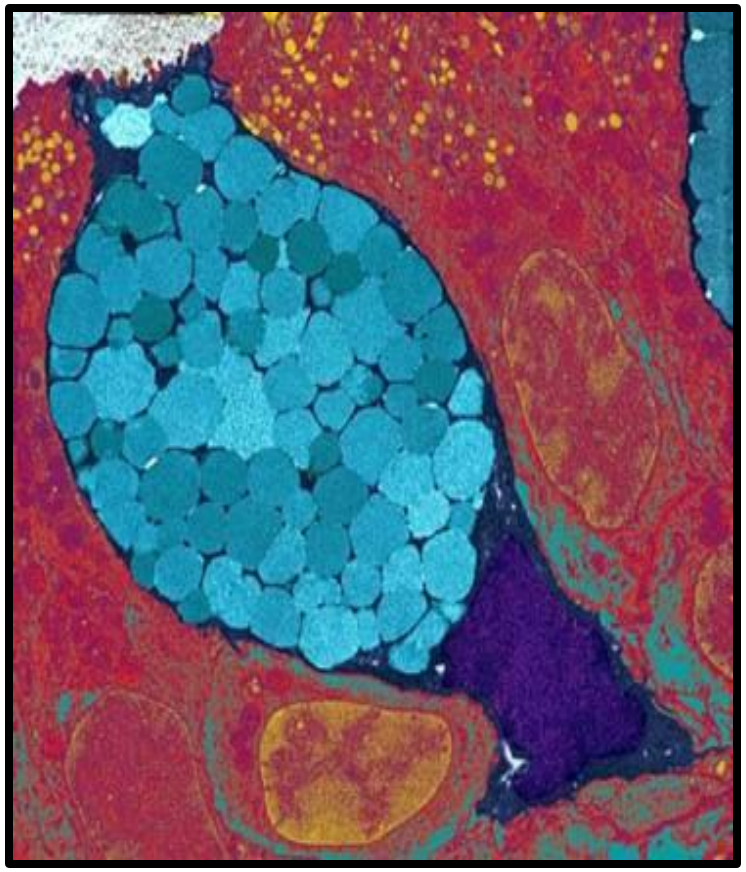
Glandular Epithelium



Glands

- **Definition:**

- "Glandular epithelia are tissues formed by cells specialized to produce secretion."

  or

- "An **aggregation of gland cells** into a definite structure for the purpose of secretion.

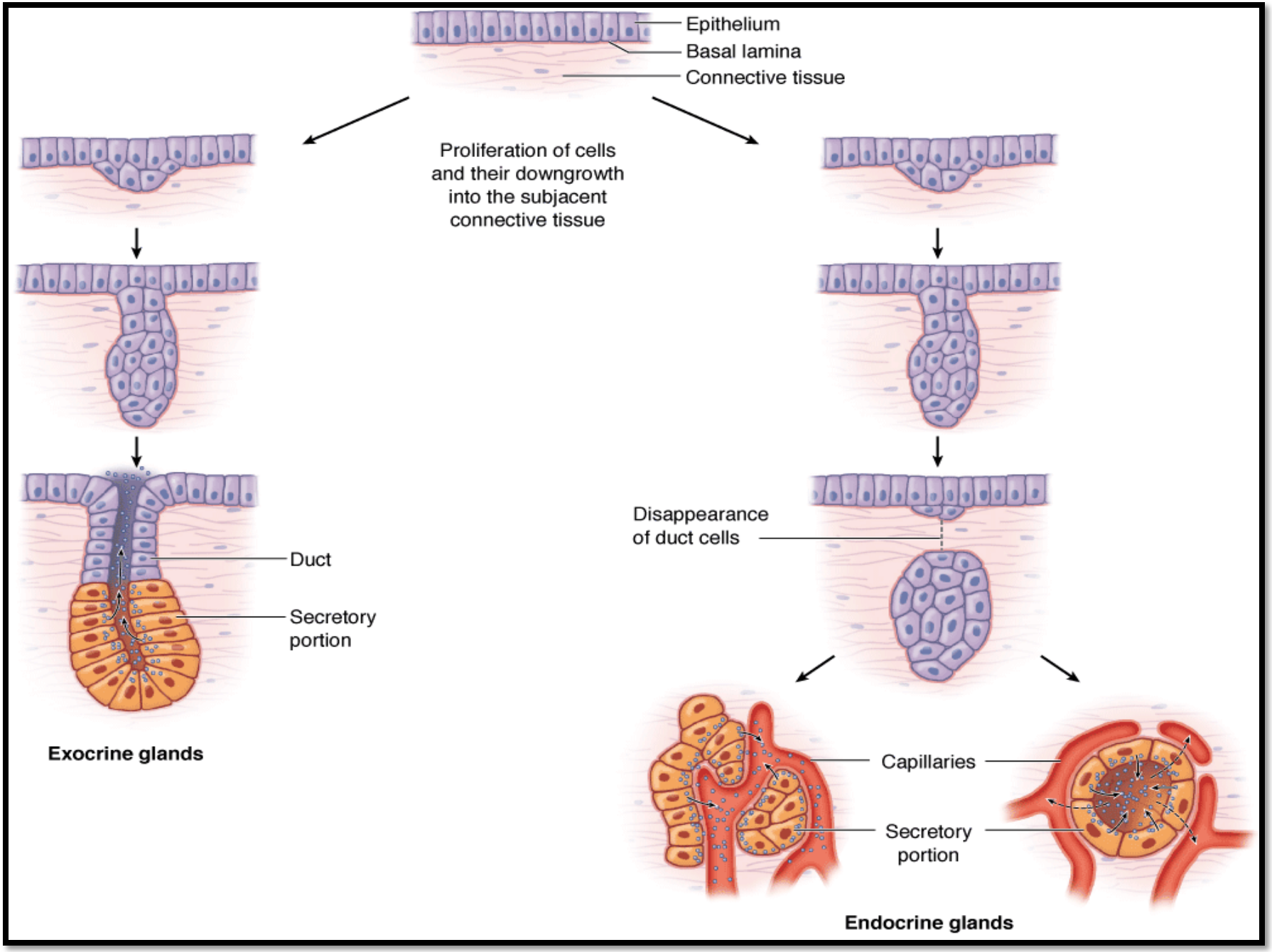
Glandular epithelial cells may synthesize, store, and secrete:

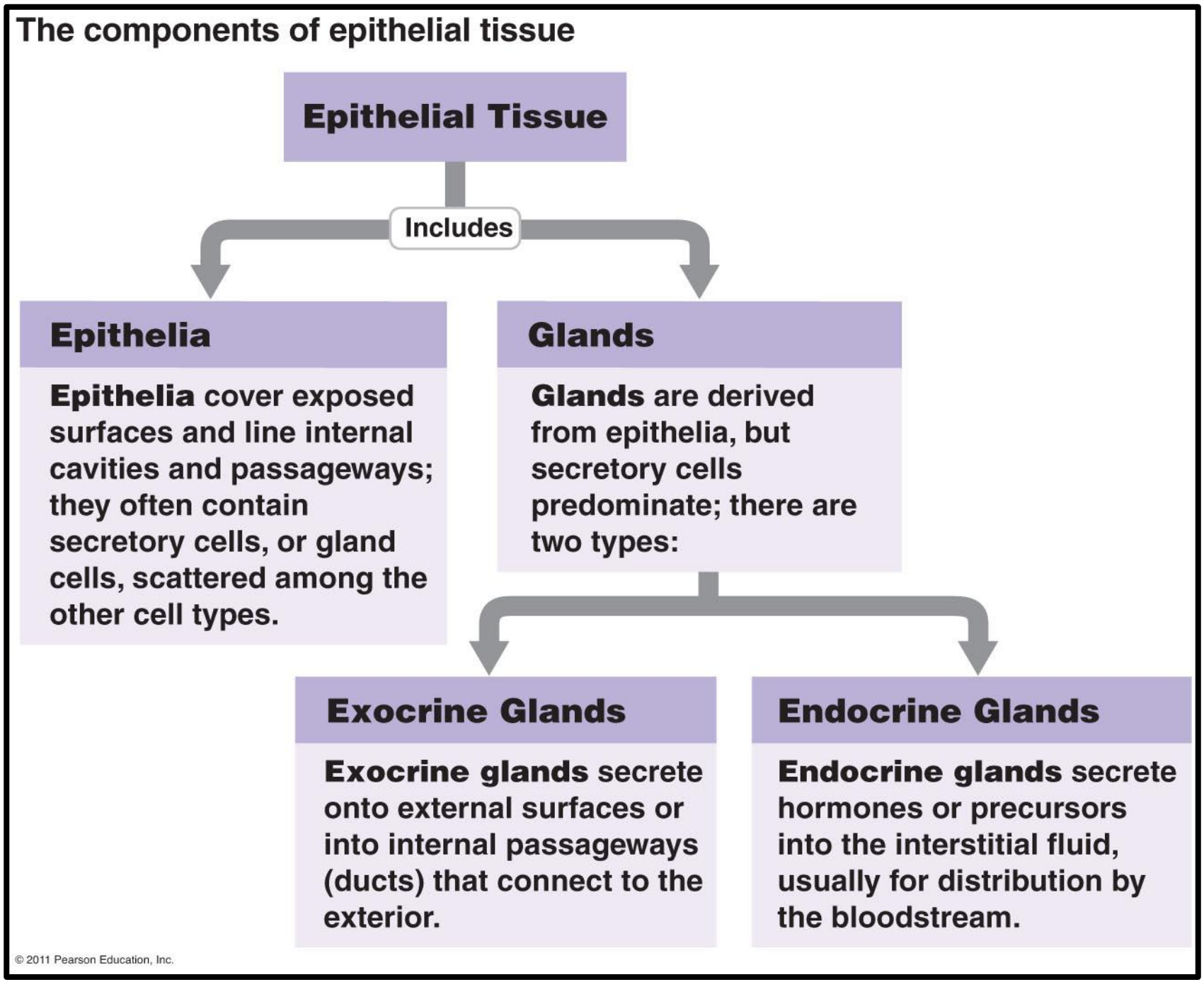
- **Proteins** (e.g; pancreas),
- **Lipids** (e.g; adrenal, sebaceous glands),
- **Complexes of carbohydrates and proteins**

