

Epithelium

By:

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Introduction

- **The human body Organs are formed of the following 4 types of tissues:**
 - 1. Epithelial tissue.
 - 2. Connective tissue.
 - 3. Muscular tissue.
 - 4. Nervous tissue.

Epithelial Tissue

- **Definition :**
- Epithelia are sheets of cells(epithelia) that cover the body on its external surface and line the body on its internal surface.
- Epithelium rests on a basement membrane.
- Epithelium can degenerate (destroyed) and can rapidly regenerate (renewed).
- Epithelial tissue covers a surface or lines a cavity or forms a gland.
- Epithelial cells may act as special receptors for taste and equilibrium.

Functions Of Epithelial Tissues

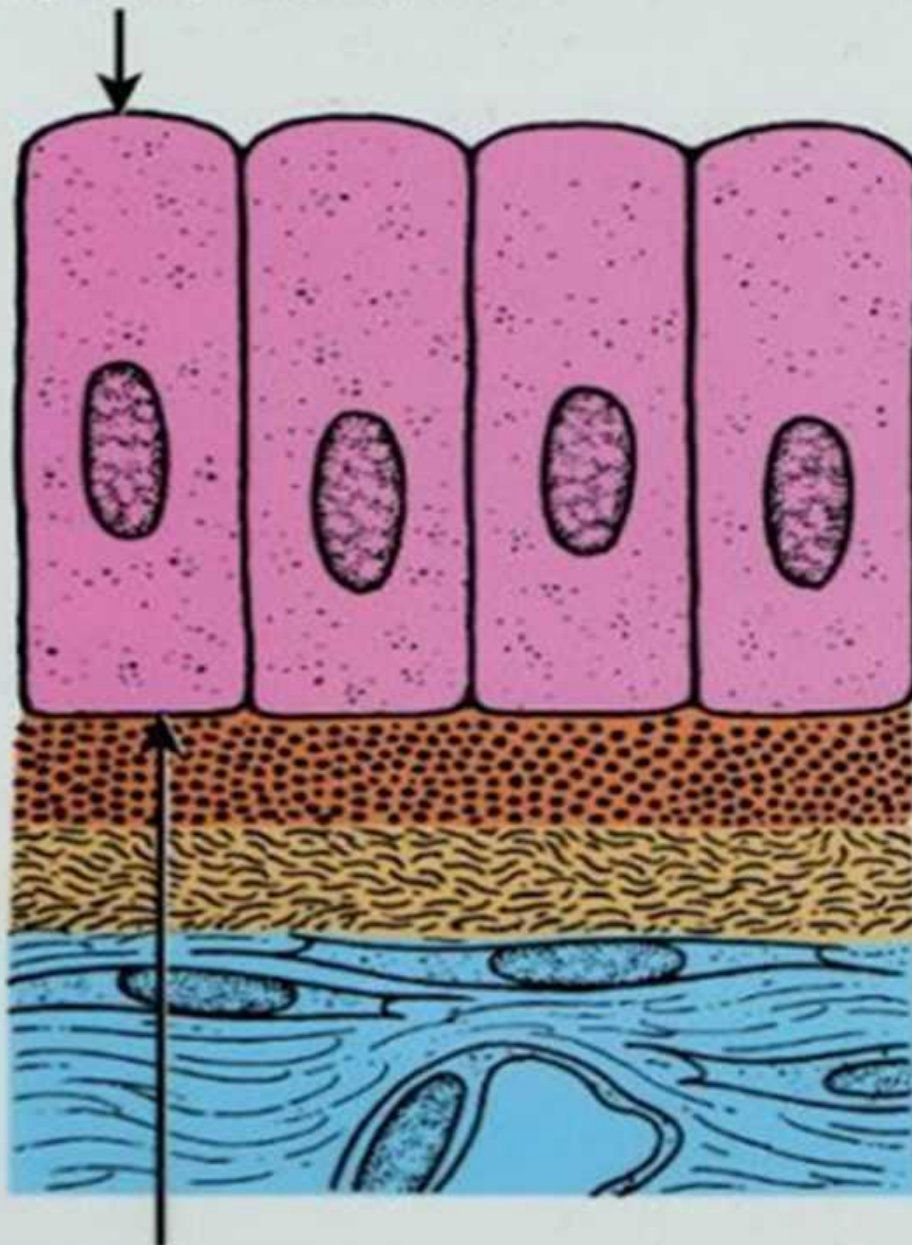
1. Protection.
2. Secretion.
3. Absorption.
4. Sensation.
5. Reproduction.
6. Excretion.
7. Covering.
8. Respiration.

Types of Epithelial Tissue:

1. Surface epithelium.
2. Glandular epithelium.

- ***The basement membrane is formed of:***
- 1. ***Basal lamina,*** formed of clear and dense layers of Ciliated With glycoprotein and collagen fibrils (mainly type IV collagen).
- 2. ***Reticular Lamina,*** it is formed of collagen (mainly type III collagen) and of glycoprotein.

Apical (free) surface



Epithelium

Basal
lamina

Reticular
lamina

Basement
membrane

Connective
tissue

Basal surface

Surface epithelium

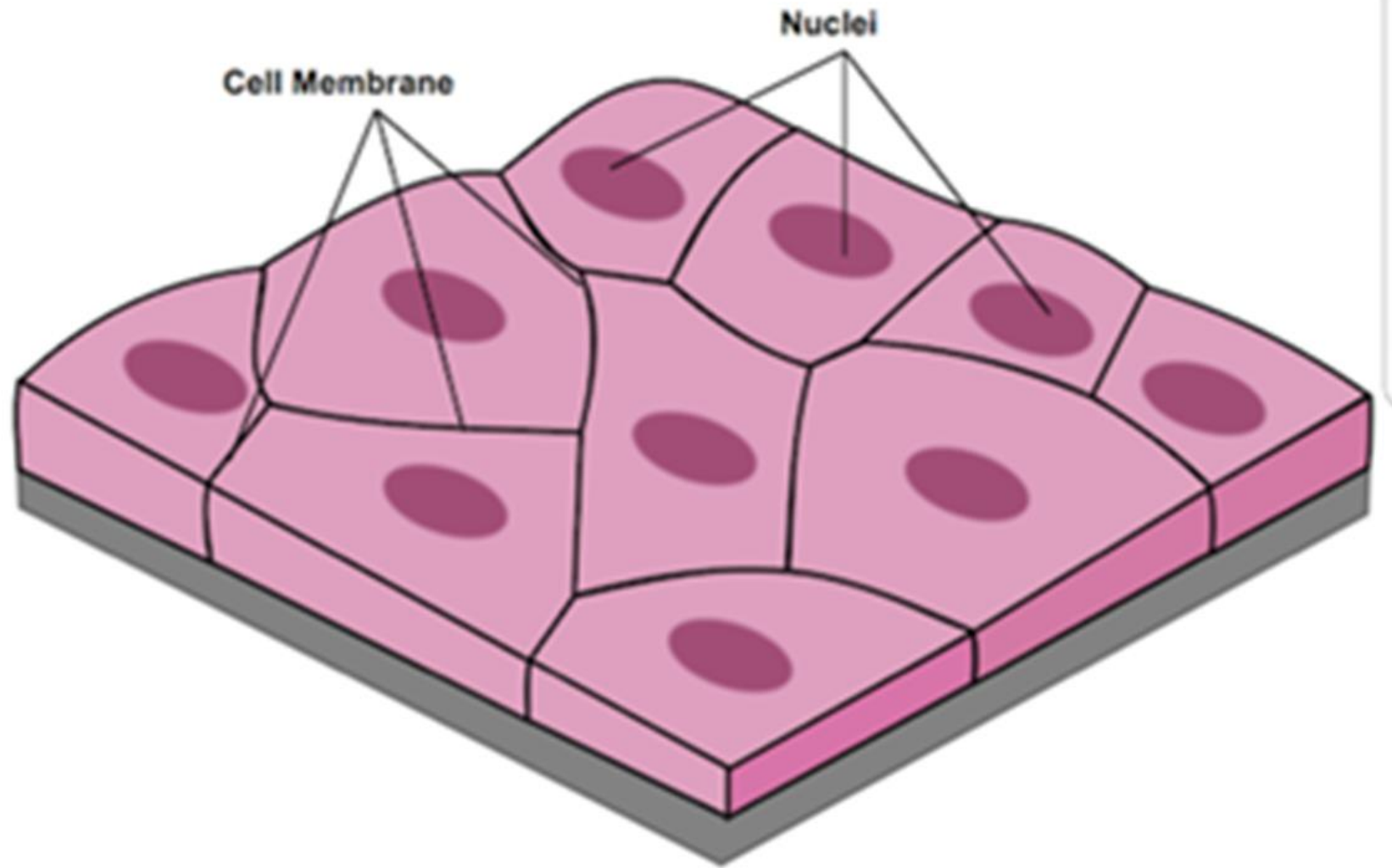
A) Simple epithelium

- Cellular sheets formed of one layer of cells.
- It has different types:

1.Simple squamous

- It is formed of one layer of flat cells with flattened nuclei.
- It forms a thin smooth lining to blood vessels to allow easy passage of blood.
- It covers the peritoneum to facilitate the movements of viscera.
- It facilitates the active filtration of urine in kidney.

