Holy Faith Presentation School

CLASS: 10TH

SUBJECT: BIOLOGY

SESSION 2024-25

UNIT 1ST

UNIT-1

TOPIC: LIFE PROCESSES.

NUTRITION:

Nutrition is the process of procuring and utilization of food to overcome the requirements of a living being. Food is the fundamental substance which is used by living organisms for obtaining energy and raw material to produce bio-chemicals required for body building, repair, growth, development, and regulation.

The organic and inorganic compounds of food provide energy materials for body building, maintenance, and regulation of metabolism are called as nutrients. The food is distinguished into main three types of energy foods (e.g. carbohydrates, fats) body building foods (e.g. protein, some minerals and carbohydrates) and protective or regulatory foods. (e.g. vitamins and minerals).

IMPORTANCE OF NUTRITION/FOOD:

ENERGY: Food is the main source of energy which is required by the body at every point of time (whether asleep, taking rest or doing work) even if the body is not doing any apparent work. It still consumes energy for the maintenance, biosynthetic activities for replacing materials which are being consumed or degraded by the body.

Further there are number of activities which are continuously consuming energy e.g. circulation of blood which is done by the pumping of heart, breathing movements which inhale oxygen and exhale carbon-dioxide.

BODY STRUCTURE: All body structures and organs are made and maintained by the materials obtained from food.

GROWTH: Nutrients in food are used in building protoplasm. Protoplasm is the main requirements for formation and enlargement of cells that take part in the growth of the organism.

REPAIR: Food provides materials which are required for the replacement and repair of worn out or damaged structures in the body.

REGULATORS: The ingredient in food plays an important role in formation of enzymes and hormones which regulate body metabolism and other body functions.

RESISTANCE: The raw materials which are acquired from food help in the formation of the defense system of the body.

REPRODUCTION: Food provides materials which are required for the formation of reproductive structures.

TYPES OF NUTRITION:

Nutrition is mainly of two types "Autotrophic" and "Heterotrophic" Nutrition

AUTOTROPHIC OR HOLOPHYTIC NUTRITION:

This mode of nutrition is seen in Green plants, protists and bacteria and the organisms or plants which perform such kind of nutrition are known as "autotrophs"

In this mode of nutrition organisms are able to manufacture or build up their own organic food from inorganic raw materials with the help of energy obtained from outside. There are two types of Autotrophic nutrition " chemosynthesis and photosynthesis"

Chemosynthesis: it is a type of autotrophic nutrition in which energy is used for the synthesis of organic food which is obtained by oxidation of substances present in the surrounding environment. E.g. Nirtobacter (nitrifying bacterium) Ferro bacillus (iron bacterium)

PHOTOSYNTHESIS:

It is the process by which plants and other organisms generate carbohydrates and oxygen from carbon dioxide and water using light energy, with the help of chlorophyll.

Photosynthesis is a process by which chlorophyll containing cells in plants (chloroplast) synthesize complex organic food (carbohydrates) from simple in organic substance like carbon dioxide (CO_2) and water (H_2O) in presence of sunlight. CO_2 from atmosphere, H_2O from soil and solar energy from sun are made available to chloroplast to be utilized for the synthesis of food in a process called photosynthesis. **$6\ CO_2 + 12H_2O$---------- $\rightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$.**

Oxygen is liberated in this reaction and simple carbohydrates or sugar (e.g. Glucose) is the main product from which other organic substances are formed and the excess of glucose is stored as starch.

THE MAJOR EVENTS OF PHOTOSYNTHESIS ARE:

* Absorption of solar energy by chlorophyll.

* Conversion of solar energy into chemical energy as well as its utilization in splitting water into hydrogen and oxygen.

* Reduction of carbon dioxide to form carbohydrates and other components or organic food.

Importance of photosynthesis:

The importance of photosynthesis in plants is as follows.

*** Organic food**: All the living creatures on the earth depend on fats, proteins and carbohydrates (basic nutrients of life) to derive their basic source of energy and thus have a direct dependence on the process of photosynthesis for their survival. Photosynthesis is the only process in which their is the formation of organic food from inorganic raw material.

*** Source of Energy**: photosynthesis is therefore a process in which the energy in sunlight is stored in the bounds of glucose for later use. Photosynthesis can therefore be considered the ultimate source of life for nearly all plants and animals by providing the source of energy that drives all their metabolic processes.

*** Carbon-dioxide and oxygen**: the process of photosynthesis and Respiration are inter-related and serve one another, while photosynthesis requires carbon-dioxide and release oxygen to produce glucose. Respiration needs oxygen while inhaling and releases carbon-dioxide while exhaling. The oxygen released (with water vapor, in transpiration) as a photosynthesis byproduct provides most of the atmospheric oxygen vital to respiration in plants and animals, and animals in turn produce carbon-dioxide necessary to plants.

Chloroplast and its pigments:

Chloroplasts are photosynthetic cytoplasmic organelles of green plant cells abundant in leaf mesophyll cells. Chloroplast contains all the requirements needed in photosynthetic process, hence is regarded as " sugar factory" of green plant cells.

Chloroplast is surrounded by double membraned envelop, enclosing within matrix called stroma. With stroma lie embedded numbers of compact structures called grana. All the reactions take place in stroma and grana.

PHOTOSYNTHETIC PIGMENTS

Chloroplast of angiosperms contains two types of pigments:

1) Dominant primary pigments.

2) Traces of accessory pigments.

Two dominant primary chloroplast pigments are chlorophyll-a and chlorophyll-b. Both chlorophyll' s absorb red and blue light of the visible spectrum (VIBGYOR) while as transmit green light. Chlorophyll-a absorbs red light rays more efficiently than blue light rays while as chlorophyll-b absorbs blue light rays more efficiently than red rays.

Traces of accessory pigments include yellow xanthophyll and orange carotenes, the two together are called carotenoids. Accessory pigments also include **chlorophyll** c, d, e and f. accessory pigments absorb light and transfer to primary pigments. A part of the light absorbed by the accessory pigments is lost during transfer, resulting in the fluorescence of the chlorophyll.

PROCESS OF PHOTOSYNTHESIS

Over all process of photosynthesis is reduction of CO_2 to carbohydrates. This reduction needs protons, electrons and energy. Proton and electron donor is water and energy source is sunlight. The electrons and protons donated by water and energy supplied by sun are not directly used for CO_2 reduction but indirectly. Protons and electrons are first accepted by NADP present in chloroplast which gets reduced to $NADPH_2$ called reducing power. Solar energy is trapped by chlorophyll. Part of this solar energy is used for breakdown of water to release protons and electrons. The unutilized solar energy is changed into chemical energy used for phosphorylation of ADP to form energy rich ATP.

Thus in first step of photosynthesis reduced power ($NADPH_2$) and energy rich compound (ATP) is generated which are collectively known as assimilatory power. In the second step of photosynthesis the protons, electrons and energy is used for reduction of CO_2 to carbohydrates.

OVER ALL MECHANISM OF PHOTOSYNTHESIS; LIGHT OR HILL REACTIONS AND DARK OR BLACKMAN' S REACTION

They are also known as the two parts of the photosynthesis:

* Photo synthetically active radiations or "PAR" are 400-700nm. Plants absorb light mostly in violet blue and red parts of visible light and violet blue light carries more energy as compared to red light.

* The primary functions of light in the process of photosynthesis are photolysis of water and excitation of chlorophyll to emit electrons. Photolysis of water produces oxygen, protons and electrons. Electrons and protons (Hydrogen ions) help in producing ATP and $NADPH_2$ popularly called as assimilatory power.

$$2H_2O \xrightarrow[Mn,Ca,Cl]{OEC} o_2+4H^{+}+4e-$$

OEC stands for oxygen evolving complex(called Z complex) having manganese ion , calcium and chlorine.

* The light reaction happens in the grana of chloroplast and converts light energy to chemical energy. This chemical reaction must, therefore, take place in the light. Each of these different– colored pigments can absorb a slightly different color of light and pass its energy to the central chlorophyll molecules to do photosynthesis. The central part of the chemical structure of a chlorophyll molecule is a porphyrin ring, which consists of several fused rings of carbon and nitrogen with a magnesium ion in the centre.

