East Point College of Pharmacy

East Point Campus, Jnana Prabha, Virgo Nagar Post
Bengaluru – 560049, Karnataka

Approved
by
Pharmacy Council of India, New Delhi

Affiliated
to
Rajiv Gandhi University of Health Sciences
Karnataka
Bengaluru – 560 041
India

LAB MANUAL

HUMAN ANATOMY AND PHYSIOLOGY-II

B. PHARMACY 2nd SEMESTER

EAST POINT COLLEGE OF PHARMACY
East Point Campus, Jnana Prabha, Virgo Nagar Post,
Bengaluru – 560049, Karnataka

B Pharmacy

Program Outcomes (PO's)

PO 1- Pharmacy Knowledge

Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioral, social, and administrative pharmacy sciences; and manufacturing practices.

PO 2- Planning Abilities

Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines.

PO 3- Problem analysis

Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions

PO 4- Modern tool usage

Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.

PO 5- Leadership skills

Understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfillment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizens or leadership roles when appropriate to facilitate improvement in health and wellbeing.

PO 6- Professional Identity

Understand, analyse and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).

PO 7- Pharmaceutical Ethics

Honor personal values and apply ethical principles in professional and social contexts. Demonstrate behaviour that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions

PO 8- Communication

Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions

PO 9- The Pharmacist and society

Apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.

PO 10- Environment and sustainability

Understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 11- Life-long learning

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Self-access and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.

Programme Specific Outcomes (PSO's)	
PSO 1	Acquire a thorough foundational knowledge in pharmaceutical sciences, including pharmacology, pharmaceutics, pharmaceutical chemistry, pharmaceutical analysis and pharmacognosy to excel in further academic pursuits
PSO 2	Gain expertise in the application of contemporary pharmaceutical techniques and technologies, enhancing employability across various sectors including the pharmaceutical industry, academia, and research institutions
PSO 3.	Equip with entrepreneurial skills and knowledge of pharmaceutical business management, including market analysis, product development, regulatory affairs, and financial planning, to initiate and run successful ventures in the pharmacy sector

Course Outcomes (CO's)
Code: BP207P HUMAN ANATOMY AND PHYSIOLOGY-II
CO1: Understand human anatomy using specimen models
CO2: Demonstrate experiments on special senses
CO3: Demonstrate experimental functions on physiological systems
CO4: To evaluate the knowledge through oral assessment

SI. No.	LIST OF THE EXPERIMENT
1	To study the integumentary and special senses using specimen, models, etc.,
2	To study the nervous system using specimen, models, etc.,
3	To study the endocrine system using specimen, models, etc
4	To demonstrate the general neurological examination
5	To demonstrate the function of olfactory nerve
6	To examine the different types of taste.
7	To demonstrate the visual acuity
8	To demonstrate the reflex activity
9	Recording of body temperature
10	To demonstrate positive and negative feedback mechanism.
11	Determination of tidal volume and vital capacity.
12	Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens.
13	Recording of basal mass index
14	Study of family planning devices and pregnancy diagnosis test.
15	Demonstration of total blood count by cell analyser
16	Permanent slides of vital organs and gonads.

Experiment No. 1

Aim: To study the integumentary and special senses using specimen, models, etc.

REQUIRMENTS: Charts and Model of Skin, Tongue, Nose, Eye, Ear.

THEORY:

INTEGUMENTARY SYSTEM:

The integumentary system is the largest organ of the body. It forms a physical barrier between the external environment and the internal environment and protects the body.

The integumentary system includes

1. Skin (epidermis, dermis)
2. Hypodermis
3. Associated glands
4. Hair
5. Nails

1. SKIN:

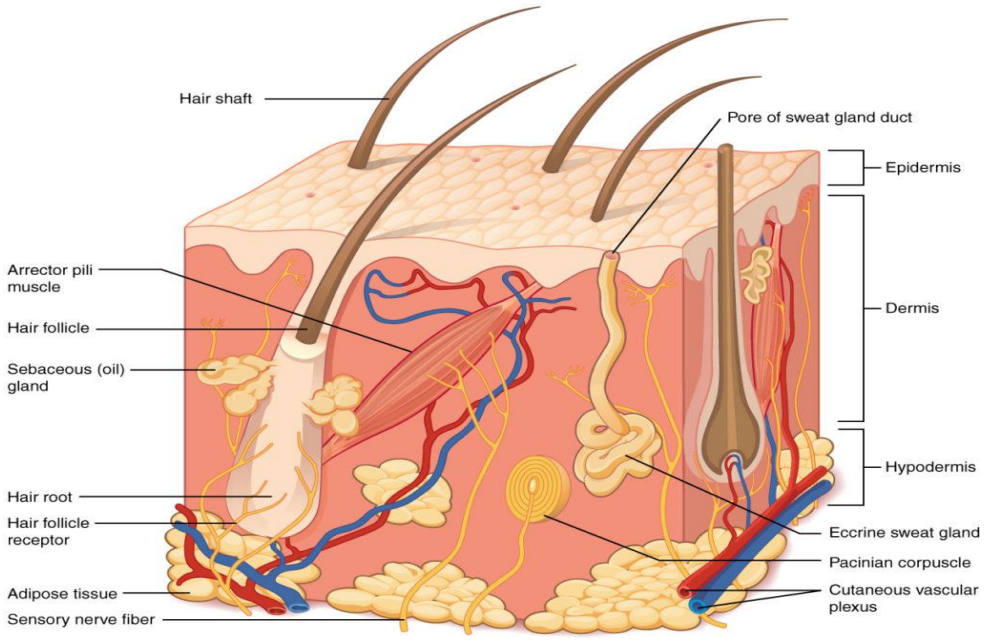


Diagram of Skin

- Skin occupy 16% of our total body weight
- Skin is made up by two layers:

i. Epidermis:

- It is a superficial layer of the skin
- It contains four principal types of cells: keratinocytes, melanocytes, Langerhans cells, and Merkel cells.
- About 90% of epidermal cells are keratinocytes which are arranged in four or five layers and produce the protein keratin, tough layer.
- About 8% of the epidermal cells are melanocytes which produce pigment melanin.Melaninisayellow-redorbrown-blackpigmentthatcontributesto skin color and absorbs damaging ultraviolet (UV) light.
- Langerhans cells develop from red bone marrow and migrate to the epidermis. They protect us from microbes.
- Merkel cells located in the deepest layer of the epidermis, it detect touch sensations.

Layers of Epidermis: (from deep to superficial) :

a. Stratum basale or germinatum– single row of cells attached to dermis; youngest cells

b. Stratum spinosum– Made up of bundles of protein resist tension

c. Stratum granulosum – layers of flattened keratinocytes producing keratin.

d. Stratumlucidum- (only found in thick skin– that is, the palms of the hands, the soles of the feet and the digits)

e. Stratum corneum–horncornified superficial layer

ii. Dermis:

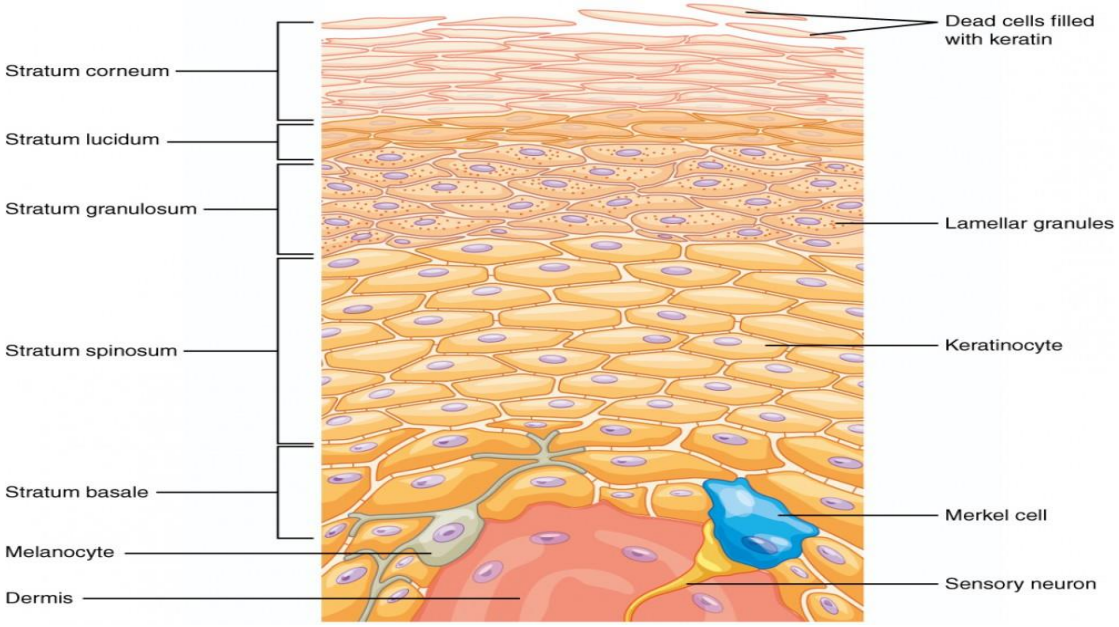
• It is a deep layer of skin made up by fibre and it having good tensile strength.

• It is divided in papillary and reticular region.

a) The Papillary Dermis: The papillary dermis is the more superficial of the two, and lies just beneath the epidermal junction. It is relatively thin and is made up of loose connective tissue, which includes:

- Capillaries
- Elastic fibers
- Reticular fibers

- Collagen



b) The Reticular dermis: The reticular dermis is the deeper and thicker layer of the dermis, which lies above the subcutaneous layer of the skin. It contains dense connective tissue, which includes:

- Blood vessels
- Elastic fibers (interlaced)
- Collagen fibers (inparallel layers)
- Fibroblasts
- Mast cells
- Nerve endings
- Lymphatics

2. HYPODERMIS:

- The hypodermis lies between the dermis and underlying organs.
- It is also known as subcutaneous layer.
- It is composed of loose areolar tissue and adipose tissue.
- This layer provides additional cushion and insulation through its fat storage function and connects the skin to underlying structures such as muscle.

3. ASSOCIATED GLANDS:

- Integumentary system has four types of exocrine glands, which secrete their product or substance outside the cells and body.

i. Sudoriferous glands:

• Sweat glands excrete sweat via very small openings at the skin's surface.

• The purpose of sudoriferous glands is to emit perspiration to help cool the body off when the body temperature rises.

ii. Sebaceous glands:

• It is responsible for releasing oil into the hair follicle to help lubricate and protect the hair shaft, keeping it from becoming hard and brittle.

iii. Ceruminous glands:

• Located in the ear. It produce earwax known as cerumen

2. EAR

Requirement: Human Ear Model

Theory:

Ear is the organ of hearing and maintenance of body equilibrium. It is controlled by the brain through the eighth cranial nerve called vestibulocochlear nerve.

Structure:-

The ear is divided into three distinct parts:

1. **Outer ear**
2. **Middle ear (tympanic cavity)**
3. **Inner ear**

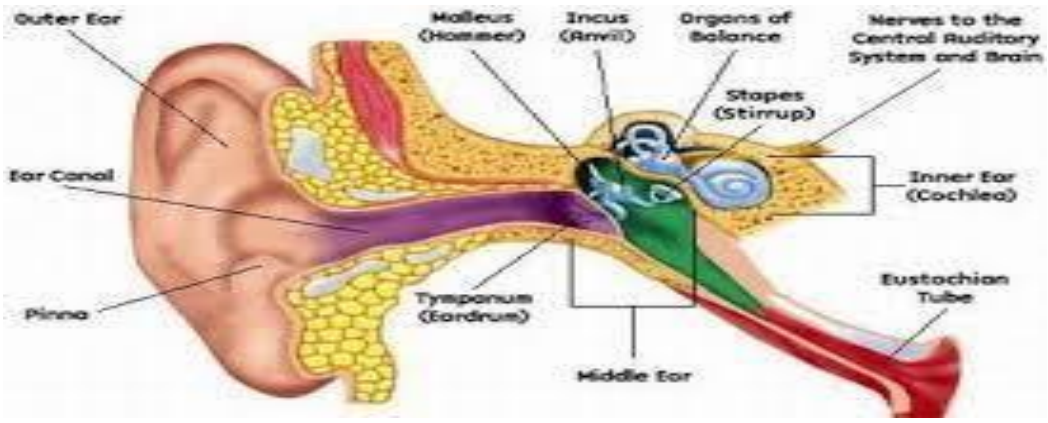


Figure 1.2

1. Outer ear

The outer ear consists of the auricle (pinna) and the external acoustic meatus.

a) The auricle (pinna)

I. It consists of pinna which helps to collect the sound wave and the external auditory which convey the sound wave from the pinna to the tympanic membrane.
II. The article is the expanded portion projecting from the side of the head. It is composed of fibrielastic cartilage covered with skin.
III. It is deeply grooved and ridged and the most prominent outer ridge is the helix. The lobule (earlobe) is the soft pliable part at the lower extremity, composed of fibrous and adipose tissue richly supplied with blood.

b) External acoustic meatus (auditory canal)

I. This is a slightly 'S'-shaped tube about 2.5 cm long extending from the auricle to the tympanic membrane (eardrum). Hair and wax are present near its outer part to arrest particles. This canal conveys sound waves to the drum.

II. The lateral third is cartilaginous and the remainder is a canal in the temporal bone. The meatus is lined with skin containing hairs continuous with that of the auricle.

III. There are numerous sebaceous and ceruminous glands in the skin of the lateral third.

c) Ceruminous Glands:

I. Are modified sweat glands that secrete cerumen(wax) , a sticky material containing Iysozyme and immunoglobulins. Foreign materials, e.g. dust, insects and microbes, are prevented from reaching the tympanic membrane by wax, hairs and the curvature of the meatus. Movements of the temporomandibular joint during chewing and speaking 'massage' the cartilaginous meatus, moving the wax towards the exterior.

II. The tympanic membrane (eardrum) completely separates the external acoustic meatus from the middle ear. It is oval- shaped with the slightly broader edge upwards and is formed by three types of tissue: the outer covering of hairless skin, the middle layer of fibrous tissue and the inner lining of mucous membrane continuous with that of the middle ear.