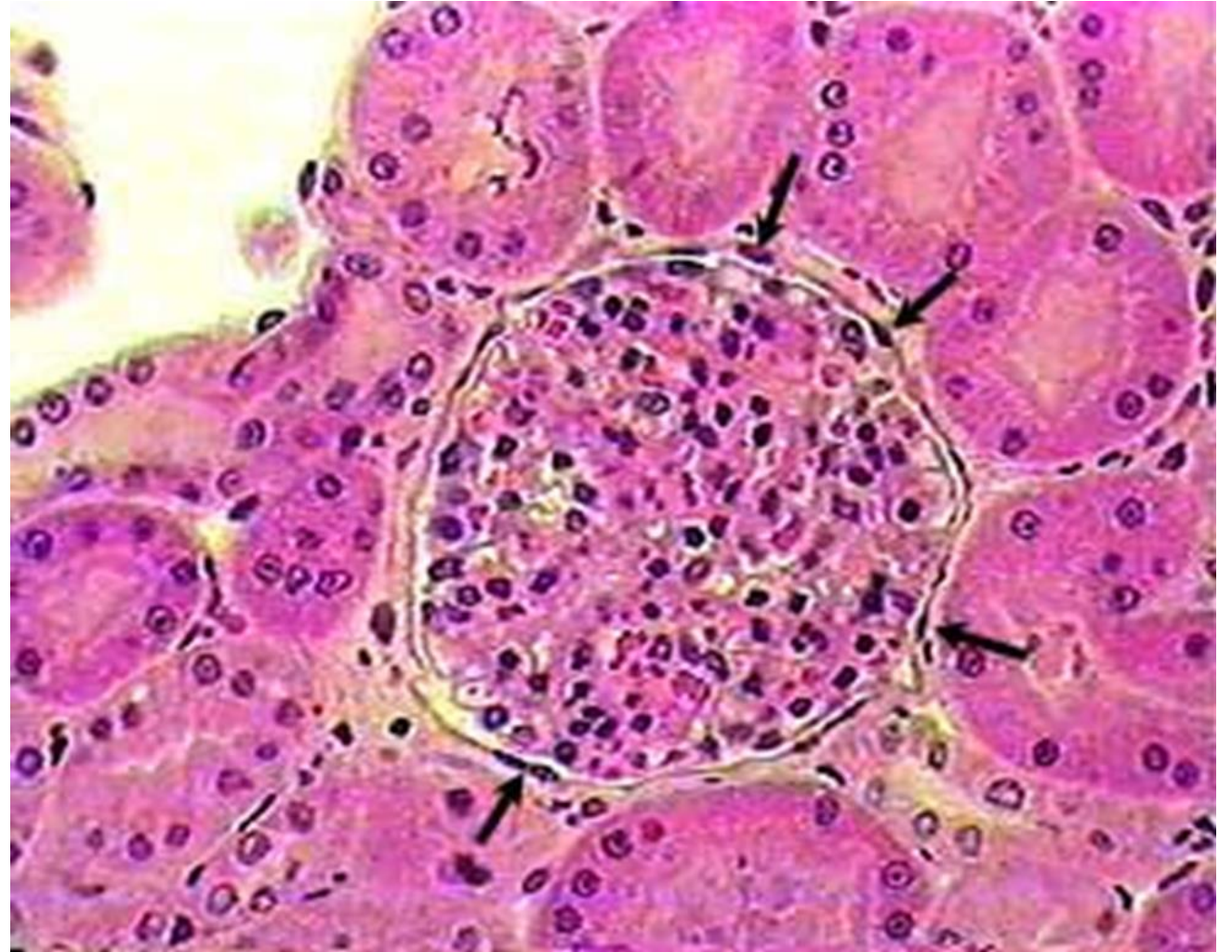
Diagram



Location

- a) The **endothelium** of heart and blood vessels.
- b) The **mesothelium** of serous membranes as: pleura (around the lung), pericardium (around the heart) and peritoneum (around the intestine).
- c) It forms the outer layer of Bowman's capsule of the kidney.
- d) Present in the alveoli of lung.
- e) It lines the anterior chamber of the eye ball.
- f) It lines parts of Henle's loop in kidney.
- g) It covers the adult ovary.

***Thin section of the
kidney***



2.Simple cuboidal Epithelium

- It is formed of one layer of cuboidal cells , with **central rounded nuclei**.
- **Functions:** secretion, excretion, absorption and lining.
- **Location**

The thyroid follicles, they secrete thyroid hormones.

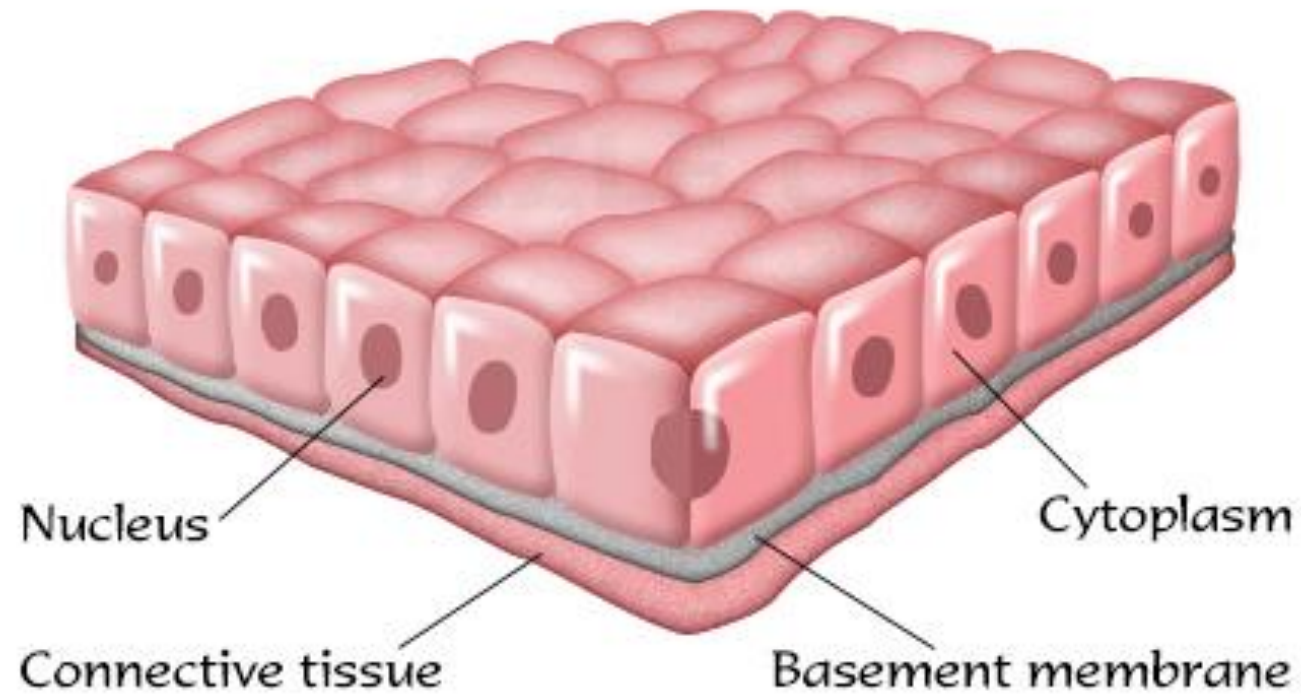
Kidney : lining its convoluted tubules and its small collecting tubules (the cells have microvilli for absorption).

Eye : Covering the anterior surface of lens and the inner cells of choroid.

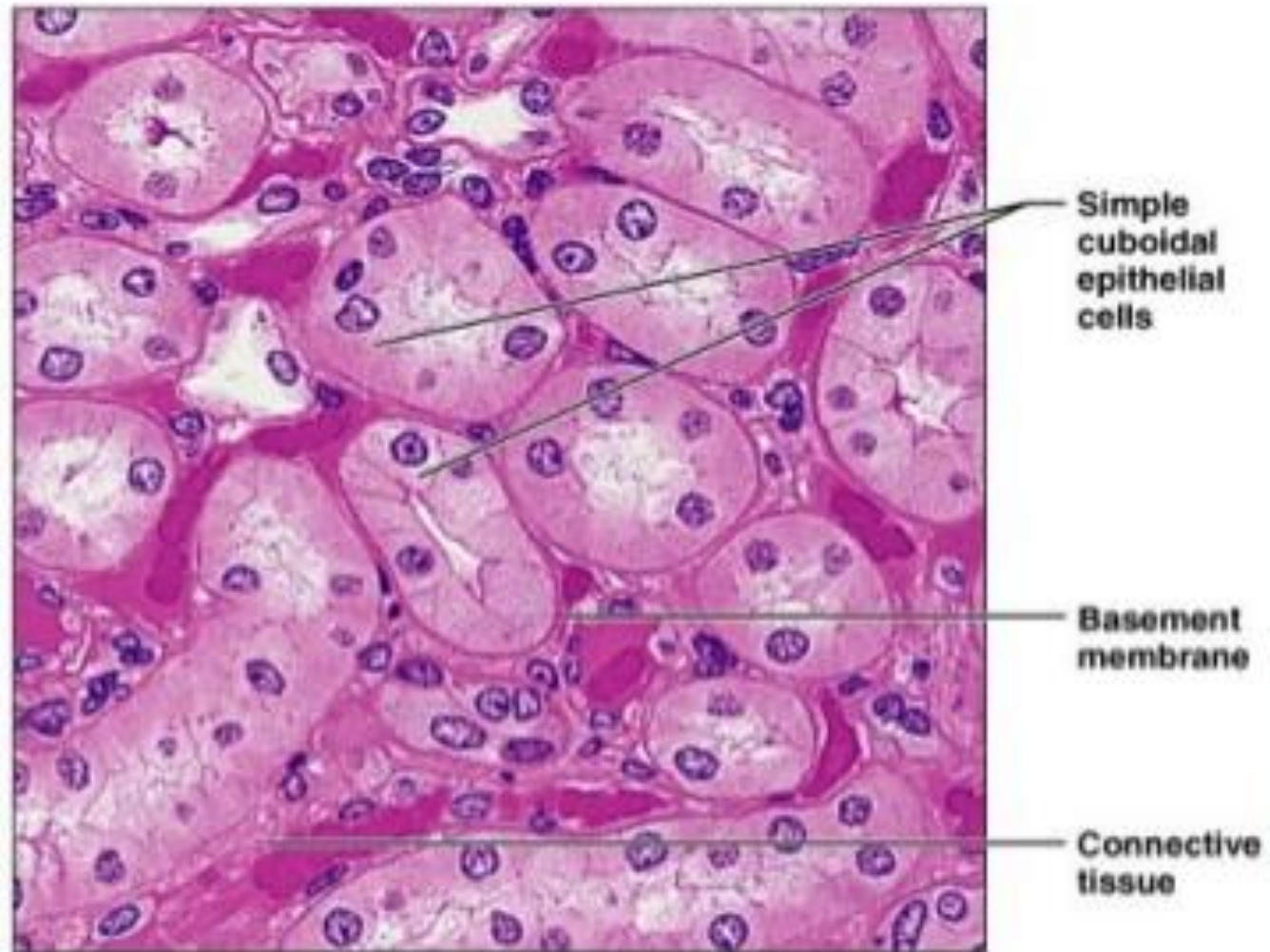
Glands : Lining the acini and small ducts of glands.

Ovary : In newly born infants, it forms the germinal epithelium of the ovary.

Simple Cuboidal Epithelium



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Photomicrograph: Simple cuboidal epithelium in kidney tubules (400 $\times$).

3. Simple Columnar Epithelium

It is formed of one layer of tall columnar cells with basal oval nuclei.

Functions: mainly concerned with secretion, absorption and protection.

Location :

Present in many areas :

In the stomach, cells secrete mucin, so the cells have clear cytoplasm.

In the intestine, they have dark cytoplasm and the surface is covered with microvilli which are rich in phosphatase enzymes in order to facilitate absorption processes.

Lining the gall bladder the common bile duct and the pancreatic duct.

Lining the large collecting tubules of the kidney.

