Bachelor of Science in Medical Laboratory Technology (BMLT)

ANATOMY & PGYSIOLOGY LAB. - I

SEMESTER: FIRST (Ist)

PRACTICAL LABORATORY MANUAL

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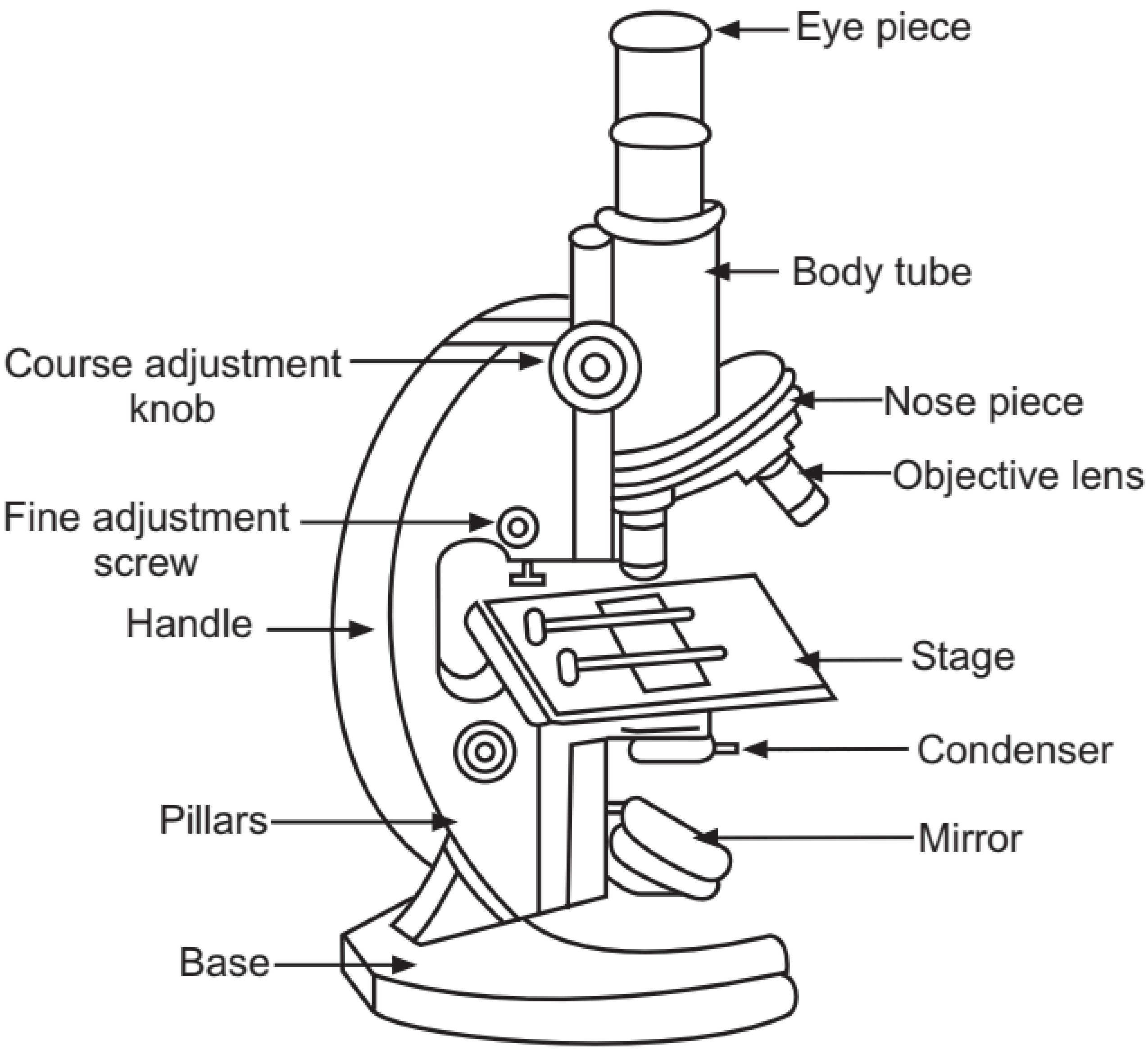
EXPERIMENT - 01

Microscopy

Aim: - To study the microscope and its related accessories

Principal- A microscope's principle involves using lenses to magnify and resolve fine details of a specimen. Light or electrons are focused onto the specimen, and then magnified by a series of lenses to produce a larger, clearer image. The primary principles at play are magnification, resolving power, and, in the case of light microscopy, numerical aperture

Requirement- Diagram of Microscope



Theory:

- **Light Source:** A light source at the base of the microscope illuminates the specimen.
- **Condenser Lens:** This lens focuses the light onto the specimen, ensuring even illumination.
- **Specimen:** The light passes through the specimen, and some of it is transmitted through the objective lens.
- **Real Image Formation:** The objective lens gathers the light and forms a magnified, inverted, real image within the body tube of the microscope.
- **Virtual Image Formation:** The eyepiece then magnifies this real image, producing a virtual image that is seen by the observer.
- **Two-Dimensional Image:** Compound microscopes provide a two-dimensional view of the specimen.
- **High Resolution:** They are capable of resolving fine details of microscopic structures, making them essential for biological and medical research.
- **Multiple Lenses:** The use of multiple lenses, including both objective and eyepiece lenses, is crucial for achieving high magnification and resolving power.

Parts of Microscope:

The compound microscope is mainly used for studying the structural details of cell, tissue, or sections of organs. The parts of a compound microscope can be classified into two:

- Non-optical parts
- Optical parts

Non-optical parts

Base

The base is also known as the foot which is either U or horseshoe-shaped. It is a metallic structure that supports the entire microscope.

Pillar

The connection between the base and the arm are possible through the pillar.

Arm: The arm is also known as the limb which is a metallic handle forming the connection between the arm to the inclined joint. The stage and the body tube is supported by the arm.

Inclination Joint

If the observation has to be done in a sitting position, then the microscope can be tilted using the inclination joint.

Stage

It is the metallic platform that is fitted to the lower part of the arm with a hole in the centre. The microscopic slides are placed on the stage either by using side clips or by mechanical stage clips.

Body Tube

The main purpose of the body tube is to hold the objective and ocular lenses at the two ends. The end where the ocular lens is present is known as the head while the end where the objective lens is placed is known as the nose piece. For the passage of light rays through the body tube, there is a pathway.

Draw Tube

The upper end of the body tube has a small fixed tube which is known as the drawtube. The main function of the drawtube is to hold the ocular lens.

Rack and Pinion

To bring the object under focus, the rack and pinion are either attached to the body tube or the stage.

Adjustment Screws

These are two pairs of adjusting screws that are used either for a coarse adjustment or for fine adjustment. When a fine adjustment is made, the body tube or the stage moves extremely short distances while in coarse adjustment, the body tube and stage move up. Through fine adjustment, a sharp image can be obtained.

Automatic Stop

The rack and pinion have a small screw that is used for stopping the downward sliding of the body tube. This prevents damage to the objective lens.

Optical Parts

DiaphragmThe amount of light falling on the object can be controlled through the diaphragm. It is present below the stage. The disc and iris are the two types of diaphragms.

Condenser: It is present below the diaphragm. The focusing of light can be done by adjusting the condenser by moving it either up or down.

Reflector

A reflector is a mirror that is attached above the base. One side of the mirror has a plane mirror while the other side has a concave mirror. When the light is strong, the plane mirror side is used and when the light is weak, the concave mirror side is used. The light on the object is directed with the help of the reflector through the diaphragm and condenser.

Objective Lenses

These lenses are present over the nose piece. There are two to three types of objective lenses:

- Low power
- High power
- Oil immersion

The objective lens is a compound lens that forms a real inverted image of the image inside the body tube.

Ocular Lens

The ocular lens is also known as the eyepiece. The image of microscopic objects can be viewed through these lenses. There are four types of magnification that can take place in the ocular lens:

- 5X
- 10X
- 15X
- 20X

The binocular head is the device that uses two eyepieces and has many mirrors and prisms, which makes the passage of light easier.