  (e.g; salivary glands).
- The mammary glands secrete all 3 substances.

Development of glands

- Formation of glands from covering epithelia.
- Epithelial cells proliferate and penetrate connective tissue followed by further differerntiation.
- They may–or may not–maintain contact with the surface.
- When contact is maintained, **exocrine glands** are formed;
- Without contact, **endocrine glands** are formed.


Epithelium
Basal lamina
Connective tissue
Proliferation of cells and their downgrowth into the subjacent connective tissue
Duct
Secretory portion
Exocrine glands
Disappearance of duct cells
Capillaries
Secretory portion
Endocrine glands



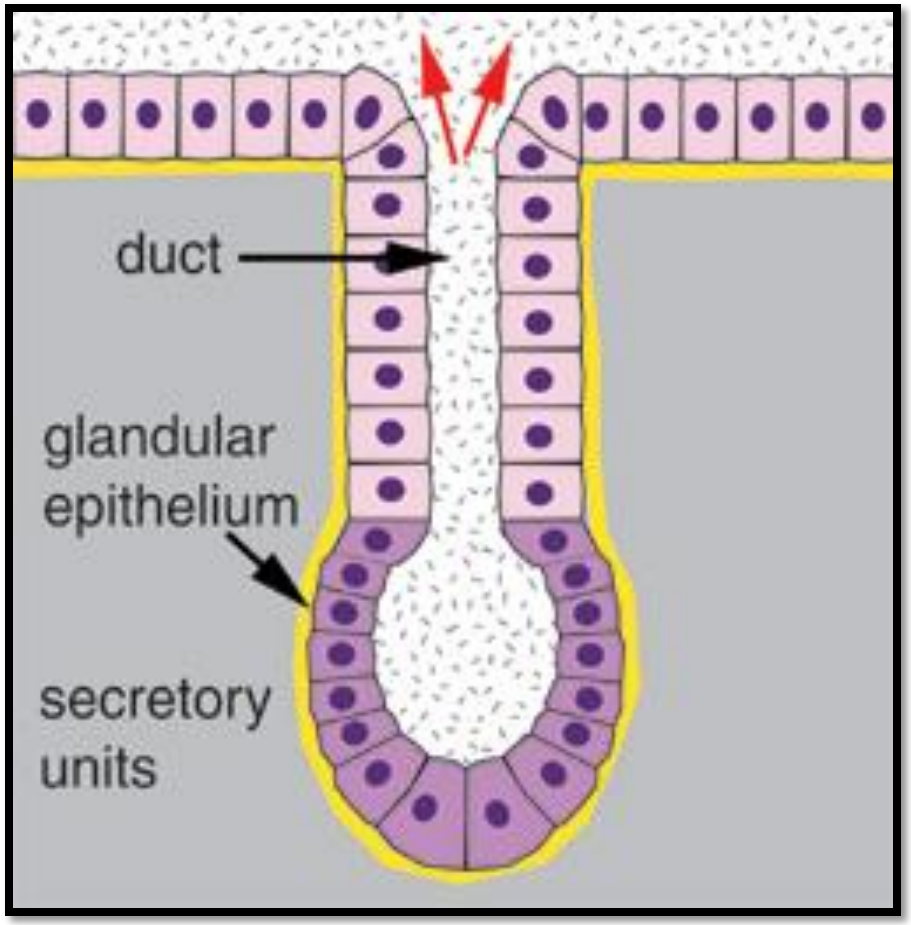
Classification of glands