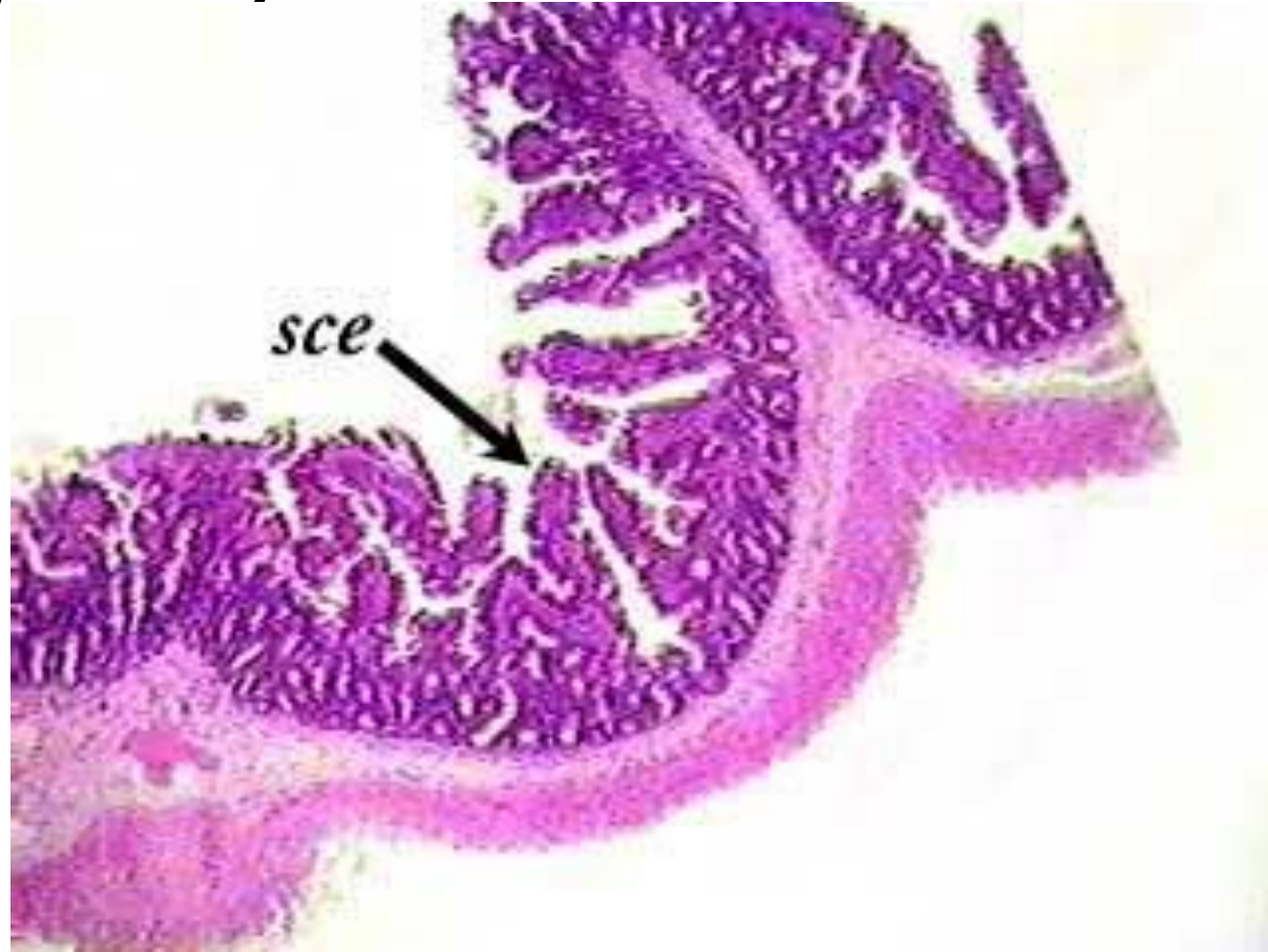


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Inner surface of intestinal wall

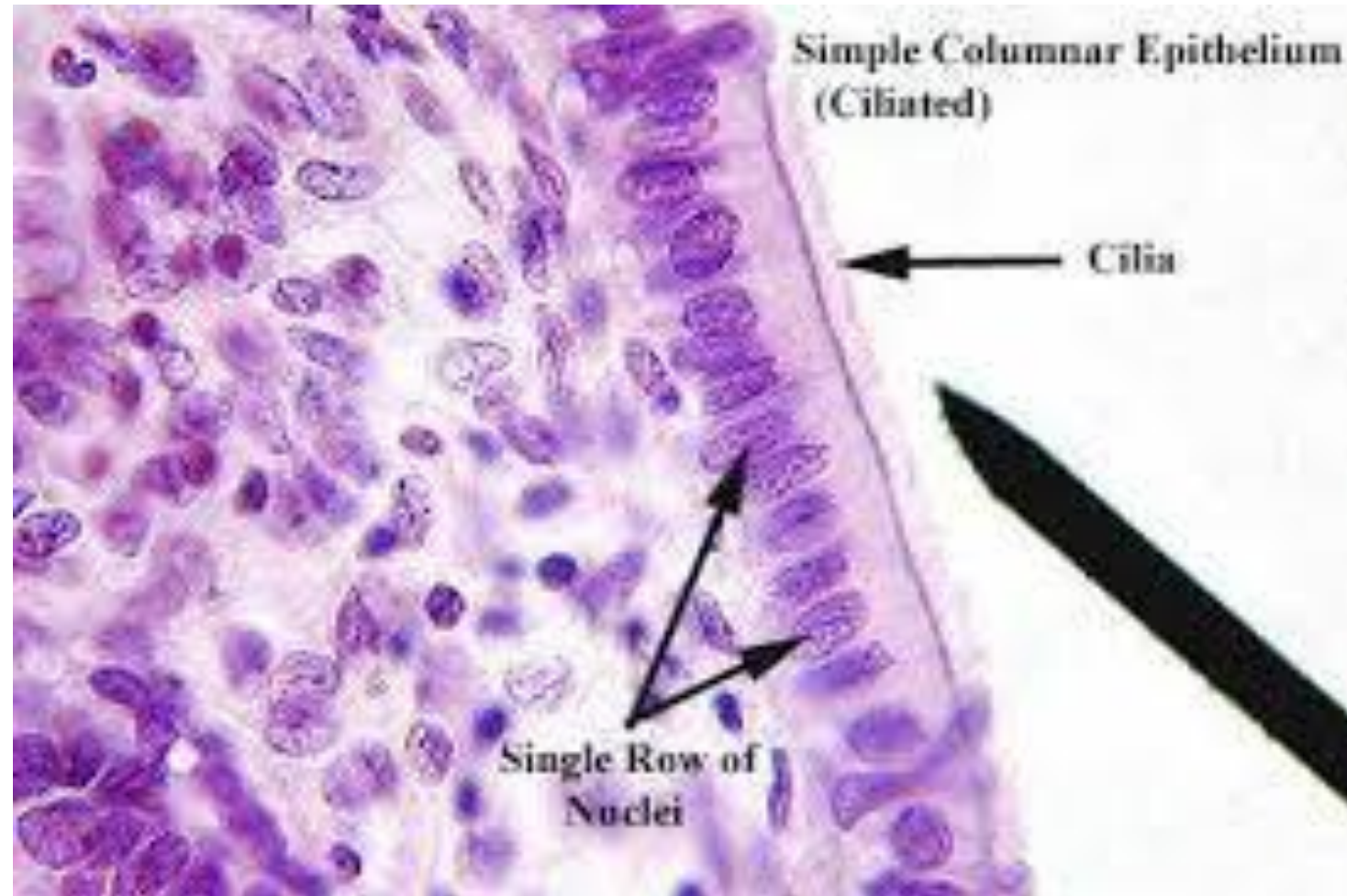


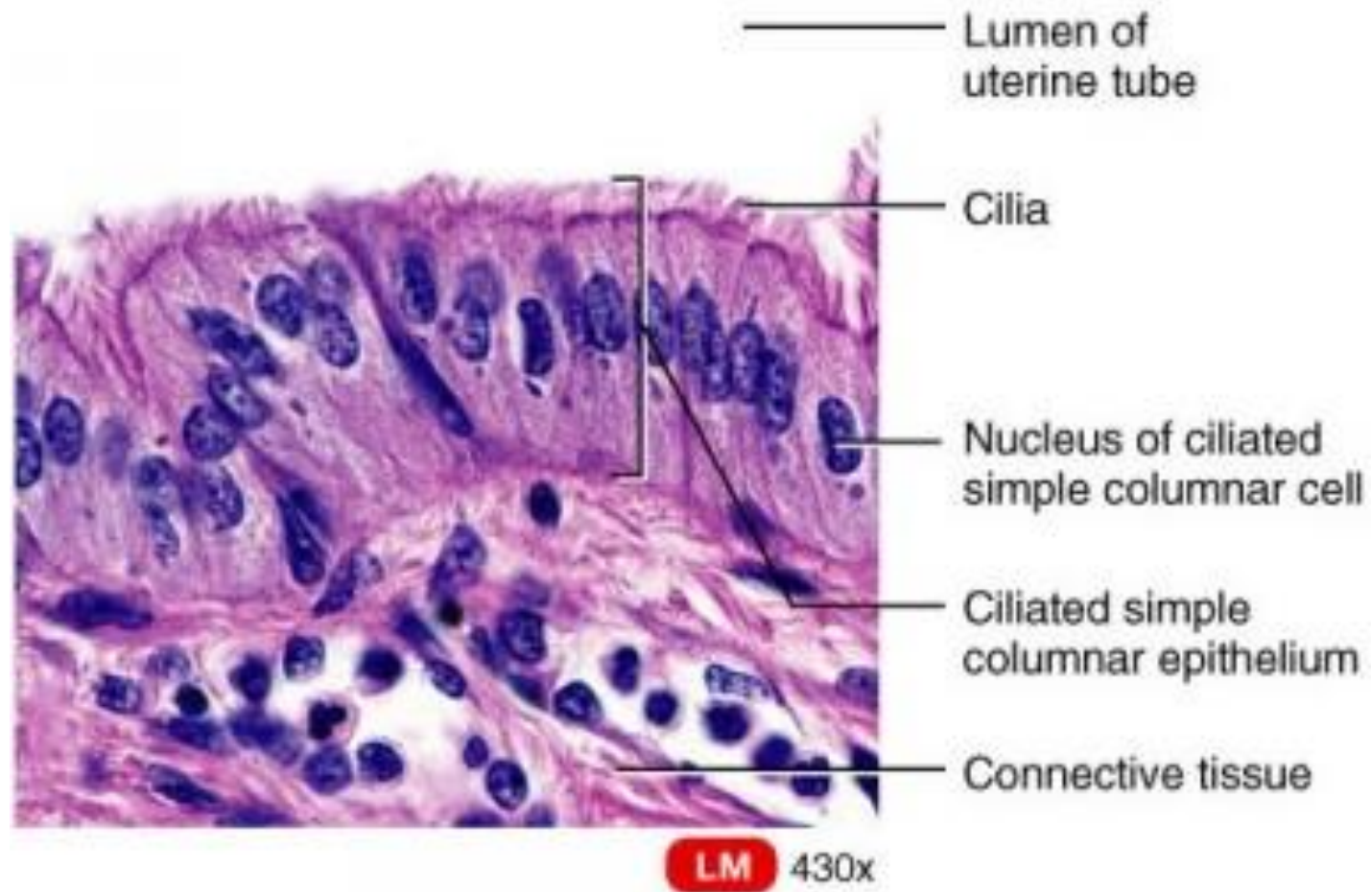
4. Simple Columnar Ciliated Epithelium

- It's formed of simple columnar cell with basal oval nuclei. The free surfaces of these cells are covered with cilia.

