Foundation Education
unlock your potential
RTO 22557

HLTAAP001

Recognise healthy body systems

Learner Guide

Contents

Unit Introduction

This learner guide explains the knowledge and skills required to effectively complete tasks outlined in elements and performance criteria of this unit, manage tasks and manage contingencies in the context of the work role. This includes knowledge of:

The basic structure and functions of the body systems and associated components, including:

- Cells, tissues and organs
- Cardiovascular system
- Respiratory system
- Musculo-skeletal system
- Endocrine system
- Digestive system
- Urinary system
- Reproductive system
- Integumentary system
- Lymphatic system
- Nervous system, including sensory systems – eye and ear
- The special senses – smell, taste, vision, equilibrium and hearing
- Immune system
- Processes, conditions and resources required by the body to support healthy functioning

Body regulation including:

- Maintenance of body temperature
- Fluid and electrolyte (including ph) balance
- Elimination of wastes from the body
- Maintenance of blood pressure
- Protection from infection
- Physical activity – active and passive

What will I learn?

This learning guide will provide you the skills and knowledge required to:

1. Work with information about the human body
2. Recognise and promote ways to support healthy functioning of the body

WHEN DO I GET ASSESSED?

You can submit your assessments as you complete them. To submit your assessments you need to upload them into the appropriate area on My eCampus. You can of course ask for help before or during your studies if you wish. Please feel free to read through the assessments at any time.

HOW WILL I BE SCORED/ASSESSED?

The assessor is looking for a demonstration of your competence in this unit. Each of the assessment items must be assessed as 'Satisfactory'. If any assessment item is assessed as 'Not Yet Satisfactory', this means that the item does not meet the unit standards/requirements. You will then be required to review and resubmit the assessment item/s. The assessor will provide comments for you for the purpose of assisting in revising and reviewing your submission so as to meet unit standards and criteria. Professional Foundation Education assistance is also available for you on request.

The final assessment outcome of the unit will recognise you to be 'Competent'. This can only be confirmed when all assessment items are assessed as 'Satisfactory'. This is the basis on which all vocational (work-based) training is assessed. Please note that neither scores nor grades are issued to candidates within the competency-based assessment process.

Remember that Foundation Education has Specialists who are available to work with you after you have commenced your studies. For more details of how to contact the team (including Live Chat), please refer to the Contact section on the left side of your My eCampus profile. If you are experiencing any technical difficulties, please select the Support icon. Standards established to assess you.

To assess any performance requires that a minimal standard or standards – or benchmark – be achieved. This is written into the performance criteria. The performance criteria will clearly state WHAT is to be demonstrated for assessment to be successful. The performance criteria for this unit are set by the Australian Qualifications Framework (AQF).

PERFORMANCE CRITERIA

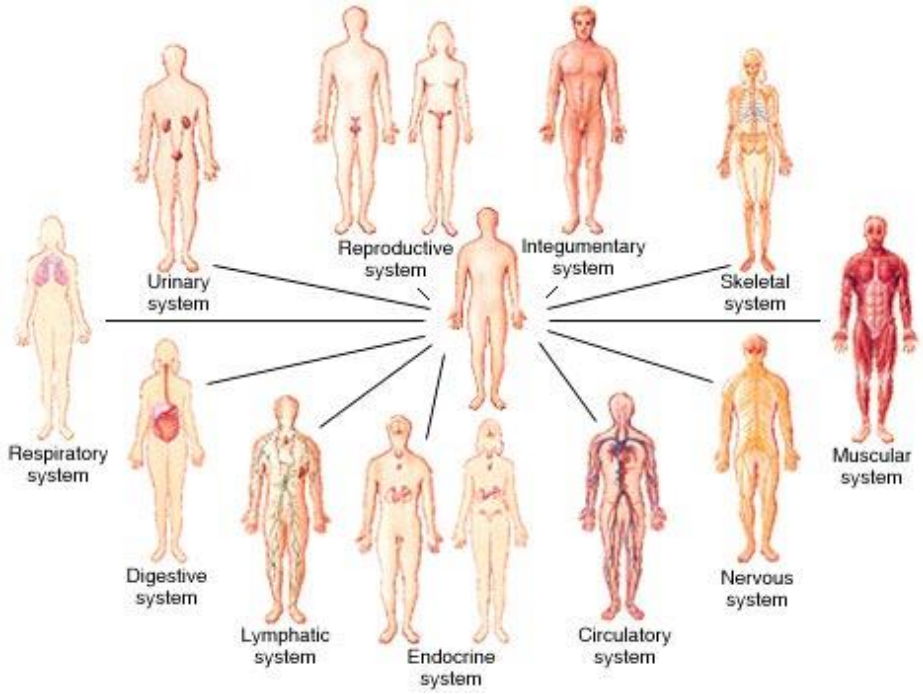
1. Work with information about the human body	1.1 Correctly use and interpret health terminology that describes the normal structure, function and location of the major body systems 1.2 Correctly use and interpret information that relates to the interrelationships between major components of each body system and other structures
2. Recognise and promote ways to support healthy functioning of the body	2.1 Review factors that contribute to maintenance of a healthy body 2.2 Evaluate how the relationships between different body systems affect and support healthy functioning 2.3 Enhance quality of work activities by using and sharing information about healthy functioning of the body

The following are the competencies that are to be demonstrated within this unit.

Performance Evidence	• The candidate must show evidence of the ability to complete tasks outlined in elements and performance criteria of this unit, manage tasks and manage contingencies in the context of the job role. There must be evidence that the candidate has worked effectively with information about the human body and its healthy functioning in at least 3 different situations
Knowledge Evidence	• The candidate must be able to demonstrate essential knowledge required to effectively complete tasks outlined in elements and performance criteria of this unit, manage tasks and manage contingencies in the context of the work role. This includes knowledge of: – Basic structure and functions of the body systems and associated components, including: ○ Cells, tissues and organs ○ Cardiovascular system ○ Respiratory system ○ Musculo-skeletal system ○ Endocrine system ○ Digestive system ○ Urinary system ○ Reproductive system ○ Integumentary system ○ Lymphatic system ○ Nervous system, including sensory systems – eye and ear ○ The special senses – smell, taste, vision, equilibrium and hearing ○ Immune system ○ Processes, conditions and resources required by the body to support healthy functioning – Body regulation including: ○ Maintenance of body temperature ○ Fluid and electrolyte (including ph) balance ○ Elimination of wastes from the body ○ Maintenance of blood pressure ○ Protection from infection ○ Physical activity – active and passive

CHAPTER 1: WORK WITH INFORMATION ABOUT THE HUMAN BODY

When working with people in a medical or care context, workers must have a basic understanding and knowledge regarding the major human body systems. Basic knowledge and understanding of the functioning of different body organs and systems helps in understanding the cause of the illness, disease or injury and to recognise the signs and symptoms of that illness in the human body. This also helps to understand the reasons for providing holistic support and care according to the given policies and procedures of an organisation.



What will I learn?

This chapter will cover the following content:

1. Correctly use and interpret health terminology that describes the normal structure, function and location of the major body systems
2. Correctly use and interpret information that relates to the interrelationships between major components of each body system and other structures

1.1 Correctly Use and Interpret Health Terminology that Describes the Normal Structure, Function and Location of the Major Body Systems

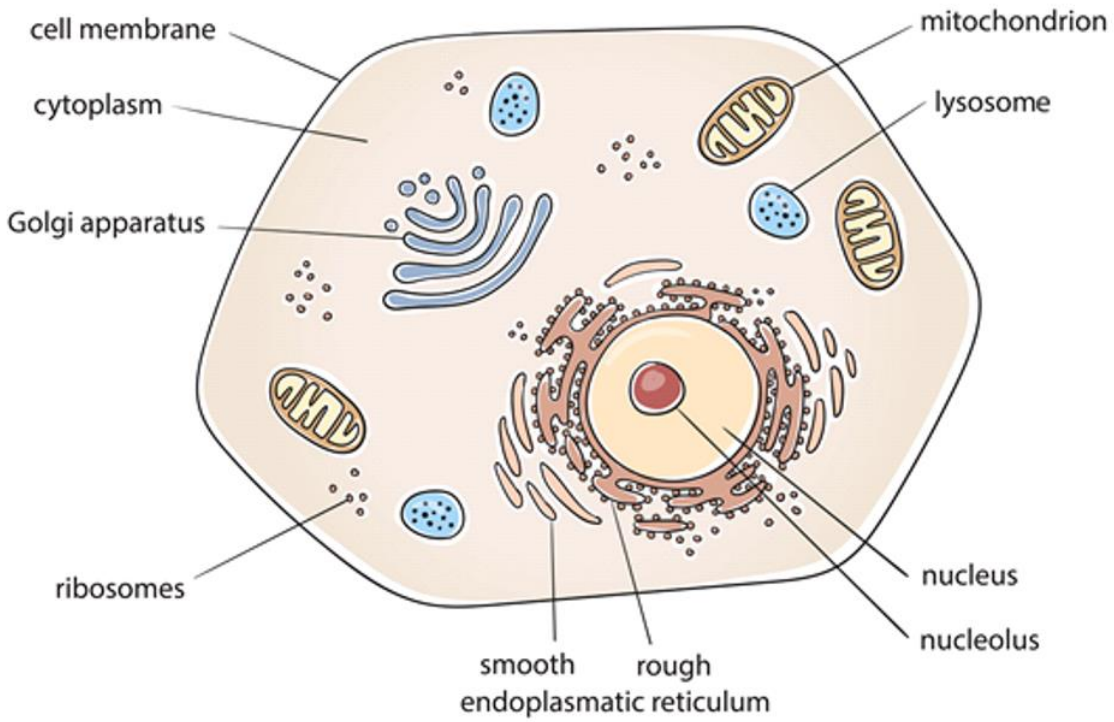
All healthcare workers should know the anatomy and physiology of the human body. Basic understanding about the organisation of the human body, starting with the cell being the smallest functional and structural unit, to the complex body systems is essential. It is important to learn medical terms with the general meanings of body structures, diseases and procedures. To deal with human beings in medical or care context, they must have the knowledge of what is inside the human body and how it works. Only then will they be able to find the cause of the illness, and can plan the strategies to cure it.

Below is detailed information of the anatomy and physiology of different human body systems.

CELLS, TISSUES AND ORGANS

CELLS

A cell is the basic structural and functional unit of life. Shape and size of the cells may vary. Cells need food, water and oxygen to survive and to perform functions.



STRUCTURE AND FUNCTIONS OF THE CELL

There are different parts of the cell which perform different functions.

1. **Cell Membrane or Plasma Membrane:**

   It is a phospholipid semipermeable bilayer. It is the outer covering of the cell with various receptor proteins. It helps to maintain the shape of the cell and control the entry and exit of the materials from the cell.

2. **Cytoplasm:**

   The cytoplasm surrounds the nucleus and contains all other cellular organelles in it. All the cellular functions and reactions are performed inside the cytoplasm.

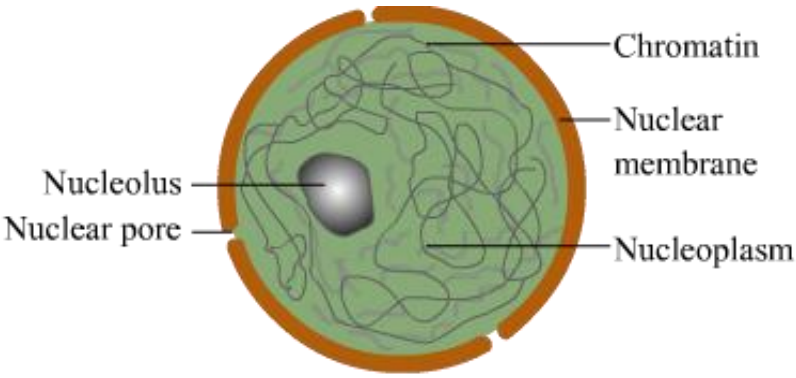
3. **Protoplasm:**

   The protoplasm is the 'living substance' of the cell, including the cytoplasm, nucleus, and other organelles. It is the colourless semi-liquid substance of the cell.

4. **Nucleus:**

   The nucleus is a membrane-enclosed organelle which is placed at the centre of the cell. It is the brain of the cell which controls all other functions of the cell. It consists of other structures which perform different functions. These are as follows:

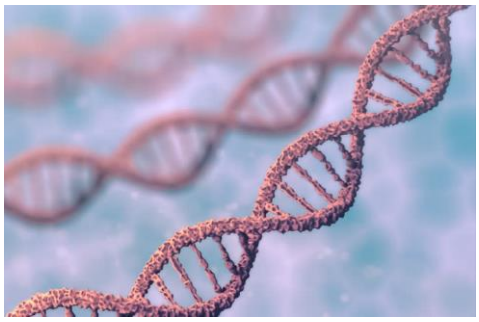
   - The *nuclear membrane* and Nuclear Pores are a cell membrane which separates the nucleus from the cell. The nuclear membrane has nuclear pores in it which allow the transport of the molecules such as RNA and ribosomal proteins, proteins, carbohydrates, signalling molecules and lipids.
   - The *nucleolus* is a dense structure made up of proteins and ribonucleic acids (RNA). Its main function is the formation of the ribosomal units with ribosomal proteins.
   - The *nucleoplasm* is the cytoplasm inside the nucleus. It contains nucleotides, enzymes, ribosomal proteins and ribosomal units. It suspends structures such as chromatin network and a dense mass called the nucleolus.
   - The Chromatin Network is the network of the chromosomes which contains all the heredity information in the form of DNA (deoxyribonucleic acid).

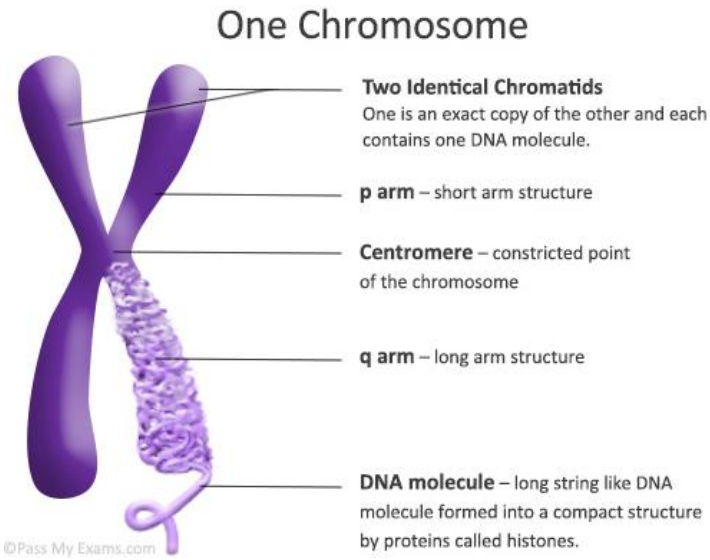


Structure of a Nucleus

DNA DOUBLE HELICAL STRUCTURE

Chromosomes are the threadlike structures which become visible during the time of the cell division within the nucleus. A human cell has 46 chromosomes which contain genes on it.

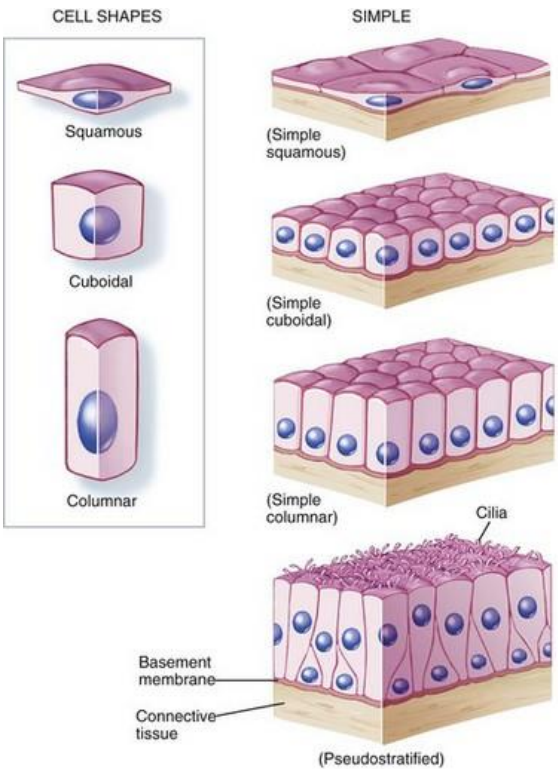




Genes are the physical and functional unit of heredity where traits are inherited from parents to their children such as height, eye colour, skin colour, hair colour and many more.

Functions of the nucleus:

- Controls cell reproduction and cell division
- Controls heredity characteristics of an organism
- It is responsible for various functions of the cell such as protein synthesis, cell division, growth and differentiation
- Produces ribosomal units and are known as the ribosome factories of the cell



TISSUES

Tissues are a group of cells that have a similar structure, function and origin. The study of tissues is known as histology. Animal tissues are divided into four basic categories which are:

1. **Epithelial tissue:**

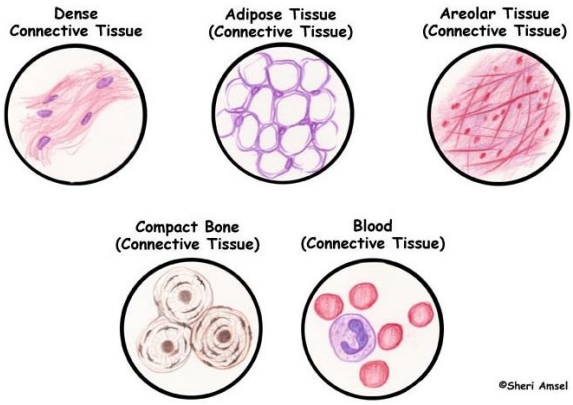
   Epithelial tissue is the internal and outer protective covering, forming a continuous sheet. Simple epithelium is a single thin layer whereas stratified epithelium is a stack of layers.

Based on shape and function, epithelial tissue is categorised into:

- **Squamous epithelium** is a single thin layer of cells on the basement membrane which lines the mouth and oesophagus.
- **Cuboidal epithelium** is made up of cells that have a cuboidal shape and lines the kidney tubules and salivary glands. Some of the cuboidal cells have cilia on them and are called 'ciliated cuboidal epithelium'.
- **Columnar epithelium** is made up of cells that are taller than they are wide and lines the intestine. Columnar epithelium with cilia lines the respiratory tract and is known as 'ciliated columnar epithelium'.
- **Glandular epithelium** or pseudostratified epithelium is made up of cells of columnar and cuboidal epithelium in the glands that have a special secretory function, such as salivary glands.

2. Connective tissue:

Connective tissue connects, anchors and supports other body tissues and is found in every part of the body. The basic structure of the connective tissue has cells embedded in an amorphous matrix, often with collagen or elastin fibres including cartilaginous and fatty tissues.

