TECHNOCRATS

Lab Work Book of

Human Anatomy and Physiology-I

(BP - 107 P)

Department of Pharmacy

Lab Manual of

Human Anatomy and Physiology-I

(BP - 107 P)

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TECHNOCRATS
PUBLICATIONS

Lab Work Book
of

Human Anatomy and Physiology-I

(BP - 107 P)

(Strictly According to RGPV Syllabus)

Name : .....

Enrollment No. : .....

Institute : .....

Academic Session : .....

Department of Pharmacy

TECHNOCRATS
PUBLICATIONS

Vision of the Institute

To grow as an institute of Excellence for Pharmacy Education and Research and to serve the humanity by sowing the seeds of intellectual, cultural, ethical, and humane sensitivities in the students to develop a scientific temper, and to promote professional and technological expertise.

Mission of the Institute

M 1: To inculcate ethical, moral, cultural and professional values in students

M 2: To provide state of art infrastructure facilities to the staff and students so as to enable them to learn latest technological advancements

M 3: State of art learning of professionalism by the faculty and students

M 4: To produce well learned, devoted and proficient pharmacists

M 5: To make the students competent to meet the professional challenges of future

M 6: To develop entrepreneurship qualities and abilities in the students

PROGRAM OUTCOMES (POs)

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.
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.
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.
4. **Modern tool usage:** Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of thelimitations.
5. **Leadership skills:** Understand and consider the human reaction to change, motivationissues, 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 well- being.
6. **Professional Identity:** Understand, analyze and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).
7. **Pharmaceutical Ethics:** Honour personal values and apply ethical principles in professional and social contexts. Demonstrate behavior 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.
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.
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.
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.
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-assess and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.

PEOs

PEO 1: To inculcate quality pharmacy education and training through innovative Teaching Learning Process.

PEO 2: To promote professionalism, team spirit, social and ethical commitment with effective interpersonal communication skills to boost leadership role assisting improvement in healthcare sector.

PEO 3: To enhance Industry-Institute-Interaction for industry oriented education and research, which will overcome healthcare problems of the society.

PEO 4: To adapt and implement best practices in the profession by enrichment of knowledge and skills in research and critical thinking

PEO 5: To generate potential knowledge pools with interpersonal and collaborative skills to identify, assess and formulate problems and execute the solution in closely related pharmaceutical industries and to nurture striving desire in students for higher education and career growth.

Course Outcomes (COs):

Student will be able to:

- CO1: Identify the major tissue types and locate examples of each in the body.
- CO2: Describe the different types of bones and provide an example of each type.
- CO3: Locate and identify anatomical structures that surround and protect the brain.
- CO4: Locate and identify anatomical structures of the special senses.
- CO5: Describe the somatic reflex arc.

Index

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Experiment No. 1

AIM:

To study compound microscope.

REFERENCE:

1. "Practical Human Anatomy and Physiology" by S. R. Kale and R. R. Kale, 6th Edition 2006, published by Nirali Prakashan, Pune, page no.01-03.

REQUIREMENTS:

Compound Microscope, Clean Microscope Slides, Cover Slips, Lens papers, Sharp razor blades, Medicine droppers, Scissors, Distilled water, Xylene.

THEORY:

The Microscope

Highlights

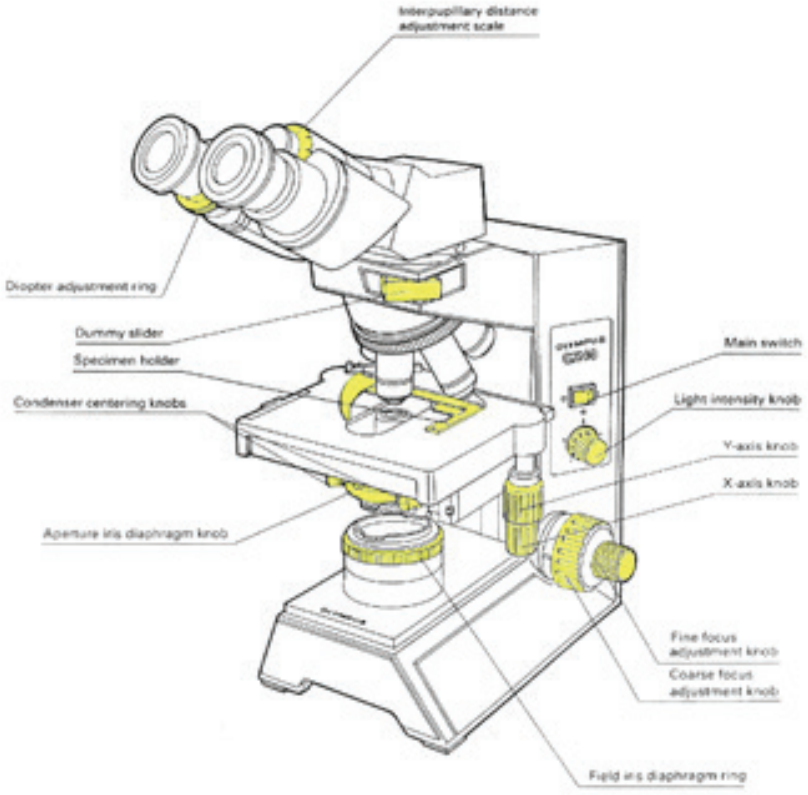
This Exercise focuses on how to develop a working knowledge of the Microscope and its use. Students should identify the different parts of the Microscope. List and follow recommended procedures in using and caring for the Microscope.

INTRODUCTION

Since an unaided eye cannot detect anything smaller than 0.1 mm in diameter, cells, tissues, and many small organisms are beyond our visual capability, so we need equipment to magnified objects which is too small to be seen with unaided eye.

There are several types of microscopes but the only one used in this laboratory is the compound light microscope. The compound microscope (sometimes called the student microscope or light microscope); these microscopes are known as compound microscope because there are two magnifying lenses in the microscope. One magnifying lens is in the ocular or eyepiece, which further magnifies the image formed by the objective lens, and one, is in the objective. Each contributes to the magnification of the object on the stage.

The total magnification of any set of lenses is determined by multiplying the magnification of the objective by the magnification of the ocular. The nose piece rotates the magnification of the microscope. Generally compound microscope magnifies from 40 x to 100 x.



A binocular compound microscope

Parts of a microscope

The compound microscope is a delicate instrument composed of many parts that are accurately filled together in (Figure)

1. Ocular of eyepiece lens : The ocular lens is the lens you look through, it is inserted at the top of the body tube. If your microscope has one ocular, it is a monocular microscope, if it has two, it is binocular. Its magnification is written on it.
2. Body tube : Body tube is the optical housing for the objective lenses.
3. Objective lenses : The objective lenses are a set of three to four lenses mounted on a rotating turret at the bottom of the body tube. The four objective lenses of your microscope and their magnifications are:

Scanning lens	4X magnification
Low power lens	10X magnification
High power lens	40-45X magnification
Oil immersion lens	100X magnification

The magnification of the objective lens is written on the lens.

4. Stage : The horizontal surface on which the slide is placed is called the stage. It may be equipped with simple clips for holding the slide in place or with a mechanical stage, a geared device for precisely moving the slide. Two knobs, either on top of or under the stage, move the mechanical stage.
5. Condenser lens : Condenser lens system, located immediately under the stage, contains a system of lenses that focuses light on your specimen. The condenser may be raised or lowered using the condenser knob. An older microscope may have a concave mirror instead.
6. Iris diaphragm : Iris diaphragm is located below the condenser or immediately below the stage in microscopes without a condenser. It functions in regulating the light intensity passing through to the stage. More light is required at higher magnification.
7. Light source : The light source has an (ON/Off) switch & may have adjustable lamp intensities & color filters.
8. Base : Base – also called the supporting stand, rests on the bench.
9. Body Arm : The body arm is used when carrying the instrument.
10. Nose piece : Nosepiece is the mounting for the objective lenses which rotates to bring the desired objective into position.
11. Coarse adjustment : Coarse adjustment knob is a large knob located at either side of the microscope which functions in controlling the distance between the objectives and the stage.

Use the coarse adjustment only with the scanning (4X) & low- power (10X) objectives.

So coarse adjustment is used for rapid focusing of the specimen until the specimen is roughly in focus & then left alone, in which the fine adjustment knob controls precise focusing of the object.

12. Fine adjustment : Fine adjustment is a small knob located at either side of the microscope. This is used for the control of the object, precise focusing you should use just the fine adjustment knob with the higher magnification objective lenses; Because using the coarse adjustment knob with the higher objective lenses may damage the lens &/or the slide you are observing.

Magnification:

Compound microscopes consist of two lens system: the objective lens, which magnifies, & projects a "virtual image" into the body tube and the ocular lens, which magnifies the image further and projects the enlarged image into the eye.

The total magnification of a microscope is the product of the magnification of the objective and the ocular. If the objective lens has a magnification of 5X and the ocular 12X, then the image produced by these two lenses is 60 times larger than the specimen.

RESULTS & DISCUSSION:

VIVA QUESTIONS

Q.1 What is magnification power?

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Q.2 Give functions of condenser lens.

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Q.3 Write down definition of oil immersion lens?

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Experiment No. 2

AIM:

Microscopic study of Epithelial and Connective tissues.

REFERENCE:

1. "Principles of Anatomy and Physiology" by G.J. Tortora, 12th Edition 2009, vol.I, published by John Wiley & Sons, Asia Pte Ltd., page no.109-120.

