



**Practicals Book of
ANATOMY
&
PHYSIOLOGY**

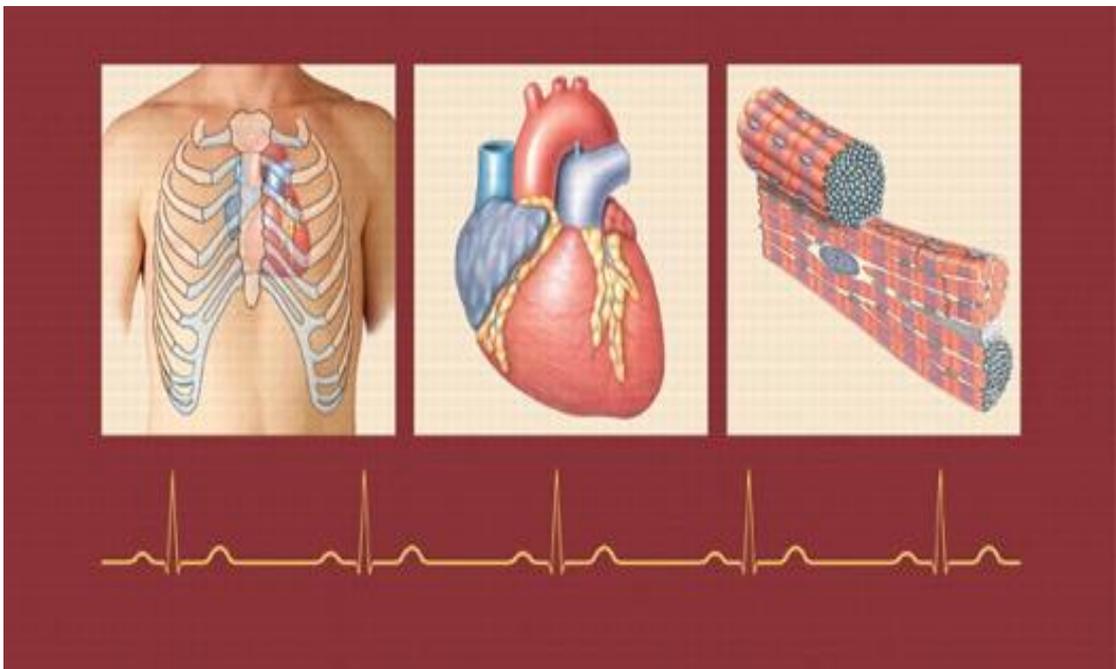
H.S.C (VOCATIONAL)

MEDICAL LABORATORY TECHNICIAN

STD: XI (PAPER-1)

ANATOMY AND PHYSIOLOGY

Practicals



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Week no.	1 st week
Practical no.	1
Title/ Aim	To study various human body parts
Objectives	Students shall be able to identify various body parts
Requirements	1. Models, 2. Charts, 3. PPT
Environment	MLT LABORATORY
Procedure	<ul style="list-style-type: none"> • With the help of chart observe the various parts of the body.
<p>Observations</p> <p>Anatomical position is the study of human body in erect position with arms by the sides and palms of the hands facing forwards, the head erect and eyes looking straight in front.</p> <p>Every body part is observed minutely and observation noted in journal. The Parts observed are -1. Head, 2. Neck, 3. Trunk- Thorax, Abdomen and pelvis. 4. Limbs- Upper (Arm, Fore arm and hand with fingers), Lower (Thigh, Leg and foot with toes.) as shown in figure 1.1</p>	

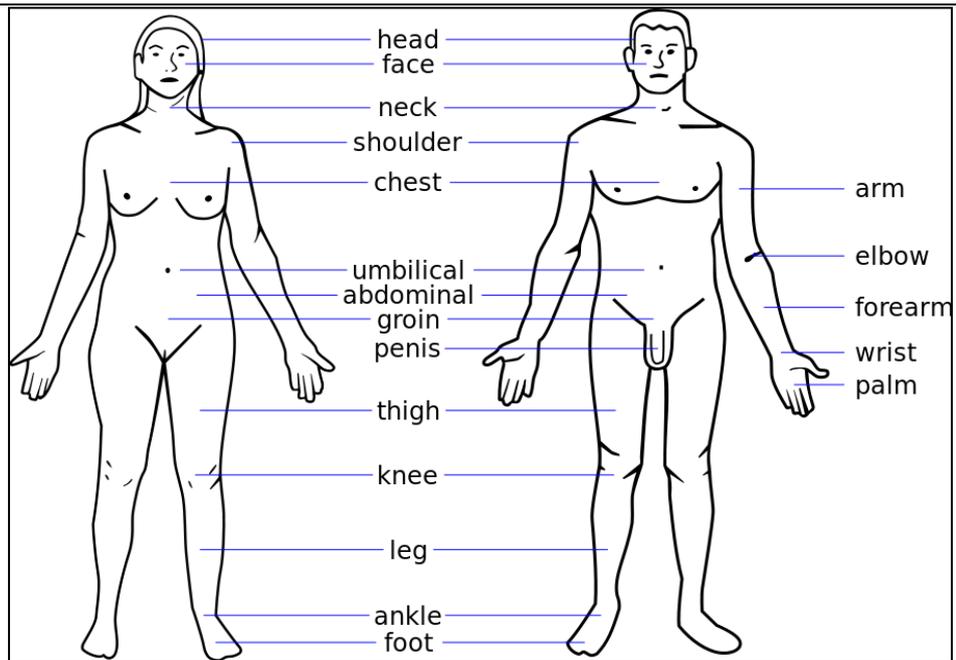


Figure 1.1

Skills achieved	Students will identify the body parts.
Skills evaluating criteria	<p>Identification of all the parts -10 marks correctly-</p> <ol style="list-style-type: none"> 1. Parts of head and face 2Marks 2. Parts of upper limb 4 marks 3. Parts of lower limb 4Marks
FAQs	Name different parts of human body.
Assignments	Draw chart showing parts of the human body.
References/Link with Theory Topic	Handbook of Anatomy & physiology - lesson 1

Week no.	2 nd week
Practical no.	2
Title/ Aim	To study different systems of human body.
Objectives	Students shall be able to identify different systems.
Requirements	Models Charts PPT presentation
Environment	MLT Laboratory
Procedures	With the help of chart, models and PPT observe the different systems of the body.

Observations – The student will observe the different systems of the body as tabulated below, its parts, structures of these parts, and their location in the body.

Various systems of the body

Sr. no.	Name of system	Functions of its parts
1	Skeletal system	Provides shape, support and protection to various internal organs.
2	Muscular system	Helps in locomotion with the bones and movement of different parts.
3	Circulatory system	Brings about circulation of blood, exchange of gases, and removal of waste products.
4	Respiratory system	Brings about respiration and acid - base balance
5	Digestive system	Helps in ingestion, digestion, absorption of food and excretion of waste.
6	Excretory system- Urinary system- Skin	Deals with excretion of various waste products and water and electrolyte balance.
7	Endocrine system	Deals with secretion of various hormones and their functions.

8	Reproductive system	Concerned with process of reproduction.
9	Nervous system	Coordination of functions of various parts of the body.

Figure 2.1 shows the different systems in diagrammatic form:

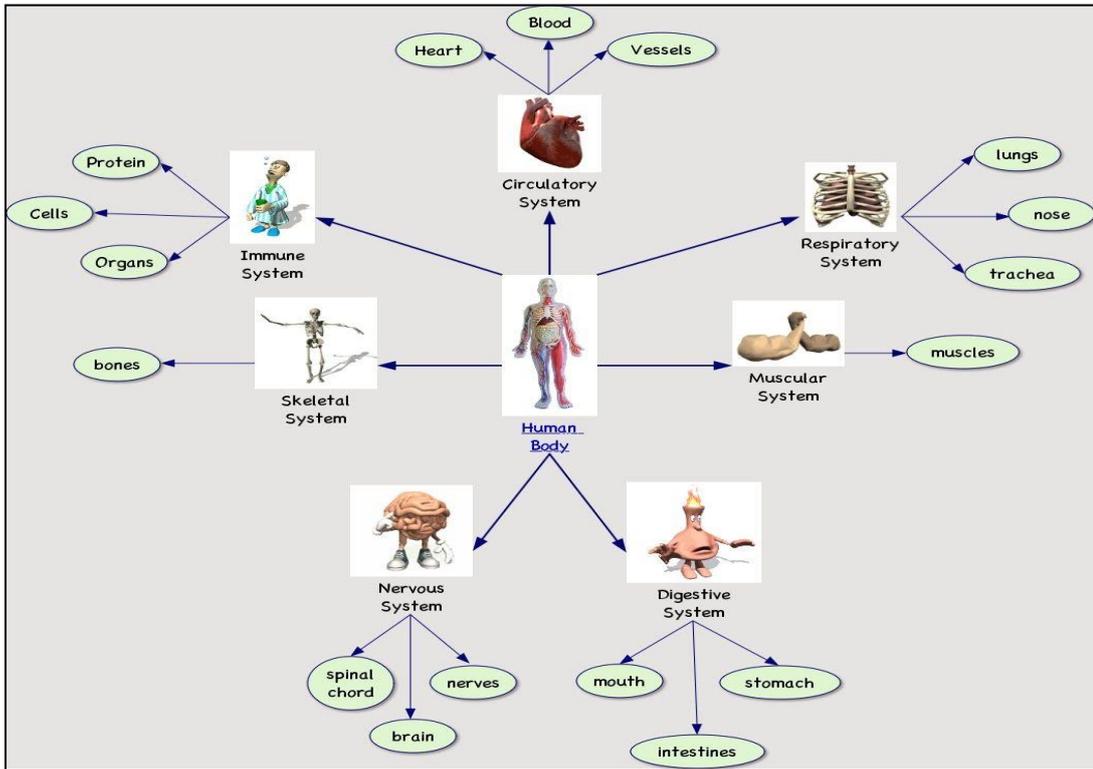


Figure 2.1

Skills to be achieved	Students will identify the various systems of the body correctly.
Skills evaluating criteria	Identify different systems-10 marks Correctly.(1 mark for each system).
FAQs	Name different systems of the human body.
Assignments	Make a chart of different systems of the human body.
References/Link with Theory Topic	Handbook of Anatomy & physiology - lesson 1

Week no.	3 rd week
Practical no.	3
Title/ Aim	To study various Anatomical terms, positions and planes (surfaces) over the human body.
Objectives	Students shall understand various anatomical terms and will identify the various positions and planes over the human body.
Requirements	<ol style="list-style-type: none"> 1. Models 2. Charts 3. PPT presentation
Environment	MLT Laboratory
Procedures	With the help of charts or models observe the various planes and surfaces.

Observations :

With the help of the charts the student will observe all the plane and surfaces.

To observe these the body has to be in the **Anatomical Position** i.e. erect position with arms by the sides and palms of the hands facing forwards, the head erect and eyes looking straight in front.

Anatomical terms and Positions:

Sr. No.	Term	Description	Example
1	Anterior (Ventral)	Towards front of body	Anterior tibial artery lies in front of leg.
2	Posterior (Dorsal)	Towards the rear of the body	Posterior tibial artery lies behind the leg.
3	Medial	Structures nearer to median plane of the body.	Ulna is medial bone of the forearm.
4	Lateral	Structures away from median plane of the body.	Radius is lateral bone of the forearm.
5	Internal	Relative distance of an organ or structure from the centre of body cavity.	Internal carotid artery is within the cranial cavity.

6	External	Relative distance of an organ or structure from the centre of body cavity.	External carotid artery is outside the cranial cavity.
7	Superficial	Relative distance from the surface of the body.	Superficial group of flexor and extensor group of muscles of forearm
8	Deep	Relative distance from the surface of the body.	Deep group of flexor and extensor group of muscles of forearm
9	Superior	Denotes position high or low particularly in relation to the trunk.	Superior surface of clavicle
10	Inferior	Denotes position high or low particularly in relation to the trunk.	Inferior surface of clavicle
11	Palmer	Similar to anterior but used to describe surface of hand.	Palmer (Anterior) surface of hand

12	Dorsal	Similar to posterior but used to describe surface of hand.	Dorsal (Posterior) surface of hand
13	Plantar	Similar to anterior but used to describe surface of foot.	Plantar (Anterior) surface of foot
14	Dorsal	Similar to posterior but used to describe surface of foot.	Dorsal (Posterior) surface of foot.
15	Proximal	Describes distance from a given point, particularly in relation to limbs.	Proximal phalanges are nearer to wrist.
16	Distal	Describes distance from a given point, particularly in relation to limbs.	Distal phalanges are away from wrist.
Anatomical positions-			

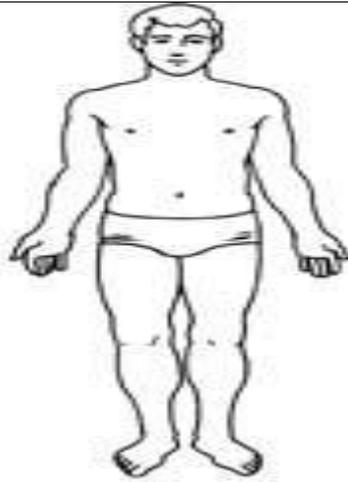


Figure 3.1

Anatomical planes- Figures 3.2 and 3.3 showing different planes –

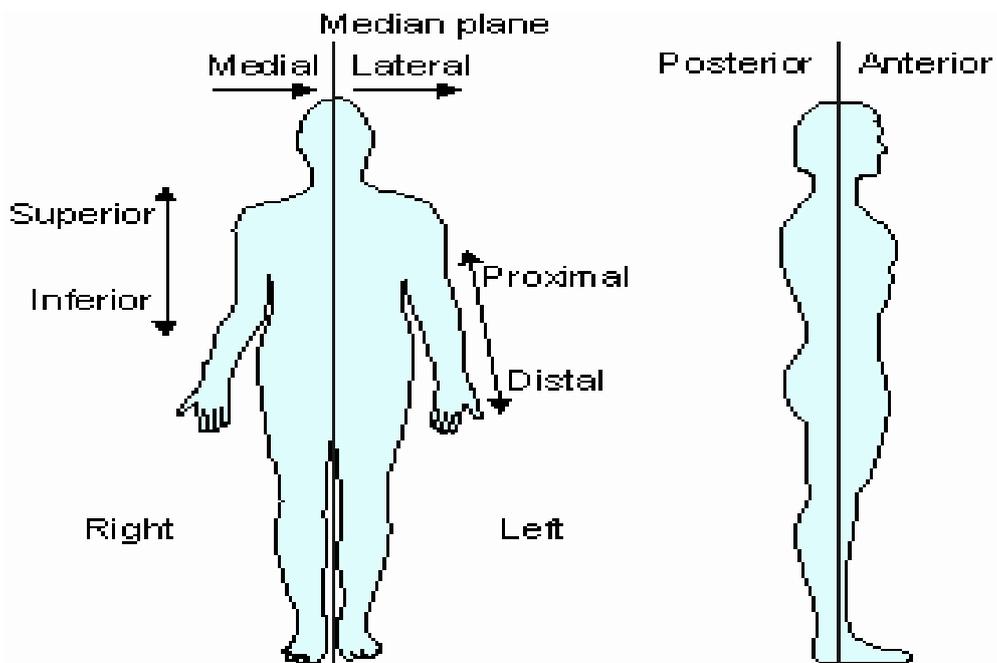


Figure 3.2

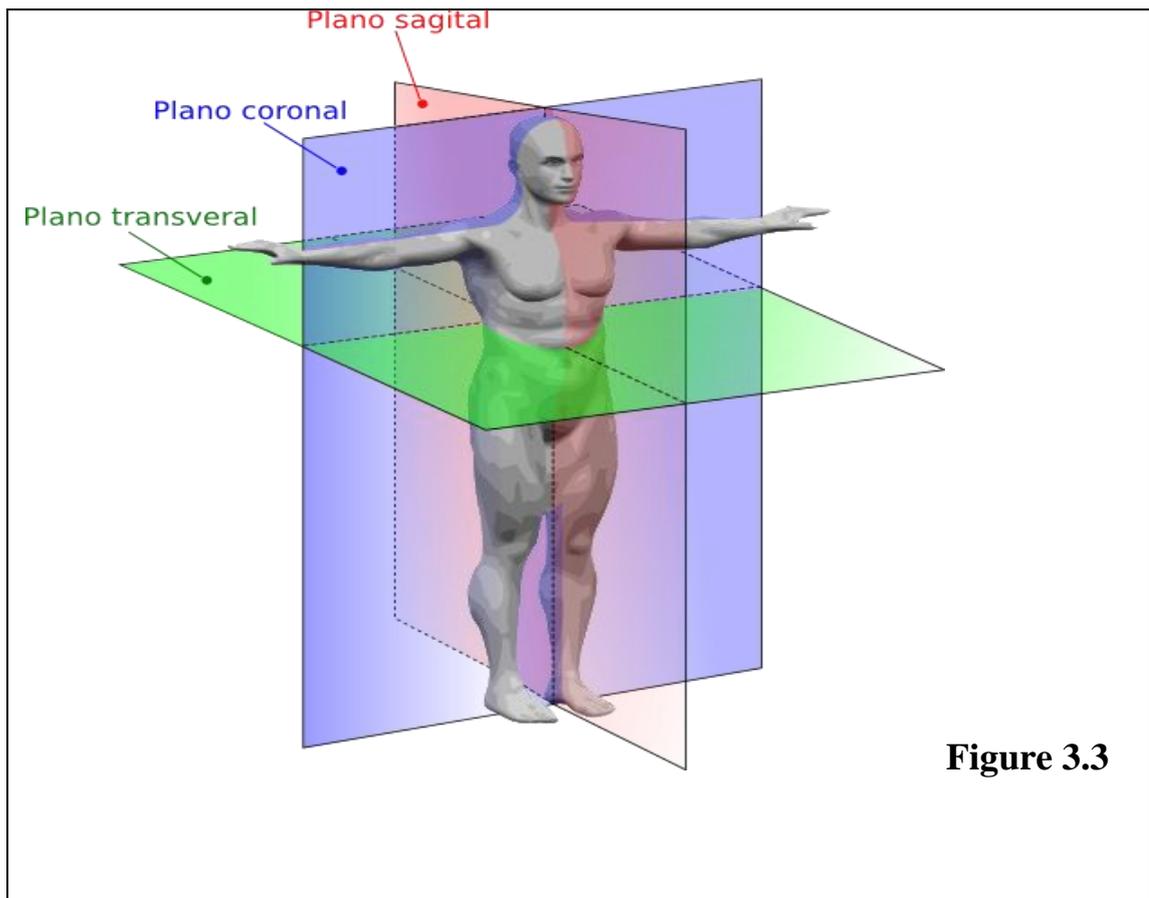
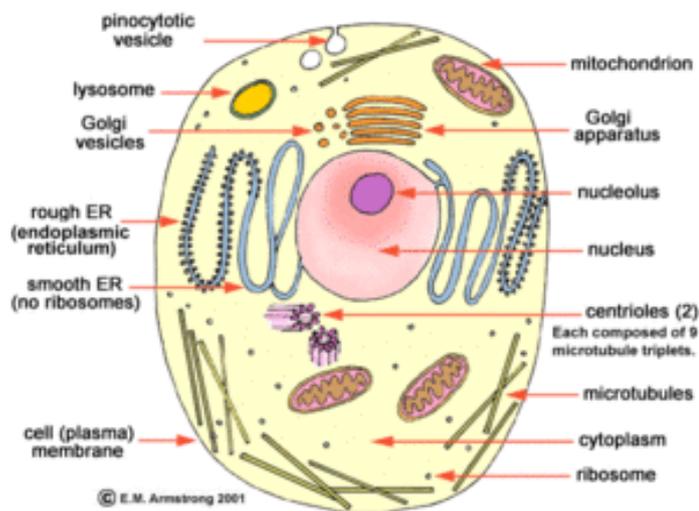


Figure 3.3

Skills to be achieved	Students will know different anatomical terms and will identify all the positions and planes over the human body correctly.
Skills evaluating criteria	<ul style="list-style-type: none"> • Knowledge of all anatomical- 5 marks Terms.(Any five) • Identification of all positions - 5 marks and planes.
FAQs	<ol style="list-style-type: none"> 1. Names different anatomical terms. 2. Enlist various positions and planes over the body.
Assignments	Draw chart showing different positions and planes over the body and display it in your laboratory.
References/Link with Theory Topic	Handbook of Anatomy & physiology - lesson 1
Week no.	4 th week

Practical no.	4
Title/ Aim	Cell structure:- To identify cell and its organelles.
Objectives	Students shall be able to identify structure of cell with its organelles.
Requirements	1. Model of cell structure 2. Chart of cell structure
Environment	MLT Laboratory
Procedures	1. With the help of chart of animal cell observe the various parts of the cell. 2. Study the structure of different cell organelles and their functions.

Observations



Different parts of cell and its functions:

Sr. No.	Part of cell	Functions
1	Nucleus	Membrane bound structure that contains the cell's hereditary information.

