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Module No.	:	02
Module Title	:	Human body systems Part-1
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Learning Outcome of Module-2

LO	Particular	Course outcomes
1.	Students will learn about Blood, its composition, blood groups and Rh factor	BP106.2
2.	Students will learn about Human circulatory system parts and functioning	BP106.2
3.	Students will learn about structure of human heart, its working and cardiac cycle.	BP106.2
4.	Students will learn about Human digestive system parts and functioning	BP106.2
5.	Students will learn about Human respiratory system parts and functioning	BP106.2

Module Content Table

No.	Topic
1.	Human body and systems
2.	Blood
3.	Human Circulatory System
4.	Human Heart
5.	Human Digestive System
6.	Human Respiratory System

The human body is everything that makes up, well, you. The basic parts of the human body are the head, neck, torso, arms and legs.

Body systems

Our bodies consist of a number of biological systems that carry out specific functions necessary for everyday living.

The job of **the circulatory system** is to move blood, nutrients, oxygen, carbon dioxide, and hormones, around the body. It consists of the heart, blood, blood vessels,arteries and veins.

The digestive system consists of a series of connected organs that together, allow the body to break down and absorb food, and remove waste. It includes the mouth, esophagus, stomach, small intestine, large intestine, rectum, and anus. The liver and pancreas also play a role in the digestive system because they produce digestive juices.

The endocrine system consists of eight major glands that secrete hormones into the blood. These hormones, in turn, travel to different tissues and regulate various bodily functions, such as metabolism, growth and sexual function.

The immune system is the body's defense against bacteria, viruses and other pathogens that may be harmful. It includes lymph nodes, the spleen, bone marrow, lymphocytes (including B-cells and T-cells), the thymus and leukocytes, which are white blood cells.

The lymphatic system includes lymph nodes, lymph ducts and lymph vessels, and also plays a role in the body's defences. Its main job is to make is to make and move lymph, a clear fluid that contains white blood cells, which help the body fight infection. The lymphatic system also removes excess lymph fluid from bodily tissues, and returns it to the blood.

The nervous system controls both voluntary action (like conscious movement) and involuntary actions (like breathing), and sends signals to different parts of the body. The central nervous system includes the brain and spinal cord. The peripheral nervous system consists of nerves that connect every other part of the body to the central nervous system.

The body's muscular system consists of about 650 muscles that aid in movement, blood flow and other bodily functions. There are three types of muscle: skeletal muscle which is connected to bone and helps with voluntary movement, smooth muscle which is found inside organs and helps to move substances through organs, and cardiac muscle which is found in the heart and helps pump blood.

The reproductive system allows humans to reproduce. The male reproductive system includes the penis and the testes, which produce sperm. The female reproductive system consists of the

vagina, the uterus and the ovaries, which produce eggs. During conception, a sperm cell fuses with an egg cell, which creates a fertilized egg that implants and grows in the uterus.

Our bodies are supported by **the skeletal system**, which consists of 206 bones that are connected by tendons, ligaments and cartilage. The skeleton not only helps us move, but it's also involved in the production of blood cells and the storage of calcium. The teeth are also part of the skeletal system, but they aren't considered bones.

The respiratory system allows us to take in vital oxygen and expel carbon dioxide in a process we call breathing. It consists mainly of the trachea, the diaphragm and the lungs.

The urinary system helps eliminate a waste product called urea from the body, which is produced when certain foods are broken down. The whole system includes two kidneys, two ureters, the bladder, two sphincter muscles and the urethra. Urine produced by the kidneys travels down the ureters to the bladder, and exits the body through the urethra.

The skin, or integumentary system, is the body's largest organ. It protects us from the outside world, and is our first defense against bacteria, viruses and other pathogens. Our skin also helps regulate body temperature and eliminate waste through perspiration. In addition to skin, the integumentary system includes hair and nails.

Vital organs

Humans have five vital organs that are essential for survival. These are the brain, heart, kidneys, liver and lungs.

- The human brain is the body's control center, receiving and sending signals to other organs through the nervous system and through secreted hormones. It is responsible for our thoughts, feelings, memory storage and general perception of the world.
- The human heart is a responsible for pumping blood throughout our body.
- The job of the kidneys is to remove waste and extra fluid from the blood. The kidneys take urea out of the blood and combine it with water and other substances to make urine.
- The liver has many functions, including detoxifying of harmful chemicals, breakdown of drugs, filtering of blood, and secretion of bile and production of blood-clotting proteins.
- The lungs are responsible for removing oxygen from the air we breathe and transferring it to our blood where it can be sent to our cells. The lungs also remove carbon dioxide, which we exhale.

Blood

Blood is the body's fluid connective tissue, and it forms a vital part of the human circulatory system. Its main function is to circulate nutrients, hormones, minerals and other essential components to different parts of the body. Blood flows through a specified set of pathways called blood vessels. The organ which is involved in pumping blood to different body parts is the heart. Blood cells, blood plasma, proteins, and other mineral components (such as sodium, potassium and calcium) constitute human blood.

Blood is composed of:

- Plasma – the fluid part of the blood and is composed of 90% of water.
- Red blood cells, white blood cells and platelets constitute the solid part of blood.

Types of Blood Cells

The human body consists of three types of blood cells, namely:

Red blood cells (RBC) / Erythrocytes

Red blood cells are mainly involved in transporting oxygen, nutrients, and other substances to various parts of the body. These blood cells also remove waste from the body.

White blood cells (WBC) / Leukocytes

White blood cells are specialized cells, which function as a body's defence system. They provide immunity by fending off pathogens and harmful microorganisms.

Platelets / Thrombocytes

Platelets are cells that help to form clots and stop bleeding. They act on the site of an injury or a wound.

Blood groups

There are 4 main blood groups (types of blood) – A, B, AB and O. Your blood group is determined by the genes you inherit from your parents.

Each group can be either RhD positive or RhD negative, which means in total there are 8 blood groups.

