidney that appears too foreign. special drugs help trick immune system so it does not reject the transplanted kidney.

Interesting :

1. The Human bladder can stretch to hold about 400ml of urine.
2. All the blood in our body passes 400 times through each kidney every day.
3. Kidneys process 1.5 L blood and 180 L water absorbed per day.

INTER CONNECTION OF URINARY SYSTEM WITH OTHER

Integumentary System : The urinary system compensates for water loss due to sweating. The kidneys and skin both play a role in vitamin D production.

Skeletal System : The kidneys and bone tissue work together to control plasma calcium levels.

Muscular System : Muscle tissue controls urine elimination from the bladder.

Nervous System : The nervous system influences urine production and elimination.

Endocrine System : The endocrine system influences urine production.

Urinary system : The urinary system controls the compositjon of the internal environment,

Cardiovascular System : The urinary system controls blood volume. Blood volume and blood pressure play a role in determining water and solute excretion.

Lymphatic System : The kidneys control extracellular fluid volume and composition (including lymph).

Digestive System : The kidneys compensate for fluids lost by the digestive system.

Respiratory System : The kidneys and the lungs work together to control the pH of the internal environment.

Reproductive System : The urinary system In males shares common organs with the reproductive system. The kidneys compensate for fluids lost from the male and female reproductive systems.

PLANT EXCRETION

Plants produce a variety of organic and inorganic substance as- by products during metabolism which are excreted in variety of ways. Oxygen and Carbon dioxide are produced as waste products during photosynthesis and respiration respectively. These are excreted through of plants. Water is produced as waste product during photosynthesis and respiration. It is excreted by transpiration. Plants produced various organic and inorganic waste products during metabolism. These waste substances are stored in the vacuoles of leaf cells and their increasing concentration may result in their crystal formation in the vacuoles. Leaves also store heavy metals which toxic.

These leaves become yellow and fall of in autumn thus removing the waste substances. Such leaves are also called excretophores. Some bulb scales e.g. blue bell store waste substances. Death of these bulbs in the ground results in excretion. Tropical trees deposit chemicals like gums, resins, tannin in the old xylem cells of stem which become darker in colour and called ebony or hard black wood called heartwood. Ebony is no longer involved in conduction of water and minerals and thus serves as storage region of some wastes. Some conifers secrete waste chemicals into the soil through root which inhibit the growth of roots of other plants in their vicinity.

Guttation : Secretion of water on to the surface of leaves through specialized pores, or hydathodes. The process occurs most frequently during conditions of high humidity when the rate of transpiration is low. Drops of water found on grass in early morning are often the result of guttation, rather than dew. Sometimes the water contains minerals in solution, such as calcium, which leaves a white crust on the leaf surface as it dries.

QUESTION BANK

EXERCISE - 1

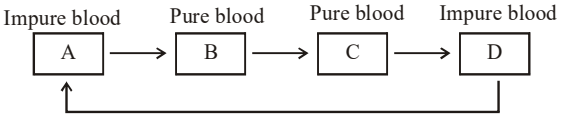
LEVEL-1

Q.1 What are herbivores, carnivores and omnovores ? Give two examples of each.
Q.2 How does Amoeba engulf the food particle ?
Q.3 Name a unicellular animal which uses cilia to move food particles into its mouth.
Q.4 What is the other name of food pipe ?
Q.5 Describe the process of digestion of food in man.
Q.6 Name the main organs of the human digestive system. Also name the associated glands.
Q.7 'Respiration is a vital function of the body'. Justify this statement.
Q.8 What are the differences between aerobic and anaerobic respiration ? Name some organisms that use anaerobic mode of respiration.
Q.9 What type of respiration takes place in human muscles during vigorous physical exercise ? Give reason for your answer.
Q.10 Describe the process of respiration in Amoeba and fish.
Q.11 What type of arrangement exists in the bodies of large animals to meet their oxygen requirements adequately ?
Q.12 What is transpiration ?
Q.13 Draw labelled diagram of a xylem vessel.
Q.14 State the term used for the transport of food from leaves to other parts of a plant.
Q.15 What are the differences between the transport of materials in xylem and phloem ?
Q.16 What are the methods used by plants to get rid of their waste products ?
Q.17 What is urethra ?
Q.18 What does the bladder in our body do ?
Q.19 What do kidneys excrete ?
Q.20 What type of patients are put on dialysis ? Explain the principle of dialysis.
Q.21 What are the various conditions necessary for photosynthesis ?
Q.22 How do plants obtain food ?
Q.23 Name the pigment which can absorb solar energy.
Q.24 Apart from carbon dioxide and water, name four other raw materials which are needed by the plants.
Q.25 Why is diffusion insufficient to meet the oxygen requirements of multicellular organisms like humans?
Q.26 What criteria do we use to decide whether something is alive?
Q.27 What are outside raw materials used by an organism?
Q.28 What processes would you consider essential for maintaining life?
Q.29 Describe the structure and functioning of nephrons.
Q.30 How is the amount of urine produced regulated?
Q.31 Name two-layered protective covering of heart.
Q.32 Name the oxygen carrying pigment.
Q.33 Is human circulatory system open or closed ?
Q.34 What are great blood vessels ?
Q.35 What is respiration ?
Q.36 Name the respiratory pigment present in the human blood.
Q.37 Where the gaseous exchange takes place in Hydra ?
Q.38 Define excretion.
Q.39 Why is it necessary for animals to excrete water ?
Q.40 Name the nitrogenous excretory product, that requires highest expenditure of energy for its synthesis.
Q.41 What is the function of the diaphragm ?

Q.42 What is the source of the O_2 and the CO_2 exchanged in alveoli ?
Q.43 What is the primary function of red blood cells ?
Q.44 In which direction does O_2 diffuse between a capillary and a cell ? Why does it diffuse in that direction?
Q.45 What is the principal advantage of "wrinkled" surface on small intestine
Q.46 Name of the transport processes that do require energy for moving substances through microvilli ?
Q.47 What are some water-soluble waste products eliminated by the urinary system ?
Q.48 Why should athletes, labourers and mountaineers live on high carbohydrate diets ?
Q.49 Why fundic stomach is said to be body of stomach ?
Q.50 Why bile juice is necessary for digestion of food however it does not contain enzymes ?
Q.51 Which vitamins are stored in liver ?
Q.52 What is nutrition ?
Q.53 Define digestion.
Q.54 State two functions of intestinal villi.
Q.55 Plants extract CO_2 from the atmosphere during photosynthesis, but which plant activity adds CO_2 to be atmosphere
Q.56 What are the sources of the materials that enter the plant ?
Q.57 If the stomata were closed, would the CO_2 concentration within the leaf increase or decrease ?
Q.58 Which would you expect to allocate a higher percentage of carbohydrates to its roots, a saguaro cactus or a tropical teak tree ?