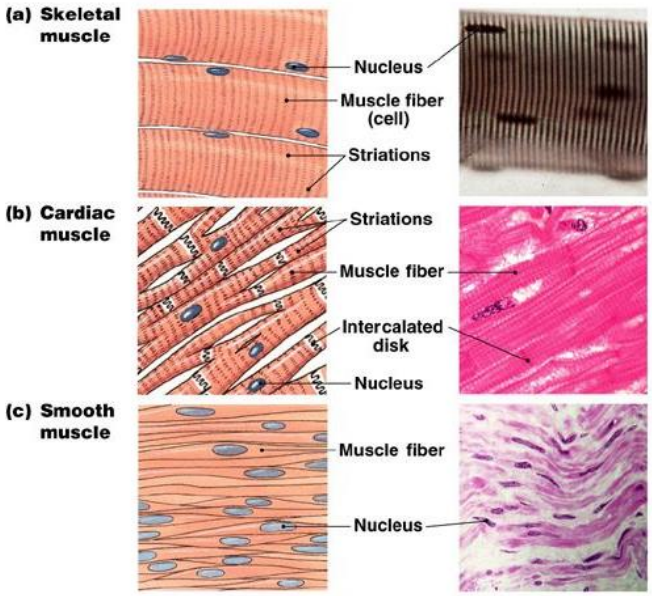


These are of five types:

1. **Blood:** Blood is a fluid connective tissue. Plasma in the blood contains red blood cells, white blood cells and platelets with proteins, salts and hormones. It helps in the transportation of gases, digested food, hormones and waste materials. It fights against infection and white blood cells act as the 'soldiers of the body'. Platelets help in the clotting of the blood during any cut or wound.
2. **Bone:** Bone is a connective tissue with a hard matrix composed of calcium and phosphorus. Ligaments connect one bone to another while tendons connect bone to other muscles.
3. **Cartilage:** Cartilage is composed of a solid matrix composed of proteins and sugars. It is commonly present in ear, nose, trachea and larynx.
4. **Areolar tissue:** Areolar tissue is found between the skin, muscles and around the blood vessels. It supports internal organs and aids in the repair of the tissue.
5. **Adipose tissue:** Adipose tissue has fat storage cells known as adipocytes which act as an insulator for the body.

3. Muscular tissue

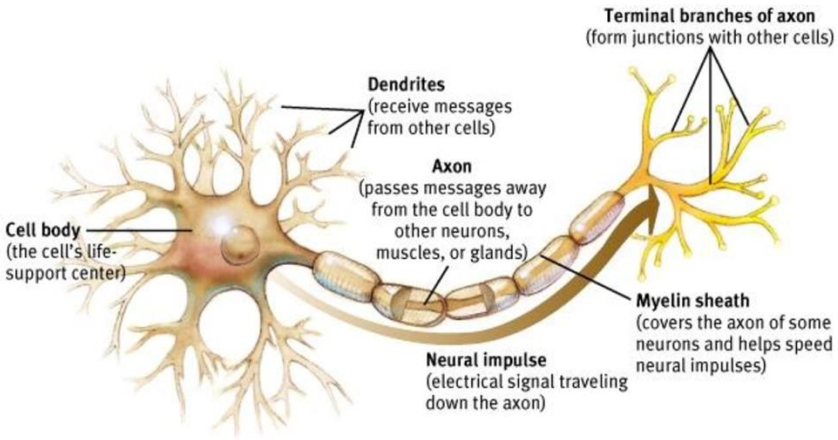
Muscular tissue is tissue with special contractile proteins which allows the body to move by contraction and relaxation. They are of three types, such as:



1. **Striated muscles/skeletal muscles/voluntary muscle: These** muscles are cylindrical, unbranched and multinucleated muscles with dark and light bands.
2. **Unstriated muscles/smooth muscles/involuntary muscles:** These muscles have no striations – this means that they have no dark and light bands. They are commonly found in the alimentary canal, uterus and the iris of an eye. They are spindle-shaped and involuntary in function.
3. **Cardiac muscles:** These are the heart muscles and are cylindrical, branched, uni-nucleate, involuntary with dark and light bands. They have intercalated discs.

4. Nervous tissue

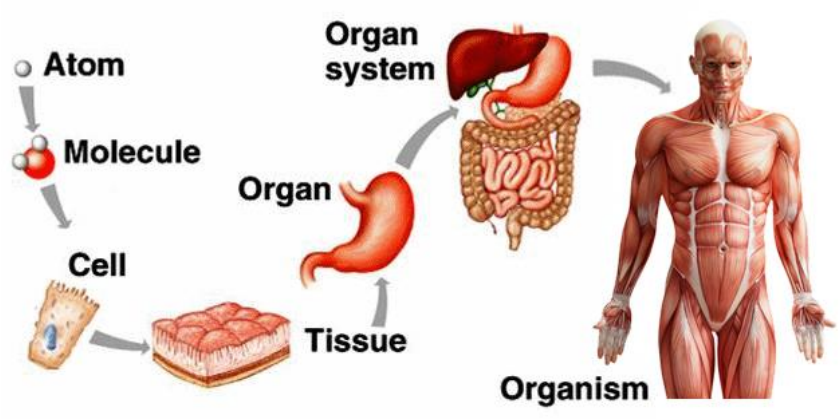
The simplest unit of nervous tissue is a neuron which consists of a cell body, cytoplasm, nucleus, dendrite, axon and nerve endings. It responds to stimuli and transmits information in the form of electrical impulses in the whole body. The brain, spinal cord and nerves are made up of this tissue.



ORGANS

When tissues combine to do a specific job, they are known as an organ. For example, the skin is an organ which is made of hair tissue, oil and sweat gland tissues, nerve tissue, blood tissue and many other tissues.

- Cells combine to form tissues, tissues make organs, organs make organ systems, and all organ systems together make an organism.



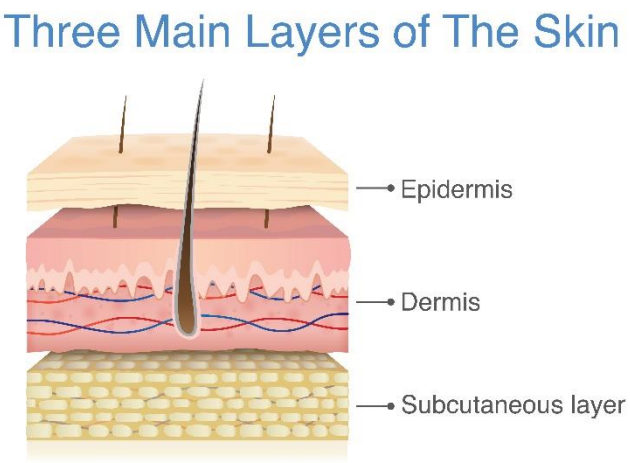
THE INTEGUMENTARY SYSTEM

This is the largest body system consisting of skin, hair and nails. It is made up of epithelial tissue, connective tissue and nervous tissue and has oil and sweat glands. It is made up of two layers, the epidermis and the dermis.

THE SKIN

THE EPIDERMIS

The epidermis is the outer layer which contains living and dead cells. Dead cells are replaced by living cells which, when they die, are peeled off. Pigment known as 'melanin' which gives colour to the skin is present in the living cells called ‘melanocytes'. The epidermis has no blood vessels but has nerve endings.



THE DERMIS

The dermis is the middle layer of the skin which is made up of connective tissue. It consists of blood vessels, nerves, sweat glands, oil glands and hair roots.

SUBCUTANEOUS

Is the inner most layer of the skin. It consists largely of fat interspersed with blood vessels and nerves, providing insulation from the cold, structural support, and shock absorption.

Functions

The skin is involved in the protection of the human body and regulation of the human body's internal functions in several ways, such as:

- Protection of the body's internal living tissues and organs
- Protection against infectious organisms such as preventing the entry of bacteria and other substances
- Protection from dehydration
- Regulation of body temperature by vasodilation (blood vessels dilate) when the temperature outside the body is high and vasoconstriction (blood vessels become narrow) when the temperature outside the body is low.
- Helps in the disposal of waste materials
- Nerve endings present in the skin act as a receptor for touch, pressure, pain, heat and cold
- Acts as a storage for water and fat

MUSCULOSKELETAL SYSTEM

The musculoskeletal system of the human body consists of bones, joints and muscles. It provides the framework for the body and allows the body to move. This system provides protection to the body and gives the body its shape.

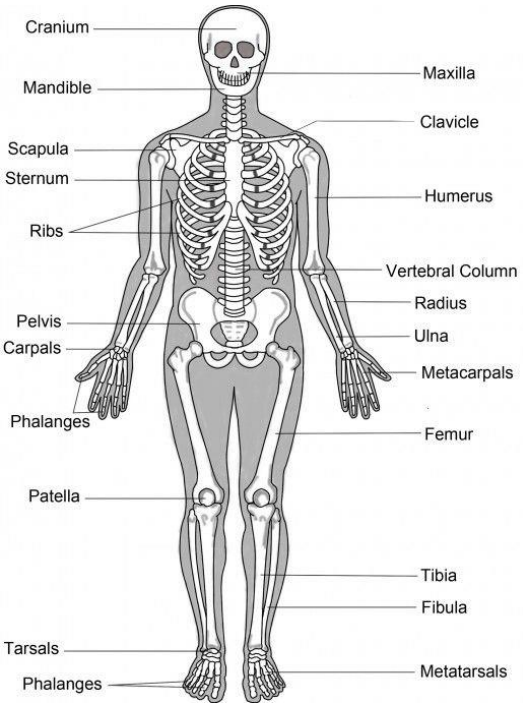
BONES

There are 206 bones in the human body. Distribution of bones in the human skeleton is as follows:

Skull (cranium and face)	**= 22 (8+14)**
Ears	**= 6**
Hyoid	**= 1**
Vertebral column	**= 26**
Sternum	**= 1**
Ribs	**= 24**
Pectoral girdle and fore limbs	**= 64**
Pelvic girdle and hind limbs	**= 62**

There are four types of bones, including:

1. **Long Bones:** Long bones bear the weight of the body. For example, leg bones (the femur).
2. **Short Bones:** Short bones help in skill and ease in movement. For example, the wrist bones (carpals), the finger bones (phalanges), the bones in the ankles (tarsals) and the toes (phalanges).
3. **Flat bones:** Flat bones protect the organs—for example, the sternum, skull bones and shoulder blades.
4. **Irregular bones:** Irregular bones form the vertebrae in the spinal cord, which allows a certain degree of movement and flexibility.



Bones are hard and rigid structures made up of living cells which are covered by a membrane called the periosteum. The periosteum consists of blood vessels that supply oxygen and food to the bone cells. The central region of the bone is soft and is called bone marrow. Formation of blood cells takes place in the bone marrow.

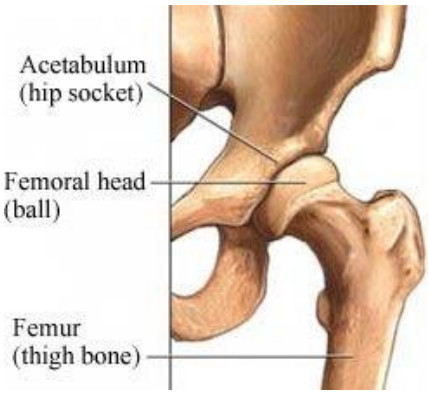
JOINTS

Joints are the part of the human skeletal system where two or more bones meet or join, which allow movement of the bones. Cartilage acts as a cushion in-between the bones or at the end of long bones so that the bones do not rub with each other. There is a membrane known as 'synovial membrane' which secretes synovial fluid which acts as cushioning between the joints.

There are three types of joints in the human body:

1. **Ball-and-Socket Joint:**

   A ball-and-socket joint is a class of synovial joints consisting of two bones, one with a spherical head and other bone with a cup-like socket. Movement takes place when the round end of one bone moves freely in the hollow end of other bone. This joint allows for the most amount of motion—for example, shoulder and hip joints.

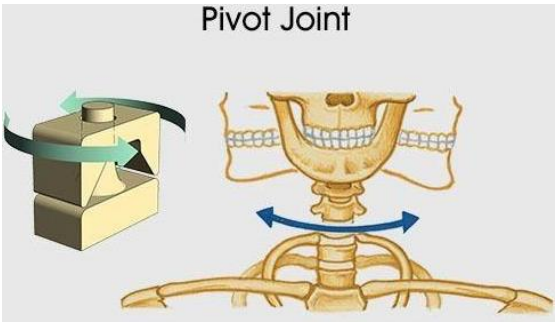


2. Hinge joint:

A hinge joint is a common class of synovial joint which allows movement only in one direction. For example, the ankle, elbow and knee joint.

3. Pivot Joint:

The pivot joint allows the movement from side to side. For example, the skull is pivoted on the spine.



MUSCLES

There are nearly 500 muscles in the human body. Some of the muscles are under our control and known as 'voluntary muscles', and some of the muscles are not under our control and are known as 'involuntary muscles'.

As discussed above, muscles are categorised into:

Voluntary muscles	Involuntary muscles	Cardiac muscles
• Known as skeletal or striated muscles • Have striations (dark and light bands) • Multinucleated • Consciously controlled • For example, leg muscles	• Known as smooth or non-striated muscles • Do not have striations (dark and light bands) • Uni-nucleated • Work automatically • For example, stomach muscles, intestinal muscles	• Known as the heart muscles • Have striations and intercalated discs • Uni-nucleated • Work automatically • Present only in the heart

Functions of muscles:

- Movement of body parts
- Maintenance of posture
- Production of body heat
- Tendons connect muscles to bones and help in the movement

NERVOUS SYSTEM

The smallest structural and functional unit of the nervous system is a nerve cell. The nervous system controls, directs and coordinates body functions. It is categorised into two main divisions:

- The Central Nervous System (CNS) which consists of the brain and spinal cord
- The Peripheral Nervous System (PNS) which consists of nerves throughout the body

Nerves carry messages in the form of the impulses to and from the brain. Some of the nerves are covered by myelin sheath and are known as myelinated nerve fibres which help to speed up the electrical impulses.

THE CENTRAL NERVOUS SYSTEM

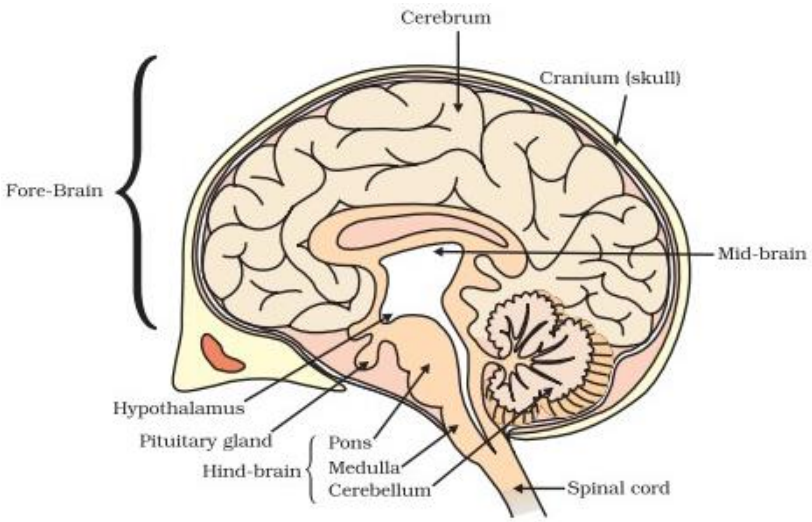
The CNS consists of the brain and spinal cord. The brain and spinal cord have coverings that are made up of three different layers of connective tissue. These layers are known as meninges:

1. **Dura mater:** Outermost tough layer that lies next to the skull
2. **Arachnoid:** Middle layer
3. **Pia mater:** Inner layer

The space between these layers is filled with a fluid called cerebrospinal fluid (CSF). It acts as a mechanical shock absorber and protects the central nervous system as well as its structures.

Brain

The brain is considered to be one of the largest and most complex organs of the human body. It is made up of more than 100 billion nerves. Nerves communicate with the help of connections called synapses.



The brain is divided into different areas which are as follows:

- **Forebrain: The Cerebrum**
- **Midbrain**
- **Hindbrain:** The Pons, Medulla oblongata and Cerebellum

The cerebrum, cerebellum and brainstem are the main parts of the brain. The brain is divided into different lobes such including the frontal lobe (front side), parietal lobe (upper side), temporal lobe (left and right side of the brain) and occipital lobe (the back side from where the spinal cord starts).

Cerebrum

The cerebrum is the largest part of the brain. It is divided into two halves, known as the left and right cerebral hemispheres. The left hemisphere controls the right hemisphere. The outside of the cerebrum is known as the cerebral cortex.

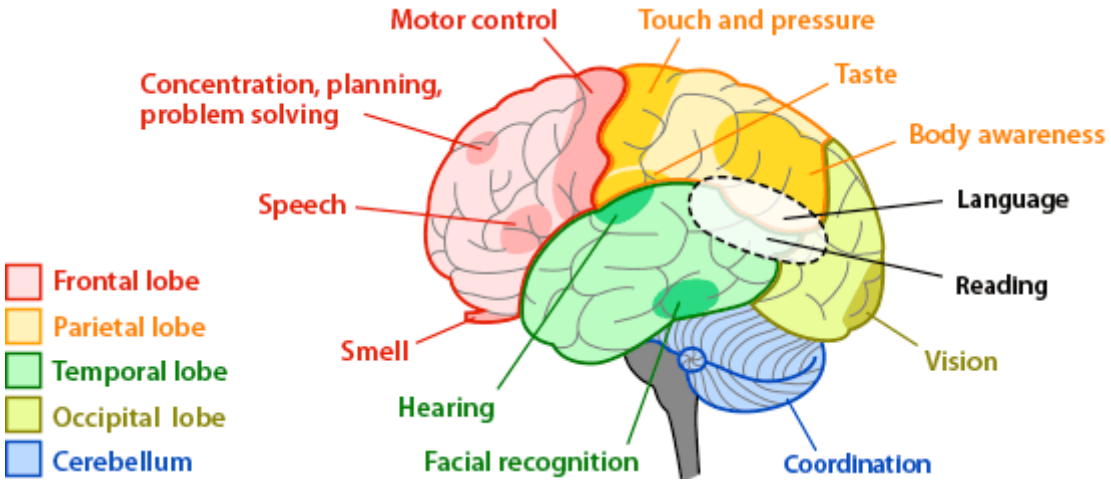
Cerebellum

The cerebellum is the second largest part of the brain. It is one of the parts of the hindbrain.

Brainstem

The brainstem is the part of the brain which connects cerebrum to the spinal cord. The midbrain, pons and medulla form the brainstem. The medulla is below the pons and brain and connects to the spinal cord at the lower end of the medulla oblongata.

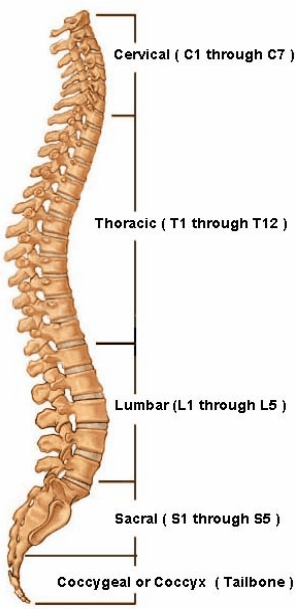
Functions of Brain



- The cerebrum is the centre of thought and intelligence.
- The right hemisphere controls movement and activities of the left side of the body and left hemisphere controls the right side.
- The cerebral cortex controls the maximum number of functions of the brain, for example, reasoning, memory, consciousness, speech, voluntary actions, vision, hearing, sensation and other activities.
- The cerebellum regulates and coordinates body movement. It controls the balance of the body by controlling voluntary muscles. Injury to the cerebellum leads to an imbalance of the body.
- The midbrain and pons relay messages between the medulla and cerebrum.
- The medulla mainly controls involuntary actions such as heart rate, breathing, blood vessel size, swallowing, coughing and vomiting.

Spinal cord

The spinal cord is a long run of nerves from the base of the brain within the spinal/vertebral column through the backbone. Pairs of nerves emerge from the sides of the spinal cord between the bony arches of the vertebrae.