Reference:

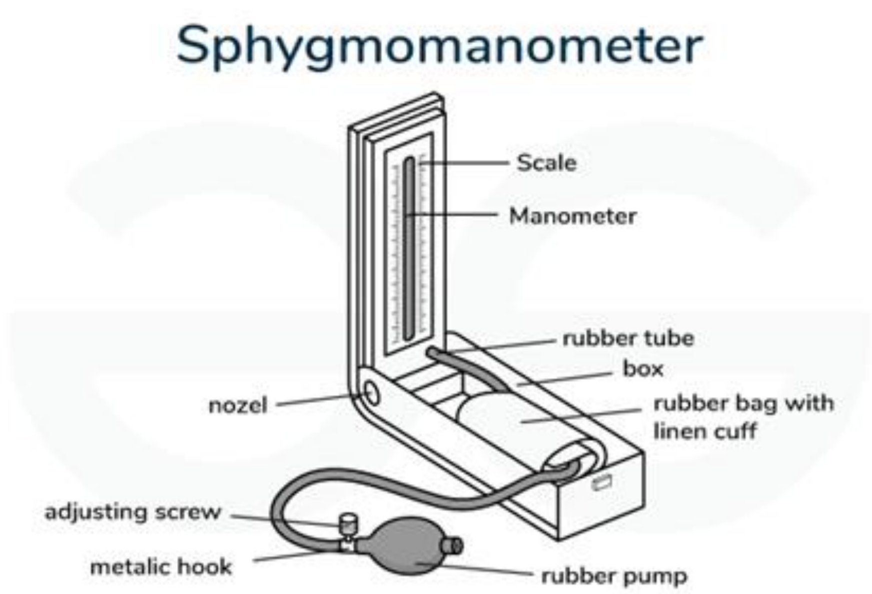
- Best and Taylor's Physiological Basis of Medical Practice,
- Best & Taylor's: William & Wilkins, Baltimore,
- Textbook of Medical Physiology, Guyton & Hall; WB Saunders Company

EXPERIMENT - 02

AIM: -. To measure the own blood pressure by using sphygmomanometer

Principal: To accurately measure your own blood pressure using a sphygmomanometer, you should be in a relaxed state, sit with your back supported, and have your feet flat on the floor. Position your arm at heart level and ensure the cuff is placed snugly around your bare upper arm, about one inch above the elbow. Inflate the cuff, then slowly release the pressure while listening for the Korotkoff sounds with a stethoscope. The first sound heard is the systolic pressure, and the point where the sounds disappear is the diastolic pressure.

Diagram of Sphygmomanometer:



Theory: A sphygmomanometer is used to measure blood pressure by wrapping an inflatable rubber cuff around the upper arm. A small, handheld air pump inflates it and as the pressure is released over time with an air valve, Korotkoff Sounds can be heard through a stethoscope which indicate changes in arterial flow. Ventricular contraction pushes blood through the arteries causing a rise and fall of arterial pressure. The highest-pressure point is the systolic pressure. It is followed by a decrease in pressure and when the lowest blood pressure point is reached, we can observe the diastolic pressure.

Systolic Pressure:

This is the higher number in a blood pressure reading. It represents the pressure in your arteries when your heart muscle contracts and pumps blood out into the body. A healthy systolic reading is generally considered to be below 120 mm Hg.

Diastolic Pressure: This is the lower number in a blood pressure reading. It represents the pressure in your arteries when your heart muscle is relaxed between beats, allowing the heart to refill with blood. A healthy diastolic reading is generally considered to be below 80 mm Hg**.**

Procedure:

Measuring with a Manual Sphygmomanometer

- **Wrap the cuff:**

Place the cuff on your bare upper arm, about 1 inch above the bend of your elbow.

- Position the stethoscope:

Place the diaphragm of the stethoscope over the brachial artery (inside of the elbow).

- **Inflate the cuff:**

Pump the bulb rapidly to inflate the cuff to about 30 mmHg above your usual systolic pressure (or at least 180 mmHg if you don't know your usual pressure).

- **Deflate and listen:**

Slowly release the valve on the cuff and listen for the Korotkoff sounds through the stethoscope.

- **Note the readings:**

The first sound you hear is your systolic pressure, and the point where the sound disappears is your diastolic pressure.

Measuring with a Digital Sphygmomanometer:

- **Wrap the cuff:** Place the cuff on your upper arm, ensuring it's snug but not too tight.
- **Follow instructions:** Turn on the device and follow the instructions provided with your specific monitor.
- **Note the readings:** The device will automatically inflate and deflate the cuff, displaying both systolic and diastolic pressures.

4. Recording:

- **Record the measurements:** Note down both the systolic and diastolic readings.
- **Repeat:** Take a few readings (2-3) with a couple of minutes in between for accuracy.
- **Keep a record:** Maintain a log of your blood pressure readings to track your health.

Result: Less than 120/80 mmHg.

Reference: - Best and Taylor's Physiological Basis of Medical Practice, Best & Taylor's: William & Wilkins, Baltimore, Textbook of Medical Physiology, Guyton & Hall; WB Saunders Company

Experiment – 03

AIM: Determination of hemoglobin by using Sahli's method.

Requirement: - Vial, Hemoglobinometry, N/10HCL

Principal - The Sahli method, also known as the acid hematin method, estimates hemoglobin concentration in blood by converting hemoglobin to acid hematin using hydrochloric acid. The intensity of the resulting brown color is then compared to a standard to determine the hemoglobin level.

1. **Theory:** When blood is mixed with a dilute hydrochloric acid solution (typically N/10 HCl), the haemoglobin within the red blood cells is converted into acid hematin, a brown-coloured substance.

2. **2. Reaction:**

The hydrochloric acid (HCl) causes haemolysis (breakdown of red blood cells) and converts the released haemoglobin into acid hematin.

3. **3. Colorimetric Measurement:**

The resulting brown solution is then compared to a standard colour (often a brown glass) using a Sahli's hemoglobinometer.

4. **4. Dilution and Comparison:**

The acid hematin solution is diluted with distilled water until its colour matches the standard, and the corresponding haemoglobin concentration is read from the calibrated scale on the hemoglobinometer.

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Procedure:

1. **Prepare the Equipment:** Ensure the Sahli's tube and haemoglobin pipette are clean and dry.

2. **Add Acid:** Fill the Sahli's tube with N/10 hydrochloric acid (HCl) up to the 2g% mark.

3. **Collect Blood Sample:** Use a haemoglobin pipette to draw 0.02 ml of blood. Avoid air bubbles.

4. **Mix Blood and Acid:** Transfer the blood into the Sahli's tube containing the HCl. Wash out the pipette with the acid solution to ensure all blood is transferred and mixed well.

5. **Incubate:** Allow the mixture to stand for 10 minutes to allow for maximum conversion of haemoglobin to acid hematin.

6. **Dilute:** Add distilled water to the mixture dropwise, carefully stirring with a glass rod after each addition. Ensure the glass rod is removed when comparing the colour.

7. **Match Colour:** Compare the colour of the solution with the standard brown glass comparator under natural daylight.

8. **Read Result:** Once the colours match, note the reading of the lower meniscus on the Sahli's tube scale. This reading represents the haemoglobin concentration in grams per decilitre (g/dL).

Normal Range:

Adults:

- **Males:** 13.5 to 17.5 g/dL
- **Females:** 12.0 to 15.5 g/dL

Infants (0-6 months):

- **Newborn's:** 14 to 24 g/dL
- **1-2 months:** 10.0 to 20.0 g/dL
- **2-6 months:** 9.5 to 13.0 g/dL
- **6 months - 1 year:** 9.5 to 14.0 g/dL

Children:

- **1-6 years:** 9.5 to 14.0 g/dL
- **6-18 years:** 10.0 to 15.5 g/dL

Advantage of Sahil's Method:

This is a Sahli-type haemoglobinometer which is used for measuring the hemoglobin content of blood. The square glass measuring tube at the top of the lid includes a measuring scale based on the 'Sahli' hemoglobin estimation system.