Note : (Q.59-62)

Please read the following data of a patient and then answer the questions. Also a box diagram is given where the four chambers of heart are indicated by A, B, C, D.



Cardiac output = 4 litre/minute
Pulse rate = 100/minute

Q.59 Label the correct names of heart chambers A, B, C, D ?
Q.60 How much amount of blood is transferred from chamber C to chamber D in a single heart beat ?
Q.61 How much amount of blood (approximately) is present in the Arteries and veins respectively of this person at any moment of time ?
Q.62 What events take place in the auricles and ventricles in the cardiac cycle of this person after end of second heart sound and before onset of first heart sound ?
Q.63 Why are little leaf and mottle leaf condition caused in plants?
Q.64 Deficiency of which element is responsible for premature fall of leaves ?
Q.65 Which are the elements required to form ATP synthesis in plants ?
Q.66 Write the overall equation for photosynthesis.
Q.67 Name the two raw materials of photosynthesis.
Q.68 What are the normal values of blood pressure in the arteries, veins and capillaries ?
Q.69 Define cardiac output and stroke volume
Q.70 Why does chlorophyll appears green ?
Q.71 In which wavelength of light of visible spectrum, the photosynthesis will be maximum and minimum ?
Q.72 What is chlorophyll ?
Q.73 Why do the marshy plants catch the insects ?
Q.74 Name the main modes of nutrition.

Q.75 What are the raw materials for photosynthesis ?
Q.76 Name the two stages of photosynthesis.
Q.77 How does amoeba engulf its food ?
Q.78 Which part of roots is involved in exchange of respiratory gases ?
Q.79 Why is nutrition necessary for an organism ?
Q.80 Explain the mechanism of gaseous exchange between tissues and blood.
Q.81 Why are the plants called producers ?
Q.82 In which part of the cell photosynthesis occurs ?
Q.83 What is transpiration ?
Q.84 Name the system responsible for transportation of materials in human beings.
Q.85 What is the other term for extracellular fluid ?
Q.86 What happens to glucose which enters the nephron alongwith the filtrate ?
Q.87 Form an arrow diagram showing the route of water molecules from root to leaf.
Q.88 Name the breathing organs in fish.
Q.89 Name the artery that has deoxygenated blood and vein that has oxygenated blood.
Q.90 What is dialysis ?

LEVEL-2

Q.91 Predict what would happen if vitamins were broken down during the process of digestion rather than being absorbed intact into the circulation.
Q.92 One serving of a food has 30g of carbohydrate. What % daily value for carbohydrate is on the food label for this food ?
Q.93 Suppose a person consumes 1800 kcal/day. What total % daily values for energy-producing nutrients is recommended
Q.94 In watching TV uses 95 kcal/h, how long does it take to burn off the kilocalories in one cola. If jogging at a pace of 6 mph uses 580 kcal/h, how long does it take to use the kilocalories in one cola ?
Q.95 You many have notices that an very cold winter days people's noses and ears turn red. Can you explain the advantage of this response ?
Q.96 Cigarette smoke produces carbon monoxide. If a nonsmoker smoked a pack of cigarettes a day for a few weeks, what would happen to the number of red blood cells in the person's blood ? Explain.
Q.97 Predict the effect on the heart if blood flow through the anterior interventricular artery is restricted or completely blocked.
Q.98 If blood supply is reduced in a small area of the heart through which the left bundle branch passed, predict the effect on ventricular contractions.
Q.99 Compare the rate of blood flow out of the ventricles between the first and second heart sounds of the same beat with the rate of blood flow out of the ventricles between the second heat sound of one beat and the first heart sound of the next beat.
Q.100 If normal heart sounds are represented by lubb-dupp, lubb-dupp, what does a heart sound represented by lubb-dubbshhh, lubb-duppshhh represent ? What does lubb-shhhduppp, lubb-shhhdupp represent (assume that shhh represents a swishing sound) ?
Q.101 Explain what happen to your throat when you sleep with your mouth open, especially when your nasal passages are plugged as a result of having a cold.
Q.102 Explain what happens to the shape of the trachea when a person swallows a large mouthful of food. Why is this advantageous?
Q.103 Explain why a person who breathes rapidly and deeply (hyperventialtes) for several seconds experiences a short period of time in which respiration does not occur (apnea) before normal breathing resumes.
Q.104 Explain why we become warm during exercise and explain the usefulness of shivering when it is cold.

Q.105 Explain why construction of skin blood vessels on a cold winter day is beneficial.
Q.106 Differentiate between autotroph and heterotrop.
Q.107 Differentiate between saprophytic nutrition and parasitic nutrition.
Q.108 What is emphysema?
Q.109 The digestive system of humans is intermediate between that of strict carnivores and that of strict herbivores. How might you expect your digestive system to be different if we had fed exclusively on plant tissues throughout our evolutionary history ?
Q.110 Our oxygen demand changes dramatically depending on how active we are. Can you think of changes that take place in the way your body works as you begin to exercise? Think of how these changes help provide more oxygen to the metabolizing cells in an active body.
Q.111 Describe and explain the variation in blood pressure throughout an indivdual's circulatory system during a single heartbeat.
Q.112 Discuss the advantages and disadvantages of a closed circulatory system.
Q.113 Humans are endotherms. What advantages do we have over ectotherms ? What disadvantages do we face ?
Q.114 What are the major features and functions of circulatory systems ?
Q.115 How does the human respiratory system work ?
Q.116 What nutrients do animals need ?
Q.117 How does excretion occur in invertebrates ?
Q.118 Donating a pint of blood reduces blood volume, which results in a decreased in blood pressure (just as air pressure in a tyre decreases as air is left out of the tire). What effect does donating blood have on heart rate ? What would happen if a negative-feedback mechanism did not return the value of some parameter such as blood pressure to its normal range ?
Q.119 Is the sensation of thirst associated with a negative or a positive feedback mechanism ?