* The energy harvested via the light reaction is stored by forming a chemical called ATP (adenosine triphosphate), a compound used by cells for energy storage. This chemical is made of the nucleotide adenine bonded to a ribose sugar, and that is bonded to three phosphate groups. This molecule is very similar to the building blocks for our DNA.

The dark reaction takes place in the stoma within the chloroplast, and converts CO_2 to sugar. This reaction doesn' t directly need light in order to occur, but it does need the products of the light reaction (ATP and other chemical called NADPH). The dark reaction involves a cycle called the Calvin cycle in which CO_2 and energy from ATP are used to form sugar. Actually, notice that the first product of photosynthesis is a three-carbon compound called glyceraldehyde 3-phosphate. Almost immediately, two of these join to form a glucose molecule.

Ribulose Bisphosphate Carboxylase (RuBP Carboxylase) catalyzes CO_2 fixation:

TOP DEFINITIONS:

* Life process: The vital processes carried out by living organisms in order to maintain and sustain life.

* Nutrition: The process of obtaining and utilizing the nutrients necessary to sustain life.

* Autotrophic nutrition: Nutrition characterized by the ability to use simple inorganic substances for the synthesis of more complex organic compounds, as in green plants and some bacteria.

* Autotrophs: An organism capable of synthesizing its own food from simple inorganic substances, using light or chemical energy.

* Heterotrophic nutrition: A type of nutrition in which energy is derived from the intake and digestion of organic substances, normally plant or animal tissues.

* Heterotrophs: An organism that cannot synthesize its own food and is dependent on complex organic substances for nutrition.

* Photosynthesis: The process by which plants and other organisms generate carbohydrates and oxygen from carbon-dioxide and water using light energy, with the help of chlorophyll.

* Stomata: The minute pores present in the epidermis of a leaf or stem through which the gaseous exchange and transpiration occur.

* Transpiration: The loss of water vapour from the aerial part of the plant.

* Translocation: The transport of soluble products of photosynthesis from leaves or storage organs to other parts of the plant through phloem.

HETEROTROPHIC NUTRITION:

A type of nutrition in which energy is derived from the intake and digestion of organic substances normally plant or animal tissues. The organisms that depend upon outside sources for obtaining nutrients are called as Heterotrophs. As the organic nutrients are complex and insoluble they are first broken down into simple substances with the help of digestive enzymes and this process is called as digestion. Evidently, degree of heterotrophism varies (complete or partial). Such individuals are either parasites or saprophytes. Still some acts as insectivorous plants.

1. Parasites: parasites obtain their nutrition from living plants or animals, which are called hosts. These parasites maintain physical contacts with the host plant through haustoria or suckers. These haustoria penetrate into host tissue and make connections with the conducting elements of host.

Total parasites like Cuscuta and Orobanche are never green, and consequently they have no power to prepare their own food. They get their food supply from the host plant on which they are parasites.

Rafflesia another root parasite, vegetative parts of the plant are highly reduced and represented by cellular filaments resembling fungal mycelium. These mycelium like structures get embedded into host tissue and flowers emerged out. Each flower of Rafflesia weighs about 11 kg in weight with diameter of one diameter are largest in plant kingdom.

Some examples of parasites are:

Total stem parasite: Cuscuta

Partial stem parasite: Lomnthus, Viscum

Total root parasite: Orobanche, Balanophora, Rafflesia

Partial root parasite: Santalum, Striga, Thesium

Parasites can be further classified into obligate parasites and facultative parasites .obligate parasites can live only on living hosts and facultative parasite have the facility to live as saprophytes besides being parasites.

2. Saprophytes: Saprophytes get their nutrition from dead and rotting organic matter. Many bacteria, fungi such as Agaricus, show saprophytic mode of nutrition. Neottia and Monotropa are the examples of flowering plants, which act as saprophytes. In such cases roots of plant constitute a mycorrhizal association with fungal hyphae, which help in absorption. Neottia (bird' s nest orchid) and Monotropa (Indian pipe) grow in forest soil which is rich in humus formed from the fallen leaves. In pteridophytes Botrychium and some species of Lycopodium are partial or complete saprophytes parasites, as long as no living organism is available.

3. Holozoic nutrition: It is a mode of heterotrophic reaction which involves intake of solid pieces of food. Since solid food is taken in. Holozoic nutrition is also called ingestive nutrition. Holozoic nutrition is found in animals and protozoan protists. Their food may consist of another animal plant or its parts.

Depending upon the sources of food, holozoic organisms are of three types.

(i) Herbivores: They are holozoic organisms which feed on plants or plant parts e.g. Cow, buffalo, deer, goat, Rabbit.

(ii) Carnivores: They are animals which feed on other animals carnivores are also called as predators as they hunt kill and feed on their preys e.g. Lion, Tiger, leopard, snake e.t.c

(iii) Omnivores: They are holozoic organisms which feed on both plants and animals e.g. Ant, Pig, Rat, Humans.

STEPS IN HOLOZOIC NUTRITION:

There are five steps in holozoic nutrition which are as follows:

1) Ingestion.

2) Digestion.

3) Absorption.

4) Assimilation.

5) Egestion.

1) Ingestion: It is taking in of solid food with the help of temporary or permanent mouth. " The intake of food inside the body is termed as ingestion" . Thus ingestion may be defined as a process by which the organisms take food.

In amoeba the intake of food may occur at any point of the body surface but usually it occurs at the advancing end after the intake of the food it moves directly into a special cell organelle called food vacuole.

In hydra the food is ingested through the mouth (on hypstome by means of tentacles).

The vertebrates like frog, birds and mammals posses well developed devices or organs which help them in ingestion.

2) Digestion: "The conversion of complex insoluble food ingredients which are ingested into simple absorbable form is called digestion." The digestion process has two components physical and chemical. During the physical process the ingested food is broken down into finer particles through chewing and grinding by teeth and churning by stomach.

In the unicellular organisms like amoeba the enzymes secreted by the cell cytoplasm act upon the food in small food vacuoles which is then digested this type of digestion is called as "intracellular digestion".

In multicellular organisms the food passes through a food pipe known as the alimentary canal several enzymes act upon the food and help in digestion and the digestion in this case takes place outside the cell and hence is known as "extra cellular digestion".

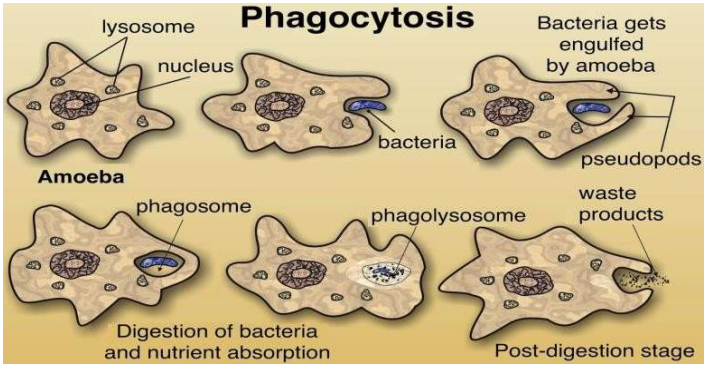
3) Absorption: Absorption is the diffusion of the digestive food by the living parts of the organisms. The digested food is absorbed from the digestive tract and transported to all body parts. It is picked up by all the living cells.

In amoeba the digested food is absorbed into the cytoplasm by passing through the membrane of the food vacuole. During the absorption the food vacuoles undergo decrease in size until only undigested matter is left them.

In higher organisms the digested food is absorbed in the small intestine through the intestinal wall having finger like projections known as villi.

4) Assimilation: It is conversion of absorbed food into protoplasmic constituents for repair, growth and storage. Assimilation is an anabolic process and it takes place in synthesis of proteins, polysaccharides and other macromolecules.

5) Egestion: Egestion is the process by which the undigested part of the food is thrown out of the body. The whole of ingested food is seldom digested the undigested components of food are thrown out of the body as faecal matter.



NUTRITION IN HUMAN BEINGS "OR" DIGESTIVE SYSTEM IN HUMAN BEINGS:

Human beings are omnivorous in nutrition. Like other multicellular animals humans have a digestive system for nutrition.