The spinal cord is divided into the following regions:

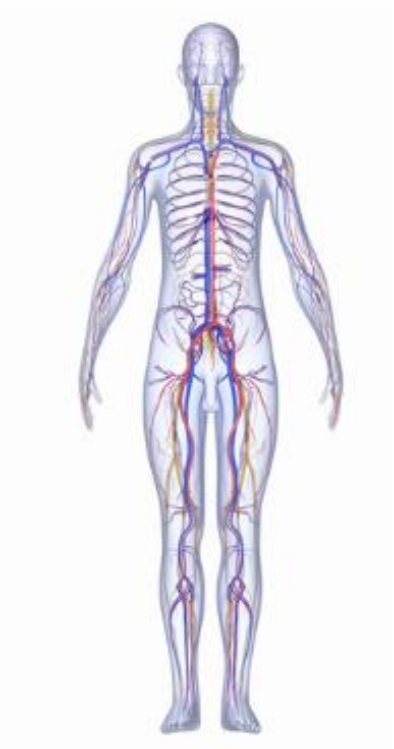
- Cervical (neck)
- Thoracic (chest)
- Lumbar (abdominal)
- Sacral (pelvic)
- Coccygeal (tailbone)

Functions of the spinal cord

- **Electrical communication:** Communication between the spinal cord and different sections of the body and the brain mainly takes place with electrical impulses.
- **Walking:** Is controlled and coordinated by several groups of neurons called central pattern generators. These neurons help in walking by causing contraction and relaxation of the leg muscles.
- **Reflex action:** An involuntary action to the stimuli that involve the brain, spinal cord and the nerves of the Peripheral nervous system.

THE PERIPHERAL NERVOUS SYSTEM (PNS)

- **Cranial nerves:** These are 12 pairs of nerves which are connected to the brain.
- **Spinal nerves:** These are 31 pairs of nerves which are connected to the spinal cord.

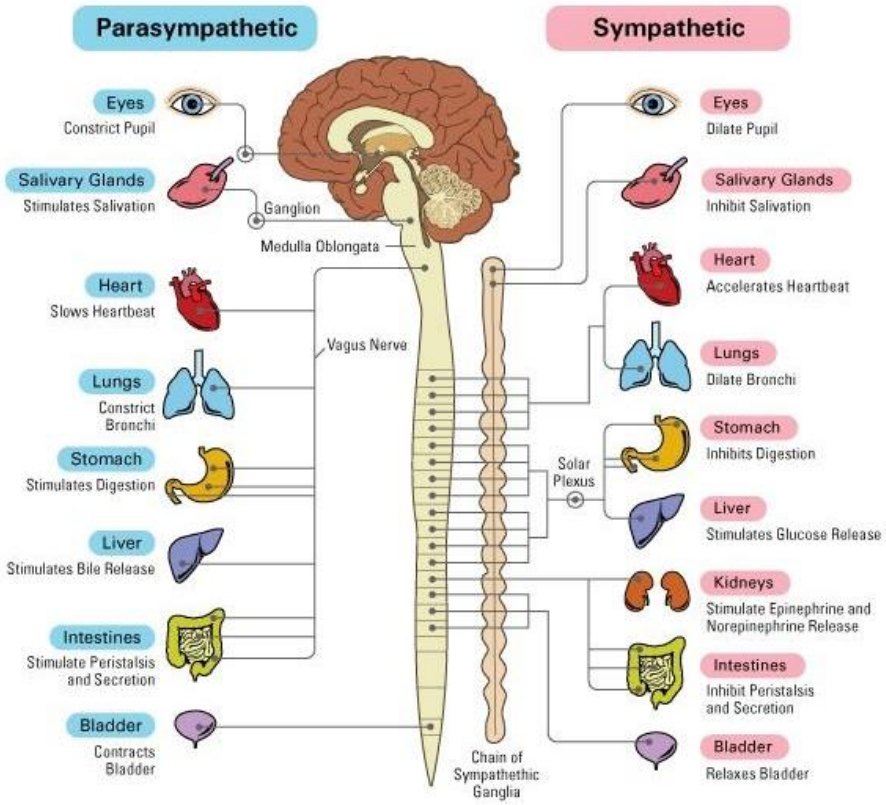


AUTONOMIC NERVOUS SYSTEM (ANS)

The ANS is formed by some of the peripheral nerves. It controls involuntary muscles of the body and other body functions including heartbeat, blood pressure, intestinal contractions and glandular secretions. This system is divided into:

- Sympathetic nervous system
- Parasympathetic nervous system

These two systems are antagonistic to each other in function. They balance one another.



Functions:

Cranial nerves:

- Conduct impulses between the brain and the head, neck, chest and abdomen
- Conduct impulses for smell, vision, hearing, pain, touch, temperature and pressure
- Conduct impulses for involuntary and voluntary muscles

Spinal nerves:

Carry sensory, motor and automatic signals between the spinal cord and the body.

The autonomic nervous system (ANS):

- The sympathetic nervous system tends to catalyse the functions
- The parasympathetic nervous system slows down the functions of the body

For example:

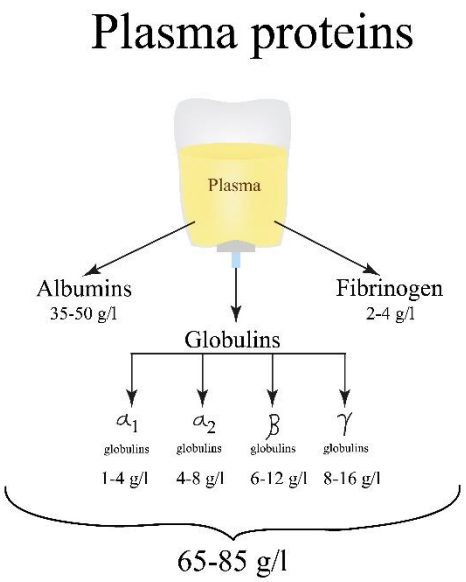
When a person is in a condition such as anger, fear, excitement or exercise, the sympathetic nervous system is stimulated and speeds up the body functions like pumping of heart, breathing, blood pressure and stimulates adrenaline in the body. During the condition of relaxation, the parasympathetic nervous system gets activated to slow the body functions catalysed by the sympathetic nervous system to normal.

CIRCULATORY SYSTEM

The circulatory system consists of the heart, blood and blood vessels. The heart is the organ which pumps the blood to the different parts of the body through blood vessels.

BLOOD

Blood is a body fluid which consists of formed elements (blood cells) and plasma.



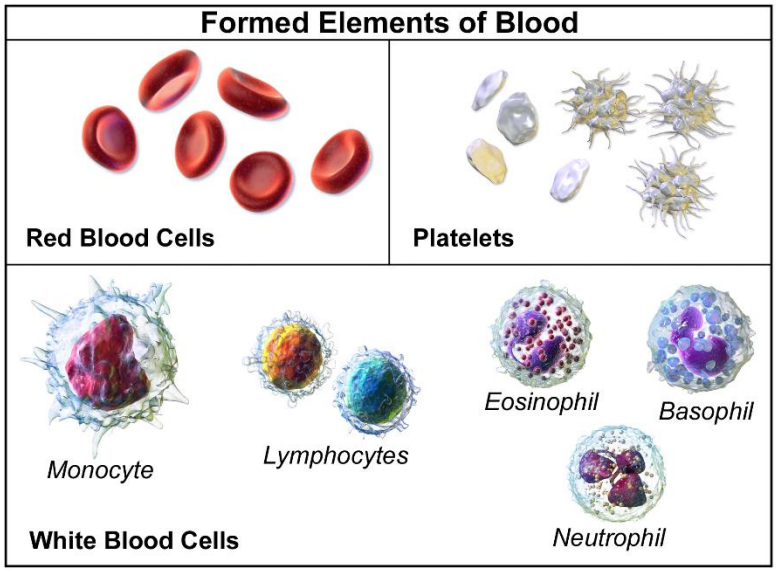
Plasma

Plasma is a straw-coloured, viscous fluid which forms the base substance of the blood. It constitutes 55% of the blood with 90-92% water and 6-8% proteins in it. It contains food, hormones, chemicals and waste products as well. Proteins present in the blood plasma are fibrinogen, globulins and albumins.

Functions of the proteins are:

- **Fibrinogens**: Clotting of blood
- **Globulins**: Defence mechanisms
- **Albumins:** Osmotic balance

Formed elements



Erythrocytes, Leucocytes and Platelets, the blood cells present in the blood plasma, are called formed elements and constitute 45% of the blood.

Erythrocytes

Erythrocytes or red blood cells (Red blood cells) have a red coloured, iron-containing complex protein called haemoglobin. Haemoglobin carries the oxygen to the whole body through the lungs, cells and the heart. Haemoglobin gives red colour to the blood. A healthy individual has 12-16gms of haemoglobin. Red blood cells are enucleated and biconcave in structure, having no cellular organelles. They have a life span of 120 days. New red blood cells are born in the bone marrow and old red blood cells are destroyed in the liver, bone marrow and spleen.

Leucocytes

Leucocytes are also known as White Blood cells (WBCs). They are colourless due to the lack of haemoglobin and are nucleated. They are generally short-lived. There are 5000-10,000 WBCs in a cubic millimetre of blood. The major function of the WBCs is to fight against infections, and they act as the 'soldiers of the body'. They live for about nine days. They are divided into two main categories, including:

- Granulocytes, the different types of granulocytes include:
  - Neutrophils which are phagocytic cells that destroy foreign organisms by phagocytosis
  - Eosinophils are associated with allergic reactions and resist infections
  - Basophil secrete histamine, serotonin, heparin etc. and create an inflammatory response to infections
- Agranulocytes, the different types of agranulocytes include:
  - Lymphocytes, there are two major types of lymphocytes that are called B-Lymphocytes and T-Lymphocytes, which are responsible for immune responses in the body
  - Monocytes kill foreign organisms by phagocytosis

Platelets

Platelets (Thrombocytes) are formed in the bone marrow and are involved in the blood coagulation or clotting. The life of a platelet is four days. They are about 200,000 to 400,000 in a cubic millimetre of blood.

Blood groups

Two types of blood groupings which are widely used all over the world are:

1. ABO grouping
2. Rh grouping

ABO grouping

This grouping is based on the presence or absence of the antigens on the surface of the red blood cells, namely A and B and of the two different types of antibodies in the plasma of the blood. It results in the blood groups of four types A, B, AB and O. Blood transfusion is done according to the matched blood group of a donor and recipient which is given in the table below:

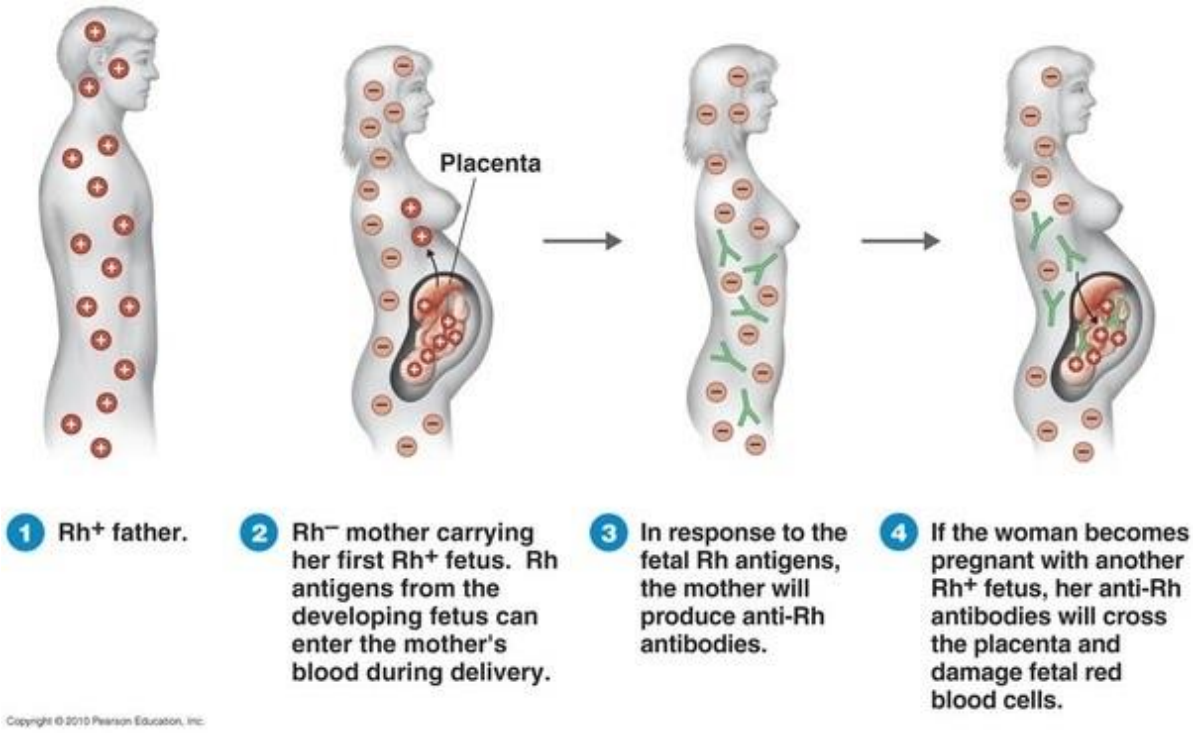
Blood Group	Antigens on red blood cells	Antibodies in Plasma	Donor's Group
A	A	Anti-B	A, O
B	B	Anti-A	B, O
AB	AB	nil	AB, A, B, O
O	nil	Anti-A, B	O

From the above table, it is evident that the blood group 'O' is a universal donor and blood group 'AB' is a universal recipient.

Rh grouping

The Rh antigen is similar to one present in Rhesus monkeys, and it is present on the surface of the red blood cells of (80%) humans. Humans in which it is present are called Rh-positive (Rh+ve) and in which it is absent are called Rh negative (Rh-ve). Rh+ve can donate and receive blood from Rh+ve and Rh-ve can donate and receive blood from Rh-ve.

A special case of Rh incompatibility (mismatching), between Rh-ve pregnant mother having Rh+ve foetus:



During the first pregnancy and delivery of the first child, the mother's blood encounters the blood of the foetus, and it starts forming antibodies against Rh antigen in her blood. During her first pregnancy, she will deliver the baby normally. However, in subsequent pregnancies, Rh antibodies present in the blood of the mother formed during the first pregnancy will not allow the foetus to survive and destroy it, taking it as a foreign substance. It could cause severe anaemia and jaundice to the baby (erythroblastosis fetalis), which can even cause miscarriage.

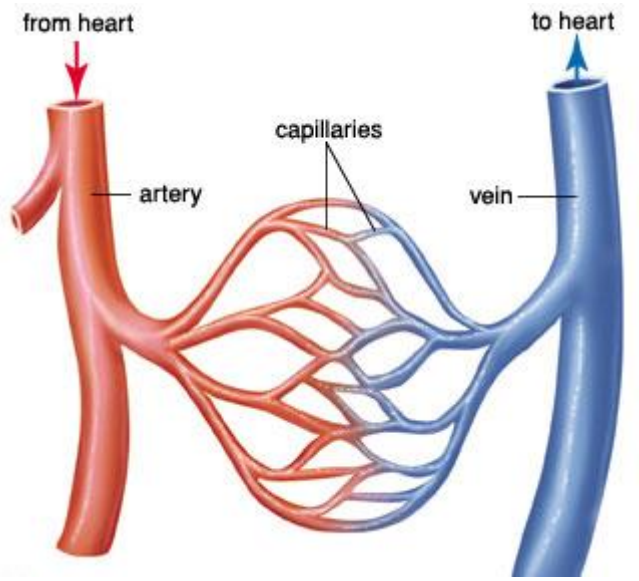
BLOOD VESSELS

Blood flows through blood vessels. There are three groups of blood vessels in the human body which are:

1. Arteries
2. Capillaries
3. Veins

The difference between arteries, capillaries and veins is given below in the table:

Type of Blood Vessel	Artery	Vein	Capillary
Direction of Flow	Away from heart	Towards heart	Both
Thickness of Walls	Thick	Thin	Very thin
Valves	No	Yes	No
Pressure	High	Low	Low
Function	Distributes blood, carries O2 and nutrients	Returns blood, carries CO2 and other wastes	Exchanges O2 and nutrients with cells, picks up CO2 and wastes



HEART

The human circulatory system consists of a muscular chambered heart which pumps blood through the blood vessels to the tissues and cells. It is situated in the thoracic cavity, between the lungs towards the left side. It is the size of a clenched fist and consists of three layers:

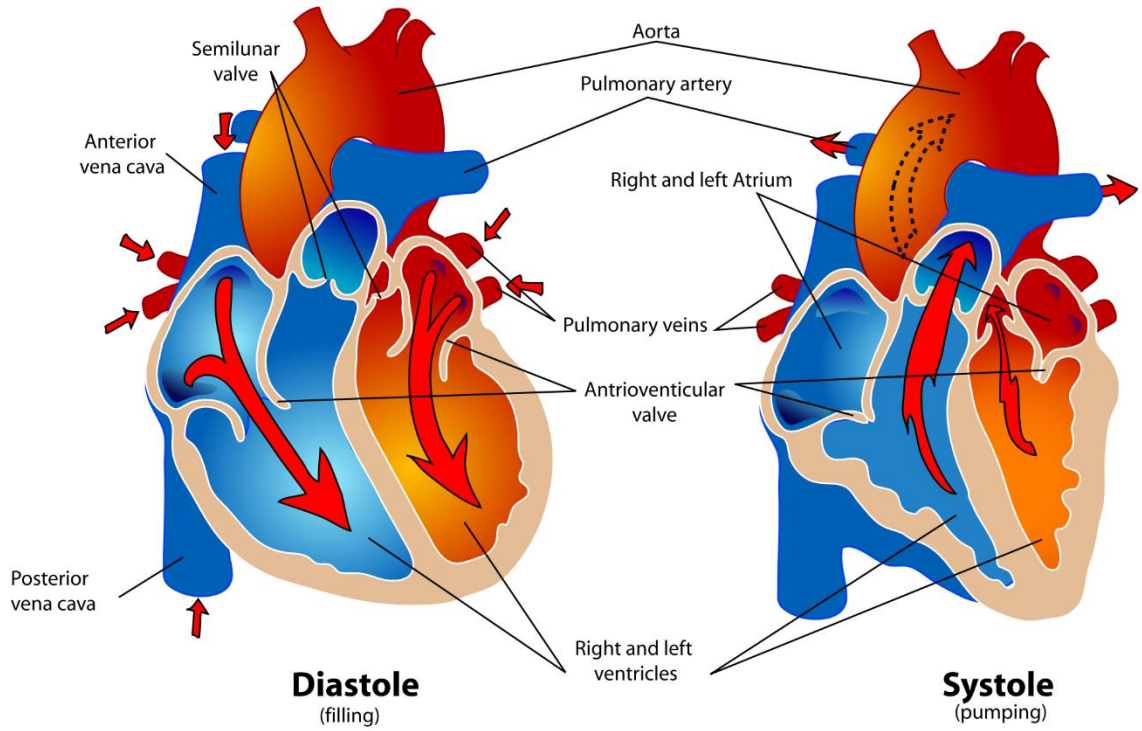
1. The **pericardium** is the thin outer layer which covers the heart enclosing the pericardial fluid
2. The **myocardium** is the second layer next to the pericardium, which is the muscular portion of the heart
3. The **endocardium** is the innermost layer and the inner membrane lining of the heart

STRUCTURE

The heart consists of four chambers. Two relatively small upper chambers are called atria, and the two larger lower chambers are called ventricles. The inter-atrial septum divides the two atria, and inter-ventricular septum divides the left and right ventricles. The atrium and the ventricles are also divided by thick fibrous tissue called the atrioventricular septum.

There are valves present at the junction of the atria and ventricles that allow unidirectional flow of the blood in the heart and prevent the backflow of blood. The tricuspid valve is present between the right atrium and right ventricle, and the mitral and bicuspid valves are present in the left atrium and left ventricle respectively. The right and left ventricles open into the pulmonary artery and the aorta respectively and are provided with the semilunar valves.