EXERCISE - 2

Fill in the blanks

Q.1 Ninety percent of the water lost by the plants during transpiration is through the ..... of the leaf
Q.2 Gibberellins were first isolated from .....
Q.3 A plant pigment known as ..... is involved in the phenomenon of photoperiodism.
Q.4 The semiliquid mixture of partially digested food found in the stomach is called .....
Q.5 The hormones ..... and ..... are the major hormones involved in the regulation of blood glucose levels.
Q.6 The major function of the ..... blood cells is to transport oxygen.
Q.7 Arteries carry blood ..... from the heart.
Q.8 The cells of our body are surrounded by a fluid known as ..... fluid.
Q.9 As your body temperature increases, the excess heat is sent to processing centers in the brain, proper temperature adjustments are made, and your temperature decreases. This is an example of ..... feedback.
Q.10 The functional unit of the mammalian kidney is the .....
Q.11 The portion of the nephron tubule nearest the Bowman's capsule is called the convoluted ..... tubule.
Q.12 On the basis of histology, outer surface of stomach is made up of squamous epithelial cells which is called as .....(1) ..... outer muscle layer is .....(2)..... and inner muscle layer is .....(3)..... One extra layer of .....(4)..... muscles is also found in stomach. So maximum peristalsis is found in .....(5)..... while least peristalsis is found in .....(6)..... Goblet cell is unicellular gland which secretes the .....(7)..... Gastrin hormone is secreted by .....(8)..... while HCl is secreted by .....(9)..... Instrinsic castle's factor hekps in absorption of vitamin B_{12} so deficiency of this factor leads to .....(10).....

Q.13 Largest digestive gland in the human body is .....

Q.14 Pepsin and trypsin both are protein-digesting enzymes, pepsin acts in ..... medium and trypsin acts in ..... medium.

Q.15 The residual volume of an average adult human is .....

Q.16 The main muscle of respiration is .....

Q.17 The structural and functional unit of lung is .....

Q.18 Difficulty in breathing is called .....

Q.19 Diaphragm contracts to help in ..... ,while the contraction of abdominal muscles helps in .....

Q.20 Gases move across the membranes by ..... For this membranes must be .....

Q.21 The ..... prevents the entry of food into the respiratory tract.

Q.22 The stroke volume of an average adult under normal condition is .....

Q.23 Veins are also called as systemic.....

Q.24 Second heart sound is heard as .... is due to closure of ..... valves at the beginning of ventricular diastole.

Q.25 Minute blood vessels which supply blood in thick wall of major arteries are called as .....

Q.26 The internal body fluids constitute the .....

Q.27 Capillaries are found in ..... circulatory system and ..... and ..... in the open one.

Q.28 ..... discovered the function of heart and ..... succeeded into determine the blood pressure.

Q.29 Kidney eliminate the excretory waste materials as their aqueous solution, called .....

Q.30 The chemicals that reduce transpiration without affecting the CO_2 uptake are called .....

Q.31 Synthesis of ATP using light energy in photosynthesis is .....

Q.32 Man is ..... in nutrition.

Q.33 Digestion process starts in ..... itself

Q.34 Starch changes blue in ..... solution.

Q.35 In ..... respiration very less energy is obtained.

Q.36 All parts of a plant perform ..... individually.

Q.37 Two ..... are present on both the sides of the stomata.

Q.38 Pulmonary artery contains ..... blood.

Q.39 Blood is a ..... tissue.

Q.40 Lymph is a ..... coloured fluid containing lymphocyte cells.

Q.41 ..... involves the intake of simple inorganic materials from the environment and using an external energy source like the Sun to synthesise complex high-energy organic material.

Q.42 ..... involves the intake of complex material prepared by other organisms.

Q.43 In human beings, the food eaten is broken down by various steps along the ..... and the digested food is absorbed in the ..... to be sent to all cells in the body.

Q.44 During the process of respiration, complex organic compounds such as ..... are broken down to provide energy in the form of ATP.

Q.45 Respiration may be .....or ..... Aerobic respiration makes more energy available to the organism.

Q.46 In human beings, excretory products in the form of soluble nitrogen compounds are removed by the ..... in the kidneys.

True-False Statements –

Q.47 The loss of water vapor by a plant is called transpiration.

Q.48 Translocation is the transportation of the products of photosynthesis.

Q.49 Cytokinins assist in the ripening of fruit.

Q.50 In a general sense, digestion is simply hydrolysis of complex polymers to monomers.

Q.51 A complete digestive tract consists of an oral and an anal opening.

Q.52 In humans, protein digestion is completed in the mouth.

Q.53 Only the multicellular organisms require transporting mechanisms.
Q.54 Humans have an open circulatory system.
Q.55 The exchange of nutrients and waste products between the blood and cells occurs within the arteries.
Q.56 The liquid portion of the blood is called plasma.
Q.57 Living organisms must maintain a constant internal environment.
Q.58 In humans the alveoli are the functioning units of external respiration.
Q.59 Trypsin digests proteins into amino acids.
Q.60 Deficiency of folic acid produces scurvy.
Q.61 Essential amino acids cannot be synthesized in human body.
Q.62 Carbod dioxide cannot be transported with haemoglobin.
Q.63 Fishes respire though the skin.
Q.64 External respiration may be called breathing.
Q.65 The P_{CO_2}, in alveolar air is less than in expired air.
Q.66 The P_{O_2}, in inspired air is more than in alveolar air.
Q.67 Circulatory system also performs the function of homeostasis.
Q.68 Generally gravitational water is utilized by the plants.
Q.69 Transpiration is a necessary evil.
Q.70 Sugars manufactured in the leaf are translocated to storage organs through the xylem in the form of sucrose.
Q.71 Respiration is the only source of energy for all organisms
Q.72 In photosynthesis, carbon dioxide is given out by diffusion process.
Q.73 Stretching of inner wall of guard cells, open the stromata.
Q.74 Arteries are the widest blood vessels.
Q.75 Bowman's capsule is found in heart.
Q.76 Only animals have tissues.
Q.77 The systems in an organism work independently.
Q.78 You can continue living if you lose the use of one of your systems.
Q.79 Some organs are used in more than one system.
Q.80 Blood is not a tissue because it is a fluid.
Q.81 All animals have a system of vessels and tubes called a circulatory system.
Q.82 While there is only one type of red blood cell, there are many white cell types.
Q.83 Some organisms have diseases that prevent them from clotting.
Q.84 Vessels are able to expand and contract.
Q.87 All animals have a mouth and anus.
Q.88 Teeth are the only part of the digestive system that physically breaks down food.
Q.89 Your liver is one of the smaller organs in your body.