" Digestive system is a group of organs and associated digestive glands that take part in ingestion of food it' s crushing, digestion, absorption of digested materials and Egestion of indigestible matter".

The digestive organs form a continuous canal called alimentary canal it contains a number of digestive glands of its own three types of external glands also pour their secretion into alimentary canal and these glands are salivary glands, liver and pancreas.

Alimentary canal is a tubular passage extending from mouth to anus through which food passes during its digestion and absorption. It is about 9 meters in length. Alimentary canal consists of mouth, buccal cavity, oesophagus, stomach, small intestines, large intestine and anus.

DIGESTION OF FOOD IN HUMAN-BEINGS:

Digestion of food in mouth: After human being ingests food it is chewed inside the mouth by the grinding movements of the lower jaw during which saliva from the three pairs of salivary glands (parotid, sub-maxillary and sub-lingual) mixes with the food. Saliva makes the food soft and slippery for easy crushing.

Saliva contains an enzyme salivary amylase (ptyalin) which changes starch and glycogen of cooked food into sweet sugar called maltose.

The food is then swallowed and pushed down into the stomach through oesophagus. About 30-35% carbohydrate digestion takes place in mouth. Saliva does not contain any protein digesting enzyme.

Digestion in stomach: when the food is passed through the oesophagus and reaches stomach the food makes the gastric glands to secrete gastric juice. This gastric juice contains HCl (PH 1.5-2.5), and enzymes like pepsin gastric lipase and rennin (chymosin).

In the presence of dilute hydrochloric acid secreted by stomach the pepsin breaks down the proteins into simpler molecules called peptides. In the stomach the food takes the form of soup, which passes into small intestines through the duodenum. The food is stored for 4-5 hrs in stomach and only protein digestion takes place here.

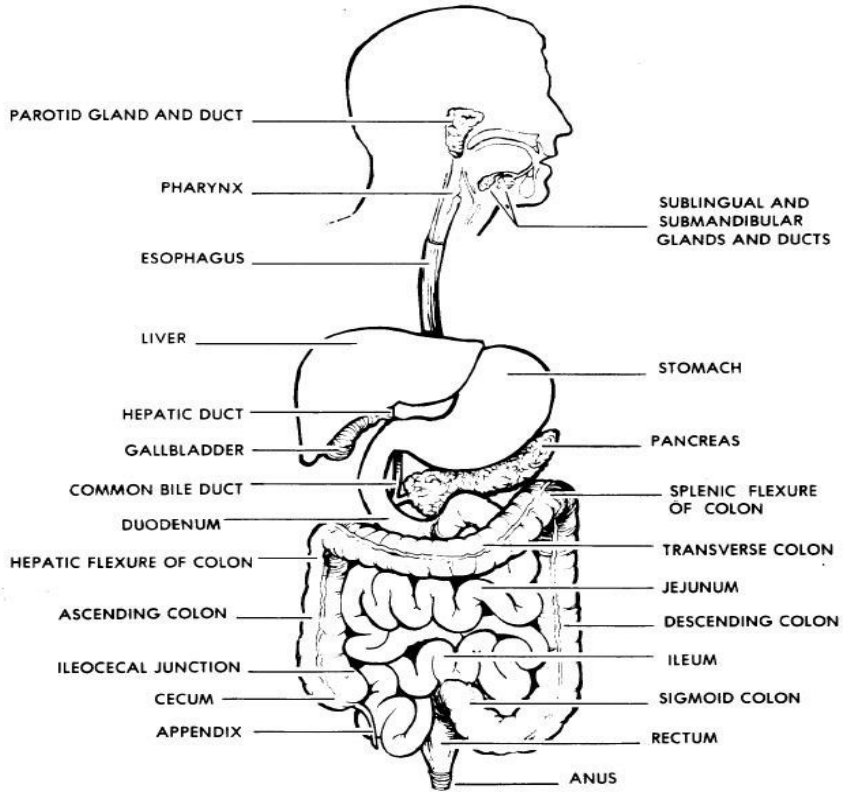
Digestion in small intestines: Duodenum is a U-shaped proximal part of small intestines which received partially digested acidified food from stomach this food here is mixed with the bile secreted by the liver (largest gland in our body) and pancreatic juice secreted by pancreas (second largest gland) and both of these juices enter duodenum through a duct named as hepatopancreatic duct. The pancreatic juice contains enzymes like Trypsin, amylase, lipase which change the proteins into peptides and amino acids.

Trypsin is a proteolytic enzyme which functions in alkaline medium. Amylase acts the remaining starch and converts into sugar and lipase converts fats into soluble fatty acids and glycerol. In small intestines protein, carbohydrate as well as fat digestion takes place.

Small intestine is the seat of major digestion and absorption as it receives secretions of pancreas and liver and possesses a number of intestinal glands.

Role of villi in digestion: Intestinal walls are made up of numerous folds having finger like projections called villi. All the food which is digested in mouth stomach and duodenum is ultimately absorbed by the cells of villi by simple diffusion.

Villi greatly increase the absorptive surface of intestine and have a rich supply of blood capillaries. This absorbed food is sent through blood to different parts of the body.



DIFFERENT ENZYMES INVOLVED IN DIGESTION AND THEIR FUNCTIONS:

In the mouth saliva is secreted by salivary glands which contain ptyalin (salivary amylase) and acts upon the starch and changes it into maltose.

In the stomach gastric juice and hydrochloric acid is secreted by the stomach lining which contains pepsin and acts upon proteins and converts them into proteoses and peptones.

In the duodenum pancreatic juice which is secreted by pancreas and this pancreatic juice contains pancreatic amylase Trypsin, lipase and they act upon starch, proteins and emulsified fats and converts them into maltose, peptones and proteoses, peptides, amino acids, fatty acids and glycerol.

In the ileum intestinal juice is secreted by intestinal glands which are called as succus entericus which contains peptides, maltase, sucrose and lactase and act upon proteins, glucose, fructose and galactose.

METABOLISM:

This process involves a set of chemical reactions that modifies a molecule into another for storage, or for immediate use in another reaction or as a by product.

The chemical reactions occurring in living organisms are called bio chemical reactions and are of two basic types.

One is the breakdown of complex molecules into simpler ones and is called catabolism. (This reaction is destructive and gives out energy mainly in the form of heat and is called as exergonic reaction) e.g. Digestion, respiration etc.

The other is the synthesis of complex molecules from simpler ones and is called as anabolism (it is a constructive process and requires energy and so is called on and as ergonic reactions) e.g. photosynthesis, protein synthesis etc.

Together the two namely anabolism and catabolism are called as metabolism .living organism tend to group if anabolic rate is higher than the catabolic rate.

RESPIRATION:

" The cellular metabolic process by which oxygen is taken in, substances are oxidized energy is released and carbon dioxide and oxidized products are given off.

The act of inhaling and exhaling air in order to exchange oxygen and carbon dioxide is called breathing and ventilation.

" It is a multi step enzyme mediated bio-chemical process of oxidative break down of organic compounds inside living cells releasing packets of energy at various steps" .

All living being require energy for various biological activities like growth, movements, digestion, excretion etc. This energy is made available by a process called respiration. During respiration energy rich food stuffs break down into simpler substances like co_2 and water by oxidation and thus release energy. The organic compounds that undergo oxidative breakdown in respiration are called respiratory substrates. Respiration is an intracellular process that occurs inside all living cells. It may thus be referred to as biological oxidation or cellular respiration. The energy released during respiration is conserved in specific compounds which can be stored or released when required. One such substance which is common to all organisms is adenosine triphosphate or ATP.

This ATP behaves as the universal intra-cellular carriers of chemical energy. Usually organic substance used as a substance or oxidation during respiration is a simple sugar like glucose and other carbohydrates, fats, amino-acids and proteins. Respiration may be thought opposite of photosynthesis because photosynthesis is anabolic while respiration is a catabolic.

Sachs (1890) discovered that respiration can occur with or without oxygen. Therefore there are two types of respiration aerobic and an-aerobic.

Thus total process of cellular respiration or oxidation and break down of glucose take place into two steps.

