JHARKHAND Rai University
RANCHI

PRACTICAL LAB MANUAL

HUMAN ANATOMY AND PHYSIOLOGY- II

B.Sc. MLT (IInd Semester)

INDEX

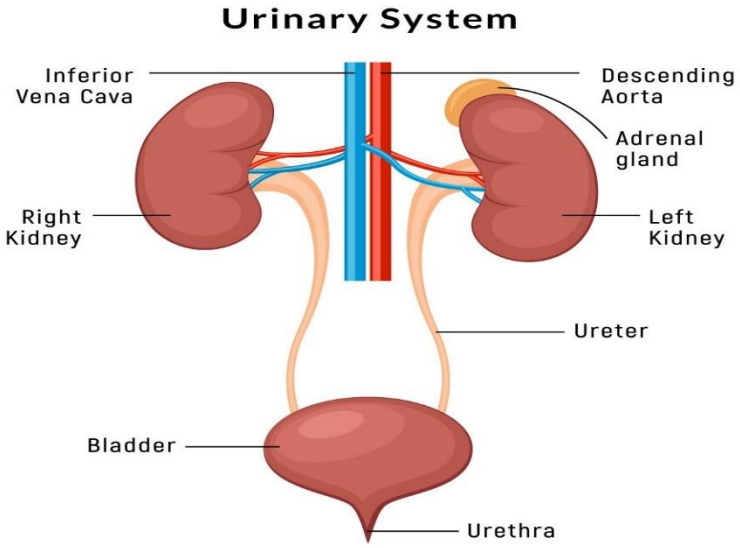
EXPERIMENT - 01

Urinary System

Aim: - To study the anatomy and physiology of urinary system by using chart and models.

Principal- The urinary system consists of two kidneys, two ureters, a single urinary bladder, and a single urethra. This system has roles that you may already be aware of, such as cleansing the blood and ridding the body of wastes. However, there are additional, equally important functions played by the system. Take for example, regulation of pH, a function shared with the lungs and the buffers within the blood.

Requirement- Model and Chart of Urinary System



Anatomy of Urinary System: -

The kidneys, ureters, bladder and urethra make up the urinary system. They all work together to filter, store and remove liquid waste from body. All of the organs in the urinary system are in abdominal and pelvic region.

Kidneys- These organs work constantly. They filter the blood and make pee, which body then eliminates. You have two kidneys, one on either side of the back of abdomen, just below rib cage. Each kidney is about as big as fist. The kidneys work hard — they filter about 120 to 150 quarts (113.6 to 141.95 liters) of blood per day, which produces about 1 to 2 quarts (0.95 to 1.95 liters) of pee each day.

Ureters- These two thin tubes inside the pelvis carry pee from kidneys to bladder. Each ureter is about 9 inches long.

Bladder- The bladder holds pee until you're ready to empty it (pee). It's hollow, made of muscle, and shaped like a triangular balloon. Bladder expands as it fills up. Most bladders can hold up to 2 cups (500 milliliters) of pee at a time. Peeing is when you empty bladder.

Urethra- This tube carries pee from bladder out of body. You have two sphincter muscles that close off urethra to keep pee in when you aren't using the toilet. These ring-like muscles open and close to let pee out. Sometimes, these muscles weaken and it becomes hard to hold pee in.

Physiology of Urinary system:-

Urinary system filters blood to get rid of what body doesn't need. It eliminates extra water and salt, toxins and other waste products. Different parts of the urinary system perform tasks, including:

Filtering blood
Separating the toxins you don't need from the nutrients you do need
Storing and carrying pee out of body
How does the urinary system filter my blood?

The kidneys are an essential part of filtering the blood. Here's how the urinary system works:

1. Blood enters each kidney through lots of little arteries.
2. Kidneys filter blood, separating toxins from nutrients.
3. Vitamins, minerals, nutrients and proteins return back to bloodstream.
4. Waste products and pee move from kidneys through ureters and to bladder.
5. Bladder stores pee until you use the toilet.
6. Pee leaves body through 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 - 02

AIM: - To Determine the pH, Specific gravity and all general characteristics of urine.

Specimen collection: - for routine examination, a clean container or capped jar is used. A mid-stream sample is preferable, i.e. first part of urine is discarded and mid-stream sample is collected.

Method for preservation of Urine: - urine should be examined fresh or within one hour of voiding. But if examination has to be delayed, then any of the following preservation procedures can be followed which prevent its decomposition: -

1. Refrigeration at 4 degree Celsius.
2. Toluene: toluene is used 1ml per 50ml of urine. It acts by forming surface layer and it preserves the chemical constituents of urine.
3. Formalin: - 6-8 drops of 40% formalin per 100ml of urine is used. Its preserve the RBCs and pus cells.
4. Acid: - hydrochloric acid, sulfuric acid and boric acid can also be used as a preservative.

Material required: - Urine, urine pot, pH paper, Urinometer.

pH: - it reflect ability of kidney to maintain H+ ion concentration in extracellular fluid and plasma. It can be measured by pH indicator paper or by electronic pH meter.

Freshly voided normal urine is slightly acidic and its pH ranges from 4.6-7.0 (average 6.0). Abnormalities in pH may be as under:

- Acidic urine pH may be lower than normal due to following conditions:
    1. High protein take, e.g. meats
    2. Ingestion of acidic fruits
    3. Respiratory and metabolic acidosis
    4. UTI by E. coli
- Alkaline urine i.e. pH more than 7 may occur due to following:
    1. Citrus fruits, certain vegetables
    2. Respiratory and metabolic alkalosis
    3. UTI by Proteus, Pseudomonas

Specific gravity

This is the ratio of weight of 1ml volume of urine to that of weight of 1ml of distilled water. It depends upon the concentration of various particles/solutes in the urine. Specific gravity is used to measure the concentrating and diluting power of the kidneys. It can be measured by Urinometer, refractometer of reagent strips.

