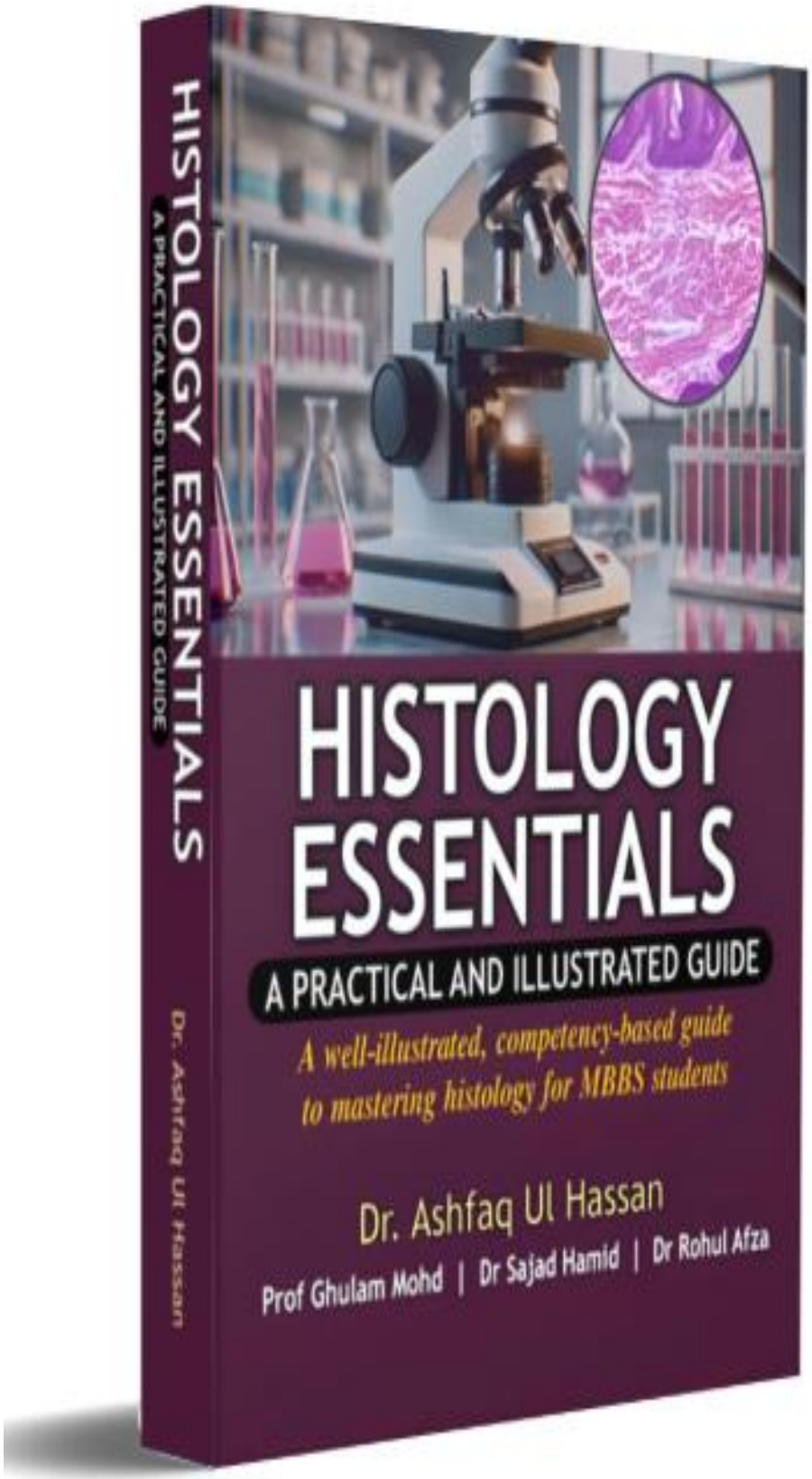
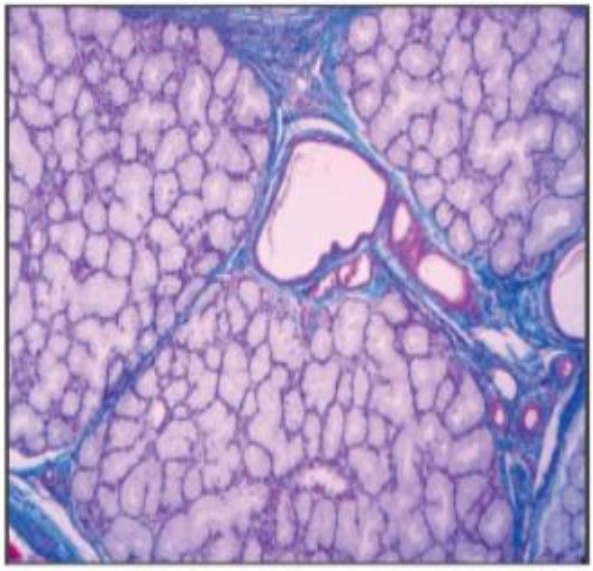