1) Anaerobic Respiration: This step of respiration happens in the absence of oxygen and in which at least one end product is organic (ethanol or lactic acid). This kind of respiration is usually seen in many lower organisms. E.g. certain bacteria, yeast. In human body it occurs regularly in red blood cells and during heavy exercise in muscles (striated muscles). Anaerobic respiration occurs entirely in the cytoplasm. Anaerobic respiration has two steps. The first step is glycolysis in which one molecule of 6- carbon glucose is degraded into two molecules of 3-carbon compounds called pyruvic acid. Glycolysis yields little energy (only 2 ATP molecules) and requires many enzymes.

2) Aerobic Respiration: This is the second step of respiration which takes place in the presence of oxygen inside mitochondria and is therefore called aerobic (in air) respiration. In this respiration there is a complete oxidative break down of respiratory substrate into carbon-dioxide and water with the help of oxygen acting as a terminal oxidant. Aerobic respiration is the usual mode of respiration in or higher organisms and most of the lower organisms. Aerobic respiration yields maximum amount of energy.

$C_6H_{12}O_6 + 6O_2$ -------→ $6CO_2 + 6H_2O$ + 2870 KJ or 686 Kcal.

The energy is stored in some 38 molecules of ATP. Aerobic respiration occurs in two steps glycolysis and Krebs cycle.

IMPORTANCE OF RESPIRATION:

* Respiration is mandatory for every organism as no organism can survive without respiring continuously or at a constant rate. It is because respiration liberates energy and energy is needed for every life process.

* The part of the energy released in the process of respiration is liberated as heat. This heat helps in maintaining body temperature. Excess of heat is passed out from the surface of the body by sweat and in exhaled heat.

* Most of the volatile waste products and co_2 are passed out from the body during exhalation.

* Regular exhalation of CO_2 maintains the acid base balance of the body.

* Respiration produces a number of intermediates that form different bio-chemicals of the body.

* Respiration maintains flow of venous blood and lymph by respiratory movements of abdomen and thorax.

* Respiration involves carrying of oxygen to the cells and taking out carbon-dioxide from the same.

Difference between respiration and combustion:

RESPIRATION	COMBUSTION
(i) It takes place in living cells only. (ii) It is carried out with the help of enzymes. (iii) The oxidation of food and the liberation of energy occur in a step-wise manner. (iv) It occurs at the body temperature of the organism. (v) 60% of energy escapes as body heat and 40% of energy is packaged directly into new chemical energy (ATP). (vi) Temperature does not rise above 40^0 C. (vii) Several intermediates are produced. (viii) It is multi step reaction.	(i) It does not take place in the living cell. (ii) Enzymes are not involved in this process. (iii) The substances are oxidized spontaneously with sudden release of energy. (iv) Sudden release of energy generates high temperature of a fire. (v) Energy released in combustion is dissipated as heat and to some extent as light. (vi) Combustion produces temperature of 600-2000^0 C. (vii) No intermediates are produced. (viii) It is a single step reaction.

Difference between respiration and photosynthesis:

Photosynthesis	Respiration
(i) It is an anabolic process. $6CO_2 + 12H_2O$------ → $C_6H_{12}O_6 + 6O_2 + 6H_2O$. (ii) CO_2 and H_2O are used for synthesizing carbohydrate molecule. (iii) CO_2 is taken in and O_2 is given out. (iv) It takes place in presence of light. (v) It takes place in chloroplast. (vi) Solar energy is stored in the covalent bonds of organic molecules. (vii) It results in an increase in dry mass.	(i) It is a catabolic process $C_6H_{12}O_6+6O_2$-------→$6CO_2 + 6H_2O$ + 283KJ energy. (ii) CO_2 and H_2O are released during break down of carbohydrate molecules. (iii) O_2 is taken in and CO_2 is given out. (iv) It takes place continuously throughout the life. (v) It takes place in mitochondria. (vi) Bond energy in form of ATP released. (vii) It results in a decrease in dry mass.

(viii) In photosynthesis the raw material required are carbon-dioxide and water. ix) The end products are glucose oxygen and other organic substances.	(viii) The raw materials required are glucose and oxygen. (ix) The end products are carbon and water.

BREATHING:

Breathing is a physical process of bringing in of fresh air obtaining oxygen and taking out of foul air elimination of carbon dioxide .The surface where exchange of gases occurs is called respiratory surface. The organ having respiratory surface is called as respiratory organ e.g. lungs in human beings, gills in fish as skin in earthworm, trachea in insects.

The respiratory organs have three common features

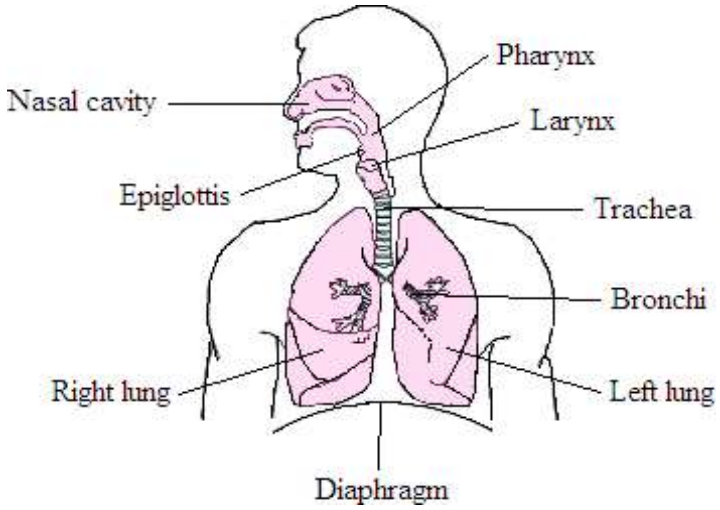
1) Large surface area.

2) Thin permeable membrane

3) Abundant blood supply

In addition to the respiratory organ there are additional structures associated to help them perform their functions e.g. diaphragm, muscles, rib cage, nasal chambers etc. All the organs connected bringing in of fresh air to respiratory surface and expulsion of foul air from the body constitute respiratory system.

RESPIRATION IN HUMAN BEINGS:



In thermodynamics point of view respiration is a process in which energy is released and whereas physiochemical point of view respiration is oxidation of food material during which energy is released.

In human physiology, respiration is the transport of oxygen from the clean air to the tissue cells and transport of co2 in the opposite direction. This is only part of the process of deliver oxygen to where it is needed in human body and removing co2 waste. Not all of oxygen breathed in is replaced by CO_2, around 15% to 18% of what we

breathe out is oxygen the exact amount of exhaled O_2 and CO_2 varies according to the fitness, energy expenditure and diet of that particular person.

The human respiratory system consists of a complex set of organs and tissues that capture oxygen from the environment and transport the oxygen into the lungs. The organs and tissues that comprise human respiratory system include the nose and pharynx, the trachea and the lungs.

NOSE AND PHARYNX

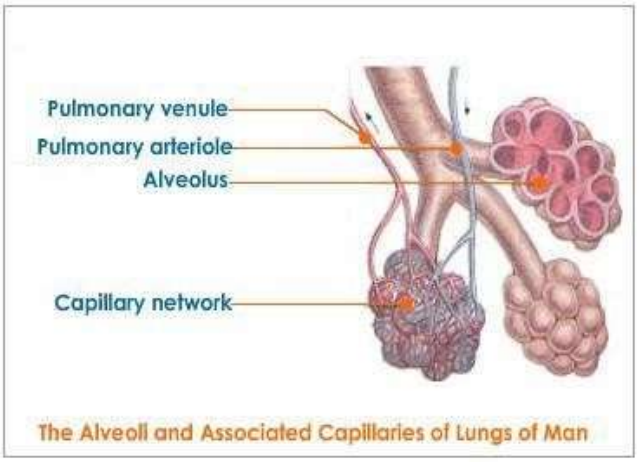
The respiratory system of humans begins with the nose, where air is conditioned by a warming and moistening. Bone partition separates the nasal cavity chambers, where air swirls about in currents. Hairs and hair like cilia trap dust particles and purify the air. The nasal chambers open into a cavity at the rear of the mouth called the pharynx (throat). From the pharynx, two tubes called Eustachian tubes open to the middle air to equalize air pressure there. The pharynx also contains tonsils and adenoids, which are pockets of lymphatic tissue use to trap and filter micro-organisms.