2	Plasma membrane	Maintains the integrity of the cell. It concerns with function of protection, secretion, absorption, excretion.
3	Mitochondria	Sites of cellular respiration.
4	Endoplasmic reticulum(ER) Two types Smooth and Rough	Smooth ER- synthesizes lipids and steroid hormones. Rough ER- These are the site of synthesis of proteins.
5	Golgi apparatus	The proteins move from the endoplasmic reticulum to the Golgi apparatus where they are 'packaged' into membrane-bound Vesicles called secretory granules.
6	Ribosomes	Synthesize proteins from amino acids, using RNA as the template.
7	Lysosomes	Sacs of enzymes that digest cellular macromolecules such as nucleic acids.
8	Microfilaments.	Provide structural support and maintain the characteristic shape of the cell.
9	Microtubules	Contractile protein structures in the cytoplasm involved in the movement of the cell and of organelles within the cell
10	Centrioles	Cylindrical structures that organize the assembly of microtubules

		during cell division.
11	Vacuoles	Collect waste products in a cell.
Result	Various cell organelles are identified and noted.	
Skills to be achieved	Students will identify the cell structure in detail.	
Skills evaluating criteria	Identify the organelles - 2 marks each Correctly (Any 5)	
FAQs	<ol style="list-style-type: none"> 1. Define cell. 2. Enumerate the cell organelles. 3. State the functions of cell and its organelles. 	
Assignments	Draw a neat and labeled diagram of an animal cell.	
References/Link with Theory Topic	Handbook of Anatomy & physiology - lesson 2	

Week no.	5 th week										
Practical no.	5										
Title/ Aim	Identification of basic tissues of body.										
Objectives	Student shall be able to identify different tissues of body.										
Requirements	Model and Charts.										
Environment	MLT Laboratory										
Procedures	With the help of chart of body tissues observe the various tissues of body.										
Observations											
<p>Tissue-Group of similar cells carrying out a specific function is known as tissue.</p> <p>Basic tissues of body are</p> <ul style="list-style-type: none"> ➤ Epithelial tissue ➤ Connective tissue ➤ Muscular tissue ➤ Nervous tissue <p>Epithelial tissue- It covers entire external surface of human body and inner surface of hollow organs. These cells lie on basement Membrane.</p> <p>Types of epithelial tissue:-</p> <table border="1"> <thead> <tr> <th>Sr. No.</th> <th>Type</th> <th>Description</th> <th>Site where found</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Simple-</td> <td>Single layer of cells lying</td> <td></td> </tr> </tbody> </table>				Sr. No.	Type	Description	Site where found	1	Simple-	Single layer of cells lying	
Sr. No.	Type	Description	Site where found								
1	Simple-	Single layer of cells lying									

	Squamous	on basement membrane. <ul style="list-style-type: none"> Thin plate like cells 	In capillaries, alveoli, glomeruli
	Cuboidal	<ul style="list-style-type: none"> Cubical cells 	Endometrial glands
	Columnar- Ciliated Nonciliated	<ul style="list-style-type: none"> Cubical but elongated cells with or without cilia. 	Gastrointestinal tract (Nonciliated) Trachea and bronchial tree (Ciliated)
2	Compound (Stratified) Squamous Transitional Columnar	More than one layer of cells. Basal layer lies on basement membrane <ul style="list-style-type: none"> Plate like cells one above the other. Basal squamous and then columnar cell. Look like pear shapes. Basal columnar then stratification of cells 	Skin, Oral cavity, esophagus, Vagina. Renal pelvis, ureter, urinary bladder, urethra Pharynx, epiglottis, Fetal tissue

- **Simple squamous epithelium**

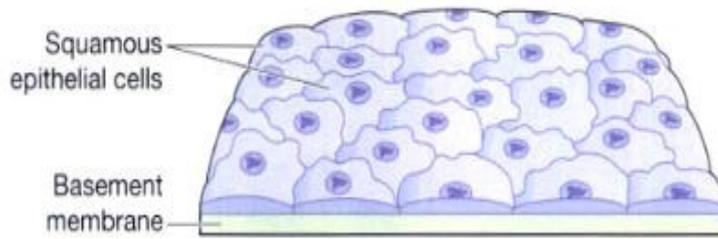


Figure -5.1.1

- **Simple Cuboidal Epithelium.**

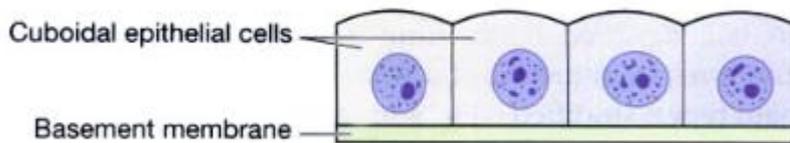


Figure 5.1.2

- **Simple Columnar Epithelium**

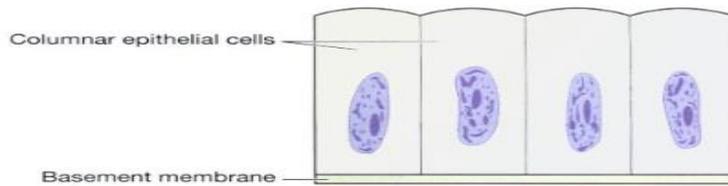
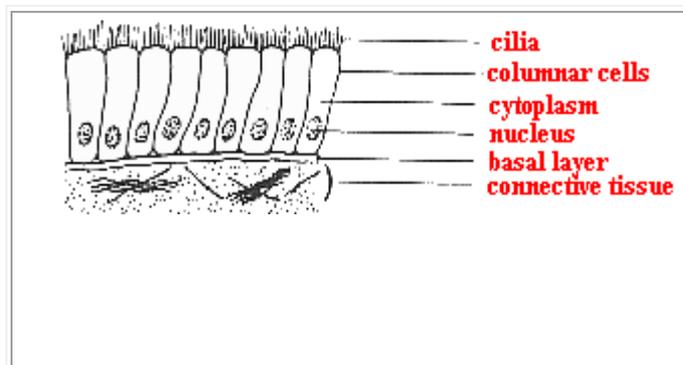


Figure 5.1.3

- **Ciliated Columnar Epithelium**



- **Stratified squamous epithelium**

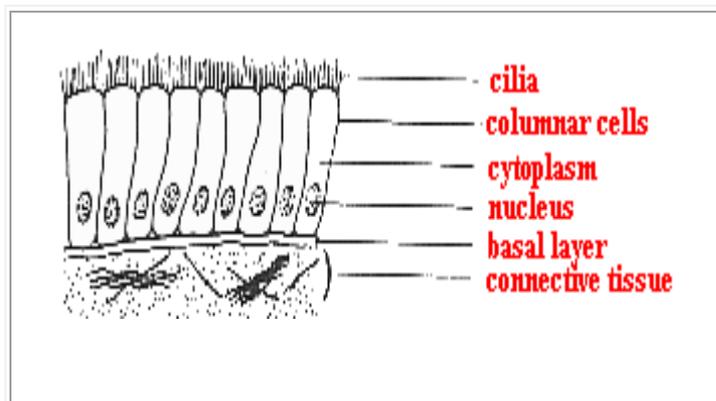


Fig 5.4

Connective tissue

This is the most widespread and abundant type of tissue in the human body. Its function is primarily to support, anchor and connect various parts of the body. Although connective tissue exists in a number of forms, all types have three basic structural elements –

- Cells- Fibroblasts, Macrophages, Mast cells , Fat cells
- Fibres- collagen, Elastic and Reticulin fibres
- Intercellular substance (ground substance)

Types of connective tissue

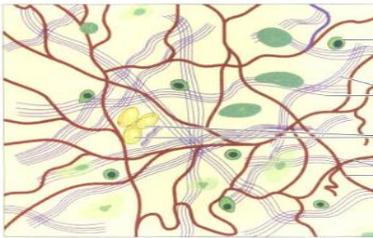
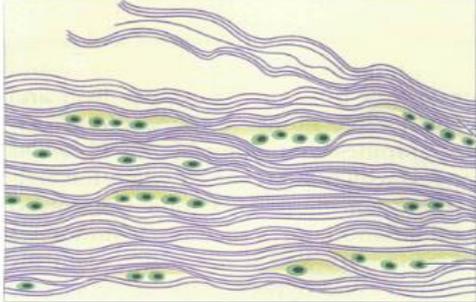
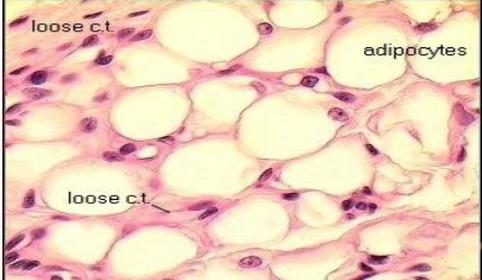
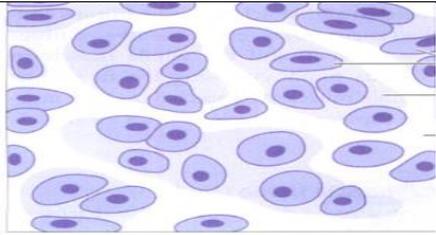
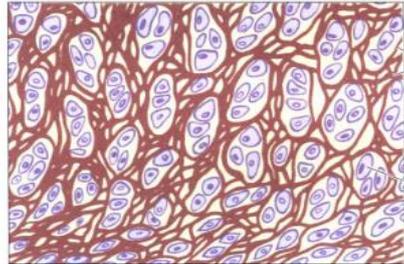
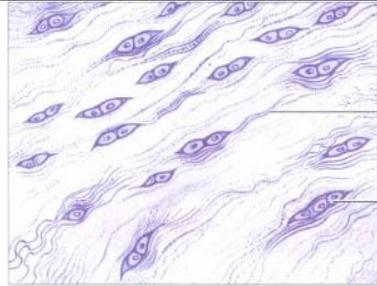
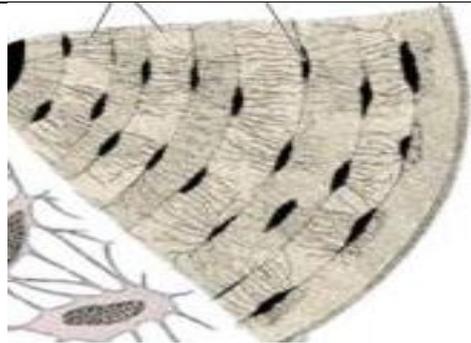
Type	Site	Diagram
Loose areolar tissue	Immediately beneath the skin, in and around the blood vessel	 <p>Figure 5.2.1</p>
Dense fibrous tissue	Ligaments, tendons, periosteum, etc	 <p>Figure 5.2.2</p>
Adipose tissue	All subcutaneous tissue except eyelids, penis and inside the cranial cavity	

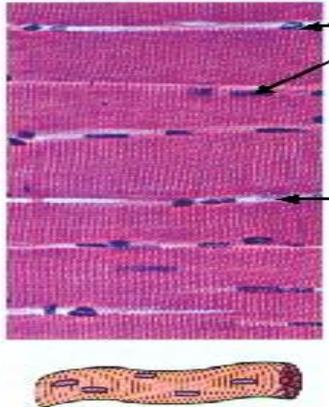
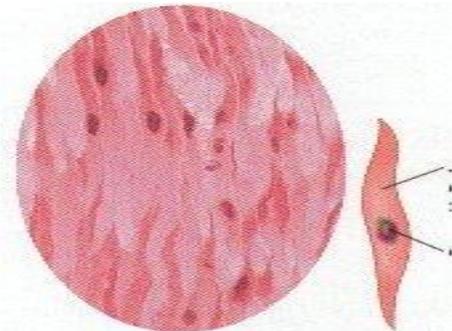
		Figure 5.2.3	
Cartilage	At joints and between bones		
Hyaline	Covering ends of long bones, in costal cartilages, nose, larynx, trachea, etc	Figure 5.2.4	
Elastic	Lining of the ear, epiglottis and Eustachian tubes		
		Figure 5.2.5	
Fibrocartilage	Deepens cavities of bony sockets as in acetabulum, glenoid cavity, in semilunar cartilage.		Figure 5.2.6
Bone	Forms skeleton of body		Figure 5.2.7

Muscular tissue

Muscle is a tissue specialized for contraction and by means of which movements are carried out.

There are three types of muscle tissue

1. Skeletal muscle

2. Smooth muscle		
3. Cardiac muscle.		
Type of muscle	Description	Location & Diagram
Skeletal	<p>Voluntary.</p> <p>Individual muscle fibers are transversally striated by light and dark bands.</p> <p>No branching anastomosis.</p>	<p>Covers skeleton</p>  <p>Figure 5.3.1</p>
Smooth	<p>Involuntary muscles.</p> <p>Activity is under the control of ANS.</p> <p>Spindle shape; do not show alternate light and dark bands.</p>	<p>Coats of blood vessels and lymphatics, walls of digestive tract, in hollow viscera, trachea, br iris, ciliary muscles of eye</p>  <p>Figure 5.3.2</p>
Cardiac	<p>Involuntary, striated but show branching</p>	<p>Heart</p>

anastomosis.

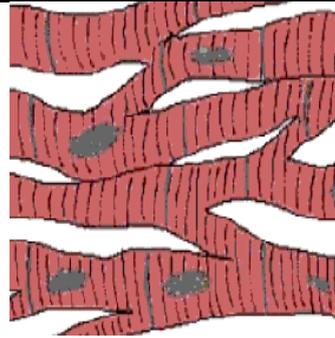


Figure 5.3.3

Nervous tissue

Neurons are the structural and functional unit of the nervous system.

Nervous tissue contains two principal cell types.

1. Neurons- Neurons are nerve cells, sensitive to various stimuli. It converts stimuli to nerve impulse. It contains 3 basic portions. These are cell body, axons and dendrites.
2. The neuroglia - Neuroglia are cells that protect, nourish and support neurons. Clinically they are important because they are potential to replicate and produce cancerous growths.

Nerve cell with its processes

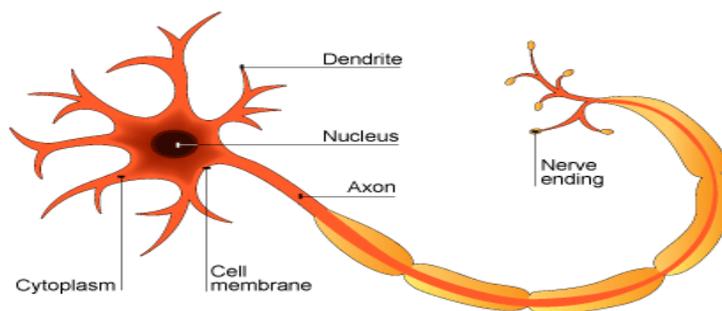
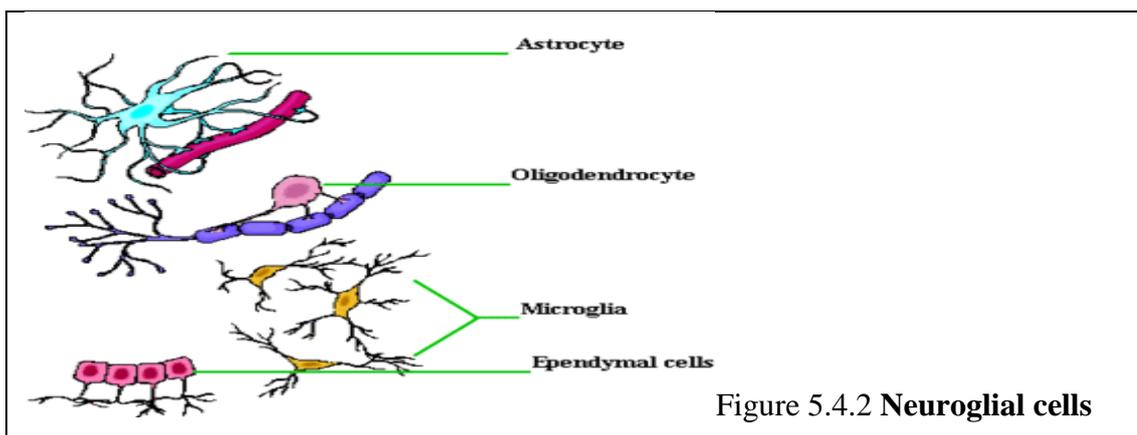
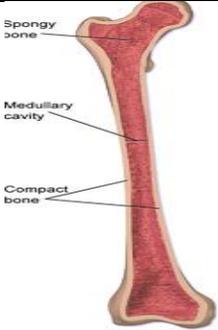


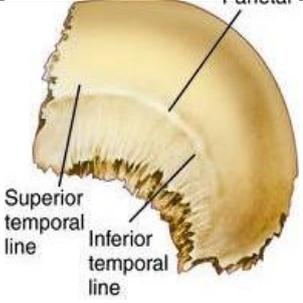
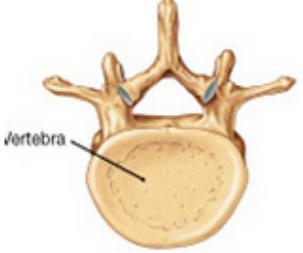
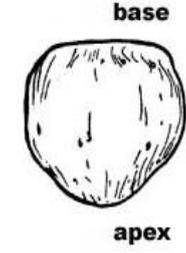
Figure 5.4.1



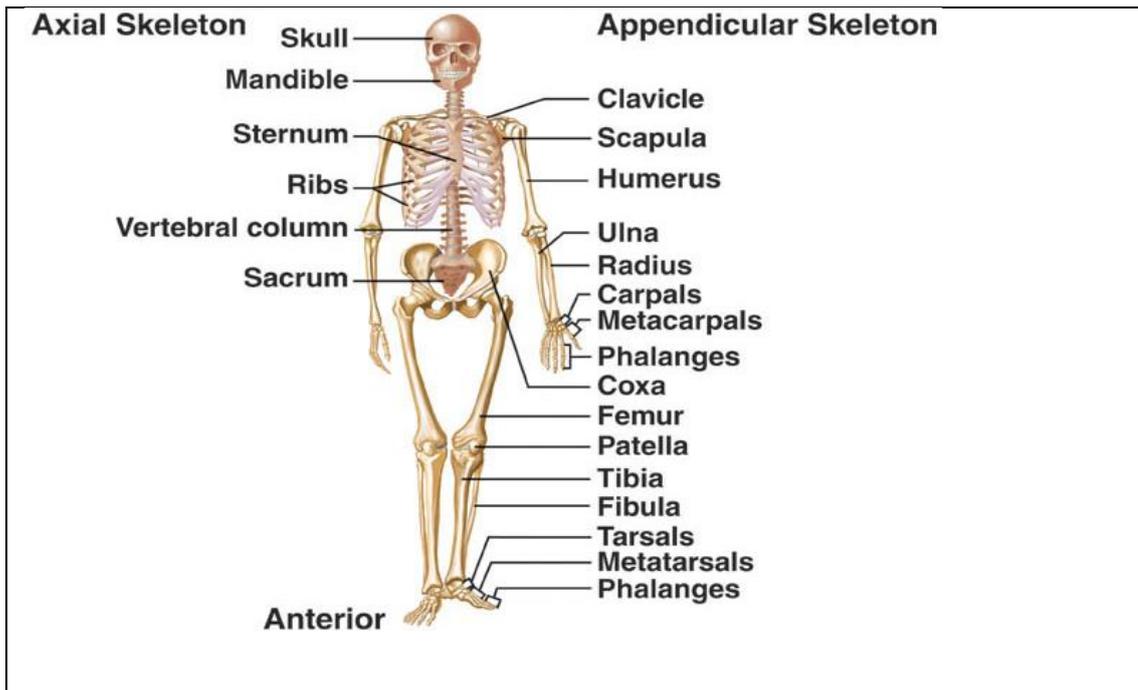
Skills to be achieved	Students will identify all the tissues correctly
Skills evaluating criteria	<ol style="list-style-type: none"> 1. Identify basic tissue of the body -2 marks 2.Examples of connective tissue -2 marks 3. Identify the slide (4 slides) 4 marks 4. Name different types of muscles 2marks
FAQs	<ol style="list-style-type: none"> 1. Define tissue. Classify them. 2. What is connective tissue? Name different types of connective tissue. 3. Draw and explain a neuron.
Assignments	<ul style="list-style-type: none"> • Draw and label different basic tissues of body. • Prepare chart of basic tissues of body along with diagram.
References/Link with Theory Topic	Anatomy & Physiology handbook Lesson 3

Week no.	6 th week
Practical no.	6
Title/ Aim	To demonstration of different types bones and joints of human body
Objectives	At the end of the practical students shall be able to

	Identify different types of bones. Different joints and their movements.			
Requirements	1. Models, 2. Chart 3. An artificial human skeleton. 4. Bone set			
Environment	MLT Laboratory			
Procedures	With the help of the human skeleton and chart study different bones, joints, their articulations. movements.			
Observations				
4.1 Types of bones- Depending on shape and formation of bones:				
Sr. No	Type of bone	Description	Example	Diagram
1	Long bones	Consists of two ends and a shaft. Found mainly in limbs. Act as lever during movements.	Humerus, Radius, Ulna, Femur, tibia	 <p>Figure 4.1.1 Humerus</p>
2	Short bones	Composed of cancellous bone tissue and thin covering of compact tissue.	Bones of carpus and tarsus	 <p>Figure 4.1.2 Tarsal</p>

3	Flat bones	Two layers of dense bone tissue with an intervening layer of spongy bone.	Skull bones, Innominate bones, Scapula	 <p>Figure 4.1.3 Skull bone</p>
4	Irregular bones	Irregular in shape.	Vertebrae, Bones of face	 <p>Figure 4.1.4 Vertebra</p>
5	Sesamoid bone	Develops in tendons of muscles and found near joints.	Pisiform (Smallest) Patella (Largest)	 <p>Figure 4.1.5 Patella</p>

4.2 Axial and Appendicular skeleton - Different bones of body



4.3 Joints and its classification

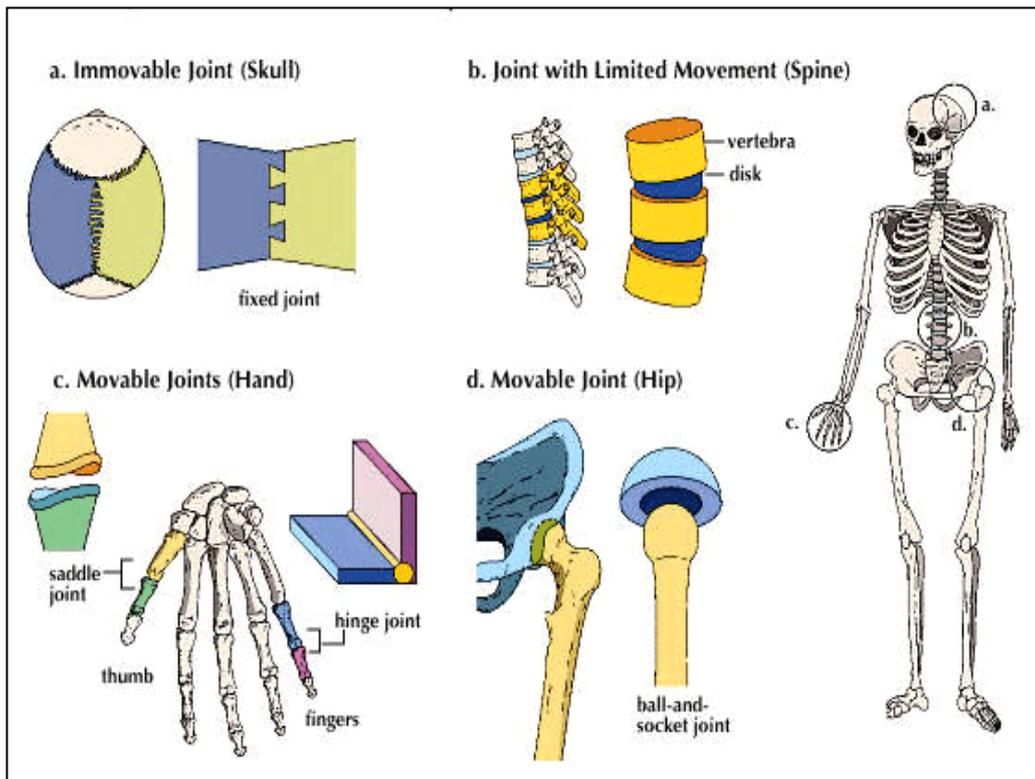
Joint- A point of articulation between two or more bones, especially such a connection that allows movement.