Antibodies and antigens

Blood is made up of red blood cells, white blood cells and platelets in a liquid called plasma. Your blood group is identified by antibodies and antigens in the blood.

Antibodies are proteins found in plasma. They're part of your body's natural defences. They recognise foreign substances, such as germs, and alert your immune system, which destroys them.

Antigens are protein molecules found on the surface of red blood cells.

The ABO system

There are 4 main blood groups defined by the ABO system:

- **blood group A** – has A antigens on the red blood cells with anti-B antibodies in the plasma
- **blood group B** – has B antigens with anti-A antibodies in the plasma
- **blood group O** – has no antigens, but both anti-A and anti-B antibodies in the plasma
- **blood group AB** – has both A and B antigens, but no antibodies

Blood group O is the most common blood group. Almost half of the UK population (48%) has blood group O.

Receiving blood from the wrong ABO group can be life-threatening. For example, if someone with group B blood is given group A blood, their anti-A antibodies will attack the group A cells. This is why group A blood must never be given to someone who has group B blood and vice versa.

As group O red blood cells do not have any A or B antigens, it can safely be given to any other group.

The NHS Blood and Transplant (NHSBT) website has more information about the different blood groups.

The Rh system

Red blood cells sometimes have another antigen, a protein known as the RhD antigen. If this is present, your blood group is RhD positive. If it's absent, your blood group is RhD negative.

This means you can be 1 of 8 blood groups:

- A RhD positive (A+)
- A RhD negative (A-)
- B RhD positive (B+)
- B RhD negative (B-)
- O RhD positive (O+)
- O RhD negative (O-)
- AB RhD positive (AB+)
- AB RhD negative (AB-)

About 85% of the UK population is RhD positive (36% of the population has O+, the most common type).

In most cases, O RhD negative blood (O-) can safely be given to anyone. It's often used in medical emergencies when the blood type is not immediately known.

It's safe for most recipients because it does not have any A, B or RhD antigens on the surface of the cells, and is compatible with every other ABO and RhD blood group.

The NHS Blood and Transplant (NHSBT) website has more information about the Rh system.

Human Circulatory System

The human circulatory system consists of a network of arteries, veins, and capillaries, with the heart pumping blood through it. Its primary role is to provide essential nutrients, minerals, and hormones to various parts of the body. Alternatively, the circulatory system is also responsible for collecting metabolic waste and toxins from the cells and tissues to be purified or expelled from the body.

Features of Circulatory System

The crucial features of the human circulatory system are as follows:

- The human circulatory system consists of blood, heart, blood vessels, and lymph.
- The human circulatory system circulates blood through two loops (double circulation) – One for oxygenated blood, another for deoxygenated blood.
- The human heart consists of four chambers – two ventricles and two auricles.
- The human circulatory system possesses a body-wide network of blood vessels. These comprise arteries, veins, and capillaries.
- The primary function of blood vessels is to transport oxygenated blood and nutrients to all parts of the body. It is also tasked with collecting metabolic wastes to be expelled from the body.
- Most circulatory system diagrams do not visually represent its sheer length. Theoretically, if the veins, arteries, and capillaries of a human were laid out, end to end, it would span a total distance of 1,00,000 kilometres (or roughly eight times the diameter of the Earth).

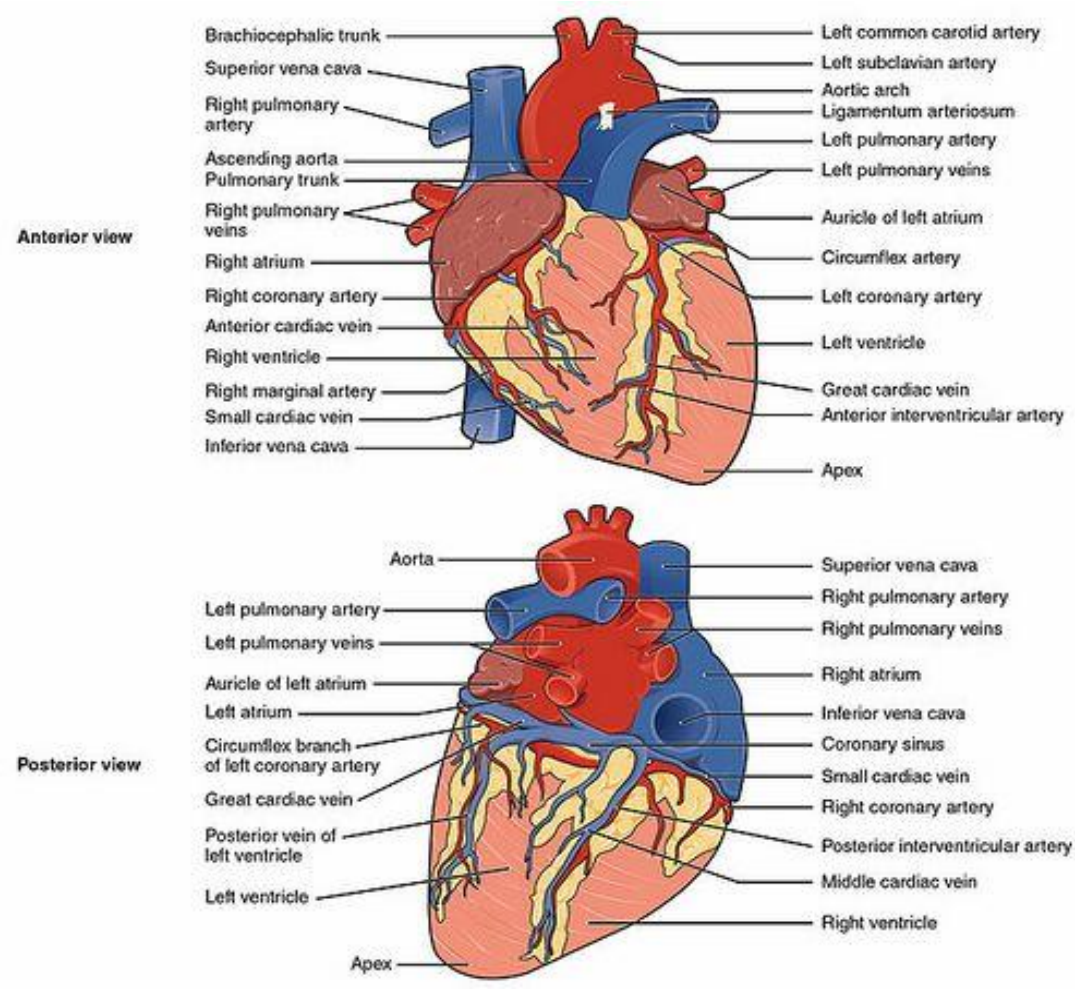
Organs of Circulatory System

The human circulatory system comprises 4 main organs that have specific roles and functions. The vital circulatory system organs include:

- Heart
- Blood (technically, blood is considered a tissue and not an organ)
- Blood Vessels
- Lymphatic system

Heart

The heart is a muscular organ located in the chest cavity, right between the lungs. It is positioned slightly towards the left in the thoracic region and is enveloped by the pericardium. The human heart is separated into four chambers; namely, two upper chambers called atria (*singular: atrium*), and two lower chambers called ventricles.



Anterior and posterior view of human heart

Heart is a major part of the human circulatory system. Though other animals possess a heart, the way their circulatory system functions is quite different from humans. Moreover, in some cases, the human circulatory system is much more evolved when compared to insects or molluscs.

Cardiac cycle

The cardiac cycle **consists of one cycle of contraction** and **relaxation** of cardiac muscle. During a heartbeat, there is contraction and relaxation of the atria and ventricles. During the cardiac cycle, the blood flows through the chambers of the heart in a specific direction. Each cardiac cycle lasts about 0.8 **seconds**.

The **contraction phase** is called the **systole**, and the **relaxation phase** is called the **diastole**. The stages of the cardiac cycle are discussed briefly below:

1. **Atrial systole**:

The **auricles contract** due to a wave of contraction stimulated by the **SA node**. The **bicuspid** and **tricuspid valves open**, forcing blood into the ventricles. The atrial systole duration lasts for 0.1 **seconds**.

2. Ventricular systole:

Ventricles contract due to a wave of contraction, which is stimulated by the **SA node**. **Bicuspid** and **tricuspid valves close immediately**, producing the **first heart sound**. The outflow of blood is first rapid from the ventricles, which slows down at the end.

When the ventricles complete their contraction, the blood flows into the **pulmonary** trunk and **aorta** as the **semilunar valves open**. The duration of ventricular systole is 0.3 **seconds**.

3. Atrial diastole:

Relaxation of atria occurs during which the atria fill blood from the vena cavae. The atrial diastole lasts for 0.7 **seconds**.

4. Ventricular diastole:

Relaxation of ventricles occurs, and the **semilunar valves close**. Next, the **tricuspid** and **bicuspid valves open**, and blood flows from the **atria into the ventricles**. The ventricular diastole lasts for 0.5 **seconds**.

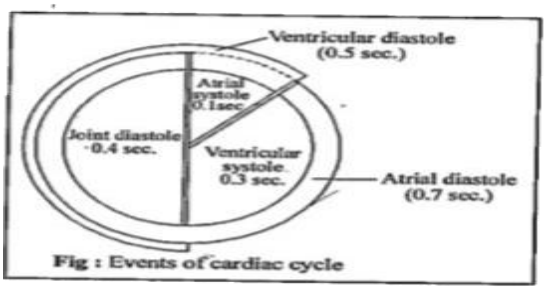


Fig : Events of cardiac cycle

Heart sound:

The **rhythmic closure** and **opening** of the **valves** cause the **sound of the heart**.

The beating heart produces sounds that can be heard by placing the ear against the chest or using a stethoscope. In an average person, **two** sounds are produced per heartbeat.

The first sound **LUBB** is **low pitched** and of **longer duration**. It is produced by the **closure of the bicuspid** and **tricuspid valves** after the beginning of ventricular systole.

The second sound **DUPP** is **highly pitched**, **louder** and of **shorter duration**. It is produced by the **closure of semilunar valves** at the end of the ventricular systole.

Electrocardiogram (ECG)

An electrocardiogram (ECG) is a simple test that can be used to check your heart's rhythm and electrical activity.

Sensors attached to the skin are used to detect the electrical signals produced by your heart each time it beats.

These signals are recorded by a machine and are looked at by a doctor to see if they're unusual.

An ECG may be requested by a heart specialist (cardiologist) or any doctor who thinks you might have a problem with your heart, including your GP.

The test can be carried out by a specially trained healthcare professional at a hospital, a clinic or at your GP surgery.

Despite having a similar name, an ECG isn't the same as an echocardiogram, which is a scan of the heart.

When an ECG is used

An ECG is often used alongside other tests to help diagnose and monitor conditions affecting the heart.

It can be used to investigate symptoms of a possible heart problem, such as chest pain, palpitations (suddenly noticeable heartbeats), dizziness and shortness of breath.

An ECG can help detect:

- **arrhythmias** – where the heart beats too slowly, too quickly, or irregularly
- **coronary heart disease** – where the heart's blood supply is blocked or interrupted by a build-up of fatty substances
- **heart attacks** – where the supply of blood to the heart is suddenly blocked
- **cardiomyopathy** – where the heart walls become thickened or enlarged

A series of ECGs can also be taken over time to monitor a person already diagnosed with a heart condition or taking medication known to potentially affect the heart.

How an ECG is carried out

There are several different ways an ECG can be carried out. Generally, the test involves attaching a number of small, sticky sensors called electrodes to your arms, legs and chest. These are connected by wires to an ECG recording machine.

You don't need to do anything special to prepare for the test. You can eat and drink as normal beforehand.