Disadvantage of Sahil's Method:

Less accurate 2-All hemoglobin's (oxyhemoglobin, sulphemoglobin) are not converted to acid hematin and hence the value of Hb obtained is less than the actual value. 3-The color of acid hematin develops slowly. 4-Individual variation in matching of color is see.

Reference: - Best and Taylor's Physiological Basis of Medical Practice, Best & Taylor's: William & Wilkins, Baltimore, Textbook of Medical Physiology, Guyton & Hall; WB Saunders Company

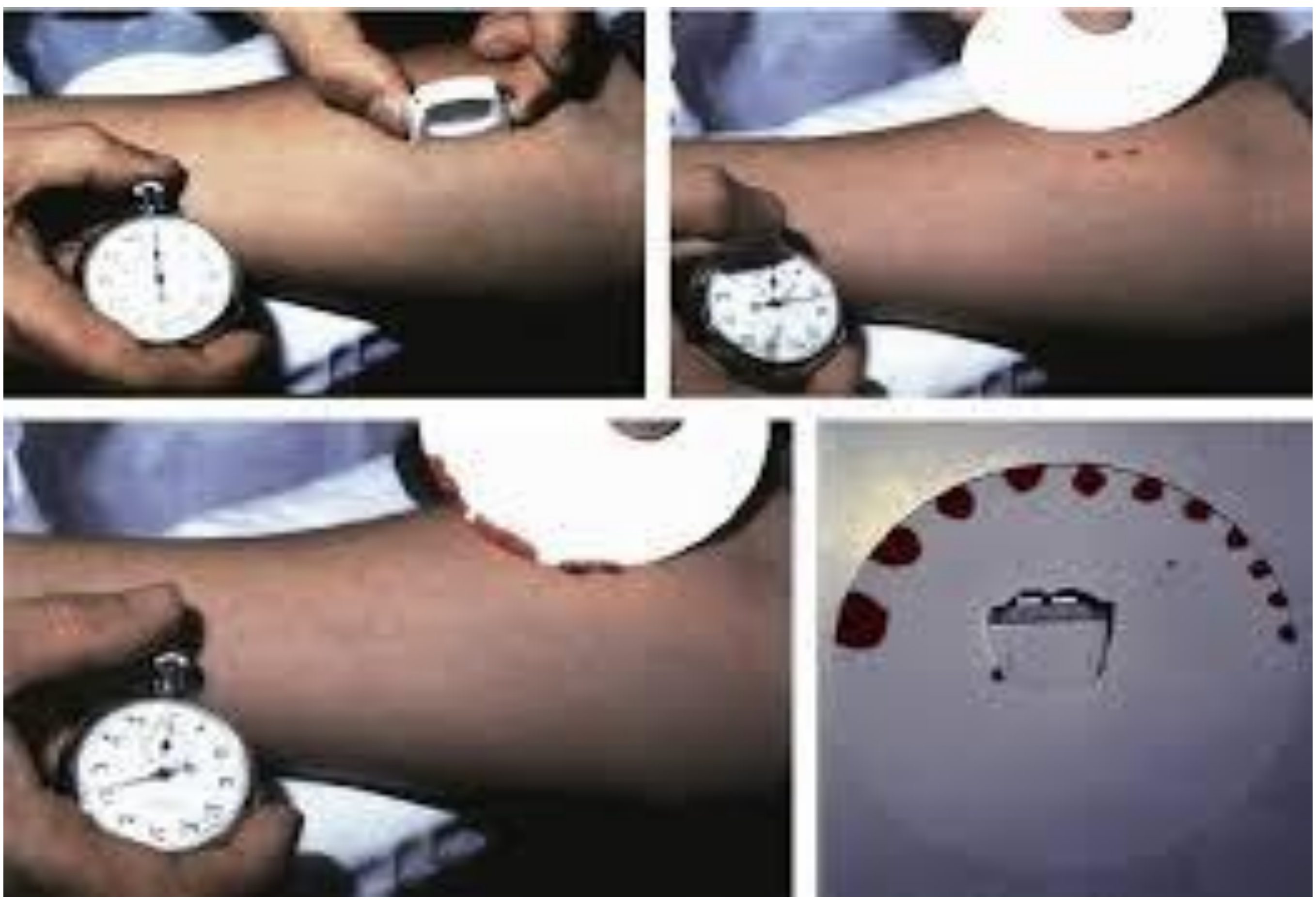
Experiment: 04

Aim: Estimation of bleeding time of own blood sample.

Principal- The test assesses two key aspects of haemostasis (the process of stopping bleeding):

- Platelet plug formation: Platelets adhere to the site of injury, aggregate together, and form a plug to stop the initial flow of blood.
- Blood vessel constriction: The blood vessels near the injury site constrict, further reducing blood flow and helping to stabilize the platelet plug

Theory- The bleeding time test (BT) assesses how quickly small blood vessels in the skin stop bleeding. It measures the time it takes for bleeding to stop after a small, standardized incision is made. This test helps evaluate platelet function and the ability of blood vessels to constrict and form a clot. The primary purpose of the bleeding time test is to assess the ability of platelets to form a plug at the site of a small injury and to evaluate how well blood vessels constrict to reduce blood flow



Procedure:

Preparation:

- The puncture site (forearm or finger) is cleaned with antiseptic to prevent infection.
- A blood pressure cuff may be applied to the upper arm and inflated to a certain pressure (e.g., 40 mmHg for the IVY method).

2. Incision:

- **IVY Method:**

A standardized incision (e.g., 10mm long and 1mm deep) is made on the volar forearm using a specialized device.

- **Duke Method:**

A stab incision is made on the patient's finger or earlobe using a lancet or specialized needle.

3. Monitoring:

- A timer is started immediately after the incision.
- The blood is blotted away every 30 seconds using filter paper.
- The blotting process is continued until no blood appears on the filter paper.

4. Recording:

- The time from incision to the cessation of bleeding is recorded.
- This time represents the bleeding time.

5. Normal Range:

- The normal bleeding time is typically between 1 and 9 minutes.
- An abnormal result (prolonged bleeding time) may indicate problems with platelet function or blood vessel structure.

- **Result:** Indicates proper platelet function and the initial stages of blood clot formation.
- **Prolonged (longer than 7 minutes):**

Suggests potential problems with platelet function, such as:

- **Platelet dysfunction:** Platelets may not be aggregating or adhering properly.
- **Thrombocytopenia:** A low platelet count, which can be caused by various factors.
- **Vascular abnormalities:** Problems with blood vessel walls that affect their ability to constrict and help form a clot.
- **Certain medications:** Medications like aspirin can impair platelet function, leading to prolonged bleeding time.
- **Other bleeding disorders:** Conditions like von Willebrand disease can also manifest as prolonged bleeding time.

General interpretations of bleeding time are as follows: 1-9 min: Normal. 9-15 min: Platelet dysfunction

EXPERIMENT- 05

Aim: Estimation of clotting time of own blood sample.

Principal: Clotting time refers to the time taken by blood to form a clot after it has been withdrawn from the body. This test helps assess the functioning of the coagulation system.

Requirements:

- Sterile lancet or needle
- Capillary tubes
- Stopwatch or timer
- Cotton and antiseptic (e.g., alcohol)
- Clean glass slide (optional)
- Gloves

Procedure (Capillary Tube Method):

1. Clean the fingertip with antiseptic and allow it to dry.
2. Prick the fingertip with a sterile lancet to obtain a drop of blood.
3. Fill a capillary tube (about 3-5 cm long) with blood by capillary action.
4. Start the stopwatch as soon as blood enters the capillary tube.
5. After 30 seconds, break off a small piece of the capillary tube every 15–30 seconds.
6. Observe for the appearance of a fibrin thread between the broken ends.
7. Stop the stopwatch once the clot or fibrin thread is visible.

Result:

- **Normal clotting time:** 2 to 6 minutes.

Precautions:

- Always use sterile equipment to avoid infection.
- Dispose of blood-contaminated materials safely.
- Do not squeeze the finger too much, as it may alter results

Experiment- 06

Aim: Estimation of erythrocytes sedimentation rate of own blood sample.