Urinometer:-

Procedure:-

a. Fill Urinometer container 3/4th with urine.

b. Insert Urinometer into it so that it floats in urine without touching the wall and bottom of container.
c. Read the graduation on the arm of Urinometer at lower urinary meniscus.
d. Add or subtract 0.001 from the final reading for each 3 degree C above or below the calibration temperature respectively marked on the Urinometer.

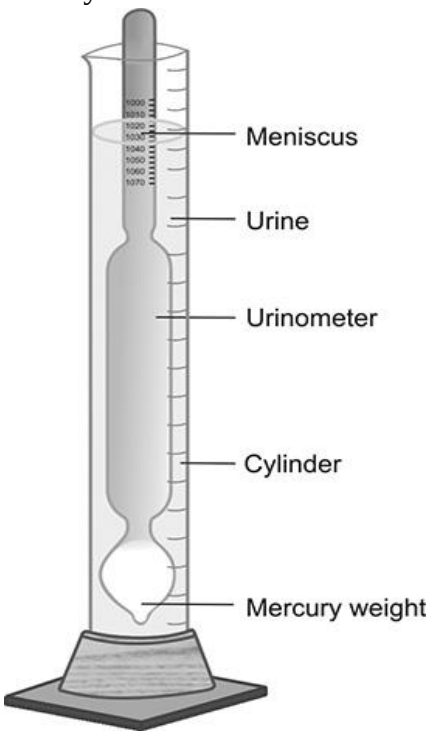


Fig: - Urinometer

Volume:-

The daily volume of urine (diuresis) is markedly affected by drinking and food intake. Volumes less than 500 ml/24 hours or more than 2,500 ml/24 hours are considered pathological.

- **Oliguria and anuria**
  Oliguria is a term for urine volume < 400ml/24 hours; while anuria stands for volume < 100ml/24 hours. Oliguria and anuria are basic symptoms of kidney failure. One of the causes might be dehydration resulting from insufficient water intake, or its excessive loss (diarrhea, sweating). A low diuresis can happen also due to water retention (oedemas, transsu dates in body cavities); or the cause may lie in primary damage to the renal parenchyma
- **Polyuria: -** Polyuria denotes increase of daily diuresis above 2,500 ml.
  Two types of polyuria conditions can be distinguished:
  • Polyuria caused by water diuresis Water diuresis results from decreased tubular reabsorption of water in distal part of the nephron. The tubular absorption as well as excretion of osmotically active substances are normal. Osmolality of urine is lower that osmolality of serum; and is always below 250 mmol/kg H2O. The water diuresis comes physiologically as a result of high-water intake; pathologically e.g. due to impaired

secretion of adiuretin (diabetes insipidus). • Polyuria caused by osmotic diuresis It results from either increased filtration of osmotically active substances due to their high concentration in the ECT (e.g. hyperglycemia), or from their decreased tubular absorption. The unabsorbed osmotically active substances "drag" water, leading in decrease in water reabsorption. Osmolality of urine is higher than 250 mmol/kg H2O. The osmotic diuresis is characteristic e.g. for diabetes mellitus (glycosuria), polyuria phase of renal failure, or comes as an effect of diuretic drugs.

- **Nocturia:** - it means when urine is passed in excess of 500ml during night. This is a sign of early renal failure.

Colour

Normally urine is clear, pale or straw-colored due to pigment urochrome. Various color changes in urine may be as under:

- Colorless in diabetes mellitus, diabetes insipidus, excess intake of water.
- Deep amber color due to good muscular exercise, high grade fever.
- Orange color due to increased urobilinogen, concentrated urine.
- Smoky urine due to small amount of blood, administration of vitamin B12, aniline dye.
- Red due to hematuria, hemoglobinuria
- Brown due to bile.
- Milky due to pus, fat.
- Green due to putrefied sample, phenol poisoning

Odour

Normally urine has faint aromatic odour. It may have following abnormal odour;

- Pungent due to ammonia produced by bacterial contamination.
- Putrid due to UTI.
- Fruity due to ketoacidosis.
- Mousy due to phenylketonuria.

Result:-

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

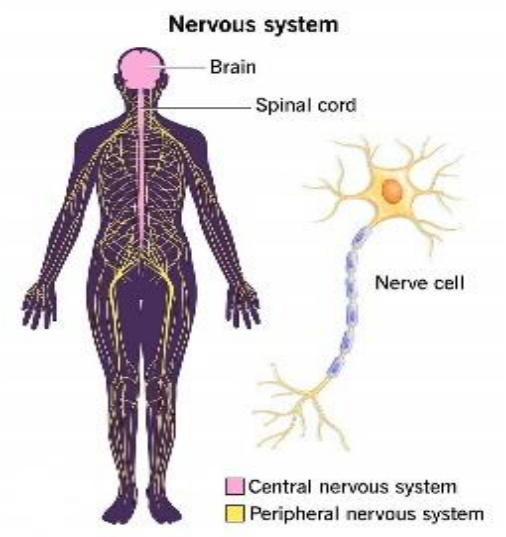
AIM: - To study and draw the structure of nervous system by using chart and model.

Requirement: - Nervous system chart and model.

Theory: - Neuroscience is the interdisciplinary study of the nervous system, encompassing the brain, spinal cord, and peripheral nerves. It investigates the structure, function, development, and disorders of the nervous system, aiming to understand how it controls behavior, cognition, and bodily functions.

Function: - Nervous system's main function is to send messages from various parts of body to brain, and from brain back out to body to tell body what to do. These messages regulate:

- Thoughts, memory, learning and feelings.
- Movements (balance and coordination).
- Senses (how brain interprets what you see, hear, taste, touch and feel).
- Wound healing.
- Sleep.
- Heartbeat and breathing patterns.
- Response to stressful situations, including sweat production.
- Digestion.
- Body processes, such as puberty and aging.



How does the nervous system work?

Nervous system uses nerve cells called neurons to send signals, or messages, all over body. These electrical signals travel among brain, skin, organs, glands and muscles.