HISTOLOGY ESSENTIALS
A PRACTICAL AND ILLUSTRATED GUIDE
Dr. Ashfaq Ul Hassan
HISTOLOGY
ESSENTIALS
A PRACTICAL AND ILLUSTRATED GUIDE
A well-illustrated, competency-based guide to mastering histology for MBBS students
Dr. Ashfaq Ul Hassan
Prof Ghulam Mohd | Dr Sajad Hamid | Dr Rohul Afza

IBQ (Image Based Questions)

Q. Below Shown Figure represents a compound acinar gland with mucous acini. Most likely Gland is:



A. Sublingual
B. Parotid
C. Liver
D. None of the Above

Ans: A. Sublingual

Sub-lingual gland: It is a **compound acinar gland and secretory end pieces are formed by mucous acini.**

Connective tissue **septa divide the gland into lobules.** Blood vessels, lymphatics, nerves and interlobular ducts run in the septa.

The mucous cells are lightly stained, cuboidal with flat peripherally placed nucleus.

Mucous acini have large lumen.

Multiple Choice Questions

Q. Gallbladder is lined by:

A. Squamous epithelium
B. Columnar epithelium
C. Transitional epithelium
D. Cuboidal epithelium

Ans: B. Columnar epithelium

Q. Germinal Epithelium of OVARY is lined by:

A. Squamous epithelium
B. Columnar epithelium
C. Transitional epithelium
D. Cuboidal epithelium

Ans: D. Cuboidal epithelium

Q. Urothelium is:

A. Squamous epithelium
B. Columnar epithelium
C. Transitional epithelium
D. Cuboidal epithelium

Ans: C. Transitional epithelium

Q. Follcles of Thyroid are lined by:

A. Squamous epithelium
B. Columnar epithelium
C. Transitional epithelium

Q. Payers Patches are most Commonly located in the:

A. Duodenum B. Jejunum
C. Ileum D. All

Ans: C. Ileum

Q. "Cords of Billroth" are seen in:

A. Liver B. Spleen
C. Thymus D. Lymph nodes

Ans: B. Spleen

Q. Corpora arenecaea are seen in:

A. Liver B. Pineal
C. Pancreas D. Pitutary

Ans: B. Pineal

Q. Howships Lacunae are seen around:

A. Plasma cells B. Adipose cells
C. Pigment cells D. Osteoclasts

Ans: D. Osteoclasts

Q. Crypts are a feature of

A. Tonsil B. Spleen

FAQs

REMEMBER EPONYMS OF HISTOLOGY	
Eponyms	**Description**
Bowman's capsule	Glomerular capsule of the kidney seen on histology slides
Bowman's membrane	Layer in the cornea below epithelium seen on histology slides
Brunner's glands	Glands in the duodenum seen on histology slides
Bundle of His	Atrioventricular bundle
Cords of Billroth	Splenic cords of the spleen seen on histology slides
Crypts of Lieberkuhn	Epithelial glands in the small intestine seen on histology slides
Descemet's membrane	Limiting layer of the cornea seen on histology slides
Ducts of Bellini	Papillary duct of the kidney seen on histology slides
Ducts of Luschka	Small ducts found in the connective tissue between the gallbladder and the liver
Golgi aparatus	Intracellular organelle
Golgi tendon organ	Sensory nerve ending embedded in a tendon for proprioception
Graafian follicle	Tertiary follicle of an ovary seen on a histology slide
Haversian canal	Central canal of an osteon of bone seen on a histology slide
Haversian system	Osteon of bone seen on a histology slide
Islets of Langerhans	Pancreatic islets of the pancreas seen on histology slides
Leydig cells	Interstitial cells of the testis
Loop of Henle	U shaped loop in the nephron of the kidney
Krause end bulbs	Cylindrical/oval sensory receptor

3. **Circumvallate papillae:** They are present at the sulcus terminalis on the V junction. They contain Von Ebners serous glands
4. **Foliate papillae:** They are not well developed in humans.