REQUIREMENTS:

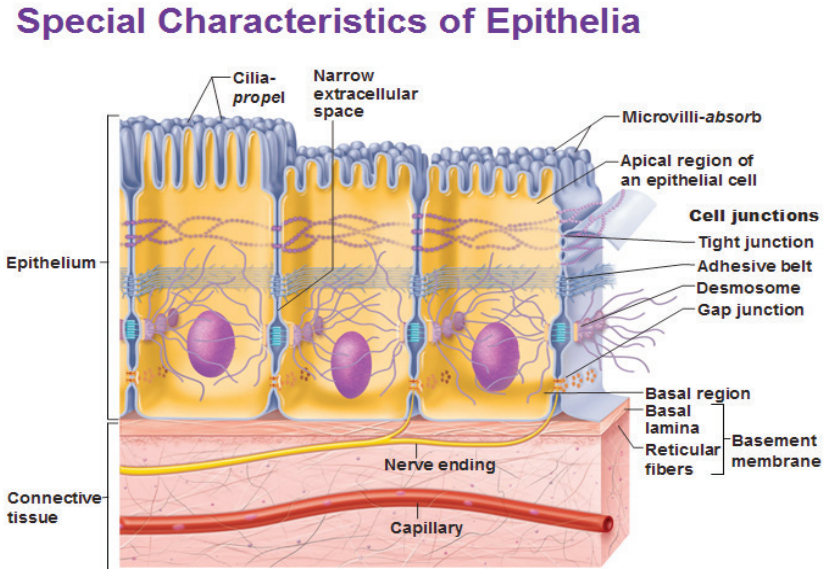
Microscope and permanent glass slide.

THEORY:

Epithelial Tissue

Epithelium is one of the four basic types of animal tissue. The other three types are connective tissue, muscle tissue and nervous tissue. Epithelial tissues line the cavities and surfaces of blood vessels and organs throughout the body.

There are three principal shapes of epithelial cells: squamous, columnar, and cuboidal. These can be arranged in a single layer of cells as simple epithelium, either squamous, columnar or cuboidal, or in layers of two or more cells deep as stratified (layered), either squamous, columnar or cuboidal. All glands are made up of epithelial cells. Functions of epithelial cells include secretion, selective absorption, protection, transcellular transport, and sensing. Epithelial layers contain no blood vessels, so they must receive nourishment via diffusion of substances from the underlying connective tissue, through the basement membrane.

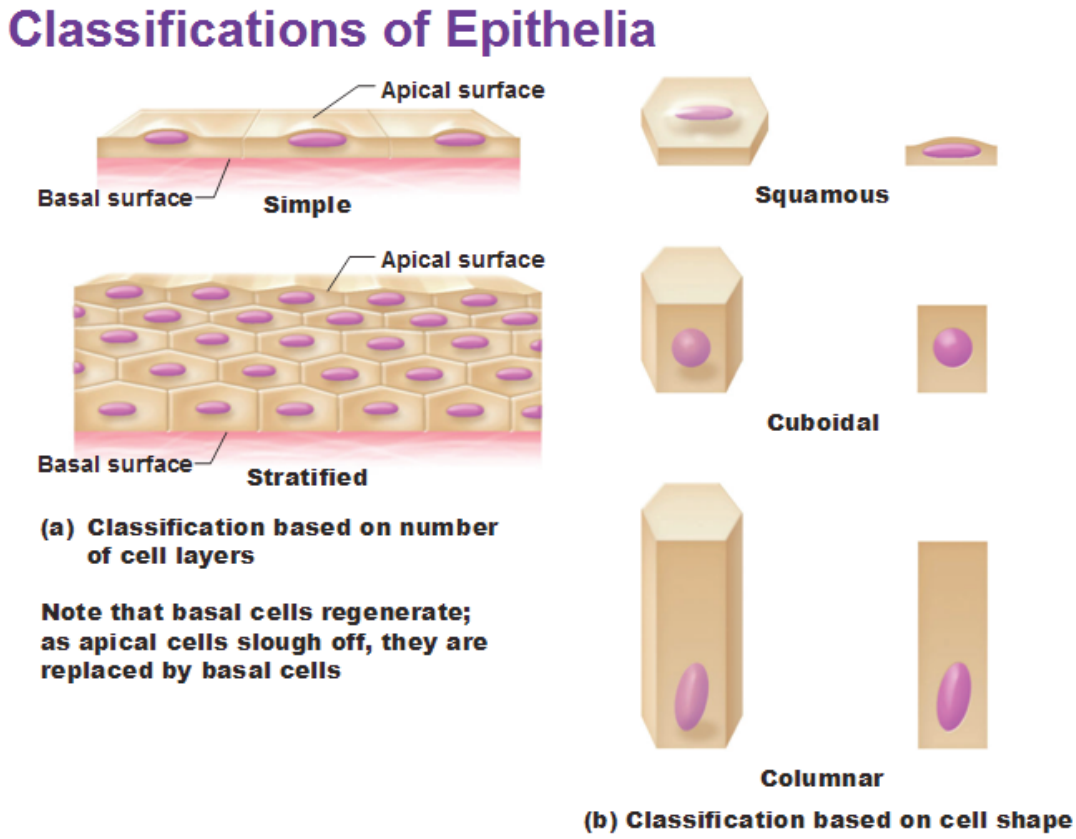


Classification

In general, tissues are classified by the morphology of their cells, and the number of their layers.Epithelial tissue that is only one cell thick is known as simple epithelium. If it is two or more cells thick, it is known as stratified epithelium. However, when taller simple epithelial cells are viewed in cross section with several nuclei appearing at different heights, they can be confused with stratified epithelia. This kind of epithelium is therefore described as "pseudostratified" epithelium.

There are three principal morphologies associated with epithelial cells:

- Squamous epithelium has cells that are wider than their height (flat and scale-like).
- Cuboidal epithelium has cells whose height and width are approximately the same (cube shaped).
- Columnar epithelium has cells taller than they are wide (column-shaped).
- Transitional epithelium has cells that can change from squamous to cuboidal, depending on the amount of tension on the epithelium.



Simple epithelium

Simple epithelium is one cell thick; that is, every cell is in direct contact with the underlying basement membrane. In general, it is found where absorption and filtration occur. The thinness of the epithelial barrier facilitates these processes.

In general, simple epithelial tissues are classified by the shape of their cells. The four major classes of simple epithelium are: (1) simple squamous; (2) simple cuboidal; (3) simple columnar; (4) pseudostratified.

1. simple squamous; which is found lining areas where passive diffusion of gases occur. e.g. walls of capillaries, linings of the pericardial, pleural,and peritoneal cavities, as well as the linings of

the alveoli of the lungs.

2. simple cuboidal: these cells may have secretory, absorptive, or excretory functions. examples include small collecting ducts of kidney,pancreas and salivary gland.
3. simple columnar; found in areas with extremely high secretive (as in wall of the stomach), or absorptive (as in small intestine) areas. they possess cellular extensions (e.g. microvilli in the small intestine, or cilia found almost exclusively in the female reproductive tract).
4. pseudostratified epithelium; this is also called respiratory epithelium as it is almost exclusively confined to the larger respiratory airways of the nasal cavity, trachea and bronchi.

Stratified epithelium

Stratified epithelium differs from simple epithelium in that it is multilayered. It is therefore found where body linings have to withstand mechanical or chemical insult such that layers can be abraded and lost without exposing subepithelial layers. Cells flatten as the layers become more apical, though in their most basal layers the cells can be squamous, cuboidal or columnar.

Squamous - Squamous cells have the appearance of thin, flat plates. They fit closely together in tissues; providing a smooth, low-friction surface over which fluids can move easily. The shape of the nucleus usually corresponds to the cell form and helps to identify the type of epithelium. Squamous cells tend to have horizontally flattened, elliptical (oval or shaped like an egg) nuclei because of the thin flattened form of the cell. Classically, squamous epithelia are found lining surfaces utilizing simple passive diffusion such as the alveolar epithelium in the lungs. Specialized squamous epithelia also form the lining of cavities such as the blood vessels (endothelium) and pericardium (mesothelium) and the major cavities found within the body.

Cuboidal - As their name implies, cuboidal cells are roughly cuboidal in shape, appearing square in cross section. Each cell has a spherical nucleus in the centre. Cuboidal epithelium is commonly found in secretive or absorptive tissue: for example the (secretive) exocrine gland the pancreas and the (absorptive) lining of the kidney tubules as well as in the ducts of the glands. They also constitute the germinal epithelium that covers the female ovary.

Columnar- Columnar epithelial cells are elongated and column-shaped. Their nuclei are elongated and are usually located near the base of the cells. Columnar epithelium forms the lining of the stomach and intestines. Some columnar cells are specialized for sensory reception such as in the nose, ears and the taste buds of the tongue. Goblet cells (unicellular glands) are found between the columnar epithelial cells of the duodenum. They secrete mucus, which acts as a lubricant.

Pseudostratified - These are simple columnar epithelial cells whose nuclei appear at different heights, giving the misleading (hence "pseudo") impression that the epithelium is stratified when the cells are viewed in cross section. Pseudostratified epithelium can also possess fine hair-like extensions of their apical (luminal) membrane called cilia. In this case, the epithelium is described as "ciliated" pseudostratified epithelium. Cilia are capable of energy dependent pulsatile beating in a certain direction through interaction of cytoskeletal microtubules and connecting structural proteins and enzymes. In the respiratory tract the wafting effect produced causes mucus secreted locally by the goblet cells (to lubricate and to trap pathogens and particles) to flow in that direction (typically out of the body). Ciliated epithelium is found in the airways (nose, bronchi), but is also found in the uterus and Fallopian tubes of females, where the cilia propel the ovum to the uterus.