The messages help you move limbs and feel sensations, like pain. Eyes, ears, tongue, nose and the nerves all over body take in information about environment. Then, nerves carry that data to and from brain

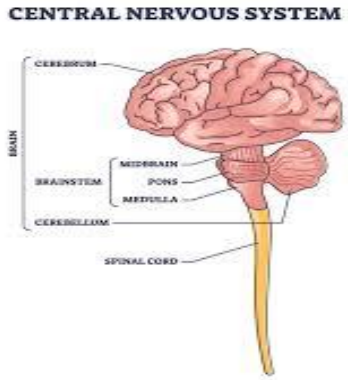
Different types of neurons

- **Motor neurons**: - take signals from the brain and spinal cord to muscles. They help you move. They also assist with breathing, swallowing and speaking.
- **Sensory neurons**: - Take information from senses (what you see, touch, taste, etc.) to brain.
- **Interneurons**: - communicate between motor and sensory neurons. These neurons regulate movement in response to sensory information (like moving away from a hot surface) and play a role in how you learn, think and remember.

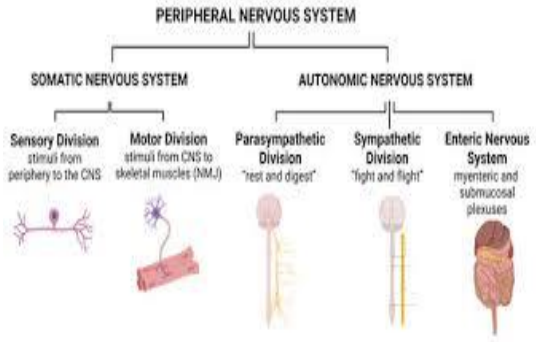
Anatomy

The nervous system has two main parts:

- **Central nervous system (CNS):** Brain and spinal cord make up CNS. Brain reads signals from nerves to regulate how you think, move and feel.

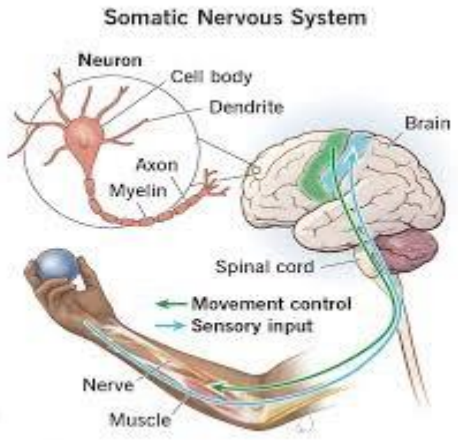


- **Peripheral nervous system (PNS):** PNS is made up of a network of nerves. The nerves branch out from spinal cord. This system relays information from brain and spinal cord to organs, arms, legs, fingers and toes.



Two parts of peripheral nervous system:

1. **Somatic nervous system: -** somatic nervous system is a subdivision of peripheral nervous system that stretches throughout nearly every part of body. The nerves in this system deliver information from senses to brain. They also carry commands from brain to muscles so you can move around.



Somatic nervous system has two main works:-

- **Sensory input**: - All but one of the senses travel through somatic nervous system to reach brain (sight is the exception because retina and optic nerve connect directly to brain). The other senses on head — sound, smell, taste and touch — all use somatic nervous system to reach brain. Sense of touch below neck uses somatic nervous system to reach spinal cord, which then relays signals to brain.
- **Movement control**: - Body's muscles rely on signals that give them instructions to help you move around. The signals from brain must pass through somatic nervous system to reach those muscles and make them move.

2. **Autonomic nervous system: -** Autonomic nervous system is a part of overall nervous system that controls the automatic functions of body that you need to survive. These are processes you don't think about and that brain manages while you're awake or asleep.

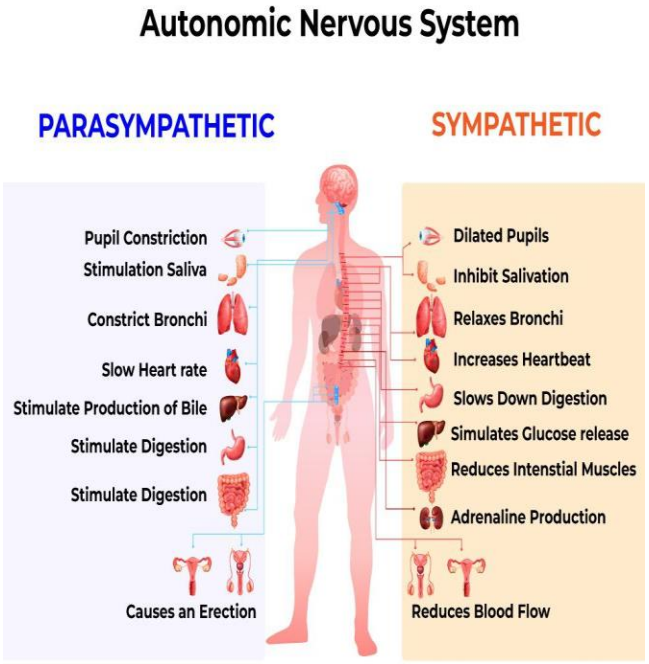


Fig: - ANS

Autonomic nervous system breaks down into three divisions:-

- **Sympathetic nervous system**: This system activates body processes that help you in times of need, especially times of stress or danger. This system is responsible for body's "fight-or-flight" response.
- **Parasympathetic nervous system**: This part of autonomic nervous system does the opposite of sympathetic nervous system. This system is responsible for the "rest-and-digest" body processes.
- **Enteric nervous system**: This part of autonomic nervous system manages how body digests food.

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: - To study and draw the structure of brain using chart and model.

Requirement: - Chart and model of Brain.

Theory: - The brain is the central organ of the nervous system, responsible for coordinating bodily functions, controlling thought, memory, and behavior. It's a complex structure composed of various regions, including the cerebrum, cerebellum, and brainstem, each with specialized functions.

Function of Brain

The brain is the most complex organ in the human body, controlling thought, memory, movement, and more. It also regulates many of the body's functions.