3. EYE

Requirement: Human Eye Model

Theory:

- Eyelids and eyelashes keep dust out of eyes; con junciva lines the eyelids and cover white of eye.
- Lacrimal glands produce tears, which flow across the eye ball to two lacrimal ducts, to lacrimal sac to nasolacrimal duct to nasal cavity. Tears wash the anerior eyeball and contain lysozyme to inhibit bacterial growth.
- The eyeball is protected by the bony orbit(socket).
- The six extrinsic muscles move the eyeball; innervated by the 3 rd, 4 th, and 6 th cranial nerves.
- Sclera- outermost layer of the eyeball; made of fibrous connective tissue ; anterior portion is the transparent cornea, the first light- refracting struc-ture.
- Choroid layer- middle layer of eyeball; dark blue pigment absorbs light to prevent glare within the eyeball.
- Ciliary body(muscle) and suspensory ligaments- change shape of lens, which is made of a transparent, elastic protein and which refracts light.
- Iris-two sets of smooth muscle fibers regulate diameter of pupil, that is, how much light strikes the retina.
- Retina – innermost layer of eyeball; contains rods and cones.
- Rods – detect light; abundant toward periphery of retina.
- Cones- detect color; abundant in center of retina.
- Fovea- in the center of the macula lutea; contains only cones; area ofbest color vision.
- Optic disc- no rods or cones; optic nerve passes through eyeball.
- Posterior cavity contains vitreous humor (semi –solid) that keeps the retina in place.
- Anterior cavity contains aqueous humor that nourishes the lens and corena; made by capillaries of the ciliary body, flows through pupil, is reabsorbed to blood at the canal of Schelmm.

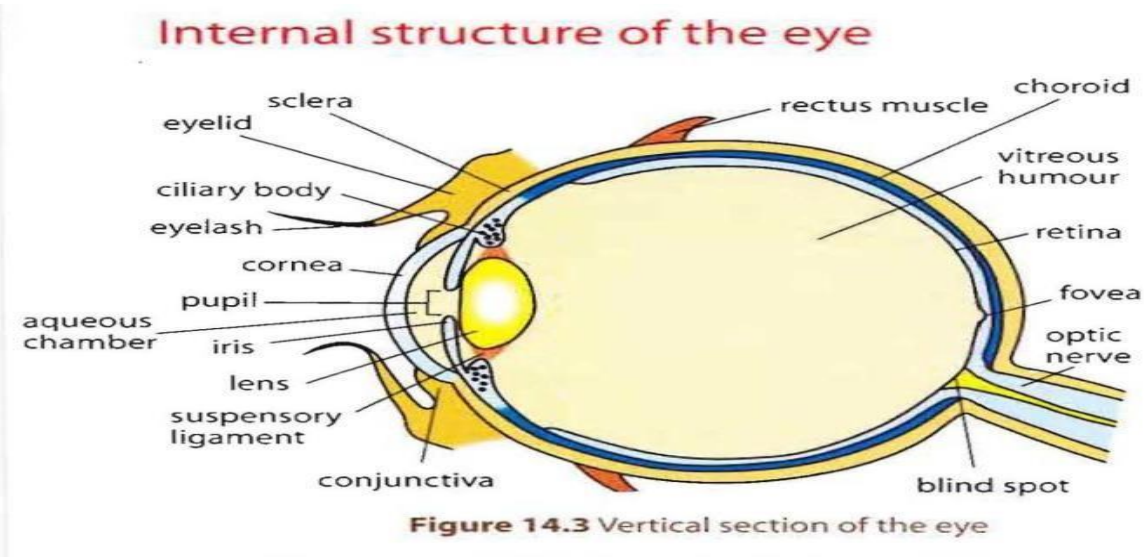


Figure .1.4

Physiolgoy of Vision:

1. Refraction (bending and focusing) pathway of light: cornea, aqueous humor , lens , vitreous humor.
2. Lens is adjustable, ciliary muscle relaxes for distant vision , and lens is thin. Ciliary muscle contracts for near vision, and elastic lens thickens and has greater refractive power.
3. Light strikes retina and stimulates chemical reactions in the rods and cones.
4. In rods: rhodopsin breaks down to scotopsin and retinal (from vitamin A), and an electrical impulse is generated . In cones; specific wavelengths of light are absorbed (red, blue, green) ; chemical reactions generate nerve impulses.
5. Ganglion neurons from the rods and cones form the optic nerve, which passes through the eyeball at the optic disc.
6. Optic chiasma- Site of the crossover of medial fibres of both optic nerves, permitting binocular vision.
7. Visual areas in occipital lobes –each area receives impulses from both eyes; both areas create one image from the two slightly different images of each eye; both areas right the upside –down retinal image.

EXPERIMENT- 2

Aim: To study the Nervous system using specimens, models etc.

Requirement: Human Brain chart model.

Theory:

The nervous system- The nervous system is the master controlling and communicating system of thebody. It controls and coordinates all essential functions of the human body. It detects and responds tochanges inside and outside the body. For descriptive purposes the parts of the nervous system are grouped as follows:

- The central nervous system (CNS), consisting of the brain and the spinal cord
- The peripheral nervous system (PNS) consisting of all the nerves outside the brain and spinal cord.

The PNS comprises paired cranial and sacral nerves — some of these are sensory (afferent), some aremotor (efferent) and some mixed. It is useful to consider two functional parts within the PNS:

- The sensory division
- the motor division

In turn the motor division is involved in activities that are:

- voluntary —the somatic nervous system (movement of voluntary muscles)
- Involuntary — the autonomic nervous system (functioning of smooth and cardiac muscle and glands).

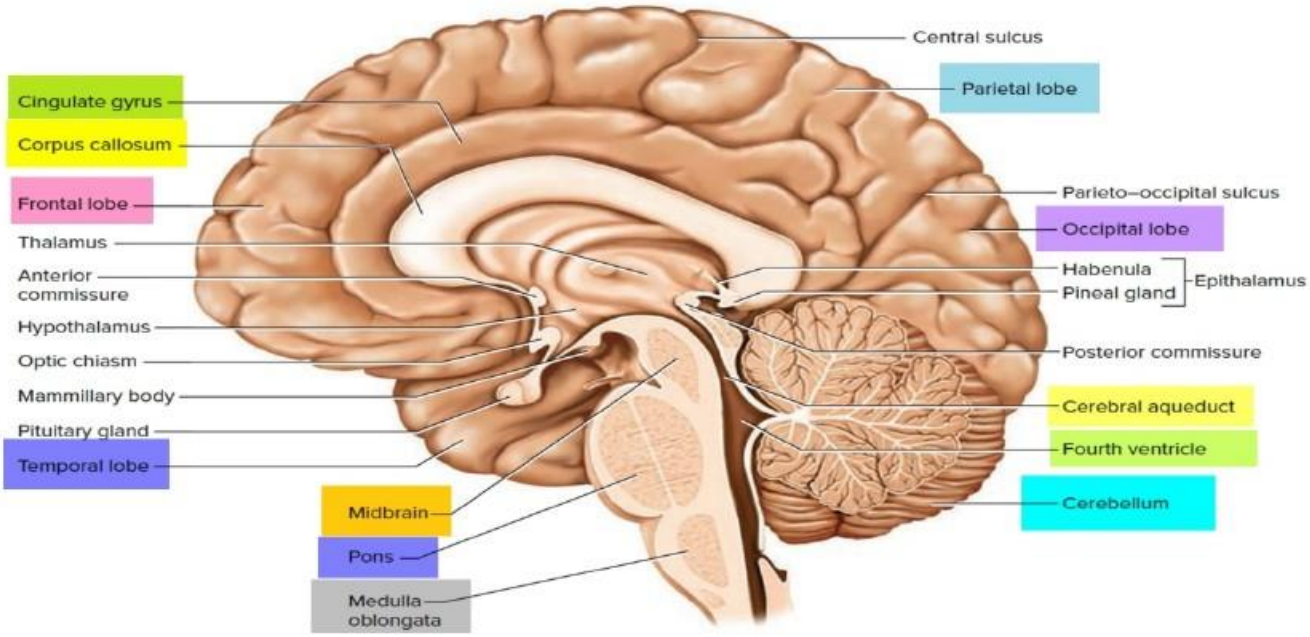
The autonomic nervous system has two parts: sympathetic and parasympathetic. The brain constitutes about one-fiftieth of the body weight and lies within the cranial cavity. The parts are cerebrum, midbrain, pons, medulla oblongata, cerebellum. The spinal cord is the elongated, almost cylindrical part of the central nervous system, which is suspended in the vertebral canal surrounded by the meninges and cerebrospinal fluid.

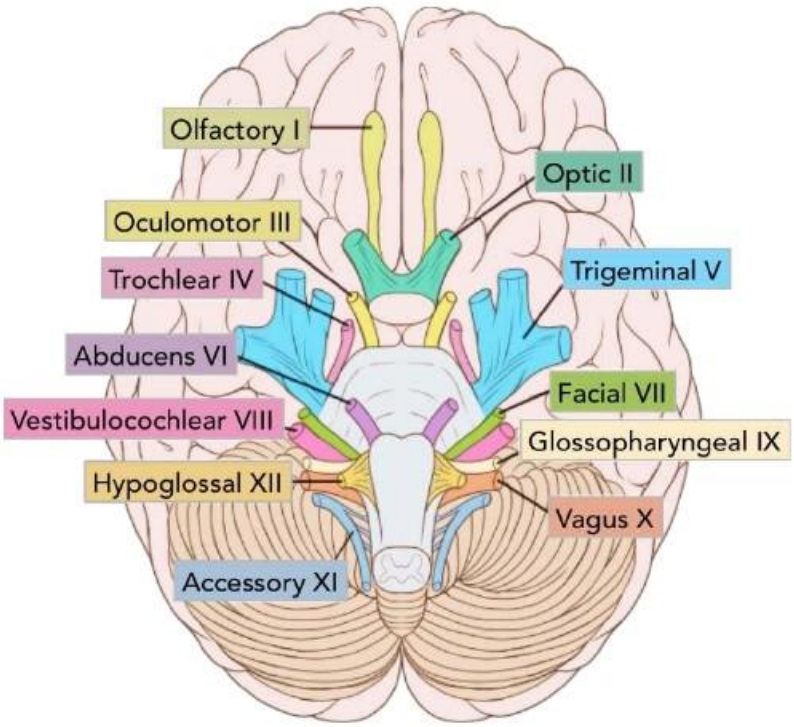
Spinal nerves

There are 31 pairs of spinal nerves that leave the vertebral canal by passing through the intervertebral foramina formed by adjacent vertebrae. They are named and grouped

according to the vertebrae with which they are associated

- 8 cervical
- 12 thoracic
- 5 lumbar
- 5 sacral
- 1 coccygeal


Central sulcus
Parietal lobe
Cingulate gyrus
Corpus callosum
Frontal lobe
Thalamus
Anterior commissure
Hypothalamus
Optic chiasm
Mammillary body
Pituitary gland
Temporal lobe
Parieto–occipital sulcus
Occipital lobe
Habenula
Pineal gland
Epithalamus
Posterior commissure
Cerebral aqueduct
Fourth ventricle
Cerebellum
Midbrain
Pons
Medulla oblongata


Olfactory I
Optic II
Oculomotor III
Trochlear IV
Trigeminal V
Abducens VI
Facial VII
Vestibulocochlear VIII
Glossopharyngeal IX
Hypoglossal XII
Vagus X
Accessory XI

Brain (Encephalon)**:** It is soft, large sized and slightly flattened structure present inside cranial cavity of cranium of the skull. In man, it is about 1200-1400 gm in weight and has about 10,000 million neurons. Brain is made up of 3 parts

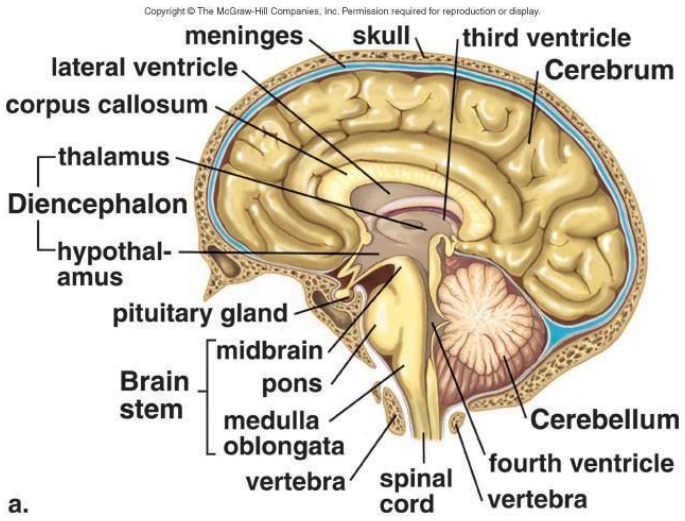


Fig.2.1 Brain (Encephalon)

(1) Fore brain (prosencephalon)

(i) Olfactory lobe – Rhinencephalon

(ii) Cerebrum **-** Telencephalon

(iii) Diencephalon – Diencephalon

(2) Mid brain (Mesencephalon)

(i) Optic lobes – Mesencephalon

(3) Hind brain (Rhambencephalon)

(i) Cerebellum – Metencephalon

(ii) Medulla oblongata – Myelencephalon

(ii) Cerebrum: (a) Structure is divided into 5 lobes (i) frontal (ii) parietal, (iii) occipital , (IV) Temporal and (v) limbic. A lobe called insula is hidden as it lies deep in the sylvian

fissure. The cerebrale hemispheres are separated from olfactory lobes by rhinal fissure. Themedian fissure divides the cerebrum into a right and a left cerebral hemisphere.

A few sulci are well developed and form three deep and wide fissures which divide each cerebral hemisphere into four lobes: anterior frontal lobe, middle parietal lobe, posterior occipital lobe and lateral temporal lobe.