A specialised cardiac musculature called the nodal tissue is present in the heart. The sino-atrial node (SAN) is the patch of this tissue present in the right upper corner of the right atrium, and the atrioventricular node (AVN) is present in the lower-left corner of the right atrium close to the atrioventricular septum. A bundle of nodal fibres, atrioventricular bundle (AV bundle) continues from the AVN which passes through the atrioventricular septa to emerge on the top of the interventricular septum and immediately divides into a right and left bundle. These branches give rise to minute fibres throughout the ventricular musculature of the respective sides and are called Purkinje fibres. These fibres along with right and left bundles are known as Bundle of His. It is auto-excitable and is responsible for initiating and maintaining the rhythmic contractile activity of the heart. Therefore, it is called the pacemaker. Our heart normally beats 70-75 times in a minute.



CARDIAC CYCLE

The cardiac cycle is the description of the functioning of the heart in different phases. These different phases are:

1. **Joint diastole** - when all the four chambers of the heart are in a relaxed state (atria and ventricles). It lasts 0.4 seconds.
2. **Atrial systole** - the contraction of the walls of both atria through the bicuspid and tricuspid valves into their respective left and right ventricles. This contraction is caused because of signalling from the SAN, the systole lasts 0.1 second. Blood in the atria comes from the vena cava and pulmonary veins. Pulmonary veins carry oxygenated blood to the left side of the heart, and vena cava from the upper and lower body carries deoxygenated to the right side of the heart. Semilunar valves remain closed during this time.
3. **Ventricular systole** - SAN transfers action potentials to the AVN and AV bundle which causes contraction of the ventricles. During ventricular systole, atria goes under diastole, and the bicuspid and tricuspid valves get closed. Semilunar valves get opened when the blood is pumped from the left and right ventricles to the aorta and the pulmonary artery. Oxygenated blood is supplied to the whole body through the aorta, and deoxygenated blood is supplied to the lungs through the pulmonary artery. It lasts 0.3 seconds.

This sequential event in the heart which is cyclically repeated is called the cardiac cycle, which lasts 0.8 seconds, 0.4 seconds of contraction and 0.4 seconds of relaxation. So, the amount of energy utilised by the heart during contraction is regained by the next 0.4 seconds. This is the reason why the heart does not get fatigued all through our life.

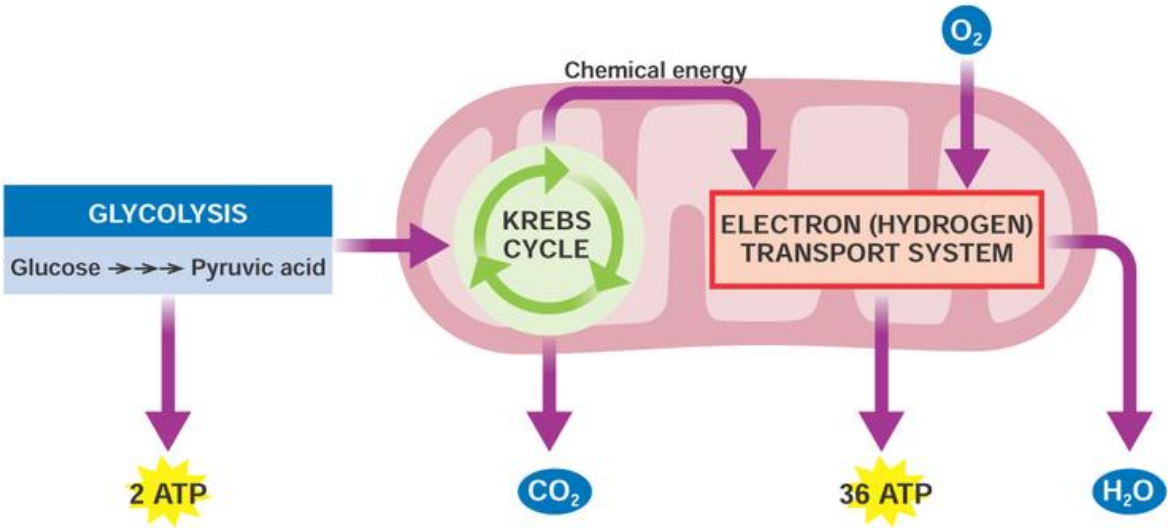
The volume of blood pumped out per minute averages 5000 mL or 5 litres in a healthy individual. During each cardiac cycle, two prominent sounds are produced, which can be easily heard through a stethoscope. The first heart sound (lub) is associated with the closure of the tricuspid and bicuspid valves. In contrast, the second heart sound (dub) is associated with the closure of the semilunar valves. These sounds are of clinical diagnostic significance.

Functions of the circulatory system:

- Pumps the oxygenated blood to the whole body
- Transports oxygen and other nutrients to the whole body
- Fights against infections
- Collects deoxygenated blood from the whole body and sends it to the lungs for oxygenation
- Capillaries provide an exchange of materials
- Regulates body temperature

RESPIRATORY SYSTEM

The human body needs oxygen to survive. Every cell needs oxygen to produce energy in the body to perform several metabolic functions. Oxygen is used for the breakdown of the glucose in the body to release carbon dioxide, water and energy. This process is known as aerobic respiration. It involves inhalation of oxygen and exhalation of carbon dioxide. This physical process of inhalation and exhalation is known as breathing.



ATP: Energy is created in the form of the ATP (Adenosine Triphosphate) molecule which is used to fuel all other activities in the cell. There is a total of 36 ATP molecules produced from one molecule of glucose, and breakdown of one terminal phosphate from ATP releases energy equivalent to 30.5 kJ/mol.

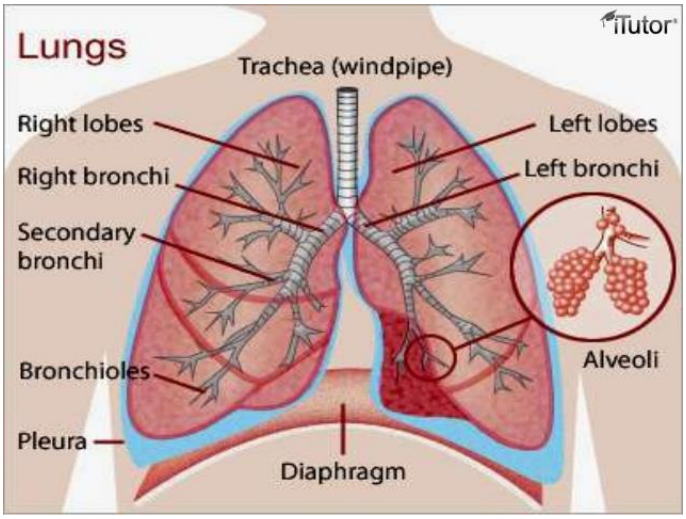
In the human respiratory system, air is inhaled through the nose and is filtered by fine hair and mucus. From here, air passes to the pharynx (throat) and then into the larynx (voice box). The pharynx is the passage for food and air. From here air reaches the trachea (windpipe) which is covered by the epiglottis. The epiglottis is a lid over the windpipe that prevents the entry of food into the windpipe. Rings of cartilage are present in the throat that ensure that the windpipe does not collapse.

The trachea divides into the left and right bronchus which enter the left and right lung respectively. Bronchi divide into bronchioles which are further sub-divided into tiny one-celled air sacs called alveoli. The alveoli contain an extensive network of blood vessels that provide a surface where the exchange of gases (oxygen and carbon dioxide) can take place.

Each lung is covered by a layer called pleura, which secretes a thin fluid called pleural fluid in-between the layers. This fluid prevents the friction between the layers and acts as a cushion for the lungs. Lungs are covered by the ribs, sternum and vertebrae.

When we breathe in, we lift our ribs and flatten our diaphragm, and the chest cavity becomes larger as a result. Because of this, the air is sucked into the lungs and fills the expanded alveoli. The blood brings carbon dioxide from the rest of the body for release into the alveoli, and the oxygen in the alveolar air is taken up by blood in the alveolar blood vessels to be transported to all the cells in the body.

During the breathing cycle, when air is taken in and let out, the lungs always contain a residual volume of air so that there is sufficient time for oxygen to be absorbed and for the carbon dioxide to be released.



Functions of the respiratory system:

- Exchange of gases takes place in the lungs
- Removes carbon dioxide from the body and provides oxygen to the body

THE DIGESTIVE SYSTEM

The breakdown of food physically and chemically so it can be absorbed and used by the cells of the body is called digestion. It consists of an alimentary canal which is essentially a long tube extending from the mouth to the anus. The following content will outline how digestion starts several parts of the alimentary canal:

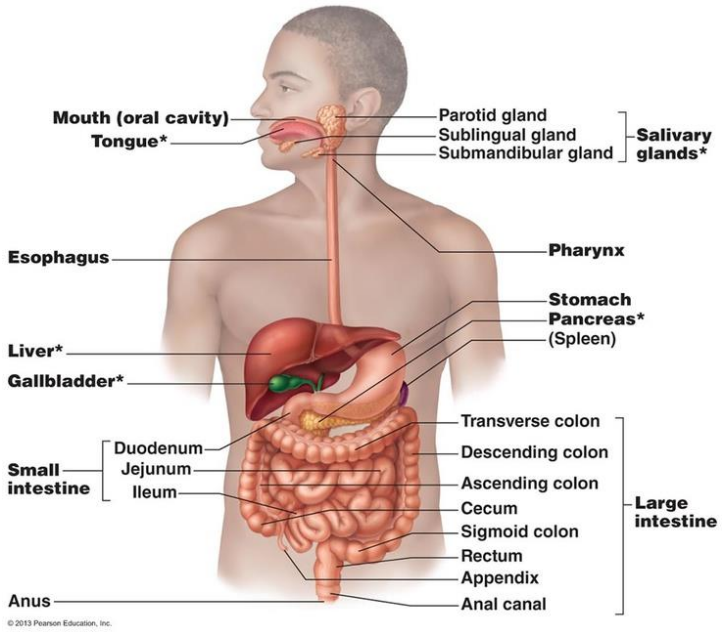
MOUTH

Teeth, tongue and saliva from the salivary glands present in the mouth play their role in the digestion of the food. Ingestion is the initial step of digestion, in which the food enters through the mouth.

- **Teeth** – There are two sets of teeth, the first are milk teeth which are the temporary teeth; there are 20 milk teeth. Once milk teeth fall out, a new set of permanent teeth erupt; there are 32 permanent teeth. There are four types of teeth present: namely canines, incisors, premolars and molars. Molars are absent in milk teeth. Crushing and grinding of food is the main function of teeth.
- **The tongue** – has taste buds which recognise four tastes, namely sweet, sour, bitter and salty. After tasting, the tongue helps to mix the food with the saliva thus converting it into a bolus which is easily swallowed on its way through to the oesophagus.
- **Salivary glands** – Parotid glands, sub-mandibular glands and sublingual glands are the three types of salivary glands which collectively secrete saliva in the mouth. It moistens the food and digests the carbohydrates present in the food with the release of an enzyme called salivary amylase or ptyalin. **Starch (Complex sugar) → Sugar (via Salivary amylase).**

THE OESOPHAGUS

Ground and crushed food mixed with saliva is transferred to the oesophagus (25cm long) which is pushed to the stomach with the help of the movement of the muscles of the canal. This movement of muscles is called peristalsis. There is no digestion in the oesophagus.



(Disclaimer * indicates this organ is an accessory organ and not part of the digestive system)

THE STOMACH

The stomach is a muscular, j-shaped, pouch-like sac in the upper left part of the abdominal cavity. The muscular walls of the stomach expand when food enters it and help in mixing the food thoroughly with more digestive juices. Chyme is formed when food gets mixed with gastric juices. Backflow of chyme is prevented by a sphincter called the esophogeal sphincter. Vomiting occurs when the muscles of the sphincter get weak or loose. Gastric juices released by the stomach contains:

- ***HCl**:* Hydrochloric Acid which helps to destroy any microbe that enters the stomach through the mouth. It makes the pH 1.5-2.0, which is highly acidic so that the enzymes in the digestive juice get activated.
- ***Mucus**:* As the HCl makes the environment in the stomach highly acidic, mucus is secreted by the walls of the stomach to prevent the walls of the stomach from erosion.
- ***Pepsin**:* It is a proteolytic enzyme which is present in the inactive form of pepsinogen. Once it is activated by HCl, pepsin breaks down the proteins in the food eaten into simpler forms of peptones and proteases.

  Protein (complex form) ⇒ Peptones, dipeptides, proteases (Pepsin)

  In infants, Renninogen is present instead of pepsinogen as they feed only on the milk protein Rennin. The exit of food from the stomach is regulated by a sphincter muscle which releases it in small amounts into the small intestine. The pyloric sphincter prevents backflow of the food from the small intestine to the stomach.

THE SMALL INTESTINE

The small intestine is the longest part of the alimentary canal and is the site of the complete digestion of carbohydrates, proteins and fats. It is divided into three sections called the duodenum, jejunum and ileum. The duodenum receives the secretions from the liver and pancreas.

The Liver is a two-lobe (right and left lobe) structure located in the upper right side of the abdomen, below the diaphragm.

- The liver makes the juice called bile juice which gets stored in the gall bladder and is released according to need in the small intestine through a duct called the bile duct.
- Bile juice emulsifies the fat molecules and makes them available for digestion
- Bile juice makes the medium alkaline as the pancreatic enzymes and the intestinal enzymes act only in an alkaline medium.

PANCREAS

Juice released by the pancreas through the pancreatic duct into the small intestine is known as the pancreatic juice, which can only work in an alkaline medium. It contains enzymes:

- Trypsin, which is used for digesting proteins
- Lipase, which breaks down emulsified fats
- Pancreatic amylase, which breaks down complex sugars into simpler ones

INTESTINAL JUICE

Clear to pale yellow, watery secretion composed of hormones, digestive enzymes, mucus, and neutralizing substances released from the glands of the jejunum is called intestinal juice. The small intestine is the coiled part of the alimentary canal and has finger-like projections on its surface called villi. The enzymes present in it finally convert the proteins to amino acids, complex carbohydrates into glucose and fats into fatty acids and glycerol.

ABSORPTION

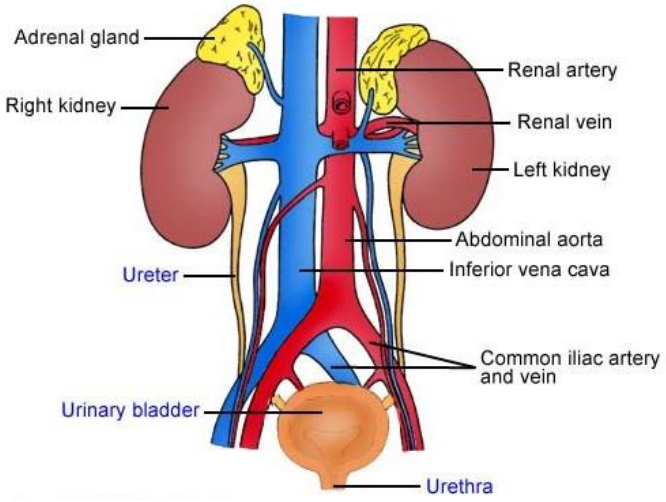
The digested food is taken up by the walls of the intestine and absorbed by villi. Finger-like projections increase the surface area for absorption. The villi are richly supplied with blood vessels which take the absorbed food to every cell of the body, where it is utilised for energy, building up new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

THE LARGE INTESTINE

The large intestine is divided into sections including the caecum, ascending colon, transverse colon, descending colon, appendix, it then joins the rectum and anus. Undigested food from the ileum enters the large intestine through caecum from where it goes to the ascending colon, then transverse and moves towards the descending colon. From the descending colon, it enters the rectum and gets passed out of the body through the anus. Excess water is reabsorbed in the large intestine. Removal of undigested food is called defaecation, and the anal sphincter regulates the exit of waste.

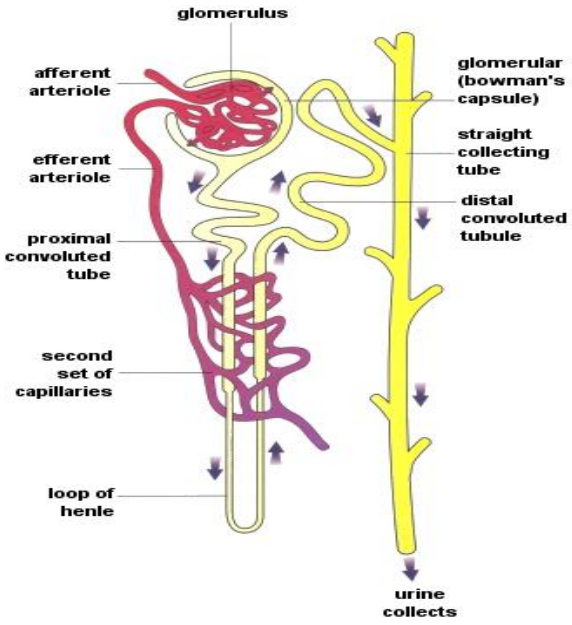
URINARY SYSTEM

Removal of the harmful metabolic waste from the human body is called excretion. The excretory or urinary system of the human body consists of a pair of kidneys, a pair of ureters, a urinary bladder and a urethra. The kidneys are located in the abdomen, one on either side of the backbone.



The **kidneys** are two bean-shaped organs in the upper abdomen that lie against the muscles of the back, on each side of the spine and are protected by the lower edge of the rib cage. Each kidney has over a million tiny filtering units called nephrons. The nephron is the basic structural and functional unit of the kidney.

Nephron: The nephron is the convoluted tiny coiled tubule. One end of the nephron is cup-shaped and known as the Bowman's capsule, and it partially surrounds a cluster of capillaries called the Glomerulus. Blood gets filtered through the fine capillaries of the Glomerulus, and the fluid portion of the blood passes to the Bowman's capsule.



From the Bowman's capsule, it passes into the tubule where most of the necessary substances are reabsorbed back into the blood. The rest of the fluid and waste products (mainly urea) forms the urine in the tubule. Urine is collected from the millions of collecting tubules within the nephrons and drains into the renal pelvis within the kidney.

The urine that is formed in each kidney will eventually enter a long tube called the ureter that connects the kidneys with the urinary bladder. The urine will be stored in the urinary bladder until it is passed out through the urethra from the pressure of the expanded bladder. The bladder is muscular; therefore, it is under nervous control. As a result, we can usually control the urge to urinate.

Urine is clear, yellowish fluid which is passed through the urethra. Passing out of urine is called urination or micturition.

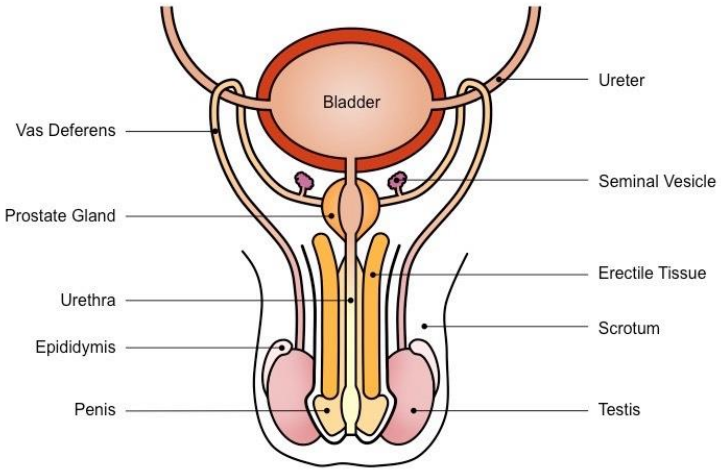
REPRODUCTIVE SYSTEM

Human reproduction is the type of sexual reproduction which is a union of female sex cell and male sex cell. In humans, structures of the female and male reproductive system are different from each other that include external genitalia and internal organs known as gonads.