Brain functions

- **Senses**: The brain interprets messages from the five senses of sight, smell, hearing, touch, and taste
- **Movement**: The brain controls movement of the arms and legs
- **Memory**: The brain controls memory and learning
- **Speech**: The brain controls speech
- **Organ function**: The brain controls the function of many organs in the body, including the heart and lungs
- **Stress response**: The brain determines how people respond to stressful situations by regulating breathing and heart rate
- **Autonomic functions**: The brain controls autonomic functions like breathing, digestion, and heartbeat

Weight and Volume:

- The average adult human brain weighs around 3 pounds (1.2-1.4 kg).
- Men's brains typically have a volume of about 1260 cm3, while women's are around 1130 cm3.
- There's individual variation in brain size and weight.

Anatomy of brain

The brain has three main parts: the cerebrum, cerebellum, and brainstem. It also has many lobes, including the frontal, temporal, parietal, and occipital lobes.

Cerebrum

- The largest part of the brain
- Divided into left and right hemispheres

- The outermost layer is the cerebral cortex, also known as the "gray matter"
- Interprets the five senses
- Regulates conscious actions like speech, memory, and movemen

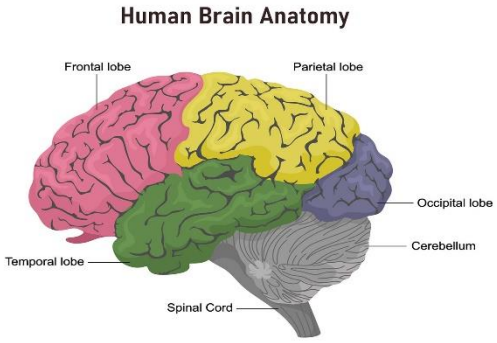


Fig: - Human Brain

Cerebellum

- A small, half-circle shaped part of the brain located at the back of the head
- Maintains balance, posture, coordination, and fine motor skills
  Brainstem
- Located at the base of the brain
- Regulates automatic body functions like breathing, heart rate, and sleep cycles
- Connects the rest of the brain to the spinal cord
  Lobes of the brain

- **Frontal lobes**

  Located behind the forehead, these lobes control language, motor function, and higher cognitive functions

- **Temporal lobes**

  Located behind the ears, these lobes process auditory information and encode memory

- **Occipital lobes**

  Located at the back of the skull, these lobes interpret visual information

- **Parietal lobes**
  Located near the center of the brain, these lobes interpret sensory and memory functions

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 - 05

AIM: - To study and draw structure of various glands using chart and model.

Requirement: - Chart and model of glands.

Theory: - Glands: - Glands are organs or tissues that synthesize and release substances, either into the bloodstream (endocrine) or through ducts to the body's surface or internal cavities (exocrine) which can be hormones, digestive juices, sweat, tears, saliva, or milk.

Function of Glands: - These substances are essential for various bodily functions, including regulating metabolism, growth, development, mood, reproduction, and maintaining homeostasis.

Glands are broadly classified into two main types: -

1. Endocrine glands
2. Exocrine glands

Endocrine glands: - Endocrine glands are part of endocrine system. They make hormones and release them into bloodstream. These hormones control a number of important functions in body, such as: Growth and development, metabolism, mood, reproduction.

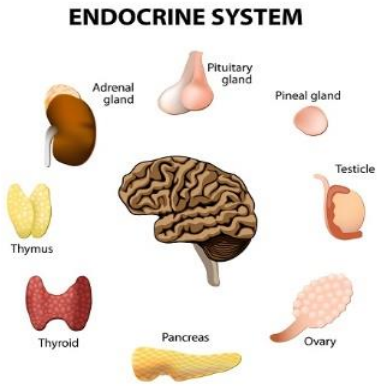


Fig: - Endocrine System

Endocrine glands are:- Adrenal glands, pituitary gland, hypothalamus, thyroid, pineal gland, pancreas, kidneys, ovaries and testes.

- **Thyroid gland:** - Thyroid gland is located in the front of neck, just below larynx. It measures approximately two inches and has a shape similar to a butterfly. It secretes hormones that affect virtually every tissue in body. Thyroid hormones regulate metabolism, heart, and digestive function. They also play a role in brain and nerve development, muscle control, and mood. Thyroid function is controlled by pituitary, which is a small gland at the base of brain.

- **Pituitary gland: -** The pituitary gland is a pea-sized gland at the base of brain, just behind the bridge of nose. It's controlled by the hypothalamus, which sits just above it. The pituitary gland is often called the master gland because it controls a number of other hormone glands, including the: Thyroid, adrenal gland, testes, ovaries.
- **Hypothalamus: -** The hypothalamus functions as a communication center for pituitary gland, sending signals and messages to the pituitary to produce and release hormones that trigger the production and release of other hormones. Hypothalamus influences a number of body's functions, including: Temperature regulation**,** food intake**,** sleep and wakefulness**,** thirst**,** memory**,** emotional behavior.
- **Pineal gland: -** The pineal gland is located deep in the center of the brain. Its function is not completely understood, but we do know that it secretes and regulates certain hormones, including melatonin. Melatonin helps regulate the sleep patterns, which are also known as circadian rhythms. The pineal gland also plays a role in the regulation of female hormones, which affect the menstrual cycle and fertility.
- **Adrenal glands: -** The adrenal glands are located at the top of each kidney. They produce various hormones, some of which include: cortisol, aldosterone, adrenaline, a small amount of sex hormones called androgens
- **Pancreas**: **-** The pancreas — a long, flat organ located in the abdomen — is made up of two types of glands: exocrine and endocrine. The pancreas is surrounded by the small intestine, stomach, liver, gallbladder, and spleen.
- **Kidney: -** The kidneys, while not glands in the traditional sense, secrete hormones like erythropoietin and renin, and also reabsorb essential substances like water, nutrients, and electrolytes from the blood, while simultaneously excreting waste products as urine.

Exocrine glands: - Exocrine glands produce other substances — not hormones — that are released through ducts to the exterior of body, such as sweat, saliva, and tears.