- ***Location:***

- *The central canal of the spinal cord and brain ventricles* are lined with simple columnar ciliated epithelium.
- *Fallopian tube and uterus.*
- *Some bronchioles of the lung.*
- *Outer or bony part of Eustachian tube.*





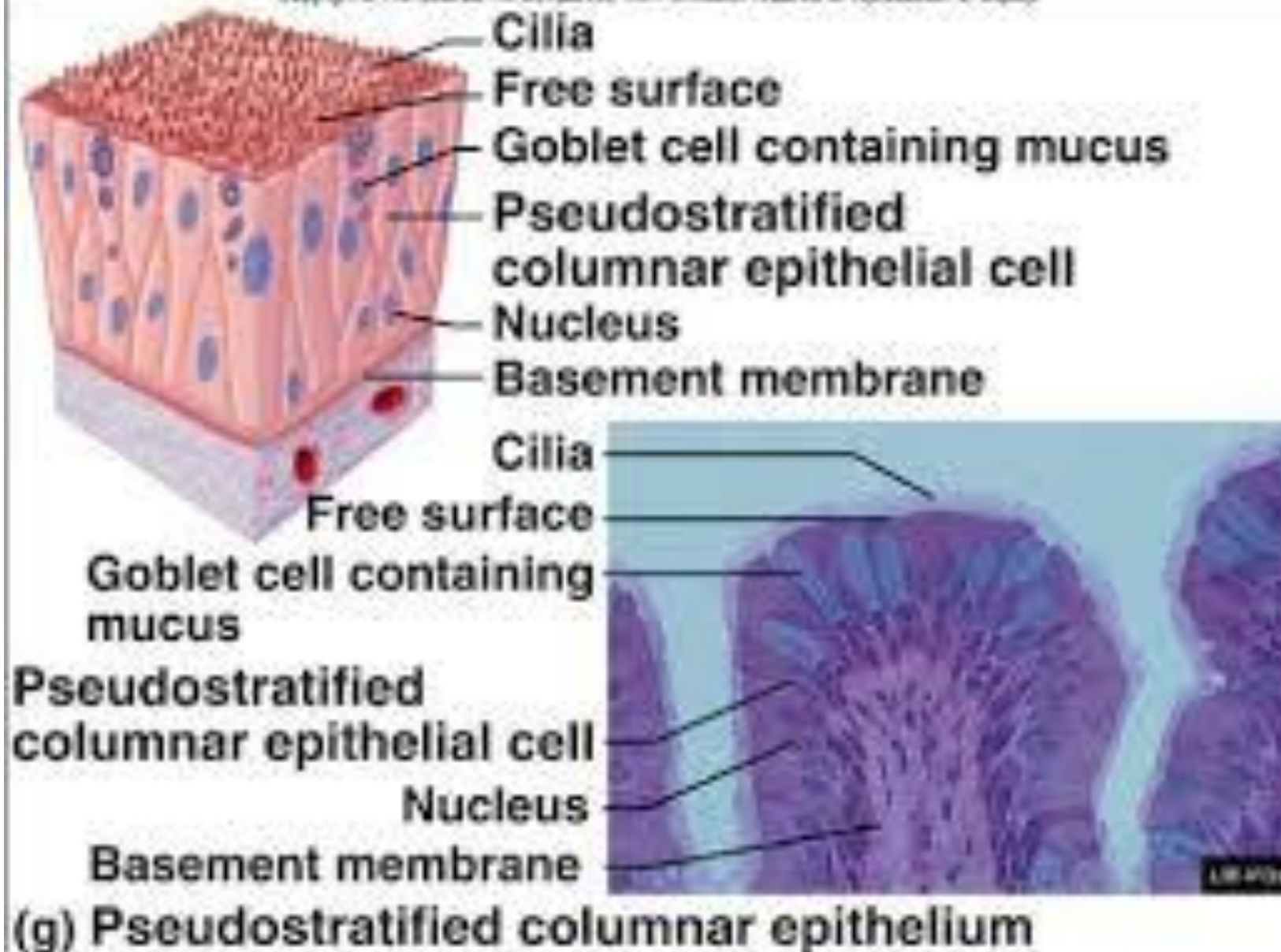
Sectional view of ciliated simple columnar epithelium of uterine tube

5. Pseudo - Stratified Columnar (Ciliated and Non - Ciliated)

- It is a simple type of epithelium formed of one layer of columnar cells resting on basement membrane.

- The columnar cells of this type of epithelium, during .their developepoment are crowded over each other, thus they lose their uniformity.
- The columnar cells are irregularly arranged, therefore their nuclei are arranged at different levels forming false rows.

- All the cells reach the basement membrane but some of them may fail to reach the surface.
- The surface may be ciliated or non - ciliated.
- Cilia may be motile or non motile (sterile).



- ***Pseudo-Stratified Columnar Ciliated Epithelium with goblet cells and motile cilia, is present in these areas:***
 - ***a) The Upper Respiratory Passages as:*** nasal air sinuses, nasopharynx, lower part of the larynx, trachea and bronchi.
 - ***b) Eustachian tube :*** (in its inner or cartilagenous part).
 - ***c) Lacrimal sac.***

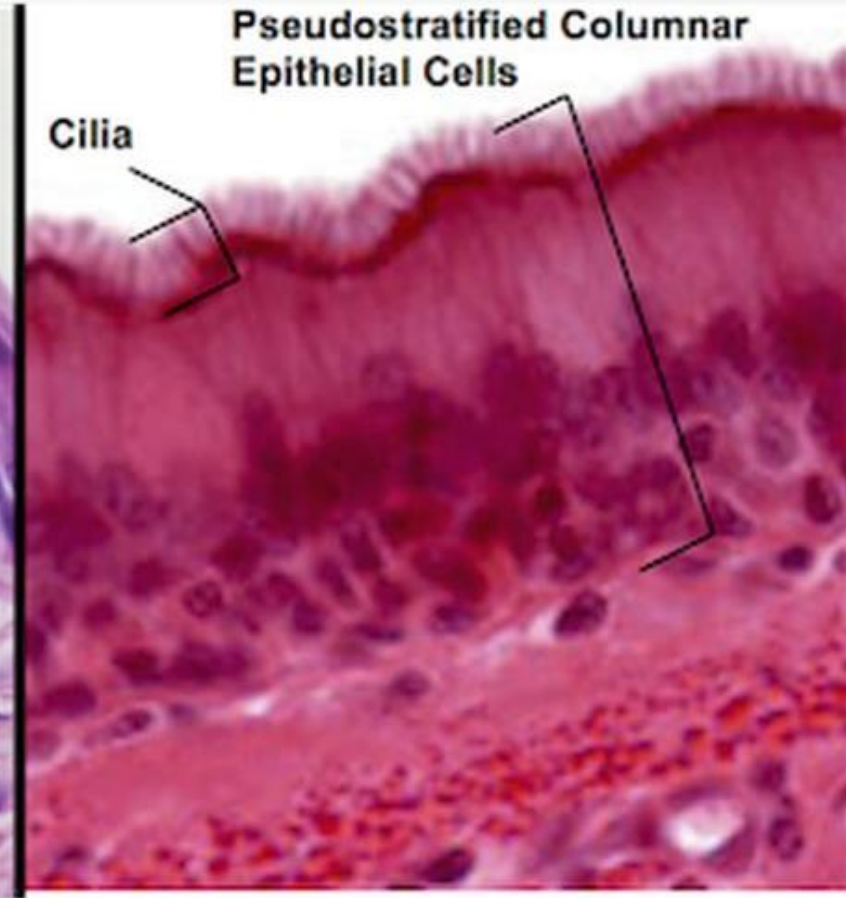
- ***Functions*** : This type of epithelium is responsible for; protection, secretion and transport of particles out of the air passages.

- **2. *Pseudo Stratified Columnar Ciliated Epithelium*** but the Cilia are non-motile.
- This type is present only in the epididymis.

- ***3. Pseudo-Stratified Columnar Non-Ciliated Epithelium is Present in:***
 - a) Upper part of Vas deferens and male urethra.
 - b) Large ducts of salivary glands.



Non-Ciliated Pseudostratified Epithelium



Ciliated Pseudostratified Epithelium

B) Stratified Epithelium

- Stratified epithelium is formed of many layers of cells.

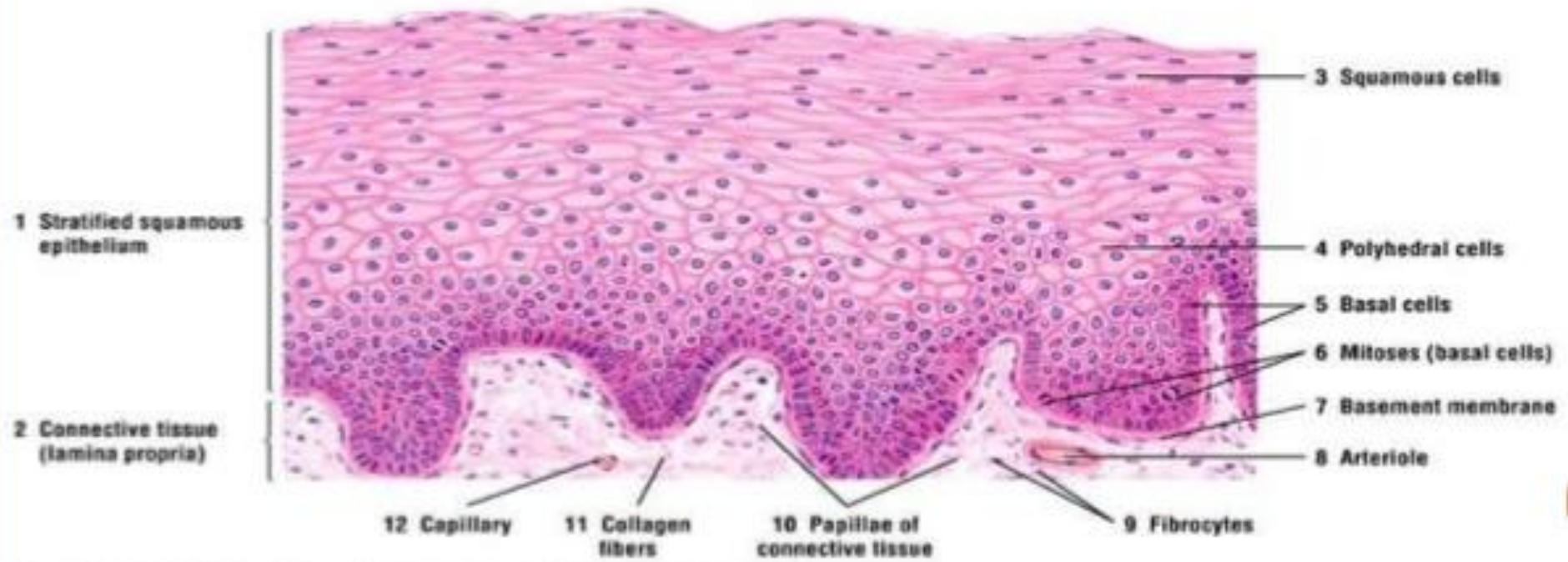
Types of Stratified Epithelium:

- The stratified epithelium is named according to the most superficial cells to:
 1. Stratified Squamous Epithelium.
 2. Stratified Columnar Epithelium.
 3. Stratified Columnar Ciliated Epithelium.
 4. Transitional Epithelium

1 - Stratified Squamous Epithelium

- It is a thick type of stratified epithelium formed of many layers of cells one above the other.
- The cells rest on a clear irregular basement membrane.