Structure

Cells of epithelial tissue are tightly packed and form a continuous sheet. They have almost no intercellular spaces. All epithelia is usually separated from underlying tissues by an extra cellular fibrous basement membrane. The lining of the mouth, lung alveoli and kidney tubules all are made of epithelial tissue. The lining of the blood and lymphatic vessels are of a specialised form of epithelium called endothelium.

Location

Epithelium lines both the outside (skin) and the inside cavities and lumina of bodies. The outermost layer of human skin is composed of dead stratified squamous, keratinized epithelial cells.

Tissues that line the inside of the mouth, the esophagus and part of the rectum are composed of nonkeratinized stratified squamous epithelium. Other surfaces that separate body cavities from the outside environment are lined by simple squamous, columnar, or pseudostratified epithelial cells. Other epithelial cells line the insides of the lungs, the gastrointestinal tract, the reproductive and urinary tracts, and make up the exocrine and endocrine glands. The outer surface of the cornea is covered with fast-growing, easily regenerated epithelial cells. Endothelium (the inner lining of blood vessels, the heart, and lymphatic vessels) is a specialized form of epithelium. Another type, mesothelium, forms the walls of the pericardium, pleurae, and peritoneum.[citation needed]

Basement membrane

Epithelial tissue rests on a basement membrane, which acts as a scaffolding on which epithelium can grow and regenerate after injuries. Epithelial tissue is innervated, but avascular. This epithelial tissue must be nourished by substances diffusing from the blood vessels in the underlying tissue, but they don't have their own blood supply. The basement membrane acts as a selectively permeable membrane that determines which substances will be able to enter the epithelium.

Cell junctions

Cell junctions are especially abundant in epithelial tissues. They consist of protein complexes and provide contact between neighbouring cells, between a cell and the extracellular matrix, or they build up the paracellular barrier of epithelia and control the paracellular transport.

Connective Tissue

This is the most widespread and abundant type of tissue in the human body. Its function is primarily to **support**, **anchor** and **connect** various parts of the body. Although connective tissue exists in a number of forms, all types have three basic structural elements -- cells, fibres and intercellular substance (ground substance).

The most common cell types are fibroblasts, which produce fibres and other intercellular materials. The two most common types of fibres are: collagen (collagenous) and elastic. Collagen fibres are for strength while the elastic ones are for elasticity of the tissue. Both the cells and the fibres are embedded in the intercellular substance. The consistency of this substance is highly variable from gelatin-like to a much more rigid material.

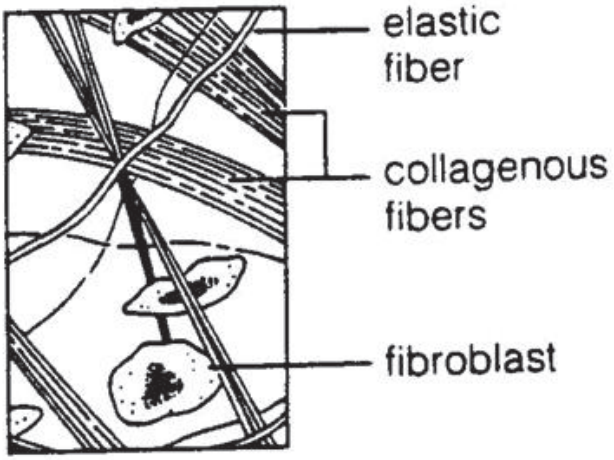
The proportions of the cells, fibres, and intercellular substance vary, depending on a particular nature and function of the connective tissue. For example, a strong connective tissue needs a greater proportion of the collagen fibres and fewer cells. An example would be a dense regular connective tissue, which is found in tendons and ligaments. On the other hand, a connective tissue composed of mostly cells would not be very strong. An example would be an adipose (fat) connective tissue.

Classification of Connective Tissue

- **Connective Tissue Proper** -- encompasses all organs and body cavities connecting one part with another and, equally important, separating one group of cells from another. This is a very large and diverse group of tissues and includes adipose tissue (fat), areolar (loose) tissue, and dense regular tissue, among others.
- **Specialized Connective Tissues** -- this group includes cartilage, bone, and blood. Cartilage and bone form the skeletal framework of the body while blood is the vascular (transport) tissue of animals.

Connective tissue proper

Areolar (Loose) Connective Tissue

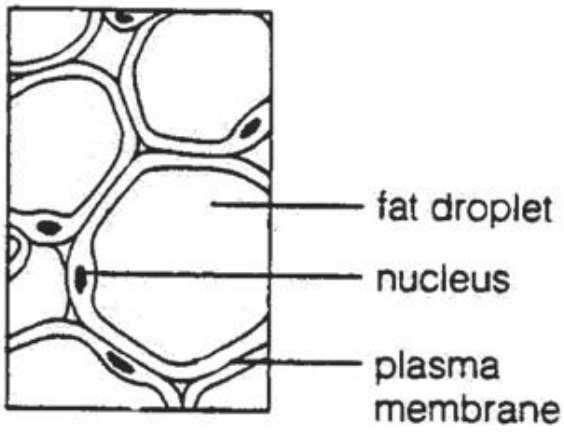


Areolar connective tissue is the most widespread connective tissue of the body. It is used to attach the skin to the underlying tissue. It also fills the spaces between various organs and thus holds them in place as well as cushions and protects them. It also surrounds and supports the blood vessels.

The fibres of areolar connective tissue are arranged in no particular pattern but run in all directions and form a loose network in the intercellular material. Collagen (collagenous) fibres are predominant. They usually appear as broad pink bands. Some elastic fibres, which appear as thin, dark fibres are also present. Examine slide #31 and locate these two types of fibres.

The cellular elements, such as fibroblasts, are difficult to distinguish in the areolar connective tissue. But, one type of cells - the mast cells are usually visible. They have course, dark-staining granules in their cytoplasm. Since the cell membrane is very delicate it frequently ruptures in slide preparation, resulting in a number of granules free in the tissue surrounding the mast cells. The nucleus in these cells is small, oval and light-staining, and may be obscured by the dark granules.

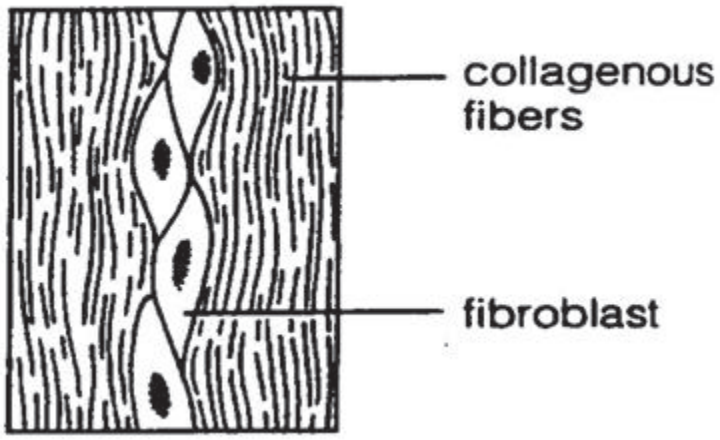
Adipose Connective Tissue



The cells of adipose (fat) tissue are characterized by a large internal fat droplet, which distends the cell so that the cytoplasm is reduced to a thin layer and the nucleus is displaced to the edge of the cell. These cells may appear singly but are more often present in groups (Figure 11). When they accumulate in large numbers, they become the predominant cell type and form adipose (fat) tissue.

Adipose tissue, in addition to serving as a storage site for fats (lipids), also pads and protects certain organs and regions of the body. As well, it forms an insulating layer under the skin which helps regulate body temperature.

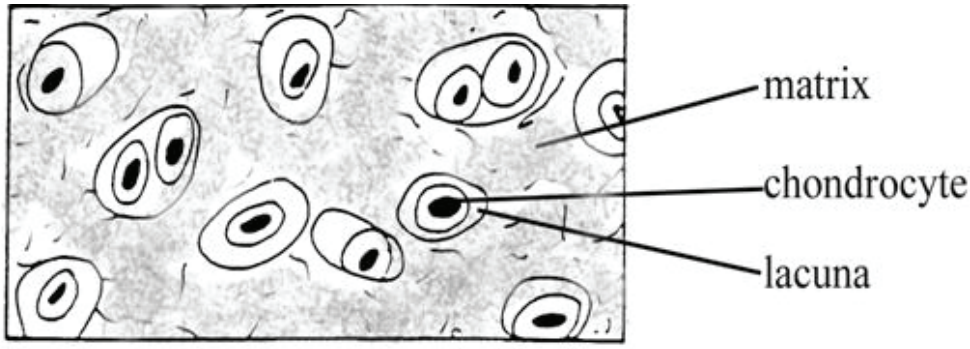
Dense (Fibrous) Regular Connective Tissue



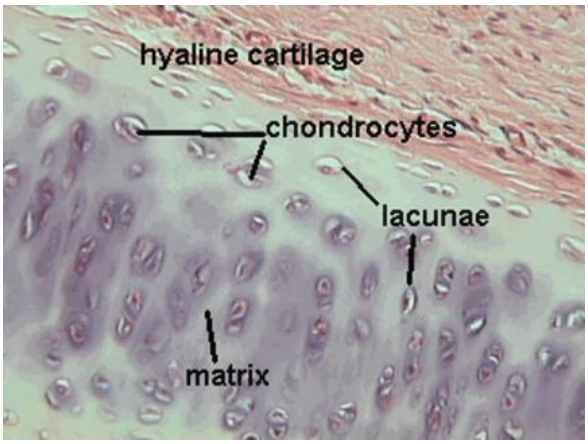
Dense connective tissue is characterized by an **abundance of fibres** with **fewer cells,** as compared to the loose connective tissue. It is also called fibrous or collagenous connective tissue because of the abundance of collagen (collagenous) fibres. Little intercellular substance is present. Furthermore, in this tissue type, the fibres are organized in a regular, parallel pattern. Hence, the name – dense regular (fibrous or collagenous) connective tissue.