The substances released by exocrine glands play important roles in the body. They do things like help regulate body temperature, protect skin and eyes, and even help mothers feed babies by producing breast milk.

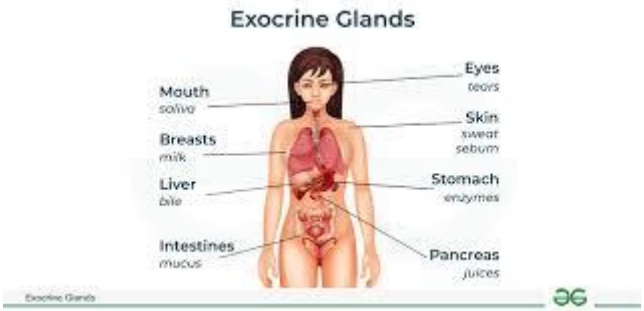


Fig: - Exocrine Glands

Exocrine glands are: **-** Salivary glands, sweat gland, mammary gland, sebaceous gland, lacrimal gland.

- **Salivary glands: -** Salivary gland secretion is a two-stage process involving acinar cells secreting isotonic primary saliva, which is then modified by ductal cells through electrolyte reabsorption, resulting in a hypotonic saliva secretion. This process is regulated by both the parasympathetic and sympathetic nervous systems.
- **Sweat glands: -** The skin is covered in sweat glands of which there are two types: eccrine and apocrine. The eccrine glands open directly onto the skin and regulate the body temperature by releasing water to the surface of the skin when the body temperature rises. Apocrine glands open into the hair follicle and are found in hair-bearing areas, such as the skin, armpits, and groin. These glands secrete a milky fluid, usually as a response to stress.
- **Mammary glands:**-The mammary gland's mechanism involves hormonal regulation, milk production by specialized cells (alveoli), and milk ejection via myoepithelial cells stimulated by oxytocin, triggered by suckling.
- **Sebaceous glands:** - The Sebaceous glands secrete sebum, an oily substance, through a process called holocrine secretion, where entire cells rupture and release their contents, including sebum, into the pilo-sebaceous canal.
- **Lacrimal Gland:** - The lacrimal gland is a tear-shaped gland that produces tears to lubricate and protect the surface of the eye. It's located above and outside the corner of each eye.

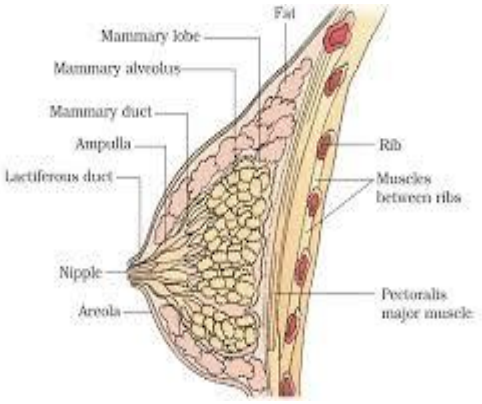


Fig: - Mammary Glands

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 - 06

AIM: - To study and draw the structure of lymphatic system by using chat and model.

Requirement: - Chart and model of Lymphatic system

Theory: - The lymphatic system is a network of organs, vessels and tissues that work together to move a colorless, watery fluid (lymph) back into the circulatory system (the bloodstream).

Function

Lymphatic system has many functions:-

Collecting excess fluid from the body's tissues and returning it to the bloodstream. This supports healthy fluid levels in the body. The lymphatic system also filters out waste products and abnormal cells from this fluid.

Helping the body absorb fats. Most nutrients can travel through tiny openings (pores) in the walls of the capillaries, and the body can then absorb and use them. But certain fats and other molecules are too large to travel in this way. The lymphatic system collects fluid from the intestines that contains these molecules and transports it back to the bloodstream.

Protecting the body against invaders. The lymphatic system is part of the immune system. It produces and releases lymphocytes (a type of white blood cell) and other immune cells. These cells look for and destroy invaders — such as bacteria, viruses, parasites and fungi — that may enter the body.

What are the lymphatic system organs?

The organs of the lymphatic system are:-

Bone marrow: - This is the soft, spongy tissue in the center of certain bones, like the hip bone, backbones and breastbone. The bone marrow has the vital job of making white blood cells, red blood cells and platelets.

Thymus: - This organ is located in the upper chest beneath the breastbone, and it's most active before puberty. It's where T-cells (a type of white blood cell) fully mature. T-cells help the body fight off invaders.

Lymph nodes: - Lymph nodes are bean-shaped glands that monitor and cleanse lymph as it filters through them. They clear out damaged cells and cancer cells. The lymph nodes also store lymphocytes and other immune system cells that attack and destroy harmful substances like bacteria. You have about 600 lymph nodes scattered throughout the body. Some are closely connected in groups called chains. You may be able to feel some lymph nodes through the skin, in areas like the armpits, groin or neck. Others are deeper inside the body.

Spleen: - This largest lymphatic organ is located on the left side under the ribs and above the stomach. The spleen filters the blood and removes cells that are old or not working properly. It also keeps red blood cells and platelets available in case the body needs them.

Mucosa-associated lymphoid tissue (MALT):- This mucus membrane exists throughout the body in many important locations. For example, it lines the tonsils, airways, small intestine and appendix. MALT looks for and destroys germs that could harm you.

Other parts of the lymphatic system:-

Lymph. Lymph, also called lymphatic fluid, is a collection of the extra fluid that drains from cells and tissues in the body and isn't reabsorbed into the capillaries. Lymph contains many different substances, including proteins, minerals, fats, damaged cells, cancer cells and germs. Lymph also transports infection-fighting white blood cells (lymphocytes).

Lymphatic vessels. Lymphatic vessels are tubes that form a complex network throughout the body. The smallest tubes are lymphatic capillaries, which ultimately connect to larger tubes that lead to two main ducts in the upper chest. The pulsing of nearby arteries and squeezing of nearby muscles help fluid move through the lymphatic vessels. These vessels contain one-way valves that keep lymph moving the right way.