EXERCISE - 3

Q.1 The movement of water and dissolved minerals from the roots to the leaves is best explained by
(A) Cohesion-tension theory (B) Translocation
(C) Tensile strength (D) Pressure-flow hypothesis

Q.2 The major function of the small intestine is:
(A) Absorption of minerals (B) Digestion and absorption of nutrients
(C) Absorption of water (D) Production of gastrin

Q.3 The major site of biological action of the human circulatory system occurs in –
(A) The arteries (B) The veins (C) The capillary bed (D) The heart

Q.4 The major function of the animal transport system is –
(A) Movement of nutrients (B) Movement of wastes
(C) Neither A nor B (D) Both A and B

Q.5 The control of heartbeat pattern is due to –
(A) Both internal and external factors (B) Only internal factors
(C) Only external factors (D) Neither internal nor external factors

Q.6 In humans the kidney's excretory function involves –
(A) Filtration (B) Reabsorption (C) Secretion (D) All of these

Q.7 A respiratory surface is usually –
(A) Moist (B) Thin (C) Permeable to gases (D) All of the above

Q.8 The excretory system helps regulate –
(A) Water content (B) Blood volume of the body
(C) pH of the body (D) All of the above

Q.9 Organisms that can both respire and photosynthesize are
(A) very rare (B) producers (C) consumers (D) fungi

Q.10 Digestion is necessary because –
(A) nutrients generally occur in a form that cannot be absorbed by an organism.
(B) nutrients must be converted into an organic form before they can be used.
(C) it allows organisms to chew food more easily. (D) both B and C

Q.11 The rate at which oxygen moves from the alveoli of our lungs into our blood –
(A) depends on the difference in oxygen concentration between the alveoli and the blood.
(B) depends on the color of the alveoli.
(C) depends on the availability of energy to transport gases across the membrane. (D) none of the above

Q.12 Oxygen is transported through the human body –
(A) as a dissolved gas in the blood plasma. (B) bound to hemoglobin molecules in red blood cells.
(C) through intercellular air spaces. (D) by diffusion.

Q.13 In which of the following ways does the circulatory system of animals differ from the vascular system of plants ?
(A) The circulatory system of animals forms loops, whereas the sap of plants does not circulate.
(B) The sap of plants flows through cells, whereas the blood of animals flows through multicellular organs called blood vessels.
(C) The internal transport system of plants can lift fluids to greater heights than the internal transport system of animals. (D) all of the above

Q.14 As the diameter of a vessel increases, the friction drag that must be overcome by the heart –
(A) remains constant. (B) increases. (C) decreases (D) increases and then decreases.

Q.15 Which of the following statements about the flow of sap through phloem is false –
(A) Sap moves through phloem under pressure.
(B) Sap moves through phloem in one direction only: from the roots to the leaves.
(C) Phloem sap moves through the inside of living cells.
(D) Sugars move into phloem sap by active transport.

Q.16 Plants lose water to their environment –
(A) during gas exchange (B) during transport of xylem sap
(C) from the surfaces inside their leaves (D) all of the above

Q.17 Which of the following is not an important function of the vertebrate circulatory system –
(A) transport of nutrients and respiratory gases (B) regulation of body temperature
(C) protection of the body by circulating antibodies
(D) removal of waste products for excretion from the body

Q.18 The sites of exchange of wastes, nutrients, gases, and hormones between the blood and body cells are the
(A) arteries (B) arterioles (C) capillaries (D) veins

Q.19 Which of the following is not a component of plasma
(A) water (B) globulins (C) fibrinogen (D) platelets

Q.20 Lymph most closely resembles which of the following –
(A) blood (B) urine (C) plasma (D) interstitial fluid

Q.21 With which other system do specialized respiratory systems most closely interface in exchanging gases between the cells and the environment –
(A) the skin (B) the excretory system
(C) the circulatory system (D) the muscular system

Q.22 The gas-exchange portion of the human respiratory system is the –
(A) larynx (B) trachea (C) bronchi (D) alveoli

Q.23 How is most of the oxygen transported in the blood –
(A) dissolved in plasma (B) bound to hemoglobin
(C) in the form of CO_2 (D) as bicarbonate

Q.24 Which of the following pairs of respiratory adaptations and animals are not correct –
(A) gills: fish (B) parabronchi: birds (C) lungs: mammals (D) moist skin: snakes

Q.25 An acidic mixture of partially digested food that moves from the stomach into the small intestine is called –
(A) cholecystokinin (B) chyme (C) lymph (D) secretin

Q.26 Humans lack digestive enzymes to attack chitin, a complex polysaccharide in the exoskeleton of lobster and crayfish. We also lack enzymes that degrade –
(A) peptides (B) plant starch (C) cellulose (D) sucrose

Q.27 Which of the following is false –
(A) Urea is more toxic than ammonia. (B) Ammonia is converted to urea in the liver.
(C) Ammonia is produced in body cells.
(D) The fluid collected in Bowman's capsule is called the filtrate.

Q.28 The function of the glomerulus and Bowman's capsule of the nephron is to –
(A) reabsorb water into the blood (B) eliminate ammonia from the body
(C) reabsorb salts and amino acids (D) filter the blood and capture the filtrate

Q.29 Which of the following processes does not occur in nephron and collecting duct –
(A) filtration (B) elimination of urea from the body
(C) reabsorption of nutrients (D) tubular secretion

Q.30 The exchange of gases in human beings takes place in –
(A) in skin (B) in mouth (C) in nostrils (D) in lungs

Q.31 The correct order of air reaching from atmosphere to the lungs is through –
(A) external nares, larynx, trachea and air sac (B) larynx, trachea, air sac and external nares
(C) trachea, air sac, external nares and larynx (D) air sac, trachea, larynx and external nares.

Q.32 The rings in trachea are –
(A) 16 - 20 (B) 18 - 22 (C) 20 - 24 (D) 22 -26

Q.33 Normal blood pressure of human is –
(A) 140/80 (B) 105/70 (C) 120/80 (D) 130/70

Q.34 Veins can be differentiated from arteries because the veins–
(A) have valves (B) have hard walls
(C) have pure blood in them (D) have thick walls

Q.35 The colour of blood in cockroach is –
(A) red (B) blue (C) yellow (D) colourless

Q.36 The life span of red blood cerpuscles in human is –
(A) 80 days (B) 120 days (C) 100 days (D) 90 days

Q.37 The weight of the human heart is –
(A) 100 gms (B) 200 gms (C) 300 gms (D) 400 gms.

Q.38 The catabolic rate in plants, as compared to animal is –
(A) low (B) high (C) equal (D) the process does not take place

Q.39 The metabolic process in plants is dependent on –
(A) proteins (B) fats (C) carbohydrates (D) vitamins

Q.40 Guard cells are found in –
(A) root (B) stem (C) leaf (D) flower

Q.41 Excretion is carried out by nephridia in –
(A) cockroach (B) amoeba (C) earthworm (D) human

Q.42 Malphigian tubules are found in –
(A) amoeba (B) earthworm (C) hydra (D) cockroach

Q.43 Urea is formed in –
(A) Liver (B) Spleen (C) Kidney (D) Lungs

Q.44 The autotrophic mode of nutrition requires :
(A) carbon dioxide and water (B) chlorophyll
(C) sunlight (D) all of the above

Q.45 Most of the photosynthesis (80%) which takes place on this earth is carried out by –
(A) Green plants on land (B) Algae present in fresh water
(C) Algae found in ocean (D) Algae present in ocean and fresh water sources