TRACHEA

After passing through the pharynx, air passes into the wind pipe or trachea .The trachea has a frame work of smooth muscles with about 16 to 20 open rings of cartilage shaped like c.

These rings give rigidity to the trachea and ensure that it remains open. The opening to the trachea is a slit like structure called the glottis. A thin flap of tissue called the epiglottis folds overt the opening during swallowing and prevents food from entering the trachea. At the upper end of the trachea, several folds of cartilage form the larynx, or voice box. In the larynx, flap like pairs of tissue called vocal cords vibrate when a person exhales and produce sounds.

At its lower end, the trachea branches into two large bronchi (singular, bronchus). These tubes also have smooth muscles and cartilage rings. The bronchi branch into smaller bronchioles, forming a bronchial "tree". The bronchioles terminate in the air sacs known as alveoli or alveolar sacs.



The Alveoli and Associated Capillaries of Lungs of Man

LUNGS

Human lungs are composed of approximately 300 million alveoli, which are cup –shaped sacs surrounded by a capillary network. Red blood cells pass through the capillaries in single file, and O_2 from each alveolus enters the red blood cells and binds to the hemoglobin in addition, CO_2 contained in the plasma and red blood cells leaves the capillaries and enters the alveoli when a breath is taken. Most CO_2 reaches the alveoli as bicarbonates ions, and about 25 % of it is bound loosely to hemoglobin

During inhalation the rib muscles and diaphragm contract, thereby increasing the volume of the chest cavity. This increases leads to reduced air pressure in the chest cavity, and air rushes into the alveoli, forcing them to expand and fill. The lungs passively obtained air from the environment by this process. During exhalation, the rib muscles and diaphragm relax, the chest cavity area diminishes, and the internal air pressure increases. The compressed air forces the alveoli to close and air flows out.

The nerve activity that controls breathing arises from impulse transported by nerve fibers passing into the chest cavity and terminating at the rib muscles and diaphragm. These impulses are regulated by the amount of CO_2 in the blood. A high CO_2 concentration leads to an increased number of nerve impulses and a higher breathing rate.

In air –breathing vertebrates such as humans, respiration of O_2 includes four stages:

1) VENTILATION, moving of the ambient air into and out of the alveoli of the lungs.

2) PULMONARY GAS EXCHANGE, exchange of gases between the alveoli and the pulmonary capillaries.

3) GAS TRANSPORT, movement of gases within the pulmonary capillaries through the circulation to the peripheral capillaries in the organs, and then a movement of gases back to the lungs along the same circulatory route.

4) PERIPHERAL GAS EXCHANGE, exchange of gases between the tissue capillaries and the tissues or organs, impacting the cells composing these and mitochondria within the cells

Note that ventilation and gas transport require energy to power a mechanical pump (heart) and the muscles of respiration, mainly the diaphragm .in heavy breathing, energy is also required to power additional respiratory muscles such as the intercostal muscles .the energy requirement for ventilation and gas transport is contrast to the passive diffusion taking place in the gas exchange steps.

Respiratory behavior is correlated to the cardiovascular behavior to control the gaseous exchange between cells and blood. Both behaviors are intensified by exercise of the body however; respiratory is voluntary compared to cardiovascular activity which is involuntary.

DIFFUSION:

Diffusion is a main way by which transport of material occurs in unicellular organisms (such as algae, amoeba, euglena and paramecium) and also in some multicellular ones such as sponges and hydria. Diffusion is the movement of molecules from a region of high concentration to one of lower concentration leading finally to uniform concentration. it is faster in gaseous phase than in liquids and in the co_2 is used up in the cytoplasm and fixed as carbohydrates. The fall in co_2 concentration inside the cell creates a diffusion gradient between the air and the intercellular spaces as a result co_2 diffuses into the cells from the atmosphere .on the other hand the oxygen gas produced during photosynthesis sets up an O_2 gradient in opposite direction than of co_2. Therefore O_2 diffuses out of the cell into the air. Since diffusion can occur in all directions therefore the larger the area available so plant leaves having a larger surface area have great advantage in diffusion process.

TRANSPPIRATION AND TRANSLOCATION:

The terrestrial plants absorb water and soluble minerals salts from the soil mostly by root hairs of the roots. They absorb water from soil by the process of osmosis but take in mineral salts by diffusion the water along with its dissolved mineral, that is absorbed by roots is conducted upward movement of sap that contains water and minerals is called ascent of sap and it takes place through xylem vessels.

The transport of water and dissolved sugar and mineral salts in a higher plant takes place by two methods:

3) Transpiration: Most plants absorb a large amount of water from the soil but retain a very small portion of it for their vital activities the greater part of it is lost from their surface into the atmosphere. The loss of water vapour from the living plants is called transpiration. Water may be transpired directly through the cuticle which is a waxy layer covering the leaf surface (cuticular transpiration) through stomata (stomata transpiration) through the ventricles (ventricular transpiration).

4) Translocation: In plants and mineral nutrients are absorbed by the roots and then carries to the stem and the leaves for utilization. Leaves synthesize food which is conducted, to other parts of the plants utilization is known as translocation. Xylem carries the water and mineral nutrients absorbed by the roots whereas phloem carries food materials from the leaves.

TRANSPORTATION OR CIRCULATION:

Transportation is the movements of materials from one part to another, usually from the region of their availability to the region of their use, storage or elimination. Transportation occurs in all organisms from microscopic ones to large sized trees and animals.

Living things must be capable of transporting nutrients, wastes and gases to and from cells. Single-celled organisms use their cell surface as a point of exchange with the outside environment. Multicellular organisms have well developed transport and circulatory systems to deliver oxygen and food to cells and remove carbon dioxide and metabolic wastes. Sponges are the simplest organisms, yet even they have a transport system. Seawater is the medium of transport and is propelled in and out of the sponge by ciliary action. Simple animals, such as the hydra and planarians, lack specialized organs such as hearts and blood vessels, instead using their skin as an exchange point for materials. This however, limits the size an animal can attain. To become larger, they need specialized organs and organ systems.

Multicellular animals do not have most of their cells in contact with the external environment and so have well developed circulatory systems to transport nutrients, oxygen, carbon dioxide and metabolic wastes. Components of the circulatory system include:

1) Blood: a connective tissue of liquid plasma and cells.

2) Heart: a muscular pump to move the blood.

3) Blood vessels: arteries, capillaries and veins that deliver blood to all tissues.

THE FUNCTIONS OF TRANSPORTION OR CIRCULATION:

After the food has been ingested by animals or produced in the leaves of the plants. Food has to be transported to every living cell of the body for maintenance of protoplasmic structures and liberation of energy. And excess of food is taken to storage organs.

1) Oxygen and carbon dioxide are two metabolic gases. Oxygen is required by every cell for cellular surfaces in lungs and then this oxygen is transported to each and every cell by blood and also the waste products formed during cellular respiration are also carried by blood for elimination.

2) Toxic waste products are formed during metabolism and it is necessary that these toxic waste products need to be excreted. To make this possible these waste products are initially taken to the kidneys for separation or filtration and after separation are transported to urinary bladder for storage and from there to the organ for elimination.

3) Plants absorb water from soil with the help of roots and it is then transported to all parts through the vascular system.

4) Hormones are formed in a particular region of a body and from there reach to the other parts of body through the blood.

TRANSPORTATION IN HUMAN BEINGS:

Transportation in human beings is carried out by the circulatory system and the circulatory system consists of tubes (veins, capillaries, arteries) a pumping heart and circulatory fluids blood and lymph and depending upon the fluid, the circulatory system is of two types, blood vascular system and lymphatic system.

BLOOD: The blood consists of a suspension of special cells in liquid called **plasma**. In an adult the blood is about $1/12^{th}$ of the body weight and this corresponds to 5-6ltr. Blood consists of 55% plasma and 45% by cells called **formed elements**. The blood performs a lot of important functions. By means of the hemoglobin contained in the erythrocytes, it carries oxygen to the tissues and collects the carbon-dioxide (CO_2). It also conveys nutritive substances (e.g. amino acids, sugar, mineral salts) and gathers the excreted material which will be eliminated through the renal filter. The blood also carries hormones, enzymes and vitamins. It performs the defense of the organisms by mean of the phagocytic activity of the leukocytes, the bactericidal power of the serum and the immune response of which they lymphocytes are the protagonists.