Collecting ducts. Two main ducts in the upper chest empty lymph into the subclavian veins. These are the right lymphatic duct and thoracic duct. These ducts are like highway on-ramps or merging points where lymph rejoins the bloodstream.

Tonsils and adenoids. These structures trap pathogens from the food you eat and the air you take in. They're part of body's first line of defense against invaders. The tonsils are in the back of the throat. The adenoids are just behind the nasal cavity but are only active during childhood.

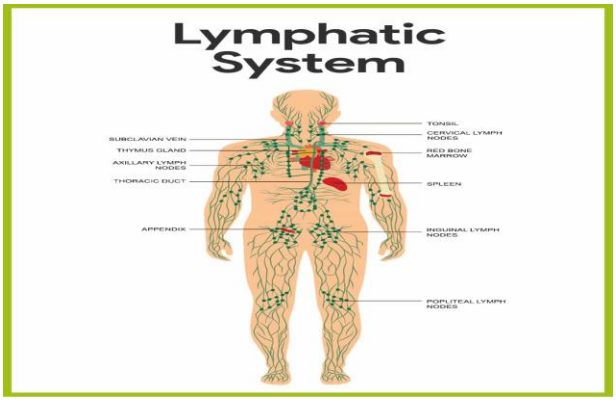


Fig: - Lymphatic system

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 - 07

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.

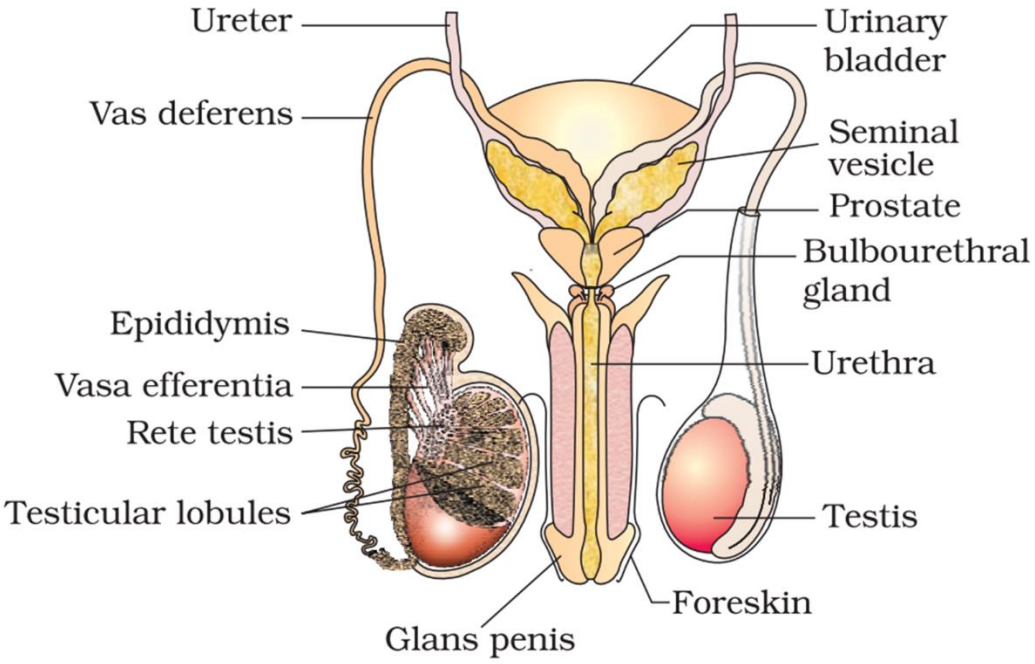


Fig: - Male Reproductive system

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 - 08

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

Requirement: - Chart and model of female reproductive system.

Theory: - The female reproductive system is a complex network of organ responsible for menstruation, providing eggs and facilitating pregnancy.

Functions of the female reproductive system

The female reproductive system provides several functions. In addition to allowing, you to have sexual intercourse, it also helps you reproduce.

Ovaries produce eggs. These eggs are then transported to fallopian tube during ovulation where fertilization by a sperm may occur. The fertilized egg then moves to the uterus, where the uterine lining has thickened in response to the normal hormones of menstrual cycle (also called reproductive cycle). Once in uterus, the fertilized egg can implant into the thickened uterine lining and continue to develop. If implantation doesn't take place, the uterine lining is shed as menstrual period. In addition, the female reproductive system produces sex hormones that maintain the menstrual cycle.

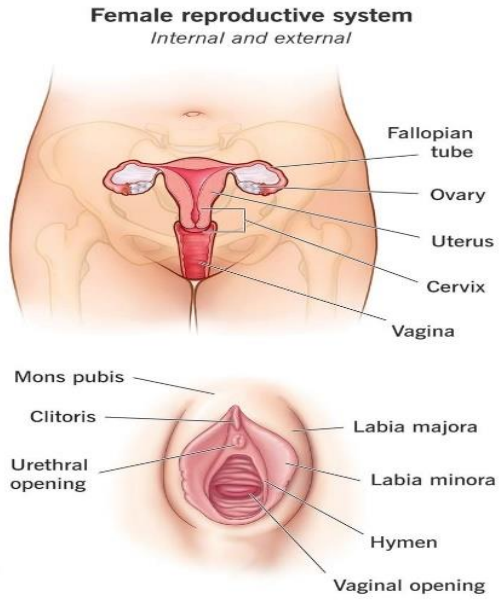


Fig: - Female Reproductive system

The female reproductive system is the body parts that help you:

- Have sexual intercourse
- Reproduce
- Menstruate

Parts of the female reproductive system.

The female reproductive anatomy includes both external and internal parts.

External parts

The function of external genitals are to protect the internal parts from infection and allow sperm to enter vagina.

Vulva is the collective name for all external genitals. A lot of people mistakenly use the term "vagina" to describe all female reproductive parts. However, vagina is its own structure located inside body.

The main parts of vulva or external genitals are:

Labia majora. Labia majora ("large lips") enclose and protect the other external reproductive organs. During puberty, hair growth occurs on the skin of the labia majora, which also contain sweat and oil-secreting glands.