TASTE BUDS

The taste buds are specialized structures present on the tongue, soft palate, epiglottis and pharynx.

Each taste bud is composed of:

Gustatory or taste cells Type I: They are modified columnar epithelial cells with darkly stained oval nuclei. They have fine hairy projections which project in the **taste pore** and a **sensory nerve fibre** plexus at the base with basal cells.

Supporting cells are columnar cells with pale central nuclei.

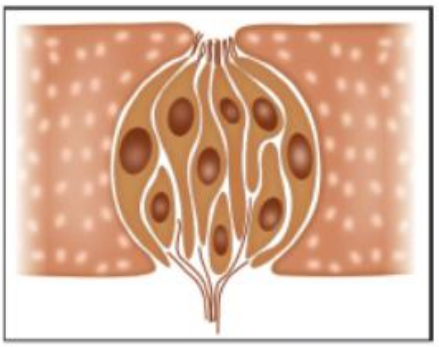


Figure: Taste Bud (Neuroepithelium)

General Plan of Histology of Digestive Tube

There are four layers forming the wall. From luminal surface to outwards these are:

1. **Mucosa:**
   - Epithelial layer
   - Lamina Propria (CT)
   - Muscularis Mucosa: Smooth muscle arranged as inner circular and outer longitudinal.
2. **Submucosa:** Formed of loose areolar CT containing blood vessels, Meissner's plexus of nerves.
3. **Musculosa:** Formed of involuntary muscle arranged as inner circular and outer longitudinal. In between the two muscles is the Aeurbachs nerve plexus.
4. **Serosa:** It is the peritoneal covering usually formed of CT and mesothelial cells. In the esophagus there is no peritoneum and serosa is formed of Fibres

Micro Anatomy of Spleen

The Stroma

The Stroma is formed of **Capsule, Trabeculae and Reticular Network.**

The Capsule is composed of Collagenous and Elastic CT fibres separated by CT cells. The capsule is thin in case of human spleens.

The Trabeculae are formed of CT Cells and CT Fibres. They extend from the deep surface of the Capsule. The trabeculae radiate from the hilum of the spleen carrying blood vessels.

The Reticular Network is a fine network which forms the background of the spleen. It is formed of reticular cells and reticular Fibres. It can be stained brown with silver salts.

The Parenchyma: It is the soft tissue which includes **the white and the red pulps.**

The White Pulp or the Malphigian Corpuscles

They are rounded or elongated lymphatic nodules which appear **white in fresh section.** In the white pulp small **lymphocytes** are present at the periphery while as large **lymphoblasts** are present at its pale non clear germinal centre. Each corpuscle contains a small artery at one side known as **central arteriole.**

The Red Pulp or the Cords of Billiroth

The tissue around the white pulp appears **red in fresh section** due to presence of **Blood Sinusoids.**

The blood sinusoids are wide, irregular channels filled with blood and appear as small lakes of blood lined by phagocytic littoral cells.

The Red pulp is present between the white pulp and the blood sinusoids. It is formed mainly of cells mainly the blood cells such as lymphocytes, erythrocytes, granular leucocytes and the phagocytic cells as Histiocytes, monocytes and primitive reticular cells.