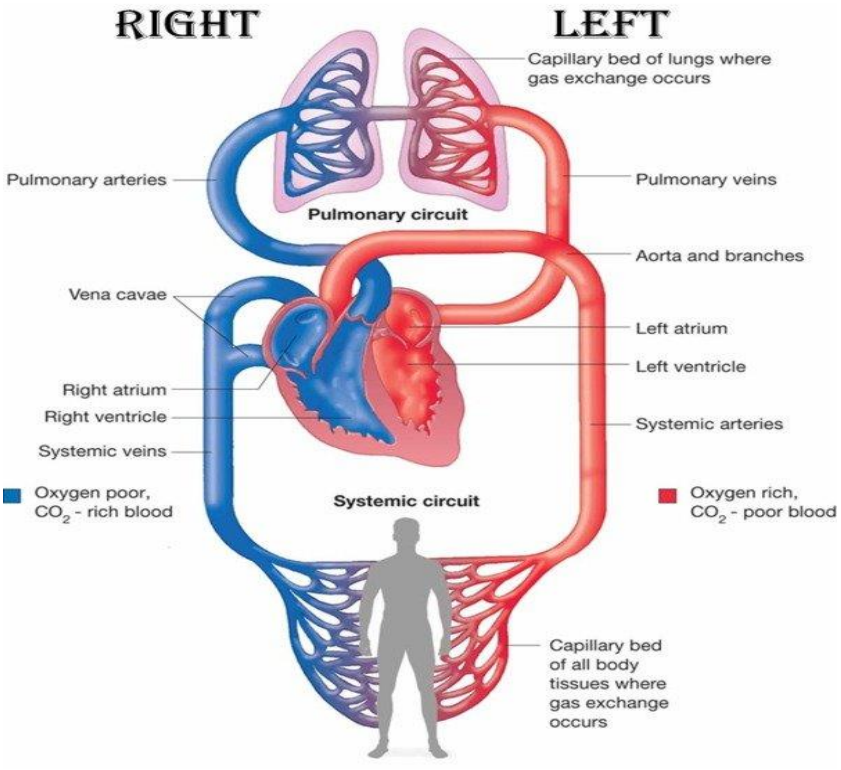
Before the electrodes are attached, you'll usually need to remove your upper clothing, and your chest may need to be shaved or cleaned. Once the electrodes are in place, you may be offered a hospital gown to cover yourself.

The test itself usually only lasts a few minutes, and you should be able to go home soon afterwards or return to the ward if you're already staying in hospital.

Double Circulation

The way blood flows in the human body is unique, and it is quite efficient too. The blood circulates through the heart twice, hence, it is called double circulation. Other animals like fish have single circulation, where blood completes a circuit through the entire animal only once.

The main advantage of double circulation is that every tissue in the body has a steady supply of oxygenated blood, and it does not get mixed with the deoxygenated blood.



Circulation of blood in humans – Double circulation

Blood Vessels

Blood vessels are a network of pathways through which blood travels throughout the body. Arteries and veins are the two primary types of blood vessels in the circulatory system of the body.

Arteries

Arteries are blood vessels that transport oxygenated blood from the heart to various parts of the body. They are thick, elastic and are divided into a small network of blood vessels called capillaries. The only exception to this is the pulmonary arteries, which carries deoxygenated blood to the lungs.

Veins

Veins are blood vessels that carry deoxygenated blood towards the heart from various parts of the body. They are thin, elastic and are present closer to the surface of the skin. However, pulmonary and umbilical veins are the only veins that carry oxygenated blood in the entire body.

Lymphatic System

The human circulatory system consists of another body fluid called lymph. It is also known as tissue fluid. It is produced by the lymphatic system which comprises a network of interconnected organs, nodes and ducts.

Lymph is a colourless fluid consisting of salts, proteins, water, which transport and circulates digested food and absorbed fat to intercellular spaces in the tissues. Unlike the circulatory system, lymph is not pumped; instead, it passively flows through a network of vessels.

Functions of Circulatory System

The most important function of the circulatory system is transporting oxygen throughout the body. The other vital functions of the human circulatory system are as follows:

1. It helps in sustaining all the organ systems.
2. It transports blood, nutrients, oxygen, carbon dioxide and hormones throughout the body.
3. It protects cells from pathogens.
4. It acts as an interface for cell-to-cell interaction.
5. The substances present in the blood help repair the damaged tissue.

The Human Digestive System

The digestive system of the human body comprises a group of organs working together to convert food into energy for the body. Anatomically, the digestive system is made up of the

gastrointestinal tract, along with accessory organs such as the liver, pancreas and gallbladder. The hollow organs that make up the gastrointestinal tract (GI tract) include the mouth, stomach, oesophagus, small intestine and large intestine that contain the rectum and anus.

Human Digestive System and Nutrition involve the intake of food by an organism and its utilization for energy. This is a vital process which helps living beings to obtain their energy from various sources. The food which we eat undergoes much processing before the nutrients present in them are utilized to generate energy. This processing is known as digestion. Humans and other animals have specialized organs and systems for this process.