Labia minora. Labia minora ("small lips") can have a variety of sizes and shapes. They lie just inside labia majora, and surround the opening to the vagina (the canal that joins the lower part of uterus to the outside of body) and urethra (the tube that carries pee from bladder to the outside of body). This skin is very delicate and can become easily irritated and swollen.

Clitoris. Two labia minora meet at the clitoris, a small, sensitive protrusion that's comparable to a penis. Clitoris is covered by a fold of skin called the prepuce and is very sensitive to stimulation.

Vaginal opening. Vaginal opening allows menstrual blood and babies to exit the body. Tampons, fingers, sex toys or penises can go inside vagina through vaginal opening.

Hymen. Hymen is a piece of tissue covering or surrounding part of vaginal opening. It's formed during development and present during birth.

Opening to the urethra. The opening to urethra is the hole you pee from.

Internal parts

Vagina. The Vagina is a muscular canal that joins the cervix (the lower part of uterus) to the outside of the body. It can widen to accommodate a baby during delivery and then shrink back to hold something narrow like a tampon. It's lined with mucous membranes that help keep it moist.

Cervix. The Cervix is the lowest part of uterus. A hole in the middle allows sperm to enter and menstrual blood to exit. Cervix opens (dilates) to allow a baby to come out during a vaginal childbirth. Cervix is what prevents things like tampons from getting lost inside body.

Uterus. The Uterus is a hollow, pear-shaped organ that holds a fetus during pregnancy. Uterus is divided into two parts: the cervix and the corpus. Corpus is the larger part of the uterus that expands during pregnancy.

Ovaries. The Ovaries are small, oval-shaped glands that are located on either side of uterus. Ovaries produce eggs and hormones.

Fallopian tubes. These are narrow tubes that are attached to the upper part of uterus and serve as pathways for egg (ovum) to travel from ovaries to uterus. Fertilization of an egg by sperm normally occurs in the fallopian tubes. The fertilized egg then moves to the uterus, where it implants into uterine lining.

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 eye by using chart and model.

Requirement: - Chart and model of eye

Theory: - The eyes are the sensory organs that allow you to see. The eyes capture visible light from the world around you and turn it into a form the brain uses to create the sense of vision. The brain doesn't have sensory abilities of its own. It needs the eyes (and other senses, like hearing and touch) to gather information about the world around you.

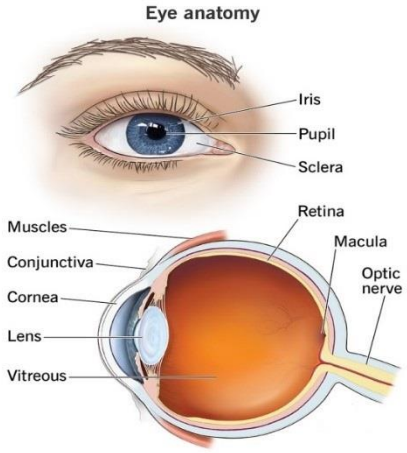


Fig: - Eye

Function

The primary function of the eye is to enable vision by capturing light, converting it into electrical signals, and transmitting them to the brain for interpretation. This process allows us to perceive objects, their colors, and their depth, as well as maintain our circadian rhythm and balance.

1. Light Capture and Focusing:

- Light enters the eye through the cornea, the transparent front part.
- The iris controls the amount of light entering through the pupil, acting like a camera shutter.
- The lens focuses the light onto the retina, the light-sensitive tissue at the back of the eye.

2. Signal Conversion:

- The retina contains photoreceptor cells (rods and cones) that convert light into electrical signals.
- Rods are sensitive to dim light and enable night vision.
- Cones detect color and allow for detailed central vision.

3. Signal Transmission:

- Electrical signals from the retina travel along the optic nerve to the brain.

4. Visual Processing:

- The brain interprets these electrical signals, allowing us to perceive what we see.

Eye anatomy

The parts of the eye include the:

Cornea: - This protects the inside of the eye like a windshield. The tear fluid lubricates the corneas. The corneas also do part of the work bending light as it enters the eyes.

Sclera: - This is the white part of the eye that forms the general shape and structure of the eyeball.

Conjunctiva: - This clear, thin layer covers the sclera and lines the inside of the eyelids.

Aqueous humor: - This is fluid that fills a space called the anterior chamber. The pressure of the aqueous humor helps maintain the eye's shape.

Iris: - This part contains the muscles that control the size of the pupil. It's also responsible for eye color. The iris can be brown, blue, green or hazel (a blend of brown, yellow and green).

Pupil: - This is the black circle inside the iris. It's like an adjustable window to the inside of the eye. It widens and narrows to control how much light enters the eye. Lens. This focuses light that enters the eye and directs it to the back of the eye.

Vitreous humor: - This clear, gel-like fluid fills the space between the lens and retina. It helps the eye hold its shape. It's also sometimes known simply as "the vitreous."

Retina: - This thin layer of light-sensitive cells at the back of the eyes converts light into electrical signals. It contains rods (which help you see in low light) and cones (which help you see colors).

Macula: - This small area of the retina is key to the vision. It's responsible for the center of the visual field. It also helps you see color and fine details.

Optic nerve: - This connects the retinas to the brain. It's like the data cable that carries signals from the eyes, with connection points linking to multiple brain areas.

External muscles: - These control the eye's position, alignment and movement. They also contribute to the eye's shape, which is part of the ability to switch the vision's focus between near and far objects.

Structure

The eye's structure can be broadly divided into three layers: the outer fibrous layer (cornea and sclera), the middle vascular layer (iris, ciliary body, and choroid), and the inner nervous layer (retina). Key structures within these layers include the cornea, iris, pupil, lens, and retina, all working together to focus light and transmit signals to the brain.

Outer Layer (Fibrous Tunic):
Cornea: - The transparent front part of the eye, responsible for refracting light.