Specialized Connective Tissues

Cartilage



Cartilage is a somewhat elastic, pliable, compact type of connective tissue. It is characterized by three traits: **lacunae, chondrocytes,** and a **rigid matrix**. The matrix is a firm gel material that contains fibres and other substances. There are three basic types of cartilage in the human body: hyaline cartilage, elastic cartilage and fibrocartilage. In this laboratory, you will examine the most common type of cartilage**,** the hyaline cartilage. Most of the skeleton of the mammalian fetus is composed of hyaline cartilage. As the fetus ages, the cartilage is gradually replaced by more supportive bone. In the mammalian adult, hyaline cartilage is mainly restricted to the nose, trachea, bronchi, ends of the ribs, and the articulating surfaces of most joints. The function of the hyaline cartilage is to provide slightly flexible support and reduce friction within joints. It also provides structural reinforcement. Cartilage is a non-vascular tissue. As such, the chondrocytes rely on blood vessels in the tissue surrounding the cartilage for nutrient supply and waste removal.



Characteristics of CT:

- Cells are spread through an extracellular fluid.
- Ground substance - A clear, colorless, and viscous fluid containing glycosaminoglycans and proteoglycans to fix the body water and the collagen fibers in the intercellular spaces. Ground substance slows the spread of pathogens.
- Fibers. Not all types of CT are fibrous. Examples of non-fibrous CT include adipose tissue and blood. Adipose tissue gives “mechanical cushioning” to our body, among other functions.[8][9] Although there is no dense collagen network in adipose tissue, groups of adipose cells are kept together by collagen fibers and collagen sheets in order to keep fat tissue under compression in place (for example, the sole of the foot). The matrix of blood is plasma.

RESULTS & DISCUSSION:

VIVA QUESTIONS

Q.1 Give functions of epithelial tissue.

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Q.2 Give functions of blood connective tissue.

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Q.3 What are the characteristics of cartilage tissue?

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Experiment No. 3

AIM:

Microscopic study of Muscular and Nervous tissues.

REFERENCE:

1. "Principles of Anatomy and Physiology" by G.J. Tortora, 12th Edition 2009, vol.I, published by John Wiley & Sons, Asia Pte Ltd., page no.109-120.

REQUIREMENTS:

Microscope and permanent glass slide.

THEORY:

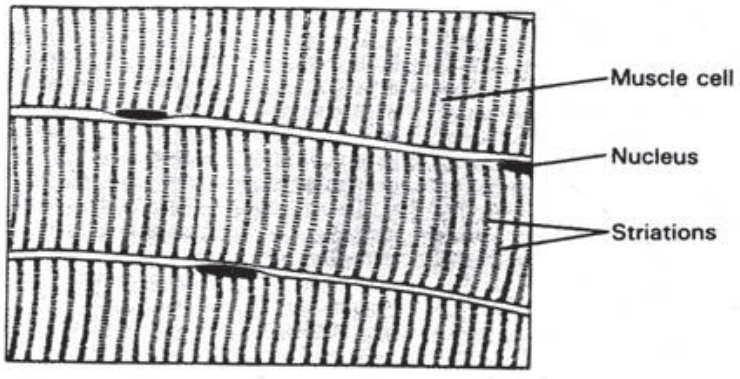
Muscle Tissue

Muscle cells are highly specialized for contractions. Such contractions may result in the movement of the whole body or a portion of it, if the muscles are attached to a movable part of the skeleton. If the muscle is located in the wall of a hollow organ, its contractions may cause the contents of the organ to move, e.g. peristaltic movement of material through the digestive tract. Several specific terms are used exclusively for muscle tissue. For example, muscle cells are called fibres; their cytoplasm is termed sarcoplasm; and their cell membrane is referred to as sarcolemma.

Three types of muscle tissue are distinguished on the basis of structural, functional and locational differences:

a) **Skeletal or striated**
b) **smooth**
c) **cardiac**

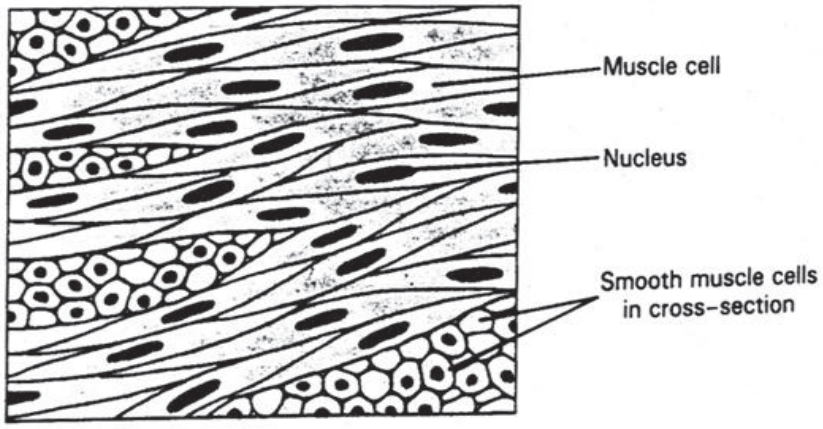
Skeletal (Striated) Muscle



Skeletal muscles form the "flesh"; sometimes referred to as the "red meat" of an animal's body. They are attached to, and result in, the movement of the bones of the skeleton. For example, the biceps brachii and pectoralis are skeletal muscles. As the contraction of the skeletal muscles is under conscious control, they are also called voluntary muscles.

A typical skeletal muscle cell is a highly modified, giant, multi-nucleate cell (fibre). Each fibre is cylindrical in shape with blunt, rounded ends. The flattened nuclei are located mainly at the periphery of the cell, just inside the sarcolemma. The "cross-striped" (or striated) appearance of light and dark banding results from the arrangement of myofibrils, small protein contractile units embedded in the sarcoplasm

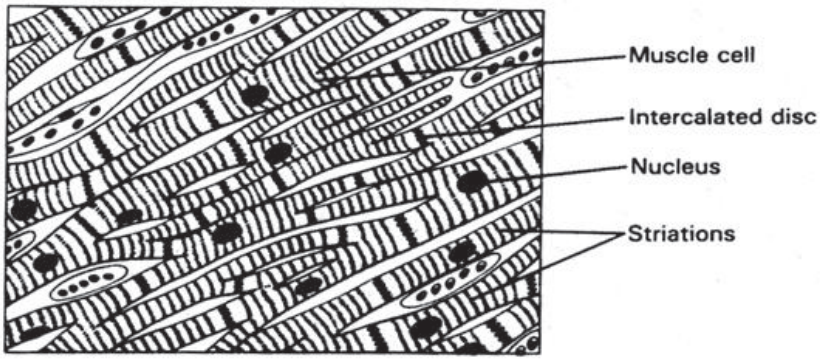
Smooth Muscle



Smooth muscle is abundant throughout the internal organs of the body especially in regions such as the digestive tract. As its contraction is not under conscious nervous control, it is referred to as involuntary muscle.

Smooth muscle fibres are spindle-shaped structures with a prominent centrally located nucleus . In comparison with skeletal muscle fibres, they are much shorter in length and they do not exhibit striations. The cells occur as individual fibres within organs or as groups of fibres closely interlaced in sheets or bands.

Cardiac Muscle

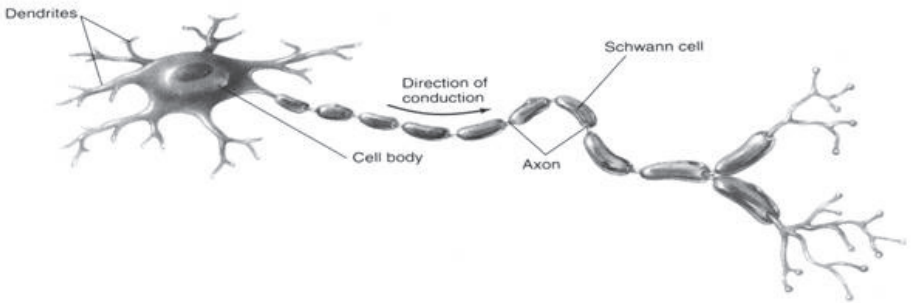


Cardiac muscle is a highly specialized tissue **restricted to the wall of the heart**. It is also an involuntary type of muscle, as its contraction is not consciously controlled. Unlike smooth or striated fibres, cardiac fibres tend to form long chains of cells which branch and intertwine. This arrangement results in the peculiar "wringing" action of the heart. The junction of one cell with another in a particular chain is known as an intercalated disc and appears as a heavy dark line running across the fibre.