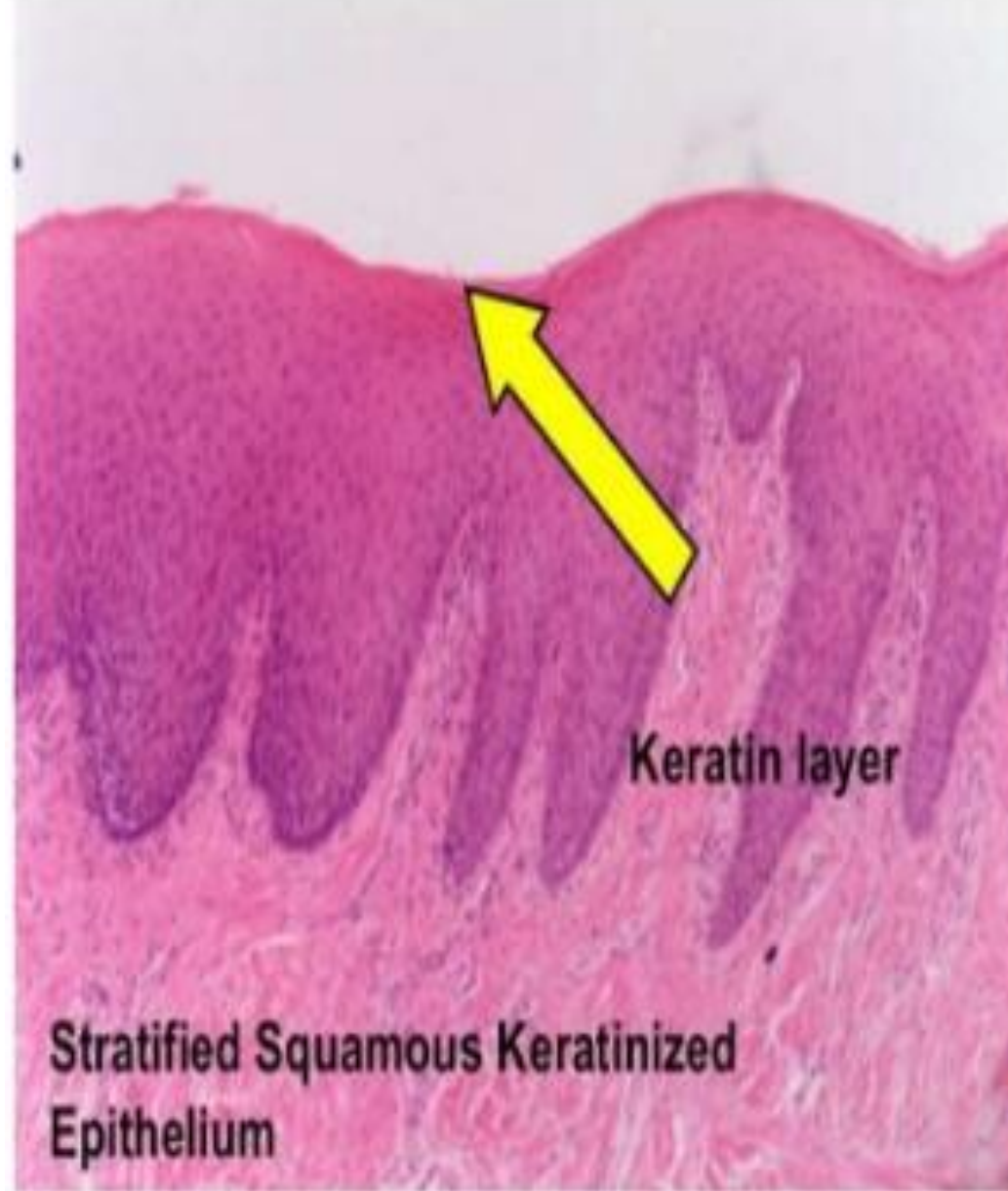
- The intermediate layers are polygonal cells (have many sides) with desmosomes between their cell boundaries (spiny appearance).
- The Superficial layers of cells, are flat squamous cells which may be nucleated or not.



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Location :

- 1- *Keratinizing Stratified Squamous Epithelium* is present in these dry surfaced areas:
 - *a) Epidermis of skin.*
 - *b) External openings of the body:* External ear, External nose, outer surface of the lip and the anal orifice.



- **2- Non-keratinizing stratified Squamous Epithelium** is present in these wet surfaced areas:
 - a) **Oral cavity**, *inner surface of the lip, gum and palatine tonsils.*
 - b) **Oesophagus**, *Oropharynx and vocal cords.*
 - **c) Cornea** and exposed parts of the conjunctiva.
 - **d) Vagina.**



2. Stratified Columnar Epithelium

- It is similar in structure to stratified squamous epithelium but:
- Its layers are less in number.
- ***Location***
- 1. Fornices of conjunctiva of the eye.
- 2. Membranous and penile parts of male urethra.
- 3. Large ducts of glands.
- 4. Recto-anal junction.

Stratified Columnar Epithelium



3 - Stratified Columnar Ciliated Epithelium

- It is formed of few layers of cells.
- ***Location***
- 1. Fetal esophagus.
- 2. Nasal surface of soft palate.
- 3. Laryngeal surface of epiglottis.

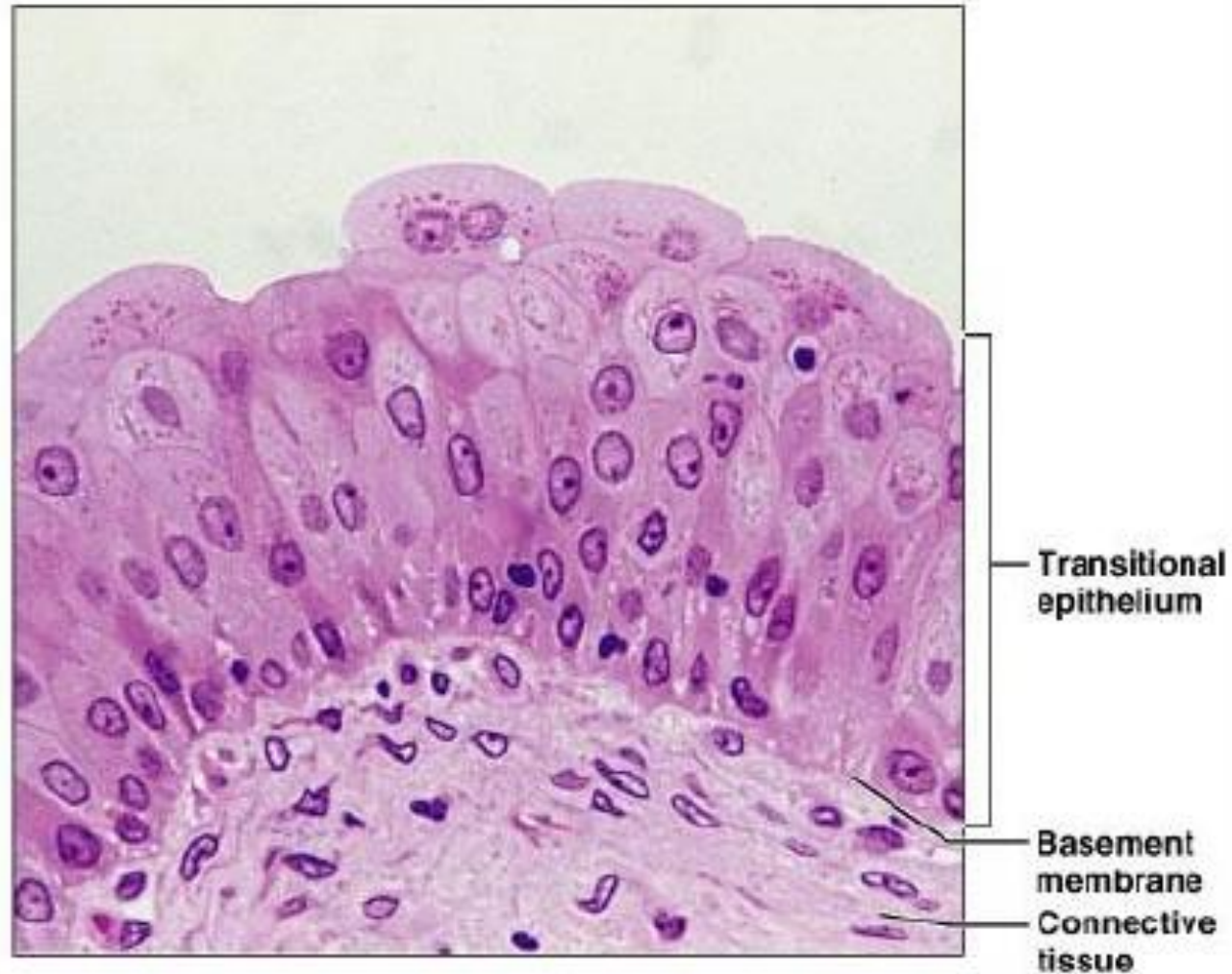
Stratified Columnar Ciliated Epithelium



4-Transitional Epithelium

- It is a stratified type of epithelium which is present in the urinary tract.
- The epithelium rests on thin basement membrane.
- Its superficial cells are cuboidal in shape with convex outer surfaces and concave inner surfaces.
- ***Function***
- Stretches readily and permits distention of urinary organ by contained urine.

- ***The Transitional epithelium is present in these urinary passages:***
 - 1. Minor and major calyces of the kidney.
 - 2. Pelvis of the ureter, the ureter and the urinary bladder.
 - 3. The prostatic part of male urethra and the inner part of female urethra.

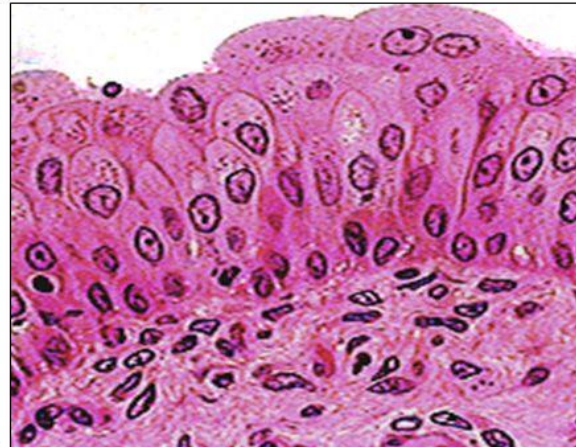


Photomicrograph: Transitional epithelium lining of the bladder, relaxed state (500 $\times$); note the bulbous, or rounded, appearance of the cells at the surface; these cells flatten and become elongated when the bladder is filled with urine.