(c) Hypothalamus: The hypothalamus is visible in the ventral view of the brain and forms the floor of diencephalon. Hypothalmus also gives a nervous process called infundibulum (forms pars nervosa) which meets a rounded non-nervous pharyngeal outgrowth called **hypophyis.** Both collectively form master gland called **pituitary body.** A stalked outgrowth of infundibulum combines with a pouch- like epithelial outgrowth (Rathke's pouch) of the roof of embryonic mouth (= stomodaeum) , forming a pituitary gland or hypophysis. Which secretes a number of hormones. In front a hypothalamus, there is cross of two optic nerves called optic chiasma. Behind the hypothalamus, there is one pair of small, rounded, nipple- like bodies called mammilary bodies or corpora mammillares. The hypothalamus consists of many masses of grey matter, called hypothalamic nuclei, scattered in the white matter.

Cerebrum is a centre for

(i) Intelligence	*(ii) Emotion*	*(iii) Will power*
(ii) Memory	*(v) Consciousness*	*(vi) Imagination*
(vii) Experience	*(viii) Knowledge*	*(ix) Reasoning*
(xiii) Defecation		

(i) **Cerebellum (Sandwitched brain) :** Cerebellum is highly convoluted and well developed in mammals. It controls the most intricate movements of the body. It coordinates sensory information received from muscles/ joints, visual, auditory and equilibrium receptors as well as flow of impulses from cerebral cortex.

Cerebellum is made up of-

(a) Vermis, (b) Cerebellar lobes (= floccular lobes), (Lateral lobes, (d) Pons.

(ii) Medulla oblongata

Medulla oblonagata is the hindest and posterior most part of brain. Cavity is known as IVth ventricle (metacoel). Which is continuous with central canal of spinal cord. It has a pair of lateral Foramina of Luschka and a median foramen magendic. Cerebrospinal fluid come in contact by these apertures from internal cavity of the brain to outer fluid of meninges. An arrangement on its ventral surface there are bulging of ascending and descending tracts whichare called pyramids. On the ventral surface these pyramids cross each other which is called deccusatn of pyramids.

In the medulla oblongata, most of the sensory and motor fibres cross from one side to the other. Thus, the left cerebral hemisphere controls the right side of the body and vice versa. The reason for this is not known. The lower end of medulla passes into the spinal cord. There is no demarcation between the two. However, the medulla is considered to start at the level of the foramen magnum of the cranium.

(iii) **Pons Varolii :** An oval mass, called the pons varolii, lies above the medulla oblongata. It consists mainly of nerve fibres which interconnect the who cerebellar hemispheres and also join the medulla with higher brain centres,hence its name pons means bridge. Pons posses pneumotoxic and apneustic areas or centre. From pons 5, 6, 7 and 8 th cranial nerve originate.

EXPERIMENT- 3

Aim: To study the endocrine system using specimens, models etc.

Requirements: Specimen, models, charts , etc. of various endocrine organs.

Procedure:

- Study of Endocrine Glands: The following method should be followed to study an endocrine gland:

1. Functional Anatomy:

a) Situation

b) Division or parts

c) Histology

d) Blood supply

e) Nerve supply

2. Functions:

a) Hormones secreted by the glands

b) Actions of each hormone

3. Study of Endocrine: The endocrine disorder is studied by analyzing.

a) Causes

b) Signs and symptoms

c) Syndrome (combination of signs and symptoms suggesting the presence of disease).

Hormones of Hypothalamus

The hormones are summarized as follows:

(a) Adrenocorticotropic releasing hormone (ARH) stimulates the anterior lobe of the pituitary gland to secrete its *adrenocorticotropic hormone* (ACTH).

(b) Thyrotropic releasing hormone (TRH) stimulates the anterior lobe of the pituitary gland to secrete its thyroid *stimulation hormone* (TSH) or thyrotropin.

(c) Somatotropin releasing hormone (GIH) or **somatostatin (SS)** stimulates the anterior lobe of the pituitary gland to release *growth hormone* (hGH) or somatotropin.

(d) Growth inhibiting hormone(GIH) or **somatostain (SS)** inhibits the secretion of hGH from the anterior lobe of the pituitary gland.

(e) **Gonadotropin releasing hormone (GnRH)** stimulates the anterior lobe of the pituitary gland to secrete two gonadotropic hormones : *follicle stimulating hormone (FSH) and luteinizing hormone (LH).*

(f) **Prolactin releasing hormone (PRH)** stimulate the anterior lobe of the pituitary gland to secrete its *prolactin.*

(g) Prolactin inhibiting hormone (PIH) inhibits the secretion of prolactin from the anterior lobe of the pituitary gland.

(h) Melanocyte releasing hormone(MRH) stimulates the intermediate lobe of the pituitary gland to secrete its *melanocyte stimulating hormone* (MSH).

(i) Melanocyte inhibing hormone(MIH) inhibits the secretion of melanocyte stimulating hormone from the intermediate lobe of the pituitary gland.

I. PITUITARY GLAND (HYPOPHYSIS CEREBRI): MASTER GLAND

Anatomy

It develops from the ectoderm of the embryo. This pear-shaped gland measuring 1-.5 cm in diameter lies in the hypophyseal fossa of sella turcica of the sphenoid bone. It attaches to the hypothalamus by a stalk,the **infundibulum ,** and has two anatomically and functionally separate lobes **(Figure 3.1)** . The **anterior pituitary (anterior lobe),** also called the **adeno hypophysis** form 75% of the total weight of the gland. It consists of two parts in an adult the **pars distails** is the larger portion, and the **pars tuberalis** forms a sheath around the infundibulum. The **posterior pituitary (posterior lobe)**, also called the **neurohypophysis,** consistof two parts –the **pars nervosa** (larger bulbar portion) and the **infundibulum.**

Adenohyphysis originates as **Rathke's pouch** from dorsal wall of stomodaeum in theembryo, but later its connection with stomodaeum disappears. The neurohypophysis originates as an outgrowth from the floor of diencephalon. Thus, pituiatary gland is dual in origin. A third lobe, called **pars intermedia** (intermediate lobe) atrophies during foetale development, but its migrate into adjacent parts of the anterior pituitary, where they persist.

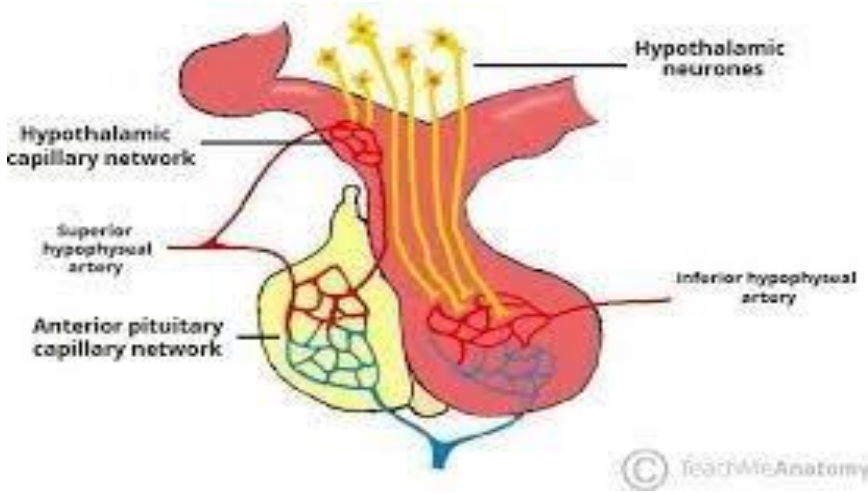


Fig.3.1 Neurosecretory cells (neurons) of hypothalamus discharging their neurohormones into hypophysial portal veins and into neurohypophysis(posterior lobe) of pituitary gland.

II THYROID GLAND

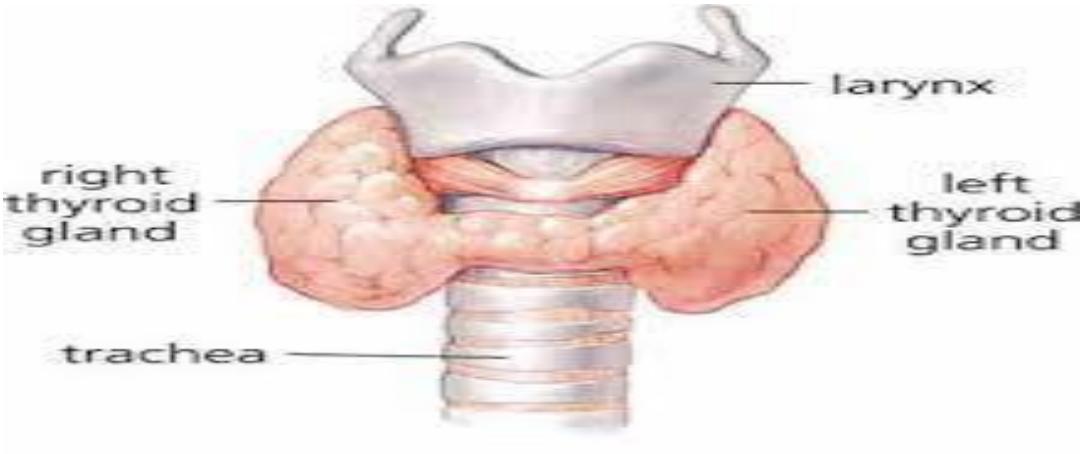


Fig 3.3 T.S. Thyroid gland

Anatomy

The thyroid gland is the largest endocrine gland (normal mass 30 g) located anterior to the thyroid cartilage of the larynx in the neck. It develop from endoderm of the embryo. It is highly vascularised and receives 80-120 ml of blood per minute. It is composed or right and left lateral lobes one on either side of the trachea, that are connected by an **isthmus.**

Microscopic spherical sacs **(Figure 3.3b)** called **thyroid follicles** make up most of the thyroid gland. The wall of each follicle consists of cuboidal **follicular cells** (thickness increases or decreases when they are active or inactive). The follicles are filled with a homogeneous material called **colloid.** Small amount of loose connective tissue forms **stroma** of the gland. Besides containing blood capillaries, the storma contains small clusters of specialized **parafollicular cells** or **'C' cells.** The thyroid gland can store enough hormones in the colloid to supply the body for about 2 months.

Hormones

The follicular cells produce two hormones : **thyroxine or tetraidothyronine(T_4),** and **triiodothyronine (T_3).** T3 and T4 are also known as **thyroid hormones** (TH). Parafollicular (or C) cells produce the hormone **calcitonin,** which helps to regulate calcium homeostasis. Thyroid gland is stimulated to release its hormones by **thyroid stimulating hormone** (TSH) or **thyrotropin** secreted by the anterior lobe of pituitary. Their secretion is controlled by a negative feedback system.

III PARATHYROID GLANDS

Anatomy (Figure 3.4)

They develop from the endoderm of embryo and consist of four separate glands located on the posterior surface of the lobes of thyroid glands. Each has a mass of about 40mg. Usually, one superior and one inferior pairs of parathyroid glands are attached to each lateral thyroid lobe.

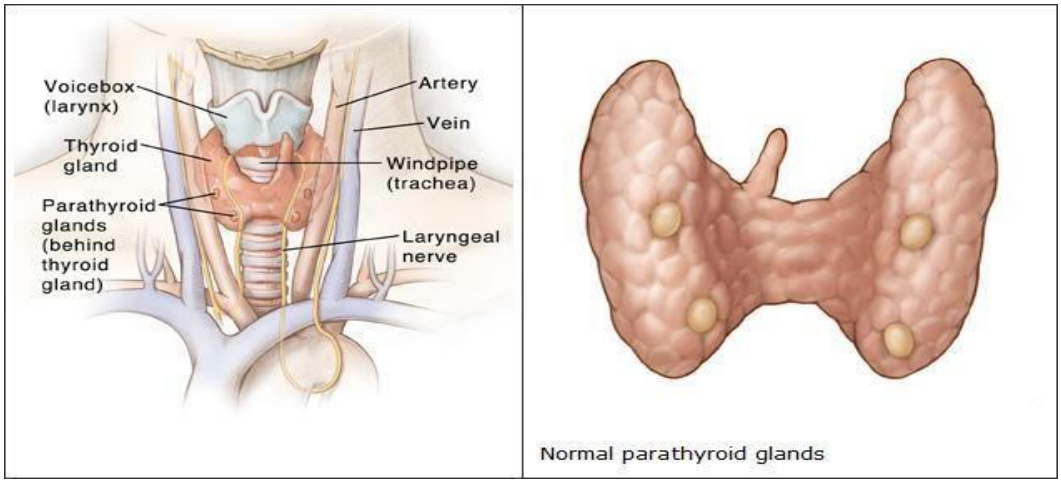


Fig.3.4 Parathyroid glands lie on the posterior surface of thyroid gland

V ADRENAL (SUPERAENAL) GLANDS- GLANDS OF EMERGENCEY

Gross Anatomy

The adrenal cortex is derived from the mesoderm of the embryo and the adrenal medulla develops from the neuroecoderm of the embryo.

These are paired structures located on the top of kidneys, and have a flattened pyramidal shape **(Figure 3.5)** In an adult, each gland is 5.5 cm in height , 2.3 cm in width anda little less than 1 cm thick, with a mass of 3.5-5 g (half its size at birth). During embryonic development , the adrenal glands differentiate into two structurally and functionally distinct regions : A large, peripheral **adrenal cortex** (80- 90% of the gland) and a small, centrally located **adrenal medulla** . A connective tissue **capsule** covers the gland. The adrenal glands are highly vascularised.

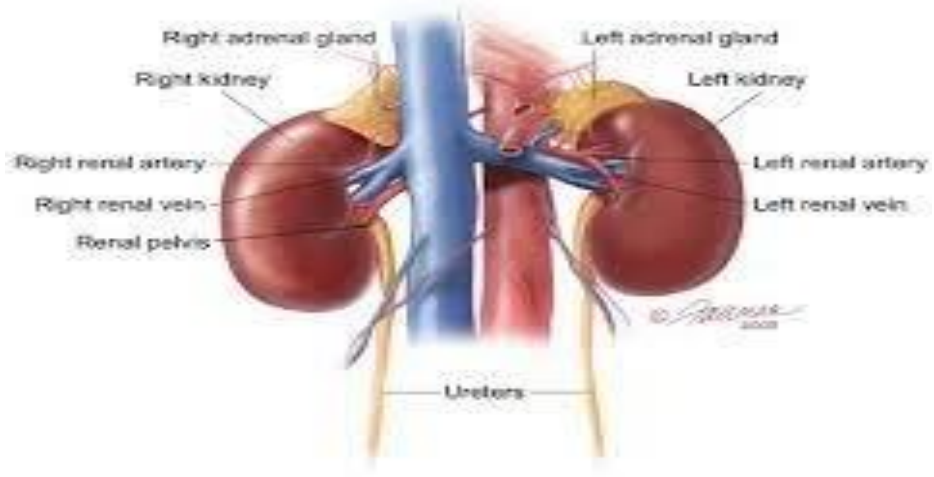


Fig . 3.5 (a) Position of adrenal gland.