Each cell has a somewhat cylindrical shape with one centrally-located, oval nucleus. Cross-striations are apparent but they are not as regular nor as prominent as those of skeletal muscle.

Nervous Tissue

The components of nervous tissue are specialized for the conduction of electrical impulses, which allow communication among other tissue types. The major structural and functional "unit" of nervous tissue is the nerve cell called neuron. Each neuron is composed of a cell body containing a nucleus and one or more long cytoplasmic extensions known as fibres. Highly branched fibres, called dendrites, bring impulses toward the cell body, while a single, unbranched fibre, the axon, carries information away from the cell body. The overall length of a neuron, including dendrites, cell body and axon, may vary from less than two centimeters to a meter or more.



The central dark H-shaped region is the grey matter and the surrounding lighter-stained area is the white matter. Neuron's cell bodies are the predominant structural elements of the grey matter whereas nerve fibres, especially axons, are the main component of the white matter.

RESULTS & DISCUSSION:

VIVA QUESTIONS

Q.1 Give functions of Nervous tissue.

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Q.2 What are the characteristics of cardiac muscle?

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Q.3 What is the physiology of muscle contraction?

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Experiment No. 4

AIM:

To study human skeletal system with the help of chart and models.

REFERENCE:

1. "Principles of Anatomy and Physiology" by G.J. Tortora, 12th Edition 2009, vol.I, published by John Wiley & Sons, Asia Pte Ltd., page no. 175-180.

REQUIREMENTS:

Human skeletal laboratory chart and model.

THEORY:

Introduction

The **human skeleton** is the internal framework of the body. It is composed of 270 bones at birth – this total decreases to 206 bones by adulthood after some bones have fused together. The human skeleton can be divided into the axial skeleton and the appendicular skeleton. The axial skeleton is formed by the vertebral column, the rib cage, the skull and other associated bones. The appendicular skeleton, which is attached to the axial skeleton, is formed by the shoulder girdle, the pelvic girdle and the bones of the upper and lower limbs.

DIVISIONS

Axial skeleton

The axial skeleton (80 bones) is formed by the vertebral column (32–34 bones; the number of the vertebrae differs from human to human as the lower 2 parts, sacral and coccygeal bone may vary in length), a part of the rib cage (12 pairs of ribs and the sternum), and the skull (22 bones and 7 associated bones).

The upright posture of humans is maintained by the axial skeleton, which transmits the weight from the head, the trunk, and the upper extremities down to the lower extremities at the hip joints. The bones of the spine are supported by many ligaments. The erector spinae muscles are also supporting and are useful for balance.

Appendicular skeleton

The appendicular skeleton (126 bones) is formed by the pectoral girdles, the upper limbs, the pelvic girdle or pelvis, and the lower limbs. Their functions are to make locomotion possible and to protect the major organs of digestion, excretion and reproduction.

Functions

The skeleton serves six major functions: support, movement, protection, production of blood cells, storage of minerals and endocrine regulation.

Support

The skeleton provides the framework which supports the body and maintains its shape. The pelvis, associated ligaments and muscles provide a floor for the pelvic structures. Without the rib cages, costal cartilages, and intercostal muscles, the lungs would collapse.

Movement

The joints between bones allow movement, some allowing a wider range of movement than others, e.g. the ball and socket joint allows a greater range of movement than the pivot joint at the neck. Movement is powered by skeletal muscles, which are attached to the skeleton at various sites on bones. Muscles, bones, and joints provide the principal mechanics for movement, all coordinated by the nervous system.

It is believed that the reduction of human bone density in prehistoric times reduced the agility and dexterity of human movement. Shifting from hunting to agriculture has caused human bone density to reduce significantly.

PROTECTION

The skeleton helps to protect our many vital internal organs from being damaged.

- The skull protects the brain
- The vertebrae protect the spinal cord.
- The rib cage, spine, and sternum protect the lungs, heart and major blood vessels.

Blood cell production

The skeleton is the site of haematopoiesis, the development of blood cells that takes place in the bone marrow. In children, haematopoiesis occurs primarily in the marrow of the long bones such as the femur and tibia. In adults, it occurs mainly in the pelvis, cranium, vertebrae, and sternum.

Storage

The bone matrix can store calcium and is involved in calcium metabolism, and bone marrow can store iron in ferritin and is involved in iron metabolism. However, bones are not entirely made of calcium, but a mixture of chondroitin sulfate and hydroxyapatite, the latter making up 70% of a bone. Hydroxyapatite is in turn composed of 39.8% of calcium, 41.4% of oxygen, 18.5% of phosphorus, and 0.2% of hydrogen by mass. Chondroitin sulfate is a sugar made up primarily of oxygen and carbon.

Sex differences

Anatomical differences between human males and females are highly pronounced in some soft tissue areas, but tend to be limited in the skeleton. The human skeleton is not as sexually dimorphic as that of many other primate species, but subtle differences between sexes in the morphology of the skull, dentition, long bones, and pelvis are exhibited across human populations. In general, female skeletal elements tend to be smaller and less robust than corresponding male elements within a given population.

Skull
A variety of gross morphological traits of the human skull demonstrate sexual dimorphism, such as the median nuchal line, mastoid processes, supraorbital margin, supraorbital ridge, and the chin.

Dentition
Human inter-sex dental dimorphism centers on the canine teeth, but it is not nearly as pronounced as in the other great apes.

Long bones
Long bones are generally larger in males than in females within a given population. Muscle attachment sites on long bones are often more robust in males than in females, reflecting a difference in overall muscle mass and development between sexes. Sexual dimorphism in the long bones is commonly characterized by morphometric or gross morphological analyses.

Pelvis
The human pelvis exhibits greater sexual dimorphism than other bones, specifically in the size and shape of the pelvic cavity, ilia, greater sciatic notches, and the sub-pubic angle. The Phenice method is commonly used to determine the sex of an unidentified human skeleton by anthropologists with 96% to 100% accuracy in some populations.

Bones of the human skeleton

The skeleton of an adult human consists of 206 bones. It is composed of 270 bones at birth, which decreases to 206 bones by adulthood after some bones have fused together. It consists of 80 bones in the axial skeleton (28 in skull and 52 in torso) and 126 bones in the appendicular skeleton (32 x 2 in upper extremities including both arms and 31 x 2 in lower extremities including both legs). Many small and often variable bones, such as some sesamoid bones, are not included in this count.

The figure of 206 bones is commonly repeated, but does have some peculiarities in its method of counting. It is taken of an adult human—the number of bones in the skeleton changes with age, as multiple bones fuse,and a process which typically reaches completion in the third decade of life. In addition, the bones of the skull and face are counted as separate bones, despite being fused naturally. Some reliable sesamoid bones such as the pisiform are counted, while others, such as the hallux sesamoids, are not.

Individuals may have more or fewer bones than this owing to anatomical variations. The most common variations include additional (i.e. supernumerary) cervical ribs or lumbar vertebrae. Sesamoid bone counts also may vary among individuals.

BONES

Vertebral column

1. The spinal vertebrae of the vertebral column (33 bones)
    2. The cervical vertebrae (7)
    3. The thoracic vertebrae (12)
    4. The lumbar vertebrae (5)
    5. Extra lumbar vertebrae
    6. The sacral vertebrae (5 at birth, later fused into one)
    7. The coccygeal vertebrae (4 at birth, later fused into one)

CHEST

1. The sternum (1)

2. The ribs (24, in 12 pairs), including:
    - (3) pairs (8th,9th and 10th pairs), also known as false ribs are attached anteriorly to each other and to the 7th rib by cartilages and synovial joints
    - (2) pairs of floating ribs (11th and 12th pairs), have no anterior attachment.
    - Cervical ribs

SKULL

1. The cranial bones (8)
    - The occipital bone
    - The parietal bones (2)
    - The frontal bone
    - The temporal bones (2)
    - The sphenoid bone (sometimes counted as facial)

- The ethmoid bone (sometimes counted as facial)

2. The facial bones (15)
   - The nasal bones (2)
   - The maxillae (upper jaw) (2)
   - The lacrimal bone (2)
   - The zygomatic bone (2);
   - The palatine bone (2)
   - The inferior nasal concha (2)
   - The vomer
   - The mandible (lower jaw)
   - The hyoid bone (sometimes not counted as facial)

3. In the middle ears (3 x 2=6)
   - malleus (2)
   - incus (2)
   - stapes (2)

4. Shoulder
   - The clavicle (2)
   - The scapula (2)

5. Arm
   - The bones of the upper arm (6 bones, 3 each side)
   - The humerus
   - The ulna
   - The radius

6. The hand (54 bones, 27 in each hand)
- The carpals
   - scaphoid bone (2)
   - lunate bone (2)
   - triquetrum bone (2)
   - pisiform bone (2)
   - trapezium (2)
   - trapezoid bone (2)
   - capitate bone (2)
   - hamate bone (2)

1. The metacarpals (5 × 2=10)

2. The phalanges of the hand
   - proximal phalanges (5 × 2=10)

- intermediate phalanges (4 × 2=8)
- distal phalanges (5 × 2=10)

Leg

- The coxal bone, or hip bones, has three regions: ilium, ischium, and pubis (2)
  - The sacrum and the coccyx attach to the two hip bones to form the pelvis
- The femur
- The patella or knee cap
- The tibia
- The fibula
- The foot (52 bones in total, 26 per foot)
  - The tarsus
- calcaneus or heel bone (2)
- talus (2)
- navicular bone (2)
- medial cuneiform bone (2)
- intermediate cuneiform bone (2)
- lateral cuneiform bone (2)
- cuboid bone (2)

1. The metatarsals (10)
2. The phalanges of the foot
   - proximal phalanges (5 × 2=10)
   - intermediate phalanges (4 x 2= 8)
   - distal phalanges (5 x 2=10)

The sesamoid bones

- Patella
- Pisiform bone
- Fabella
- Cyamella (bone)
- sesamoids in first and second metacarpal bones
- sesamoids in first metatarsal bone
- inconsistant sesamoids on other fingers and toes
- Lenticular process of the Incus bone
- Rider’s bone
- inconsistant sesamoids in legs, arms, and buttocks

RESULTS & DISCUSSION:

VIVA QUESTIONS

Q.1 Discuss structure of bones.