Principle of ESR: The ESR test measures the rate at which red blood cells (erythrocytes) settle at the bottom of a vertical tube over a specified period (usually **1 hour**). Inflammation causes changes in blood proteins (like fibrinogen), which make red cells clump together and fall faster.

Methods for ESR Estimation:
There are two common methods:
1. **Westergren Method (standard)**
2. **Wintrobe Method**

Procedure Using Westergren Method:
Materials Required:
- Westergren pipette
- ESR stand
- 0.5 mL of 3.8% sodium citrate (anticoagulant)
- 2 mL of your own venous blood
- Syringe and needle
- Timer or stopwatch

1. Collect **2 mL** of your own blood using aseptic technique.
2. Mix the blood with **0.5 mL of sodium citrate** (in 4:1 ratio, i.e., 4 parts blood, 1 part anticoagulant).
3. Fill the Westergren pipette up to the "0" mark with the anticoagulated blood.
4. Place the pipette vertically in the ESR stand.
5. Leave it undisturbed for **1 hour** at room temperature.
6. After 1 hour, record the level of the clear plasma above the red cell column in **mm/hr**

Interpretation:
- **High ESR**: Suggests infection, inflammation, anaemia, autoimmune disease, or cancer.
- **Low ESR**: May be seen in polycythaemia, sickle cell anaemia, or conditions with abnormal RBC shape.

Precautions:
- Do not shake the pipette after filling.
- Ensure the pipette is perfectly vertical.
- Avoid air bubbles.
- Process the blood sample within 2 hours of collection.

Normal ESR Values:

Category	**ESR (Westergren) Normal Range**
Men	0 – 15 mm/hr
Women	0 – 20 mm/hr
Children	0 – 10 mm/hr

EXPERIMENT- 07

AIM: To study and draw the structure of Respiratory system by using charts and model.

Respiratory system: The respiratory system is a biological system that enables gas exchange, primarily the intake of oxygen and the release of carbon dioxide, in living organisms. It includes various organs and structures that work together to facilitate this vital process.

Key Components of the Respiratory System:

- **Lungs:**

The primary organs for gas exchange, where oxygen is transferred to the blood and carbon dioxide is removed.

- **Airways:**

These include the nose, mouth, pharynx (throat), larynx (voice box), trachea (windpipe), and bronchi (large airways leading to the lungs).

- **Muscles:**

The diaphragm and intercostal muscles play a crucial role in breathing by expanding and contracting the chest cavity.

- **Other Structures:**

Blood vessels, lymphatic vessels, nerves, and pleura (membranes surrounding the lungs) also contribute to the respiratory system's function.

Function of the Respiratory System:

1. Gas Exchange:

The primary function is to bring oxygen into the body and remove carbon dioxide, a waste product of cellular activity.

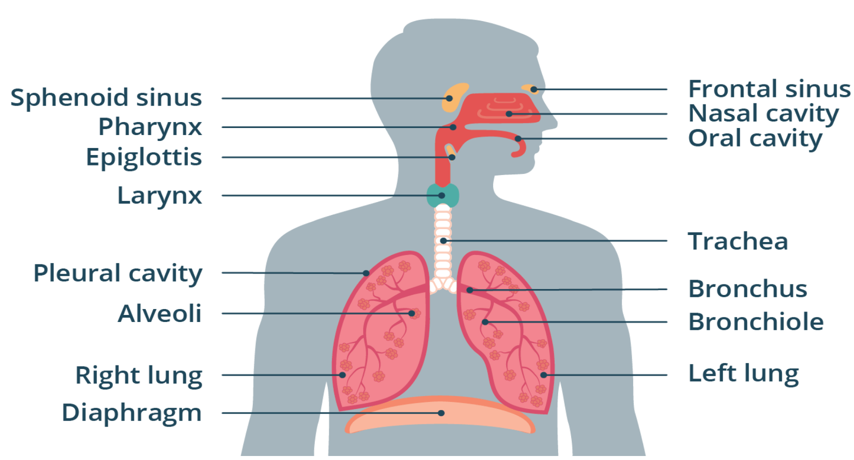
2. Protection:

The respiratory system helps protect the body from harmful particles and germs through mechanisms like cilia (tiny hairs) in the nasal passages and mucus production.

3. Speech and Smell:

The respiratory system is also involved in speech production and the sense of smell.

Diagram of Respiratory System



EXPERIMENT – 08

AIM: - To study and draw the structure of Digestive system by using charts and model.

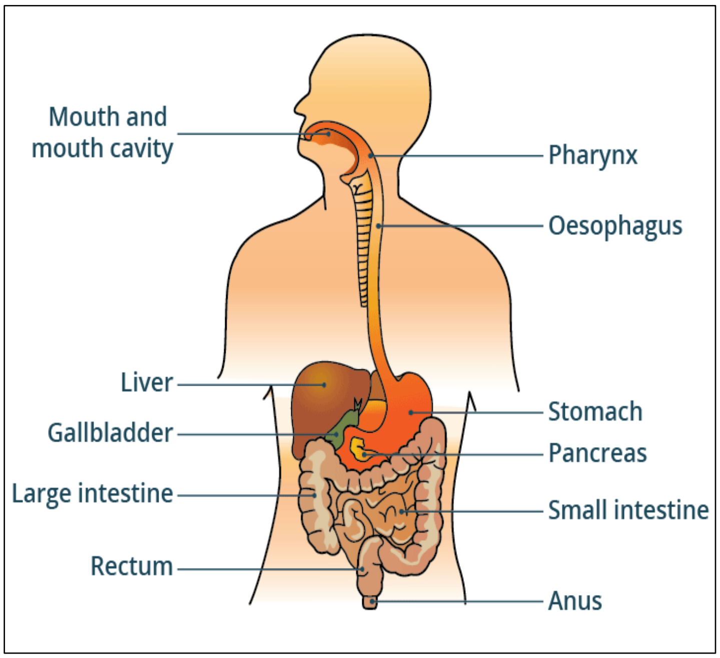
Requirement: - Chart and model of Digestive system.

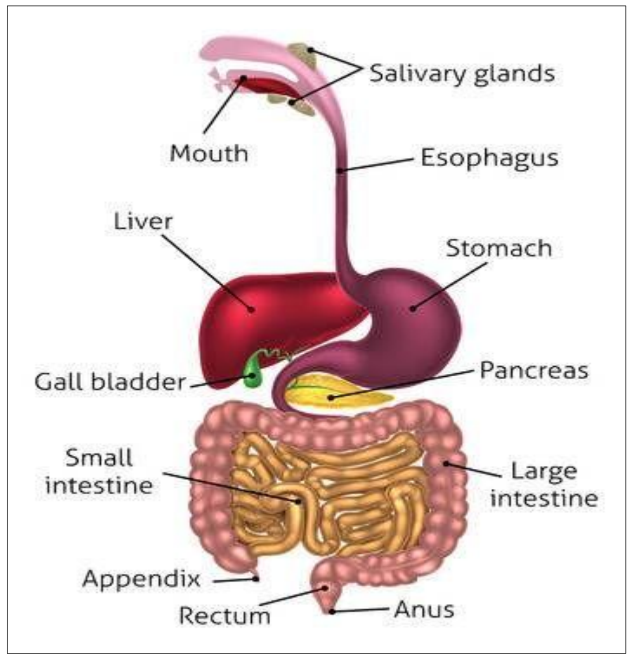
Theory: - The digestive system is a complex group of organs and glands that work together to convert the food we eat into essential nutrients that the body uses for energy, growth, and cell repair. It also plays a critical role in removing undigested waste from the body.

Main Functions of the Digestive System:

1. **Ingestion** – Taking in food through the mouth.
2. **Digestion** – Breaking down food into smaller, absorbable components.
3. **Absorption** – Nutrients from digested food are absorbed into the bloodstream.
4. **Excretion** – Removal of indigestible substances and waste products as faeces.