Classification: Depending on structure and movement

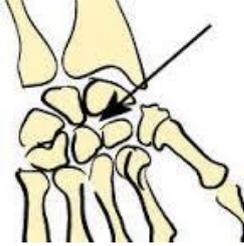
Sr. No.	Type of Joint	Description/Example
1	Fibrous (Immovable)	Fixed joints. No movement between the bones is possible. i) Joints of skull bones called Sutures- Sagittal- between two parietal bones Coronal- between frontal and two parietal bones and Lambdoid- between occipital and two parietal bones. ii) Peg joint- teeth in their socket
2	Cartilaginous (Slightly movable)	Slight movement is possible due to some intervening substance. i) Pubic symphysis- A pad of cartilage unite

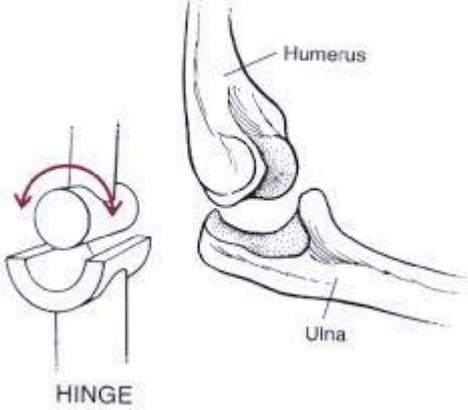
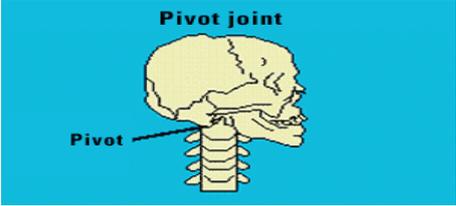
		two pubic bones. ii) Intervertebral joints.
3	Sinovial (Freely movable)	Movements are possible at this joint The ends of bones are covered by hyaline cartilage. Ligaments are required to bind the bones. A joint cavity enclosed by fibrous capsule strengthened by ligaments. i) Shoulder joint ii) Hip joint.

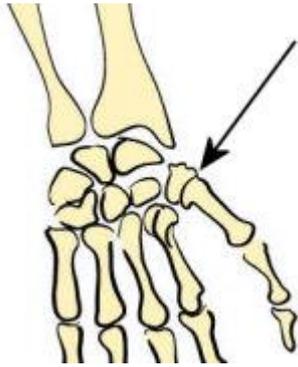
Types of synovial joints- Depending on type of movement



Sr. No.	Type of joint	Description & Example
1	Gliding or plane	Two flat surfaces glide over each

		<p>other.</p> <p>Joints of carpus and tarsus</p> 
2	Ball and socket	<p>One rounded extremity fitted into cavity of another bone allowing movement in all directions.</p> <p>Shoulder joint and Hip joint.</p> 
3	Hinge	<p>One rounded surface is received in to another surface in such a way that movement is possible in one plane only.</p> <p>Elbow joint</p>

		
4	Condyloid	<p>Similar to hinge but movement is in two planes-lateral and forward and backward planes.</p> <p>Wrist joint</p> 
5	Pivot	<p>Only rotation is possible.</p> <p>Movement of head-Atlas rotates round the peg shape axis.</p> <p>Movement of radius and ulna in pronation and supination of forearm.</p> 
6	Saddle	<p>A joint of reciprocal reception.</p> <p>Allowing thumb to be opposed to the rest of fingers.</p> <p>A joint between trapezium and</p>

		<p>first metacarpal.</p> 	
Skills to be achieved	Students will identify all bones and joints of the body correctly.		
Skills evaluating criteria	<ol style="list-style-type: none"> 1. Identify 5 bones correctly – 5 marks 2. Identify 5 joints correctly – 5 marks 		
FAQs	<ol style="list-style-type: none"> 1. Write examples of- <ul style="list-style-type: none"> long bones Short bones Flat bones Irregular bones Sesamoid bones 2. Enlist different joints with examples. 		
Assignments	Visit to anatomy department.		

Week no.	7th week
Practical no.	7
Title/ Aim	To demonstrate different parts of heart and process of circulation.
Objectives	At the end of this practical the students shall understand the structure and function of the heart.
Requirements	1. Model 2. Charts
Environment	MLT Laboratory
Procedures	With the help of model/chart of heart observe different parts of heart.
<p>Observations</p> <p>It is well organized transport system of body by which blood being circulated within a closed system under different pressure gradients created by pumping mechanism where heart acts as a central pump. Blood gets reduced in tissues and oxygenated in lungs. Thus it has to pass alternatively through lungs and tissues. So circulatory system is divided into two parts which are functionally opposite.</p> <ul style="list-style-type: none"> ➤ Systemic circulation- Passing through tissues ➤ Pulmonary circulation- Passing through lungs. <p>7.1 Structure of Heart</p> <ul style="list-style-type: none"> • The heart is cone shape hollow muscular organ situated obliquely in thoracic cavity with base above and apex below. Lies in thorax between two lungs. It is a size of closed fist. It is more on left side and less on right side. • It is composed of three layers of tissue pericardium, myocardium and endocardium. Pericardium is outermost layer. The myocardium is 	

composed of specialized cardiac muscle found only in the heart. It is not under voluntary control but like skeletal muscle it is striated. The myocardium is thickest at the apex and thins out towards the base. Endocardium forms the lining of the myocardium and the heart valves. It is a thin, smooth, glistening membrane which permits smooth flow of blood inside the heart.

- Heart is divided into right and left part by a septum. Each part is further divided into two chambers- atrium and ventricles. Thus heart has four chambers
 - Right and left atrium
 - Right and left ventricle
- Ventricles have thick walls than atria and left ventricle is thicker than right ventricle. Left side contains oxygenated and right side deoxygenated blood.

Blood vessels attached to Heart

Name of chamber	Names of blood vessel
Right atrium	Superior vena cava Inferior vena cava & Coronary sinus
Left atrium	Left and right pulmonary veins
Right ventricle	Pulmonary trunk dividing into Right and left pulmonary artery
Left ventricle	Aorta

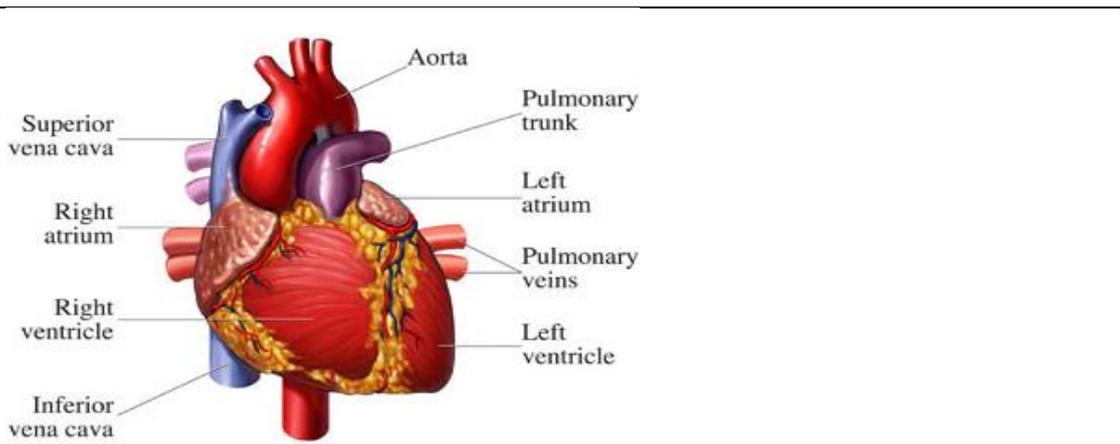


Figure 7.1.1

Valves of heart:

Name of chamber	Names of valve
Between right atrium and right ventricle	Tricuspid valve
Between left atrium and left ventricle	Bicuspid or mitral valve
Between left ventricle and Aorta	Aortic valve
Between right ventricle and Pulmonary trunk	Pulmonic valve

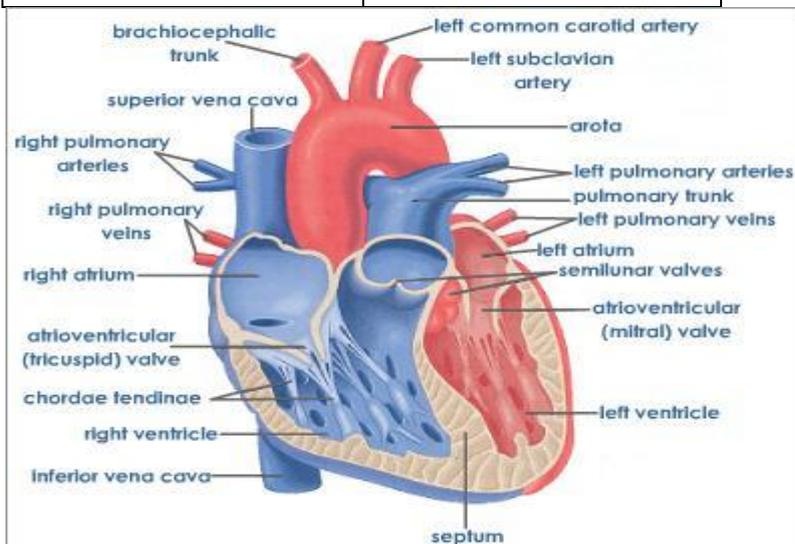


Figure 7.1.2

5.2 Process of circulation

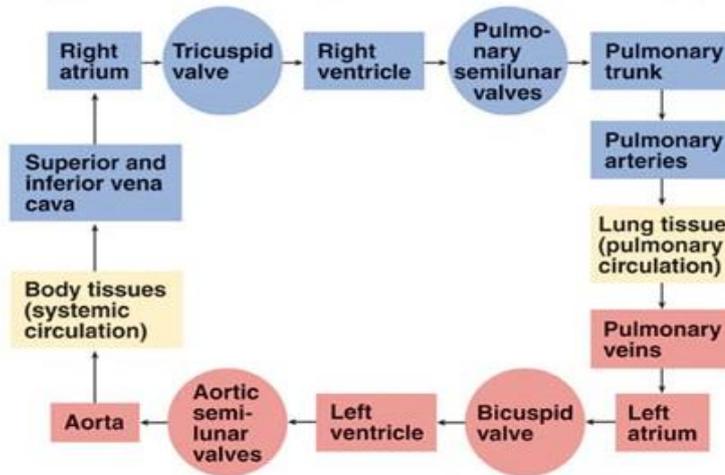


Figure 7.2

Skills to be achieved	Students will identify heart and its parts correctly They will also know the correct functioning and importance of the circulatory system.
Skills evaluating criteria	1. Identify the parts of heart – 4marks 2. Name valves of heart – 2 marks 3. Name blood vessels – 4 marks
FAQs	1. What is circulatory system? Name its parts. 2. Explain cardiac cycle? 3. Describe the structure of heart with a diagram.
Assignments	Visit to anatomy department Draw a neat and labeled diagram of heart.
References	Anatomy & Physiology handbook- Lesson-6

Week no.	8 th week
Practical no.	8
Title/ Aim	To demonstrate different parts of respiratory tract and their functions.
Objectives	Students shall be able to identify <ul style="list-style-type: none"> • Different parts of respiratory system • Their functions.
Requirements	Model of Lung Chart of respiratory system
Environment	MLT Laboratory
Procedures	With the help of model/chart of lung identify different parts of respiratory system.
Observations	The student will use the chart to observe and identify various parts of respiratory system.

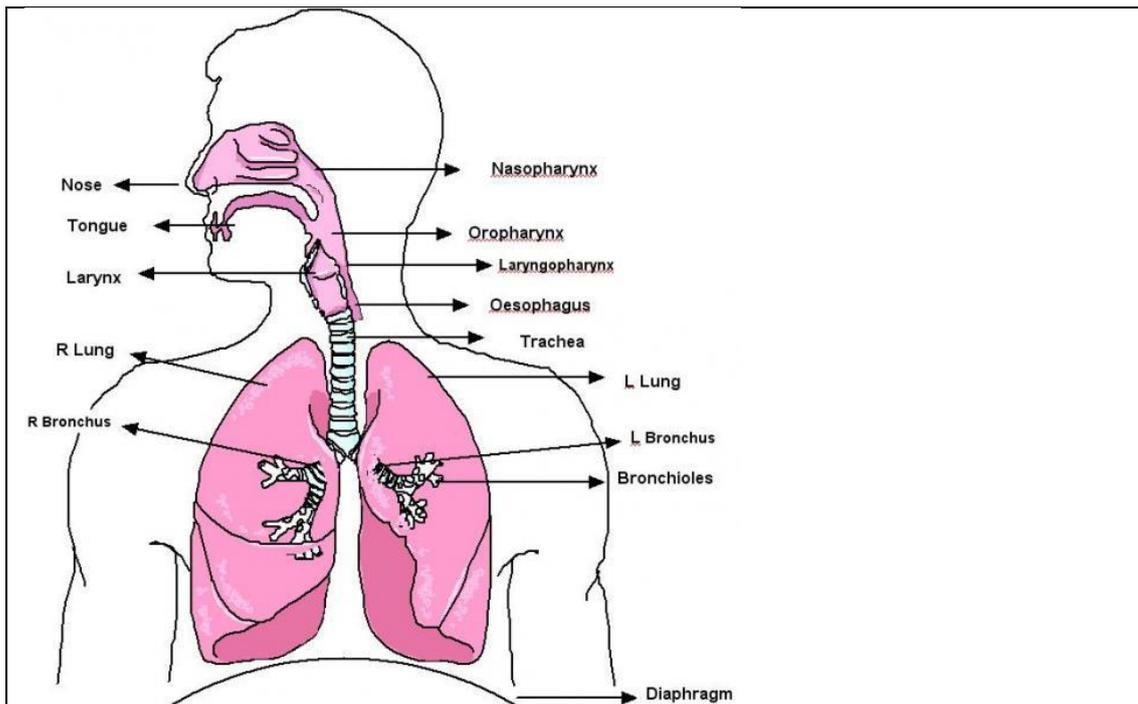


Figure 8.1.1

8.1 Structure of Respiratory tract:

The fundamental purpose of the respiratory system is to supply oxygen to the individual tissue cells and to remove their gaseous waste product.

Name of organ/part	Description & Function
Nose, Nasal cavity	First part of respiratory tract 1. Foreign bodies, such as dust particles and pathogens, are filtered out by the hairs of the nostrils or caught in the surface mucus. 2. Air is warmed by the blood in the vascular membrane. 3. Air is moistened by the liquid secretion
Pharynx	The upper portion behind the nasal cavity is called the nasopharynx. The middle section behind the mouth is called the oropharynx.

	<p>The lowest portion is called the laryngeal pharynx.</p> <p>The pharynx carries air into the respiratory tract</p>
Larynx	<p>The larynx (voice box) is located between the pharynx and the trachea.</p> <p>At the upper end of the larynx are the vocal cords,</p> <ol style="list-style-type: none"> 1. Vocal cords take part in production of speech. 2. The larynx is lined with ciliated mucous membrane. The cilia trap dust and other particles, moving them upward to the pharynx to be expelled by coughing, sneezing, or blowing the nose.
Trachea (Wind pipe)	<p>The trachea is a tube that extends from the lower edge of the larynx to the upper part of the chest above the heart.</p> <p>It has a framework of cartilages to keep it open.</p> <ol style="list-style-type: none"> 1. The trachea conducts air between the larynx and the lungs.
Bronchi and bronchioles	<p>The trachea divides into two bronchi Right and Left which enter the lungs at hilum.</p> <p>The right bronchus is considerably larger in diameter than the left.</p> <ol style="list-style-type: none"> 1. Air passes from the trachea into the lungs through bronchi
Alveoli	<p>Cluster of air sacs, resembling a bunch of grapes.</p> <p>Each alveolus is lined by a single-cell layer of squamous epithelium. They have very thin wall.</p> <ol style="list-style-type: none"> 1. Provides easy passage for the gases entering and leaving the blood

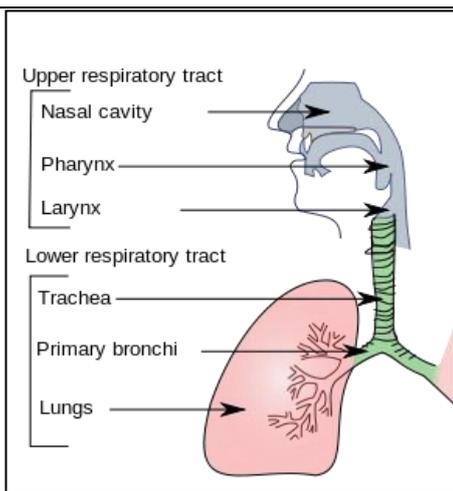


Figure 8.1.2

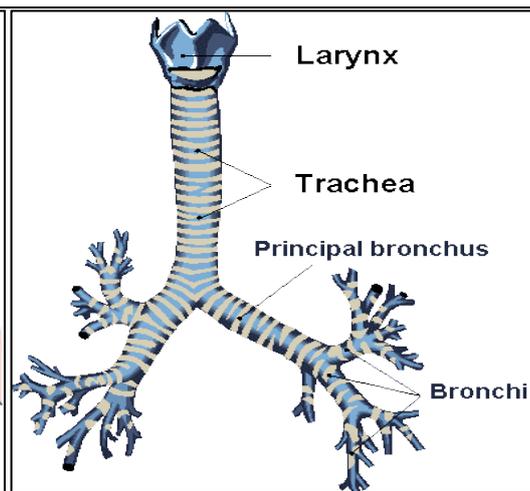


Figure 8.1.3

8.2 Anatomy of lungs

The Lungs

- The lungs are the organs in which external respiration takes place through the extremely thin and delicate lung tissues.
- The two lungs set side by side in the thoracic cavity.
- The lungs occupy a considerable portion of the thoracic cavity, which is separated from the abdominal cavity by the muscular partition known as the diaphragm.
- The region between the lungs- the mediastinum, contains the heart, great blood vessels, esophagus, trachea, and lymph nodes.
- Each lung is enveloped in a double sac of serous membrane called the pleura.
- Lungs are divided in to lobes.
- On right side three lobes- Upper, middle and lower and on left side two lobes- upper and lower.
- Within lobes bronchi enter which undergo division and finally become alveoli where gaseous exchange takes place.
- Lungs are porous, elastic organs, filled with air, so float in water.

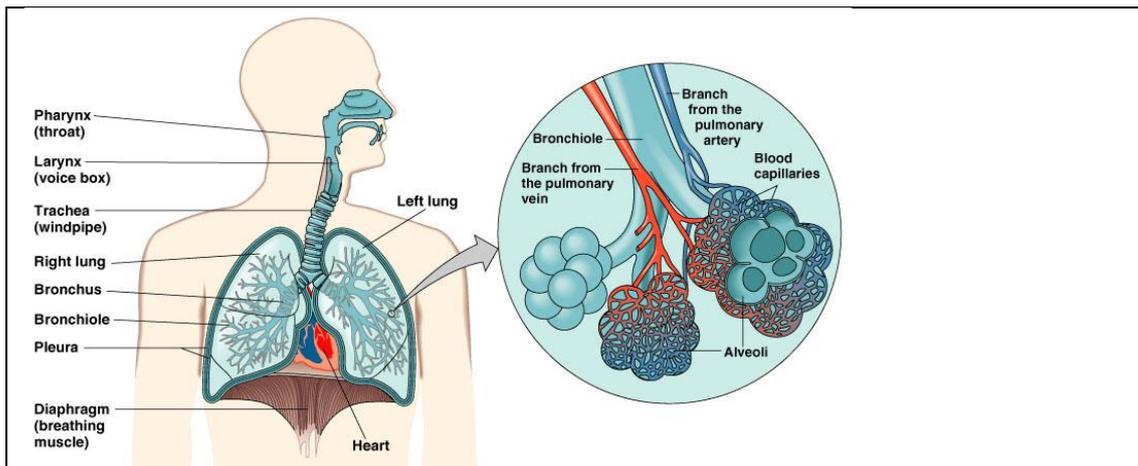


Fig 8.2

Skills to be achieved	Students will identify all parts of the respiratory system correctly.
Skills evaluating criteria	<ol style="list-style-type: none"> 1. Identify parts of the Respiratory - 4marks system correctly – 2. Parts of lung – 4 marks 3. Draw a bronchial tree – 2 marks.
FAQs	<p>Name parts of respiratory system.</p> <p>What is respiration? Explain its mechanism.</p>
Assignments	<ul style="list-style-type: none"> • Visit to anatomical museum. • Draw and label a neat diagram of respiratory system.
References/Link with Theory Topic	Anatomy & Physiology handbook- Lesson 7

Week no.	9 th week
Practical no.	9
Title/ Aim	To study anatomy of digestive tract and their functions.
Objectives	At the end of the practical students shall be able to – identify different parts of digestive system along with their functions.
Requirements	Model/chart of digestive system
Environment	MLT Laboratory
Procedures	With the help of model or chart of digestive system identify different parts of digestive system.

Observations

Anatomy of Digestive Tract

The system deals with ingestion, digestion, absorption and excretion of food. The digestive tract is a long hollow muscular tube composed of : the mouth, pharynx, esophagus, stomach, small intestine, and large intestine. The digestive tract is sometimes called the alimentary tract, derived from a Latin word that means "food". It is more commonly referred to as the gastrointestinal (GI) tract because of the major importance of the stomach and intestine in the process of digestion.