Differences between Lymph node and Spleen

Lymph Node	Spleen
Multiple and present in groups	Singleintra abdominal organ
Filter lymph	Filter blood
Covered with fascia	Covered with peritoneum
Capsule is thin	Capsule is thick
Lymphatic nodules arranged into cortex and medulla	Lymphatic tissue arranged as white and red pulp
Have clear Germinal centres	Have non clear germinal centres
Trabeculae are thin, arise from capsule	Trabeculae are thick, arise from hilum
Contain cortical and medullary lymphatic sinuses	Contain blood sinuses all over
Presence of medullary lymphatic cords	Presence of red pulp or cords of Billiroth
Contain afferent and efferent lymph vessels	Contain only a few lymph vessels

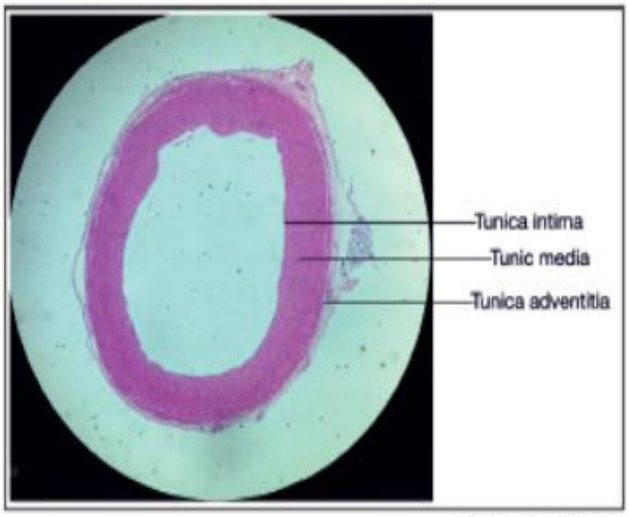


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FIGURE: Elastic Artery

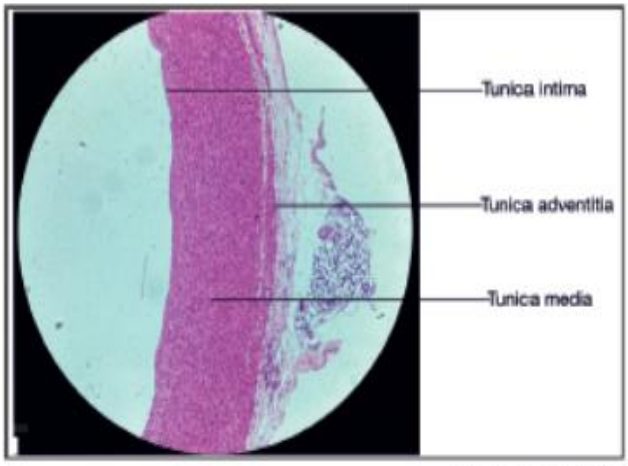

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FIGURE: Wall of an Elastic Artery (High Magnification)

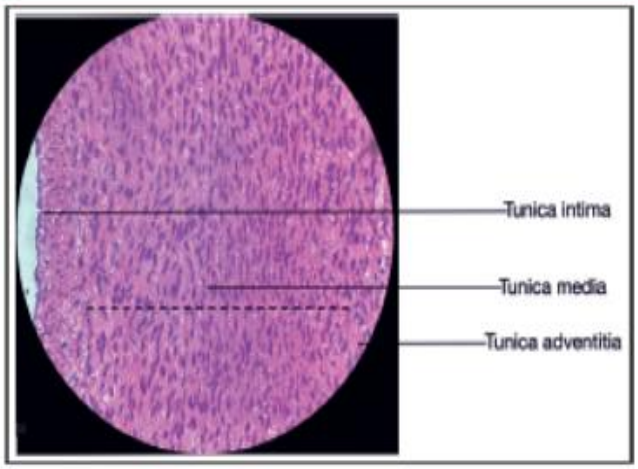

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FIGURE: Wall of an Elastic Artery (Under very High Magnification)