VI Pineal Gland (Eplphysiss Cerebrl)

It develops from the ectoderm of the embryo. It is a small pinecone- shaped endocrine gland attached to the roof of the third verticle of the brain at the midline. Part of the epithalamus, it is positioned between the two colliculi. The gland consists of masses of neuroglia and secretory cells called **pinealocytes.**

VII THYMUS GLAND

It is derived from the endoderm of the embryo. The **thymus** is located behind the sternum between the lungs **(Figure 3.7).** It is soft, pinkish, bilobed mass of lymphoid tissue. It is prominent gland at the time of birth but is gradually atrophies in the adult. An enveloping layer of connective tissue holds the two lobes closely together , but a connective tissue **capsule** separates the two. Extensions of the capsule, called **trabeculae**, penetrate inward and divide each lobe into **lobules**. Each lobule consists of an outer **cortex** and a central **medulla.**

VIII PANCREATIC ISLETS

Anatomy

Pancreas is derived from the endoderm of the embryo and is both an endocrine gland and an exocrine gland. Only its endocrine functions will be discussed here. This flattened organ measures about 12.5-15 cm in length and is located in the curve of the duodenum. It consists

of a head, a body and a tail. About 99% of pancreatic cells are arranged in clusters called **acini.** The acini produce digestive enzymes, which flow into the gastrointestinal tract of endocrine tissue called **pancreatic islets** or **islets** of **Langerhans (Figure 3.8).** Abundant capillaries serve both the exocrine and endocrine portions of the pancreas.

IX. GONADS (OVARIES AND TESTES)

Gonads develop from the mesoderm of the embryo and are organs that produce gametes-sperms in males and oocytes in females. They also secrete hormones.

Ovaries

These are paired oval bodies located in the female pelvic cavity in close proximity to the oviducts and the uterus. Ovaries secrete estrogens, progesterone, relaxin and inhibin/ actin.

(i) **Estrogens (Estradiol and Estrone) :** These are secreted by the cells of Graafian follicles and stimulate the development of female secondary sex characteristics during puberty and maintain them through the reproductive years of adult life. They also stimulate maturation of ova and development of the uterine epithelium and the mammary glands.

(ii) **Progesterone :** This secretion of the **corpus luteum** stimulates further development of the uterine epithelium and mammary glands. It is also required for the formation of the placenta and for the maintenance of pregnancy. It is also required for ovulation along with estradiol.

(iii) **Relaxin ;** It is produced by the corpus luteum during the later stages of pregnancy and helps to soften ligaments that hold the public symphysis together. It may also affect other ligaments, e.g., foot ligaments causing increase in shoe size following pregnancy, and helps dilate the uterine cervix during labour and delivery.

(iv) **Inhibin/ Action :** Inhibin/ actin is secreted by the corpus luteum. **Inhibin,** a protein hormone, inhibits and **actin** hormone activates the FSH and GnRH production.

Testes

A pair of **testes ,** the male gonads, are oval glands that lie in scrotum. The connective tissue present between the seminiferous tubles in a testis contains small clusters of endocrine cells called **interstitial cells** or **Leydig's cells.** The main hormone secreted by these cells is **testosterone,** an **androgen** or male sex hormone.

(i) **Functions of Testosterone :** It stimulates descent of testes before birth, regulates spermatogenesis, and promotes development and maintenance of secondary sex characteristics *(e.g.,* beard, moustache, and low- pitch male voice), growth of bones and muscles, *etc.*

(ii) **Inhibin/ Actin :** It is secreted by sustentacular (supporting) cells of the seminiferous tubules of the testes. **Inhibin** hormone inhibits and **actin** hormone activates the secretion of FSH from anterior pituitary.

Experiment- 4

Aim: To demonstrate the general neurological examination.

Procedure: It involves following steps :

1. History Taking : Taking a careful history of the subject is of great importance and requires a great skill. It helps a lot in later physical examination in a case of neurological disease. Barriers to communication with a patient of low level of intelligence, or when he/she is confushed, or not fully conscious include impatience, boredom, disbelief, embarrassment and reproach. In such cases, help should be taken from the patient's attendants.

❖ In neurology patient, the history of progress of disease will provide following valuable information.

- Parts of the nervous system involved, and
- The nature of the underlying pathology.

Understanding about the pathological condition may lead the examiner to ask more questions for obtaining more information.

I. Common Signs and Symptoms of Neurological Disease:

The common signs and symptoms of neurological diseases are as follows :

1. Speech and language defects such as dyarthria, dysphasia(cognitive disturbance), difficulty in communification.

2. Partial unconsciousness (with restlessness) or coma.

3. Altered behavior and emotional state , eg, confusion, disorientation.

4. Motor defects, eg, weakness, paralysis, fits (convulsions) , rigidity, tremors, involuntary movements, alterations of gait.

5. Sensory disturbances, eg, hyperesthesia, hypoesthesia, paraesthesia, general anesthesia, analgesia, hyperalegesia, paralgesia, illusion, hallucination , etc.

6. Effects of involvement of cranial nerves , eg, unilateral visual loss.

❖ The major causes of these signs and symptoms aree :

- Vascular insults (haemorrhage, ischemic strokes)
- Head and spinal injuries

- Infections (bacterial and viral)

- Nerve pressing by tumors, and so on

Experiment- 5

Aim : To demonstrate the function of olfactory nerve.

Introduction :

- Sense of smell is highly developed in animals (e.g., dog., called macrosomatic) as compared to man. It has survival value in searching for food and animals, and is also involved in other instinctual behaviours such as mating.
- The **receptors for olfaction** (10-20 million), which are **bipolar** neurons, are in the nasal epithelium (area 5 cm^2) along with olfactory glands, which produce mucus that dissolves odorants.
- Genetic evidence suggests to the existence of hundreds of **primary odors** such as aromatic or resinous (camphor, lavender, clove, etc.), ambrosial (musk) burning (of feathers, tobacco, roasted coffee, meat , etc.) ethereal (fruits, ethers), fragrant or balsamic (flowers, perfumes), garlic odor (garlic, onion, sulphur), goat odor (caproic acid, sweet cheese), nauseating odor (decayed vegetables, feces), repulsive odor (bed bug),etc.
- In olfactory reception, a generator potential (depolarization) develops and triggers one or more nerve impulses. For example, an odorant (chemical molecule) binds to a receptor linked to 6 proteins in the plasma membrane that activates the enzyme **adenylate cyclase.** This results in the following chain of events : production of cAMP → opening of sodium (Na^+) channels → inflow of Na^+→depolarizing generator potential → generation of nerve impulse → propagation along axon of olfactory receptor.
- The threshold of smell is low, and **adaptation** (olfactory fatigue) occurs quickly (within seconds to minutes).
- Axons of olfactory receptors form the olfactory (I) nerves, which convey nerve impules to the olfactory bulbs→ olfactory tracts→ limbic system, and cerebral cortex (temporal and

frontal lobes).

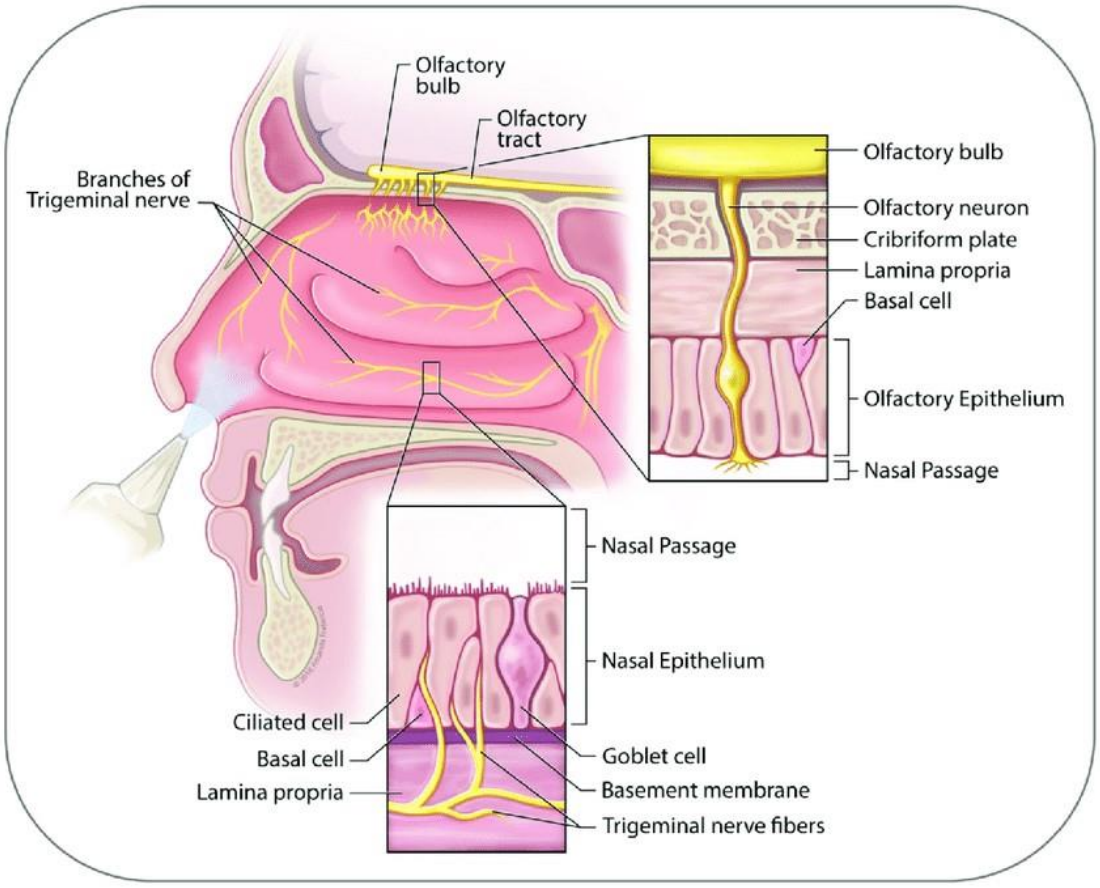
- **Abnormalities** include **anosmia** (complete absence of smell), **parosmia** (alternations of smell sensation), **hyposmia** (decreased sense of smell) and **hyperosmia**(increased olfactory sensation).

Materials Required : Different types of odorants such as clove oil, turpentine, alcohol, garlic etc.

Procedure :

1. Ask the subject to close his eyes, and occlude one of his nostrils. Allow him to smell and distinguish the odors of each of the test substances one by one. Repeat the procedure by occluding the second nostril.

2. For studying the effect of adaptation, ask the subject to occlude one nostril. Allow him smell the clove oil until the odor no longer be detected. Immediately after this, ask the subjects to try to distinguish with the same adapted nostril, between alcohol and turpentine. Describe the result in your practical notebook.



Experiment- 6

Aim : To examine the different types of taste.

Introduction :

- Sense of taste or **gestation** is a chemical sense. Five **primary tastes** can be distinguished: **sour, sweet, bitter, salty** and **umami** (stimulated by monosodium glutamate or MSG). Other flavors are combination of the five primary tastes along with other elements such as pain (ginger), touch, temperature and texture.
- **Gustatory receptor cells** are located in **tastebuds** present in 3 types of **papillae** (filiform, fungiform, cirumvallate) on different parts of tongue. Each taste bud contains about 40 cells (modified epitheliale cells), which are 4 types- Type I (Sustentacular) I, III (Taste receptors) and IV (basal cells).
- **Tastants** (dissolved chemicals) stimulate gustatory receptor cells causing the release of neurotransmitter, generating nerve impulses in first order sensory neurons. The mechanism involved in development of receptor potential is different in each taste receptor cells, eg, cyclic AMP cause depolarization in **sweet receptor cells,** increasing passive transport of Na+ ions through continuously opened (ungated) channels in **salty receptor cells,** blocking K+ channels with H+ by acid depolarization in **sour receptor cells** and production of inosital triphosphate (IP3)e by activation of phospholipase C through G proteins in **bitter receptor cells.**
- First order neurons of taste pathway are in the nuclei of three different cranial nerves (VII ,IX and X). Their axons run together in medulla oblongata and terminate in the **nucleus of tractus solitaries** where they stimulate second order neurons. The axonsof second order neurons cross the midline, run through medial lemniscus and terminate in **posteroventral nucleus** of thalamus, thus stimulating third order neurons. The axons from them project into parietal lobe of cerebral cortex. The taste centre is in the **opercular insular cortex** (lower part of post central gyrus).
- The **threshold** varies with the taste involved, and **adaptation** to taste occurs quickly.
- The sweet taste is better experienced near the tip of tongue, salt of the sides and top, bitter in the posterior part, and sour sensation in between these areas.
- Abnormalities of taste include ageusia (absence of taste) , hypogeusia (decreased taste sensitivity), and dysgeusia (disturbed taste). Different diseases and drugs can cause these conditions.

Material Required:

- Dropping bottles containing strong solutions of sucrose (10%) and NaCl (15%) and weak solutions of acetic acid (1%) and quinine sulphate (0.1%).
- A hand lens.
- Gauze; small cotton swabs or toothpicks.
- Four cards with printed sweet, salt, sour , and bitter.

Experiment- 7

Aim: To demonstrate the visual acuity.

Introduction:

❖ Visual acuity (VA) is the ability to see the details and contours of objects clearly. It is tested for both distant as well as near vision.