MALE REPRODUCTIVE SYSTEM

The male reproductive system includes:

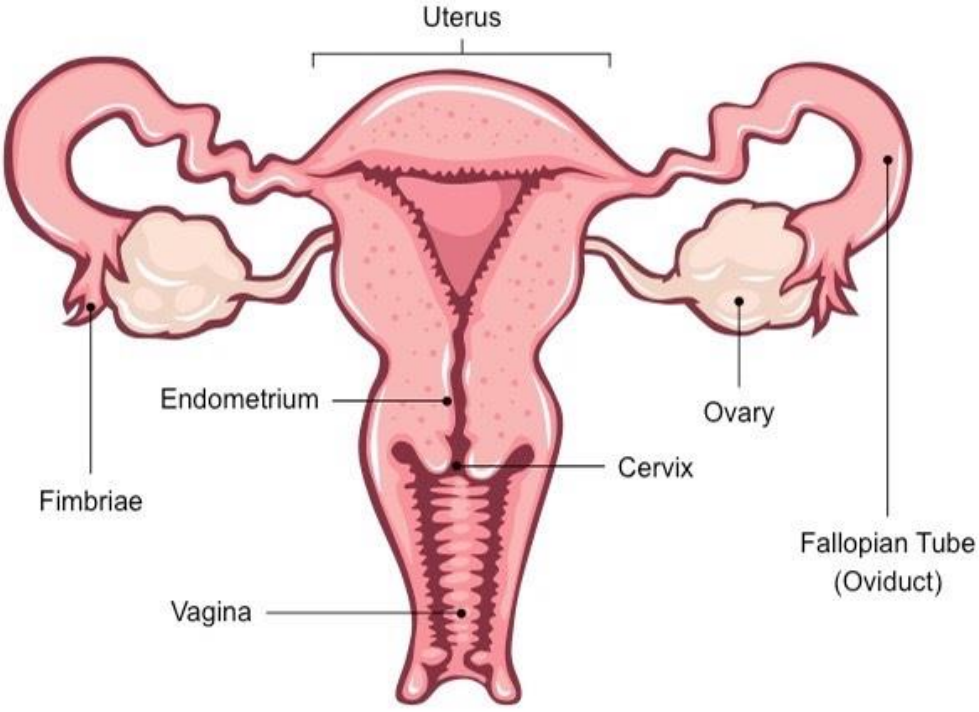
- **Testes (Testicles)** - these are sex glands called gonads. There is one pair of oval or almond-shaped glands. Male sex cells or sperm formation takes place in testes. It also produces hormone testosterone which is essential for the functioning of gonads and secondary sex characters in male such as facial hair, pubic and axillary hair, the hair on the arms, the hair on chest and legs, deepening of the voice, broadening of shoulder and neck muscles.
- **The scrotum** - testes are surrounded in a sac-like structure called the scrotum. It lies outside the male body as the sperm formation needs 2-3^{0}C cooler temperature than the body temperature.
- **The epididymis** - is a coiled tube on top and to the side of the testis where sperms enter from the testis.
- **Vas deferens** - sperms enters the duct from epididymis known as vas deferens. It takes the sperms inside the abdomen of the human body where it joins with the seminal vesicle.
- **The seminal vesicle** - there is a pair of seminal vesicles that store sperm and produce semen. Semen is a fluid which acts as a medium that carries sperm from the male reproductive tract.
- **The ejaculatory duct** - the duct of the seminal vesicles from each side combine to form ejaculatory duct from where semen is ejaculated.
- **The prostate gland** - lies below the urinary bladder and is present only in males. It is the shape of a donut and secretes fluid into the semen.
- **The urethra and penis** - the ejaculatory duct combines with the urethra and forms the single opening outside the body through the penis. It is the common duct for the passage of urine and semen but at one-time urethra can either pass semen or urine. The penis is the muscular erectile tissue which gets filled with blood when a man becomes sexually active or ready for sexual intercourse. It is used for penetration into the vagina of the female reproductive organ to release semen in it during sexual intercourse.



FEMALE REPRODUCTIVE SYSTEM

The female reproductive organs or gonads are two almond-shaped ovaries present on each side of the uterus in the abdominal cavity. It includes:

- **Ovary** - contains ova or egg that are known as the female sex cell. One ova is released monthly, from alternative ovaries, during the age of puberty. The release of ova from the ovary is called ovulation. Ovaries secrete hormones like oestrogen and progesterone that are needed for the functioning of female reproductive organs and female secondary sex characters such as increase in breast size, pubic and axillary hair, slight deepening of the voice and widening and rounding of the hips after the onset of puberty.
- **The fallopian tube** - ovum released during ovulation travels through the fallopian tubes to the uterus. There is a pair of fallopian tubes.
- **The uterus** - is a hollow, muscular, pear-shaped organ known as the womb. The fundus is the main part of the uterus and tissue lining the uterus is called endometrium, which is supplied with many blood vessels. If the fertilisation takes place, then the zygote formed gets implants in the endometrium where it grows into the baby. Here it receives nourishment from mother through the placenta.
- **The cervix** - a narrow section of the uterus is called the cervix
- **The vagina** - the cervix projects into the muscular vagina, which is the outside opening of the female reproductive system. It receives the penis during the sexual intercourse with semen released from the penis. It delivers baby outside the body of the female during labour. In young girls, hymen partially encloses the external vaginal opening.



Menstruation

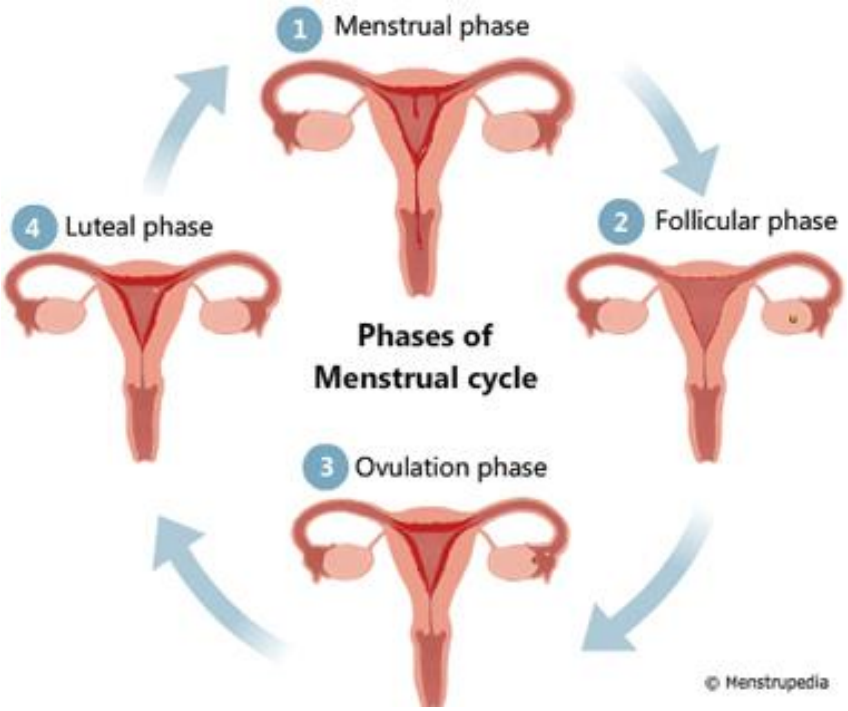
If fertilisation does not occur, then the endometrium formed to nourish the baby is of no use. It is shed down and gets removed from the body in the form of bleeding. It is known as menstruation. It occurs about every 28 days, and therefore, it is called the menstrual cycle.

The first day of the cycle starts with menstruation, and it stays for 3-7 days.

Ovulatory phase- ovulation takes place in this phase in which ova gets released from the ovary about every 14th day of the cycle.

Oestrogen and progesterone thickens the walls of the endometrium. If pregnancy does not take place, then the level of hormones decreases which leads to the breaking of the endometrium wall and another menstrual cycle begins.

The onset of the menstrual cycle is called menarche, and the offset of the menstrual cycle is called menopause. Menarche takes place in the girls at the age of 10-13yrs and menopause at 45-50yrs of age.

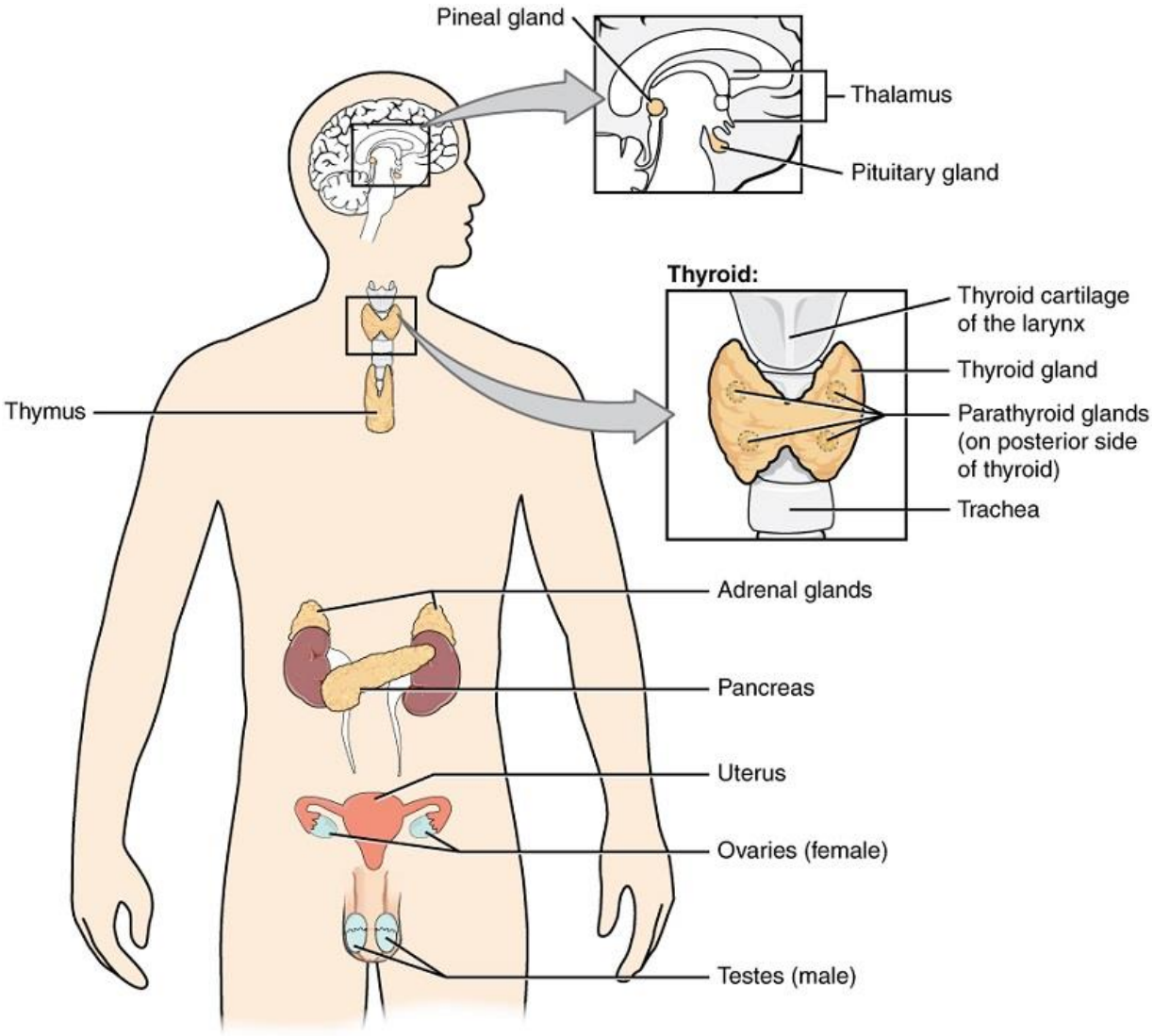


Fertilisation

When ovum from female ovary fuses with the sperm from the male testes, it results in one cell structure called a zygote. This process of fusion of the male and female gamete is called fertilisation.

ENDOCRINE SYSTEM

The endocrine system is a system which is made up of glands known as endocrine glands. Endocrine glands are the ductless glands which secrete hormones directly into the bloodstream. Hormones are the chemical messengers that are specific in their action and regulate the activities of other organs and glands in the body.



GLANDS AND HORMONES

Pituitary gland

The pituitary gland is the master gland which mainly controls all other glands of the body. It is located in the centre of the skull, inferior to the hypothalamus of the brain. The hypothalamus produces hormones to regulate the synthesis and secretion of pituitary gland hormones. It is divided into two lobes which secrete different hormones:

The anterior pituitary lobe secretes:

- Growth hormone:
  - Needed for the growth of muscles, bones and other organs
  - Maintain normal-sized bones throughout life
  - Deficiency causes Dwarfism in which growth is stunted
  - Excessive release causes Gigantism in which there is excessive growth occurs
- Thyroid-stimulating hormone (TSH):
  - Stimulates synthesis and secretion of thyroid hormones from the thyroid gland
- Adrenocorticotropic hormone (ACTH):
  - Stimulates the production of cortisol by the adrenal glands
  - Stimulates synthesis and secretion of steroid hormones called glucocorticoids
- Follicle-stimulating hormone (FSH):
  - Regulate spermatogenesis in males
  - Growth and development of ovarian follicles in females
- Luteinizing hormone (LH):
  - Synthesis and stimulation of androgens in males
  - Helps in ovulation and maintenance of corpus luteum in females
- Prolactin:
  - Growth of mammary glands
  - Formation of milk in mammary glands

The posterior pituitary lobe secretes:

- Antidiuretic hormone (ADH) or Vasopressin:
  - Acts on kidneys to control the amount of water excreted
  - Stimulates reabsorption of water and electrolytes to reduce water loss through urine in kidneys
- Oxytocin:
  - Helps in the contraction of uterine muscles during childbirth
  - Helps in milk ejection from mammary gland in females
  - The nurturing hormone released with touch (hugs, massage etc)

Pineal gland

The pineal gland is located on the dorsal side of the forebrain. It secretes:

- Melatonin to regulate the sleep-wake cycle, menstrual cycle, pigmentation etc.

Thyroid gland

The thyroid gland is shaped like a butterfly which is situated in the neck in front of the larynx (soundbox). Iodine is necessary for the normal functioning of the thyroid gland.

The thyroid gland secretes:

- Thyroid Hormone (TH):
  - Synthesise thyroxine (T4) and triiodothyronine (T3)
  - Regulates metabolism such as oxidation of the food for heat and energy
  - Regulates blood calcium level

Goitre (Hypothyroidism) is caused due to deficiency of TH. It results in enlargement of the thyroid, weight gain, slowed body processes and movements. Stunted growth (cretinism) results in the baby having the deficiency.

Hyperthyroidism is caused due to the excess of the TH. It results in increased metabolism, excess energy and weight loss.

Parathyroid glands

The four parathyroid glands in pairs are present on the back of each side of the thyroid gland. They secrete:

- Parathyroid Hormone or parathormone:
  - Stimulates bone resorption and reabsorption of calcium from blood and reabsorption of calcium by renal tubules

Tetany is a condition of severe muscle contraction and spasm due to a deficiency of calcium or other electrolytes imbalance. It can cause death, if untreated.

Thymus gland

It is located on the dorsal side of the heart and aorta.

It secretes Thymosins (peptide hormones) stimulate the production of T cells - an important part of the immune system - and assists in the development of B cells to plasma cells to produce antibodies.

Adrenal glands

The adrenal glands are located in the anterior part of each kidney and consist of two parts, adrenal medulla and adrenal cortex. The adrenal medulla is centrally located and adrenal cortex at the periphery in the kidney.

The adrenal medulla

The adrenal medulla secretes epinephrine (adrenaline) and norepinephrine (noradrenaline), called catecholamines. These are emergency hormones or hormones of flight and fight. They:

- Stimulate the body to produce more energy during emergencies
- Increase heartbeat, rate of respiration, blood pressure, breakdown of glycogen to release energy, raising of hair, sweating etc.

The adrenal cortex

The adrenal cortex, the outer layer of the adrenal gland, produces regulating hormones that control your metabolism, blood pressure, immune system, and response to stress.

There are three main types of hormones produced by the cortex:

- **Cortisol**, which helps to regulate the body's use of fats, proteins, and carbohydrates; supresses inflammation; regulates blood pressure; increases blood sugar; and can also decrease bone formation
- **Aldosterone**, which regulates the balance of water and electrolytes, and plays a central role in regulating blood pressure); and
- **DHEA and androgenic steroids**, which are small amounts of sex hormones that are converted into estrogens in the ovaries and androgens in the testes. Both of these hormones are produced in much larger amounts in the repective gonads

Pancreas

The pancreas has both exocrine and endocrine functions. The pancreas contains islets of Langerhans which has glucagon secreting α-cells and insulin-secreting β-cells.

- Glucagon (Peptide hormone):
  - Stimulates glycogenolysis in liver cells
  - Stimulates gluconeogenesis
- Insulin (Peptide hormone):
  - Regulates blood sugar level
  - Enhances cellular glucose uptake by stimulating glycogenesis

Diabetes mellitus is a disorder in which the body does not produce enough or respond normally to insulin, causing blood sugar (glucose) levels to be abnormally high and abnormally high glucose in urine.