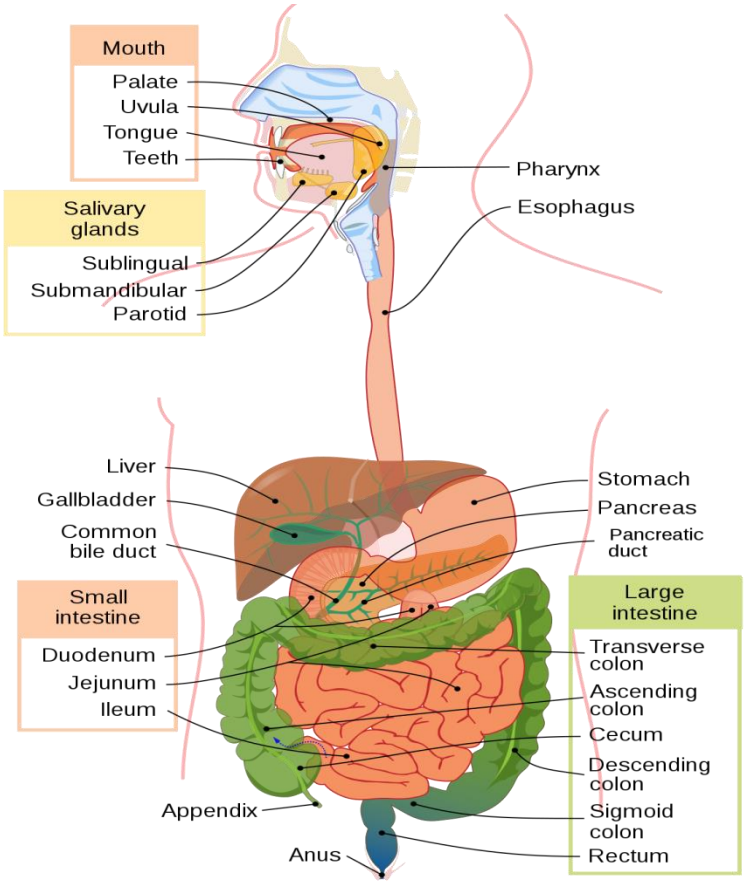
The digestion process involves the alimentary canal along with various accessory organs and organ systems. In humans, the process is quite simple due to our monogastric nature. This means that we have a one-chambered stomach, unlike other animals such as cows, which have four chambers.

Some parts of nervous and circulatory systems also play a significant role in the digestion process. A combination of nerves, bacteria, hormones, blood and other organs of the digestive system completes the task of digestion.

Let us have a detailed look at the human digestive system, its parts and functions. Also provided at the end of the chapter are digestive system notes.

The Human Digestive System

The diagram given below represents different parts of the human digestive system that convert food into essential nutrients absorbed by the body.



Parts of the Human Digestive System

The digestive system of the human body comprises a group of organs that work together in converting food into energy and other basic nutrients to power the body. The food we take in is digested and utilized by our body, and the unused parts of the food are defecated.

The digestive system of the human body is the sum of the gastrointestinal tract (GIT; also called alimentary canal) and accessory organs (tongue, liver, pancreas, etc.). These two parts together help in the digestion process.

The alimentary canal is the long tube through which the food that we eat is passed. It begins at the mouth (buccal or oral cavity), passes through the pharynx, oesophagus or food pipe, stomach, small intestines, large intestines, rectum and finally ends at the anus. The food particles gradually get digested as they travel through various compartments of the alimentary canal.

Accessory organs are organs which participate in the digestion process but are not actually a part of GIT. They stimulate the digestion by releasing certain enzymes that help in breaking down the food.

Mouth

Food starts its journey from the mouth or the oral cavity. There are many other organs that contribute to the digestion process, including teeth, salivary glands, and tongue. Teeth are designed for grinding food particles into small pieces and are moistened with saliva before the tongue pushes the food into the pharynx.

Pharynx

A fibromuscular y-shaped tube attached to the terminal end of the mouth. It is mainly involved in the passage of chewed/crushed food from the mouth through the oesophagus. It also has a major part in the respiratory system, as air travels through the pharynx from the nasal cavity on its way to the lungs.

Oesophagus

This is a muscular tube that connects the pharynx, which is a part of an upper section of the gastrointestinal tract. It supplies swallowed food along with its length.

Stomach

It serves as a muscular bag which is situated towards the left side of the abdominal cavity, beneath the diaphragm. This vital organ acts as a storage for the food and provides enough time to digest meals. The stomach also produces digestive enzymes and hydrochloric acid that maintains the process of digestion.

- **Mucous**: It is an aqueous secretion produced by the mucous membranes. It functions by protecting the stomach lining and gastric pits from the acid, which is produced by the glands to destroy the bacteria that entered along with the food particles.
- **Digestive enzymes**: They are the group of enzymes which functions by breaking down polymeric macromolecules like biopolymers into their smaller and simpler substances.
- **Hydrochloric acid**: It is the digestive fluid formed by the stomach during the process of digestion. It functions by destroying harmful microorganisms present in the food particles.

Small Intestine

The small intestine is a thin, long tube of about 10 feet long and a part of the lower gastrointestinal tract. It is present just behind the stomach and acquires a maximum area of the abdominal cavity. The complete small intestine is coiled and the inner surface consists of folds and ridges.

Large Intestine

This is a thick, long tube measuring around 5 feet in length. It is present just beneath the stomach and wraps over the superior and lateral edges of the small intestine. It absorbs water and consists of bacteria (symbiotic) that support the breakdown of wastes to fetch small nutrients.

Rectum

Waste products are passed into the end of the large intestine called the rectum and eliminated out of the body as a solid matter called stool. It is stored in the rectum as semi-solid faeces which later exits from the body through the anal canal through the process of defecation.

Accessory Organs

Pancreas

It is a large gland present just behind the stomach. It is short with its anterior connected to the duodenum and posterior pointing towards the left part of the abdominal cavity. The pancreas releases digestive enzymes to complete the process of chemical digestion.

Liver

The liver is a roughly triangular, reddish-brown accessory organ of the digestive system located to the right of the stomach. It produces bile, which helps in the digestion of fat in the small intestine. The bile is stored and recycled in the gallbladder. It is a small, pear-shaped organ which is located just next to the liver.

Digestion Process

The process of digestion begins from the mouth and ends in the small intestine – the large intestines' main function is to absorb the remaining water from the undigested food and enable bacterial fermentation of materials that can no longer be digested.

The alimentary canal or the gastrointestinal tract is a series of hollow organs and tubes that begins from the mouth cavity and continues into the pharynx, through the stomach, small intestines, large intestines, and finally ending at the anus. Food particles gradually get digested as they travel through various compartments of the gastrointestinal tract.

The digestion process takes place in the following steps.

Ingestion

The very first step involves mastication (chewing). The salivary glands, along with the tongue, helps to moisten and lubricate food, before being pushed down into the food pipe.

Mixing and Movement

It involves the process of lubricating and manipulating food and pushing it down the food through the food pipe (using peristalsis), and into the stomach.