Digestive system





Key Components of the Digestive System:

1. Alimentary Canal (Gastrointestinal Tract):

- **Mouth** – Starts mechanical and chemical digestion.
- **Pharynx and Oesophagus** – Pathways that transport food to the stomach.
- **Stomach** – Mixes and breaks down food using acids and enzymes.
- **Small Intestine** – Primary site for digestion and nutrient absorption.
- **Large Intestine (Colon)** – Absorbs water and forms faeces.
- **Rectum and Anus** – Stores and eliminates waste.

2. Accessory Organs:

- **Salivary Glands** – Produce saliva that begins digestion of carbohydrates.
- **Liver** – Produces bile, which helps digest fats.
- **Gallbladder** – Stores bile and releases it into the small intestine.
- **Pancreas** – Secretes digestive enzymes and hormones (like

Food enters the **mouth**, where it's chewed and mixed with saliva. It then moves through the **oesophagus** into the **stomach**, where acid and enzymes continue digestion. The **small intestine** absorbs nutrients, while the **large intestine** absorbs water and forms stool for elimination

Importance:

The digestive system ensures that the body gets the nutrients needed to maintain energy, repair tissues, and support overall health. Any issues in this system can affect the entire body.

Reference: - Best and Taylor's Physiological Basis of Medical Practice, Best & Taylor's: William & Wilkins, Baltimore, Textbook of Medical Physiology, Guyton & Hall; WB Saunders Company

EXPERIMENT – 09

AIM: - To study and draw the structure of Cardiovascular system by using charts and model

Requirement: - Chart and model of Cardiovascular system

Theory: - The cardiovascular system**,** also called the circulatory system, is responsible for transporting blood, nutrients, oxygen, carbon dioxide, and hormones throughout the body. It also plays a vital role in maintaining homeostasis, removing waste, and protecting against disease.

Main Components of the Cardiovascular System

1. **Heart**

A muscular organ that pumps blood through the body.
Divided into four chambers:
Right atrium
Right ventricle
Left atrium
Left ventricle

Blood Vessels
Arteries: Carry oxygen-rich blood away from the heart to the body.
(Exception: pulmonary artery carries deoxygenated blood to lungs)

Veins: Carry deoxygenated blood back to the heart.
(Exception: pulmonary vein carries oxygenated blood from lungs)

Capillaries: Tiny vessels where gas, nutrient, and waste exchange occur between blood and tissues.

Blood
Contains:
Red blood cells (RBCs) – carry oxygen
White blood cells (WBCs) – fight infection
Platelets – help in clotting
Plasma – liquid part that carries nutrients, hormones, and proteins

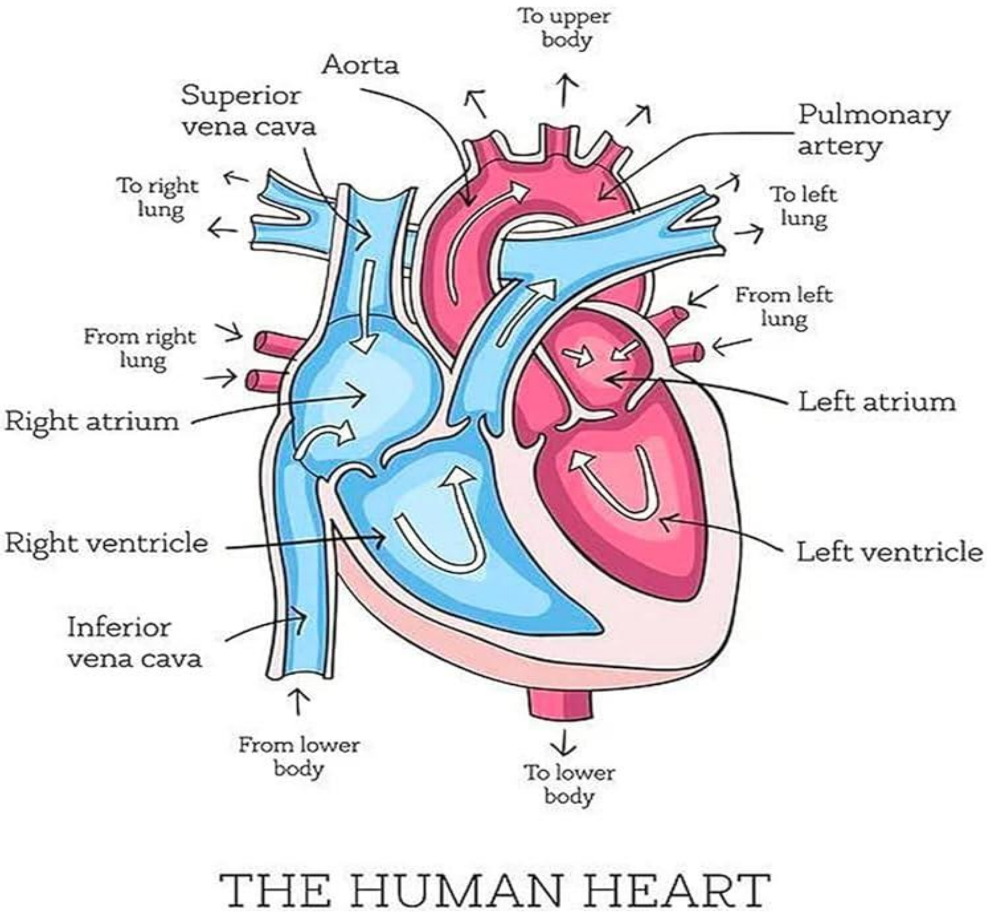
Blood Circulation Pathways

1. **Pulmonary Circulation** (Right side of heart)
   - Pumps deoxygenated blood to the **lungs** for oxygenation.
   - Blood returns oxygen-rich to the **left side of the heart**.

2. **Systemic Circulation** (Left side of heart)
   - Pumps oxygenated blood to the **rest of the body**.
   - Returns deoxygenated blood back to the **right side of the heart**.

Function of the Cardiovascular System

- Delivers **oxygen and nutrients** to tissues.
- Removes **carbon dioxide and metabolic waste**.
- Helps regulate **body temperature**, **pH levels**, and **fluid balance**.
- Protects the body via **immune response** and **clotting mechanisms**.



Reference: - Best and Taylor's Physiological Basis of Medical Practice, Best & Taylor's: William & Wilkins, Baltimore, Textbook of Medical Physiology, Guyton & Hall; WB Saunders Company

EXPERIMENT – 10

AIM: - To study the flow of circulations of cardiovascular system by using chart and models.

Requirement: - Chart and model of Cardiovascular system.

Theory: - The cardiovascular system**,** also called the circulatory system, is responsible for transporting blood, nutrients, oxygen, carbon dioxide, and hormones throughout the body. It also plays a vital role in maintaining homeostasis, removing waste, and protecting against disease.

Main Components of the Cardiovascular System

Heart
A muscular organ that pumps blood through the body.
Divided into four chambers:
Right atrium
Right ventricle
Left atrium
Left ventricle
Blood Vessels

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Capillaries: Tiny vessels where gas, nutrient, and waste exchange occur between blood and tissues.