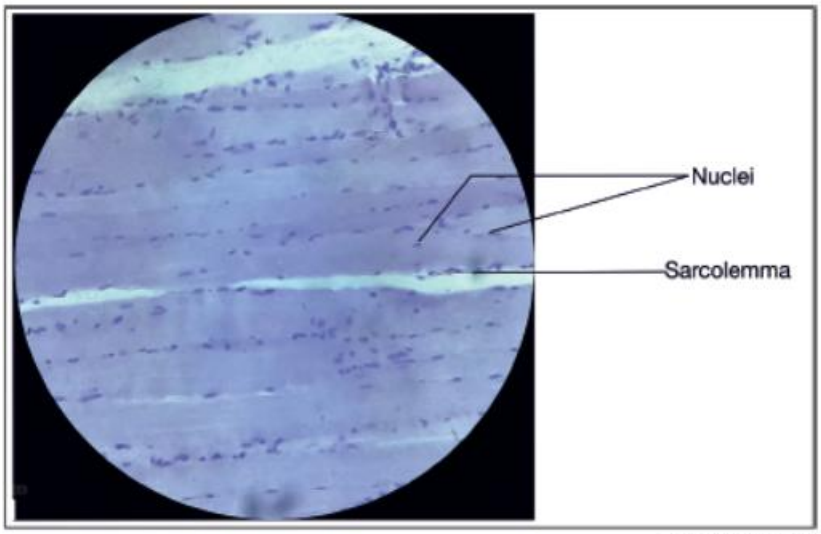

FIGURE: Skeletal Muscle (High Magnification)

Each muscle fibre has many nuclei. Which are peripheral. The skeletal muscle fibres are two types: **Red Fibres and white fibres.**

Red Fibres	White Fibres
Have irregular striations	Have Regular striations
Have Central nuclei	Have peripheral nuclei
Have rich vascular supply	Have poorer blood supply
Non Fatiguable	Are Fatiguable
Are rich in Myoglobin, fats	Are poor in mitochondria, Myoglobin , fats
Examples: Diaphragm, muscles of eye, mastication. Their contraction in response to nervous stimulation is slow and steady, resulting in their designation as slow fibers.	***Examples:*** Diaphragm, muscles of eye, mastication. Their contraction in response to nervous stimulation is slow and steady, resulting in their designation as slow fibers.

The Cardiac Muscle

It is an **involuntary muscle** formed of branching and anastomosing fibres forming a continuous sheath.

Their diameter ranges from 15-20 microns.

They have irregular transverse striations.

Their nuclei are central in position and circular in shape. They have a thin sarcolemma.

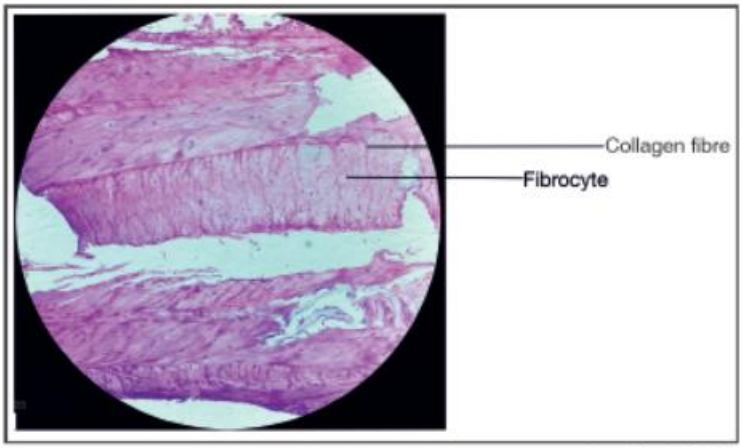

FIGURE: Fibro-cartilage

It is present in:

- Menisci of knee joints
- Glenoid Cavity
- Acetabulum
- Intervertebral discs

THE BONE

Bone is the **hardest tissue** of the human body, and is second only to cartilage in its ability to withstand stress.

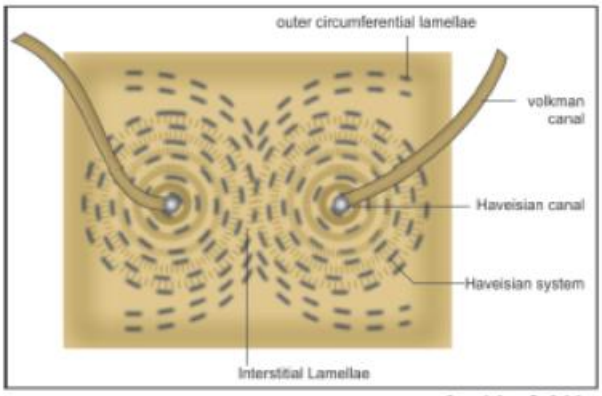

FIGURE: Bone

It is also a **specialized type of CT** which is hard, calcified forming the main framework of the body and protecting the vital organs of the body. Besides other supplementary functions are:

- Serve as attachments for muscles and ligaments

Pseudo Stratified Columnar (Pseudo: False, Stratified: Layered)

It is a simple type of columnar cells resting on a clear wavy basement membrane. The cells are crowded over each other and appear multi layered. The nuclei are arranged at different levels, some situated basal and others centrally as a result of which a false impression of multi layered cells is created. However, most of the cells reach the basement membrane. The cells may be ciliated or non ciliated.