Q.46 Plants are green in colour because –
(A) They absorb green light only
(B) The reflect green light
(C) The absorb green light but reflect all other lights
(D) None of the above are correct

Q.47 Amongs the following which is a parasitic plant –
(A) Plasmodium (B) Cuscutta (C) Amoeba (D) Rhizobium

Q.48 In amoeba the digestion is intracellular because
(A) Amoeba is unicellular (B) Amoeba is multicellular
(C) Amoeba is found in a pond (D) Amoeba is a microscopic animal

Q.49 Digestion of food in human starts from –
(A) Duodenum (B) Small intestine (C) Mouth (D) Large intestine

Q.50 Which of the following secretions does not contain enzymes
(A) Bile (B) Pancreatic juice (C) Intestinal juice (D) Saliva

Q.51 In amoeba the digestion of food is –
(A) Extracellular (B) Intracellular (C) Intercellular (D) None of the above

Q.52 The wave of contractions that pushes the food through the almientary canal is called –
(A) Peritoneum (B) Peristalsis (C) Stomatisis (D) Polarisation

Q.53 In amoeba absorption of the digested nutrients occur in –
(A) Cytoplasm (B) Plasma membrane (C) Contractile vacuole (D) Pseudopodia

Q.54 Digestion of starch starts from –
(A) Stomach (B) Intestine (C) Oesophagus (D) Mouth

Q.55 Ptyalin enzyme is secreted by –
(A) Salivary gland (B) Mouth (C) Oesophagus (D) Stomach

Q.56 The ultimate cause for the movement of water against a gravity in a tree is –
(A) Osmosis (B) Transpiration (C) Imbibition (D) Photosynthesis

Q.57 The process of transpiration in plants helps in :
(A) Opening of stomata (B) Absorption of CO_2 from atmosphere
(C) Upward conduction of water and minerals (D) Absorption of O_2 from atmosphere.

Q.58 In a closed circulatory system, blood is completely enclosed with in :
(A) Sinuses (B) Vessels (C) Heart (D) Skeleton.

Q.59 The phenomenon of uptake of water at the expense of energy by the cell and usually against the osmotic gradient is known as –
(A) Active absorption (B) Passive absorption
(C) Osmosis (D) Diffusion

Q.60 Root cap has no role in water absorption because –
(A) It has no direct connection with the vascular system
(B) It has no cells containing chloroplasts
(C) It has no root hairs
(D) It has loosely arranged cells.

Q.61 A mature human erythrocyte has the typical characteristic of –
(A) An eukaryotic cell (B) A prokaryotic cell
(C) Both an eukaryotic and a prokaryotic cell (D) Neither eukaroyotic nor prokaryotic

Q.62 In the cardiac cycle, diastole is –
(A) The number of heart beats per minute (B) The relaxation period after contraction of the heart
(C) The forceful pumping action of the heart (D) The contraction period after relaxation of the heart.

Q.63 Blood vessel carrying blood from lung to heart through –
(A) Pulmonary artery (B) Pulmonary vein (C) Coronory artery (D) None of these

Q.64 What is the smallest organizational piece of an organism?
(A) Cell (B) Tissue (C) Organ (D) System

Q.65 What is the most complex organizational grouping in an organism?
(A) Cell (B) Tissue (C) Organ (D) System

Q.66 Which of these choices is not connective tissue?
(A) Collagen (B) Cartilage (C) Bone (D) They are all connective tissues.

Q.67 If you look in your mouth, which systems can you see?
(A) Digestive (B) Respiratory (C) Muscular (D) All of these systems.

Q.68 The most advanced hearts have how many chambers?
(A) 1 (B) 2 (C) 3 (D) 4

Q.69 Vessels that take blood away from the heart to the body are called...
(A) Arteries (B) Veins (C) Capillaries (D) None

Q.70 Vessels that take blood to the heart from the body are called.
(A) Arteries (B) Veins (C) Capillaries (D) None

Q.71 What is the term used when vessels open and let more blood through?
(A) Vasoconstriction (B) Vasodilatation (C) Increased Permeability (D) None of these

Q.72 What are the official terms for the sounds of your heart?
(A) Goo-oog (B) Wish-wash (C) Lub-dup (D) Ugh-rug

Q.73 Dislocation is a disease caused by –
(A) Biological agent (B) Mechanical agent (C) Physical agent (D) Chemical agent

Q.74 Droplet infection is a mode of –
(A) Direct transmission (B) Indirect transmission
(C) Pathogen spread through mosquitoes (D) Formite transmission

Q.75 Animals that only eat plant material for food are...
(A) Carnivores (B) Herbivores (C) Omnivores (D) None of the above

Q.76 Pulse polio programme is organised in our country for –
(A) Curing polio (B) Eradicating polio (C) Spreading polio (D) None of the above

Q.77 Which of these is a part of your digestive system?
(A) Stomach (B) Pancreas (C) Rectum (D) All of the Above

Q.78 A non-infectious unnatural and unusual reaction to a substance or condition is –
(A) Immunity (B) Allergy (C) Infection (D) Toxin

Q.79 Chemical digestion begins in the...
(A) Mouth (B) Stomach (C) Small Intestine (D) None of these

Q.80 What tube is used by both the digestive and respiratory systems ?
(A) Esophagus (B) Larynx (C) Pharynx (D) None of these

Q.81 A person has developed interferon in his body. He seems to carry infection of –
(A) Tetanus (B) Malaria (C) Measles (D) Typhoid

Q.82 Which of these molecules is broken down and digested?
(A) Carbohydrates (B) Lipids (C) Proteins (D) All of the Above

Q.83 Antibodies are –
(A) Lipids (B) Genes (C) Proteins (D) Carbohydrates

Q.84 Most of your feces is made of.
(A) Water (B) Bacteria (C) Fiber (D) None of these

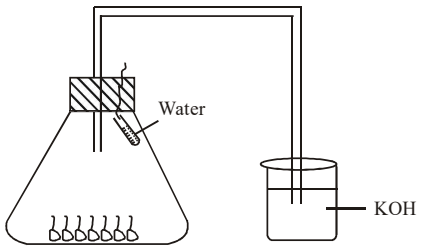
Q.85 The antigen present in pathogen is –
(A) A specific protein involved in metabolism
(B) Polysaccharide synthesized by it in the host
(C) A specific protein or polysaccharide present on its coat
(D) Any of two, A or B

Q.86 Remain healthy means –
(A) Free of infection by pathogen (B) Tension free mental status
(C) Living in pollution free environment (D) All of the above

Q.87 World health day is on –
(A) 1st May (B) 7th April (C) 30th June (D) 5th December