❖ VA is expressed as the minimum distance between two points or lines when they can be recognized as two. If the distance is less than this, they will be seen as one (point or line). When perceived as two, they subtend an angle (visual angle) of 1 minute (1'; 1^0=60'). The nodal point lies at about the middle of the lens and is the optical centre of the eye. Any ray passing thorugh this point does not suffer refraction. This angle of 1 minute = 4.5µm retinal distance between two images. Since the diameter of a foveal cone is about 1.5µm one unstimulated cone separates the two images. Some people can separate the two images even when the visual angle is only 25 seconds (2.5µm retinal distance between two images).

❖ Three types of factors affect the visual acuity: stimulus factors, optical errors, and retinal factors.

Experiment- 8

Aim : To demonstrate the reflex activity.

Introduction : A **reflex,** or **reflex action** is an involuntary contraction of a muscle or a group of muscles (or secretion of a gland) in response to a specific stimulus, and which involves some part of the nervous system (brain and spinal cord).

- **Reflex arc** is the anatomical nervous pathway for a reflex action. A simple reflex arc includes 5 components:

1. Receptor, the end organ which receives the stimulus.

2. Afferent nerve (sensory nerve) which transmits sensory impulses from the receptor to the center.

3. The **center** (located in the brain or spinal cord) receives the sensory impulses via afferent nerve fibers and then generates appropriate motor impulses.

4. Efferent nerve (motor nerve) transmits motor impulses from the center to the effector organ.

5. Effector organ such as the muscle or gland shows the response to the stimulus.

- Reflexes are **classified** depending upon:

(a) **whether inborn**(unconditioned) or **acquired** (conditioned; need previous training)

(b) **situation of the center** (cerebeller, cortical, midbrain, bulbar or medullary, and spinal);

(c) **purpose or functional significance** (protective or flexor and antigravity or extensor reflexes);

(d) **number of synapse** (monosynaptic and polysynaptic); and
(e) **clinical basis** (superficial, deep, visceral and pathological reflexes).

- **Clinically Tested Reflexes :** In health, these reflexes should be present and equal on two sides of the body.

1. **Superficial Reflexes** (from skin and mucous membranes) include the plantar responses; the epigastric and abdominal reflexes; the ciliosplinal reflex; cremasteric, gluteal and anal reflexes; and the various mucous membrane reflexes (corneal or conjuctival, pharyngeal, palate reflex , etc.)

Experiment- 9

Aim: To measure the body temperature .

Principle: Normally, the body maintains a constant pulse, respiration and temperature. Any departure form the normal provides valuable clues to the progress of disease. Heat is produced in the body of oxidation of the food which results in the production of the energy. Most of the heat is produced by the muscles and the liver and carried to all; parts of the body by the blood. The body temperature is measured by an instrument called self registering clinical thermometer which is calibrated according to centigrade or Fahrenheit scale of both. The mercury in the bulb at the bottom expands with heat and rises into the fine capillary marked with readings.

Procedure: The temperature can be taken by placing the thermometer in the area of the body where it will; be surrounded by the tissue and close to large area of blood supply in the superficial blood vessels. Five such suitable areas are mouth, rectum, armpit, groin and vagina.

The mouth is simplest, most convenient and most comfortable part of the body for taking the temperature. However, other alternative places are used when a person is unable to hold the thermometer in the mouth or when he is unconscious. Rectal temperature is generally taken in young children. The thermometer should be washed and wiped before use with a clean handkerchief, sterilized cotton or a napkin. The reading of the mercury level should be below the 95^0C mark before recording the temperature. If it is above it then the thermometer should be shaken so that mercury level falls desired level.

Experiment- 10

Aim: To demonstrate positive and negative feedback mechanism.

Requirements: Charts showing positive and negative feedback mechanism.

Theory:

- **Homeostasis**

  Homeostasis is the condition of dynamic equilibrium (balance) in the body's internal environment due to ceaseless interplay of its many regulatory processes, e.g., the level of glucose in blood normally stays between 70 and 110 mg/ 100 ml of blood. Each structure, from the cellular level to the systemic level, contributes in some way to keeping the internal environment of the body within normal limits.

- **Disruption of homeostasis**

  Disruption of homeostasis comes from external and internal stimuli and psychological stresses. If the disruption is mild and temporary, responses of body cells quickly restore balance.

  - Most often, the **nervous** and **endocrine** systems acting together or separately regulate homeostasis. The nervous detects body changes and sends nerve impulses to counteract changes in controlled conditions. The endocrine system regulates by secreting hormones. Both work usually through negative feedback systems.

Experiment- 11

Aim: To determine tidal volume (TV) and vital capacity (VC)

Introduction: Lung volumes and capacities are measured by the method of spirometry. The simple instrument used for this purpose is called spirometer. The modified spirometer is called respirometer.

Plethymograph is also used to measure lung volumes and capacities.

Spirometer: The metallic spirometer contains two chambers (see Figure). The **outer chamber** is called the water chamber because it is filled with water. A floating chamber is immersed in water in an inverted manner. The inverted drum is counter balanced by a weight. The weight is attached to the top of the inverted drum by means of a string or chain passed over a pulley. A writing pen with ink is attached to the counter weight. The pen is made to write on a calibrated paper, which is fixed to a recording device.

Procedure: When the subject expires air during breathing, the drum moves up and the counter weight comes down. Reverse of this occurs when the subject inspires the air from the spirometer. The upward and downward movements of the counter weight are recorded in the form of a graph. The upward deflection of the curve in the graph shows inspiration and the downward deflection denotes expiration.

Experiment- 12

A) Human Respiratory System

Aim: To study the Human Respiratory System.

Requirement: Respiratory System chart model.

Theory

Respiration: Respiration is a process which involves intake of oxygen from environment and to deliver it to the cells. It includes oxidation of flood in cells with incoming oxygen, elimination of CO_2 produced in oxidation, release of energy during oxidation and storing it in the form of ATP.

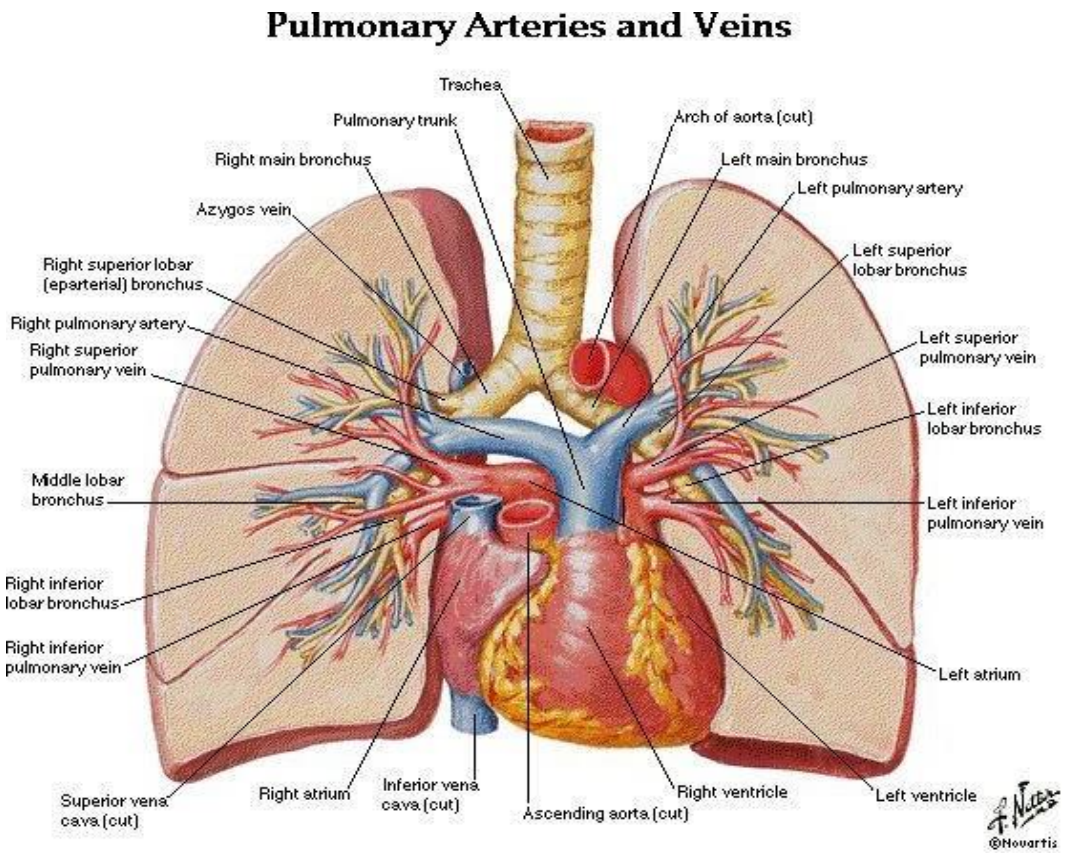


Fig.12.2 Lungs of Human

B) Human Digestive System

Aim: To study the Human Digestive System.

Requirement: Digestive System chart/ model.

Theory: The human digestive system is a complex series of organs and glands that process food. In order to use the food we eat, our body has to break the food down into smaller molecules that it can process; it also has to excrete waste. Most of the digestive organs (like the stomach and intestines) are tube- like and contain the food as it makes its way through the body. The digestive system is essentially a long, twisting tube that runs from the mouth to the anus, plus a few other organs (like the liver and pancreas) that produce or store digestive chemicals.

Alimentary tract- This is a long tube through which food passes. It commences at the mouth and terminates at the anus, and the various parts are given separate names, although structurallay they are remarkably similar.

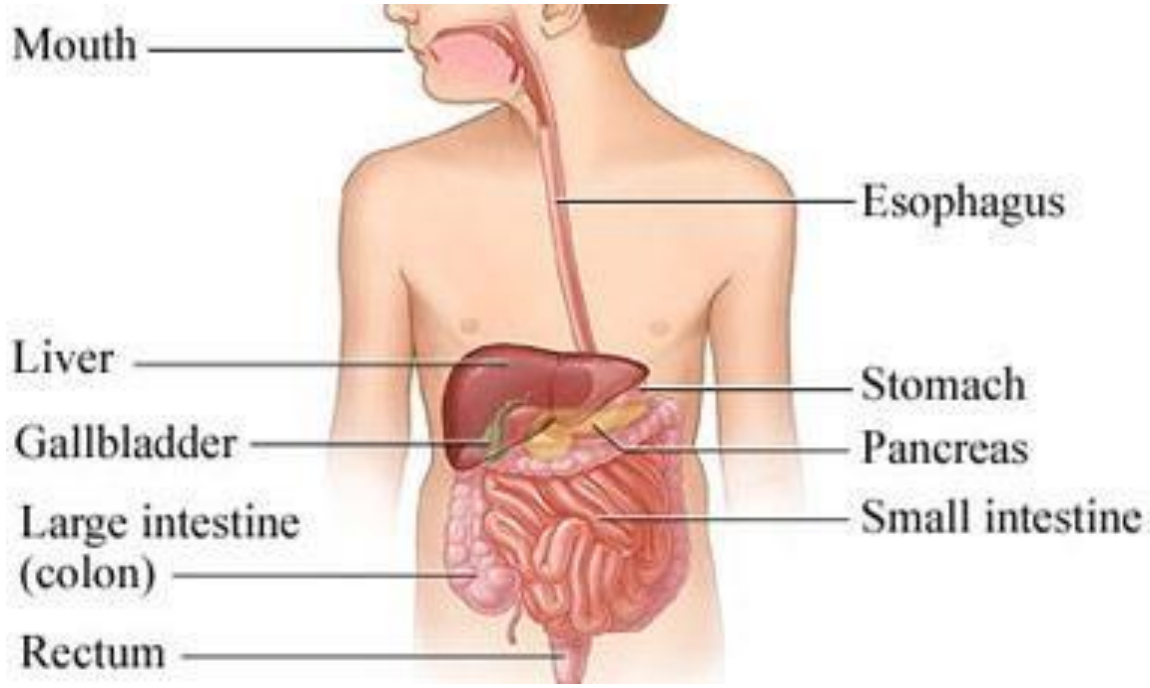


Fig. 13.1 PARTS OF HUMAN DIGESTIVE SYSTEM

C) Human Excretory System

Aim: To study the Human Excretory System.

Requirement: Excretory System char or model.

Theory : The human urinary system consists of a pair of kidneys, a pair of ureters, a urinary bladder and a urethra.

(i) Kidneys: The kidneys are dark- red, bean –shaped organs about 11 cm long, 5 cm wide and 3 cm thick, each weighing about 150 g in an adult male and about 135 g in adult female. They are placed against the back wall of the abdominal cavity just below the diaphragm, one on either side opposite the last thoracic and first three lumbar vertebrae. The lower two pairs of ribs protect them.

The kidneys are covered by peritoneum on the front (ventral) side only. Thus, they are retroperitoneal. The right kidney is attached more anterior than the left in rabbit. This asymmetry is just the reverse of that found in man.

In man left kidney occurs at a slightly higher level than the right one, because right side has prominent right liver lobe. In rabbit the condition is little different due to quadropedilism i.e. left kidney is in normal position while the right kidney is attached more anterior to provide place for stomach below it.

In mammals, the kidney is bean-shaped i.e. concavo-convex. The center of concave inner surface is called as **hilum** or **hilus** which gives out a ureter. From this hilus surface the renal artery enters into the kidney, the renal vein comes out and the renal nerves enter into the kidney.

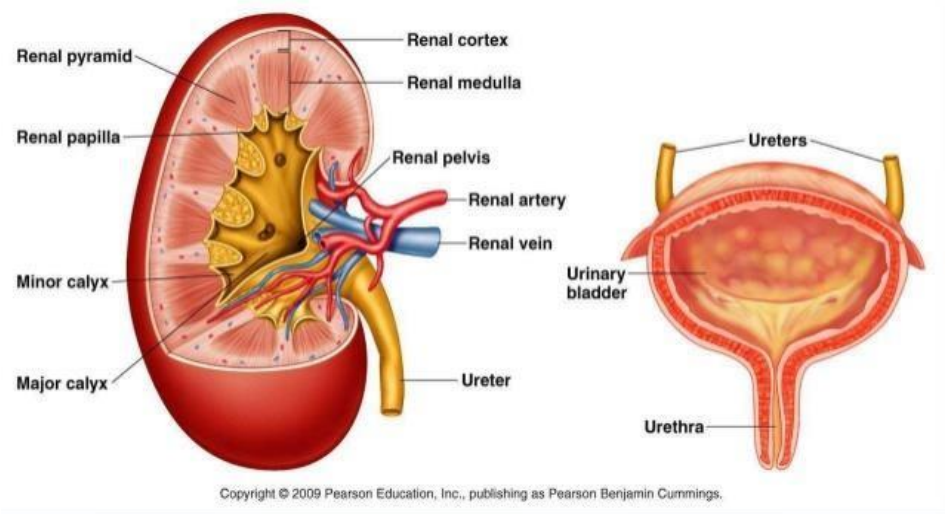


Fig.14.1 H.L.S. of human kidney

D) Human Cardiovascular System

Aim: To study the Human Cardiovascular system

Requirement: Cardiovascular system chart/ model.