PLASMA: Cells free serum or plasma can be obtained by centrifugation. The plasma is a slightly alkaline fluid, with a typical yellowish color. It consists of 90% water and 10% dry matter. Nine parts of it are made up of organic substances, whereas one part is made up of minerals. The organic substances are composed of glycosides (glucose), lipids (cholesterol, triglycerides, phospholipids, lecithin and fats), proteins (globulins, albumins, and fibrinogen), glycoprotein, hormones (gonadotropins, erythropoietin, and thrombopoietin), amino acids and vitamins. The mineral substances are dissolved in ionic form that is dissociated into positive and negative ions.

BLOOD CORPUSCLES:

They are also called formed elements. Blood corpuscles constitute 45% of the blood. They are of three types Red blood corpuscles, white blood corpuscles and blood platelets. All of them are synthesized inside red bone marrow.

RED BLOOD CORPUSCLES (RBC' S ERYTHROCYTES): Erythrocytes are the most numerous blood cells i.e. about 4-6 millions/mm^3. They are also called red cells. In man and in all mammals, erythrocytes are devoid of a nucleus and have shape of a bi-concave lens. In the other vertebrates (e.g. fishes, amphibians, reptilians and birds), they have a nucleus. The red cells are rich in hemoglobin, a protein able to bind in a faint manner to oxygen. Hence, these cells are responsible for providing oxygen to tissues and partly for recovering carbon-dioxide produce as waste. However, most CO_2 is carried by plasma, in the form of soluble carbonates.

The mean life of erythrocytes is about 100-120 day. When they come to the end of their life, they are retained by the spleen where they are phagocyted by macrophages.

The process of destruction of RBC' S is called "heamolysis". Spleen also stores a large number of fresh RBC' S for meeting any emergency it is therefore known as blood bank of the body.

WHITE BLOOD CORPUSCLES (WBC' s, LEUCOCYTES):

They are colorless nucleated blood corpuscles of different shapes and size. The density of the leukocytes in the blood is 5000-7000/mm^3. The life span of WBC' s is 12 hours to several(10) days. WBC' s are of two types' granulocytes and Agranulocytes.

Granulocytes possess large size granules in their cytoplasm and the nucleus is lobulated and depending upon their reaction granulocytes are of three subtypes known as basophils, eosinophils, (acidophils) and neutrophils.

Agranulocytes are devoid of granules and the nucleus in them is not lobulated (single lobe) and they are of two subtype "monocytes" and " lymphocytes" WBC' S are either phagocytes or immunocytes. Phagocytes ingest germs and immunocytes secrete antibodies against foreign bodies. It is the basis for immunity against various pathogens.

BLOOD PLATELETS:

The main function of platelets, or thrombocytes, is to stop the loss of blood from wounds (hematostasis). To this purpose, they aggregate and release factor which promote the blood coagulation. Among them, there are the serotonins which reduce the diameter of lesioned vessels and slow down the hematic flux, the fibrin which trap cells and forms the clotting. Even if platelets appear roundish in shape, they are not real cells. Their diameter is 2-3 about; hence they are much smaller than erythrocytes. Their density in the blood is 200000-300000/mm^3

FUNCTIONS OF BLOOD:

Transports:

1) Dissolved gases (e.g. oxygen, carbon dioxide);
2) Waste products of metabolism (e.g. water, urea); hormones;
3) Enzymes;
4) Nutrients (such as glucose, amino acids, micro-nutrients (vitamins and minerals), fatty acids, glycerol);
5) Plasma proteins (associated with defence, such as blood-clotting and anti-bodies);

6) Blood cells (include white blood cells ' leucocytes' , and red blood cells ' erythrocytes').

7) Maintains body temperature.

8) Controls pH of blood must remain in the range 6.8 to 7.4; otherwise it begins to damage cells.

9) Remove toxins from the body: the kidneys filter all of the blood in the body (approx. 8 points), 36 times every 24 hours. Toxins removed from the blood by the kidneys leave the body in the urine. (Toxins also leave the body in the form of sweat).

10) Regulation of body fluid electrolytes: Excess salt is removed from the body in urine, which may contain around 10g salts per day (such as in the cases of people on western diets containing more salt than the body requires.

Functions of plasma:

1) Plasma helps in transportation of various chemicals, hormones, ions etc.

2) Plasma provides body immunities through immunoglobulin.

3) It helps in retention of fluid in the blood.

4) It helps in maintenance of blood pH5. It helps in uniform distribution of heat all over the body.

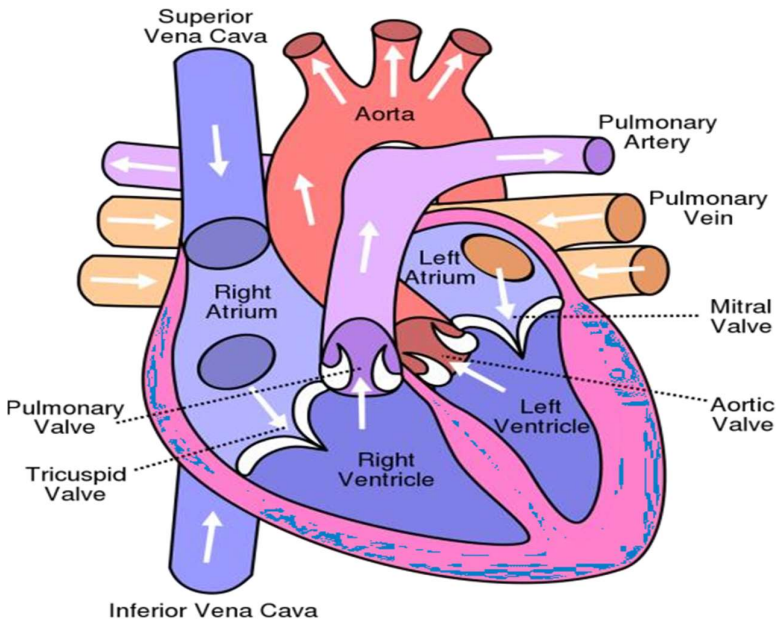
5) It conducts heat to skin for dissipation.

FUNCTIONS OF HEART:

The heart is a muscular pumping organ that circulates blood throughout the body by its pumping action. It is divided into four chambers. The right Auricle and left Auricle and right Ventricle and left Ventricle. The right and left side of heart are separated and do not communicate. The upper chamber the auricles, which are relatively thin walled receive blood from veins. Oxygenated blood from the lungs enters the left auricle from pulmonary veins and deoxygenated from the body enters the right auricle relaxodion of the ventricular muscle allow the lower chambers, the ventricles to expand and fill with blood which flows in from veins about 0.1ml per second and later both ventricles contrast simultaneously expelling their blood into the arteries. Both ventricles have thick muscular walls but those of left are thicker as they have to pump blood all around the body. The right ventricles pump blood to the lungs through the pulmonary arteries. Powerful contraction of the ventricles forces the blood into the aorta and pulmonary arteries. When the ventricles relax the packet like semi lunar valves in these two arteries are closed and prevent the return of blood into the ventricles. The heart contracts about 72 times a minute when an adult person at rest but the heart rate increases to 100 or more during activity or excitement. The total volume of blood in the system is about 5-6 liters and approx. 5 liters of blood are pumped out by heart every minute.

BLOOD CIRCULATION:

The circulation of blood in human beings takes place through 3(three) routes i.e. the systemic route, the pulmonary route and the portal route. When the ventricles contract blood from the right ventricle moves into the lungs from where it is brought back to the left auricle this forms pulmonary circulation and at the same time blood from the left ventricle is pumped into a major artery the aorta that gives off branches to all parts of the body as blood passes through the intestinal walls it picks up absorbed food and through the kidneys it is filtered and cleaned of the nitrogenous excretory waste while passing through the tissues it supplies the cells with oxygen and picks up co_2 and waste products or bromines from the endocrine glands. Several veins from different organs collect blood and unite and reunite to from two large veins the superior vena-cava, bringing back all blood from the heard region and the inferior vena-cava returning blood from the rest of the body. The two vena-cava empty their contents into the right auricle this is known as systemic circulation.