Transitional Epithelium



Distended bladder



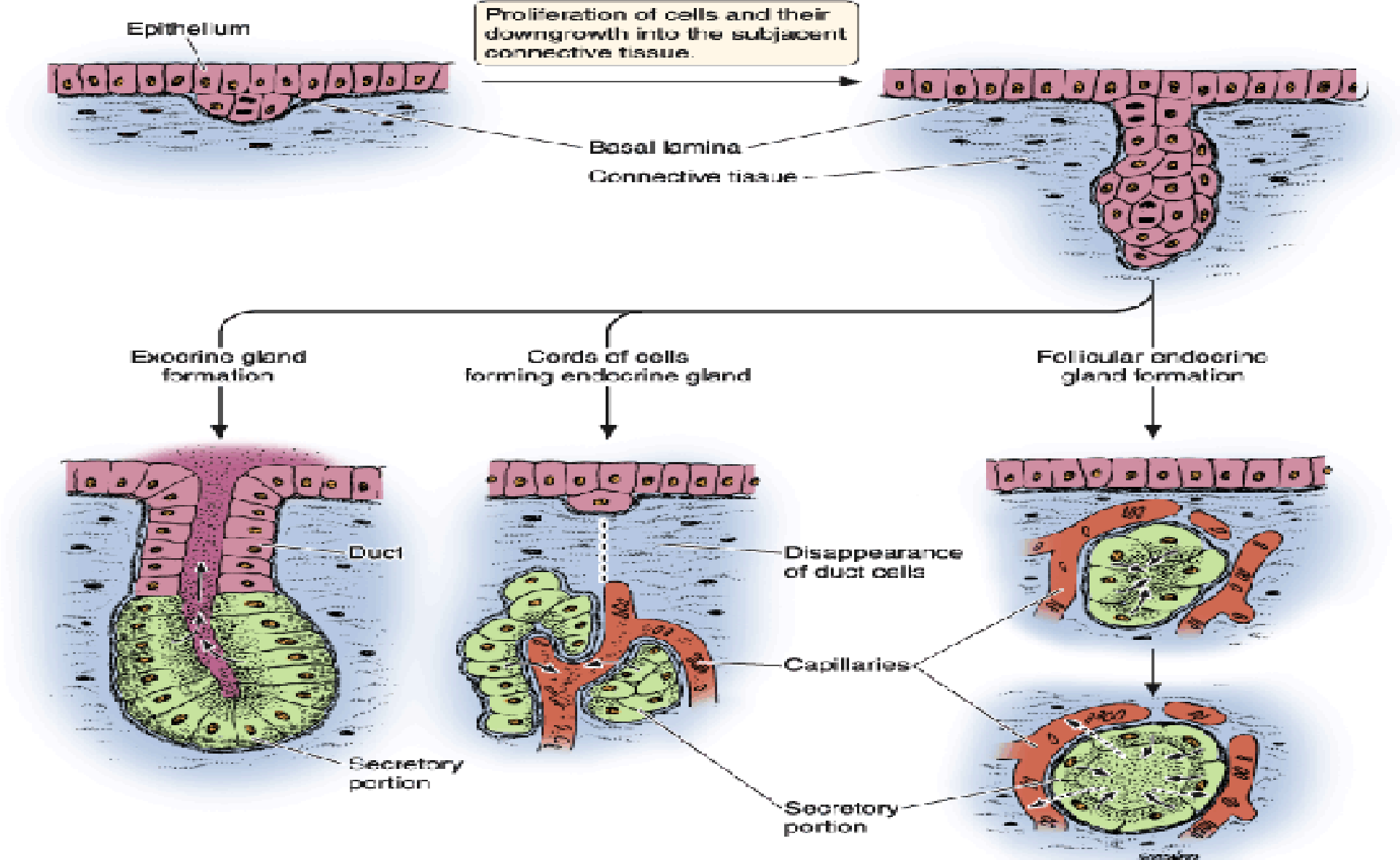
Empty bladder

Type of epithelium	Sub classification	Site
Squamous	Simple	Lining blood vessels(endothelium),lining body cavities (mesothelium),alveoli of the lungs , bowman's capsule and loop of Henle of kidney.
Squamous	stratified	Lining oral cavity ,epiglottis , esophagus , vagina , cornea
Squamous	Stratified , keratinizing	Skin (epidermis)
Cuboidal	Simple	Collecting tubules of kidney , rete testis, small duct exocrine gland , surface of ovary.
Cuboidal	stratified	Larger duct of exocrine gland.

Type of epithelium	Sub classification	Site
columnar	Simple	Gall bladder , collecting ducts of kidney
columnar	Pseudostratified , ciliated	Respiratory tract including nose & sinus.
columnar	Simple ciliated	Fallopian tubes
Transitional	None	Lower urinary tract(renal pelvis ,ureters , bladder & urethra).

Glandular Epithelium

- A **gland** consists of a functional portion of secretory and ductal epithelial cells (**parenchyma**), which is separated by a basal lamina from supporting connective tissue elements (**stroma**).
- Glandular epithelium is a type of epithelium that penetrates the connective tissue and forms **secretory units**.



Glandular epithelium showing the secretory, ductal portion of the gland and the proliferation process of the cell

Classification of Glands

➤ **The different glands in our body are classified according to the following classifications:**

- 1. Presence or absence of ducts.***
- 2. Changes in the secretory cells (Mechanisms of secretion).***
- 3. Kind of their secretion.***
- 4. Shape and branching of the secretory part and their ducts.***
- 5. Their functions.***
- 6. Location of the duct.***

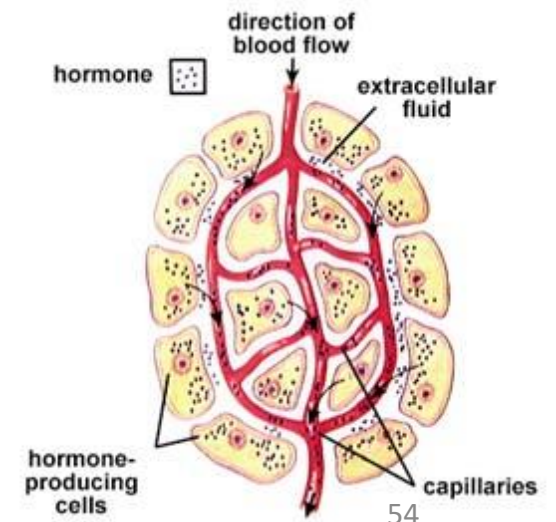
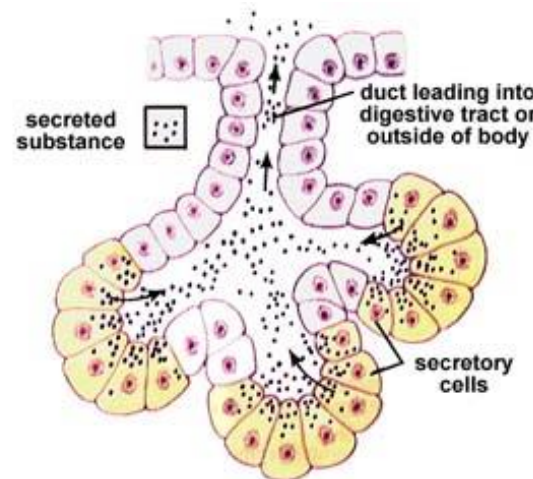
1. According to *presence or absence of ducts*, the glands are classified into:

a) Endocrine or ductless glands, secreting hormones directly in the blood as:

-Thyroid, parathyroid, pituitary, suprarenal, pineal body, placenta, corpus luteum and special cells in the testis and ovary.

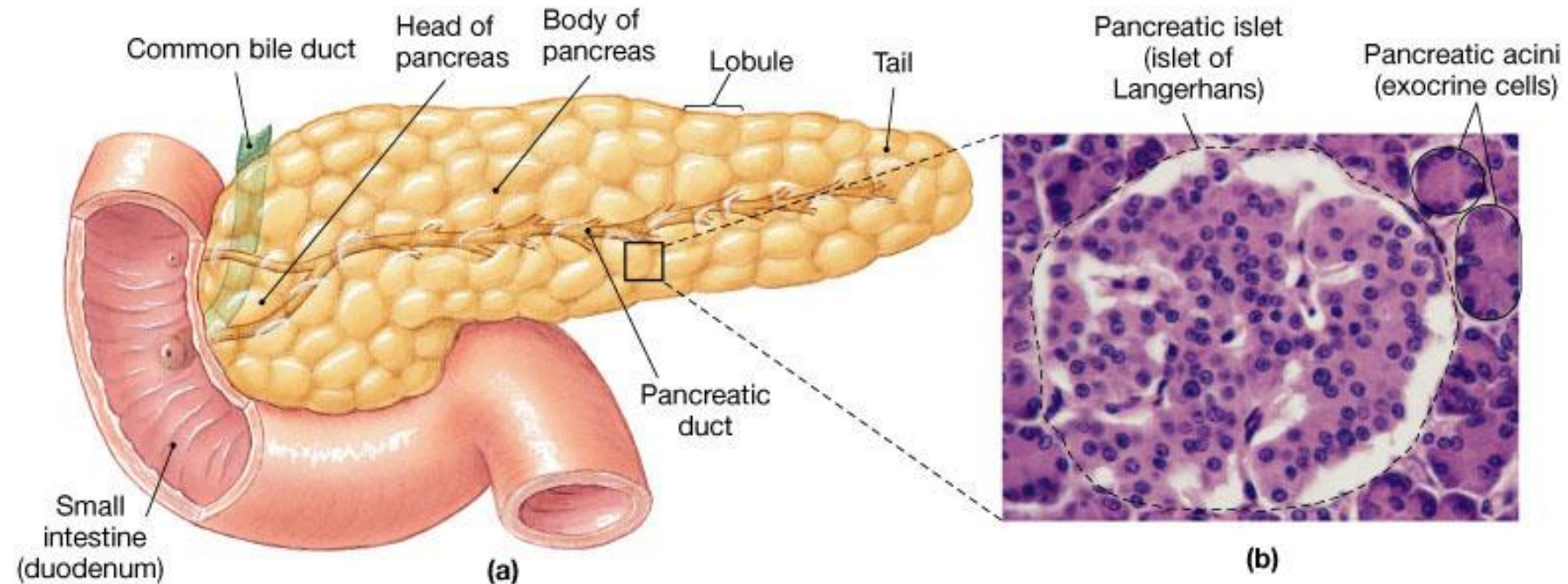
b) Exocrine glands: They have **ducts** to carry their secretions.