Theory: Cardiovascular system is a closed circulatory transport system that transports gases, nutrients and excretory products. This system consists of the pumping station, the heart and the blood vessles.

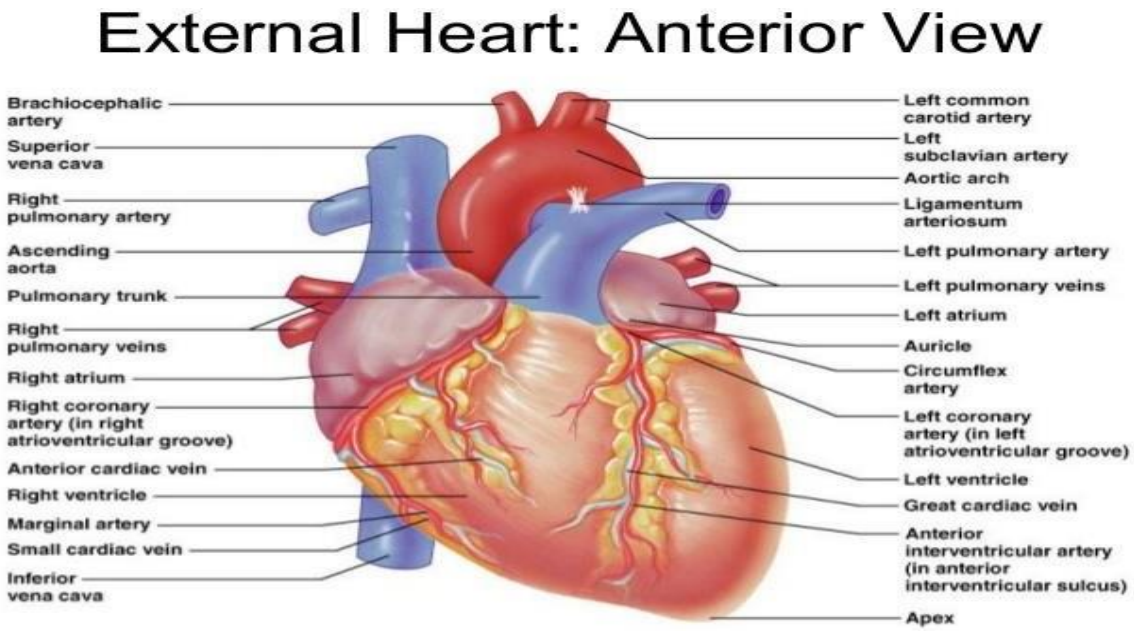


Fig.15.4 External features of human heart

E) Human Male reproductive system

Aim: To study the Human Male reproductive system.

Requirements: Male reproductive system chart or model.

MALE REPRODUCTIVE SYSTEM

The male reproductive system consists of a scrotum, a pair of testes, vasa efferentia, a pair of epididymis, a pair of vasa deferentia, a pair of ejaculatory ducts, a urethra, a penis and glands.

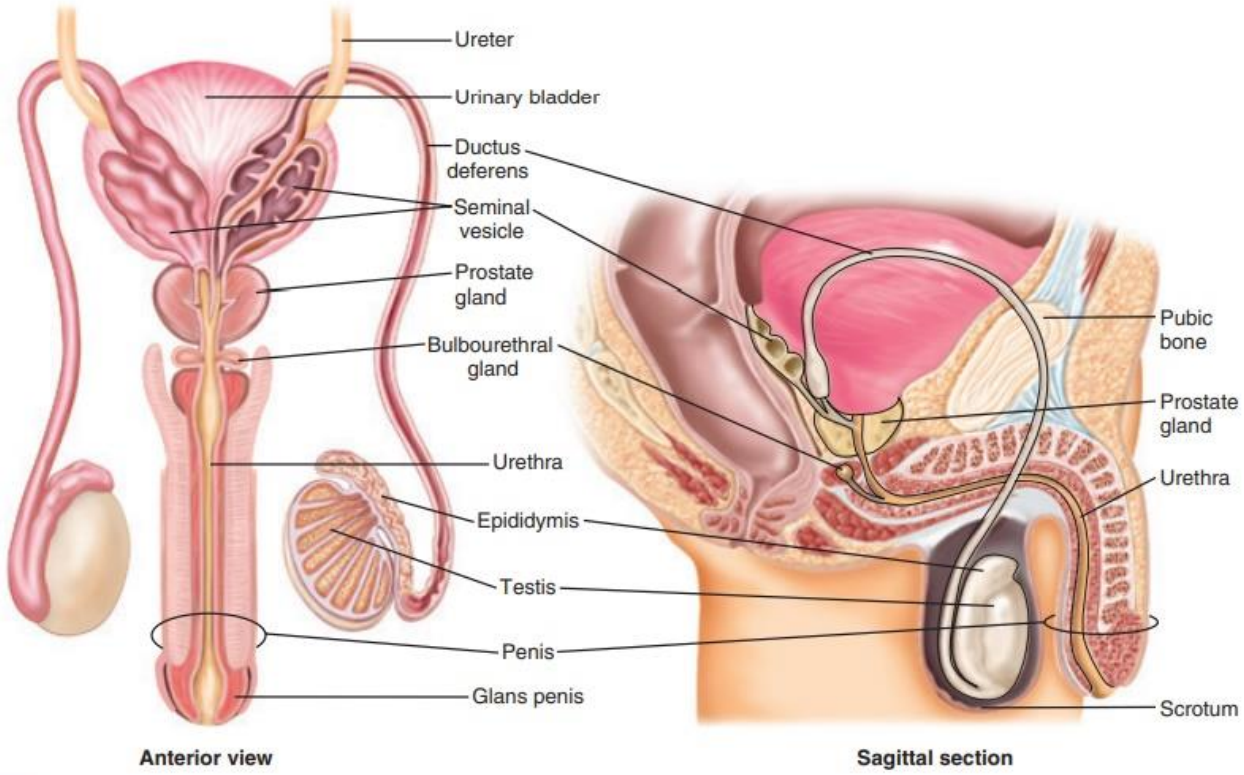


FIGURE The male organs of reproduction.

F) Human Female reproductive system

Aim: **To study the Human Female Reproductive System**.

Requirement: Female reproductive system chart or model.

Theory:

FEMALE REPRODUCTIVE SYSTEM

The female reproductive system consists of a pair of ovaries, a pair of fallopian tubes,uterus, vagina, external genitalia or vulva and breasts.

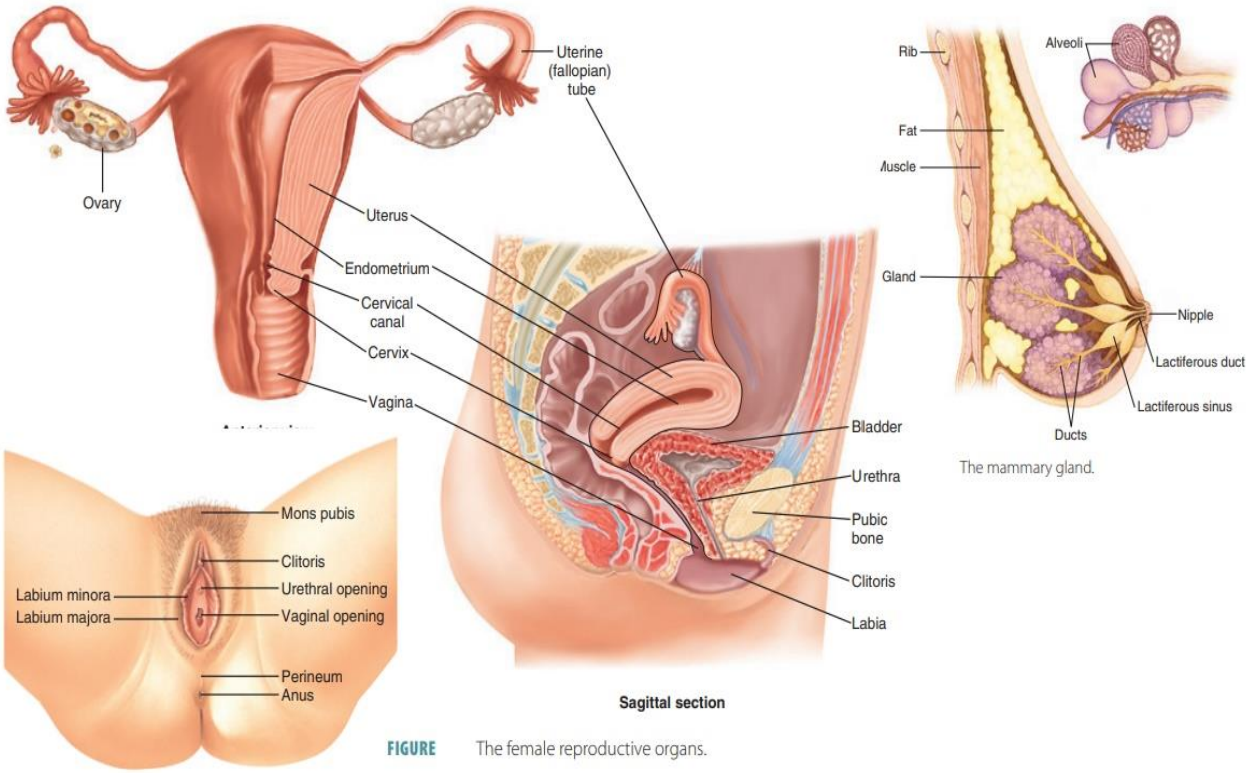


FIGURE The female reproductive organs.

Experiment- 13

Aim: To record basal mass index (BMI).

Overweight and obesity affect over 25% adults in developed countries and can lead to serious health problems, if not treated early. The common cause of obesity is consumption of foods in excess of requirements. Obesity is very common among the people of high income groups in India and people living in western countries. It is more common in people. who lead sedentary life.

Assessment of Obesity

There are various methods used to assess the obesity.

The most effective and scientific method is **BMI.**

Body mass index: Today the weight of an individual is assessed on a more scientific basis known as the body mass index (BMI)

$$\text{Body mass index} = \frac{\text{Weight in kilograms}}{(\text{Height in means})^2} \quad \frac{W}{H^2}$$

$$\text{Normal value for men} = \frac{W}{H^2} \quad 20\text{-}25$$

$$\text{For women} = \frac{W}{H^2} \quad 19\text{-}24$$

Experiment- 14

Aim: To study family planning devices and pregnancy diagnosis tests.

There are a number of family planning methods such as the mechanical methods, chemical methods, biological methods, hormonal methods, emergency contraceptive methods and surgical methods. These include : oral contraceptive, the IUD, the condom, and the diaphragm, jellies, creams, foaming tablets, and suppositories, thermometer, rhythm or safe period;, tubal ligation, hysterectomy , and vasectomy; and , other methods, abstinence, with drawal, and douche.

Confirmatory testes for Pregnancy:

The confirmatory tests carried during pregnancy are:

A) Urinary Immunological Tests – Urinary immunological tests include Latex agglutination slide test and Immuno chromatographic test.

1. Latex Agglutination Slide test – In slide test, when hCG antisera is combined with urine having hCG, if no agglutination appears then the pregnancy is positive. If there is visible agglutination, there is no pregnancy. This test comes positive after 2 weeks of missed menses.

2. Immunochromatographic test – These testes are available in market as Pregcolor Card or Asccutest hCG, etc. This test is more sensitive than the former test and come positive after one week of missed menses.

3. ELISA or Radioimmunoassay (RIA) – This test is specially indicated in patients with trophoblastic disease. It can detect hCG on the 8^{th} day of fertilization, before menses is missed.

4. Biological Tests, Achheim and Zondek test – As there is problem of availing of animals, this test is no more used.

Experiment- 15

Aim: To demonstrate total or complete blood count by automated cell analyser.

Procedure of Automated CBC (Complete Blood Count)

Complete blood count performed by an automated analyser. Differentials not seen here. Most blood counts today include a CBC count and leukocyte differential count (LDC) (that is not just the total WBC count but also the broken down percentage of each WBC type such as neutrophils, eosinophils, basophils, monocytes and lymphocytes). More sophisticated modern analyzers can provide extended differential counts, which include hematopoietic progenitor cells, immature granulocytes, and erythroblasts.

The blood is mixed (though not shaken) and placed on a rack in the analyzer. This instrument has flow cells, photometers and apertures that analyze different elements in the blood. The cells counting component counts the numbers and types of different cells within the blood. The results are printed out or sent to a computer for review.

Blood counting machines aspirate a very small amount of the specimen through narrow tubing followed by an aperture and a laser flow cell. Laser eye sensors count the number of cells passing through the aperture, and can identify them; this is flow cytometry. The two main sensors used are light detectors and electrical impedance. The instrument measures the type of blood cell by analyzing data about the size and aspects of light as they pass teristics of the cells to categorize them.