LYMPH:

Lymphatic system runs parallel to the veins it collects the tissue fluid called as lymph in the blindly ending thin walled channels or lymphatic which untie to form main lymph duct these ducts then open into a pair of veins entering the right auricle. Thus lymph forms another medium of circulation in human body proteins which cannot re-enter the blood capillaries because of their size return to circulation by the lymphatic fluid. The lymph is light yellow in color not red since it lacks hemoglobin. However its composition is similar to blood plasma the lymph also flows in one direction that is from the tissues to the heart.

BLOOD PRESSURE:

Blood pressure is the force of blood against the walls of arteries. Blood pressure is recorded as two numbers- the systolic pressure (as the heart beats) over the diastolic pressure (as the heart relaxes between beats). The measurement is written one above or before the other, with the systolic number on top and the diastolic number on the bottom. For example, a blood pressure measurement if 120/80 mmHg (millimeters of mercury) is expressed verbally as " 120 over 80".

Normal blood pressure is less than 120 mmHg systolic and less than 80.

About the heart and circulatory system:

The circulatory system is composed of the heart and blood vessels, including arteries, veins, and capillaries. Our body actually has two circulatory systems: the pulmonary circulation is a short loop from the heart to the lungs and back again, and the systemic circulation (the system we usually think of as our circulatory system) sends blood from the heart to all the other parts of our bodies and back again. The heart is the key organ in the circulatory system. As a hollow, muscular pump, its main function is to propel blood throughout the body. It usually beats from 60 to 100 times per minute, but can go much faster when necessary. it beats about 100,000 times a day, more than 30 million times per year, and about 2.5 billion times in a 70-year lifetime.

The heart gets messages from the body that tells it when to pump more or less blood depending on an individual' s needs. When we are sleeping, it pumps just enough to provide for the lower amounts of oxygen needed by our bodies at rest. When we are exercising or frightened, the heart pumps faster to increase the delivery of oxygen.

The heart has four chambers that are enclosed by thick, muscular walls. It lies between the lungs and just to the left of the middle of the chest cavity. The bottom part of the heart is divided into two chambers called the right and left ventricles, which pump blood out of the heart. A wall called the interventricular septum divides the ventricles.

The upper part of the heart is made up of the other two chambers of the heart, the right and left atria. The right and left atria receive the blood entering the heart. A wall called the interartrial septum divides the right and left atria, which are separated from the ventricles by the artrioventricular valves. The tricuspid valve separates the right atrium from the right ventricle, and the mitral valve separates the left atrium and the left ventricle.

Two other cardiac valves separate the ventricles and the large blood vessels that carry blood leaving the heart. These are the pulmonic valve, which separates the right ventricle from the pulmonary artery leading to

the lungs, and the aortic valve, which separates the left ventricle from the aorta, the body' s largest blood vessel.

Arteries carry blood away from the heart. They are the thickest blood vessels, with muscular walls that contract to keep the blood moving away from the heart and through the body. In the systemic circulation, oxygen-rich blood is pumped from the heart into the aorta. This huge artery curves up and back from the left ventricle, then heads down in front of the spinal column into the abdomen. Two coronary arteries branch off at the beginning of the aorta and divide into a network of smaller arteries that provide oxygen and nourishment to the muscles of the heart.

Unlike the aorta, the body' s other main artery, the pulmonary artery, carries oxygen-poor blood. From the right ventricle, the pulmonary artery divides into right and left branches, on the way to the lungs where blood picks up oxygen.

Arterial walls have three layers:

6) The endothelium is on the inside and provides a smooth lining for blood to flow over as it moves through the artery.

7) The media is the middle part of the artery, made up of a layer of muscle and elastic tissue.

8) The adventitia is the tough covering that protects the outside of the artery.

As they get farther from the heart, the arteries branch out into arterioles, which are smaller and less elastic.

Veins carry blood back to the heart. They are not as muscular as arteries, but they contain valves that prevent blood from flowing backward. Veins have the same three layers that arteries do, but are thinner and less flexible. The two largest veins are the superior and inferior vena cava. The terms superior do not mean that one vein is better than the other, but that they are located above and below the heart.

A network of tiny capillaries connects the arteries and veins. Through tiny, the capillaries are one of the most important parts of the circulatory system because it is through them that nutrients and oxygen are delivered to the cells. In addition, waste products such as carbon-dioxide are also removed by the capillaries.

EXCRETORY SYSTEM:

Excretion is the elimination of metabolic waste products from the body. Waste products are unwanted and often toxic byproducts of metabolism. Excretory system is a system of organs and tissues that take part in separation, collection and voiding of waste products.

Waste products formed in human body during metabolism:

The major waste products formed during the breakdown amino acids, nuclei acids and alkaloids are nitrogenous waste products and e.g. urea, uric acid, creatinine, hippuric acid and ammonia. The other waste products are non-nitrogenous products like oxalic acid, lactic acid and waste products also include chemicals like minerals, drugs, pigments, vitamins, hormones, cholesterol, waste products also include bile pigments like Bilirubin,Biliverdin, urochrome and other waste products are co_2 and excess water.

EXCRETION IN HUMAN BEINGS:

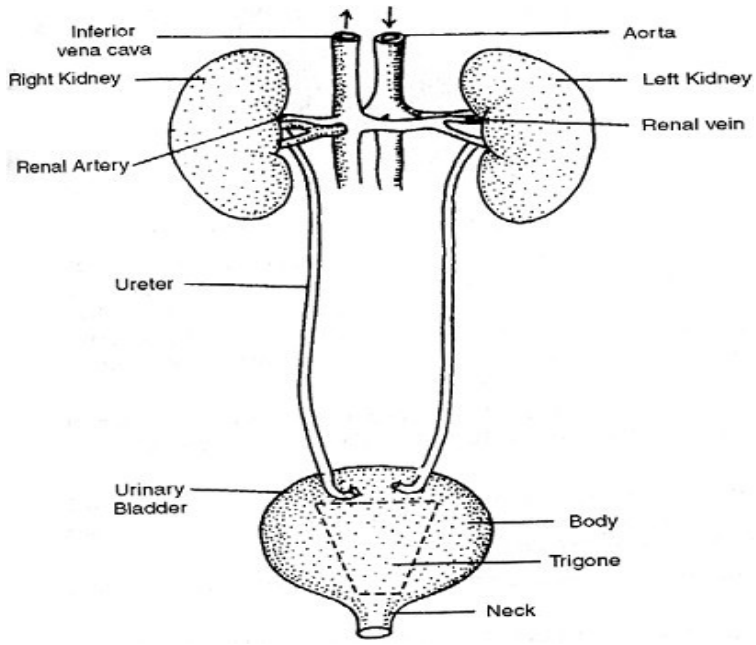


Diagram of urinary system.