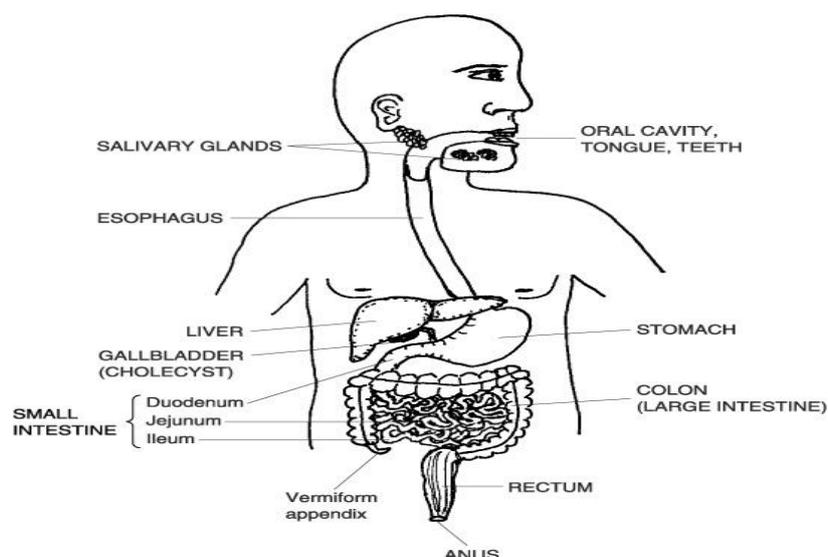


Figure 9.1.1

Parts of GIT	Description	Function
The Mouth	The mouth, also called the oral cavity, where a substance begins its travel through the digestive tract. The oral cavity also contains the teeth which masticates food.	<ul style="list-style-type: none"> • To receive food, a process called ingestion. • Bolus of food gets formed. • Digestion of starch begins.
The Pharynx	The pharynx is commonly referred to as the throat. It has three parts – Nasopharynx, oropharynx and laryngopharynx.	<ul style="list-style-type: none"> • Swallowing occurs rapidly by an involuntary reflex action.
Esophagus	A muscular tube about 25cm (10 inches) long that carries food into the stomach.	<ul style="list-style-type: none"> • Swallowed food is passed through esophagus into stomach. • No digestion
Stomach	The stomach is an expanded J-shaped organ in the epigastric region of the abdominal cavity. It has fundus, body and pylorus. It has greater and lesser curvature.	<ul style="list-style-type: none"> • Secretion of gastric juice containing digestive enzymes.

<p>The Small Intestine</p>	<p>The small intestine is the longest part of the digestive tract. It is about 6 m long.</p> <p>It has three parts the first 25 cm make up the duodenum. Beyond the duodenum are two more divisions: the jejunum, which forms the next two fifths of the small intestine, and the ileum, which constitutes the remaining portion.</p>	<ul style="list-style-type: none"> • Different foodstuffs get completely digested here under the effects of digestive juices. • Absorption of digested food also occurs through the walls of the small intestine. 	
<p>The Large Intestine</p>	<p>The large intestine is about 6.5 cm in diameter and about 1.5 m (5 feet) long. The large intestine begins in the lower right iliac region as a small pouch called the caecum. Then it has three parts- ascending colon, transverse colon and descending colon</p> <p>The lower part of the colon continues downward as the sigmoid</p>	<ul style="list-style-type: none"> • Absorption of water. • Defecation. 	

	colon.	
Rectum and anal canal	The sigmoid colon empties into the rectum.	<ul style="list-style-type: none"> • Serves as a temporary storage area for indigestible or unabsorbable food residue

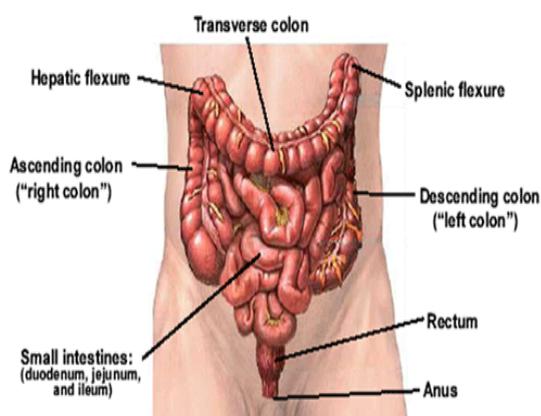


Figure 7.1.2

7.2 The Accessory organs of digestion

The Liver

The liver, often referred to by the word root *hepat*, is the largest glandular organ of the body. It is located in the upper right hypochondriac region in the abdominal cavity. It starts from fifth rib. The human liver is reddish brown in color. It has a larger right lobe and a smaller left lobe; the right lobe includes two inferior smaller lobes.

The liver is supplied with blood through two vessels- the portal vein and the hepatic artery. These vessels deliver about 1quarter of blood to the liver every minute. The hepatic artery carries oxygenated blood, whereas the portal system of veins carries blood that is rich in the end products of digestion.

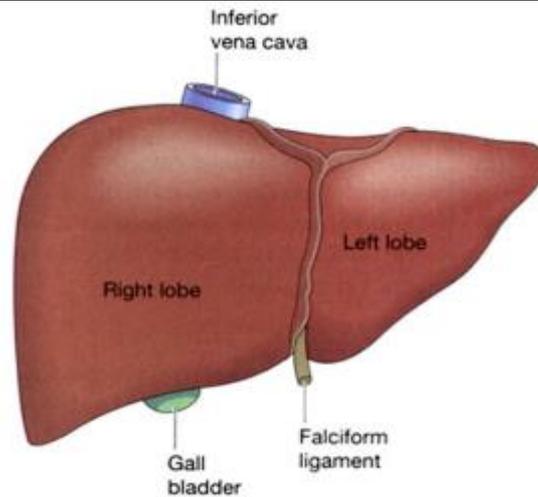


Figure 9.2.1

The Gallbladder

The gallbladder is a muscular sac on the inferior surface of the liver that serves as a storage pouch for bile.

The Pancreas

The pancreas is a mixed type of gland that extends from the duodenum to the spleen. The pancreas secretes pancreatic juice which contains enzymes that digest fats, proteins, carbohydrates, and nucleic acids. The pancreas also functions as an endocrine gland, producing the hormones insulin and glucagon that regulate sugar metabolism.

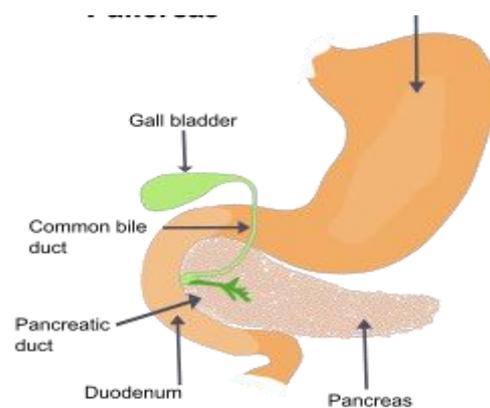


Figure 9.2.2

Skills to be achieved	Student should identify the parts of digestive system and viscera correctly.
Skill evaluating	1. Identify the parts of digestive tract- 6 marks

criteria	2. Identify the viscera of the abdomen – 4 marks
FAQs	<ol style="list-style-type: none"> 1. Name parts of digestive system. 2. Draw and explain stomach. 3. Write a note on liver.
Assignments	<p>Visit to anatomical museum.</p> <p>Draw and label a neat diagram of digestive system.</p>
References/Link with Theory Topic	Anatomy & Physiology handbook- Lesson 8

Week no.	11 th Week
Practical no.	10
Title/ Aim	To study different organs of excretory system.
Objectives	Students shall be able to identify different organs of urinary system and layers of skin.
Requirements	Model of urinary system and skin Chart of urinary system and skin
Environment	MLT Laboratory
Procedures	With the chart / model of urinary system identify different parts of urinary system. With the chart / model of skin identify layers of skin.
<p>Observations</p> <p>Excretion is process of removal of waste products from body through various channels.</p> <p>Different channels of excretion are:</p> <ol style="list-style-type: none"> 1. Kidneys 2. Skin 3. Lungs 4. Large intestine <p>10.1 Different parts of urinary system.</p> <p>It is one of the important systems of the body. The urinary system plays a vital part in excretion and maintaining homeostasis. The kidneys produce urine that contains metabolic waste products, including the nitrogenous compounds like urea and uric acid, excess ions and some drugs.</p> <p>It consists of the following structures:</p> <ul style="list-style-type: none"> • Pair of kidneys • Pair of ureters 	

- urinary bladder
- urethra

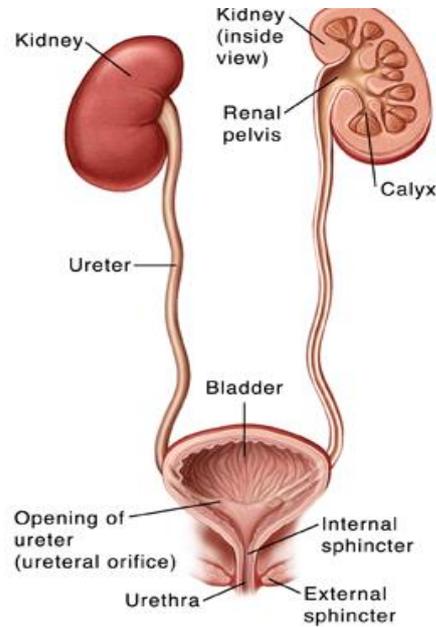


Figure 8.1.1

Name of part	Description	Functions
Kidneys	Paired organs, extends from T-12 to L-3. Bean-shaped organs, 11cm × 6cm × 3cm and weigh 150gm. Outer border is convex and inner border has a notch called hilum of kidney through which passes ureters and renal vessels. On upper pole supra renal glands are present.	Formation of urine. Maintenance of water and electrolyte balance.
Ureters	Paired organs, about 25 to 30 cm long starts at hilum of kidney enter obliquely into the urinary bladder.	Propel the urine from kidneys to urinary bladder.

Urinary bladder	Pear-shape organ lying in pelvic cavity opens in to urethra. Ureters open in to bladder.	Reservoir for urine
Urethra	A canal extending from the neck of the bladder to the exterior. The male urethra is common pathway for urine and semen, in females it is different.	Passage of urine outside the body.

Structure of kidneys On longitudinal section kidneys show

The **cortex**-peripheral reddish-brown layer of tissue immediately below the capsule.

The **medulla**-the innermost layer which is pale in color.

The medulla consists of pale conical shape structures the **renal pyramids**.

The **renal pelvis** is dilated portion of ureters at the beginning which acts as a receptacle for the urine formed by the kidney.

Urine formed in the kidney passes through a papilla at the apex of a pyramid into a **minor calyx**, then into a **major calyx** before passing through the pelvis into the ureter.

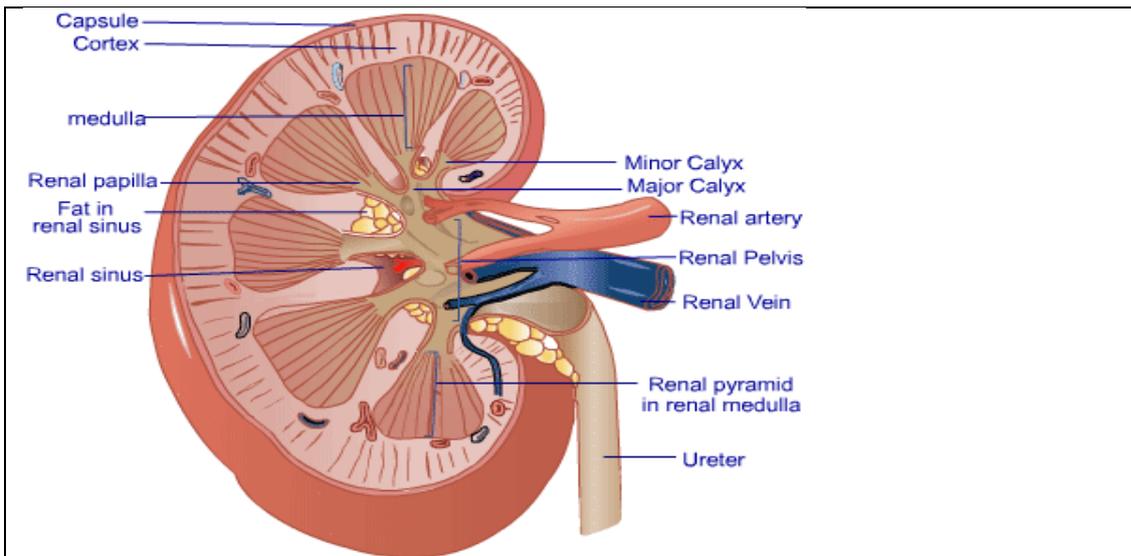


Figure 10.1.2

Microscopic structure of the kidney-

The kidney is composed of about 1 million functional units, the nephrons.

The nephron consists of

- Malpighian corpuscles
 - Glomerulus
 - Bowman's capsule
- Renal tubules
 - Proximal convoluted tubule
 - Loop of Henley
 - Distal convoluted tubule
 - Collecting duct

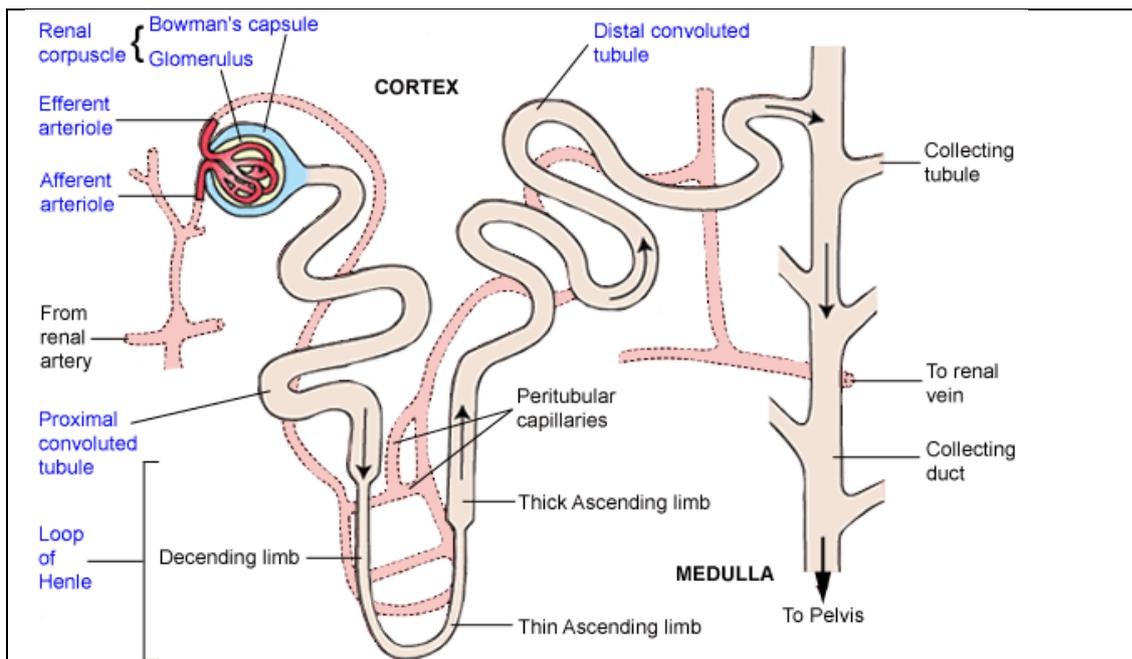


Figure 10.1.3

10.2 Skin structure and functions

➤ Introduction-

The skin completely covers the body and protects the surface of the body. It is continuous with the mucus membrane lining the cavities and orifices which open on to the surface.

➤ Functions

- Protects the underlying structures from injury and from invasion by microbes.
- Contains sensory (somatic) nerve endings of pain, temperature and touch.
- Is involved in the regulation of body temperature.

➤ Structure

There are two main layers:

- Epidermis
- Dermis.

Between the skin and underlying structures there is a layer of subcutaneous fat.

Epidermis-

The epidermis is the most superficial layer of the skin and is composed of stratified keratinized squamous epithelium which varies in thickness in different parts of the body. It consists of number of layers of cells.

Sr. No.	Layers of epidermis	Description
1	Stratum corneum	Thin, flat, scale like cells which cast off constantly
2	Stratum lucidum	Cells with indistinct outline and no nuclei
3	Stratum granulosum	Well defined cells with nuclei and granules
4	Stratum spinosum	Also called prickle cell layer. Minute fibrils which connect one cell with another giving appearance of prickle.
5	Stratum basale	From these cells new epidermal cells are constantly produced. Cells are closely packed.

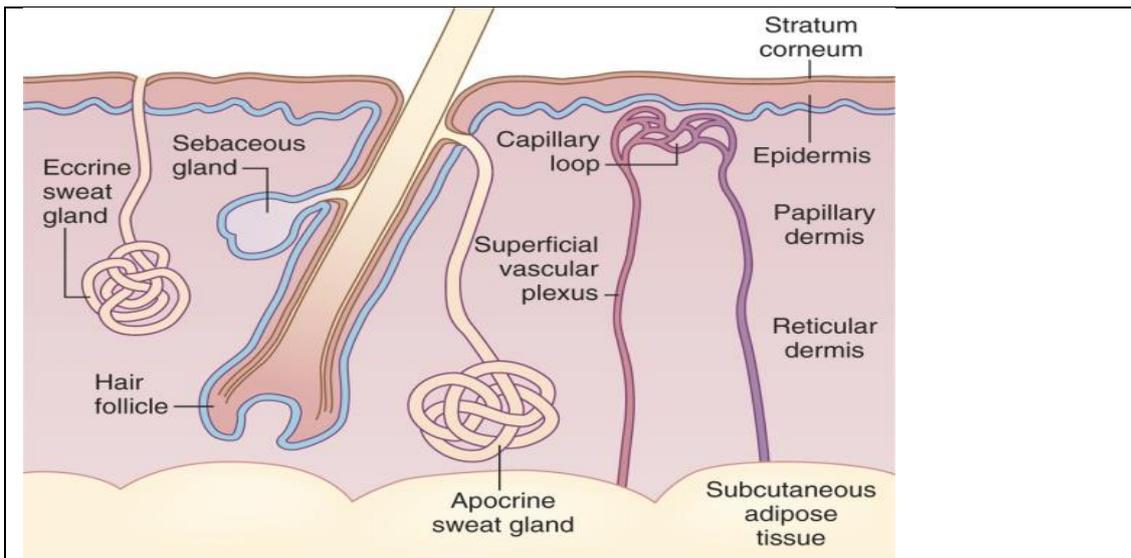


Figure 10.2.1

Skills to be achieved	Students should identify all parts of urinary system and layers of skin.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Identify parts of urinary system- 4marks 2. Parts of nephron – 2 marks 3. Layers of Skin – 4 marks 4. Appendages of skin – 2 marks
FAQs	<ol style="list-style-type: none"> 1. Draw and label a neat diagram of urinary system. 2. Draw a nephron. 3. Draw and label a neat diagram of cut section of skin.
Assignments	<p>Visit anatomy department.</p> <p>Identify the organ, state its function/importance.</p>
References/Link with Theory Topic	Anatomy & Physiology handbook lesson 9.

Week no.	12 th week
Practical no.	11
Title/ Aim	To study male and female reproductive organs.
Objectives	Student shall understand structure of male and female reproductive system and their important functions.
Requirements	Model/ chart of male reproductive system Model/ chart female reproductive system.
Environment	MLT Laboratory
Procedures	With the help of model / chart of male and female reproductive system identify different parts of system

Observations

Reproduction is the process of formation of embryo by fertilization of ovum with sperm. Reproductive system consists of primary and secondary sex organs in both males and females which are required for formation of gametes and concerned with passage and maintenance of these gametes respectively.

11.1 Male reproductive system

The organs of the male reproductive system perform the following functions:

- Production of sperms.
- Secretion of male sex hormones responsible for maintaining secondary sexual organs and characteristics.

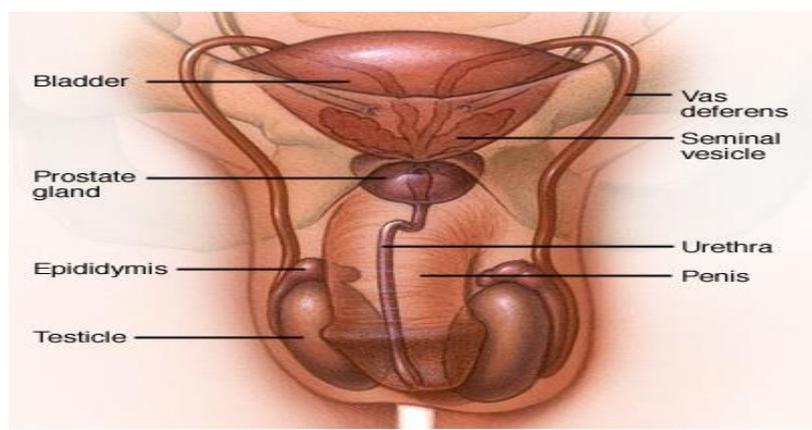


Figure 11.1.1

Parts and their functions:

Name of part	Description	Functions
Testes	<ul style="list-style-type: none"> • Primary sex organ. These are paired oval organs about the size of large olives that lie in the scrotum, secured at either end by a structure called the spermatic cord. Within the testes are coiled masses of tubes called seminiferous tubules. 	<ul style="list-style-type: none"> • The testis is responsible for Producing sperm cells. • Secretion of testosterone, the primary male sex hormone.
Penis	<ul style="list-style-type: none"> • Covered with a loose layer of skin called foreskin. The opening of the urethra, the tube that transports semen and urine, is at the tip of the penis. The penis also contains a number of sensitive nerve endings. 	<ul style="list-style-type: none"> ➤ This is the male copulatory organ.
Scrotum	<ul style="list-style-type: none"> • This is the loose pouch-like sac of skin that hangs behind and below the penis. It contains the testicles (also called testes), as well as many nerves and blood vessels. 	<ul style="list-style-type: none"> ➤ The scrotum acts as a "climate control system" for the testes. ➤ For normal sperm development, the testes must be at a temperature slightly cooler than body temperature.
	The epididymis is a long, coiled	<ul style="list-style-type: none"> ➤ It transports and

Epididymis	tube that rests on the backside of each testicle.	stores sperm cells that are produced in the Testes.	
Vas deferens	The vas deferens is a long, muscular tube that travels from the epididymis into the pelvic cavity, to just behind the bladder.	➤ The vas deferens transports mature sperm to the urethra,	
Ejaculatory ducts	These are formed by the fusion of the vas deferens and the seminal vesicles.	➤ The ejaculatory ducts empty into the urethra	
Urethra	In males when the penis is erect during sex, the flow of urine is blocked from the urethra, allowing only semen to be ejaculated.	➤ It has the function of ejaculating semen during sexual activity.	
Seminal vesicles	The seminal vesicles are sac-like pouches that attach to the vas deferens near the base of the bladder.	<ul style="list-style-type: none"> ➤ The seminal vesicles produce a sugar-rich fluid (fructose) that provides sperm with a source of energy to help them move. ➤ The fluid of the seminal vesicles makes up most of the volume of semen. 	
Prostate gland	<ul style="list-style-type: none"> • The prostate gland is a walnut-sized structure that is located below the urinary bladder in front of the rectum. The urethra, 	➤ The prostate gland contributes additional fluid to ejaculate.	

	which carries the ejaculate to be expelled during orgasm, runs through the center of the prostate gland.	➤ Prostate fluids also help to nourish the sperm.	
Bulbourethral glands	<ul style="list-style-type: none"> Also called Cowper's glands, these are pea-sized structures located on the sides of the urethra just below the prostate gland 	➤ These glands produce a clear, slippery fluid that serves to lubricate the urethra and to neutralize any acidity that may be present due to residual drops of urine in the urethra.	