Blood
Contains:
Red blood cells (RBCs) – carry oxygen
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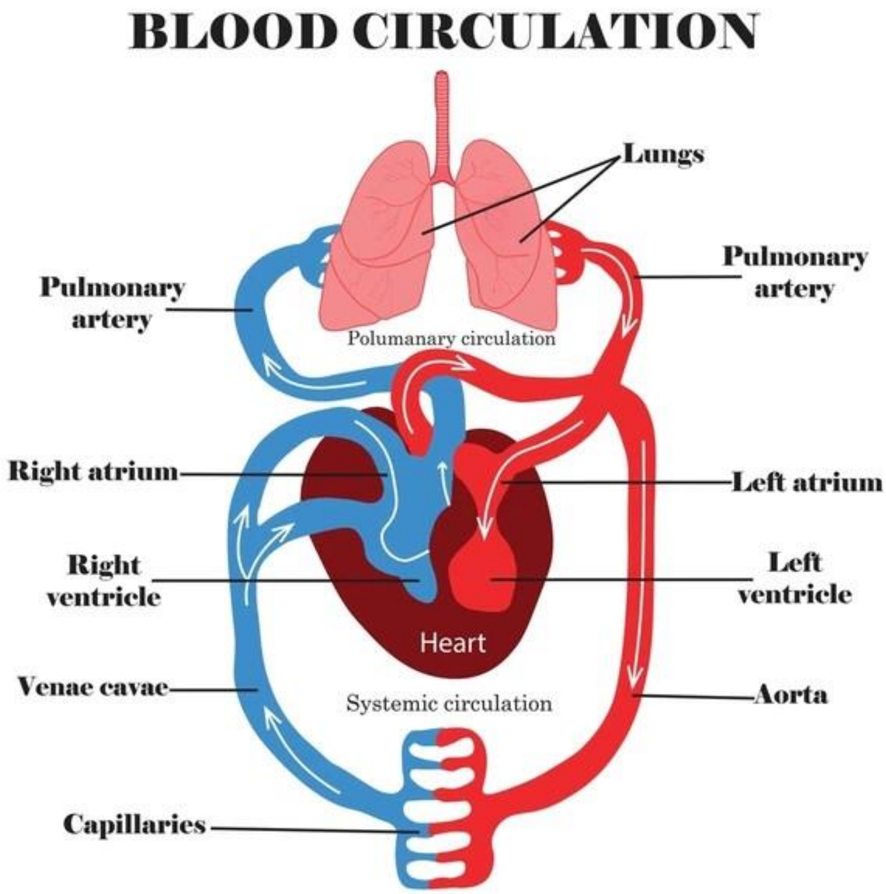
Blood Circulation Pathways
Pulmonary Circulation (Right side of heart)
- Pumps deoxygenated blood to the **lungs** for oxygenation.
- Blood returns oxygen-rich to the **left side of the heart**.

Systemic Circulation (Left side of heart)
- Pumps oxygenated blood to the **rest of the body**.
- Returns deoxygenated blood back to the **right side of the heart**.

Function of the Cardiovascular System
- Delivers **oxygen and nutrients** to tissues.
- Removes **carbon dioxide and metabolic waste**.
- Helps regulate **body temperature**, **pH levels**, and **fluid balance**.
- Protects the body via **immune response** and **clotting.**

Diagram of Blood Flow Through Cardiovascular System



Reference: - Best and Taylor's Physiological Basis of Medical Practice, Best & Taylor's: William & Wilkins, Baltimore, Textbook of Medical Physiology, Guyton & Hall; WB Saunders Company

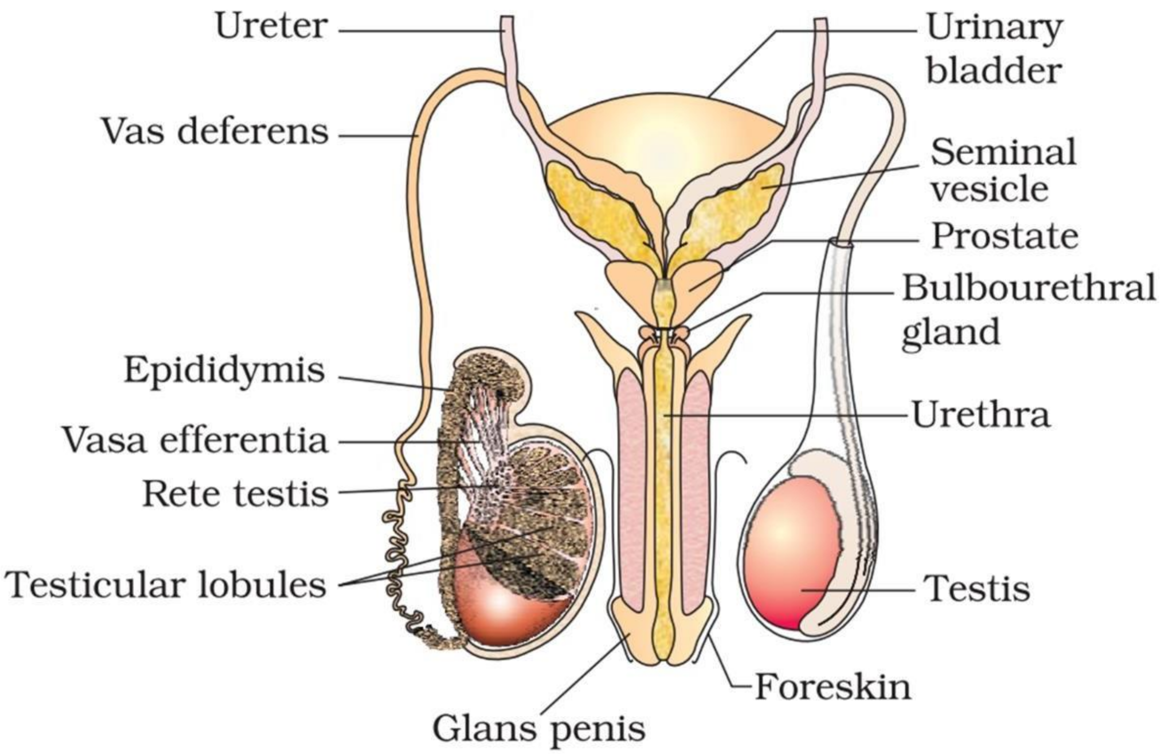
EXPERIMENT – 11

AIM: - To study and draw the structure of male reproductive system by using chart and model.

Requirement: - Chart and model of male reproductive system.

Theory: - The male reproductive system refers to the organs involved in sexual function and in the production of children in men or people assigned male at birth (AMAB). These organs are both external and internal. Together, they make, store, and ejaculate sperm, which fertilizes eggs produced by the female reproductive system in order to begin a pregnancy. The male reproductive system also produces hormones such as testosterone, which play a key role in male development.

Male Reproductive system



Functions of the Male Reproductive System

The male reproductive system performs the following functions:

- Produces, maintains, and transports sperm (the male reproductive cells) and protective fluid (semen)
- Discharges sperm during sex
- Produces and secretes male sex hormones responsible for maintaining the male reproductive system

Male Reproductive System Parts and Functions External

male reproductive organs

Unlike the female reproductive system, most of the male reproductive system is located outside of the body. These external structures include the penis, scrotum, testicles, and epididymis.

- **Penis : -** This is the male organ used in sexual intercourse. The penis has three parts: the root, which attaches to the wall of the abdomen; the body, or shaft; and the glans, which is the cone-shaped part at the end of the penis. The glans, also called the head of the penis, is covered with a loose layer of skin called foreskin. This skin is sometimes removed in a procedure called circumcision. The opening of the urethra, the tube that transports semen and pee, is at the tip of the penis. The glans of the penis also contains a number of sensitive nerve endings.

The body of the penis is cylindrical in shape and consists of three circular shaped chambers. These chambers are made up of special, sponge like tissue. This tissue contains thousands of large spaces that fill with blood when you are sexually aroused. As the penis fills with blood, it becomes rigid and erect, which allows for penetration during sexual intercourse. The skin of the penis is loose and elastic to allow for changes in penis size during an erection.

Semen, which contains sperm (reproductive cells), is expelled (ejaculated) through the end of the penis when you reach sexual climax (orgasm). When the penis is erect, the flow of pee is blocked from the urethra, allowing only semen to be ejaculated at orgasm.

- **Scrotum: -** 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. 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. Special muscles in the wall of the scrotum allow it to contract and relax, moving the testicles closer to the body for warmth or farther away from the body to cool their temperature.
-
- **Testicles (testes): -** These are oval organs about the size of large olives that lie in the scrotum, secured at either end by a structure called the spermatic cord. Most men or people AMAB have two testes. The testes are responsible for making testosterone, the primary male sex hormone. They also make inhibin B (which plays a role in sperm production), insulin-like factor 3 (which helps with the development of the testes), Mullerian inhibiting substance hormone, or anti-Mullerian hormone (which helps with the growth of male sexual organs), and estradiol (which aids in sperm production).