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Q.2 Give difference between bones and cartilages.

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Q.3 Give composition of bones.

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Experiment No. 5

AIM:

To study the nervous system with the help of chart and model.

REFERENCE:

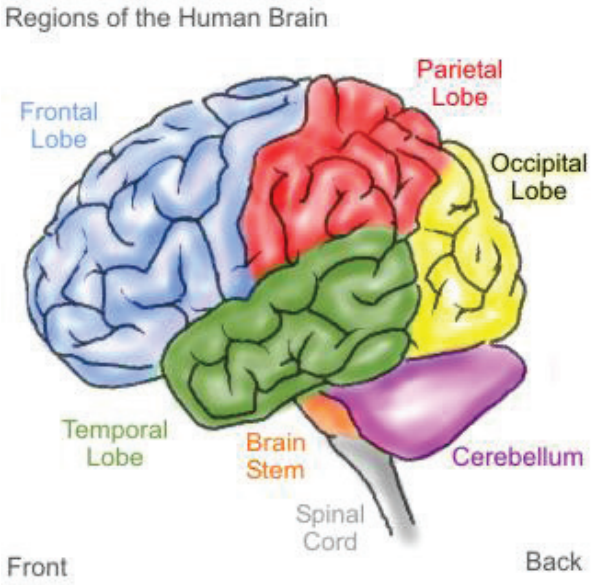
1. "Principles of Anatomy and Physiology" by G.J. Tortora, 12th Edition 2009, vol.I, published by John Wiley & Sons, Asia Pte Ltd., page no.231-240 .

REQUIREMENTS:

Nervous system laboratory chart and model.

THEORY:

Brain- The brain is the center of the nervous system in all vertebrate and most invertebrate animals — only a few primitive species such as sponges, jellyfish, and starfishes do not have one. In vertebrates, the brain is located in the head, protected by the skull and close to the primary sensory apparatus of vision, hearing, balance, taste, and smell.



CEREBRUM

The **cerebrum** or **telencephalon**, together with the diencephalon, constitutes the forebrain. The cerebrum is the most anterior (or, in humans, most superior) region of the vertebrate central nervous system. **Telencephalon** refers to the embryonic structure, from which the mature **cerebrum** develops. In mammals, the dorsal telencephalon, or pallium, develops into the cerebral cortex, and the ventral telencephalon, or subpallium, becomes the basal ganglia. The cerebrum is also divided into approximately

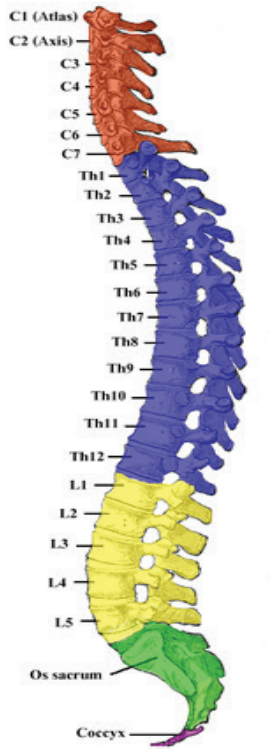
symmetric left and right cerebral hemispheres.

CEREBELLUM

The **cerebellum** (Latin for *little brain*) is a region of the brain that plays an important role in motor control. It is also involved in some cognitive functions such as attention and language, and probably in some emotional functions such as regulating fear and pleasure responses. Its movement-related functions are the most clearly understood, however. The cerebellum does not initiate movement, but it contributes to coordination, precision, and accurate timing. It receives input from sensory systems and from other parts of the brain and spinal cord, and integrates these inputs to fine tune motor activity. Because of this fine-tuning function, damage to the cerebellum does not cause paralysis, but instead produces disorders in fine movement, equilibrium, posture, and motor learning.

SPINAL CORD:

The **spinal cord** is a long, thin, tubular bundle of nervous tissue and support cells that extends from the brain (the medulla oblongata specifically). The brain and spinal cord together make up the central nervous system. The spinal cord begins at the occipital bone and extends down to the space between the first and second lumbar vertebrae; it does not extend the entire length of the vertebral column. It is around 45 cm (18 in) in men and around 43 cm (17 in) long in women. Also, the spinal cord has a varying width, ranging from 1/2 inch thick in the cervical and lumbar regions to 1/4 inch thick in the thoracic area. The enclosing bony vertebral column protects the relatively shorter spinal cord. The spinal cord functions primarily in the transmission of neural signals between the brain and the rest of the body but also contains neural circuits that can independently control numerous reflexes and central pattern generators. The spinal cord has three major functions: A. Serve as a conduit for motor information, which travels down the spinal cord. B. Serve as a conduit for sensory information, which travels up the spinal cord. C. Serve as a center for coordinating certain reflexes.



There are 33 spinal cord nerve segments in a human spinal cord:

- 8 cervical segments forming 8 pairs of cervical nerves (C1 spinal nerves exit spinal column between occiput and C1 vertebra; C2 nerves exit between posterior arch of C1 vertebra and lamina of C2 vertebra; C3-C8 spinal nerves through IVF above corresponding cervica vertebra, with the exception of C8 pair which exit via IVF between C7 and T1 vertebra)
- 12 thoracic segments forming 12 pairs of thoracic nerves (exit spinal column through IVF below corresponding vertebra T1-T12)
- 5 lumbar segments forming 5 pairs of lumbar nerves (exit spinal column through IVF, below corresponding vertebra L1-L5)
- 5 (or 1) sacral segments forming 5 pairs of sacral nerves (exit spinal column through IVF, below corresponding vertebra S1-S5)
- 3 coccygeal segments joined up becoming a single segment forming 1 pair of coccygeal nerves (exit spinal column through the sacral hiatus).

There are two regions where the spinal cord enlarges:

- Cervical enlargement - corresponds roughly to the brachial plexus nerves, which innervate the upper limb. It includes spinal cord segments from about C4 to T1. The vertebral levels of the enlargement are roughly the same (C4 to T1).
- Lumbosacral enlargement - corresponds to the lumbosacral plexus nerves, which innervate the lower limb. It comprises the spinal cord segments from L2 to S3 and is found about the vertebral levels of T9 to T12.

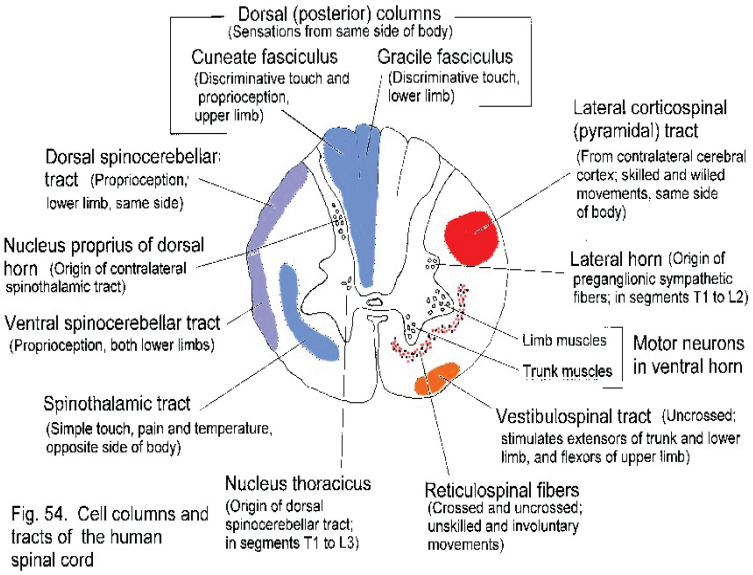


Fig. 54. Cell columns and tracts of the human spinal cord

RESULTS & DISCUSSION:

VIVA QUESTIONS

Q.1 Discuss functions of cerebral cortex.

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Q.2 Discuss functions of spinal nerves.

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Q.3 Differentiate between sympathetic and parasympathetic nerves.

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Experiment No. 6

AIM:

To study integumentary senses with the help of chart and model.

REFERENCE:

1. "Principles of Anatomy and Physiology" by G.J. Tortora, 12th Edition 2009, vol.I, published by John Wiley & Sons, Asia Pte Ltd., page no.74-85 .

REQUIREMENTS:

Human skin laboratory chart and model.

THEORY:

The **skin** is the outer covering of the body. In humans, it is the largest organ of the integumentary system. The skin has multiple layers of ectodermal tissue and guards the underlying muscles, bones, ligaments and internal organs. Human skin is similar to that of most other mammals, except that it is not protected by a pelt. The adjective **cutaneous** literally means "of the skin" (from Latin cutis, skin).