Gonads

Glands of the human reproductive system are called gonads. Male sex glands are known as testes, and female sex glands are called ovaries. Functions of these gonads are as follows:

- Testes (Androgens): Pair of testes present in the scrotal sac of males.
  - Testosterone (androgens) are secreted by Leydig cells
  - Regulate the development and maturation of male accessory sex organs
  - Formation of secondary sex characters
  - Stimulation of spermatogenesis
  - Influence male sexual behaviour
- Ovaries (Oestrogen and Progesterone): Pair of ovaries present in the abdomen in females.
  - Alternatively, produce an ovum in each menstrual cycle
  - Oestrogen stimulates the growth of female secondary sex organs, female behaviour, mammary gland development and female secondary sex characteristics
  - Progesterone is secreted from the corpus luteum. It supports pregnancy and stimulates alveoli formation and milk secretion in mammary glands

IMMUNE SYSTEM

The immune system defends the body against attacks by 'foreign' invaders. Invaders are the infectious agents such as bacteria, parasites and fungi and other microbes. The main components of the system are the skin and organs of the lymphatic system, bone marrow, white blood cells and antibodies. This system protects the body from diseases and infections, and this protection is called immunity. There are two types of immunity:

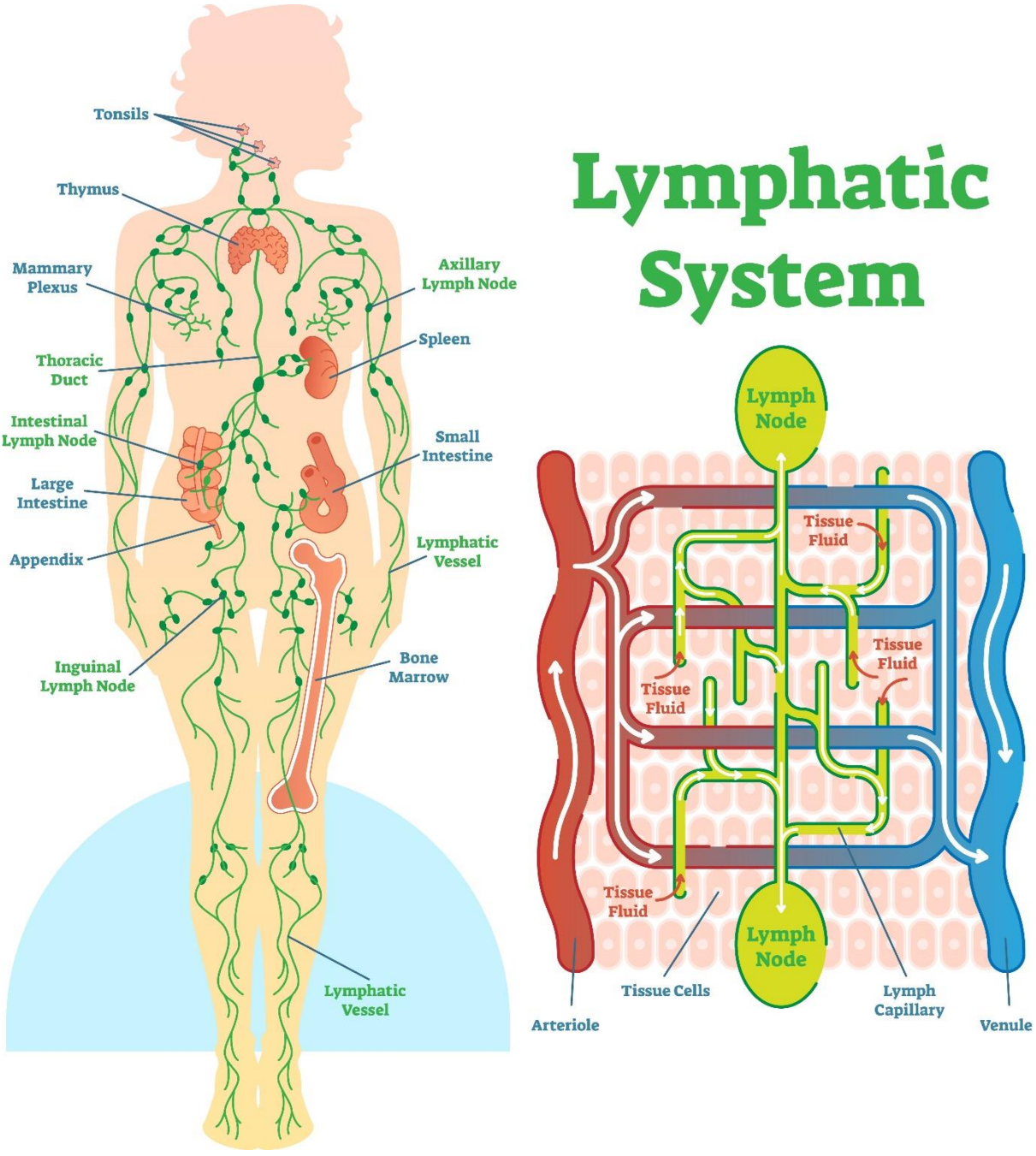
- Specific immunity: immunity against a specific infection
- Non-specific immunity: when the body responds to any foreign substance

SOLDIERS OF THE IMMUNE SYSTEM

- Antibodies- these are the immunoglobulins which are produced by the plasma cells. They recognise abnormal or unwanted substances (antigens) of the body and destroy them.
- Phagocytes- these are white blood cells (WBCs) which engulf and destroy the foreign agents with the process of phagocytosis.
- Lymphocytes- are the White blood cells (WBCs) that produce antibodies when an antigen enters the body. Antibody production increases with an increase in infection.
- B Lymphocytes (B cells)- cause the production of the antibodies from the plasma cells and enhance specific immunity.
- T lymphocytes (T cells)- these cells destroy invading cells. Killer T cells produce poisonous substances near the invading cells and attract other phagocytotic cells. Phagocytotic cells destroy invading cells by phagocytosis or lysis.

Autoimmune diseases: Autoimmune diseases are a broad range of diseases in which a person's immune system starts destroying their own cells. The immune system has lost the property to differentiate between self and non-self-cells. It results in inflammation and damage, for example, rheumatoid arthritis, Pernicious anaemia, autoimmune hepatitis and many more.

LYMPHATIC SYSTEM



The lymphatic system consists of lymph, lymphatic vessels (which are like blood vessels) and lymphatic organs. Lymph is a colourless fluid connective tissue which drains into the lymphatic capillaries from the intercellular spaces. Lymph flows in lymph vessels which are connected to lymph nodes where the lymph gets filtered. Tonsils, adenoids, spleen and thymus are the part of the lymphatic system.

The **spleen** is the largest lymphatic organ and is located on the left side of the body just above the kidney.

Functions:

- Drains excess tissue fluid from extracellular spaces back into the blood
- Contains lymphocytes, antibodies and white blood cells
- Transport digested fats which are absorbed through lymph in the lacteals present in the intestinal villi
- Helps to get rid of toxins, waste and other unwanted materials
- The spleen is the graveyard for the red blood cells as RBCs are buried in the spleen after completing their life span

THE SPECIAL SENSES – VISION, EQUILIBRIUM AND HEARING, TASTE AND SMELL

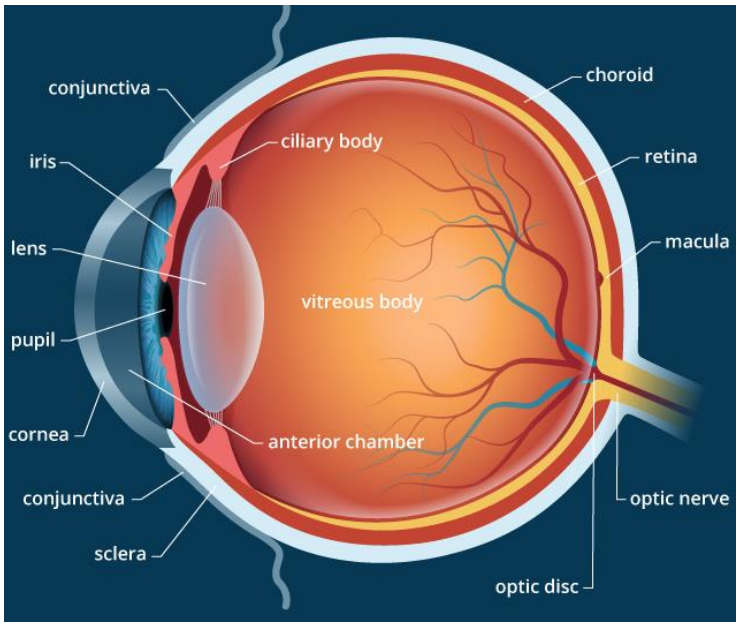
VISION

Vision is initiated by light interacting with sensory receptors in the retina of the eye. Bones of the skull, eyelids and eyelashes and tears protect the eyes from injury. It is made up of three layers:

- The sclera- the outer white part of the eye made of tough connective tissue
- The choroid- the second layer of the eye made up of blood vessels, the ciliary muscle and the iris.
  - The iris gives colour to the eye and opening of the middle of the iris is called the pupil. The pupil contracts in bright light and dilates in dim light. It adjusts the amount of light entering the eye.
- The retina- the inner layer of the eye, which contains receptors of vision and the nerve fibres of the optic nerve.

Light enters through the cornea, which is the outer transparent layer over the eye and passes through the lens which lies behind the pupil. From the lens, the light is reflected to the retina, and the image formed on the retina is carried to the brain via the Optic nerve.

The aqueous or anterior chamber of the eye separates the cornea from the lens. This chamber is filled with a fluid called the aqueous humour. It helps in holding the shape and position of the cornea. The vitreous body is the chamber behind the lens. It is a gelatin-like substance that supports the retina and maintains the eye's shape.



EQUILIBRIUM AND HEARING

The ear is a sense organ which functions in hearing and balance. Hearing is initiated by sound waves and equilibrium is initiated by motion interacting with sensory receptors in the ear. The ear is divided into the:

The external ear

The external ear is the outer part called the pinna or auricle of the ear. Sound waves are guided through the external ear to the auditory canal. The glands secrete cerumen in the auditory canal. It extends to the eardrum which separates external ear and middle ear.

The middle ear

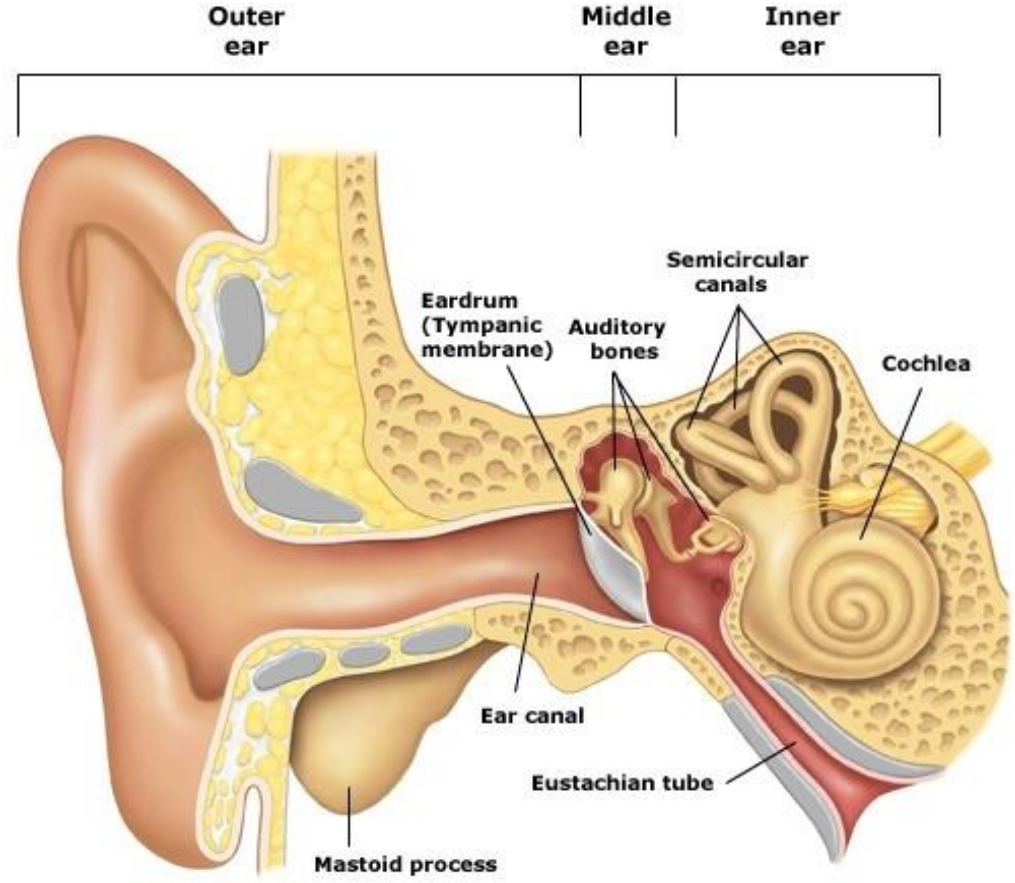
The middle ear is a small space which contains the eustachian tube and three small bones called ossicles. The Eustachian tubes connect the middle ear and the throat. Air in the Eustachian tube equalises pressure on either side of the eardrum. Ossicles amplify the sound waves and transmit the vibration to the inner ear. The three ossicles include:

- The malleus: hammer-like
- The incus: an anvil-like
- The stapes: stirrup like

The inner ear

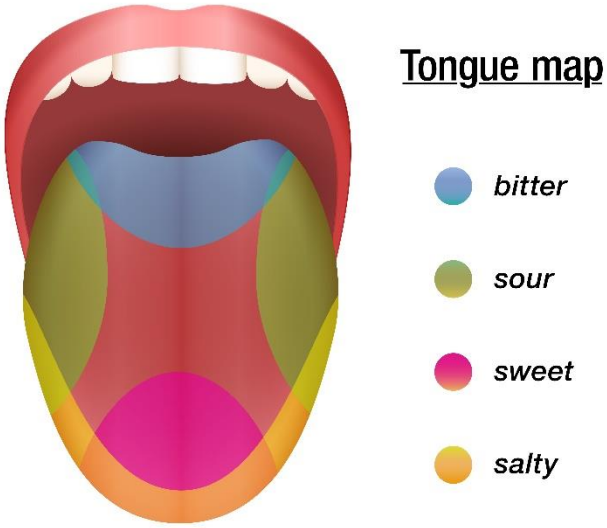
The inner ear consists of semicircular canals and cochlea. Cochlea looks like a snail shell with two and a half-circular turns. It contains fluid which carries sound waves coming from the middle ear to the auditory nerve, which carries the sound signals to the brain.

Three semilunar valves have the function to maintain the posture and balance of the body. They maintain the balance of the body according to the position of the head and send the message to the brain.



TASTE

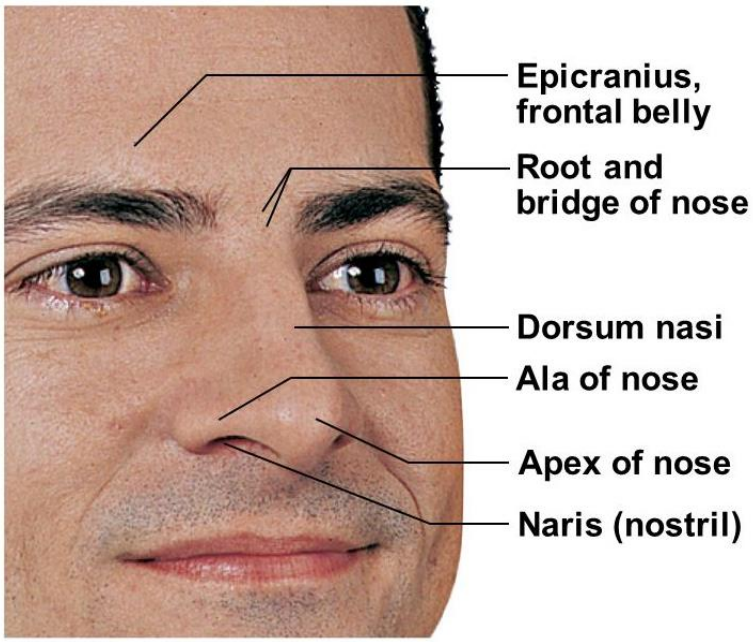
- The sensation of taste is initiated by the interaction of chemicals on the tongue with sensory receptors present in the form of taste buds. Taste buds are found on the tongue, the palate of the mouth and the part of the pharynx.
- Epithelial cells and taste cells form the taste buds
- The sensation of the taste is determined when the chemical dissolved in the saliva is transferred to the taste cortex in the parietal lobe of the brain. It takes place via several nerves
- Taste is of four types which our tongue can taste, which is sweet, sour, bitter and salty.



SMELL

The sensation of smell is initiated by chemicals interacting with the receptors in the nose. Molecules dissolved in the mucus lining are transferred to the olfactory bulb and cortex in the temporal and frontal lobes of the cerebrum. The brain interprets the signal and gives the sensation of smell.

The nose is the part which is projecting above the mouth on the face. It contains two nostrils and hairs with mucus in it. It purifies the air which is going inside and is used for breathing and smelling.

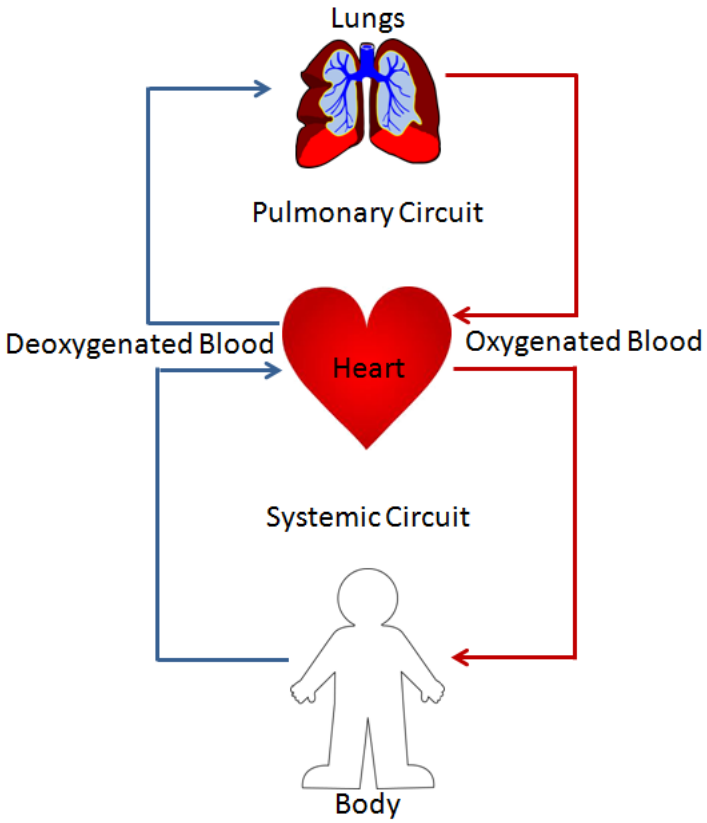


1.2 CORRECTLY USE AND INTERPRET INFORMATION THAT RELATES TO THE INTERRELATIONSHIPS BETWEEN MAJOR COMPONENTS OF EACH BODY SYSTEM AND OTHER STRUCTURES

Human body systems are interrelated with each other to perform functions and work together to deal with the daily needs of the body. The human body performs as one through the combination of activities of the individual body systems. Each body system is interrelated with another system in some way. If one stops, automatically, it will affect the other body systems. So, all the body systems must work together as a team.

CARDIOVASCULAR AND RESPIRATORY SYSTEMS

The cardiovascular system pumps blood with the help of the heart through a network of arteries, veins and capillaries to the different parts of the body. It transports oxygen-rich blood from the lungs to all the body's organs, tissues and cells of the body. Cells throughout the body take oxygen from oxygenated blood coming from the heart and dispose of carbon dioxide and waste products in the deoxygenated blood, which eventually flows back to the heart's right-sided chambers through the superior and inferior vena cava and then pumped to the lungs by the heart through the pulmonary artery to exchange carbon dioxide with oxygen. Inhaled air rich in oxygen passes through the nasal passages, throat and lung airways reaching tiny balloon sac-like structure called alveoli which is the site of gas exchange. The newly oxygen-rich blood travels back from the lungs to the heart's left-sided chambers through pulmonary veins, where it gets pumped out at great pressure via arteries to reach the needy tissues once again.



This whole circulation of blood going through the cardiovascular and respiratory system is called double circulation. It is known as double circulation because the blood travels through the heart twice in one cycle. Other organ systems, such as the endocrine and nervous system, directly and indirectly regulate the cardiovascular system.

DIGESTIVE AND EXCRETORY SYSTEMS

The digestive system is responsible for breaking down complex food into small, simple molecules and energy which can be used by the body's cells and tissues. The food is broken physically through chewing and stomach-churning, but also chemically through the several digestive enzymes, such as gastric enzymes, pancreatic enzymes and enzymes in the intestinal juice that are used to digest proteins, carbohydrates and fibres to make them available for the cells of the body.

Bile from the liver also emulsifies fats. Absorption is mainly the function of the finger-like protrusions called villi in the small intestines. Digested nutrients pass through from the small intestines through their microvilli to blood capillaries and lymph on to the liver for detoxification and further processing and conditioning, then out to the body.

Fibres, indigestible material, bile and loads of bacteria travel through the long large intestines and out through the rectum and anus. The kidneys filter out nitrogenous and other chemical wastes from the blood to form urine, which flows down the ureters and enters the urinary bladder.

The bladder collects the urine (up to 1-1.5 litres and releases when full), which passes out through the urethra after getting the signal from the brain.