With Cilia

- Nasal cavity, nasal air sinuses, nasopharynx, larynx, trachea and bronchi
- Eustachian tube in its cartilaginous parts.

Without Cilia

- Vas deferens
- Part of male urethra

Types of Stratified Epithelium:

1. Stratified Squamous epithelium
2. Stratified Cuboidal epithelium
3. Stratified Columnar ciliated epithelium
4. Transitional epithelium

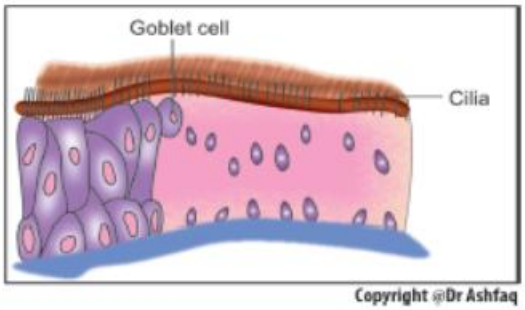

FIGURE: Pseudo-stratified Columnar Ciliated with Goblet Cells

Stratified Squamous Epithelium

It is a type of multi layered epithelium composed of 5-30 cell layers. The cells rest on a basement membrane under which lies a CT containing blood vessels.

The basal cells are columnar cells.

The intermediate cells are polygonal.

The superficial cells are flat.

The surface of the cells may be keratinized (Protective function) as in case of:

1. Epidermis of Skin
2. External ear
3. External nose

The surface of the cells may be without keratin called Non Keratinized as in case of:

1. Esophagus
2. Tongue
3. True vocal cords

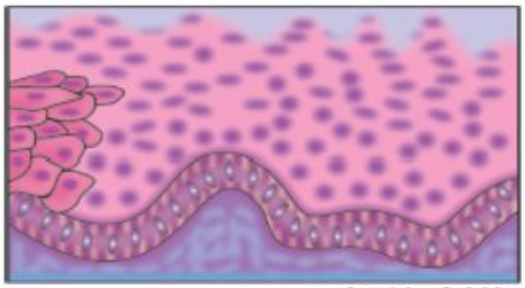

FIGURE: Stratified Squamous Epithelia (Non-keratinizing)

Stratified Columnar Epithelium

It is also multi layered. It is like stratified Squamous epithelium but:

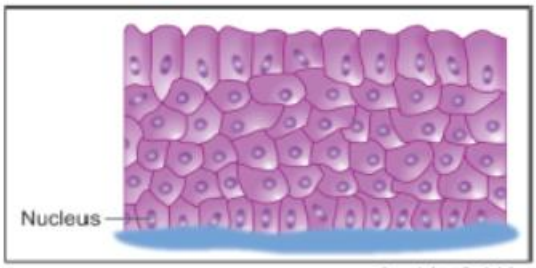

FIGURE: Stratified Columnar Epithelium

The Epithelium

Epithelial tissues usually occur as structurally minor but functionally important components of complex organs.

A. **Diversity:** Epithelial tissues range from one to several cell layers in thickness, forming sheets, solid organs, or glands.

B. **Metaplasia:** When faced with a chronic change of environmental conditions, epithelia are capable of metaplasia; i.e. they may change from one type to another.

C. **Lining and Covering:** Epithelia cover or line all body surfaces and cavities except articular cartilage in joint cavities. Their function is analogous to that of cell membranes: They (1) separate self from nonself; (2) divide the body interior into functional compartments; and (3) form passive and active barriers which monitor, control, and modify substances that traverse them.

D. **Basal Lamina:** Epithelia rest on an extra cellular basal lamina (or basement membrane) that separates them from an underlying connective tissue layer, the lamina propria

E. **Renewal:** Epithelia are continuously renewed and replaced. The epithelial cells closest to the basal lamina undergo continuous mitosis, and their progeny replace the surface cells.