11.2 Female reproductive system

The female reproductive system carries out following functions.

- Production of the female egg cells the ova or oocytes.
- To transport the ova to the site of fertilization.
- Production of female sex hormones that maintains the reproductive cycle.

The external genitalia are

Name of External genitalia	Description	Function
Labia majora	The labia majora are relatively large and fleshy, and are comparable to the	➤ The labia majora enclose and protect the other external reproductive organs.

	scrotum in males. The labia majora contain sweat and oil-secreting glands. After puberty, the labia majora are covered with <u>hair</u> .	
Labia minora	The labia minora can be very small or up to 2 inches wide.	➤ They lie just inside the labia majora, and surround the openings to the vagina.
Bartholin's glands	These glands are located besides the vaginal opening.	➤ Produce a fluid (mucus) secretion.
Clitoris	The two labia minora meet at the clitoris, a small, sensitive protrusion that is comparable to the penis in males. The clitoris is covered by a fold of skin, called the prepuce, which is similar to the foreskin at the end of the penis.	➤ Like the penis, the clitoris is very sensitive to stimulation and can become erect.

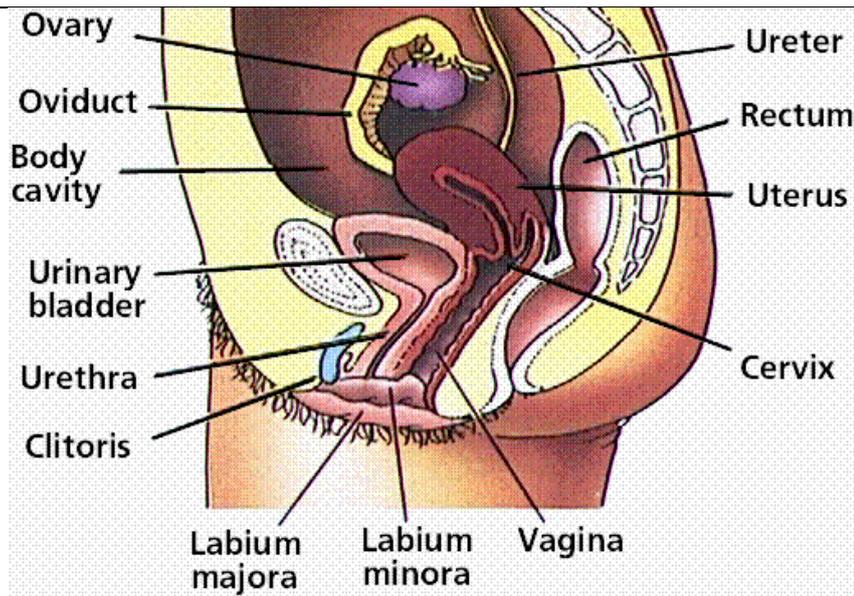


Figure 11.2.1

The internal reproductive organs are

Name of internal organ	Description	Functions
Ovaries	The ovaries are primary sex organs. They are small, oval-shaped glands that are located on either side of the uterus near fimbrial end of fallopian tube.	<ul style="list-style-type: none"> ➤ The ovaries produce eggs. ➤ Produce female sex hormones.
Uterus (womb)	The uterus is a hollow, pear-shaped organ that is the home to a <u>developing fetus</u> . The uterus is divided into two parts: the cervix, which is the lower part that opens into the vagina,	<ul style="list-style-type: none"> ➤ Growth and development of fetus occurs here. ➤ Passage for unfertilized ovum along with menstrual blood.

	and the main body of the uterus, called the corpus.		
Fallopian tubes	These are narrow tubes that are attached to the upper part of the uterus and serve as tunnels for the ova (egg cells) to travel from the ovaries to the uterus.	➤ Conception, the fertilization of an egg by a Sperm, normally occurs in the fallopian tubes.	
Vagina	The vagina is a canal that joins the cervix (the lower part of uterus) to the outside of the body.	<ul style="list-style-type: none"> ➤ It is known as the birth canal. ➤ It is female copulatory organ. 	

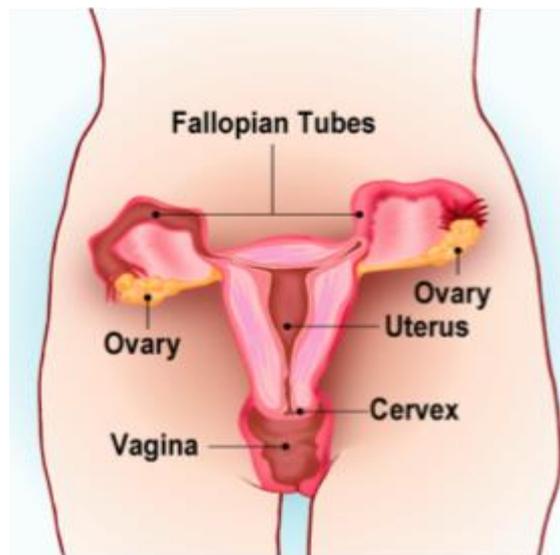


Figure 11.2.2

Skills to be achieved	Students should identify various parts of male and female reproductive system.
Skill evaluating criteria	1. Identification of external genitalia of male – 2 marks

	<p>2. Identification of internal organs of malereproductive system- 3 marks</p> <p>3. Identification of external genitalia of female – 2 marks</p> <p>4. Identification of internal organs of female reproductive system –3 marks</p>
FAQs	<p>1) Name parts of female reproductive system with a note on uterus.</p> <p>2) Explain ovary with a cut section diagram.</p> <p>3) Name parts of male reproductive system.</p>
Assignments	<ul style="list-style-type: none"> • Visit to anatomy museum. • Draw and label a neat diagram of male reproductive system. • Draw and label a neat diagram of female reproductive system.
References/Link with Theory Topic	Anatomy & Physiology handbook- Lesson 10

Week no.	13 th week
Practical no.	12
Title/ Aim	To demonstrate different endocrine glands.
Objectives	The students shall be able to-

	Identify the different endocrine glands and study their hormones and functions.
Requirements	Chart/ model of endocrine glands.
Environment	MLT Laboratory
Procedures	With the help of model / chart of endocrine glands identify different endocrine glands.
<p>Observations</p> <p>Endocrine glands consist of groups of secretory cells surrounded by an extensive network of capillaries which facilitates diffusion of hormones (chemical messengers) from the secretory cells into the bloodstream. They are commonly referred as the ductless glands because they do not have ducts and the hormones are secreted and diffused directly into the bloodstream.</p> <p>The endocrine glands are:</p> <ol style="list-style-type: none"> 1. Pituitary gland 2. Thyroid gland- 3. Parathyroid glands - 4. Adrenal (suprarenal) glands- 5. The pancreas 6. Pineal gland or body 7. Thymus gland 8. Ovaries in the female 9. Testes in the male <p>12.1 Different endocrine glands</p>	

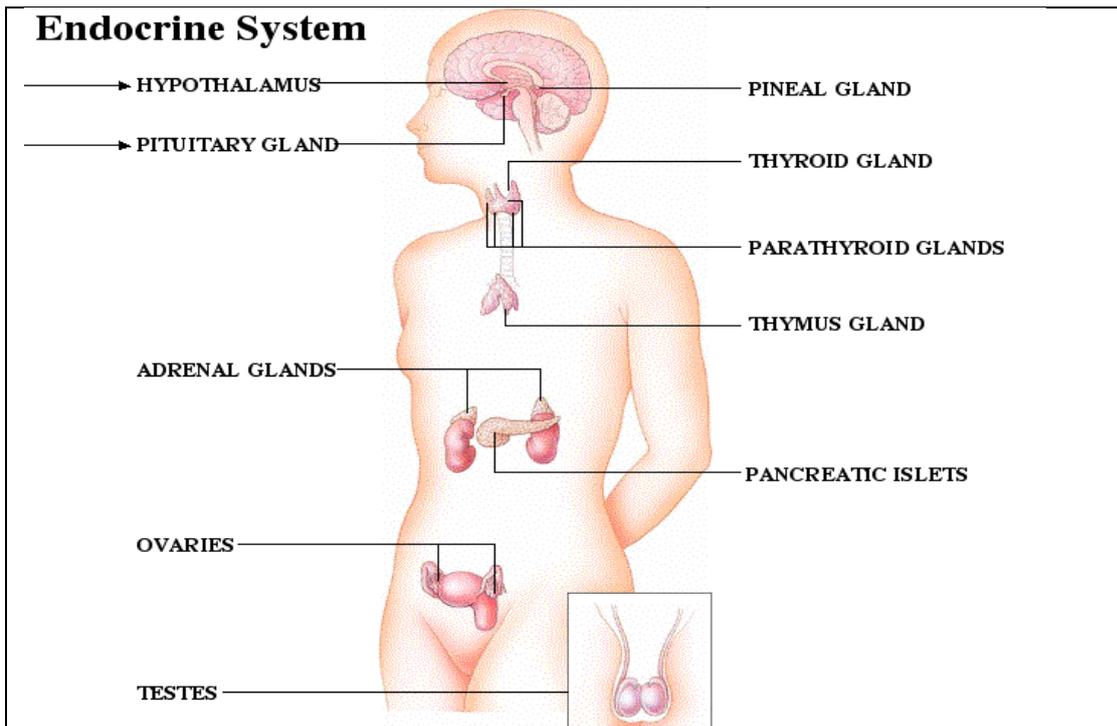


Figure 12.1.1

Name of gland	Location	Hormones
Pituitary gland ❖ Anterior pituitary	Hypophyseal fossa of the sphenoid bone	<ul style="list-style-type: none"> • GH • Prolactin • TSH • ACTH • FSH • LH
❖ Posterior pituitary		<ul style="list-style-type: none"> • Antidiuretic hormone • Oxytosin
Thyroid gland	The thyroid gland is situated in the neck in front of the larynx and trachea	<ul style="list-style-type: none"> • Thyroxin (T4) • Tri-iodo-thyronin (T3)
Parathyroid	Four small	<ul style="list-style-type: none"> • Parathyroid hormone

gland	parathyroid glands, embedded in the posterior surface of each lobe of the thyroid gland	
Adrenal gland	On the upper pole of kidney	<ul style="list-style-type: none"> • Cortical hormones- Mineralocorticoids Glucocorticoids, Androgens. • Medullary hormones Adrenaline, Noradrenaline
Pancreas	Mixed gland present in umbilical region of abdominal cavity.	<ul style="list-style-type: none"> • Insulin • Glucagon
Gonads Testes Ovaries	Present in pelvic cavity.	<ul style="list-style-type: none"> • Testes- Testosterone • Ovaries- Oestrogen and Progesterone

12.2 Functions of hormones:

Hormone	Functions
Anterior pituitary hormones Growth hormone	Stimulates growth and division of most body cells but especially those in the bones and skeletal muscle
Thyroid stimulating	It stimulates growth and activity of the thyroid gland It stimulates growth and activity of the Adrenal cortex.

hormone (TSH)	Stimulates lactation.	
Adrenocorticotrophic hormone (ACTH)	Has a direct effect on the breasts immediately after parturition (childbirth).	
Prolactin	In both sexes FSH stimulates production of gametes (ova or spermatozoa).	
Follicle stimulating hormone (FSH)	In females FSH are involved in secretion of the hormones oestrogen and progesterone during the menstrual Cycle.	
Luteinising hormone (LH)	In females LH are involved in secretion of the hormones estrogen and progesterone during the menstrual Cycle. In males LH (ICSH) stimulates the interstitial cells of the testes to secrete the hormone testosterone.	
Posterior pituitary hormones	Stimulates two target tissues during and after parturition uterine smooth muscle and the muscle cells of the lactating breast.	
Oxytocin Antidiuretic hormone (ADH or vasopressin)	ADH increases the permeability to water in the distal convoluted and collecting tubules of the nephrons. As a result the reabsorption of water from the glomerular filtrate is increased.	
Thyroid hormones	Increasing the basal metabolic rate Regulating metabolism of carbohydrates, proteins	

Tri-iodothyronin (T3) Thyroxin(T4)	and fats. T3 and T4 are essential for normal growth and development, especially of the skeleton and nervous system.	
Parathyroid hormone (PTH)	Increase the blood calcium level when it is low. This is needed for: <ul style="list-style-type: none"> • Muscle contraction • Nerve impulse transmission. 	
Corticoids- Glucocorticoids- Mineralocorticoids (aldosterone)- Sex hormones-	They are essential for life, regulating metabolism and responses to stress. Maintenance of water and electrolyte balance in the body. Development of secondary sexual characteristics.	
Medullary hormones Adrenaline and noradrenaline	They are structurally similar. Adrenaline has a greater effect on the heart and metabolic processes whereas noradrenaline has more influence on blood vessel. <ul style="list-style-type: none"> • Increasing heart rate • Increasing blood pressure • Diverting blood to essential organs including the heart, brain and skeletal muscles by dilating their blood vessels and constricting those of less essential organs, such as the skin. • Increasing metabolic rate • Dilating the pupils. 	
Pancreatic hormones		

Insulin	Decreases blood sugar level.	
Glucagon	Increases blood sugar level.	
Ovarian hormones Oestrogen Progesterone	Required for reproductive activity in females.	
Testicular hormone Testosterone.	Required for reproductive activity in males.	
Skills to be achieved	Students should know all endocrine glands and its hormones.	
Skill Evaluating criteria	1. Name glands of endocrine system 4 marks. 2. Name hormones of each glands – 6 marks.	
FAQs	<ul style="list-style-type: none"> • Enlist different endocrine glands and hormones secreted by them. • Write a note on pituitary gland. 	
Assignments	Visit to anatomy department. Draw a chart showing all the glands of endocrine system with their respective locations.	
References/Link with Theory Topic	Anatomy & Physiology handbook Lesson No. 11	

Week No.	14 th
Practical no.	13

Title/ Aim	To demonstrate different parts of nervous system.
Objectives	Student shall be able to Identify different parts of brain and spinal cord. Explain their functions.
Requirements	1. Models of brain 2. Chart of nervous system
Environment	MLT Laboratory
Procedures	With the help of model / chart of nervous system identify different parts of nervous system.
Observations	<p>The nervous system detects and responds to changes inside and outside the body. The nervous system consists of neurons which is functional unit of nervous system.</p> <p>The nervous system is further divided into following parts-</p> <p>Central nervous system(CNS)- Brain and Spinal cord</p> <p>Peripheral nervous system(PNS)- Peripheral nerves</p> <p>Autonomous nervous system (ANS) - Sympathetic and parasympathetic nervous system.</p> <p>13.1 Brain and its parts- It lies within the cranial cavity, made of bones called skull bones. Externally it is covered by a three layer tough membrane called meninges. They are within outwards as- Pia matter, Arachnoids matter and Dura matter.</p> <p>Within brain cavities are present which contains CSF.</p> <p>Figures 12.1 showing cut section views of brain-</p>

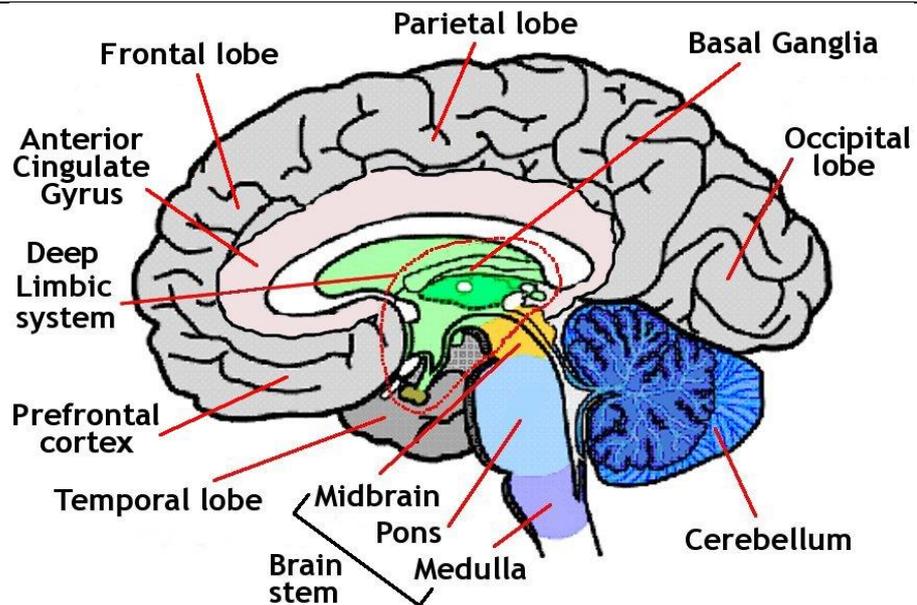


Figure 13.1.1

Parts of brain-

Cerebrum- is the largest part of the brain and it occupies the anterior and middle cranial fosse. It is divided by a deep cleft, the longitudinal cerebral fissure, each containing one of the lateral ventricles into

Right cerebral hemispheres

left cerebral hemispheres,

Deep within the brain the hemispheres are connected by a mass of white matter (nerve fibers) called the corpus callosum.

The superficial (peripheral) part of the cerebrum is composed of nerve cell bodies or grey matter, forming the cerebral

cortex, and the deeper layers consist of nerve fibers or white

matter. The cortex is folded in a complex manner so that there are number of raised areas (gyri) that are separated by

depressions (sulci). These folds increase the surface area of the cerebrum. Each hemisphere of the cerebrum is divided

into lobes which take the names of the bones of the cranium under which they lie:

Frontal

Parietal

Temporal

Occipital.

Brain stem-It includes midbrain, pons and medulla oblongata.

Midbrain- The midbrain is the area of the brain situated around the cerebral aqueduct between the cerebrum above and the pons below. It consists of groups of cell bodies and nerve fibers (tracts). It contains reflex center for sight, hearing, and control of balance and movements of eyes.

Pons- The pons means 'bridge' connecting the midbrain to medulla situated in front of the cerebellum, below the midbrain and above the medulla oblongata. It consists of many fibers which link two lobes of cerebellum and cerebellum with cerebral cortex. It consists of nuclei of 5th 6th 7th and 8th cranial nerves.

Medulla oblongata- The medulla oblongata extends from the pons above and is continuous with the spinal cord below. It is about 2.5 cm long and it lies just within the cranium above the foramen magnum. The vital centers (Respiratory and Vasomotor) are situated in it.

Cerebellum- The cerebellum is situated in the posterior cranial fossa behind the pons and medulla oblongata. It is ovoid in shape and has two hemispheres, separated by a narrow median strip called the vallecule. Grey matter forms the surface of the cerebellum and the white matter lies deeply. It has three lobes- anterior, middle and flocculonodular. It controls the same side of the body.

Functions of brain-

- Important activities involved in memory, intelligence, sense of responsibility, thinking, reasoning, moral sense and learning are attributed to the higher centers
- Sensory perception, including the perception of pain, temperature, touch, sight, hearing, taste and smell
- Initiation and control of skeletal (voluntary) muscle contraction.
- Coordination of skeletal muscle activity associated with voluntary motor movement and the maintenance of balance.
- Coordination of activity controlled by the autonomic nervous system, e.g. cardiovascular, respiratory and gastrointestinal activity
- The cerebellum controls and coordinates the movements of various groups of muscles ensuring smooth, even, precise actions.
- It coordinates activities associated with the maintenance of the balance and equilibrium of the body.
- Contains nuclei of cranial nerves.

13.2 Spinal Cord-The spinal cord is the elongated, almost cylindrical part of the central nervous system, which is suspended in the vertebral canal surrounded by the meninges and cerebrospinal Fluid. It starts at the lower end of the medulla oblongata. It is approximately 45 cm long in an adult, and is about the thickness of the little finger. Nerves conveying impulses from the brain to the various organs and tissues descend through the spinal cord. Similarly sensory

nerves from organs and tissues enter and pass upwards in the spinal cord to the brain. Along its length the cord presents two thickenings the cervical and lumbar giving rise to large nerves to limbs. It gives rise to 31 pairs of spinal nerves.