EAST POINT COLLEGE OF PHARMACY
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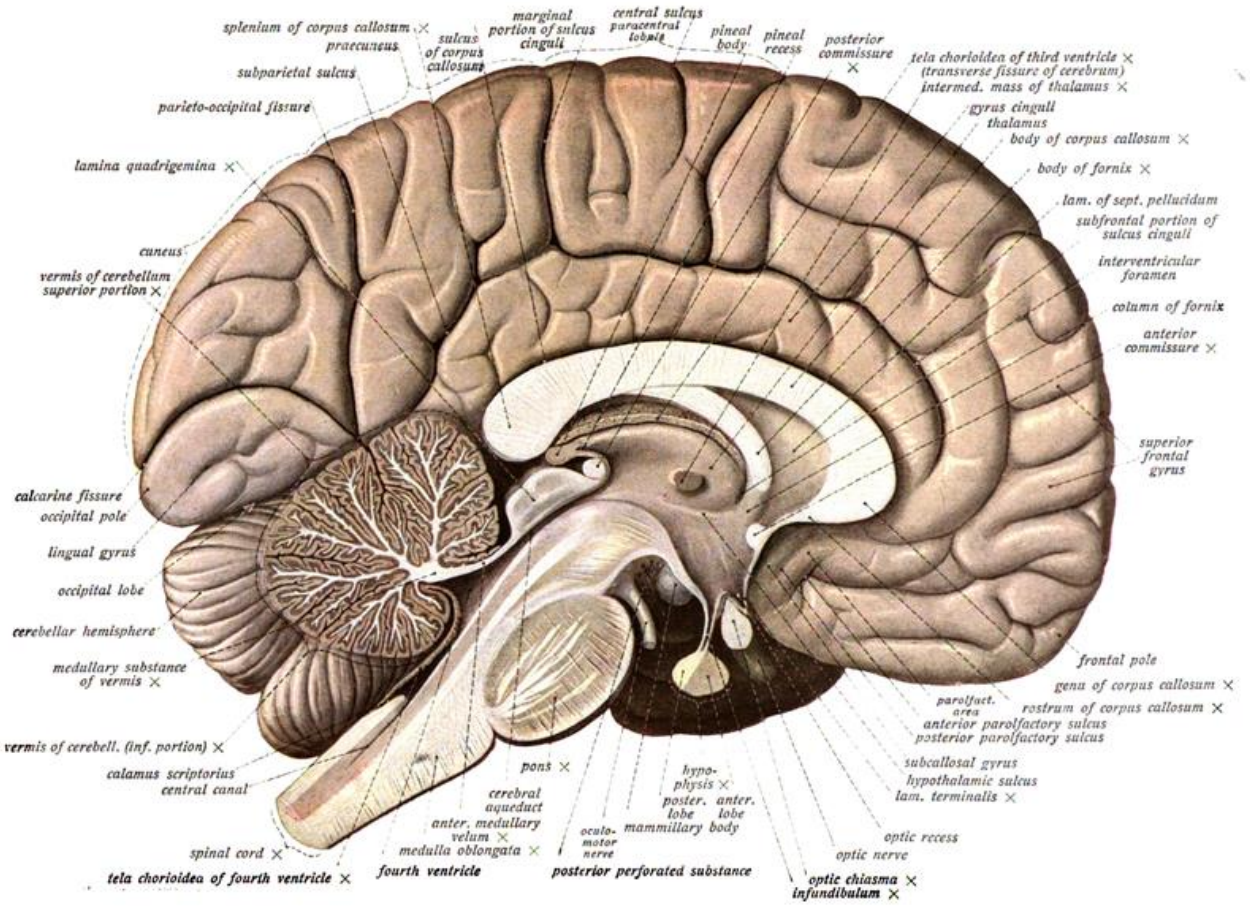
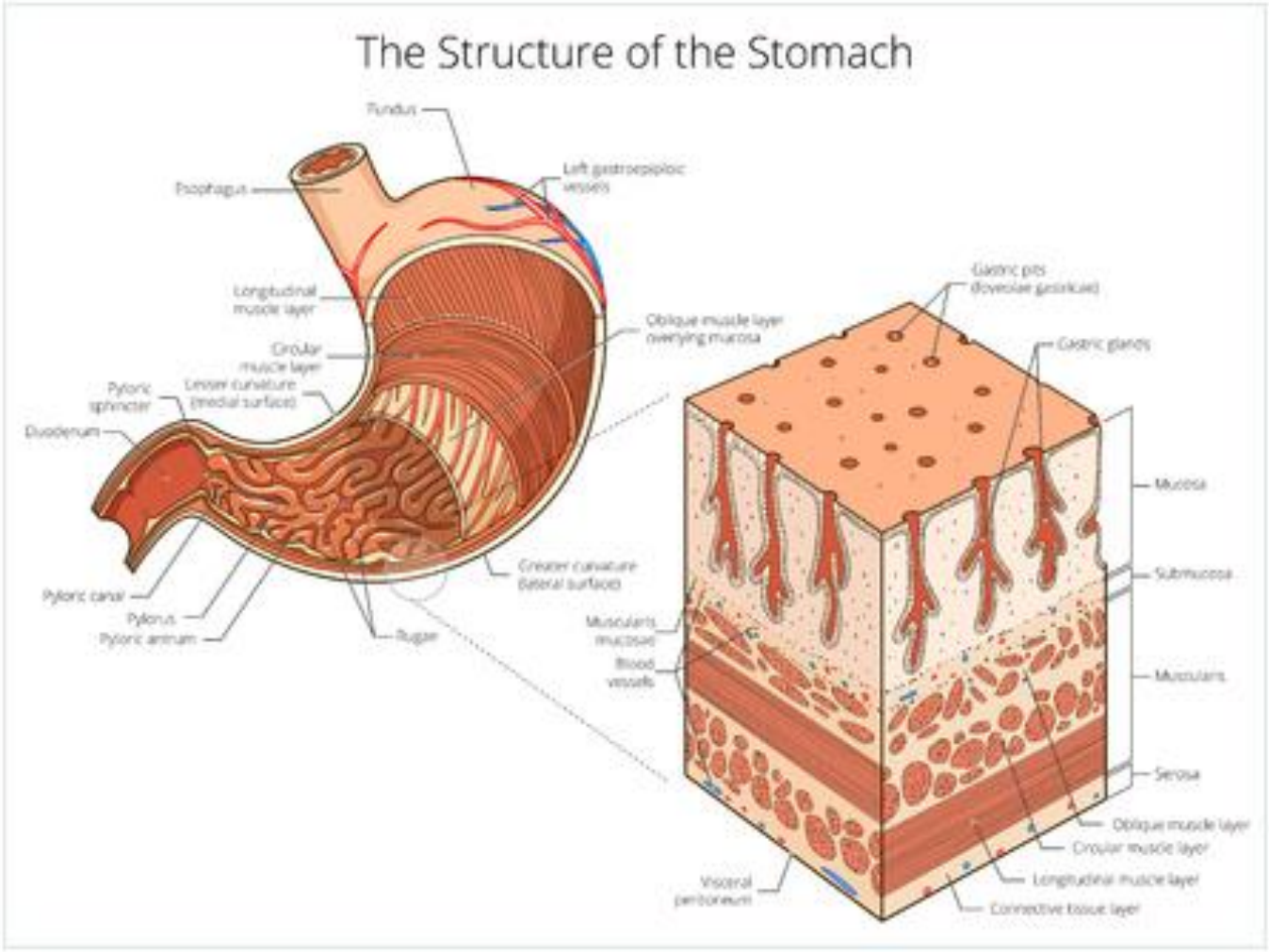
Experiment- 16

Aim: To study permanent slides of vital organs and gonads

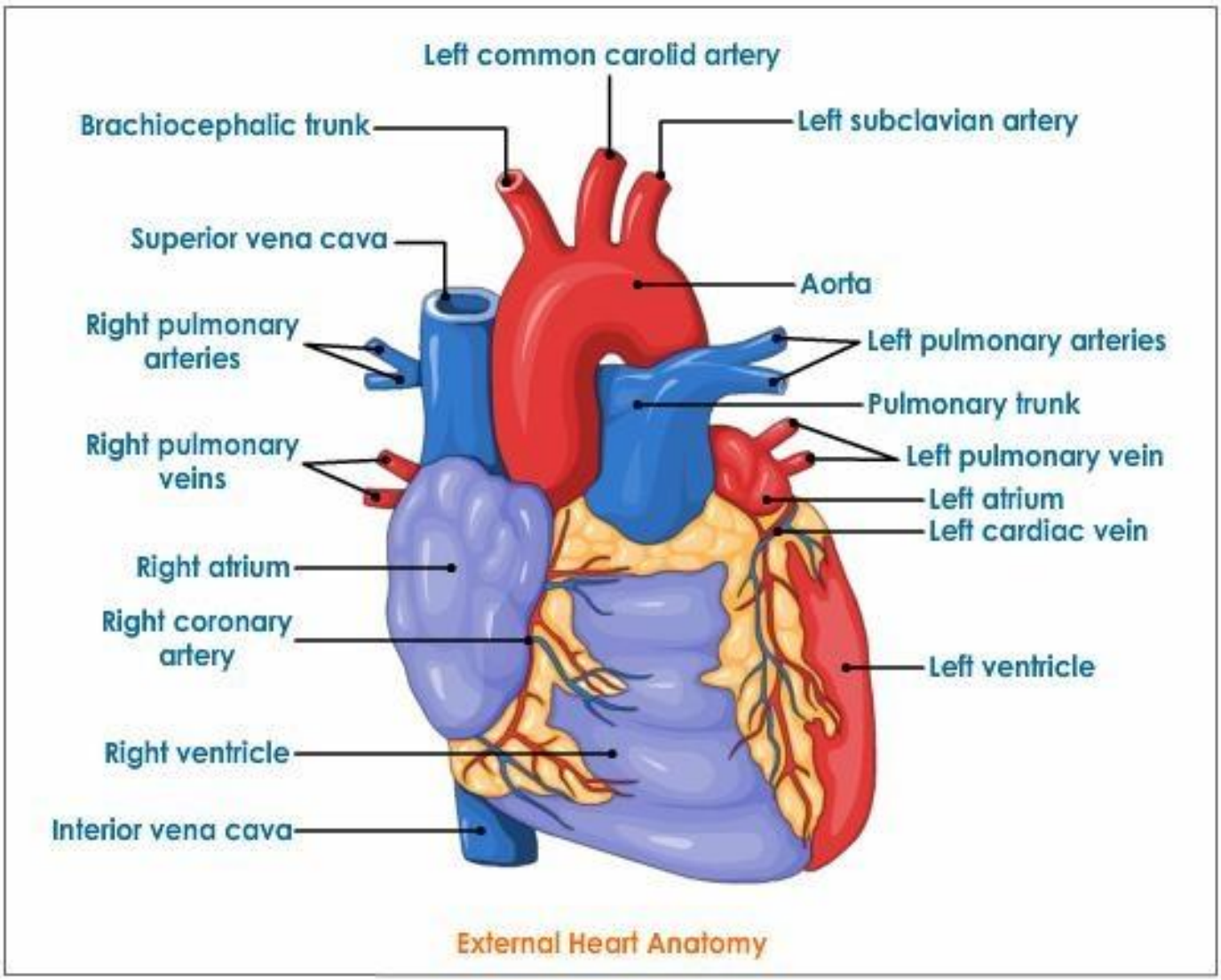
HUMAN BRAIN



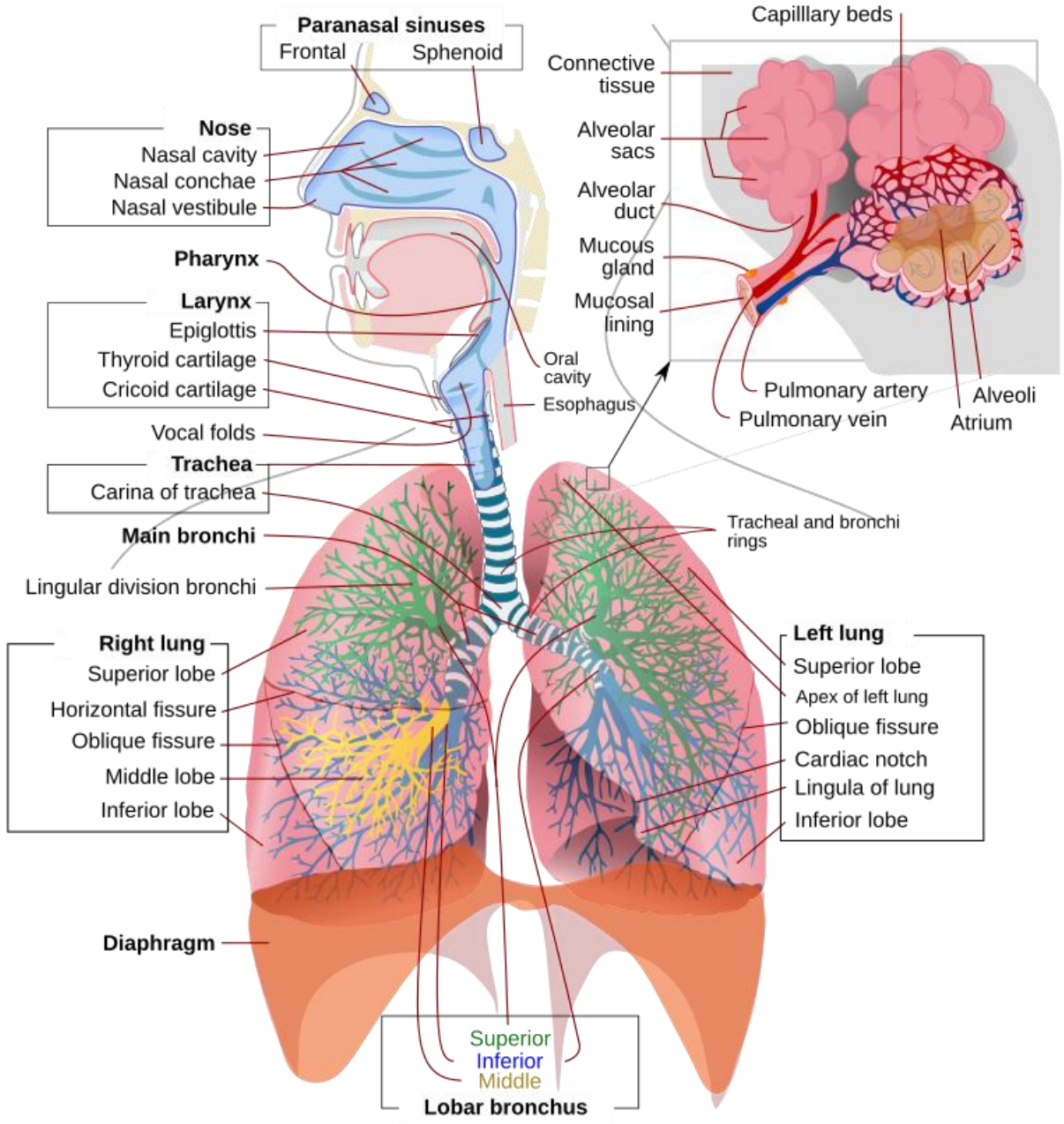
THE STOMACH


The Structure of the Stomach
Fundus
Oesophagus
Left gastroepiploic vessels
Longitudinal muscle layer
Circular muscle layer
Oblique muscle layer overlying mucosa
Pyloric sphincter
Lesser curvature (medial surface)
Duodenum
Pyloric canal
Pylorus
Pyloric antrum
Rugae
Greater curvature (lateral surface)
Gastric pits (foveolae gastricae)
Gastric glands
Mucosa
Submucosa
Muscularis mucosae
Blood vessels
Muscularis
Serosa
Oblique muscle layer
Circular muscle layer
Longitudinal muscle layer
Connective tissue layer
Visceral peritoneum