Secretion

The stomach, small intestine, liver, and pancreas secrete enzymes and acids to aid the process of digestion. It functions by breaking down food particles into simple components and easily absorbable components.

Digestion

The process of converting complex food particles into simpler substances in the presence of enzymes and acids secreted by different digestive organs.

Absorption

This process begins in the small intestine where most of the nutrients and minerals are absorbed. The excess water in the indigestible matter is absorbed by the large intestines.

Excretion

The process of removing indigestible substances and waste by-products from the body through the process of defecation.

In a nutshell, the digestion process consists of the six following steps:

Ingestion ⇒Mixing and Movement ⇒ Secretion ⇒ Digestion ⇒Absorption ⇒Excretion

Digestive enzymes-

There are so many digestive enzymes present in our digestive tract which help in the digestion process and make digestion easier. Digestive enzymes help in digestion of complex food into simpler form and these digestive enzymes are produced by different parts of the digestive tract.

Different Types of Digestive Enzymes

There are mainly three main types of Digestive Enzymes present in our body. They're grouped based on the reactions they catalyze:

Amylase Enzyme: They break down starches and carbohydrates into sugars.

Protease Enzyme: it breaks down proteins into amino acids.

Lipase Enzyme: It breaks down lipids, which are fats and oils, into glycerol and fatty acids.

Nuclease Enzyme: They break nucleic acid into nucleotides.

Function of Different Digestive Enzymes along with their Secretion Location

1. **Different Types of Digestive Enzymes produced inside the Mouth**, They are:

- Lipase Enzyme: digestion of lipid is initiated in the mouth. Lipase starts the digestion of the lipids/fats.
- Salivary Amylase: digestion of carbohydrates also initiated in the mouth. Amylase, produced by the salivary glands, breaks complex carbohydrates to smaller chains, or even simple sugars. It is sometimes called ptyalin.
- Lysozyme: Food contains nonessential nutrients, e.g. bacteria or virus, it acts as an antimicrobial agent.

2. **Different Types of Digestive Enzymes produced inside Stomach**, They are:

- Pepsin: It is the main gastric enzyme. It is produced by the stomach cells called "chief cells" in its inactive form that is known as pepsinogen. Pepsinogen is then activated by the stomach acid into its active form, known as pepsin. Function: It helps in breaking down protein in the food into smaller particles known as peptide and amino acids. First step of protein digestion occurs in the stomach, whereas digestion of carbohydrates and lipids starts in the mouth.
- Gastric Lipase: It is an acidic lipase secreted by the gastric chief cell in the fundic region of mucosa in the stomach. Optimum pH for gastric lipase is in between 3-6. Function: It is responsible for digestion of dietary fat present in our stomach.
- Hydrochloric Acid(HCL): It helps to denature the ingested protein and kill any bacteria and virus that remains in food, it also helps in activating pepsinogen to convert them into pepsin.
- Intrinsic Factor: It is produced by parietal cells of the stomach. It self in transformation and absorption of various micro nutrients.
- Mucin: It is highly acidic in nature and destroys different bacteria and viruses present in food.
- Gastrin: This hormone is produced by the G-cell of the stomach and it is mainly endocrine hormone. It stimulates parietal cells for HCL production and production of several intrinsic factors.

3. Role of Pancreas in Digestion Process

Pancreas secretes pancreatic juice and this pancreatic juice contains various digestive enzymes, They are:

- Trypsinogen: They are present in inactive form, once they are activated they are converted into trypsin, which help in breakdown of protein. Trypsinogen is activated with the help of enterokinase enzyme.

- Chymotrypsinogen: It is present in inactive form and with the help of enterokinase it is converted into active chymotrypsin.
- Carboxypeptidase: It is a protease that takes the terminal amino acid group from protein.
- Pancreatic Lipase: It degrades triglycerides into two fatty acids and a monoglyceride.
- Cholecystokinin: It is a unique peptide released by duodenal I- cell, they are also produced in response to chyme containing high fat.

4. Enzymes produced by Small Intestine

There are various digestive enzymes which are produced by small intestine, they are:

- Secretin: It is an endocrine hormone produced by the duodenal S type cell in response to decrease acidity of gastric chyme.

- Cholecystokinin (CCK): It is a unique peptide released by the duodenal "I cells" in response to chyme containing high fat or protein content. It also increases gallbladder contraction, causing release of pre-stored bile into the cystic duct, and eventually into the common bile duct and via the ampulla of vater into the second anatomic position of the duodenum.
- Gastric Inhibitory Peptide (GIP): It is a kind of peptide that decreases gastric motility and is produced by duodenal mucosal cells.

Disorders of the Human Digestive System

Vomiting: It is the ejection of stomach contents through the mouth.

Diarrhoea: It is the abnormal watery bowel movement. Prolonged diarrhoea eventually leads to dehydration.

Constipation: A condition in which the faeces are clutched within the rectum due to an irregular bowel movement.

Indigestion: A pain or discomfort in the stomach which is caused when food is not digested properly, resulting in the feeling of fullness. Indigestion is mainly caused due to inadequate enzyme secretion, food poisoning, anxiety, overeating and eating spicy foods.

Functions of the Human Digestive System

Digestion and absorption are the two main functions of the digestive system.

Digestion is necessary for breaking down food particles into nutrients that are used by the body as an energy source, cell repair and growth.

Food and drink need to be converted into smaller molecules of nutrients before it is absorbed by the blood and carried to the cells throughout the body. The body breaks the nutrients present in the drinks and food into carbohydrates, vitamins, fats and proteins.