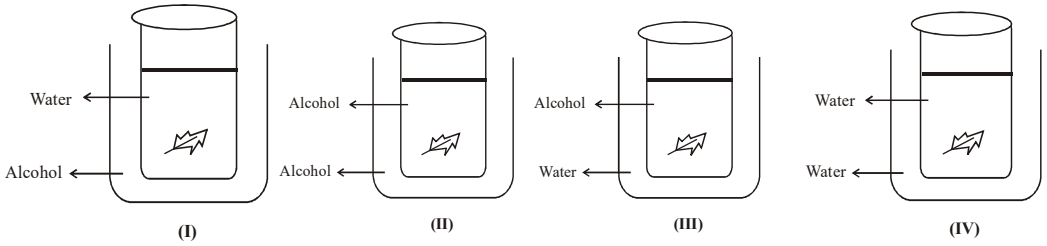
Q.88 Head quarter of World Health Organisation (WHO) is located at –
(A) Newyork (B) Geneva (C) London (D) Paris

Q.89 A student while setting up the experimental to show that CO_2 is evolved during respiration committed some errors shown in figure. What changes should be made in the set up to get the desired results –



(A) KOH solution should be taken in the small test tube inside the flask and germinating seeds in the beaker
(B) Water should be taken in the beaker and KOH solution in the flask.
(C) KOH solution should be taken in the small test tube inside the flask and water should be taken in the beaker
(D) Water should be taken in the flask and KOH solution in the small test tube.

Q.90 The figure given below illustrate boiling of leaf to remove chlorophyll. This is one of the steps in the experiment to show that light is necessary for photosynthesis



The correct methods is –

(A) I (B) II (C) III (D) IV

EXERCISE - 4

MATCH THE COLUMN

Each question contains statements given in two columns which have to be matched.

Statements (A, B, C, D) in **column I** have to be matched with statements (p, q, r, s) in **column II**.

Q.1 Match them correctly.

Column I	**Column II**
(A) Nutrition	(p)The process of obtaining food.
(B) syntheis	(q) Combining small molecules to create larger more complex molecules.
(C) growth	(r) The increase in cell size and/or number
(D) transprot	(s) The momement of materials within the cell or within the organism.

Q.2 Match them correctly.

Column I	**Column II**
(A) regulation	(p) The control and coordination of chemical processes within the organism.
(B) reproduction	(q) Ther replicationof an organism
(C) respiration	(r) The chemical process of oxidizing organic molecules to release energy.
(D) excretion	(s) The removal of metabolic waste from an organism.

Q.3 Match them correctly.

Column I	**Column II**
(A) stomach	(p) The structure is the site where the chemical breakdown of proteins first occurs.
(B) large intestine	(q) This organ absorbs most of the water from the undigested food.
(C) small intestine	(r) This organ is the section of the alimentary canal where most of the food is absorbed into the blood.
(D) liver	(s) This organ secretes the chemical bile, which is used to emulsify fats

Q.4 Match them correctly.

Column I	**Column II**
(A) pancreas	(p) This organ secretes the chemical enzymes of amylase, protease and lipase
(B) rectum	(q) This is a storage site for feces before being egested from the body
(C) esophagus	(r) This tube structure transports food from the oral vacity to the stomach.
(D) oral cavity	(s)The structure where mechanical digestion of food first occurs.

ASSERTION & REASON TYPE

Each question contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 5 choices (A), (B), (C), (D) and (E) out of which ONLY ONE is correct.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is not a correct explanation for Statement-1.
(C) Statement -1 is True, Statement-2 is False.
(D) Statement -1 is False, Statement-2 is True.
(E) Statement -1 is False, Statement-2 is False.

Q.5 **Statement 1 :** Leguminous plants are nitrogen fixers.
Statement 2 : Leguminous plants have Rhizobium in their root nodules.

Q.6 **Statement 1 :** Blood of insects in colourless.
Statement 2 : The blood of insect does not play any role in transport of oxygen.

Q.7 **Statement 1 :** If there is no air in trachea, it will collapse.
Statement 2 : Trachea is having the cartilagenous ring.

Q.8 **Statement 1 :** Blood pressure is arterial blood pressure.
Statement 2 : It is measured by sphynimanometer.

EXERCISE - 5

PREVIOUS YEARS COMPETITION PROBLEMS

Q.1 Which of the following elements is not required by plants for their normal healthy growth –
(A) Calcium (B) Magnesium (C) Lead (D) Iron

Q.2 The transfer of minerals from top soil to sub soil through soil water is called –
(A) Transpiration (B) Conduction (C) Percoloation (D) Leaching

Q.3 The function of tongue is to –
(A) Help in the act of swallowing (B) Help in mixing salive with the food
(C) Help in speaking (D) All the above

Q.4 Stomach in vertebrates is the main site for digestion of –
(A) Proteins (B) Carbohydrates (C) Fats (D) Nucleic acid

Q.5 Water is largely absorbed in –
(A) Stomach (B) Oesophagus (C) Small intestine (D) Colon

Q.6 Enzymes, vitamins and hormones can be classified into a single category of biological chemicals, because all of them
(A) Are proteins (B) Enhance the oxidative metabolism
(C) Aid the regulating mechanism (D) Are synthesised within the body of an organism

Q.7 The contraction of gall bladder is due to –
(A) Gastrin (B) Secretin (C) Cholecystokinin (D) Enterogastrone

Q.8 Starch and cellulose are compounds of many units of–
(A) Amino acids (B) Glycerol (C) Simple sugars (D) Fatty acids

Q.8 In which of the following animals, respiration occurs with out any respiratory organ –
(A) Fish (B) Frog (C) Cockroach (D) Earthworm

Q.10 The exchange of gases (O_2 and CO_2) in a mammal takes place in –
(A) Trachea (B) Brochin (C) Bronchiole (D) Alveoli

Q.11 The exchange of gases in the alveoli of the lungs takes place –
(A) Osmosis (B) Simple diffusion (C) Passive transport (D) Active transport

Q.12 In anaerobic respiration –
(A) Oxygen is taken in (B) Carbon dioxide is taken in
(C) Oxygen is given out (D) Carbon dioxide is given out

Q.13 The blood returning to the heart from lungs via pulmonary vein has more –
(A) RBC per ml of blood (B) Haemoglobin per ml of blood
(C) Oxygen per ml of blood (D) Nutrient per ml of blood

Q.14 The first heart should is –
(A) 'Lubb' sound at the end of systole (B) 'Dub' sound at the end of systole
(C) 'Lubb' sound at the beginning of systole (D) 'Dub' sound at the beginning of systole

Q.15 Nature of valves in the heart is –
(A) Membranous (B) Muscular (C) Tendinous (D) Ligamentous

Q.16 Heart beat can be initiated by –
(A) Sinu-auricular node (B) Atrio-ventricular node
(C) Sodium ion (D) Purkinje's fibres