F. **Avascularity:** Blood vessels in the subjacent connective tissue rarely penetrate the basal lamina to invade epithelia.

G. **Cell Packing:** Epithelial tissues have very little intercellular substance. The cells are densely packed, closely apposed, and joined by specialized junctions.

H. **Derivation:** Ectoderm, mesoderm, and endoderm can all give rise to epithelia

The epithelial tissue is a special type of tissue widely distributed in the body and covers the surfaces of the body as well as forms the glands.

The Histological Technique for Preparing Microscopic Sections from Tissues

The most important technique is the **Paraffin technique.**

It comprises of many sequential steps such as:

1. **Procurement of Tissue** means getting the desired tissue from the body in a well equipped lab, theatre etc.
2. **Fixation** Here small pieces of fresh procured tissue are placed in fixatives such as **5% Formalin, Susas, Zenkers or Bouins Fluid.** The Role of Fixation is to:
   - Coagulate the proteins and hence harden the tissue
   - Prevent Putrefaction and autolysis of the tissue
   - To facilitate staining of tissues
   - To fortify the tissues against harmful effects of various stages in preparation of sections
3. **Washing:** The Fixed tissue is washed in clean/ distilled water to remove fixative
4. **Dehydration** is an orderly process of gradual removal of water in ascending grades of Alcohol. (70 %, 90%, 100%). It is done gradually to prevent shrinkage of delicate tissue and provide effective dehydration
5. **Clearing** It is called so to make the tissue clear. The Clearing agents are Xylene, Toluene, chloroform l and Benzene.
6. **Impregnation:** The tissues are put in paraffin at 54-56 degrees Celsius so that paraffin impregnates into the tissue
7. **Embedding:** The tissues are embedded in the centre of hard Paraffin which is then allowed to cool to form a paraffin block with tissue in the centre. Leuckharts L pieces are used for the purpose. They are 15 mm pieces of rust proof material to make enclosures of various sizes.
8. **Cutting:** The tissues are cut into thin sections by microtome of various types such as Rotary, Rocking Microtomes.
9. **Mounting:** The thin tissue sections are put on a glass slide by Mayer's egg albumin.
10. **Staining:** The sections are now ready to be stained by specific stains. For H&E staining following steps are taken:
    - For staining put the slide in Xylol for 3 minutes to dissolve wax.

Introduction

Histology is the study of tissue sectioned as a thin slice, using a microscope. It can be described as "microscopic anatomy". Histology is an essential tool of biology. Histopathology, the microscopic study of diseased tissue, is an important tool of anatomical pathology since accurate diagnosis of tumors and other diseases usually requires histopathological examination of samples.

MICROSCOPY

A microscope (Greek: micron = small and scopos = aim) is an instrument for viewing objects that are too small to be seen by the naked or unaided eye. The science of investigating small objects using such an instrument is called microscopy, and the term microscopic means minute or very small, not easily visible with the unaided eye. Anton van Leeuwenhoek (1632-1723) is generally credited with bringing the microscope to the attention of biologists, even though simple magnifying lenses were already being produced in the 1500's.

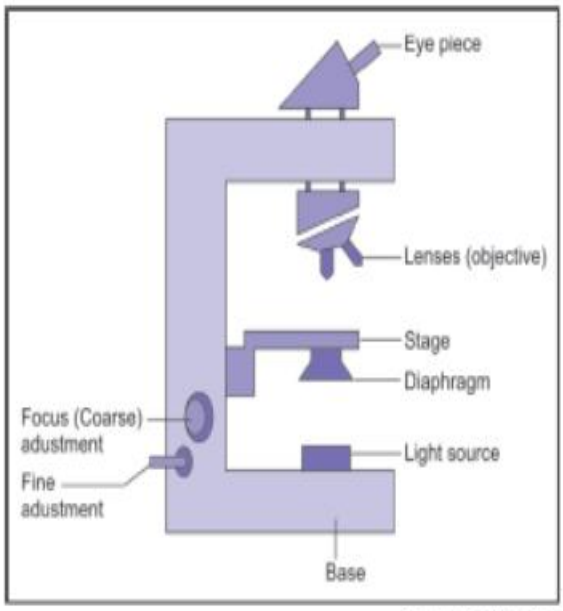

FIGURE: Microscope

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