FUNCTIONS

Skin performs the following functions:

1. Protection: an anatomical barrier from pathogens and damage between the internal and external environment in bodily defense; Langerhans cells in the skin are part of the adaptive immune system.

2. Sensation: contains a variety of nerve endings that react to heat and cold, touch, pressure, vibration, and tissue injury; see somatosensory system and haptics.

3. Heat regulation: the skin contains a blood supply far greater than its requirements which allows precise control of energy loss by radiation, convection and conduction. Dilated blood vessels increase perfusion and heatloss, while constricted vessels greatly reduce cutaneous blood flow and conserve heat.

4. Control of evaporation: the skin provides a relatively dry and semi-impermeable barrier to fluid loss.Loss of this function contributes to the massive fluid loss in burns.

5. Aesthetics and communication: others see our skin and can assess our mood, physical state and attractiveness.

6. Storage and synthesis: acts as a storage center for lipids and water, as well as a means of synthesis of vitamin D by action of UV on certain parts of the skin.

7. Excretion: sweat contains urea, however its concentration is 1/130th that of urine, hence excretion

by sweating is at most a secondary function to temperature regulation.

8. Absorption: the cells comprising the outermost 0.25–0.40 mm of the skin are "almost exclusively supplied by external oxygen", although the "contribution to total respiration is negligible". In addition, medicine can be administered through the skin, by ointments or by means of adhesive patch, such as the nicotine patch or iontophoresis. The skin is an important site of transport in many other organisms.

9. Water resistance: The skin acts as a water resistant barrier so essential nutrients

Components

The epidermis contains no blood vessels, and is nourished by diffusion from the dermis. The main type of cells which make up the epidermis are keratinocytes, melanocytes, Langerhans cells and Merkels cells. The epidermis helps the skin to regulate body temperature.

Layers

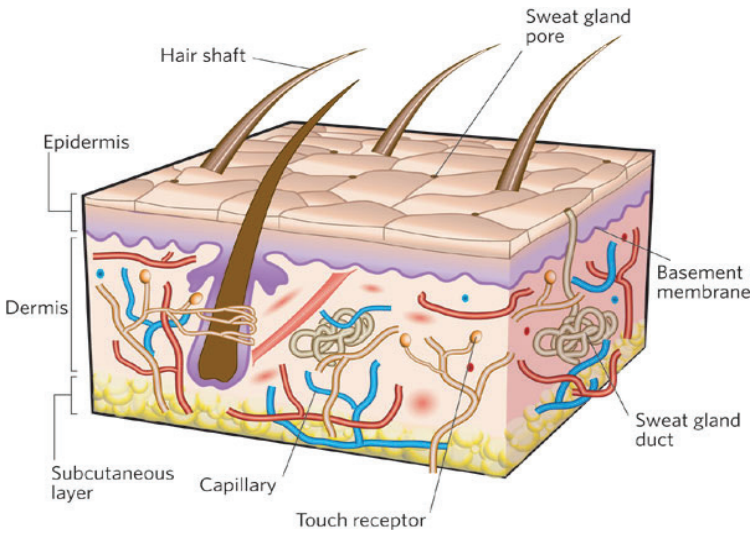
Epidermis is divided into several layers where cells are formed through mitosis at the innermost layers. They move up the strata changing shape and composition as they differentiate and become filled with keratin. They eventually reach the top layer called stratum corneum and are sloughed off, or desquamated. This process is called keratinization and takes place within weeks. The outermost layer of the epidermis consists of 25 to 30 layers of dead cells.

SUBLAYERS

- Epidermis is divided into the following 5 sublayers or strata:
- Stratum corneum
- Stratum lucidum
- Stratum granulosum
- Stratum spinosum
- Stratum germinativum (also called "stratum basale")

Dermis

The **dermis** is the layer of skin beneath the epidermis that consists of connective tissue and cushions the body from stress and strain. The dermis is tightly connected to the epidermis by a basement membrane. It also harbors many Mechanoreceptor/nerve endings that provide the sense of touch and heat. It contains the hair follicles, sweat glands, sebaceous glands, apocrine glands, lymphatic vessels and blood vessels.



RESULTS & DISCUSSION:

VIVA QUESTIONS

Q.1 What are the functions of skin?

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Q.2 Discuss role of different glands in skin.

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Q.3 How skin regulate body temperature.

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Experiment No. 7

AIM:

To study the structure and physiology of nose with the help of chart and model.

REFERENCE:

1. "Principles of Anatomy and Physiology" by G.J. Tortora, 12th Edition 2009, vol.I, published by John Wiley & Sons, Asia Pte Ltd., page no.344-352 .

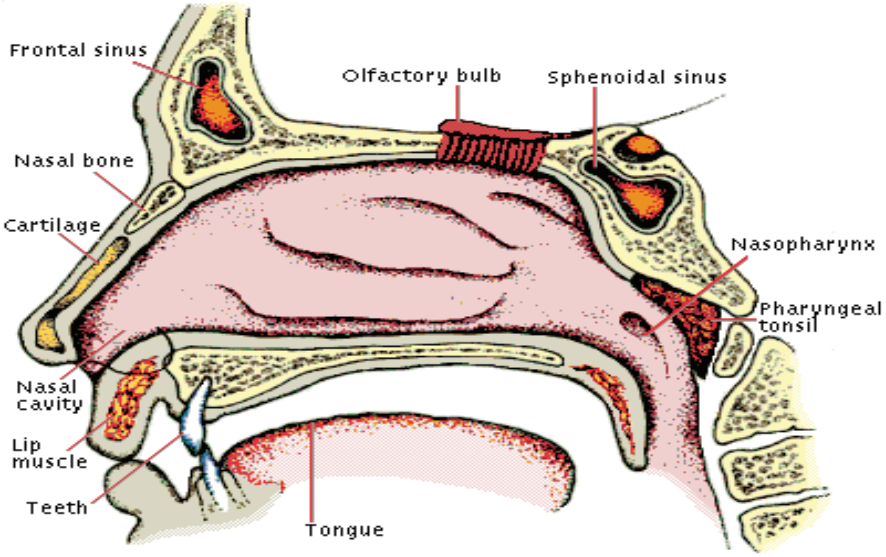
REQUIREMENTS:

Human nose laboratory chart and model.

THEORY:

The visible part of the **human nose** is the protruding part of the face that bears the nostrils. The shape of the nose is determined by the ethmoid bone and the nasal septum, which consists mostly of cartilage and which separates the nostrils. On average the nose of a male is larger than that of a female.[1]

Anatomy



The nasal root is the top of the nose, forming an indentation at the suture where the nasal bones meet the frontal bone. The anterior nasal spine is the thin projection of bone at the midline on the lower nasal margin, holding the cartilaginous center of the nose. Adult humans have nasal hairs in the anterior nasal passage.

The nose is an alteration of the angle of skull following human skeletal changes due to bipedalism. This changed the shape of the skull base causing, together with change in diet, a knock-on morphological reduction in the relative size of the maxillary and mandible and through this a "squeezing" of the protrusion of the most anterior parts of the face more forward and so increasing nose prominence and modifying its shape. In which the downward-facing nostrils and flexible philtrum prevented water from entering the nasal cavities. The theory is not generally accepted by mainstream scholars of human evolution

RESULTS & DISCUSSION:

VIVA QUESTIONS

Q.1 Write down the functions of mucous?

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Q.2 Discuss olfactory nerves and senses.

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Q.3 Give functions of pharynx.

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Experiment No. 8

AIM:

To study the structure and physiology of taste buds with the help of chart and model.

REFERENCE:

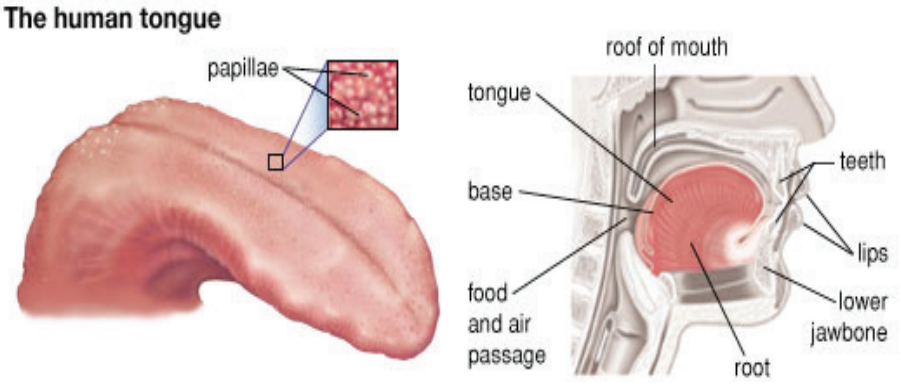
1. "Principles of Anatomy and Physiology" by G.J. Tortora, 12th Edition 2009, vol.I, published by John Wiley & Sons, Asia Pte Ltd., page no.479-790.

REQUIREMENTS:

Human taste buds laboratory chart and model.