Q.17 Oxygenated blood is carried by –
(A) Pulmonary vein (B) Pulmonary artery (C) Renal vein (D) Hepatic portal vein

Q.18 Largest heart is found in –
(A) Elephant (B) Giraffe (C) Crocodile (D) Lion

Q.19 Heart beat originates from –
(A) Pacemaker (B) Cardiac muscles (C) Left atrium (D) Right ventricle

Q.20 The circulation of blood was discovered by –
(A) Jagdish Chandra Bose (B) Karl Landstiner
(C) Watson and Crick (D) William Harvey

Q.21 The normal percentage of glucose in the blood of man is 0.1%. It is found in –
(A) Plasma (B) RBC (C) WBC (D) Serum

Q.22 Erygthropoesis may be stimulated by the deficiency of –
(A) Iron (B) Oxygen (C) Protein (D) None of the above

Q.23 The medium of plasma is –
(A) Acidic (B) Basic (C) Neutral (D) None of these

Q.24 In man, the urea is mainly produced in –
(A) Liver (B) Kidneys (C) Gall bladder (D) Spleen

Q.25 Excretion means –
(A) Removal of useless substances and substances present in excess
(B) Formation of those substances which have some role in the body
(C) Removal of such substances which have never been part of the body
(D) All of these

Q.26 The major nitrogenous waste (s) in the respective animals is/are –
(A) Urea and uric acid in cow, frog and lion
(B) Uric acid in parrot, cockroach and garden lizard
(C) Ammonia in elephant, sea horse and shark
(D) Urea in scorpion, earthworm and shark

Q.27 The nephrostomes, in the kidneys are functional in –
(A) Rabbit (B) Adult frog (C) Tadpole (D) Cockroach

Q.28 An advantage of excreting nitrogeneous wastes in the form of uric acid is that –
(A) Uric acid can be excreted in almost solid form
(B) The formation of uric acid requires a great deal of energy
(C) Uric acid is the first metabolic breakdown products of acids
(D) Uric acid may be excreted through the lungs

EXERCISE - 6

PREVIOUS YEARS BOARD QUESTIONS

Q.1 Name the term for transport of food from leaves to other parts of plants.
Q.2 Name the two stages of photosynthesis
Q.3 Name the excretory unit of a kidney.
Q.4 Name the respiratory organs of : (i) fish (ii) mosquito (iii) earthworm.
Q.5 Why is nutrition necessary for an organism ?
Q.6 What is breathing ?
Q.7 Name the type of blood vessels which carry blood from organs to the heart.
Q.8 Name the mode of nutrition in amoeba.
Q.9 Name the respiratory organs of animals like fish that live in water.
Q.10 Name two kinds of cells (elements) of xylem.
Q.11 Write the mode of nutrition in fungi.
Q.12 Name the largest artery in the human body.
Q.13 Name the pigment present in plants which can absorb solar energy.
Q.14 Name the vestigeal part of human alimentary canal.
Q.15 Which organelle in a cell is associated with the production of energy by aerobic respiration ?
Q.16 The first step of photosynthesis is :
(a) Ionisation of water (b) Attachment of CO_2 to 5-carbon sugar.
(c) Excitation of electron of chlorophyll by a photon of light (d) Formation of ATP
Q.17 Pulmonary artery is different from pulmonary vein in having
(a) Large lumen (b) Thick muscular walls (c) No endothelium (d) Valves
Q.18 Haemoglobin is a type of
(a) Carbohydrate (b) Skin pigment (c) Vitamin (d) Respiratory pigment
Q.19 Which of the four chambers of the human heart has the thickest muscular walls ?
Q.20 How does diaphragm help in inspiration ?
Q.21 Write the full form of SA-node. What is its other name ?
Q.22 Why it is said in insects, exchange of gases takes place directly between the outer atmosphere and tissues ?
Q.23 Name the passage that leads bile from liver into the gall bladder.
Q.24 Name the different parts of the large intestine of humans in their natural sequence.
Q.25 Name the structures which help in excretion in
(i) tapeworm and (ii) earthworm
Q.26 What is formed when CO_2 combines with globin of reduced haemoglobin ? Where does it occur ?
Q.27 Why is blood group identification not required while transfusing serum ?
Q.28 The basic functional unit of kidney is
(a) Henle's loop (b) Nephron (c) Nephridium (d) Pyramid
Q.29 State the two vital functions of the human kidney. Name the procedure used in the working of artificial kidney.
Q.30 Point out of differences between an artery and a vein.
Q.31 Name any two autotrophic plants which also show heterotrophic mode of nutrition. Why do they need to do so ?
Q.32 Bring out the differences between internal respiration and external respiration.
Q.33 Name the passage in sequence through which urine passes from kidneys to the outside in humans. How is urine prevented from flowing back into the ureters ?
Q.34 Why is sino-atrial node also called pace maker ?
Q.35 How is the digested fat absorbed in the body ?
Q.36 What is a cardiac cycle ?
Q.37 Name two proteases in pancreatic juice. What are their specific roles ?

Q.38 Draw the diagram of a palisade cell of a plant leaf and label the following in it :
(i) Chloroplast (ii) Vacuole (iii) Cytoplasm (iv) Nucleus

Q.39 (a) Draw diagram of a stomata when it is open.
(b) Label Epidermal cell, Guard cell, Chloroplast and stomatal opening on the diagram drawn.

Q.40 Write the functions of the following in the digestive process :
(i) Bile (ii) Bicarbonate secreted by the duodenal wall. (iii) Pancreatic amylase.

Q.41 Give reasons for the following :
(i) The glottis is guarded by epiglottis. (ii) The lung alveoli are covered with blood capillaries.
(iii) The wall of trachea is supported by cartilage rings.

Q.42 State the role of following in the human respiratory system :
(a) Nasal cavity (b) Diaphragm (c) Alveoli

Q.43 Define the terms 'excretion' and 'osmoregulation'. Name the excretory unit of the following :
(a) Amoeba (b) Earthworm

Q.44 Explain the role of the following in the process of digestion in the human body ?
(a) Saliva (b) Gastric juices (c) Trypsin **Or**
Draw a diagram of the human respiratory system showing larynx, trachea, primary bronchus and lungs.

Q.45 How does blood circulate between lungs and heart in human beings ? Give two function of lymph in human body.

Q.46 Name the constituents of blood. Why are white blood corpuscles called 'soldiers of the body' ?

Q.47 List three points of distinction between aerobic and anaerobic respiration.

Q.48 Name the three kinds of blood vessels of human circulatory system. Write the function of each.

Q.49 Give three points of difference between respiration in plants and respiration in animals.