DIGESTIVE AND NERVOUS SYSTEM

The Autonomic nervous system controls a number of body functions including intestinal contractions during digestion. The Autonomic nervous system branches into the parasympathetic and sympathetic nervous system. The parasympathetic nervous system stimulates digestion whereas the sympathetic system inhibits digestion.

RESPIRATORY AND URINARY SYSTEM

Both the urinary and the respiratory system contribute to the removal of waste from the body to regulate blood pH levels. The kidneys are predominately responsible for maintaining the acid-base balance in the body. The respiratory system however works together with the urinary system to reduce blood pH levels through the removal of carbon dioxide from the blood.

REPRODUCTIVE AND ENDOCRINE SYSTEM

The endocrine system releases hormones that help to coordinate and regulate reproductive functions. The endocrine system also releases hormones during adolescence that facilitate the maturation of the sex organs.

LYMPHATIC AND IMMUNE SYSTEM

The immune system is a network of cells, tissues and organs that works together to fight against infectious agents. If an infectious agent is detected in the body the lymphatic system makes white blood cells called lymphocytes. These lymphocytes produce antibodies whose function is to kill the infectious agents and prevent the infection from spreading.

ENDOCRINE AND NERVOUS SYSTEM

The endocrine and nervous system may work together on the same organ, and each may influence the actions of the other system. In an emergency response, there is a coordination of both the nervous and endocrine systems. The nervous system detects stimuli, either inside or out with the help of the sense organs. For example, an oncoming truck about to run someone over is seen by the eyes, which send an impulse to the brain through the nervous system. The brain interprets this as danger and sends an impulse to the endocrine system where a response is carried out.

The response, in this case, is the release of adrenaline into the bloodstream, by the adrenal glands which stimulates the body by increasing the heartbeat, blood pressure, sending more blood to muscles of legs to provide energy to the muscles. A stimulus will be received by the muscle, which makes the muscle active for contraction and relaxation. And the person will be able to move from the path of the oncoming truck which would have taken his life.

The endocrine system also largely governs reproduction and sexual maturity processes.

IMMUNE AND NERVOUS SYSTEMS

The immune system is a network of cells, tissues and organs that work together to attack pathogens or outside microorganisms that will infect your body. Bacteria, parasites and fungi like infectious organisms encounter immune soldiers, including T-lymphocytes, macrophages and neutrophils. The immune system's B-lymphocytes can produce antibodies against an antigen and destroy it. The immune system also plays a role in detecting non-self-cells of the body that may arise in cancer cells and due to organ transplants.

Stress, as perceived by the nervous system, can have a remarkable impact on the immune system and the digestive system, which happens to be another major site of immune cell activity.

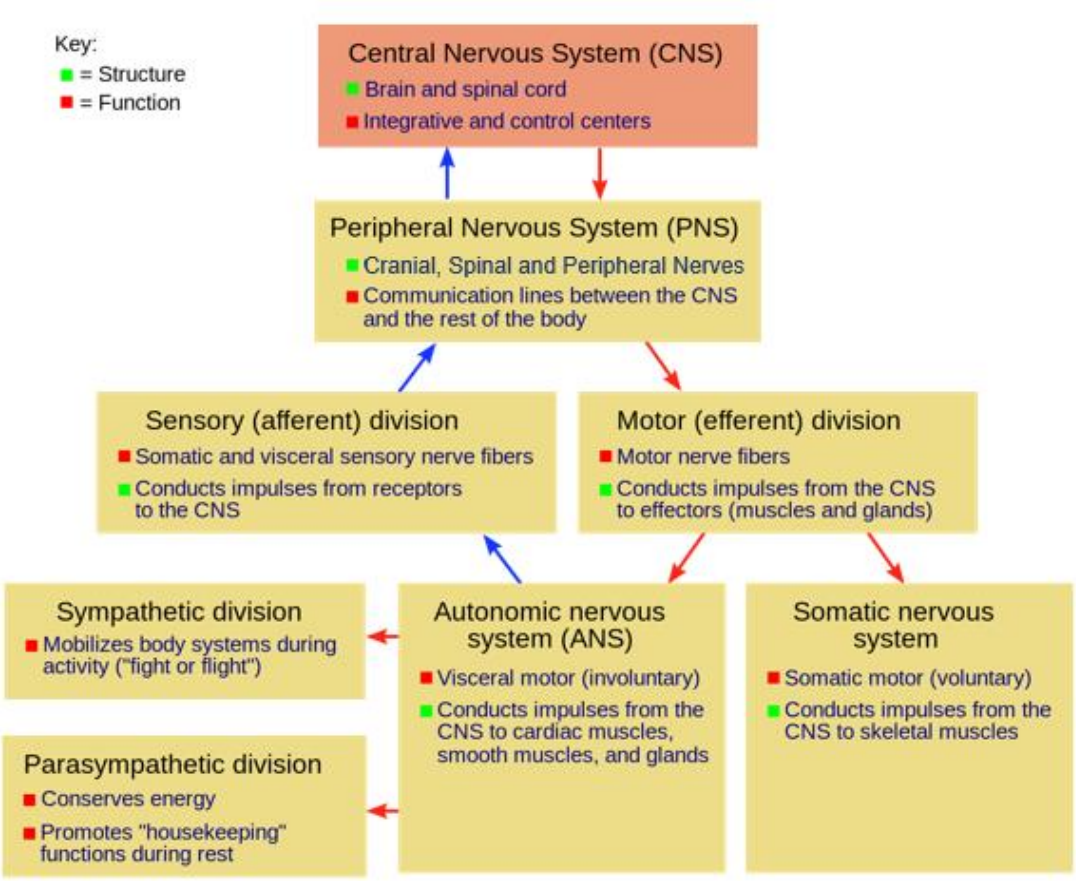
INTEGUMENTARY AND NERVOUS SYSTEMS

The integumentary system, or skin, is known as the body's first line of defence. It performs many functions such as regulation of body temperature, protection of underlying layers of tissue from sun damage and prevents the entry of the pathogens inside the body. The integumentary system also consists of millions of nerves that respond to touch, pressure and pain. There are two interconnected nervous systems:

1. The central nervous system
2. Peripheral nervous system

The CNS consists of the spinal cord and the brain, which gets the information from the body and sends out instructions. The PNS includes nerves outside the brain and the spinal cord. It sends and receives messages from the CNS to and from the rest of the body. The nervous system controls both voluntary and involuntary body functions.

THE ENDOCRINE SYSTEM AND THE URINARY SYSTEM



Both the nervous system and endocrine system serve to integrate the body's various other systems, keeping them in synchronisation. When the cardiovascular system is low on fluid, such as in severe dehydration, the skin prevents the loss of water from the body as it prevents excessive sweating.

MUSCULOSKELETAL SYSTEM AND INTEGUMENTARY SYSTEM

The skeletal system provides shape to your body, and it is made up of cartilage and bone. The human skeleton provides a hard framework for the body to provide support and protection to the organs that they surround. Cartilage provides support and flexibility and resistance and acts as a cushion to soften the pressure that is exerted from the bones.

Movement in the body is the result of muscle contraction. When muscles combine with the action of joints and bones, movements are performed, such as jumping and walking. The contraction of muscles provides the body posture, joint stability and heat production.

The integumentary system provides protection for the musculoskeletal system to prevent damage from the external environment as well as protection from infectious agents. The muscular system also works together with the skin to regulate body temperature through muscular contractions known as shivering.

CHECKPOINT: CHAPTER 1

Let's check your understanding before proceeding further.

Apply what you've learnt so far by correctly completing the activities below. (Note: you can revisit any information above at any time.)

1. Which of the following is not part of a cell?
   a. Cytoplasm
   b. Chromatin
   c. Dermis

2. Choose the correct definition of the integumentary system
   a. The integumentary system is the most extensive body system and includes muscles, tendons and the bones of the body.
   b. The integumentary system is an extensive system found throughout the body and includes plasma and formed elements.
   c. The integumentary system is the most extensive body system consisting of skin, hair and nails.

3. The nervous system is made up of two main divisions. What are they?
   a. The brain and the spinal column
   b. The dura mater and the pia mater
   c. The central nervous system and the peripheral nervous system

4. In the table below, indicate which body system below the body part belongs to.
   a. The respiratory system
   b. The musculoskeletal system
   c. The nervous system
   d. The circulatory system

Part	System	Part	System
Alveoli		Cerebrum	
Muscles		Cerebellum	
Arteries		Lungs	
Cranial nerves		Spinal nerves	
Capillaries		Red blood cells	

Part	System	Part	System
Brain stem		Trachea	
Bronchii		Bones	
Pharynx		White blood cells	
Veins		Platelets	
Joints			

5. Draw a line between the matching parts of the sentence.

Amongst other hormones, the pituitary gland secretes		...testosterone, oestrogen and progesterone.
Gonads secrete...		... glucagon and insulin
The pancreas secretes ...		... luteinizing growth hormone, thyroid stimulating hormone and prolactin.

CHAPTER 2: RECOGNISE AND PROMOTE WAYS TO SUPPORT HEALTHY FUNCTIONING OF THE BODY

This topic covers the processes, conditions and resources required by the body to support healthy functioning and body regulation, including:

- Maintenance of body temperature
- Fluid and electrolyte (including pH) balance
- Elimination of wastes from the body
- Maintenance of blood pressure
- Protection from infection
- Physical activity – active and passive

What will I learn?

This chapter will cover the following content:

1. Review factors that contribute to maintenance of a healthy body
2. Evaluate how the relationships between different body systems affect and support healthy functioning
3. Enhance quality of work activities by using and sharing information about healthy functioning of the body

2.1 REVIEW FACTORS THAT CONTRIBUTE TO MAINTENANCE OF A HEALTHY BODY

Maintaining a healthy body is an ongoing process. Several factors support healthy functioning of the body. It includes environment, lifestyle, human biology and healthcare services.

To maintain the whole body in healthy state, the following factors need to be understood:

- Physical health
- Social health
- Mental health

PHYSICAL HEALTH

Physical fitness is the result of regular exercise, proper diet and nutrition, adequate rest and hydration. It includes:

- Good hygiene practices
- Keeping the body clean to prevent infection and illness
- Avoidance of contact with pathogens

SOCIAL HEALTH

Maintenance of personal health also depends partially on the social life of the person. Strong social relationships are linked to good health conditions, longevity, and a positive attitude. This increases many chemical levels in the brain, which are linked to personality, intelligence traits and wellbeing of the person.

MENTAL HEALTH

Mental health relates to general attitudes towards life, the ability to cope with stress and change, to identify and solve problems, overcome upsetting life events and to resolve grief and loss issues.

Stress has a great impact on the body of a person. The human body responds to a stressful stimulus by initiating about 1400 different activities, including pumping a variety of chemical mediators into the bloodstream.

Generally, stress goes unnoticed and may cause other secondary conditions. Heart attacks or high blood pressure may be induced, sustained and aggravated by stress; these health issues may be fatal for the person.

BASIC MAINTENANCE FOR A HEALTHY BODY

As we grow our body experiences changes physically. The changes that come with time are dependent on many aspects such as lifestyle, disease and environmental factors.

With good nutrition, exercise, proper hygiene practices and regular health care check-ups, it is easy to preserve and maintain optimal health.

STRATEGIES FOR MAINTAINING A HEALTHY LIFESTYLE

A person's lifestyle has a great impact on overall health and influences diseases you may experience and life expectancy. Smoking, alcohol consumption, levels of stress, poor eating habits, lack of physical activity are responsible for lifestyle-related health problems.

Lifestyle changes include:

NUTRITION

The most important factor in maintaining a healthy body is the food we eat. A healthy diet will make a person's immune system stronger and helps to prevent major diseases, as well as improving energy levels and assisting with stress control.

Good nutrition is essential for good health, healing, fighting infection, and maintaining a healthy weight.

The importance of nutrition increases as a person ages, as the body requires the appropriate amount of nutrients for the maintenance of health.

A healthy diet contains an appropriate balance of nutrients. It should include food variety, with minimum fat, adequate fibre, limited salt and adequate water. The person must have a balanced diet.

PHYSICAL ACTIVITY

An inactive lifestyle can cause the loss of ability in four areas that are important in maintaining a healthy and independent body:

- Strength
- Balance
- Flexibility
- Endurance

Physical activity is divided into two categories:

1. **Active movement** - when movement is controlled by the person through muscular contractions.
2. **Passive movement** - when the person does not contract their own muscles to create movement. This movement happens through another person or piece of equipment taking the body part through the movement.
   This may happen in a therapy session for a client who is unable to move their body part on their own.

   Effects of lack of physical activity include:
   - Poorer general health and reduced function
   - Psychological problems such as depression
   - Social problems such as isolation
   - Increased risk of hospital/nursing home admissions
   - Increased mortality

Benefits of physical activity include:

- **Physical benefits**:
  - Assist in reducing the risk of falls and fracture
  - Assists in reducing the risk of developing some diseases such as coronary heart disease
  - Assists those with chronic, disabling conditions to improve their stamina and muscle strength
  - Improves balance
  - Being outdoors helps to maintain normal vitamin D levels
  - Supports the maintenance of healthy muscles and joints
  - May help to reduce blood pressure in some individuals that suffer from hypertension
  - May improve bowel motility and reduce issues of constipation
  - Improves appetite
  - May improve some medical conditions, such as arthritis and diabetes
- **Functional benefits**:
  - Increases independence in activities of daily living
  - Improves physical functioning, including activities such as walking, climbing stairs
  - May improve cognitive function, e.g. planning, memory

- Psychological and social benefits:
  - Fosters improvements in mood, feelings of wellbeing
  - Reduces symptoms of anxiety and depression
  - Helps maintain social networks

SLEEP AND REST PATTERNS

Sleep is a period of reduced consciousness, diminished muscular activity and depressed metabolism. It promotes the growth and repair of cells.

The circadian rhythm is a 24-hour physiological cycle based on light and dark where functions tend to be highest during the early evening, i.e. metabolic rate, heart, ventilation and body temperature, and at their lowest in the early morning. Any disruption to this circadian rhythm can cause discomfort, i.e. fatigue, insomnia, sluggish physical and mental function. This is the cause of 'jet lag'.

Evidence of a client's lack of sleep or a sleep disturbance

A person who experiences a sleep pattern disturbance may exhibit:

- Changes in behaviour and performance
- Increased irritability
- Lack of energy
- Fatigue

Such disturbances include:

- Difficulty in falling asleep
- Periods of wakefulness during the night
- Waking earlier than usual
- Not feeling rested after sleep

Factors affecting rest and sleep include:

- Changes in sleep patterns with ageing
- Fatigue
- Change of environment/communal living
- Lack of exercise
- Drugs

Other conditions that may affect sleep include:

- Cardiovascular diseases
- Respiratory diseases
- Pain
- Intestinal disorders
- Endocrine disorders
- Urinary problems due to hyperglycemia
- Urinary tract and renal disorders
- Psychiatric disorders (depression, anxiety, mania)

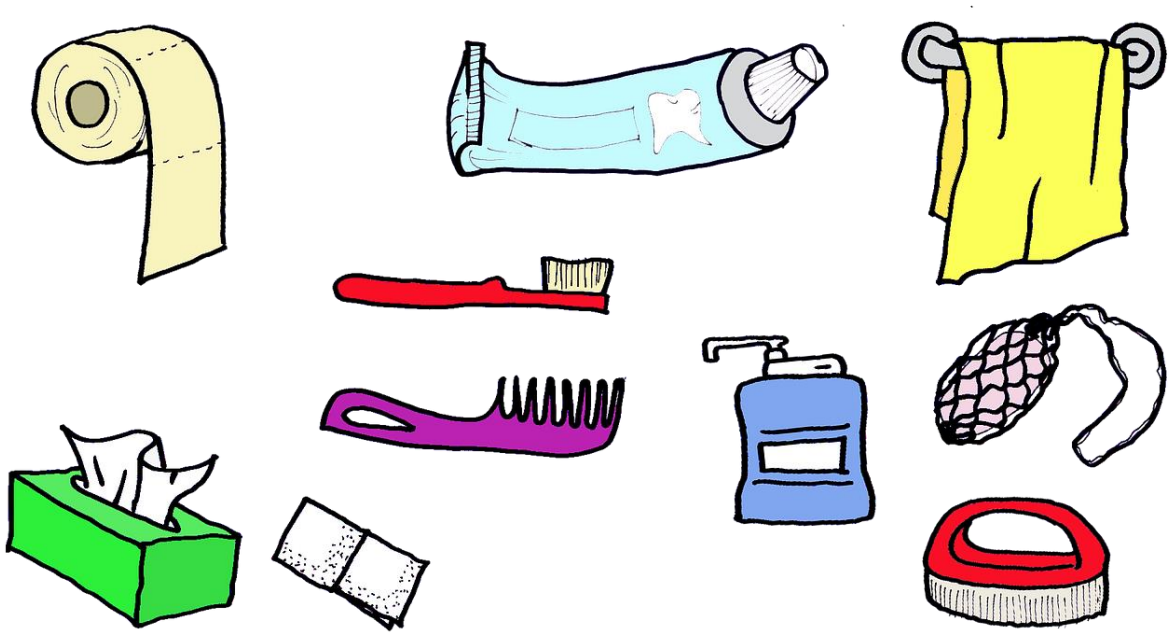
HYGIENE

Appropriate hygiene practices can help to prevent many illnesses. Microorganisms (germs) enter the body through cuts in the skin or the mouth, nose and other mucosal surfaces of the body. Microorganism are often transmitted from person to person or surfaces through contaminated hands.

Hygiene is:

- Washing hands and washing your entire body carefully
- Not sneezing or coughing on others
- Washing hands before touching food
- Disposing of things properly that might cause an infection like used tissues

Hygiene should be a part of everyday health care of daily living. The core to health and a key factor for improving health is proper hygiene which includes personal and environmental practices.



2.2 EVALUATE HOW THE RELATIONSHIPS BETWEEN DIFFERENT BODY SYSTEMS AFFECT AND SUPPORT HEALTHY FUNCTIONING

Each body system needs the other body systems so the body will function properly. The disease process occurs when the normal balances within a healthy body are disrupted. As body systems are interrelated with each other, there is a need to evaluate the effectiveness of the working relationships of these body systems according to the functions they are performing that can affect and support healthy body functions.

The following sections will help you to evaluate if the body systems are supporting healthy functioning.

REGULATION OF THE OPTIMUM TEMPERATURE OF THE BODY

The human body maintains a constant temperature of the internal environment to function properly. At the cellular level, maintenance of a constant temperature plays an important role; for example, enzymes work only within a narrow temperature range.

- When the body is too hot, the enzymes get denatured and lose their functions
- When the body is too cold, enzymes work very slowly. This ultimately slows the metabolic reactions occurring in the body below the rate at which life can be supported

Metabolism of deep organs such as the liver, brain and heart, and contractions of skeletal muscles are the primary sources of heat generation in the body. Skin loses heat when the temperature of the body is higher than the surroundings. Blood vessels maintain the temperature of the body by vasodilation and vasoconstriction in the hot and cold surrounding conditions.

Another means of cooling the body down and getting rid of excess heat is through evaporation. Organs also perform the best at optimal body temperature.

WHAT CAUSES OPTIMUM BODY TEMPERATURE TO DROP?

Body temperature may drop under the following circumstances:

- **Slowing Metabolism.** As a person ages, their metabolism slows.
- **Exposure to Cold Temperatures.** Exposure to cold temperatures and cold, wet or windy weather
- **Low Blood Sugar Levels.**
- **Inactive Lifestyle.** An inactive lifestyle can, over time lower a person's metabolism, thereby lowering their body temperature.

WHY MAINTAINING OPTIMUM BODY TEMPERATURE IS IMPORTANT.

Maintaining an optimal body temperature plays an important role in maintaining good health, staying strong and living longer. It also helps prevent common colds.