THEORY:

Anatomy-



Physiology- Taste receptor cells, taste buds and taste nerves

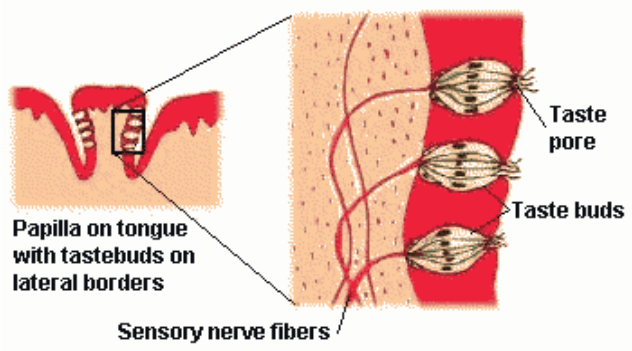
The sense of taste is mediated by taste receptor cells which are bundled in clusters called taste buds. Taste receptor cells sample oral concentrations of a large number of small molecules and report a sensation of taste to centers in the brainstem.

In most animals, including humans, taste buds are most prevalent on small pegs of epithelium on the tongue called papillae. The taste buds themselves are too small to see without a microscope, but papillae are readily observed by close inspection of the tongue's surface. To make them even easier to see, put a couple of drops of blue food coloring on the tongue of a loved one, and you'll see a bunch of little pale

bumps - mostly fungiform papillae - stand out on a blue background.

Taste buds are composed of groups of between 50 and 150 columnar taste receptor cells bundled together like a cluster of bananas. The taste receptor cells within a bud are arranged such that their tips form a small taste pore, and through this pore extend microvilli from the taste cells. The microvilli of the taste cells bear taste receptors.

Interwoven among the taste cells in a taste bud is a network of dendrites of sensory nerves called "taste nerves". When taste cells are stimulated by binding of chemicals to their receptors, they depolarize and this depolarization is transmitted to the taste nerve fibers resulting in an action potential that is ultimately transmitted to the brain. One interesting aspect of this nerve transmission is that it rapidly adapts - after the initial stimulus, a strong discharge is seen in the taste nerve fibers but within a few seconds, that response diminishes to a steady-state level of much lower amplitude.



Once taste signals are transmitted to the brain, several efferent neural pathways are activated that are important to digestive function. For example, tasting food is followed rapidly by increased salivation and by low level secretory activity in the stomach. Among humans, there is substantial difference in taste sensitivity. Roughly one in four people is a "supertaster" that is several times more sensitive to bitter and other tastes than those that taste poorly. Such differences are heritable and reflect differences in the number of fungiform papillae and hence taste buds on the tongue.

In addition to signal transduction by taste receptor cells, it is also clear that the sense of smell profoundly affects the sensation of taste. Think about how tastes are blunted and sometimes different when your sense of smell is disrupted due to a cold.

Taste Sensations

The sense of taste is equivalent to excitation of taste receptors, and receptors for a large number of specific chemicals have been identified that contribute to the reception of taste. Despite this complexity, five types of tastes are commonly recognized by humans:

- Sweet - usually indicates energy rich nutrients
- Umami - the taste of amino acids (e.g. meat broth or aged cheese)
- Salty - allows modulating diet for electrolyte balance
- Sour - typically the taste of acids
- Bitter - allows sensing of diverse natural toxins

RESULTS & DISCUSSION:

VIVA QUESTIONS

Q.1 Give functions of saliva.

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Q.2 Write down the name of different type of taste buds.

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Q.3 White down the name of three salivary glands.

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Experiment No. 9

AIM:

To study the structure and physiology of ear with the help of chart and model.

REFERENCE:

1. "Principles of Anatomy and Physiology" by G.J. Tortora, 12th Edition 2009, vol.I, published by John Wiley & Sons, Asia Pte Ltd., page no.8174-180 .

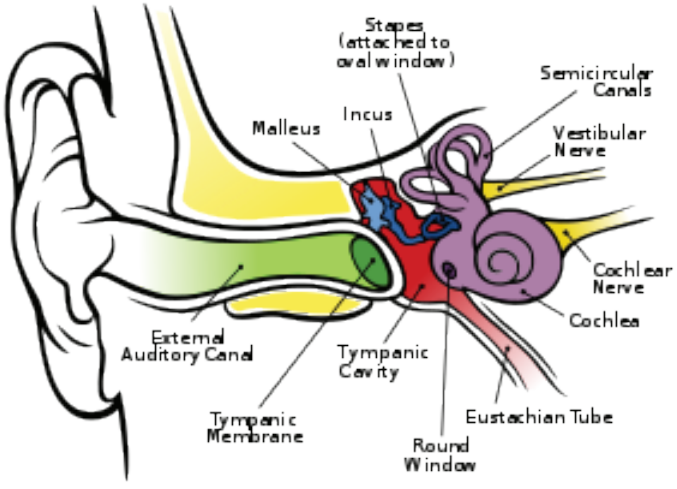
REQUIREMENTS:

Human ear laboratory chart and model.

THEORY:

The ear is the organ that detects sound. It not only receives sound, but also aids in balance and body position. The ear is part of the auditory system.

The word "ear" may be used correctly to describe the entire organ or just the visible portion. In most mammals, the visible ear is a flap of tissue that is also called the pinna and is the first of many steps in hearing. In people, the pinna is often called the auricle. Vertebrates have a pair of ears, placed somewhat symmetrically on opposite sides of the head. This arrangement aids in the ability to localize sound sources.



OUTER EAR:

The outer ear is the most external portion of the ear. The outer ear includes the pinna (also called auricle), the ear canal, and the very most superficial layer of the ear drum (also called the tympanic membrane). In humans, and almost all vertebrates, the only visible portion of the ear is the outer ear.

MIDDLE EAR

The middle ear, an air-filled cavity behind the ear drum (tympanic membrane), includes the three ear bones or ossicles: the malleus (or hammer), incus (or anvil), and stapes (or stirrup). The opening of the Eustachian tube is also within the middle ear. The malleus has a long process (the manubrium, or handle) that is attached to the mobile portion of the eardrum. The incus is the bridge between the malleus and stapes. The stapes is the smallest named bone in the human body.

INNER EAR

The inner ear includes both the organ of hearing (the cochlea) and a sense organ that is attuned to the effects of both gravity and motion (labyrinth or vestibular apparatus). The balance portion of the inner ear consists of three semicircular canals and the vestibule. The inner ear is encased in the hardest bone of the body. Within this ivory hard bone, there are fluid-filled hollows. Within the cochlea are three fluid filled spaces: the scala tympani, the scala vestibuli and the scala media. The eighth cranial nerve comes from the brain stem to enter the inner ear.

RESULTS & DISCUSSION:

VIVA QUESTIONS

Q.1 Write down the name of different ear bones.

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Q.2 Write the functions of perilymph.

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Q.3 Write the function of tymphanic membrain.

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Experiment No. 10

AIM:

To study the structure and physiology of eye with the help of chart and model.

REFERENCE:

1. "Principles of Anatomy and Physiology" by G.J. Tortora, 12th Edition 2009, vol.I, published by John Wiley & Sons, Asia Pte Ltd., page no.182-185 .

REQUIREMENTS:

Human eye laboratory chart and model.

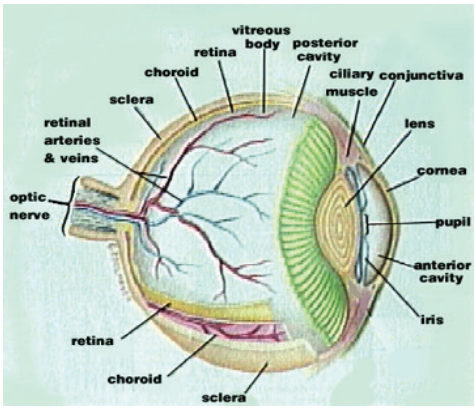
THEORY:

The human eye is an organ which reacts to light for several purposes. As a conscious sense organ, the eye allows vision. Rod and cone cells in the retina allow conscious light perception and vision including color differentiation and the perception of depth. The human eye can distinguish about 10 million colors[1]

Components

The eye is made up of three coats, enclosing three transparent structures. The outermost layer is composed of the cornea and sclera. The middle layer consists of the choroid, ciliary body, and iris. The innermost is the retina, which gets its circulation from the vessels of the choroid as well as the retinal vessels, which can be seen in an ophthalmoscope. Within these coats are the aqueous humor, the vitreous body, and the flexible lens. The aqueous humor is a clear fluid that is contained in two areas: the anterior chamber between the cornea and the iris and exposed area of the lens; and the posterior chamber, behind the iris and the rest. The lens is suspended to the ciliary body by the suspensory ligament (Zonule of Zinn), made up of fine transparent fibers. The vitreous body is a clear jelly that is much larger than the aqueous humor, and is bordered by the sclera, zonule, and lens. They are connected via the pupil.

Extraocular muscles



Each eye has six muscles that control its movements: the lateral rectus, the medial rectus, the inferior rectus, the superior rectus, the inferior oblique, and the superior oblique. When the muscles exert different tensions, a torque is exerted on the globe that causes it to turn, in almost pure rotation, with only about one millimeter of translation. Thus, the eye can be considered as undergoing rotations about a single point in the center of the eye.

Pupil constriction

Lenses cannot refract light rays at their edges as well as they can closer to the center. The image produced by any lens is therefore somewhat blurry around the edges (spherical aberration). It can be minimized by screening out peripheral light rays and looking only at the better-focused center. In the eye, the pupil serves this purpose by constricting while the eye is focused on nearby objects. In this way the pupil has a dual purpose: to adjust the eye to variations in brightness and to reduce spherical aberration.

RESULTS & DISCUSSION:

VIVA QUESTIONS

Q.1 Write the functions of cones.

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Q.2 Write the name of pigment present in rods.

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Q.3 Write the functions of aqueous humor.

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