- Glands are generally classified into two major groups:
- **Exocrine glands** (Gr. Exo, outside,+ krinein, to separate).
- Release their products onto an epithelial surface, either directly or through **a duct** e.g; the **salivary glands**, **sweat glands, mammary glands.**

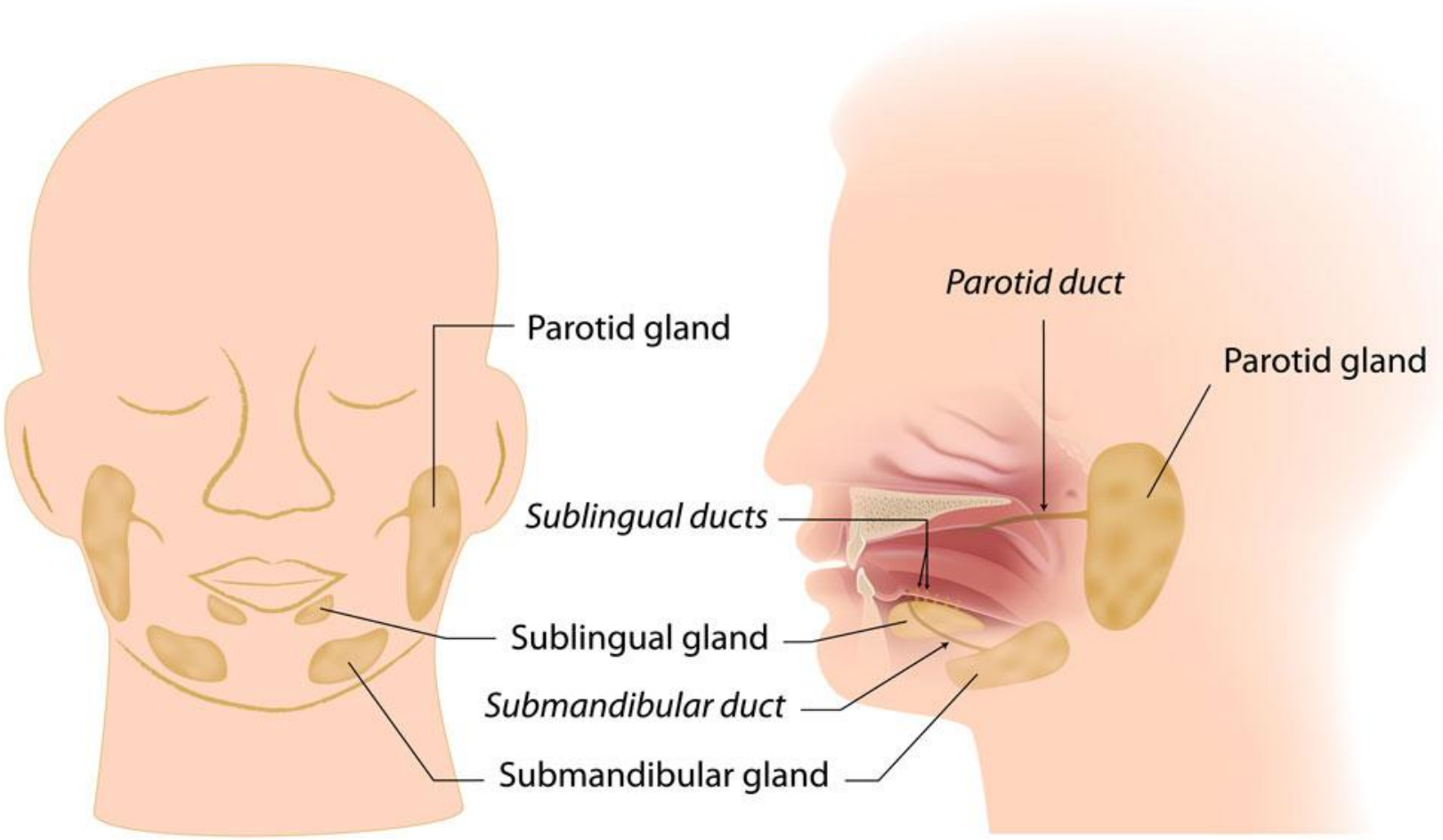
- **Endocrine glands** (Gr, endon, within,+ krinein).
- Release their products (hormones) into the **blood stream**, e.g; **thyroid gland, parathyroid glands, pituitary gland, Adrenal glands.**

- **Mixed variety:** Some glands possess both **exocrine and endocrine** function. e.g; **pancreas, liver cells.**

- **Exocrine glands** secrete substances to specific organ via duct systems.