When Optimal Body Temperature is maintained, a person's body is better able to defend against cold virus infections. When a person's body temperature drops, their systems and immune system do not function as well, and they become more susceptible to colds and disease.

HOW TO MAINTAIN OPTIMUM BODY TEMPERATURE

A person's Optimum Body Temperature is achieved and maintained with:

- Regular exercise. Activity = Life
- A good diet that contains nutritious carbohydrates, fats and proteins. Eating foods high in quality nutrients provide the fuel to keep the metabolism active and keep the body warm.
- Stay hydrated and maintain a good electrolyte balance
- Train your body to provide metabolism for maintaining body warmth. It is possible to train the body to increase metabolism for providing internal warmth in the colder weather. this is done in part by properly fueling the body with high quality nutrients while at the same time relying less on layers of clothing.
- Sleep slightly cool. Sleeping slightly cool will help the body maintain a level of metabolism that will keep the body warm.
- Be outdoors. Being outdoors helps the body adjust to a more vibrant environment, building metabolism.

REGULATION OF FLUID AND ELECTROLYTE BALANCE

A balance between fluids and electrolytes is known as osmotic balance of the body, which is necessary if cells are to survive and function normally. Approximately 60 per cent of the human body is water, and body water contains electrolytes. It is the kidneys' job to control fluid and electrolytes; we must also ensure that our water intake through drinking is balanced with the amount of water loss in the urine or sweat.

Osmoregulation is to maintain the osmotic pressure of the body fluids to make sure that the body does not become too concentrated or too diluted.

FLUID BALANCE

Water for the body comes from both liquids and food and is lost mostly through urine, evaporation from skin when sweating, the respiratory tract and in feces. When water intake is high, the kidneys produce larger amounts of urine to help maintain a balance. When the body is losing water, the kidneys will try to conserve water by producing a small amount of concentrated urine.

ELECTROLYTE SIGNIFICANCE

Electrolytes are charged particles in body fluids that help transmit electrical impulses for the proper functioning of the heart, nerves and muscles. Electrolytes need to in the correct concentrations for the proper functioning of the cell.

An upset of body fluid balance can result in life-threatening conditions which can be caused by:

Dehydration

Dehydration is a common side effect of illness that causes an imbalance of fluids and electrolytes. Patients can become dehydrated when their appetite is low, and they don't eat enough food and drink enough fluids.

Physical problems such as vomiting, bowel disorders or unconsciousness can be other reasons for dehydration.

Fever from infections and increased urine output from medications or diabetes can also cause dehydration.

When dehydration occurs, the human body conserves body fluids, especially water, by drawing water into the blood to maintain blood volume and blood pressure. At the same time, the kidneys will produce concentrated urine to conserve water, and as a result, the person feels thirstier.

Over-Hydration

Over-hydration is the condition of an excess of body water. It is more common in patients with heart failure, kidney impairment and liver disease. When it occurs, and the kidneys are not able to compensate, fluid will back up, affecting the heart and creating an imbalance of fluid and electrolytes in the body. If the kidneys fail completely, dialysis may be necessary.

Electrolyte Imbalance

The primary electrolytes in the body are potassium, magnesium, calcium and phosphorus. Excess and deficiency of any one of these can quickly become a major problem for the patient. The balance of electrolytes is regulated through a feedback system.

If a specific electrolyte level is too high, the kidneys attempt to increase excretion or retain fluid as a compensatory mechanism to equalise. Extreme highs or lows of electrolytes can cause muscle weakness or paralysis, confusion, abnormal heart rhythms or cardiac arrest.

REGULATION OF BODY FLUIDS

Regulation of body fluids is done by the hormonal control or endocrine system of the body. Regulation of body fluid is a response to a disturbance in fluid and electrolytes for the prevention and repair of damage done.

Fluid Intake is regulated by the thirst mechanism.

The hypothalamus of the brain is the centre of thirst. Adults intake about 2200-2700 ml/day of fluids.

- **Hormonal Regulation** - Fluid intake through hormonal regulation takes place through various mechanisms. The pituitary gland stores the Antidiuretic hormones (ADH), which are released with the response to the change in blood osmolarity. ADH acts on renal tubules and collecting ducts to make them more permeable to water.

- **Fluid Output Regulation** - Fluid output takes place through 4 organs, including:
  - **The kidneys:** The kidneys collect 1800ml of plasma to filter each day and produce 1500ml urine per day.
  - **Skin:** Sweat glands are activated by the nervous system to regulate water loss through the skin. About 400-500ml of fluid is lost in the form of sweat per day
  - **Lungs:** The lungs expire 1350-400ml of water vapour daily
  - **Gastrointestinal tract:** An adult loses 100-200ml of the 3-6 litres each day through faeces.

Daily Intake and Output

Daily Input	Daily Output
Water as fluid (oral/infusion) = 1500ml	Urine = 1500ml
Water in food = 950ml	Sweat = 450ml
Water from Metabolism = 250 ml	Air and faeces = 350+200
Total= 2500ml	**Total = 2500ml**

Major electrolytes imbalance

- **Hyponatremia**: Sodium level below 135meq/lt Normal level=135-145meq/lt
- **Hypernatremia**: Sodium level above normal
- **Hypokalemia**: Potassium level below 3.5-5meq/lt. Normal level=3.5-5.0meq/lt
- **Hyperkalemia**: Potassium level above normal
- **Hypocalcemia**: Calcium level below 4.5meq/lt Normal level=4.5-5.5meq/lt
- **Hypercalcemia**: Calcium level above normal
- **Hypo-magnesium**: Magnesium level below 1.5meq/lt Normal level=1.-2.5meq/lt
- **Hyper-magnesium**: Magnesium level above normal

ELIMINATION OF WASTE FROM THE BODY

When we talk about elimination, waste such as carbon dioxide, nitrogenous waste, salts, undigested food and other products need to be removed from the body. There are five major channels that the body uses to help remove waste from the body. These include:

- The skin
- The bowels
- The lymphatic system
- The kidneys
- The lungs

Although these systems are sometimes discussed separately, they are all equally important and must interoperate effectively to ensure the body is kept toxin-free.

If there is congestion in any of these channels, it may result in other channels having to work harder to ensure that there is adequate elimination of waste from the body.

Generally, signs of congestion are seen in the skin, as skin conditions such as acne, dermatitis, eczema or psoriasis may result from an overburdened bowel or lymphatic system. It is important to note that there are exceptions. Constant production of concentrated urine, continuous bad breath despite good dental hygiene as well as heavily bloodshot eyes may also be indicators that the bowel or lymph require attention.

MAINTENANCE OF BLOOD PRESSURE

Blood pressure is the pressure of the blood in the arteries as it is pumped around the body by the heart due to the contraction of the muscles of the heart. It is affected by various factors, including body position, breathing, emotional state, exercise and sleep.

High blood pressure leads to serious issues such as heart attack, stroke, heart failure or kidney disease. The medical name for persistently high blood pressure is **hypertension**, and the medical name for low blood pressure is **hypotension**.

MEASURING BLOOD PRESSURE

Blood pressure is usually measured by a machine called a sphygmomanometer.

Blood pressure is recorded as a reading such as 120/80. The larger number indicates the pressure in the arteries due to the maximum contraction of the ventricles of the heart. This is called systolic blood pressure. The lower number indicates the pressure as the ventricles of the heart relax before the next beat. This is called the diastolic blood pressure. Both are measured in units called millimetres of mercury (mmHg).

Blood pressure readings

There is no 'normal' or 'ideal' blood pressure reading. The following figures should only be used as a guide:

- Optimal <120/<80
- Normal 120-129/80-84
- High-normal 130-139/85-89
- Mild hypertension 140-159/90-99
- Moderate hypertension 160-179/100-109
- Severe hypertension ≥180/≥110

MANAGING HIGH BLOOD PRESSURE

If a person's blood pressure remains high, it can lead to serious health problems. They will be more at risk of these problems if they:

- Smoke
- Are overweight
- Are physically inactive
- Have diabetes
- Have high cholesterol
- Are socially isolated
- Have depression

Lifestyle changes are very important to help manage high blood pressure and lower a person's risk of cardiovascular disease. Suggestions include:

- Achieve and maintain a healthy weight
- Be physically active
- Limiting alcohol intake to no more than two drinks a day (men) or one drink a day (women)
- Quit smoking
- Decreasing salt/sodium intake
- Increase potassium intake by eating a wide variety of fruit, vegetables, plain unsalted nuts and legumes

Some people may also need medicine to manage high blood pressure; however, they must make lifestyle changes too.

HIGH BLOOD PRESSURE AND DIET

Healthy eating is important in managing high blood pressure and reducing the risk of heart disease. Enjoying a variety of foods from the different food groups is the key to healthy eating. Every day, try to include:

- Vegetables
- Whole grains
- Lean meats
- Oily fish
- Fruit
- Reduced-fat, low-fat or no-fat dairy products
- Monounsaturated or polyunsaturated vegetable and seed oils
- Nuts, seeds and legumes

SALT INTAKE AND HIGH BLOOD PRESSURE

Reducing the amount of salt that is consumed can also help to manage or even avoid high blood pressure. To help reduce your salt intake, a person should:

- Choose low-salt or reduced-salt food where available
- Avoid adding salt to cooking or at the table – flavor meals with herbs and spices instead
- Avoid high-salt foods, such as potato crisps or chips, salted nuts, commercial sauces (such as tomato, soy and fish), processed meat and most takeaway foods

MEDICATIONS FOR HIGH BLOOD PRESSURE

There are a large variety of medicines available to lower and manage high blood pressure. The medical term for them are antihypertensives.

These medications do not cure high blood pressure, but once you start taking medicines to manage your blood pressure, you may need to take them for the rest of your life.

These medicines must be taken regularly. Some things that may help to remember to take them include:

- Taking them at the same time each day
- Using a weekly pillbox
- Marking the time on your calendar
- Asking a family member or friend to remind you to take the medication
- Always carry a list of medicines and their doses
- Entering a daily alarm in your mobile phone to serve as a reminder

ORGAN SYSTEMS: THEIR ROLE IN MAINTAINING HOMEOSTASIS

There are ten major organ systems in the human body play a role in maintaining equilibrium within the body. These systems work together to maintain homeostasis. Here is the brief description of how they work together to maintain homeostasis:

INTEGUMENTARY, MUSCULAR AND SKELETAL SYSTEMS

The integumentary system is comprised of the skin, nails, hair and glands. Its primary function is to protect the body from foreign infections and thermal regulation. The muscular system consists of skeletal muscle, smooth muscle and cardiac muscle.

It is involved in activities such as digestion, walking, running, breathing and picking up objects. The skeletal system consists of all the bones, ligaments, connective tissue and tendons. It involves proper posturing of the body, balance and locomotion of the body. The muscular and skeletal system work together as these two systems are supported by a framework of the skeletal system.

The integumentary system maintains the muscular system by keeping the body cool with the process of evaporation and blood vessels dilate to get rid of excess heat. The three systems work together to maintain homeostasis.

LYMPHATIC AND DIGESTIVE SYSTEMS

The lymphatic system is responsible for protecting the body from pathogens. Lymph, lymph nodes, lymphatic vessels, tonsils, thymus and the spleen all comprise the organs of the lymphatic system.

The digestive system is responsible for the digestion and absorption of the nutrients from the food, and it comprises the mouth, pharynx, esophagus, stomach, large and small intestines. Absorption of substances such as fats, toxins from the digestive system occurs through the lymphatic system. This is one of the ways in which these systems maintain homeostasis.

ENDOCRINE SYSTEM

The endocrine system secretes hormones that affect the overall growth and development of the body. The endocrine system regulates metabolism and releases hormones directly into the bloodstream.

The endocrine system regulates various systems such as the nervous system, the circulatory system, the muscular system and all the other major systems of the body. This helps achieve homeostasis.

CIRCULATORY SYSTEM

The circulatory system, also known as the cardiovascular system, is responsible for the circulation of blood throughout the body. Removal of waste products and the transportation of hormones and nutrients takes place through the circulatory system.

Practically every other system in the body is reliant upon the circulatory system for supplying nutrients, oxygen and the removal of waste products.

RESPIRATORY SYSTEM

The respiratory system provides oxygen to the circulatory system and works together with the circulatory system. It is also responsible for the removal of waste from metabolic processes and the supply of oxygen, both of which help to maintain homeostasis in the body.

URINARY SYSTEM

The urinary system is responsible for getting rid of excess wastes in the body and regulating body fluids. The urinary system is also responsible for maintaining red blood cell count within the body and the optimum pH levels in the blood. These functions help maintain homeostasis within the body.

NERVOUS SYSTEM

The nervous system is composed of the central nervous system and the peripheral nervous system. The hypothalamus within the brain is one of the key players in the human body in maintaining homeostasis. The nervous system regulates all the other systems in the body to maintain homeostasis.

2.3 Enhance Quality of Work Activities by Using and Sharing Information about Healthy Functioning of the Body

Quality of work activities can be significantly enhanced by using and sharing information about the healthy functioning of the body. If the body is healthy, it can fight against infections, and it will increase a person's life expectancy. It is important to make yourself and other people aware of the benefits of the healthy functioning of the body and the work activities to be followed to maintain a healthy body. This can be done by using the present knowledge and sharing that knowledge with other people.

Healthy functioning of the body leads to several benefits, such as:

- Reduced long-term health problems
- Reduced sick leave at work
- Decrease stress and other related illness
- Improved mental alertness, concentration and energy levels

Using and sharing information about the healthy functioning of the body can be done by:

EFFECTIVE COMMUNICATION

Communication plays a vital role in sharing ideas about the healthy functioning of the body. Training programs may be delivered to inform colleagues about the healthy functioning of the body. This may be a refresher course, or if there is new information or updated treatment options become available.

LEAFLETS AND BROCHURES

Leaflets and brochures may also be created to share ideas with other people on the healthy functioning of the body. The sections may be divided into:

- The cardiovascular system
- The respiratory system
- The musculoskeletal system
- The endocrine system
- The nervous system
- The digestive system
- The urinary system
- The reproductive system
- The integumentary system
- The lymphatic system
- The special senses – vision, hearing, equilibrium smell and taste
- The cells, tissues and organs

Use of this information regarding healthy functioning of the body can also assist in making decisions and in the assessment of clients if their body systems are not healthy.

VISUAL AIDS

Visual aids such as posters that you can strategically place around the workplace can be used for sharing your ideas about the healthy functioning of the body to the other people.

Remember that during any visit to the GP, there are posters, flyers and brochures about common health problems, explaining the symptoms, treatments and possible actions to take for them. This helps in educating people by making the information freely available to them and clearly visible in an appropriate setting.

It is important to be aware of the symptoms and treatment options for common health problems, as well as indicators of the healthy functioning of the body.

SEMINARS

Seminars may be held to educate other people about the body systems and the diseases which can be caused by them. In these seminars, the focus should be more on the prevention than the cure. Make people understand why 'prevention is always better than cure', as damage may sometimes be so great that it is unable to be fully repaired.

During these seminars, it may also be important to educate people on the importance of physical activities as well as a balanced diet. Topics that may also be covered include the administration of first aid, as well as knowing when to advise a person to see a doctor immediately.

CHECKPOINT: CHAPTER 2

Let's check your understanding before proceeding further.

Apply what you've learnt so far by correctly completing the activities below. (Note: you can revisit any information above at any time.) Answers are found on the last page of this Learner Guide.

1. Which statement below describes the main function of the immune system?
   a. The immune system attacks microbes and red blood cells
   b. The immune system creates red blood cells
   c. The immune system attacks pathogens threatening to infect your body

2. You are looking after John who is a 64 year old male. John was recently diagnosed with type 2 diabetes. Which of the following is false?
   a. The body part and body system which does not behave normally when a person has diabetes is the lymph nodes and the immune system.
   b. Diabetes mellitus is a disorder in which the body does not produce enough or respond normally to insulin, causing high blood sugar.
   c. Insulin regulates blood sugar levels and enhances cellular glucose uptake by stimulating glycogenesis.

3. Complete the following statements:
   a. The whole circulation of blood going through the cardiovascular and respiratory system is called:

   b. What are the chemical messengers used by the endocrine system called?

   c. There are two interconnected nervous systems. What are they?

4. Ossicles amplify the sound waves and transmit sound to the inner ear. The three ossicles are: (select the correct 3)
   a. The malleus
   b. The schlera
   c. The incus
   d. The stapes

5. Draw a line between the matching parts of the sentence.

The ear is a sense organ whose functions include..		... the pinna or auricle of the ear.
The external ear is the outer part called...		... ...fluid which carries sound waves coming from the middle ear to the auditory nerve
The inner ear consists of...		... hearing and balance.
The cochlea contains		... semicircular canals and cochlea.

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ANSWERS TO CHECKPOINT QUESTIONS

CHECKPOINT: CHAPTER 1

1. Which of the following is not part of a cell?
   a. Cytoplasm
   b. Chromatin
   c. Dermis

2. Choose the correct definition of the integumentary system
   a. The integumentary system is the most extensive body system and includes muscles, tendons and the bones of the body.
   b. The integumentary system is an extensive system found throughout the body and includes plasma and formed elements.
   c. The integumentary system is the most extensive body system consisting of skin, hair and nails.

3. The nervous system is made up of two main divisions. What are they?
   a. The brain and the spinal column
   b. The dura mater and the pia mater
   c. The central nervous system and the peripheral nervous system

4. In the table below, indicate which body system below the body part belongs to.
   a. The respiratory system
   b. The musculoskeletal system
   c. The nervous system
   d. The circulatory system

Part	System	Part	System
Alveoli	Respiratory	Cerebrum	Nervous
Muscles	Musculoskeletal	Cerebellum	Nervous
Arteries	Circulatory	Lungs	Respiratory
Cranial nerves	Nervous	Spinal nerves	Nervous
Capillaries	Circulatory	Red blood cells	Circulatory

Part	System	Part	System
Brain stem	Nervous	Trachea	Respiratory
Bronchi	Respiratory	Bones	Musculoskeletal
Pharynx	Respiratory	White blood cells	Circulatory
Veins	Circulatory	Platelets	Circulatory
Joints	Musculoskeletal		

5. Draw a line between the matching parts of the sentence.

Amongst other hormones, the pituitary gland secretes		...testosterone, oestrogen and progesterone.
Gonads secrete...		... glucagon and insulin
The pancreas secretes ...		... luteinizing growth hormone, thyroid stimulating hormone and prolactin.

CHECKPOINT: CHAPTER 2

Let's check your understanding before proceeding further.

Apply what you've learnt so far by correctly completing the activities below. (Note: you can revisit any information above at any time and this checkpoint won't count toward your final assessment results.) Answers are found on the last page of this Learner Guide.

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   b. Diabetes mellitus is a disorder in which the body does not produce enough or respond normally to insulin, causing high blood sugar.
   c. Insulin regulates blood sugar levels and enhances cellular glucose uptake by stimulating glycogenesis.

3. Complete the following statements:

   a. The whole circulation of blood going through the cardiovascular and respiratory system is called:

   Circulation of blood going through the cardiovascular and respiratory system is called double circulation. It is known as double circulation because the blood travels through the heart twice in one cycle.

   b. What are the chemical messengers used by the endocrine system called?

   Hormones

   c. There are two interconnected nervous systems. What are they?

   The central nervous system and the peripheral nervous system

4. Ossicles amplify the sound waves and transmit sound to the inner ear. The three ossicles are: (select the correct 3)

   a. The malleus

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The external ear is the outer part called...		... ...fluid which carries sound waves coming from the middle ear to the auditory nerve
The inner ear consists of...		... hearing and balance.
The cochlea contains		... semicircular canals and cochlea.