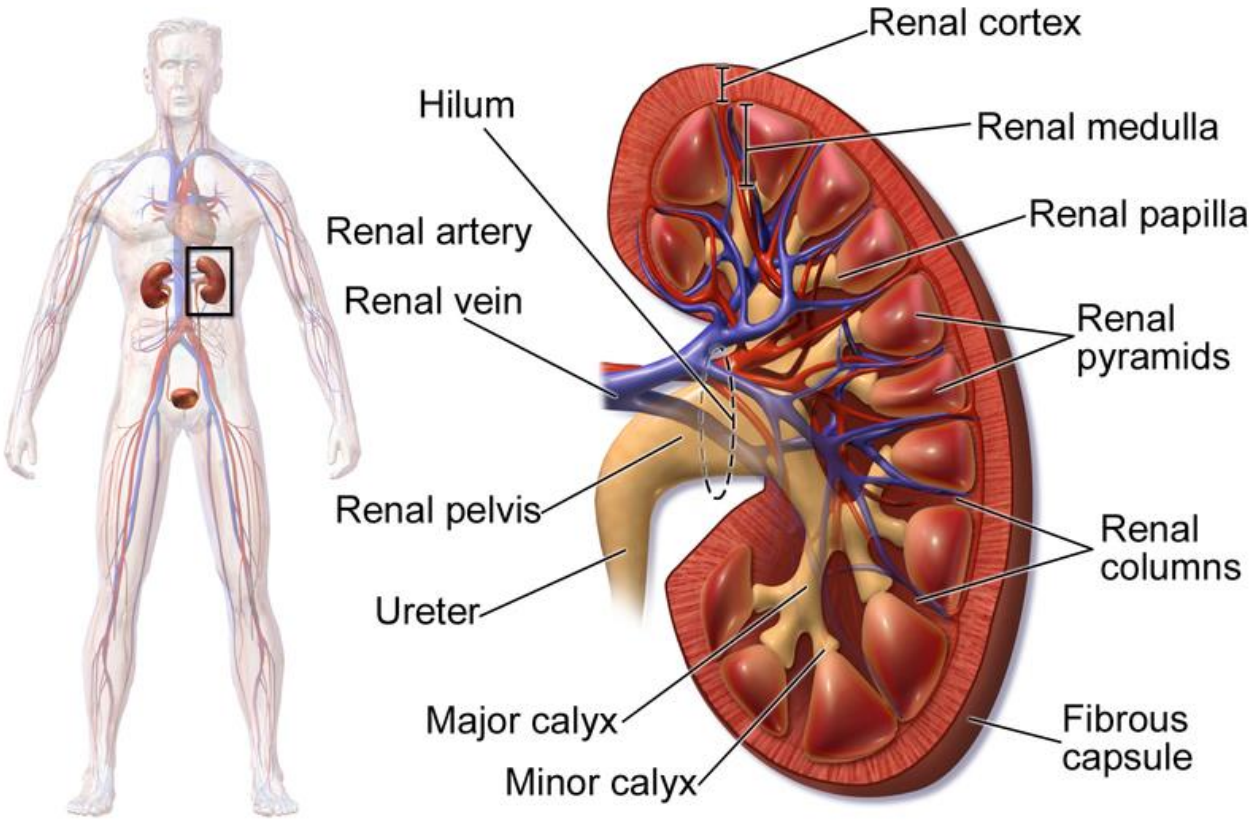
THE HEART


Left common carolid artery
Brachiocephalic trunk
Left subclavian artery
Superior vena cava
Aorta
Right pulmonary arteries
Left pulmonary arteries
Pulmonary trunk
Right pulmonary veins
Left pulmonary vein
Left atrium
Left cardiac vein
Right atrium
Right coronary artery
Left ventricle
Right ventricle
Interior vena cava
External Heart Anatomy

THE LUNGS

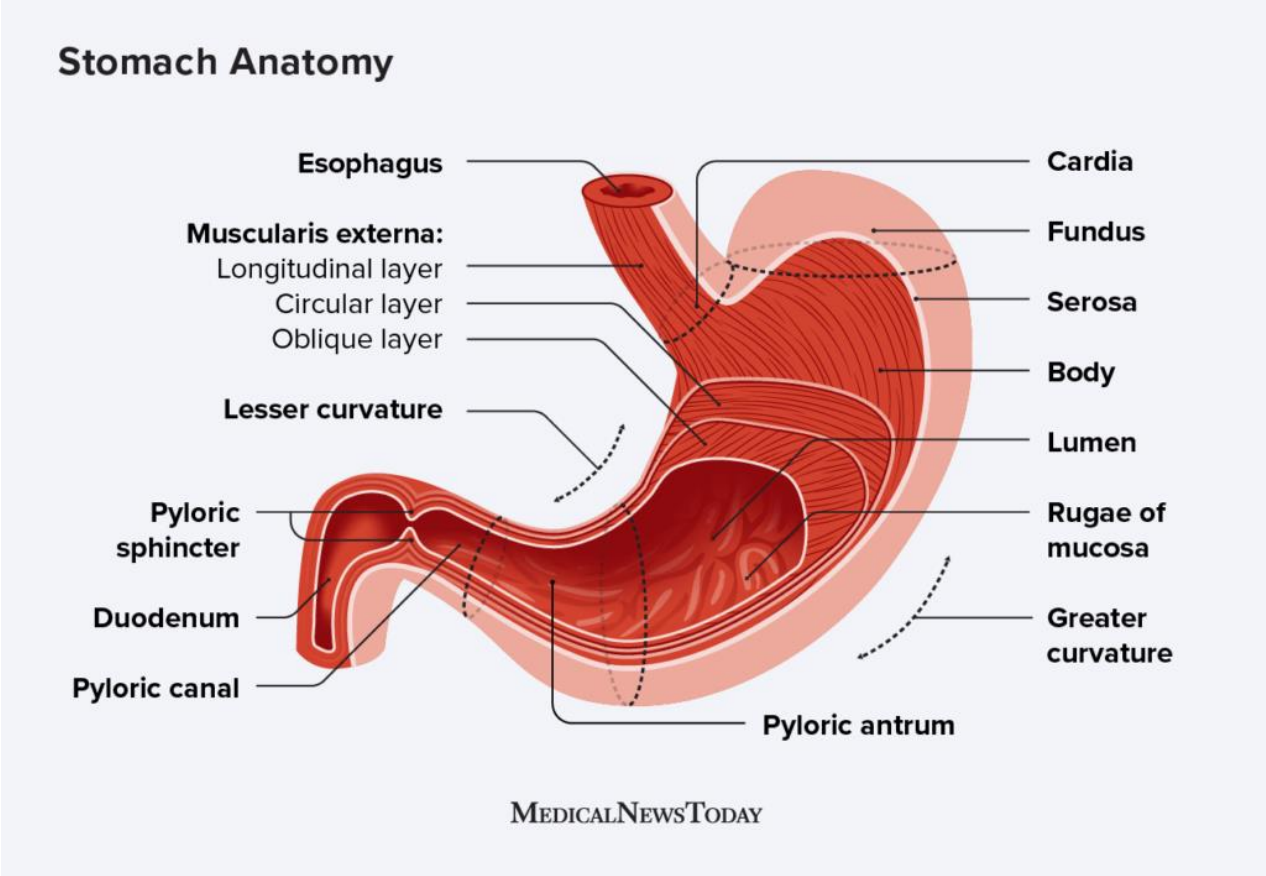

Paranasal sinuses
Frontal
Sphenoid
Nose
Nasal cavity
Nasal conchae
Nasal vestibule
Pharynx
Larynx
Epiglottis
Thyroid cartilage
Cricoid cartilage
Vocal folds
Trachea
Carina of trachea
Main bronchi
Lingular division bronchi
Right lung
Superior lobe
Horizontal fissure
Oblique fissure
Middle lobe
Inferior lobe
Diaphragm
Oral cavity
Esophagus
Capilllary beds
Connective tissue
Alveolar sacs
Alveolar duct
Mucous gland
Mucosal lining
Pulmonary artery
Pulmonary vein
Alveoli
Atrium
Tracheal and bronchi rings
Left lung
Superior lobe
Apex of left lung
Oblique fissure
Cardiac notch
Lingula of lung
Inferior lobe
Superior
Inferior
Middle
Lobar bronchus

THE KIDNEY

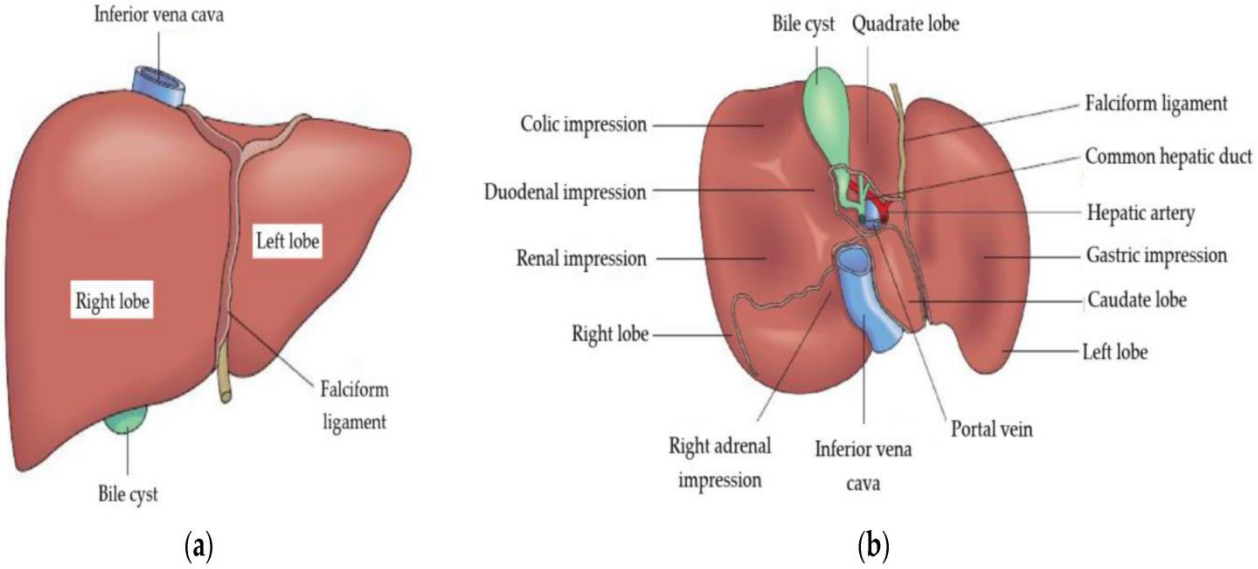


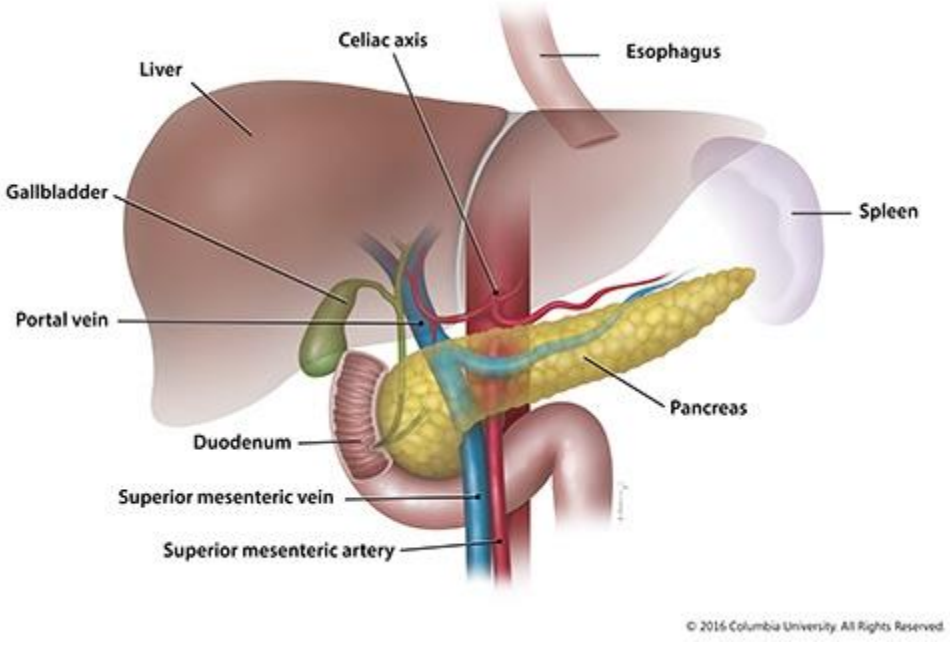
Kidney Anatomy

THE STOMACH


Stomach Anatomy
Esophagus
Muscularis externa:
Longitudinal layer
Circular layer
Oblique layer
Lesser curvature
Pyloric sphincter
Duodenum
Pyloric canal
Cardia
Fundus
Serosa
Body
Lumen
Rugae of mucosa
Greater curvature
Pyloric antrum
MEDICALNEWSTODAY

THE LIVER AND PANCREAS





GONADS

OVARY