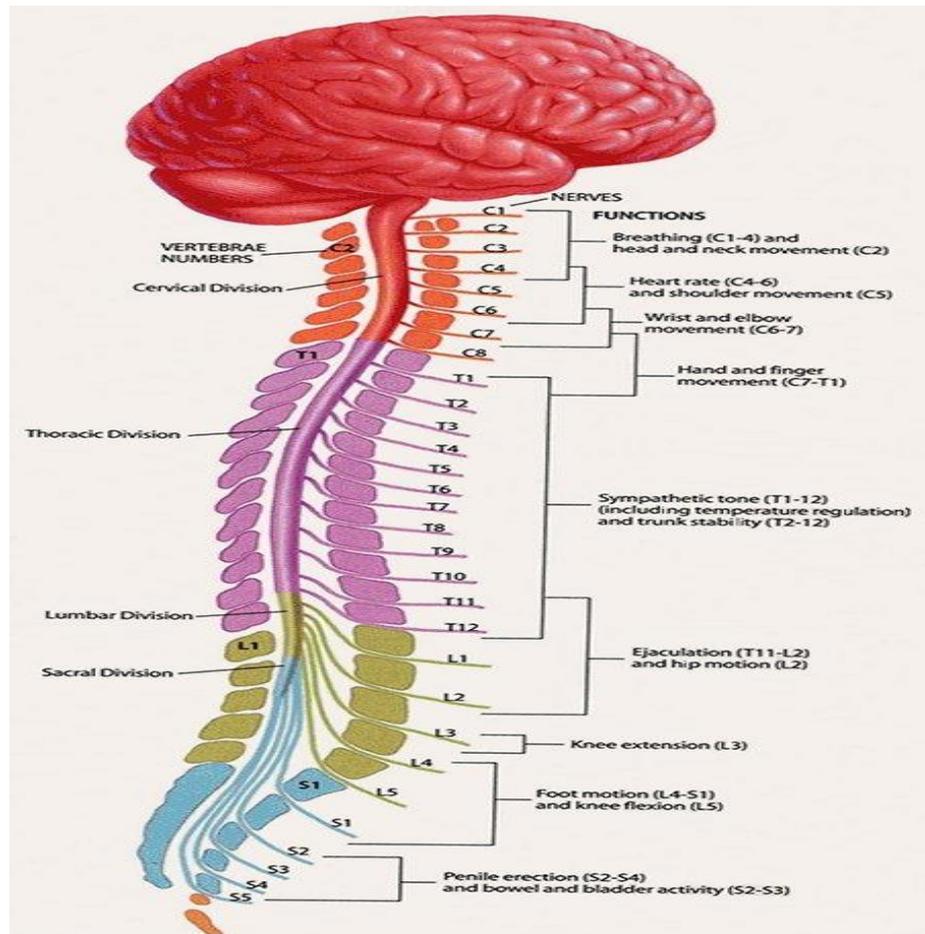


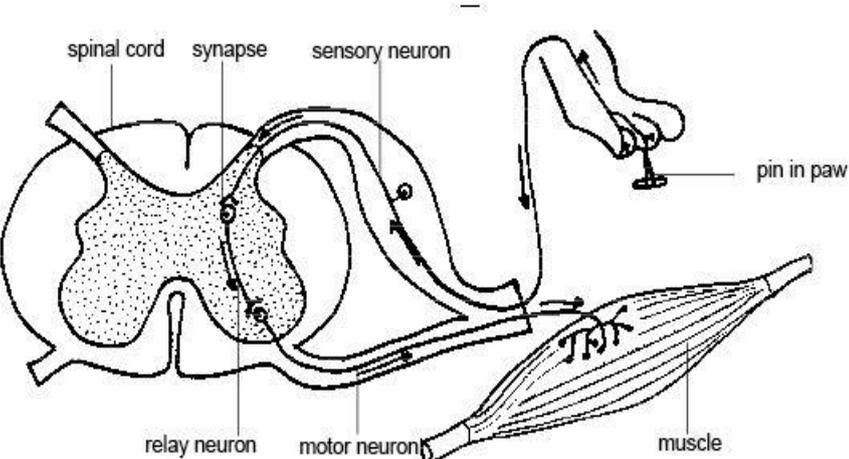
Figure 13.2.1

Functions of spinal cord-

- Forms spinal nerves-

Sensory nerves- carry sensation or stimulus from different organs of the body to the brain.

Motor nerves- bring response from the Brain to different organs of the body.

	<ul style="list-style-type: none"> • Reflex action- <p>The reflex action is brought about by the reflex arc of the spinal cord. The reflex arc is shown in the figure 13.2.2. It is the sudden withdrawal of the part of the body or the whole body due to injury or fear of injury.</p>  <p>The diagram illustrates a reflex arc. A pin is shown in a paw, which stimulates a sensory neuron. This neuron travels to the spinal cord where it meets a relay neuron at a synapse. The relay neuron then connects to a motor neuron, which carries the signal to a muscle, causing it to contract and withdraw the paw. Labels include: spinal cord, synapse, sensory neuron, relay neuron, motor neuron, muscle, and pin in paw.</p> <p style="text-align: center;">Figure 13.2.2</p>
Skills to be achieved	Students will identify the brain, spinal cord and nerves.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Parts of CNS – 4 marks. 2. Covering of brain and spinal cord -2 marks. 3. Parts of reflex arc – 4marks.
FAQs	<ol style="list-style-type: none"> 1. Explain brain with its diagram. 2. What is nervous system? Classify it. 3. What is reflex arc and reflex action?
Assignments	<ul style="list-style-type: none"> • Visit to anatomical museum. • Draw and label a neat diagram of nervous system.
References/Link with Theory	Anatomy & Physiology handbook Lesson no. 13

INDEX-**PHYSIOLOGY PRACTICALS**

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Week no.	1 & 2 nd
Practical no.	1
Title/ Aim	Microscope:-

	To identify different parts of microscope.
Objectives	Students shall be able to 1. Identify the various parts of a microscope and study their uses.
Principle	A microscope helps in obtaining an enlarged and well-defined image of the object. The degree up to which the object gets magnified is termed ' magnification ' or ' magnifying power ' of the microscope. The laboratory microscope provides a magnification of 100X (low power), 450X (high power) and 1000X (oil immersion).
Requirements	1. Microscope
Environment	MLT Laboratory
Procedure	Identify and Study the various parts of microscope and their functions.
<p>Observations- Various parts of a microscope are-</p> <p>❖ <u>The supporting system:</u></p> <ol style="list-style-type: none"> 1. The foot-The foot is the base of the microscope. Other components are erected on the foot, especially the limb. 2. The limb-The limb has its base on the foot. It holds the mechanical stage and the eyepieces in place. 3. The revolving nosepiece (objective revolver) -The revolving nosepiece, also known as the objective revolver, is the part that holds the set of objective lenses. It allows the user to revolve the objective lenses. 4. The stage-Also called the mechanical stage, the stage is a platform below the objective, which supports the specimen to be observed. It 	

has a hole in the centre through which light passes to illuminate the specimen. It has clips for holding microscopic slides.

❖ **The magnification system:**

1. **The eyepiece-**The eyepiece is a cylinder containing two or more lenses. Its function is to bring the image into focus for the eye. Eyepieces are interchangeable with different degrees of magnification. Typical magnification values for eyepieces are, 5X, 10X and 15X.
2. **The objectives-**At the lower end of the optical tube, there are one or more objective lenses that are used to observe the specimen. Microscope objectives are characterized by two parameters—magnification and numerical aperture.

Magnifying power	Total Magnification
X10	100 times
X40	400 times
X100	1000 times

❖ **The illumination system:** A light source is the basis of the illuminating system. It may be natural light (microscope placed near a window) or electric light (halogen lamp).

1. **The mirror-**The mirror reflects rays of light onto the specimen. One side has a concave surface (used when condenser is absent) and the other has plain surface (used when condenser is present).
2. **The condenser-**The condenser is situated between the stage and the mirror. It is a lens designed to focus light from the light source onto the specimen.
3. **The diaphragm-**The diaphragm is a component of the condenser. It acts as a filter to adjust the quality and intensity of the illumination.

❖ **The adjustment system:**

1. **The adjustment screws**— The screw for coarse adjustment is used to achieve an approximate focus, while the screw for fine adjustment is used to achieve maximum perfect focus.
2. **The condenser adjustment screw**— The condenser adjustment screw is used to adjust the condenser. Besides this, three screws are used to centre the condenser in a relative position with the specimen.
3. **The mechanical stage control**— The mechanical stage is controlled by two screws. One screw is used to adjust the height, while the other screw is used to move the stage left or right.

Microscope

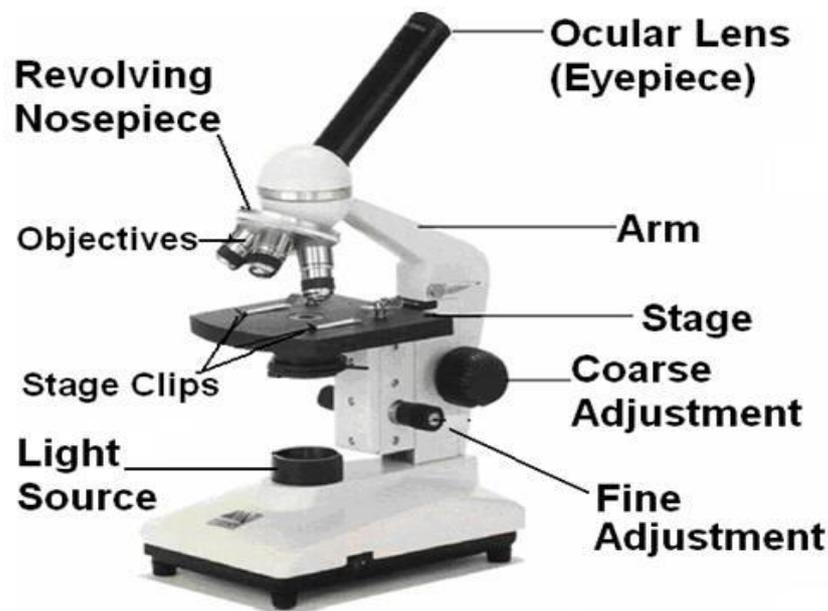


Figure 1.1

Result	Different parts of the microscope are identified.
Clinical significance	<ol style="list-style-type: none"> 1. Microscope is used in various sections of pathological laboratory like histopathology, hematology, clinical pathology, etc. 2. Microscope helps to identify objects which are invisible to naked eye, e.g. Bacteria,

	parasites,etc.
Skills to be achieved	<ul style="list-style-type: none"> • Students will identify different parts of microscope. • Students will adjust the microscope to visualize the objects.
Skill evaluating criteria	1. Identify parts of microscope –10 marks (Any 5-2 marks each).
FAQs	<ol style="list-style-type: none"> 1. What is microscope? 2. Name the different parts of microscope. 3. State the functions of various parts of microscope. 4. What are other types of microscopes?
Assignments	Draw a neat and labeled diagram of a microscope.
References/Link with Theory Topic	Chapter 3-Hand book of Microbiology

Week no.	1 & 2 nd
Practical no.	2
Title/ Aim	Microscope:-

	To clean different parts of microscope.
Objectives	Students shall be able to clean the various parts of microscope and maintain the microscope.
Principle	To obtain service for longer period of time the different parts of microscope should be properly cleaned and maintained.
Requirements	1. Microscope 2. Soft cloth 3. Xylene
Environment	MLT Laboratory
<p>Procedure</p> <p>Cleaning of different parts of microscope.</p> <p>❖ Cleaning the objectives</p> <ol style="list-style-type: none"> 1. <u>Dry objectives</u> <ul style="list-style-type: none"> • Wipe the objectives by using a soft cloth. 2. <u>Oil immersion objectives</u> <ul style="list-style-type: none"> • Remove the oil with an absorbent paper or a dry piece of cloth. • Moisten the cloth with xylene and wipe the lens carefully, remove excess xylene. • Wipe again with a dry piece of cloth. <p>❖ Cleaning the eyepieces</p> <ul style="list-style-type: none"> • Clean the upper surface with a soft cloth and lower surface with paint brush. <p>❖ Cleaning the condenser and mirror</p> <ul style="list-style-type: none"> • Clean the condenser with a soft cloth moistened with xylene. • Clean the mirror with a soft cloth moistened with alcohol. <p>❖ Cleaning the support and stage</p> <ul style="list-style-type: none"> • Clean the support with a soft piece of cloth. [Xylene should not be 	

	used, which may remove the black paint.] <ul style="list-style-type: none"> • Clean the stage thoroughly using a cloth dipped in petroleum jelly. • Clean the parts with xylene.
Observation	Various parts of microscope are cleaned properly.
Result	Different parts of the microscope are cleaned and adjusted.
Skills to be achieved	<ul style="list-style-type: none"> • Clean the microscope properly. • Students will adjust the microscope to visualize the objects.
Skill evaluating criteria	<ul style="list-style-type: none"> • Cleaning of different parts 10 marks Correctly. (any 5) (2 marks each).
FAQs	1. How will you clean the different parts of microscope?
Assignments	Perform cleaning of different parts of microscope.
References/Link with Theory Topic	Chapter 3-Hand book of Microbiology

Week No.	3 & 4th
Practical No.	3

Title/ Aim	Blood collection To collect blood by capillary Puncture Method.
Objectives	Students shall be able to collect blood by capillary puncture.
Principle	Capillary puncture is used to collect blood for various tests.
Requirements	<ol style="list-style-type: none"> 1. Disposable needles or lancet, 2. spirit swab 3. Other as per test e.g. Sahli's pipette in case of Hb estimation or slides in case of blood groups. 4. Sites of blood collection <ul style="list-style-type: none"> • Ball of Finger • Ear lobe • Great toe or heel in case of infants
Environment	MLT laboratory
Procedure	<ol style="list-style-type: none"> 1. First clean the site with 95% alcohol or spirit. Allow it to dry completely. 2. Hold the ball of a finger tightly with the thumb and index finger. 3. With the help of a disposable needle or lancet give a bold prick. (The prick should be sharp and quick to minimize pain. It should be deep enough (2-4 mm). Squeezing tends to stop the flow of blood, also adding tissue fluid to the drop of blood, which gives inaccurate count, so squeezing should not be done.)

	<p>4. Wipe off the first drop of blood and next is used for testing.</p> <p>5. After collection place a cotton swab over the punctured site. Apply slight pressure to stop blood flow.</p>
--	--

Observations- The procedure used to collect blood by capillary puncture is described in the form of image as follows-



Figure 3.1 Skin puncture

Result-	Blood is collected as per requirement.
Clinical significance	<ul style="list-style-type: none"> When amount of blood required is small capillary method is used. E. g. Hemoglobin estimation, blood group determination, blood sugar level estimation by Glucometer (in emergency cases), etc.
Skills to be achieved	Students will collect blood by capillary puncture.
Skill evaluating criteria	<ol style="list-style-type: none"> Proper preparation and selection of site for capillary puncture – 4 marks Correct procedure – 4 marks Proper organization of requirements as per test to be carried out. – 2 marks.

FAQs	1. What are different sites for capillary puncture? 2. Precautions to be taken before collecting capillary blood.
Assignment/Activity	Collect blood of 25 different subjects for various tests.
Reference	Chapter 5- Handbook of Anatomy and Physiology.

Week No.	5 & 6th
Practical No.	4
Title/ Aim	Blood collection To collect blood by vein puncture method.
Objectives	Students shall be able to collect blood by vein

	puncture.
Principle	Vein puncture is used to collect blood for various tests.
Requirements	<ol style="list-style-type: none"> 1. Disposable syringe (2cc, 5cc, 10cc) and needle 2. Tourniquet 3. Spirit swab 4. Anticoagulant bulbs - <ul style="list-style-type: none"> ▪ EDTA Bulb – This bulb is used for cell counts, hemoglobin estimation, etc. ▪ Fluoride Bulb – This bulb is used for blood sugar level estimation. ▪ Double Oxalate Bulb – It is also used for hematological studies. 5. Sites of blood collection <ul style="list-style-type: none"> ▪ Anticubital fossa
Environment	MLT laboratory
Procedure	<ol style="list-style-type: none"> 1. Ask the patient sit or lie down with the forearm rested on the table. 2. Apply tourniquet. 3. Choose one of the veins in anticubital fossa. Select a vein which is both visible and palpable and well fixed to surrounding. 4. Now release the tourniquet. 5. Clean the anticubital fossa thoroughly with a spirit swab. 6. Reapply the tourniquet. 7. Ask the patient to close his/her fist by taking

	<p>thumb inside, so that the veins become prominent.</p> <p>8. Grasp the patient's forearm with left hand and retract the soft tissues downwards below the site of puncture with the help of thumb.</p> <p>9. Hold the syringe in the right hand and bring the needle to the skin over vein. (If vein is large and fixed the skin and vein may be punctured with single thrust. If vein is small or slippery then the skin is punctured first and then vein.) Puncture the vein with single thrust.</p> <p>10. When blood starts flowing into the syringe release the tourniquet.</p> <p>11. When necessary amount of blood is collected slowly withdraw the needle keeping a cotton swab over the punctured site.</p> <p>12. Press the punctured site gently for 2 minutes.</p> <p>13. Ask the patient to elevate the arm and give pressure for few minutes.</p> <p>14. Immediately transfer the collected blood in to an appropriate bulb.</p> <p>First remove the needle from the syringe to prevent clotting of blood and then pour the blood in to the bulb.</p>
<p>Observations-The procedure used to collect blood by vein is described in the form of images as follows-</p>	

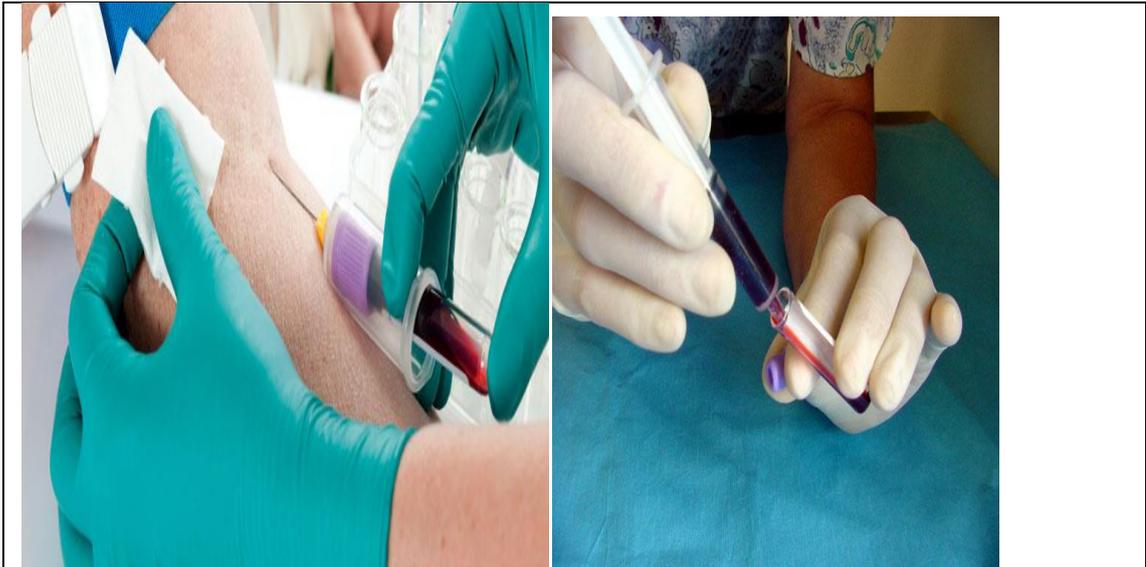
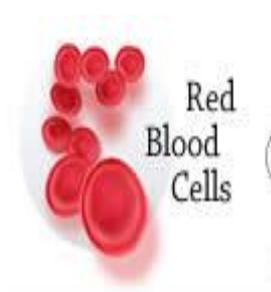


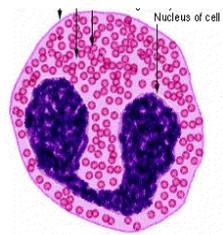
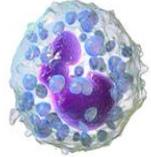
Figure 4.1 Vein puncture method Figure 4.2 Transferring blood into container

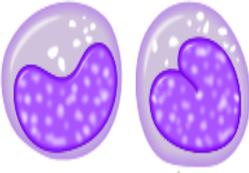
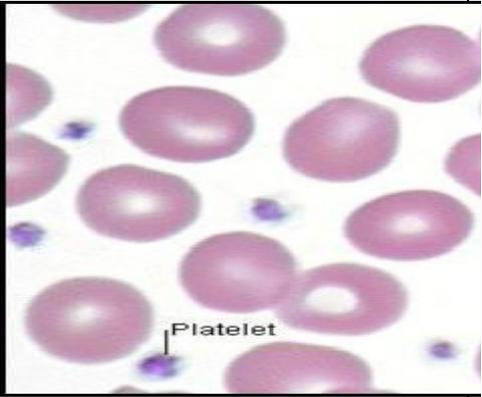
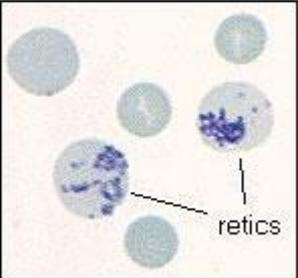
Result-	Blood is collected and labeled as per requirement.
Clinical significance	<ul style="list-style-type: none"> • Quantity of blood collected by vein puncture is more than capillary puncture so when numbers of tests to be carried out are more then vein puncture is method of choice. • When serum or plasma is to be separated from blood vein puncture is used. • Different tests carried out by vein puncture are biochemistry- LFT, KFT, Special hematological tests, ESR, PCV, etc.
Skills to be achieved	Students will collect blood by vein puncture.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Proper preparation of site and selection of vein – 2 marks 2. Correct procedure- Proper steps – 4 marks 3. Correct quantity – 2 marks 4. Proper use of anticoagulant – 2 marks
FAQs	<ol style="list-style-type: none"> 1. What are sites of vein puncture?

	2. What are complications of vein puncture?
Assignment/Activity	Collect blood of 10 different subjects.
Reference	Chapter 5- Handbook of Anatomy and Physiology.