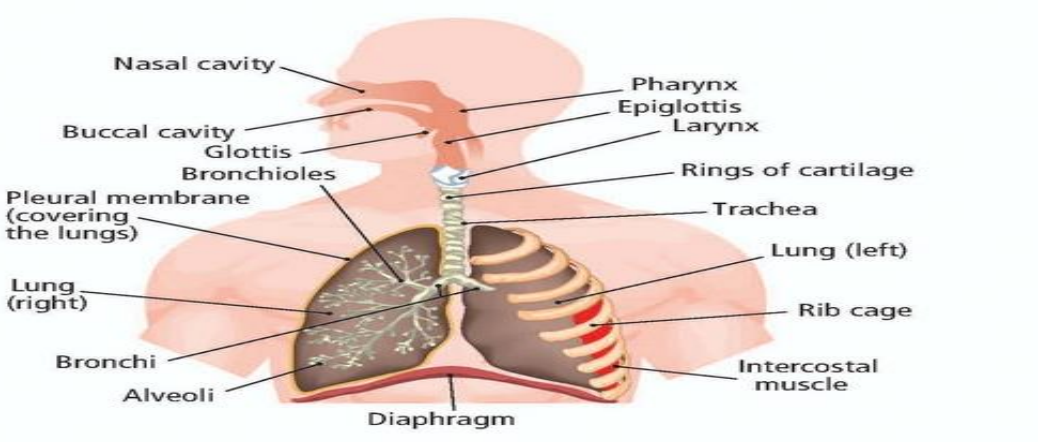
Human Respiratory System

Respiration is necessary for every living being, and there's a distinct, special organ system working constantly to carry it out. In humans, it is called the respiratory system.

The human body is a complex structure of many organs and organ systems, and the human respiratory system is one of them. The respiratory system functions continuously without a break, as we breathe by inhaling oxygen and exhaling carbon dioxide. Breathing is essential for our survival and effective for the functioning of all our organs. The respiratory system is made up of a complicated collection of organs and tissues that let you breathe. The muscles that propel your lungs are also part of the respiratory system. These parts work together to deliver oxygen throughout the body while also removing waste gasses like carbon dioxide.

Human Respiratory System Diagram

If you carefully observe the respiratory system diagram, you will be able to see the various organs involved in its functioning.



Features of the Human Respiratory System

The structure of the lungs is created in such a way that it helps the exchange of gasses. The other parts of the respiratory system include the nose, larynx, pharynx, trachea or the windpipe, bronchi, lungs, blood vessels, the airways for the passage of air, and the muscles that support the breathing.

All these parts together form the respiratory tract that starts from the external nostrils and nasal chamber and goes up to the lungs. Warms and moisturizes the air to the appropriate humidity level for your body. Your body's cells are supplied with oxygen. When you exhale, you remove waste gasses from your body, including carbon dioxide. Protects dangerous substances and irritants out of your airways.

Respiratory System Parts and Functions

Nose

We inhale air through our nose which is the first step in the process of respiration. The nose and nasal cavity are the initial segment of the body's airway—the respiratory tract through which air moves—and are the principal external opening for the respiratory system. The nose is a cartilage, bone, muscle, and skin structure on the face that supports and protects the nasal cavity's anterior section. Before being expelled into the environment, air leaving the body through the nose returns moisture and heat to the nasal cavity.

Larynx

These are two cartilaginous chords, situated at the joining point of the pharynx and trachea. They are also called the voice box. The laryngopharynx and the trachea are connected by a brief piece of the airway. The larynx is found in the anterior part of the neck, slightly below the hyoid bone and above the trachea. The form of the larynx is determined by various cartilage components. The larynx has specific structures termed vocal folds, which allow the body to produce speaking and singing sounds in addition to cartilage. Vocal folds are mucous membrane folds that vibrate to make vocal sounds. The pitch produced by the vocal folds can be altered by altering the tension and vibration speed of the vocal folds.

Pharynx

The pharynx is a common path for the passage of both air and food, to their respective organ systems. The pharynx, often known as the throat, is a muscular funnel that runs from the nasal cavity's posterior end to the esophagus and larynx's superior end. The nasopharynx, oropharynx, and laryngopharynx are the three parts of the pharynx. The nasopharynx is the upper part of the pharynx that is located in the back of the nasal cavity. The nasopharynx receives inhaled air from

the nasal cavity and transports it to the oropharynx, which is positioned in the back of the oral cavity. At the oropharynx, air inhaled through the mouth cavity enters the pharynx. The epiglottis is a flap of elastic cartilage between the trachea and the esophagus that serves as a switch between the two.

Trachea

The trachea or the windpipe is like a long tube that takes the inhaled air into the further process. It is divided into left and right bronchi. The trachea, or windpipe, is a 5-inch long tube coated with pseudostratified ciliated columnar epithelium and formed up of C-shaped hyaline cartilage rings. The trachea's primary role is to maintain a free airway for air to enter and exit the lungs. Furthermore, the mucus produced by the epithelium lining the trachea collects dust and other impurities, preventing them from reaching the lungs. Mucus is moved superiorly toward the throat by cilia on the surface of epithelial cells, where it can be eaten and processed in the gastrointestinal system.

Bronchi

Bronchi are further subdivided into small, finer channels called bronchioles. These bronchioles have balloon or bag-like structures at their ends that are known as alveoli. The airway splits into left and right branches at the inferior end of the trachea, known as the main bronchi. Before branching off into smaller secondary bronchi, the left and right bronchi enter each lung. The secondary bronchi—two in the left lung and three in the right lung—carry air into the lobes of the lungs. Within each lobe, the secondary bronchi branches into several smaller tertiary bronchi. The tertiary bronchi are divided into several smaller bronchioles that travel throughout the lungs. Each bronchiole then differentiates into multiple smaller branches, known as terminal bronchioles, with a diameter of less than a millimeter. Finally, the air is carried to the lungs' alveoli by millions of small terminal bronchioles.

Lungs

Then there are lungs. The inhaled air is purified, and the oxygen necessary for all the body functioning is passed to various organs through the blood vessels. The exchange of oxygen and carbon dioxide takes place in small bags, alveoli. And the impure air of the carbon dioxide is exhaled out of the body through the same tract. The lungs are a pair of big, spongy organs located in the thorax, above the diaphragm, and lateral to the heart. A pleural membrane surrounds each lung, providing space for it to expand as well as a negative pressure area relative to the rest of the body. As the lungs relax, they passively fill with air thanks to the negative pressure.