E.g. *salivary glands, sweat and sebaceous glands.*



c) Mixed glands: Which possess the exocrine and endocrine functions as:

Pancreas



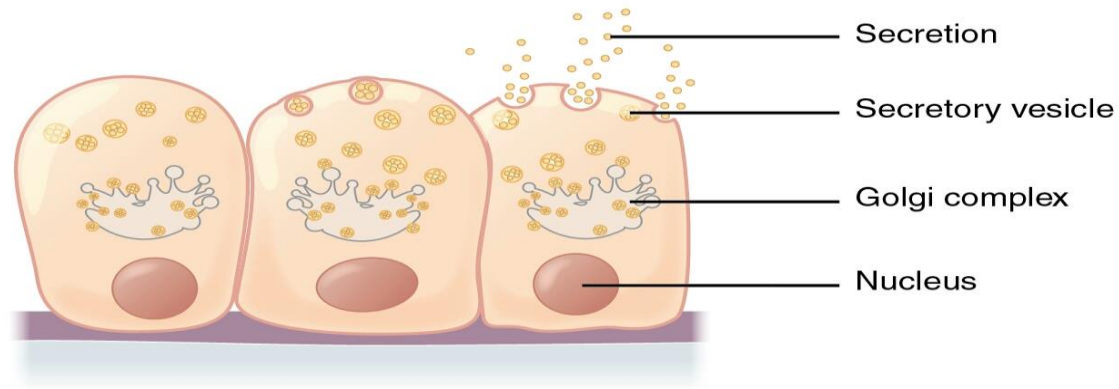
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2. According to *changes in the secretory cells (Mechanisms of secretion)*, the glands are classified into:

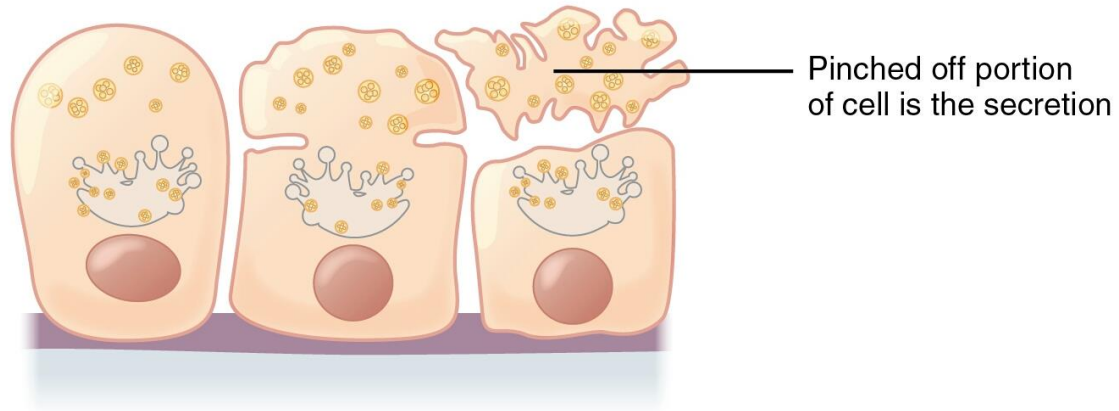
- a) **Merocrine gland:** In these glands, there is no cellular change in their secretory cells (**no part of the gland is lost**); for example: the *salivary glands*.
- b) **Apocrine gland:** In which the tips of the secretory cells of the gland are detached and come out with the secretory products of the gland (**loses part of its cytoplasm**) e.g. *mammary glands and sweat glands of axilla*.
- c) **Holocrine gland:** In which the whole secretory cells are destroyed and come out with the secretion e.g. the cells of the *sebaceous glands & meibomian gland of the eyelid*.

EXOCYTOSIS

(a) Merocrine secretion

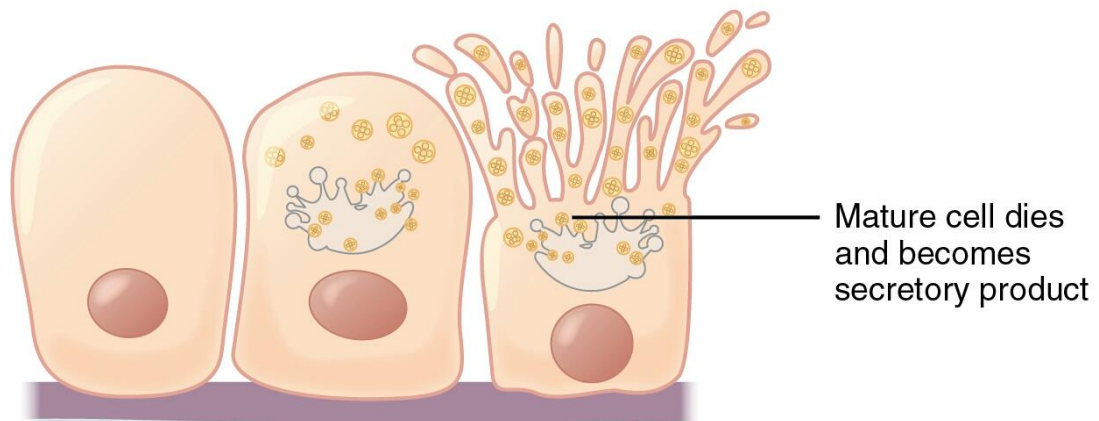


(b) Apocrine secretion



MEMBRANE BUDDING

(c) Holocrine secretion



MEMBRANE RUPTURE

3. The glands are classified according to the *kind of their secretion* into:

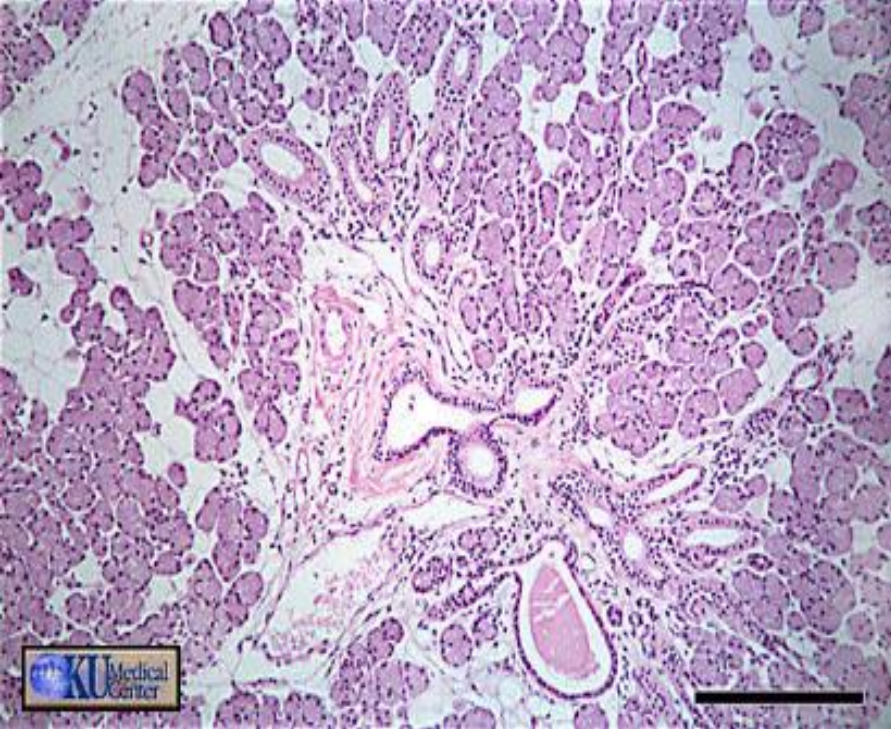
A) Serous secretory glands: as **parotid gland** and Von Ebner gland of the tongue.

B) Mucous secretory glands: as Brunner's (duodenal) gland and goblet cell.

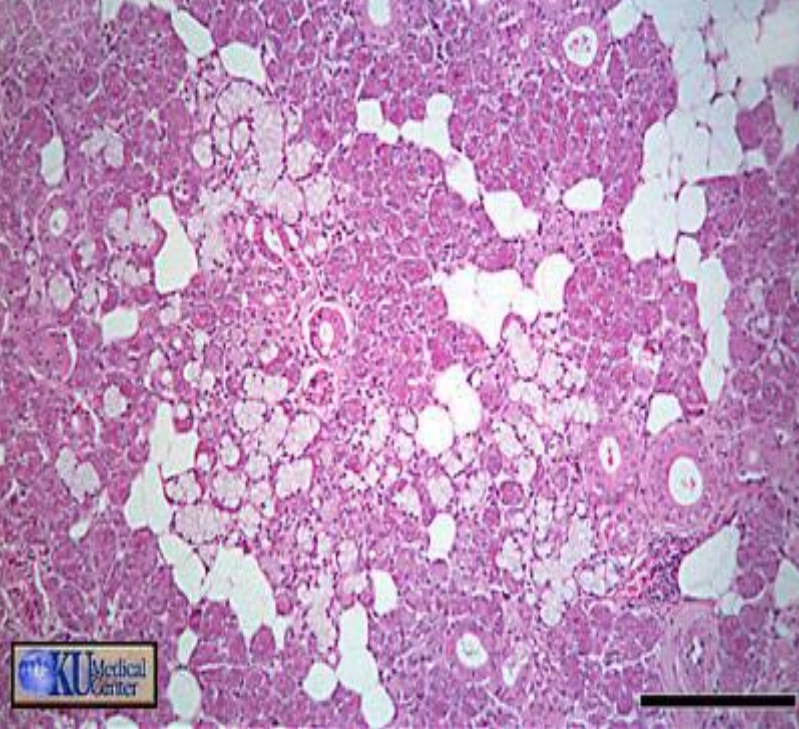
C) Mucoserous secretory glands: as submandibular and sublingual glands.

Others:

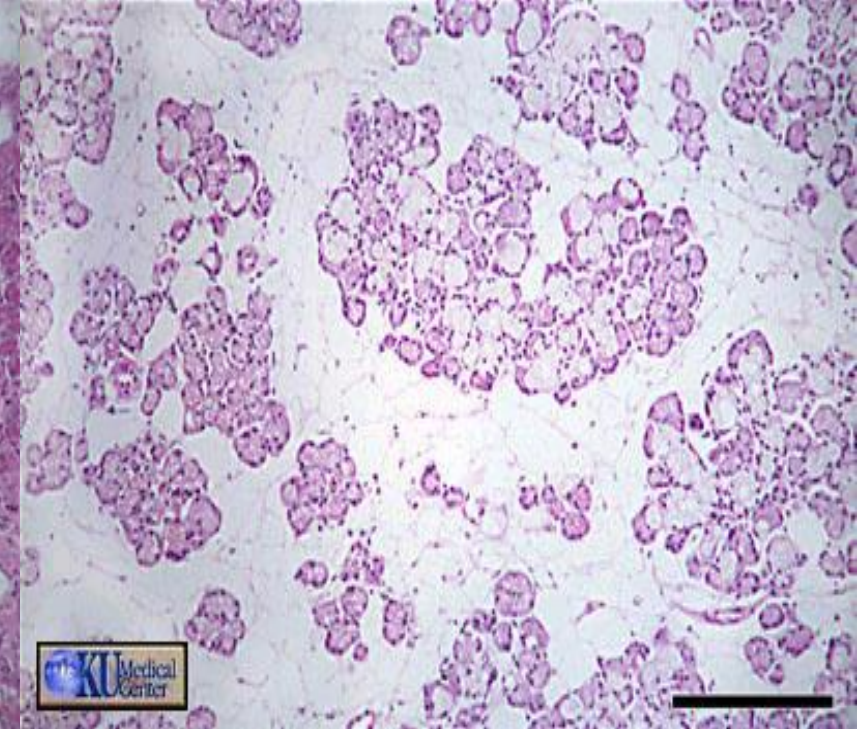
- **Fatty secretory glands:** as sebaceous glands.
- **Watery secretory glands:** as sweat glands.
- **Waxy secretory glands:** as glands of external ear.
- **Cellular secretory glands:** as testis and ovary.



Parotid Gland - The parotid salivary gland consists almost entirely of serous acini and no mucous acini.



Sub-mandibular Gland - The submandibular salivary gland has predominately serous acini, but also includes numerous mixed sero-mucus acini.