Week No.	7 & 8th
Practical No.	5
Title/ Aim	To identify different types of blood cells.
Objectives	Student should identify different blood cells.
Principle	A good peripheral smear is prepared and

	stained to observe various types of blood cells.	
Requirement	<ol style="list-style-type: none"> 1. Stained peripheral smear 2. Microscope 3. Immersion oil 	
Environment	MLT laboratory	
Procedure	<ol style="list-style-type: none"> 1. Mount a stained peripheral smear on the stage of microscope. 2. First examine under low power, 3. Then put a drop of oil on smear and turn it under oil immersion lens. Observe for different blood cells. 	
Observations		
Name of cell	Description	Normal value/ Diagram
Red blood cell	Mature human erythrocytes are non-nuclear biconcave disk 7.2 μ in diameter. They are red in color due to presence of hemoglobin. On smear they appear round in shape with small central area of pallor.	Males- 4-6 millions/mm ³ Females- 4-5.5 millions/mm ³  Figure 5.1 RBCs
White blood cells Different types	Large nucleated cells. Do not contain hemoglobin.	4000-10000 cells/mm ³

are		
Granulocytes-		
i) Neutrophil	<p>i) 10-12μ in diameter, multilobed nucleus. No of lobes are 2-7. Cytoplasm shows fine neutrophilic granules which appear pale pink in color.</p>	<p>i) 40-70%</p>  <p>Figure 5.2 Neutrophil</p>
ii) Eosinophil	<p>ii) 10-12μ in diameter, bilobed nucleus giving spectacle appearance. Cytoplasm shows coarse granules which appear dark pink or red in color.</p>	<p>ii) 1-8%</p>  <p>Figure 5.3 Eosinophil</p>
iii) Basophil	<p>iii) 8-10μ in diameter, kidney shape nucleus. Cytoplasm shows large thick granules which appear deep blue or violet in color. Granules</p>	<p>iii) 0-1%</p>  <p>Figure 5.4 Basophil</p>

	abundant, pale blue in color, contains vacuoles giving frosted glass appearance.	 <p>Figure 5.6 Monocyte</p>
Platelets	Non-nucleated oval or round cells of variable size covered by unit membrane. Average size-2-5μ. On PS appear in clumps.	<p>1.5 to 4.5 lakh /mm³</p>  <p>Figure 5.7 Platelets</p>
Reticulocytes	Immature red blood cells that contain a reticular (mesh-like) network of RNA. They are nonnucleated.	<p>Adult- 0.2-2%</p> <p>Infant-2-6%</p>  <p>Figure 5.8</p>
Result-	Blood cells are identified.	
Clinical significance	<ul style="list-style-type: none"> • Study of morphology of white blood cells help in differential count of WBCs, identifying abnormal WBCs like toxic 	

	<p>granulations, hyper segmented neutrophils, etc.</p> <ul style="list-style-type: none"> • Study of morphology of RBCs helps to get an idea regarding anemia or polycythemia.
Skills to be achieved	<ul style="list-style-type: none"> • Students will identify different types of blood cells correctly.
Skill evaluating criteria	<p>Identification of blood cells-</p> <p>WBC – 5 marks</p> <p>RBC - 3 marks</p> <p>Platelets – 2 marks</p>
FAQs	<ol style="list-style-type: none"> 1. Describe morphology of each blood cell. 2. Give normal values of each.
Assignment/Activity	<ol style="list-style-type: none"> 1. Prepare a chart of different blood cells. 2. Observe and identify different types of blood cells in 10 different samples.
Reference	<p>Chapter 5-Handbook of Anatomy and Physiology.</p>

Week No.	9th & 10th
Practical No.	6
Title/ Aim	Preparation of Plasma and Serum -

	To obtain plasma from given blood sample.
Objectives	At the end the practical, students shall be able to obtain plasma from the collected blood sample.
Principle	Anticoagulated blood is centrifuged to separate plasma.
Requirements	<ol style="list-style-type: none"> 1. Test tubes 2. Anticoagulant bulbs (15ml) 3. Centrifuge machine 4. Centrifuge tubes
Environment	MLT laboratory
Procedure	<ol style="list-style-type: none"> 1. Collect blood by vein puncture from the patient in an anticoagulant bulb. 2. Mix it well. 3. Take whole blood in a clean and dry centrifuge tube. 4. Place the centrifuge tube in a tabletop model of centrifuge and rotate it at 1000 rpm for about 5-10 minutes. 5. Remove the centrifuge tube from the centrifuge machine and observe.
Observations- Plasma <ul style="list-style-type: none"> • The uppermost level of the centrifuge tube shows a pale yellow layer of plasma. • The RBCs settle at the bottom of the centrifuge tube. 	

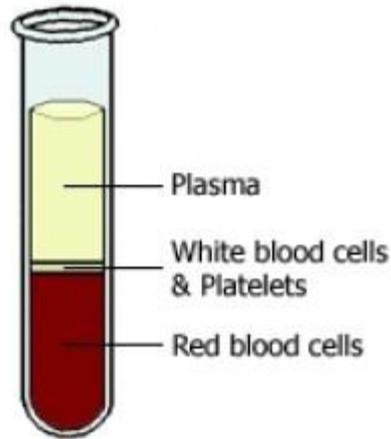


Fig. 6.1

Result	<ul style="list-style-type: none"> • Unhaemolysed plasma is obtained.
Clinical significance	<ul style="list-style-type: none"> • To diagnose metabolic disorders and to carry out organ function tests plasma is used as a sample.
Skills to be achieved	<ul style="list-style-type: none"> • Students will obtain plasma from given blood sample to perform different tests. • Students will gain knowledge of use of centrifuge during plasma separation.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Proper collection of blood - 5 marks 2. Sufficient quantity – 2 marks 3. Proper use of centrifuge – 3 marks
FAQs	1. What is plasma? How is it obtained?
Assignment/Activity	Obtain plasma from 10 different samples.
Reference	Chapter 5- Handbook of Anatomy and Physiology.

Week No.	11 & 12th
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Practical No.	7
Title/ Aim	Preparation of Plasma and Serum To obtain serum from given blood sample.
Objectives	At the end the practical, students shall be able to obtain serum from the collected blood sample.
Principle	Coagulated blood is centrifuged to obtain serum.
Requirements	<ol style="list-style-type: none"> 1. Test tubes 2. Plain bulbs (15ml) 3. Centrifuge machine 4. Centrifuge tubes
Environment	MLT laboratory
Procedure	<ol style="list-style-type: none"> 1. First collect the blood by vein puncture from the patient in a plain bulb. 2. Allow to clot at room temperature. After 30 minutes loosen the clot and transfer the separated serum in a centrifuge tube. 3. Place the centrifuge tube in a tabletop model of centrifuge and rotate it at 1000 rpm for about 5-10 minutes. 4. Remove the centrifuge tube from the centrifuge machine and observe.
Observations	
Serum	
<ul style="list-style-type: none"> • The uppermost layer in the centrifuge tube is serum, while clot settles at the bottom of the centrifuge tube. 	

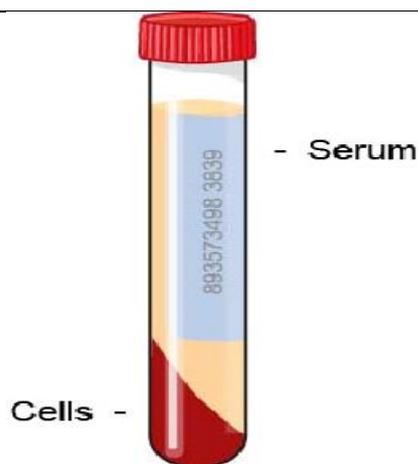


Fig. 7.1

Result	<ul style="list-style-type: none"> • Unhaemolysed serum is obtained.
Clinical significance	<ul style="list-style-type: none"> • To diagnose metabolic disorders and to carry out organ function tests serum is used as a sample. • Serum is used in various diagnostic tests to detect antibody formation, e.g. VDRL test, ASO test, etc.
Skills to be achieved	<ul style="list-style-type: none"> • Students will obtain serum from given blood sample to perform different tests. • Students will gain knowledge of use of centrifuge during serum separation.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Proper collection of blood – 5 marks 2. Sufficient quantity – 2 marks. 3. Proper use of centrifuge -3marks.
FAQs	1. What is serum? How is it separated?
Assignment/Activity	Obtain serum from 25 different samples.
Reference	Chapter 5- Handbook of Anatomy and Physiology.

Week No.	13th
Practical No.	8
Title/ Aim	To observe behavior of RBC in isotonic, hypotonic and hypertonic solution.
Objectives	Students shall learn the effect of Isotonic, hypotonic and hypertonic solution on RBCs.
Principle	<p>RBCs have semi permeable membrane. Water can pass freely inside and outside the cell. This water content is determined by the nature and concentration of substances present in RBCs and plasma.</p> <p>If more water passes into the cell it swells up and ruptures ultimately (haemolysis).</p> <p>If water content of RBCs is lowered by passing out of cell, cells shrink and become crenated.</p> <p>If RBCs are kept in isotonic solution (0.85% saline) there will be no change in RBCs.</p>
Requirements	<ol style="list-style-type: none"> 1. Microscope 2. Microscopic slides, 3. Saline solution— 1%, 0.85%, 0.3%.
Environment	MLT laboratory
Procedure	<ol style="list-style-type: none"> 1. Set up a row of 3 test tubes of different NaCl concentration. 2. To each tube add 2 ml of one of the various saline solutions. 3. Add 2 drops of red blood cell suspension. 4. Mix immediately but gently. 5. Set tubes aside for 20 minutes. Remember to

	<p>set a timer.</p> <p>6. Remove a drop with a disposable pipette and place on a slide and put a cover slip over it.</p> <p>7. Observe under high power objective (45X).</p>
<p>Observations</p> <ol style="list-style-type: none"> Behavior of RBCs in isotonic solution <ul style="list-style-type: none"> Normal RBCs do not show any change at 0.85% saline solution (isotonic). Behavior of RBCs in hypertonic solution <ul style="list-style-type: none"> A hypertonic solution is a solution that contains higher concentration of solute. When RBCs are placed in a hypertonic solution (1%), RBCs shrink, due to exosmosis. Behavior of RBCs in hypotonic solution <ul style="list-style-type: none"> A hypotonic solution is a solution that contains lower concentration of solute. When placed in a hypotonic solution (0.30%), RBCs inflate due to endosmosis and haemolysis takes place due to excessive swelling of RBCs. <div data-bbox="432 1294 1141 1758" style="text-align: center;"> </div>	
<p>Result</p>	<ul style="list-style-type: none"> RBCs shrink in hypertonic (1% saline) solution. RBCs remain normal shape in isotonic (0.85% saline) solution

	<ul style="list-style-type: none"> • RBCs swell or rupture in hypotonic (0.30% saline) solution.
Clinical significance	<ul style="list-style-type: none"> • Identifying behavior of RBCs in isotonic, hypotonic and hypertonic solution helps to diagnose diseases like Spherocytosis, Thalassaemia, etc. • Spherocytes are round cells which are unable to swell much and rupture even when small amount of water enters in to the cell. Thus haemolysis starts at 0.75% and gets completed by 0.40%. Found in congenital spherocytosis. • Target cells and hypochromic iron deficient cells can swell too much degree before rupture as they are relatively flat. Found in Thalassaemia and severe iron deficiency anemia.
Skills to be achieved	<ul style="list-style-type: none"> • Students will prepare different concentrations of saline solutions. • They will find out whether RBCs are swollen, shrunken or normal in appearance.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Preparation of correct concentrations of saline solutions – 6 marks(3solutions-2marks each). 2. Visualizing shrinkage and lysis of RBCs – 4 marks. (2-shrinkage & 2-lysis).
FAQs	<ol style="list-style-type: none"> 1. Define isotonic /hypertonic /hypotonic solution.

	<p>2. Describe behavior of RBCs in these solutions.</p> <p>3. What is spherocytosis?</p>
Assignment/Activity	Study the behavior of RBCs in various concentrations of NaCl.
Reference	Chapter 5-Handbook of Anatomy and Physiology.

Week No.	13
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Practical No.	9
Title/ Aim	Anticoagulants To prepare of anticoagulant bulbs.
Objectives	Students shall be able to prepare EDTA anticoagulant bulb.
Principle	An anticoagulant is a chemical substance that helps to prevent clotting of blood, when mixed with blood in correct proportion.
Requirements	1. 250ml beaker, 2. Test tubes 3. Measuring cylinder (100ml), 4. Distilled water, 5. Glass bulbs (15ml) Chemicals:EDTA
Environment	MLT laboratory
Procedure	1. EDTA is Ethylene Diamine Tetra-acetic Acid. These are used in the concentration of 2 mg/ml of blood. 2. 0.2 ml solution is dried per bottle, which contains 8mg of the dry chemical, and prevents coagulation of 3-4 ml of blood. The solution of EDTA is prepared as follows: <ul style="list-style-type: none"> • EDTA — 4.0 gms • Distilled water — 100 ml
Observations- Different anticoagulant bulbs are identified by color of their stoppers.	



Fig. 9.1 Fig. 9.2

Result	<ul style="list-style-type: none"> • EDTA bulbis prepared.
Clinical significance	<ul style="list-style-type: none"> • EDTA is most commonly used anticoagulant used for various hematological tests. • EDTA is also used as decalcifying fluid in histopathology.
Skills to be achieved	Students will prepare EDTA bulb.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Use of correct quantity of constituents – 4 marks. 2. Proper use of container – 3 marks. 3. Proper color code of stopper- 3 marks.
FAQs	<ol style="list-style-type: none"> 1. Define anticoagulant. 2. Which tests are carried out with EDTA?
Assignment/Activity	Prepare 50 anticoagulant bulbs from EDTA.
Reference	Chapter 5-Handbook of Anatomy and Physiology.

Week No.	14
Practical No.	10
Title/ Aim	Anticoagulants To prepare of citrate bulbs.
Objectives	Students shall be able to prepare citrate bulb.
Principle	An anticoagulant is a chemical substance that helps to prevent clotting of blood, when mixed with blood in correct proportion.
Requirements	<ol style="list-style-type: none"> 1. 250ml beaker, 2. Test tubes 3. Measuring cylinder (100ml), 4. Distilled water, 5. Glass bulbs (15ml) <p>Chemicals:</p> <ol style="list-style-type: none"> 1. Trisodium citrate
Environment	MLT laboratory
Procedure	<p>Preparation of Sodium Citrate</p> <ul style="list-style-type: none"> • Sodium (specifically Trisodium) Citrate is an anticoagulant used in the liquid form. <p>The solution of Sodium citrate is prepared as follows:</p> <ul style="list-style-type: none"> • Sodium citrate---- 3.8 gm • Distilled Water---- 100 ml
Observations- Different anticoagulant bulbs are identified by color of their stoppers.	



Fig. 10.1 Fig. 10.2

Result	<ul style="list-style-type: none"> Sodium citrate bulbis prepared.
Clinical significance	<ul style="list-style-type: none"> Sodium citrate bulb is used to collect blood for ESR and Prothrombin time estimation.
Skills to be achieved	Students will prepare bulbs of sodium citrate.
Skill evaluating criteria	<ol style="list-style-type: none"> Use of correct quantity of constituents – 4 marks. Proper use of container- 3 marks. Proper color code of stopper – 3 marks.
FAQs	<ol style="list-style-type: none"> Define anticoagulant. Which tests are carried out with sodium citrate?
Assignment/Activity	Prepare 50 anticoagulant bulbs from Na-citrate.
Reference	Chapter 5-Handbook of Anatomy and Physiology.

Week No.	15
Practical No.	11
Title/ Aim	Anticoagulants To prepare Double oxalate bulb.
Objectives	Students shall be able to prepare double oxalate bulbs.
Principle	An anticoagulant is a chemical substance that helps to prevent clotting of blood, when mixed with blood in correct proportion.
Requirements	<ol style="list-style-type: none"> 1. 250ml beaker, 2. Test tubes 3. Measuring cylinder (100ml), 4. Distilled water, 5. Glass bulbs (15ml) <p>Chemicals</p> <ol style="list-style-type: none"> 1. Ammonium oxalate, 2. Potassium oxalate,
Environment	MLT laboratory
Procedure	<p>Preparation of Double Oxalate</p> <ul style="list-style-type: none"> • Three parts of ammonium oxalate and two parts of potassium oxalate are combined together in order to balance the swelling effect of ammonium oxalate and the shrinking effect of potassium oxalate on RBCs. • The solution of double oxalate is prepared as follows: <ul style="list-style-type: none"> ▪ Ammonium oxalate — 2.4 g

	<ul style="list-style-type: none"> ▪ Potassium oxalate — 1.6 g ▪ Distilled water — 100 ml
<p>Observations- Different anticoagulant bulbs are identified by color of their stoppers.</p>	
	
<p>Fig. 11.1 Fig. 11.2</p>	
Result	<ul style="list-style-type: none"> • Double oxalate bulb is prepared.
Clinical significance	<ul style="list-style-type: none"> • Double oxalate is used for various hematological tests, e.g. Hb estimation, PS for Differential count, etc.
Skills to be achieved	Students will prepare double oxalate bulb.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Use of correct quantity of constituents – 4 marks. 2. Proper use of container – 3 marks. 3. Proper color code of stopper – 3 marks.
FAQs	<ol style="list-style-type: none"> 1. Define anticoagulant. 2. Which tests are carried out with Double oxalate?
Assignment/Activity	Prepare 50 anticoagulant bulbs from double oxalate.
Reference	Chapter 5 Handbook of Anatomy & Physiology.

Week No.	16
Practical No.	12
Title/ Aim	Anticoagulants To prepare fluoride bulb.
Objectives	Students shall be able to prepare fluoride bulb.
Principle	An anticoagulant is a chemical substance that helps to prevent clotting of blood, when mixed with blood in correct proportion.
Requirements	<ol style="list-style-type: none"> 1. 250ml beaker, 2. Test tubes 3. Measuring cylinder (100ml), 4. Distilled water, 5. Glass bulbs (15ml) <p>Chemicals:</p> <ol style="list-style-type: none"> 1. Sodium fluoride 2. Potassium oxalate
Environment	MLT laboratory
Procedure	<p>Preparation of Fluoride</p> <p>The solution of fluoride is prepared as follows:</p> <ul style="list-style-type: none"> • Sodium fluoride- 1.0 g • Potassium oxalate- 3.0 g • Distilled water – 100 ml
Observations- Different anticoagulant bulbs are identified by color of their stoppers.	



Fig. 12.1



Fig.12.2

Result	<ul style="list-style-type: none"> • Sodium fluoride bulb is prepared.
Clinical significance	<ul style="list-style-type: none"> • Blood glucose undergoes glycolysis to form lactic acid. Such samples provide inaccurate blood sugar level and therefore an anticoagulant must be used to prevent enzyme action. Sodium fluoride is an anticoagulant which is an enzyme poison. It is used for determination of blood sugar.
Skills to be achieved	Students will prepare fluoride bulb.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Use of correct quantity of constituents -4 marks. 2. Proper use of container 3 marks. 3. Proper color code of stopper – 3 marks.
FAQs	<ol style="list-style-type: none"> 1. Define anticoagulant.

	2. Why sodium fluoride is used for blood sugar estimation?
Assignment/Activity	Prepare 25 anticoagulant bulbs from fluoride.
Reference	Chapter 5-Handbook of Anatomy and Physiology.

Week No.	17 & 18th
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Practical No.	13
Title/ Aim	Haematocrit (PCV) To perform PCV by Wintrobe's method.
Objectives	Students shall be able to carry out PCV from the collected blood sample by Wintrobe's method.
Principle	When anti-coagulated blood is centrifuged at a standard speed, erythrocytes which are heavier than white cells and plasma, will settle down at bottom. This red cells volume is known as Haematocrit or Packed Cell Volume (PCV). This volume of red cells is expressed as a percentage of whole blood.
Requirements	<ol style="list-style-type: none"> 1. Wintrobe's tube 2. Anticoagulated blood 3. Pasteur pipette 4. Centrifuge
Environment	MLT laboratory
Procedure	<ol style="list-style-type: none"> 1. Mix the blood sample. 2. Label a Wintrobe's tube. Fill the tube by using a Pasteur pipette or a syringe up to 100 mm mark. Avoid trapping of bubbles. 3. Place the tube in a centrifuge machine. Use another Wintrobe's tube filled with another sample for the purpose of balancing. 4. Centrifuge for 30 minutes at 3000 rpm. 5. Note the reading. Multiply by 100 for volume percentage (%).

Observations

Upper level of red cell column. It indicates PCV.

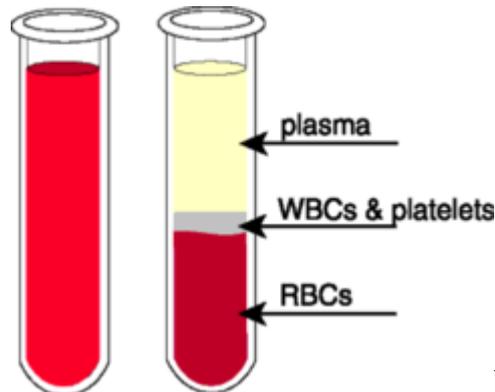


Fig. 13.1

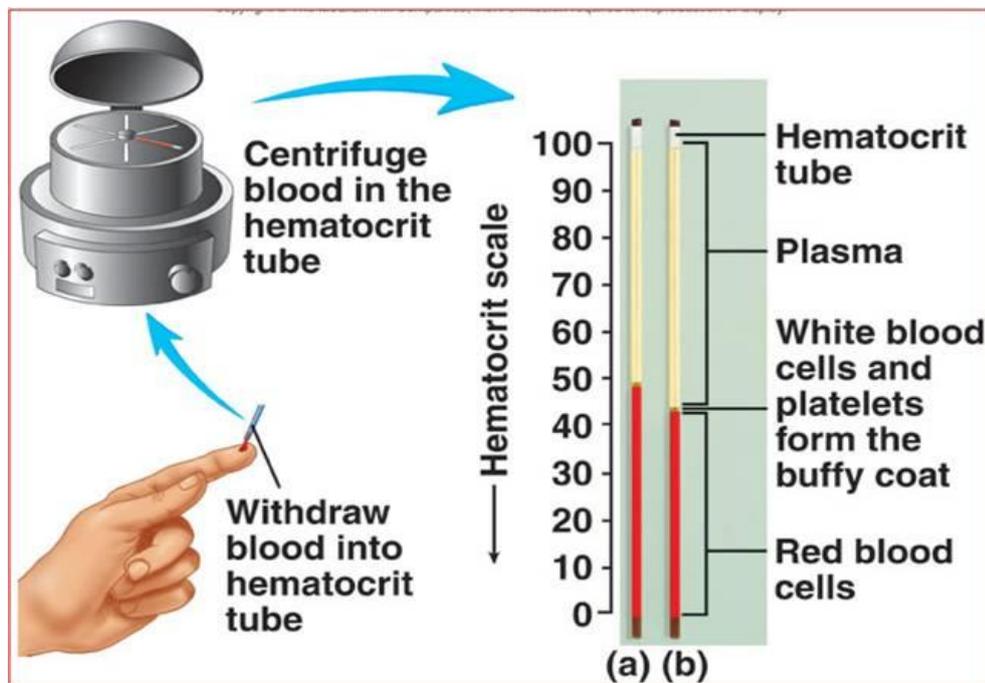


Fig. 13.2

<p>Result</p>	<p>Normal Value Males: 42-52% Females: 36-47%</p>
<p>Clinical significance</p>	<p>1. PCV decreases in Anemia. 2. PCV increases in polycythaemia, dehydration, congenital heart disease.</p>
<p>Skills to be achieved</p>	<p>Students will develop the skill of filling of PCV tube and perform test.</p>

Skill evaluating criteria	<ol style="list-style-type: none"> 1. Proper collection of blood – 3 marks. 2. Proper filling of Wintrobe’s tube – 4 marks. 3. Correct reading of Red cell column – 3 marks.
FAQs	<ol style="list-style-type: none"> 1. Define PCV. Give normal value. 2. Explain the procedure of PCV determination.
Assignment/Activity	Perform PCV of 10 different blood samples.
Reference	Handbook of Anatomy and Physiology.