Respiratory Tract

The respiratory tract of the human respiratory system is a series of organs, starting from the external organs and going up to the internal ones. Each of these organs performs a distinct role in the respiratory system function.

Respiratory System Functions

The respiratory system function is a very important metabolic process in our body that plays a crucial role in all living beings.

Inhalation and Exhalation:

It begins by breathing and ends by exhalation, that's the simplest explanation. But during and after these two acts, several processes are going on endlessly in our bodies.

Exchange of Gasses Between Lungs and Bloodstream:

The oxygen is exchanged for carbon dioxide and is pumped through the bloodstream. Hundreds of millions of small sacs called alveoli are used to carry out the breathing process. The oxygen inhaled by the alveoli diffuses into the pulmonary capillaries that surround them. It attaches to hemoglobin molecules in red blood cells and then circulates around the body.

Exchange of Gasses Between Bloodstream and Body Tissues

The oxygen-carrying blood releases oxygen into body tissues, through the walls of capillaries. Internal respiration, another important function of the respiratory system, transports oxygen to cells and eliminates waste carbon dioxide. Red blood cells transport oxygen received from the lungs around the body via the vasculature in this respiratory process. When oxygenated blood enters the small capillaries, red blood cells release oxygen. It diffuses into body tissues through capillary walls. Carbon dioxide diffuses from the tissues into red blood cells and plasma in the meantime. Deoxygenated blood carries the carbon dioxide back to the lungs.

The Vibration of the Vocal Cords

The larynx muscles move when we speak, creating sound and vibration. The same process happens during the exhalation also.

Olfaction or Smelling

When we inhale air, the chemicals present in the air activate the receptors of the nervous system on the cilia, and we can identify the smell. The sense of smell, or olfaction, is another particular sense that is affected by chemical stimuli. In the superior nasal cavity, the olfactory receptor neurons are integrated into a small area of the nasal epithelium.

Respiration in Humans

Respiration in humans is divided into two types –

1. The External Respiration

The exchange of gasses between the air in the alveoli and the blood in the capillaries that border the alveolar walls is known as external respiration. The partial pressure of oxygen in the air that enters the lungs from the atmosphere is higher than the partial pressure of carbon dioxide in the blood in the capillaries. The gasses diffuse passively through the simple squamous epithelium lining of the alveoli due to the difference in partial pressures. The passage of oxygen from the air into the blood and carbon dioxide from the blood into the air is the end consequence of external respiration. After then, the oxygen may be carried to the body's tissues, while the carbon dioxide is exhaled and discharged into the atmosphere.

2. Internal Respiration

It involves the exchange of gasses between the blood and cells in the body. Lungs are the largest organ in the respiratory system. The exchange of gasses between the blood in capillaries and the body's tissues is known as internal respiration. Capillary blood has a higher oxygen partial pressure and a lower carbon dioxide partial pressure than the tissues through which it travels. Gasses diffuse through the endothelial lining of capillaries along pressure gradients from high to low pressure due to the difference in partial pressures. The diffusion of oxygen into the tissues and the diffusion of carbon dioxide into the blood are the end results of internal respiration.

Issues Affecting the Respiratory System in Health

It is evident that something is obstructing our ability to exchange carbon dioxide for oxygen. Allergies, asthma, pneumonia, and lung cancer are just a few of the health issues that can cause respiratory problems. Infection (bacterial or viral), environmental exposure (pollution or cigarette smoke, for example), genetic inheritance, or a mix of variables are among the causes of these problems. We don't seek medical help till the problem has progressed because the onset is so slow. Symptoms may appear gradually, as in the case of alpha-1 antitrypsin deficiency (A1AD), and are frequently misunderstood or underdiagnosed. A1AD genetic risk can be detected through DNA health testing.

Diseases of the Lungs and the Respiratory System

- **Asthma:** Your airways are congested, and you're producing an excessive amount of mucus.
- **Bronchiectasis:** Bronchial walls get thicker as a result of inflammation and infection.
- **COPD (chronic obstructive pulmonary disease):** A lung illness that affects millions of people (COPD). Over time, this long-term ailment deteriorates. Bronchitis and emphysema are two of the most common conditions.

- **Pneumonia:** Inflammation of the alveoli is caused by infection. It's possible that they'll become clogged with pus or fluid.
- **Tuberculosis:** This deadly infection is brought on by a bacterium. It most commonly affects your lungs, but it can also impact your kidneys, spine, or brain.
- **Lung Cancer:** Cancer of the lungs A tumour formed when cells in the lungs alter and expand. This is frequently the result of smoking or inhaling other substances.
- **Cystic Fibrosis:** Cystic fibrosis is a disease characterised by the presence of cysts in the lungs, this condition develops over time and is caused by a genetic issue. It leads to recurrent lung infections.
- **Pleural Effusion:** Pleural effusion is a condition in which fluid accumulates in the lungs between the tissues that line your lungs and chest, too much fluid accumulates.
- **Idiopathic Pulmonary Fibrosis:** Idiopathic pulmonary fibrosis is a condition in which the tissue of your lungs gets damaged and unable to function properly.
- **Sarcoidosis:** Granulomas are small clusters of inflamed cells that grow in the lungs and lymph nodes.

IMPORTANT QUESTION

2 marks

1. What do you mean by digestion?
2. Define Cardiac cycle.
3. Define Mastication.
4. Enumerate various parts of human respiratory system.
5. What do you understand by blood group?
6. Name the digestive enzymes produced by stomach.
7. What is ECG?

5 Marks

1. Explain role of small intestine in digestion.
2. Describe various phases of cardiac cycle.
3. Write a brief note on digestive enzymes.
4. Draw a well labeled diagram of human heart.
5. What is respiration? Enumerate various parts of human respiratory system.
6. Discuss double circulation.

10 marks

1. Write a detailed note on human circulatory system.
2. Write a detailed note on human digestive system.
3. Write a detailed note on human respiratory system.
4. Write a detailed note on blood, its composition, various blood groups and Rh factor.