The testes also produce sperm. Within the testes are coiled masses of tubes called seminiferous tubules. These tubes are responsible for producing sperm cells.

- **Epididymis: -**The epididymis is a long, coiled tube that rests on the backside of each testicle. It transports and stores sperm cells that are produced in the testes. It also is the job of the epididymis to bring the sperm to maturity, since the sperm that emerge from the testes are immature and incapable of fertilization. During sexual arousal, contractions force the sperm into the vas deferens.

Internal male reproductive organs

The internal organs of the male reproductive system, also called accessory organs, include the following:

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, the tube that carries pee or sperm to outside of the body, in preparation for ejaculation.

- **Ejaculatory ducts: -** These are formed by the fusion of the vas deferens and the seminal vesicles (see below). The ejaculatory ducts empty into the urethra.
- **Urethra: -** The urethra is the tube that carries pee from the bladder to outside of the body. It has the additional function of ejaculating semen at orgasm. When the penis is erect during sex, the flow of pee is blocked from the urethra, allowing only semen to be ejaculated at orgasm.
- **Seminal vesicles: -** The seminal vesicles are sac-like pouches that attach to the vas deferens near the base of the bladder. 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 a man's ejaculatory fluid, or ejaculate.
- **Prostate gland**: - The prostate gland is a walnut-size structure that is located below the bladder and in front of the rectum. The prostate gland contributes additional fluid to the ejaculate. Prostate fluids also help to nourish the sperm. The urethra, which carries the ejaculate to be expelled during orgasm, runs through the center of the prostate gland. The prostate also converts some of the testosterone into another hormone, called dihydrotestosterone (DHT), which plays a part in sexual development throughout the life. When you're an adult, for example, it's involved in both prostate growth and male pattern baldness.

Bulbourethral glands: - Also called Cowper's glands, these are pea-size structures located on the sides of the urethra just below the prostate gland. These glands produce a clear, slippery fluid that empties directly into the urethra. This fluid serves to lubricate the urethra and to neutralize any acidity that may be present due to remaining drops of pee in the urethra.

Reference: - Best and Taylor’s Physiological Basis of Medical Practice, Best & Taylor’s: William & Wilkins, Baltimore, Textbook of Medical Physiology, Guyton & Hall; WB Saunders Company

EXPERIMENT - 12

Aim: - To study the human skeleton systems by using chart and models.

Requirement: - Chart and model of Skeleton System.

Theory: The human skeletal system is a dynamic, living framework of bones, cartilage, and connective tissues that provides support, protection, movement, and mineral storage for the body. It's composed of 206 bones in adults, divided into the axial and appendicular skeletons. The axial skeleton includes the skull, vertebral column, ribs, and sternum, while the appendicular skeleton comprises the bones of the limbs and their attachments.

Functions of the Skeleton System:

- **Support:**

The skeleton provides the structural framework for the body, maintaining its shape and upright posture.

- **Protection:**

Bones shield delicate internal organs from injury. Examples include the skull protecting the brain, the rib cage protecting the heart and lungs, and the vertebrae protecting the spinal cord.

- **Movement:**

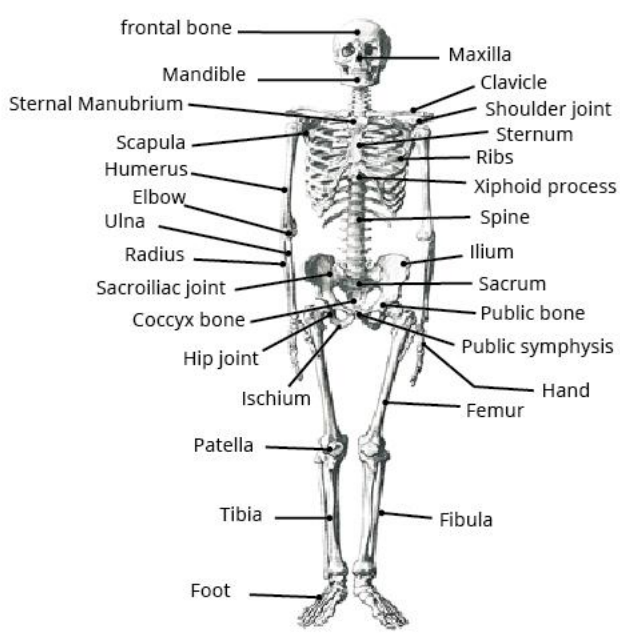
The skeletal system works with muscles to enable movement. Bones act as levers, and muscles attach to bones via tendons to create movement when they contract.

- **Mineral Storage:**

Bones store essential minerals like calcium and phosphorus, releasing them into the bloodstream when the body needs them.

- **Haematopoiesis:**

Bone marrow, found within certain bones, is the site of blood cell production, including red blood cells, white blood cells, and platelets.



Reference: - Best and Taylor's Physiological Basis of Medical Practice, Best & Taylor's: William & Wilkins, Baltimore, Textbook of Medical Physiology, Guyton & Hall; WB Saunders Company

EXPERIMENT – 13

AIM: -. Demonstration of different types bones of the human skeleton systems

Requirement: - Chart and model of different bones

Theory: - Bones are rigid organs that form the skeletal system in vertebrates, providing support, protection, and enabling movement. They are made of living tissue that is constantly being remodeled, and they store minerals like calcium. The human skeleton typically has 206 bones, divided into the axial and appendicular skeletons.

- **Function Support and Structure:**

Bones give the body its shape and keep it upright, preventing it from collapsing.
- **Protection:**

They shield delicate internal organs from injury. For example, the skull protects the brain, the rib cage protects the heart and lungs, and the pelvis protects the reproductive organs.
- **Movement:**

Bones, along with muscles, tendons, and ligaments, allow for a wide range of movements.
- **Mineral Storage:**

Bones serve as a reservoir for minerals like calcium and phosphorus, releasing them into the bloodstream when needed.
- **Blood Cell Production:**

The bone marrow, found within certain bones, is the site where red and white blood cells are produced.
- **Fat Storage:**

Bone marrow also stores fat.
- **Endocrine Regulation:**

Bones can release hormones that affect blood sugar levels and other bodily functions.

TYPES OF BONES

1. Long Bones:
- **Shape:**

Longer than they are wide, with a shaft (diaphysis) and two ends (epiphyses).
- **Examples:**

Femur (thigh bone), humerus (upper arm), radius and ulna (forearm), tibia and fibula (lower leg).
- **Function:**

Act as levers for movement, support weight, and provide structure.
- **Note:**

Long bones have distinct regions: the diaphysis (shaft), epiphyses (ends), and metaphysis (between the diaphysis and epiphysis).

2. Short Bones:
- **Shape:** Roughly cube-shaped, with similar length, width, and thickness.
- **Examples:** Carpals (wrist bones), tarsals (ankle bones).
- **Function:** Provide limited motion and support.

3. Flat Bones:
- **Shape:** Thin, flattened, and often curved.
- **Examples:** Skull bones (frontal, parietal, occipital), ribs, sternum (breastbone), scapulae (shoulder blades).
- **Function:** Protect internal organs and provide large surface areas for muscle attachment.