Q.50 Define 'breathing' Explain the mechanism of breathing in human beings.

Q.51 How do each of the following factors affect the productivity in the process of photosynthesis ?
(i) Temperature (ii) Water (iii) Carbon dioxide

Q.52 What happens to glucose, which enters the nephron along with filtrate during excretion in human being ? State two vital functions of kidney.

Q.53 Explain the process by which inhalation occurs during breathing in human beings.

Q.54 Leaves of a healthy potted plant were coated with vaseline to block the stomata. Will this plant remain healthy for long ? State three reasons for your answer.

Q.55 What is the function of epiglottis in man ? Draw a labelled diagram showing the human respiratory system.

Q.56 Describe the mechanism of blood clotting.

Q.57 Draw a diagram of the front view of human heart and label any six parts including at least two, that are concerned with arterial blood supply to the heart muscles.

Q.58 How does intestinal juice contribute to the digestion of proteins ? What provides an alkaline pH in the small intestine ?

Q.59 Describe the structure and the main digestive function of liver.

Q.60 Draw a labelled diagram of a portion of human alimentary system showing the location of liver, pancreas and gall bladder and their associated ducts.

Q.61 Explain why photosynthesis is considered the most important process in the biosphere.

Q.62 Draw a diagram of the vertical section of human heart to show the internal structure. Label any one of the heart chambers and any other five parts.

Q.63 How does liver serve both as a digestive as well as an excretory organ ?

Q.64 (a) Explain why the rate of photosynthesis in plant is low both of lower and higher temperatures.
(b) Is green light most or least useful in photosynthesis and why ?
(c) Describe an activity to show that chlorophyll is necessary for photosynthesis in plants.

Q.65 (i) Name the blood vessel that brings oxygenated blood to the human heart.
(ii) Which chamber of human heart receives oxygenated blood ?
(iii) Explain how oxygenated blood from this chamber is sent to all parts of the body.

Q.66 (i) Name the blood vessel that brings deoxygenated blood to the human heart.
(ii) Which chamber of the human heart receives deoxygenated blood ?
(iii) Describe how deoxygenated blood from this chamber is sent to lungs for oxygenation.

Q.67 Name the main organs of the human digestive system in the order they participate in the process of digestion. Describe how digestion of carbohydrates and proteins take place in our body.

ANSWER KEY

EXERCISE - 1

(31) Pericardium **(32)** Haemoglobin **(33)** Closed **(36)** Haemoglobin.
(37) General body surface. **(40)** Urea **(46)** Diffusion **(47)** Urea, H^+ and K^+.
(51) Vitamin-A, D, E, K and B_{12} **(60)** 50 ml
(61) Veins 3200 ml, Arteries - 650 ml
(62) Auricular diastole, ventricular diastole and auricular systole
(63) By zinc (Zn) deficiency **(64)** Phosphorus (P) **(65)** Nitrogen and phosphorus
(67) Carbondioxide (CO_2) and water (H_2O) **(74)** Autotrophic and Heterotrophic
(75) (i) CO_2 (ii) water (iii) light (iv) chlorophyll

EXERCISE - 2

(1) stomata **(2)** fungi **(3)** phytochrome **(4)** chyme
(5) insulin, glucagon **(6)** red **(7)** away **(8)** interstitial
(9) negative **(10)** nephron **(11)** proximal
(12) (1) Visceral peritoneum or serosa
(2) Longitudinal (3) Circular (4) Oblique (5) Stomach
(6) Rectum (7) Mucus (8) G-cells (9) Oxyntic cell
(10) Pernicious anaemia
(13) liver **(14)** acidic, alkaline **(15)** 1500 ml. **(16)** Diaphragm
(17) Alveoli **(18)** dyspnoea **(19)** inspiration, forced expiration **(20)** diffusion, wet
(21) epiglottis **(22)** 70 ml. **(23)** Reservoirs **(24)** Dup/Dubb, semilunar
(25) Vasa vasorum **(26)** circulatory system **(27)** closed, lacunae, sinuses **(28)** William Harvey, Halls
(29) urine **(30)** Anti-transpiration **(31)** Photophosphorylation **(32)** heterotrophic
(33) mouth-cavity **(34)** iodine **(35)** anaerobic **(36)** respiration.
(37) guard cells **(38)** impure **(39)** connective **(40)** yellow
(41) Autotrophic nutrition **(42)** Heterotrophic nutrition **(43)** alimentary canal,small intestine
(44) glucose **(45)** aerobic, anaerobic **(46)** nephrons **(47)** True
(48) True **(49)** False **(50)** True **(51)** True
(52) False **(53)** False **(54)** False **(55)** False
(56) True **(57)** True **(58)** True **(59)** False
(60) False **(61)** True **(62)** False **(63)** False
(64) True **(65)** True **(66)** True **(67)** True

(68) False **(69)** True **(70)** False **(71)** False
(72) False **(73)** True **(74)** True **(75)** False
(76) False **(77)** False **(78)** Maybe **(79)** True
(80) False **(81)** False **(82)** True **(83)** True
(84) True **(85)** True **(86)** True **(87)** False
(88) False **(89)** False

EXERCISE - 3											
Q	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
A	A	B	C	D	A	D	D	D	B	A	A
Q	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
A	B	D	C	B	D	D	C	D	D	C	D
Q	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**
A	B	D	B	C	A	D	B	D	A	A	C
Q	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**
A	A	D	B	C	A	C	C	C	D	A	D
Q	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**
A	D	B	B	A	C	A	B	B	C	D	A
Q	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
A	B	C	B	A	C	D	B	B	A	D	D
Q	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**
A	D	D	A	B	B	C	C	A	B	B	D
Q	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**
A	B	A	C	C	D	C	A	C	D	B	B
Q	**89**	**90**									
A	C	C									

EXERCISE - 4

(1) (A) → p (B) → q (C) → r (D) → s **(2)** (A) → p (B) → q (C) → r (D) → s
(3) (A) → p (B) → q (C) → r (D) → s **(4)** (A) → p (B) → q (C) → r (D) → s
(5) (A) **(6)** (B) **(7)** (E) **(8)** (B)

EXERCISE - 5											
Q	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
A	C	D	D	A	D	A	C	C	D	D	B
Q	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
A	D	C	C	A	A	A	A	A	D	A	B
Q	**23**	**24**	**25**	**26**	**27**	**28**					
A	B	A	A	B	C	A					

EXERCISE - 6

(1) Translocation. **(2)** Light reaction and Dark reaction. **(3)** Nephron.
(7) Veins. **(9)** Gills **(10)** Tracheids and vessels **(11)** Saprophytic nutrition.
(12) Aorta. **(13)** Chlorophyll pigment. **(14)** Vermiform appendix. **(15)** Mitochondria.