Sublingual - The sublingual salivary gland consists predominately mixed sero-mucus glands. Also notice the large amount of fat tissue present.

4. According to the *shape and branching of the secretory part* of the glands and the shape and branching of their ducts, it is classified into:

A/ Tubular glands

B/ Acinar (Alveolar) glands

C/ Tubulo-acinar glands

A/ Tubular glands:

Tubular glands which may be of the following types:

- 1) **Simple tubular glands:** as the *intestinal gland* (the crypts of Lieberkuhn).
- 2) **Simple branched tubular:** as the glands of the *stomach*.
- 3) **Simple coiled tubular:** as the *sweat glands*.
- 4) **Compound tubular glands:** as the *kidney* and *testis*.

B/ Acinar (Alveolar) Glands:

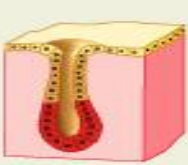
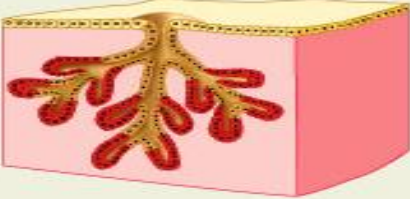
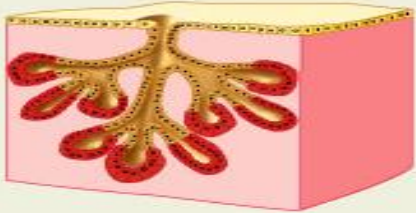
Acinar Glands are classified into:

- 1) **Simple acinar:** as *male urethral glands* and *sebaceous glands*.
- 2) **Simple branched acinar:** as the *sebaceous* and *tarsal glands* of eye lid.
- 3) **Compound acinar:** as the *sebaceous gland* and *mammary gland*.

C/ Tubulo-Acinar Glands:

Tubulo-Acinar Glands: which may be:

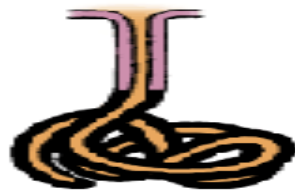
- 1) **Simple Tubulo-acinar**: not found in man.
- 2) **Branched tubulo- acinar**: as the *glands of the mouth cavity*.
- 3) **Compound tubulo-acinar**: as *pancreas, prostate and salivary glands*.

	Tubular secretory structure		Alveolar secretory structure	
Simple duct structure (duct does not branch)				
	(a) Simple tubular Example: intestinal glands	(b) Simple branched tubular Example: stomach (gastric) glands	(c) Simple alveolar Example: No important example in humans	(d) Simple branched alveolar Example: sebaceous (oil) glands
Compound duct structure (duct branches)				
	(e) Compound tubular Example: duodenal glands of small intestine	(f) Compound alveolar Example: mammary glands	(g) Compound tubuloalveolar Example: salivary glands	

Key:  = Surface epithelium  = Duct  = Secretory epithelium



Simple tubular



Simple coiled tubular



Simple branched tubular



Simple branched acinar



Compound tubuloalveolar

Compound tubular



Compound acinar

5. The glands can be classified *according to their functions* into:

a) Secretory Glands:

Which *synthesize* specific substances to be *secreted* in the body as *salivary* and *endocrine glands*.

b) Excretory Glands:

Which *eliminate* and *excrete* the waste products outside the body as *kidney* and *sweat glands*.

6. Classification according to the **number** of the cell:

A) Unicellular : Single cell distributed among non- secretory cells.

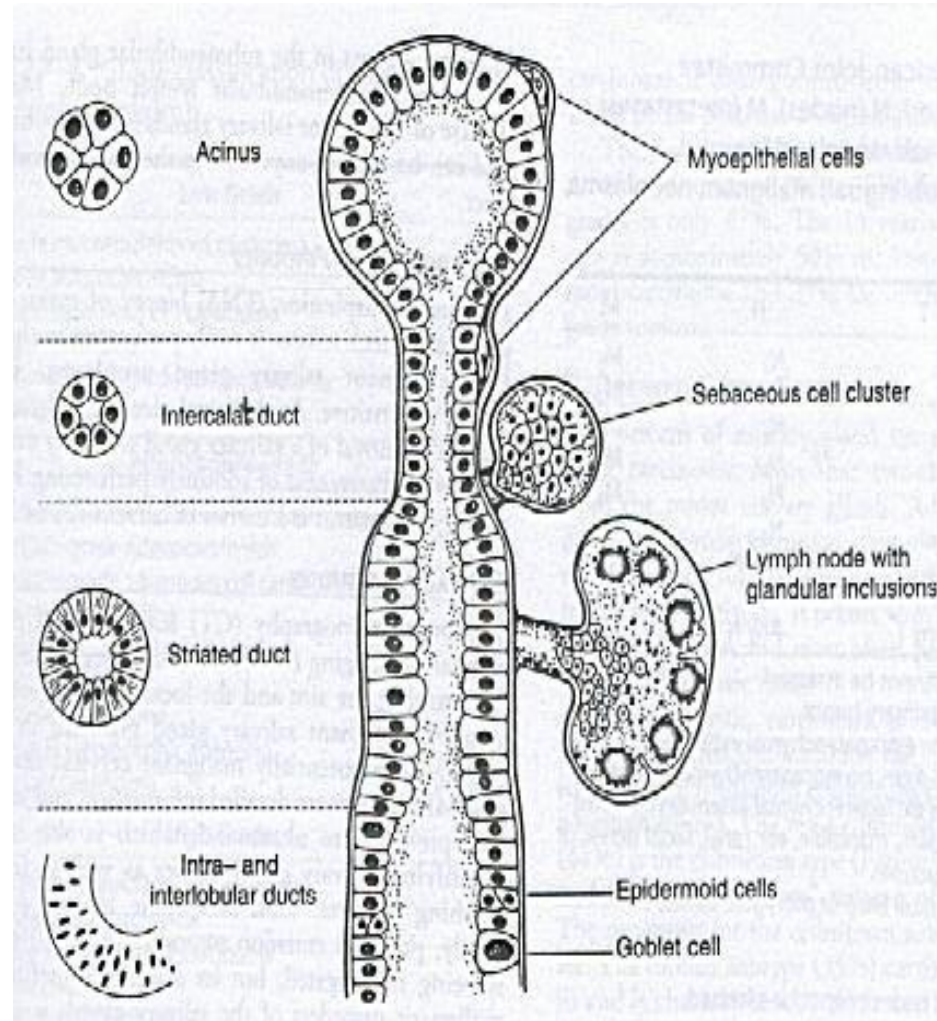
(e.g., individual endocrine cells in gastrointestinal and respiratory epithelia).



Goblet Cell

Goblet cell

B) Multicellular (e.g. adrenal gland ,salivary).

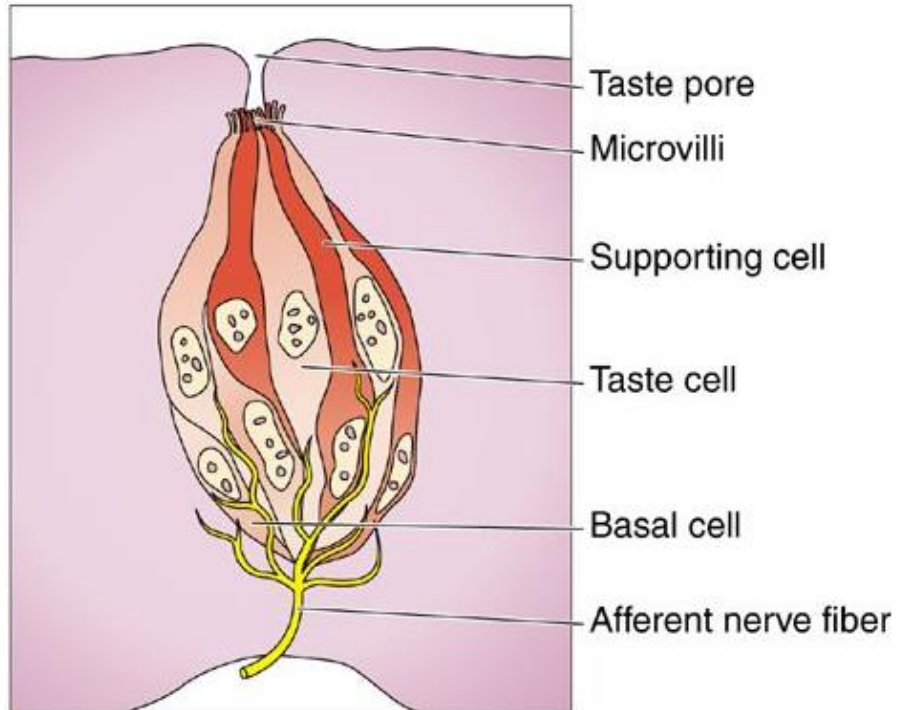
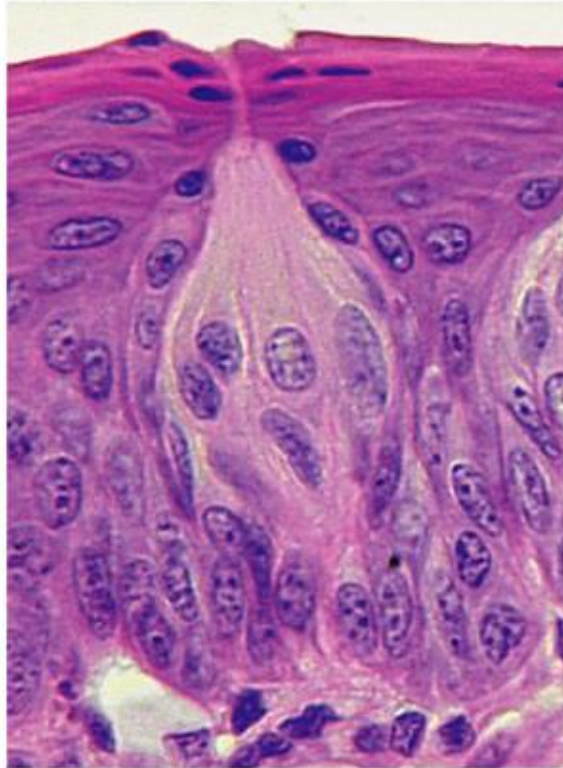


Picture showing the secretory and ductal cells of the exocrine portion of salivary gland

Neuro-Epithelium

- In this type, the epithelial cells act as sensory receptors for special stimuli.
- The neuro - epithelial cells are provided with small hairs (hairlets) on their free surfaces, while their bases are surrounded with sensory nerves.
- ***Neuro-epithelium is found in:***
 - *a) Taste buds in the tongue.*
 - *b) Organ of Corti in internal ear (for hearing).*
 - *c) Crista Ampullas in the ampullae of the semicircular canals, in the internal ear (for equilibrium).*

Neuroepithelium



(Taste buds: dorsal surface of the tongue)

Myo - Epithelium

Myoepithelial Cells (Basket cells) are branched epithelial cells rich in actin and myosin filaments.

- *They surround some secretory acini.

- *They are present on the outer surfaces of the acini of: sweat, salivary and mammary glands.

Slide 43 Thick skin



Thank You