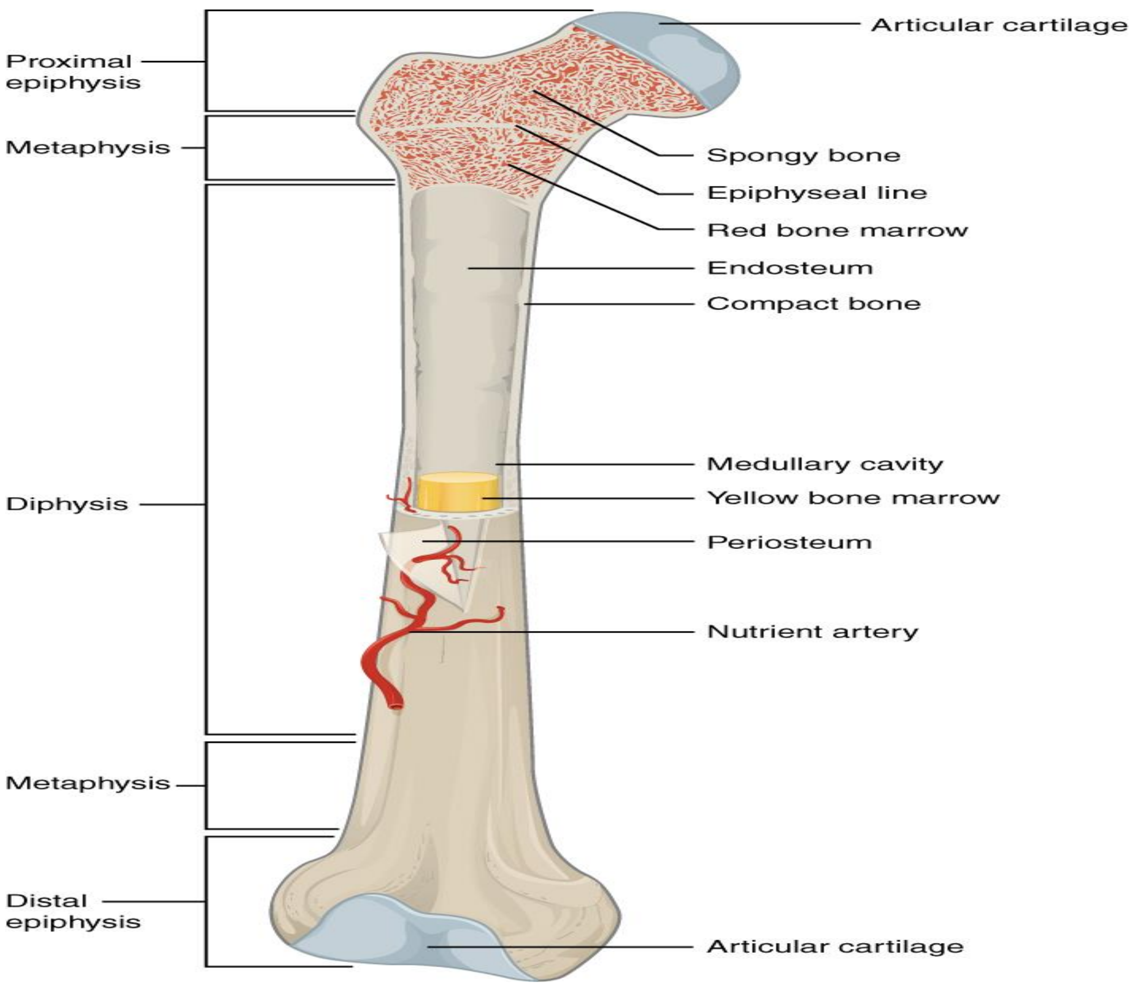
4. Irregular Bones:

- **Shape:** Complex shapes that don't fit into the other categories.
- **Examples:** Vertebrae (bones of the spine), some facial bones, pelvic bones.
- **Function:** Provide protection, support, and muscle attachment.

5. Sesamoid Bones:

- **Shape:** Small, round bones embedded within tendons.
- **Examples:** Patella (kneecap).
- **Function:** Protect tendons from stress and improve leverage of muscles.

Fig of long bone



Reference: - Best and Taylor's Physiological Basis of Medical Practice, Best & Taylor's: William & Wilkins, Baltimore, Textbook of Medical Physiology, Guyton & Hall; WB Saunders Company

EXPERIMENT – 14

AIM: - Demonstration of division of skeleton system- Appendicular & Axial

Requirement: - Chart and model of Appendicular and Axial Bones

Theory: - The human skeleton is divided into two main parts: the axial skeleton and the appendicular skeleton. The axial skeleton forms the central axis of the body and includes the skull, vertebral column, and rib cage. The appendicular skeleton consists of the bones of the limbs (arms and legs) and the girdles (pectoral and pelvic) that attach the limbs to the axial skeleton.

Axial Skeleton:

- **Skull:** Includes bones of the cranium and face.
- **Vertebral column:** Also known as the spine, it supports the head and trunk.
- **Thoracic cage:** Composed of ribs and sternum, it protects the heart and lungs.

Appendicular Skeleton:

- **Pectoral girdle:** Attaches the arms to the axial skeleton (scapula and clavicle).
- **Upper limbs:** Includes the bones of the arms, forearms, wrists, and hands.
- **Pelvic girdle:** Attaches the legs to the axial skeleton (hip bones).
- **Lower limbs:** Includes the bones of the thighs, legs, ankles, and feet.

Function: -

Axial Skeleton:

- **Skull:** Includes bones of the cranium and face.
- **Vertebral column:** Also known as the spine, it supports the head and trunk.
- **Thoracic cage:** Composed of ribs and sternum, it protects the heart and lungs.

Appendicular Skeleton:

- **Pectoral girdle:** Attaches the arms to the axial skeleton (scapula and clavicle).
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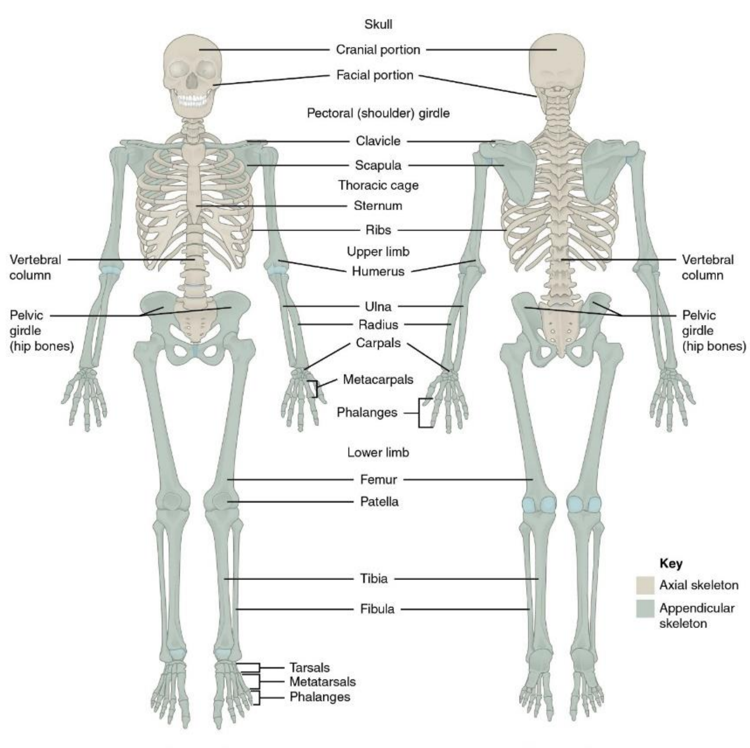
- **Pelvic girdle:** Attaches the legs to the axial skeleton (hip bones).
- **Lower limbs:** Includes the bones of the thighs, legs, ankles, and feet.



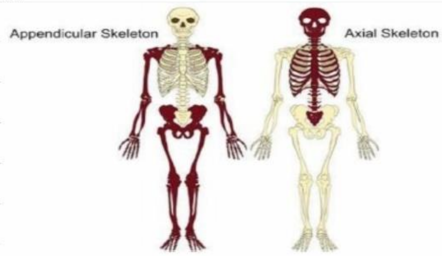
Classification of Axial and Appendicular bones

Chapter 7: bones of the human body

Adult humans have 206 named bones
- Most are paired
- Infants and children may have more

The skeletal system-pg 198
- Axial =80
- Appendicular=126

Total =206



Axial skeletal system
- Skull
  - Cranium =8
  - Face = 14
- Hyoid =1
- Auditory ossicles= 6
- Vertebral column =26
- Thorax
  - Sternum= 1
  - Ribs = 24

Total =80

Appendicular skeletal system
- Pectoral (shoulder) girdles
  - Clavical=2.
  - Scapula =2
- Upper limbs
- Lower limbs

Reference: - Best and Taylor's Physiological Basis of Medical Practice, Best & Taylor's: William & Wilkins, Baltimore, Textbook of Medical Physiology, Guyton & Hall; WB Saunders Company