Week No.	19th
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Practical No.	14
Title/ Aim	Neubaur's Chamber To identify Neubaur's rulings.
Objectives	Students shall be able to identify the ruling areas in Neubaur's Chamber.
Principle	The Neubaur's chamber offers fixed measured squares for counting of blood cells.
Requirements	1. Microscope 2. Neubaur's chamber
Environment	MLT laboratory
Procedure	1. Keep Neubaur's chamber under microscope. 2. First observe under low power note the rulings. 3. Then turn under high power and note the rulings.
Observations	
<p>Ruling areas in Neubaur Chamber</p> <ul style="list-style-type: none"> • The Neubaur chamber is a special slide having two ruled stages separated from two ridges on either side by a gutter. • The surface of the two ridges is 1/10 mm above the stage. It is the depth of chamber. • The ruled area is divided in to 9 squares having an area of 9sqmm. • The four corner squares measure 1 sq.mm each. • The corner squares are further divided into 16 small squares each and are used for counting White blood cells. • The central square is separated from other squares by double line. • The central square is divided into 25 squares. Each square is separated from other by triple lines. Each of these squares is further divided into 	

Skill evaluating criteria	<ol style="list-style-type: none"> 1. Correct adjustment of Neubaur chamber under microscope – 2 marks. 2. Proper focusing of ruled areas of Neubaur chamber – 4 marks. 3. Proper identification of ruled areas for counting blood cells – 4 marks.
FAQs	<ol style="list-style-type: none"> 1. Explain rulings on Neubaur chamber.
Assignment/Activity	<ol style="list-style-type: none"> 1. Observe the Neubaur chamber under microscope and identify the rulings. 2. Draw a diagram of Neubaur chamber and label the counting areas.
Reference	Chapter 5-Handbook of Anatomy and Physiology.

Week No.	20th & 21st
Practical No.	15
Title/ Aim	Hemoglobin-

	To perform hemoglobin estimation by Sahli's method.
Objectives	Students shall be able to estimate hemoglobin of the given blood sample.
Principle	When blood is mixed with 0.1N hydrochloric acid, hemoglobin is converted to 'acid haematin' which is brown color complex. The resulting color is compared with standard brown glass comparators of a Sahli's haemoglobinometer.
Requirements	<ol style="list-style-type: none"> 1. Sahli's haemoglobinometer 2. Anticoagulated blood
Environment	MLT laboratory
Procedure	<ol style="list-style-type: none"> 1. Add 0.1N hydrochloric acid in the tube up to the mark 20 by using a Pasteur pipette. 2. Draw blood up to 20μl in the Sahli's pipette. Adjust the blood column carefully without bubbles. Wipe excess of blood using a dry piece of cotton. 3. Transfer blood to the graduated tube, mix it and allow the tube to stand for at least 10 minutes. 4. Dilute the solution with distilled water by adding a few drops at a time carefully and by matching the color of reaction mixture, with the standards in the comparator. 5. The matching should be done against natural light only. The level of the fluid is noted at

its lower meniscus, and the reading corresponding to this level on the scale is recorded in g/dl.

Observations-When the color of the sample matches with the standard brown glass comparators, this is the level where the readings are noted which corresponds to the concentration of the hemoglobin.

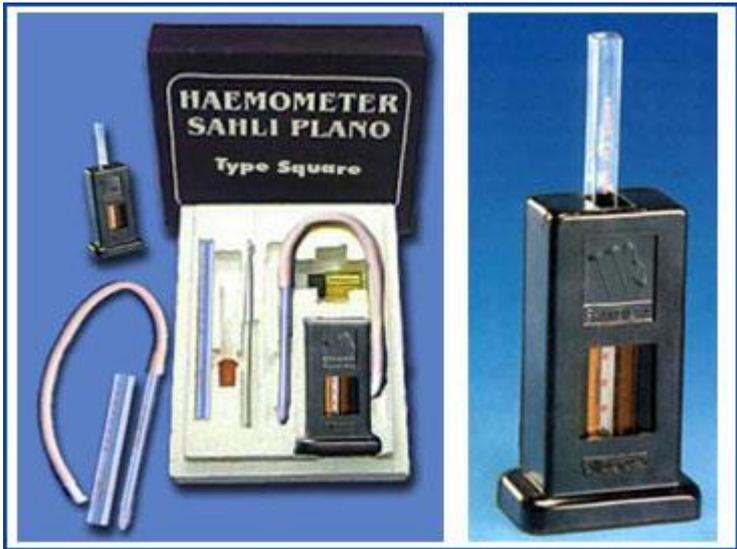


Fig. 15.1

Result- Normal values

Men	14.0-18.0 g/dl
Women	11.5-16.5 g/dl
Children (up to 1 year)	11.0-13.0 g/dl
Children (10-12 years)	11.5-14.5 g/dl
Infants (full term cord blood)	13.5-19.5 g/dl

Clinical significance

1. A decrease in hemoglobin in the blood below the normal range is an indication of anemia.
2. It is usually performed as a part of Complete Blood Count (CBC).

Skills to be achieved	Students will pipette exact quantity of blood in Sahli's pipette and determine Hemoglobin of patients correctly.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Proper collection of blood – 2 marks. 2. Correct filling of Sahli's pipette up to mark (20μl) - 2 marks. 3. Use of correct quantity of HCl up to 20 mark in Sahli's (Calibration) tube (20) – 2 marks. 4. Correct reading of Hb level in Sahli's tube – 2 marks. 5. Proper selection of standard comparator to compare color – 2 marks.
FAQs	<ol style="list-style-type: none"> 1. What is hemoglobin? 2. Explain principle of Sahli's method. 3. Give normal value of Hb in males and females.
Assignment/Activity	Perform Hb of 10 different patients with Sahli's method.
Reference	Chapter 5-Handbook of Anatomy and Physiology.

Week no.	20 th and 21 st
Practical No.	16

Title/ Aim	Hemoglobin estimation To estimate Hb by cyanmethemoglobin method.
Objective	Students shall carry out hemoglobin estimation by cyanmethemoglobin method.
Principle	When blood is mixed with Drabkin's reagent containing K cyanide & K ferricyanide hemoglobin reacts with ferricyanide to form methemoglobin which is converted to stable cyanmethemoglobin by cyanide. The intensity of the color is proportional to hemoglobin concentration & is compared with a known cyanmethemoglobin standard at 540nm (green filter).
Requirements	<ol style="list-style-type: none"> 1. Hb-pipette. 2. Test tubes 3. Photometer or spectrophotometer. 4. Drabkin's reagent- <ul style="list-style-type: none"> • K ferricyanide- 400mg • K dihydrogen phosphate 280mg • K cyanide 100mg • Distilled water- 1000ml <p>This reagent is stable in a polythene container at 2-8 °C.</p> 5. Cyanmethemoglobin standard (Hb standard)- commercially available. It is directly pipetted in a cuvette & optical density measured at 540nm. The reading obtained corresponds to

	<p>15 gm% Hb</p> <p>6. Specimen -</p> <ul style="list-style-type: none"> • Capillary blood or • Thoroughly mixed anticoagulated (EDTA or double oxalate) venous blood. <p>The sample need not be a fasting sample.</p>									
Environment	MLT laboratory									
Procedure										
1. Pipette in the tubes labeled as follows-										
	<table border="1"> <thead> <tr> <th></th> <th>Test</th> <th>Blank</th> </tr> </thead> <tbody> <tr> <td>Drabkin's reagent</td> <td>5.0 ml</td> <td>5.0ml</td> </tr> <tr> <td>Blood</td> <td>0.02 ml</td> <td></td> </tr> </tbody> </table>		Test	Blank	Drabkin's reagent	5.0 ml	5.0ml	Blood	0.02 ml	
	Test	Blank								
Drabkin's reagent	5.0 ml	5.0ml								
Blood	0.02 ml									
2. Mix the contents in the tube labeled as 'Test 'thoroughly and wait for 5 minutes.										
3. Measure the absorbance of this solution at 540nm in a colorimeter after adjusting the OD at 0 by using Drabkin's solution as blank.										
4. Read absorbencies of standard (15 g/dl) by pipetting it directly in a cuvette.										
Observations										
<p style="text-align: center;"> Haemoglobin + Ferricyanide → Methemoglobin ↓ cyanide ions Cynomethemoglobin ---Stable red compound ---Measured Colorimetrically ---Intensity directly proportional to amount of Hb in sample </p>										



Figure 16.1

Calculation-

$$\text{Hemoglobin, g/dl} = \frac{\text{O.D. of TEST} \times 15}{\text{O.D. of STD}}$$

<p>Result</p>	<p>Normal values</p> <p>Men 14-18gm%</p> <p>Women 12-16gm%</p>
<p>Clinical significance</p>	<ol style="list-style-type: none"> 1. This is the internationally recommended method for determining hemoglobin. 2. This method is highly accurate and is the most direct analysis available for hemoglobin iron. Its disadvantage is the use of cyanide compounds, which, if handled carefully, should present little hazard. 3. Hemoglobin estimation is used as a screening test for detecting anemia. 4. It is usually performed as a part of Complete Blood Count (CBC).
<p>Skills to be achieved</p>	<p>Students will pipette exact quantity of blood in sahli's pipette and determine Hemoglobin of</p>

	patients correctly.
Skill evaluating criteria	<ul style="list-style-type: none"> • Proper collection of blood- 2marks • Proper mixing of blood sample- 2marks • Correct filling of Sahli's pipette up to mark (20µl)- 2marks • Proper pipetting of Drabkin's reagent- 2marks • Proper adjustment of colorimeter- 2marks
FAQs	<p>4. What is hemoglobin?</p> <p>5. Explain principle of Drabkin's method.</p> <p>6. Give normal value of Hb in males and females.</p>
Assignment	Perform Hb of 10 different patients with Drabkin's method.
Reference	Chapter 5-Handbook of Anatomy and Physiology

Week No.	22 & 23rd
Practical No.	17
Title/ Aim	Blood groups To detect blood groups of given blood sample
Objectives	Student shall be able to detect blood groups.
Principle	The procedures used with the antisera are based

	on the principle of agglutination. Normal human red cells possessing antigens will clump in the presence of corresponding antibody.
Requirements	<ol style="list-style-type: none"> 1. Blood sample 2. Glass slides 3. Anti-A 4. Anti-B 5. Anti-D
Environment	MLT laboratory
Procedure	<ol style="list-style-type: none"> 1. Take three clean glass slides. Label them as 1, 2, and 3. 2. Take a drop of blood on each slide. 3. Add a drop of anti A in 1st slide, anti B in 2nd slide and anti D in 3rd slide. 4. Mix it and observe for agglutination within 2 minutes. 5. Interpret it.
Observations	
<ul style="list-style-type: none"> • If agglutination is there in 1st slide i.e. ‘A’ antigen must be present in blood sample which reacts with anti A, so blood group is ‘A’ • If agglutination is there in 2nd slide i.e. ‘B’ antigen must be present in blood sample which reacts with anti B, so blood group is ‘B’ • If agglutination is there in 1st slide and 2nd slide i.e. ‘A’ and ‘B’ both the antigens must be present in blood sample which reacts with anti A and anti B so blood group is ‘AB’. • If no agglutination in 1st and 2nd slide i.e. neither ‘A’ nor ‘B’ antigen is present in blood sample so blood group is ‘O’. • If agglutination is there in 3rd slide i.e. ‘D’ antigen must be present in 	

bloodsample which reacts with **anti D**, so blood group is **Rh positive**.

- If no agglutination in 3rd slide i.e. ‘D’ antigen must be absent in bloodsample so blood group is **Rh negative**.

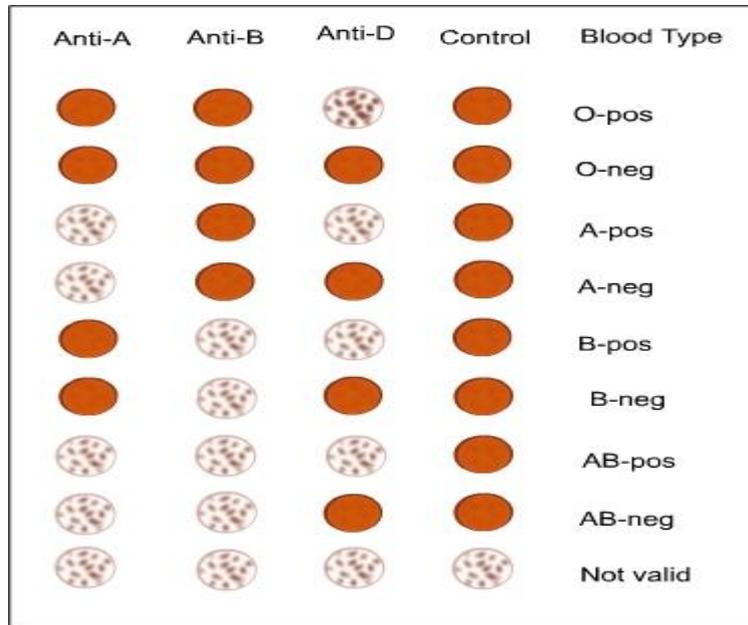


Fig. 17.1

Result-

ABO Grouping

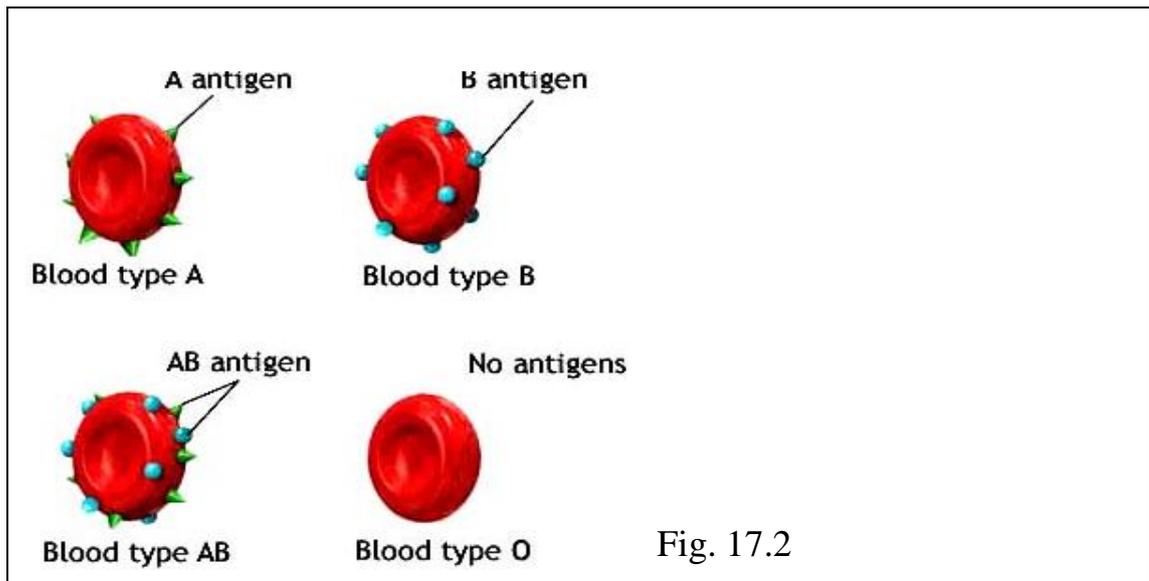
Antigen	Antibody	Blood Group
A	B	A
B	A	B
A & B	No antibody	AB
No antigen	A&B	O

Table 17.1

Rh typing

Antigen	Blood Group
D	Rh positive
No antigen	Rh negative

Table 17.2



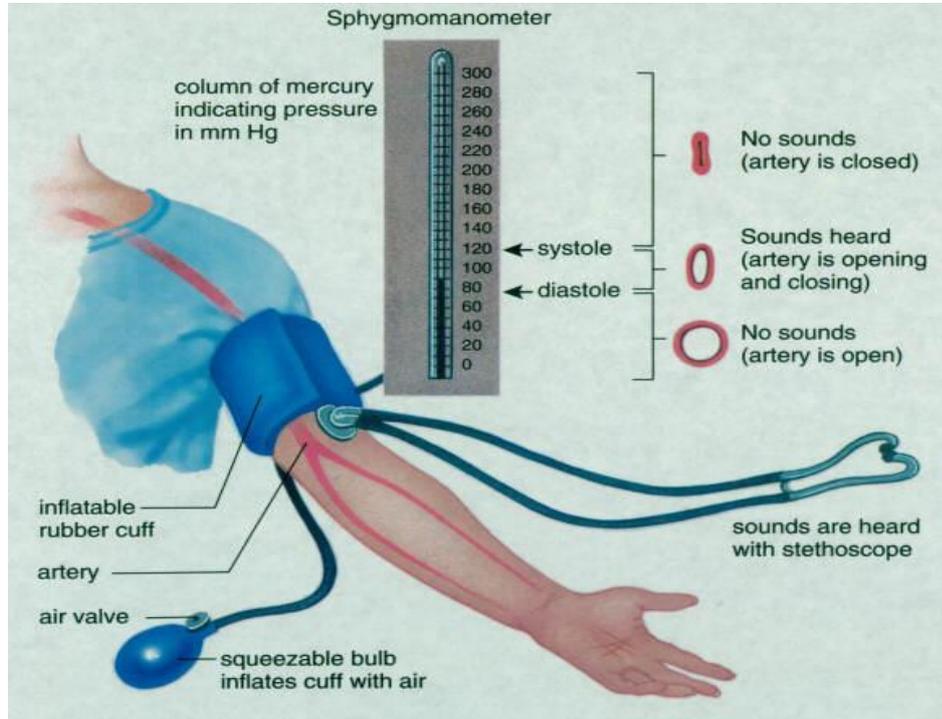
Clinical significance	Determination of blood groups is necessary in cases of blood transfusion, medico-legal cases, HDN, etc.
Skills to be achieved	Students will identify the blood groups perfectly.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Proper use of antisera – 2 marks 2. Correct method – 4 marks. 3. Proper observation for agglutination – 2 marks. 4. Correct time for observation - 2 marks.
FAQs	<ol style="list-style-type: none"> 1. What are blood groups? 2. Explain principle of blood grouping. 3. Give significance of blood groups.
Assignment/Activity	Perform blood groups of 25 different subjects.
Reference	Chapter 5-Handbook of Anatomy and Physiology.

Week No.	24th
Practical No.	18
Title/ Aim	Blood pressure and Pulse- To record the blood pressure of patient or normal person.
Objectives	Students shall be able to measure

	bloodpressure.
Principle	Blood pressure is the lateral pressure exerted by the blood on the vessel wall while flowing through it. Measurement of blood pressure by using sphygmomanometer gives valuable information.
Requirements	<ol style="list-style-type: none"> 1. Sphygmomanometer 2. Stethoscope
Environment	MLT laboratory
Procedure	<ol style="list-style-type: none"> 1. First do palpatory method and find out systolic pressure. 2. Tie the cuff of the sphygmomanometer over the mid arm of the person. 3. Close the air valve of the cuff. 4. Place the stethoscope over the anticubital fossa of the elbow. 5. Squeeze the rubber bulb to inflate the cuff up to or slight more than the value obtained with palpatory method. 6. Slowly go on releasing the pressure by opening the valve. 7. The mercury column will start fluctuating at some level and at the same time the measuring person will also hear the sound in the ear. The point at which the sound appears is the systolic pressure. 8. The column fluctuation and the sound will persist for some time and when the sound

	disappears the level of mercury column indicates the diastolic pressure.
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Observations-Use of sphygmomanometer to record blood pressure is explained in the form of images.



18.1

Result- Normal range of blood pressure

- Systolic pressure - 90-120 mm of Hg
- Diastolic pressure - 60-90 mm of Hg

Clinical significance	Recording of blood pressure helps to diagnose patients of hypertension or hypotension.
Skills to be achieved	Students can record blood pressure of patients perfectly.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Correct site – 2 marks. 2. Checking of BP apparatus – 2 marks. 3. Correct area for applying BP apparatus cuff – 2 marks. 4. Correct reading of mercury levels – 4 marks.

FAQs	<ol style="list-style-type: none"> 1. Define blood pressure. 2. What is systolic and diastolic pressure? 3. Give normal value of blood pressure.
Assignment/Activity	Record the blood pressure of 10 different persons.
Reference	Chapter 6-Handbook of Anatomy and Physiology.

Week No.	25th
Practical No.	19
Title/ Aim	Blood pressure and Pulse- To record the pulse of patient or normal person.
Objectives	Students shall be able to measure pulse.
Principle	It is the expansion and elongation of arterial

	walls passively produced by the pressure changes during systole and diastole of ventricles.
Requirements	Any subject-patient or normal person
Environment	MLT laboratory
Procedure	<ol style="list-style-type: none"> 1. Place the index, middle and ring finger over the wrist as shown in the figure. 2. Press the fingers down towards the radial bone. 3. The pulp of the examining fingers will feel the pulsation. 4. Count the pulsations for one minute by watch. 5. The counted pulsation is the pulse rate of the person.
<p>Observations-</p> <p>Technique of measuring pulse is as follows-</p> <div style="text-align: center;">  <p style="text-align: right;">19.1</p> </div>	
Result-	<p>Normal range of Pulse</p> <p>60 - 80/min at rest</p>
Clinical significance	Recording of pulse helps to identify abnormalities like tachycardia, bradycardia,

	pulsus alternans, Atrial fibrillation, etc.
Skills to be achieved	Students can record pulse of patients.
Skill evaluating criteria	<ol style="list-style-type: none"> 1. Correct site – 2 marks. 2. Correct use of three fingers to locate and measure pulse - 6 marks. 3. Knowing different sites for pulse measurement – 2 marks.
FAQs	<ol style="list-style-type: none"> 1. Define pulse. 2. What are sites of recording pulse? 3. Give normal value of pulse.
Assignment/Activity	Record the pulse rate of 10 different persons.
Reference	Chapter 6-Handbook of Anatomy and Physiology.