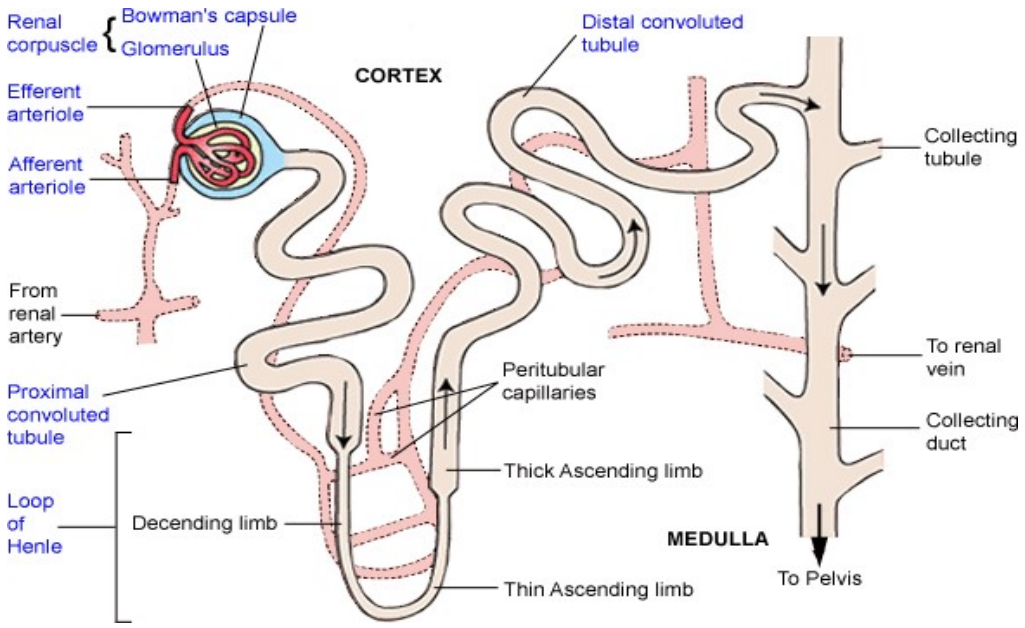
In human beings the excretion is generally done by the urinary system. The skin also acts as an organ of excretion by removing water and small amounts of urea and salts (as sweat). The urinary system includes a pair of bean-shaped kidneys located in the back of the abdominal cavity. Each day, the kidneys filter about 162qt (180 L) of blood, enough to fill a bathtub. They remove urea, toxins, medications, excess ions and form urine. The kidneys also balance water and salts as well as acids and bases. At the same time, they return needed substance to the blood. Of the total liquid processed, about 1.3 qt (1.5 L) leaves the body as urine.

KIDNEYS:

They are a pair of reddish brown, solid bean shaped structures which are located in the abdominal cavity attached to dorsal body wall one on either side of vertebral column. Left kidneys lies at slightly higher level and near the midline than the right one.

The size of an adult kidney is approximately 4 in (10 cm) long and 2 in (5 cm) wide. Urine leaves the kidneys in tubes at the hilus, a notch that occurs at the Center of the concave edge. Blood vessels, lymph vessels, and nerves enter and leave the kidneys at the hilus. If we cut into a kidney, we see that the hilus leads into a space known as the renal sinus. We also observe two distinct kidney layers. There is the renal cortex, an outer reddish layer, and the renal medulla, a reddish brown layer. Within the kidneys, nephrons clear the blood of wastes, create urine, and deliver urine to a tube called a ureter, which carries the urine to the bladder. The urinary bladder is a hollow muscular structure that is collapsed when empty and pear-shaped and distended when full. The urinary bladder then empties urine into the urethra, a duct leading to outside the body. A sphincter muscle controls the flow of urine between the urinary bladder and the urethra.

Each kidney contains over one million nephrons, each of which consists of a tuft of capillaries surrounded by a capsule on top of a curving tube. The tuft of capillaries is called glomerulus. Its capsule is cup-shaped and is known as Bowman' s capsule. The glomerulus and Bowman' s capsule form the top of a tube, the renal tubule. Blood vessels surrounded the renal tubule, and urine forms in it. The renal tubules of many nephrons join in collecting tubules, which in turn merge into larger tubes and empty their urine into the ureters in the renal sinus. The ureter exits the kidney at the hilus.



Structure of Nephron.

GLOMERULAR FILTRATION:

9) The first stage in clearing the blood is filtration, the passage of a liquid through a filter to remove impurities. Filtration occurs in the glomeruli. Blood pressure forces plasma, the liquid portion of the blood, through the capillary walls in the glomerulus. The plasma contains water, glucose, amino acids, and urea. Blood cells and

proteins are too large to pass through the wall, so they stay in the blood. The fluid, now called filtrate, collects in the capsule and enters the renal tubule.

REABSORPTION:

10) During reabsorption, needed substances in the filtrate travel back into the bloodstream. Reabsorption occurs in the renal tubules. There, glucose and other nutrients, water and essential ions materials pass out of the renal tubules and enter the surrounding capillaries. Normally 100% of glucose is reabsorbed. (Glucose detected in the urine is a sign of diabetes mellitus, which is characterized by too much sugar in the blood due to a lack of insulin). Reabsorption involves both diffusion and active transport, which uses energy in the form of ATP. The waste-containing fluid that remains after reabsorption is urine.

TUBULAR SECRETION (AUGMENTATION):

11) Tubular secretion is the passage of certain substances out of the capillaries directly into the renal tubules. Tubular secretion is another way of getting waste materials into the urine. For example, drugs such as penicillin and Phenobarbital are secreted into the renal tubules from the capillaries. Urea and uric acid that may have been reabsorbed and secreted. Excess potassium ions are also secreted into the urine. Tubular secretions also maintain the PH of the blood.

URETERS:

They are a pair of whitish narrow distensible muscular tubes of about a length of 30 cm each ureter arises from hilus part of the kidney. It moves downward and open into urinary bladder. Ureters carry urine from kidneys to the urinary bladder.

URINARY BLADDER:

It is a median pear-shaped distensible sac that is located in the pelvic part of the abdomen. It stores urine brought by two ureters and the storing capacity is about 300-800ml.

URETHRA:

It is a tube that takes urine from urinary bladder to outside the openings of urinary bladder into urethra is guarded by a ring of muscles known as sphincter. The length of urethra is 4 cm long in female and 20 cm long in males.

The opening of urethra is separate in females but is associate with the reproductive organs in males.

MICTURITION:

The word micturition actually means urination. The urge for micturition occurs when urinary bladder is filled up to 300-400 ml of urine and due to the filling of urinary bladder stimulates the nerve ending to develop the reflex. However urine can be retained in the urinary bladder till it gets filled upto maximum capacity that is 700-800 ml but by this time the urge of micturition turns into a painful issue. Voluntary micturition can be carried out by an individual at any time an average person excretes urine upto 1.6-1.8 ltr.

BOWMAN' S CAPSULE:

It is a cup-shaped structure around the glomerulus of each nephrons of the vertebrate kidney. It serves as a filter to remove organic wastes, excess inorganic salts, and water. Bowman' s capsule is named after it identifier, English physician and physiologist, Sir William Bowman (1816-1892).

A " renal corpuscle" is composed of tangled clusters of blood capillaries called a " glomerulus," and a thin walled, saclike structure, called the " Bowman' s capsule," which surrounds the glomerulus. The Bowman' s capsule is an expansion at the closed end of a renal tubule. It is composed of two layers of cells: an inner layer that closely covers the " glomerulus" and an outer layer that is continuous with the inner layer and with the wall of the renal tubule. The renal tubule leads away from the Bowman' s capsule and becomes highly coiled. The coiled portion is named the " proximal convoluted tubule" . Several of the distal convoluted tubules merge into the renal cortex to form a collecting duct, which in turn passes into the renal medulla, becoming larger and larger as it joins other collecting ducts the resulting tube is called the papillary duct.

ACCESSORY EXCRETORY ORGANS:

The other organs in human body which also perform excretion apart from kidneys and these organs are known as " Accessory Excretory organs" .

Skin also performs excretion through sweat and sebaceous glands excrete a fluid called sweat and with sweat it excretes excess water, traces or lactic acid, amino acids urea and salt. Sebaceous glands secrete oil or sebum and wax sterols and other lipids.

In liver amino acids processed and toxic ammonia is converted into less harmful urea in liver. Lungs on the other hand eliminate carbon dioxide and some aromatic substances. Large intestines excrete heavy metals and toxins into faecal matter. Salivary glands excrete toxins excess drugs and salts and are passed into alimentary canal.

DIALYSIS/ HEAMODIALYSIS:

The principle of dialysis has been used in the fabrication of artificial kidneys. If the natural kidney of a person is damaged doctors either surgically remove it and transplant another kidney from the healthy body of a donor or choose to utilize the service of an artificial kidney. In such a kidney the blood of a patient is pumped from one of the arteries into cellophane tube suspended in a salt solution. The salt solution is similar in composition to blood plasma. As the blood flows through cellophane tube ions and small molecules of waste products such as ammonia and urea are dialyzed out from within to the outside solution, while the larger molecules of proteins are retained in the blood. Such filtering of blood is called as heamodialysis after a series of such dialysis the purified blood is returned to a vein of the patient.