Sclera: - The white, protective outer layer of the eye.
Middle Layer (Vascular Tunic):
Iris: - The colored part of the eye that controls pupil size, regulating light entry.
Ciliary Body: - Contains muscles that adjust the lens shape for focusing.
Choroid: - A vascular layer that nourishes the retina.
Inner Layer (Nervous Tunic):
Retina: - A light-sensitive layer that converts light into electrical signals.
Additional Structures:
Lens: - Located behind the iris and pupil, it focuses light onto the retina.
Pupil: - The central opening of the iris that allows light to enter the eye.
Optic Nerve: - Carries signals from the retina to the brain.
Aqueous Humor: - A clear fluid that fills the space between the corneas and lens.
Vitreous Humor: - A clear, gel-like substance that fills the space between the lens and retina.

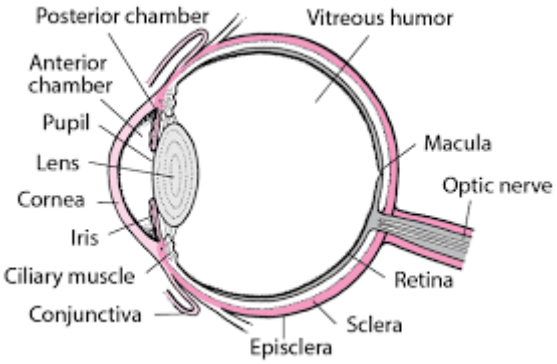


Fig: - Structure of Eye

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 and draw the structure of ear by using chart and model.

Requirement: - Chart and model of ear.

Theory: - The ears are organs that detect and analyze sound. Located on each side of the head, they help with hearing and balance.

Function: - The ears have two main functions: hearing and balance.

Hearing: When sound waves enter the ear canal, the tympanic membrane (eardrum) vibrates. This vibration passes on to three tiny bones (ossicles) in the middle ear. The ossicles amplify and transmit these sound waves to the inner ear. Once the sound waves reach the inner ear, tiny hair cells called stereo cilia transform the vibrations into electrical energy and send it along nerve fibers to the brain.

Balance: The inner ear contains semicircular canals filled with fluid and hair-like sensors. When you move the head, the fluid inside these loop-shaped canals sloshes around and moves the hairs. The hairs transmit this information along the vestibular nerve to the brain. Finally, the brain sends signals to the muscles to help you stay balanced.

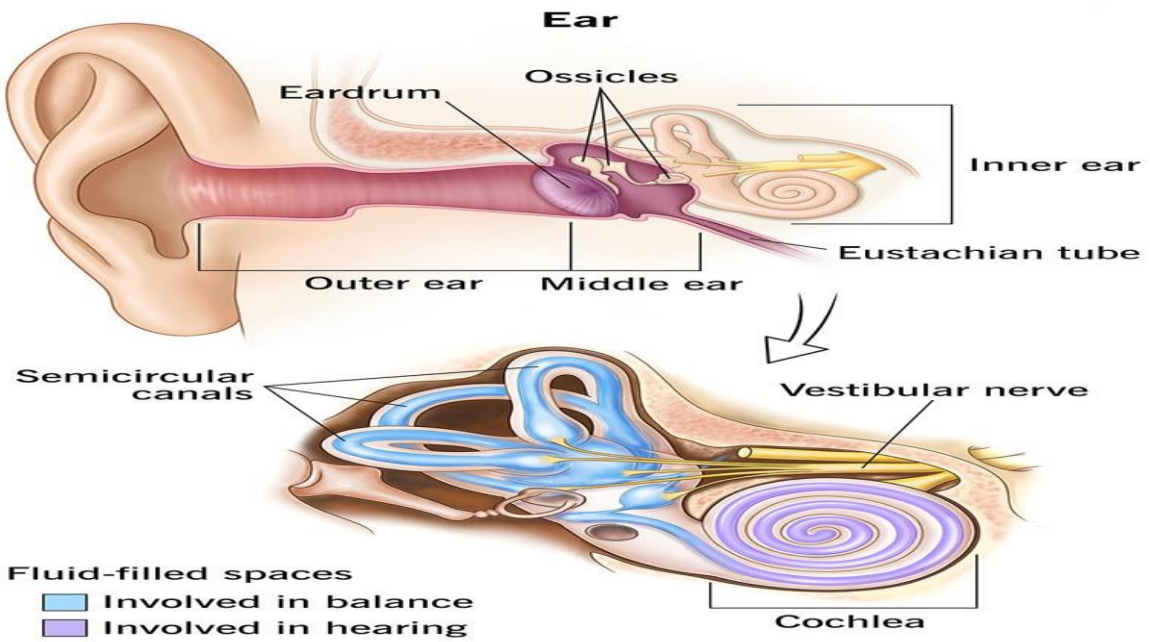


Fig: - Parts of Ear

Anatomy

Ears are on either side of the head, directly over the temporal lobe. This part of the brain is responsible for hearing, speech, memory and some emotion.

What are the parts of the ear?

The three main parts of the ear include the outer ear, middle ear and inner ear. The tympanic membrane (eardrum) separates the outer ear and middle ear.

Outer ear (external ear)

The outer ear is the part of the ear that's visible. It's what most people mean when they say "ear." Also called the auricle or pinna, the outer ear consists of ridged cartilage and skin, and it contains glands that secrete earwax. Its funnel-shaped canal leads to the eardrum, or tympanic membrane.

Middle ear

The middle ear begins on the other side of the tympanic membrane (eardrum). There are three tiny bones in this area — the malleus, incus and stapes. (Healthcare providers refer to these three bones as the ossicles.) They transfer sound vibrations from the eardrum to the inner ear. The middle ears also house the eustachian tubes, which help equalize the air pressure in the ears.

Inner ear

The inner ear contains two main parts: the cochlea and the semicircular canals. The cochlea is the hearing organ. This snail-shaped structure contains two fluid-filled chambers lined with tiny hairs. When sound enters, the fluid inside of the cochlea causes the tiny hairs to vibrate, sending electrical impulses to the brain.

The semicircular canals, also known as the labyrinthine, are responsible for balance. They tell the brain which direction the head is moving.

Fig: - Structure of Ear

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