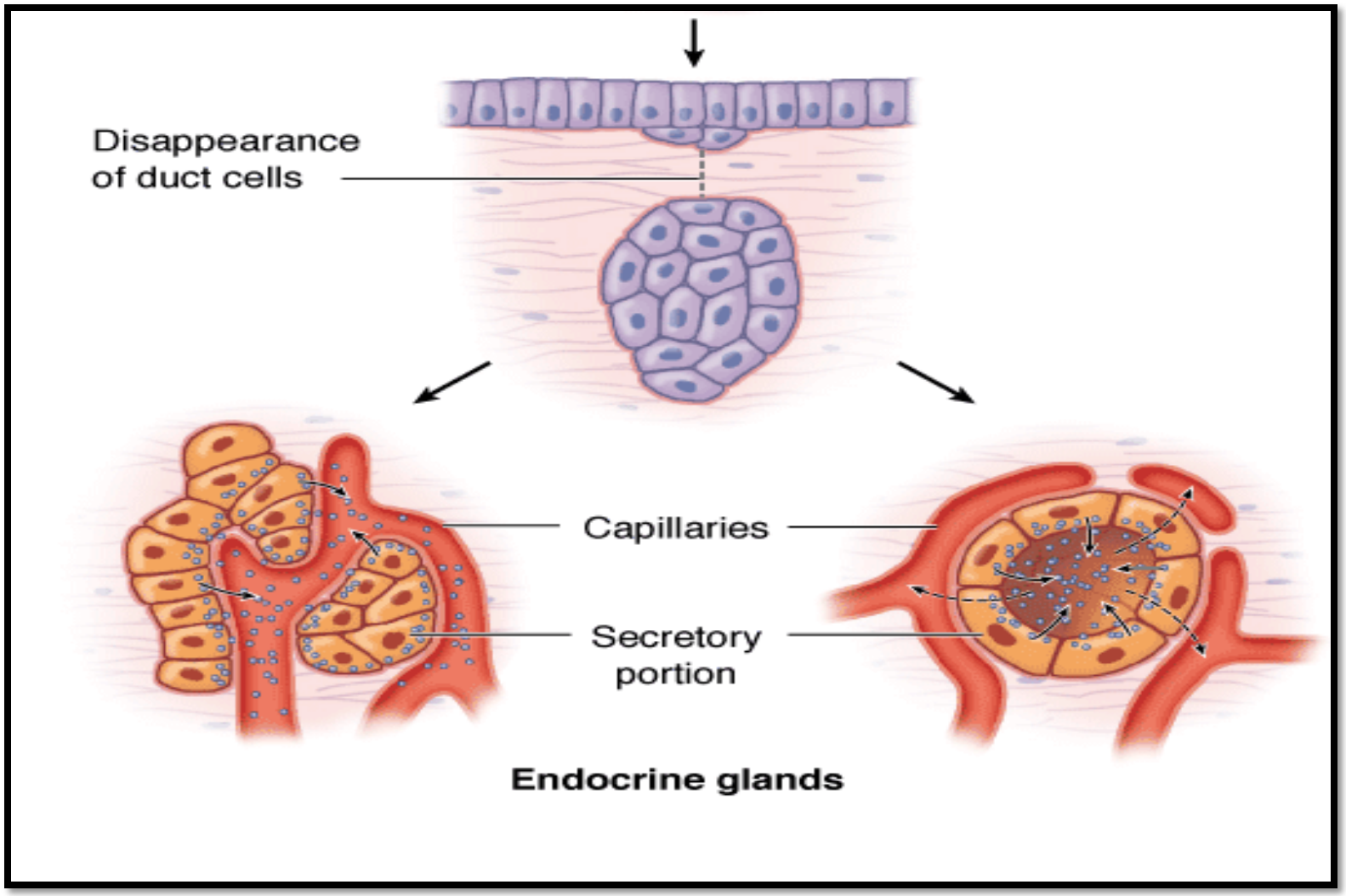
The Salivary Glands



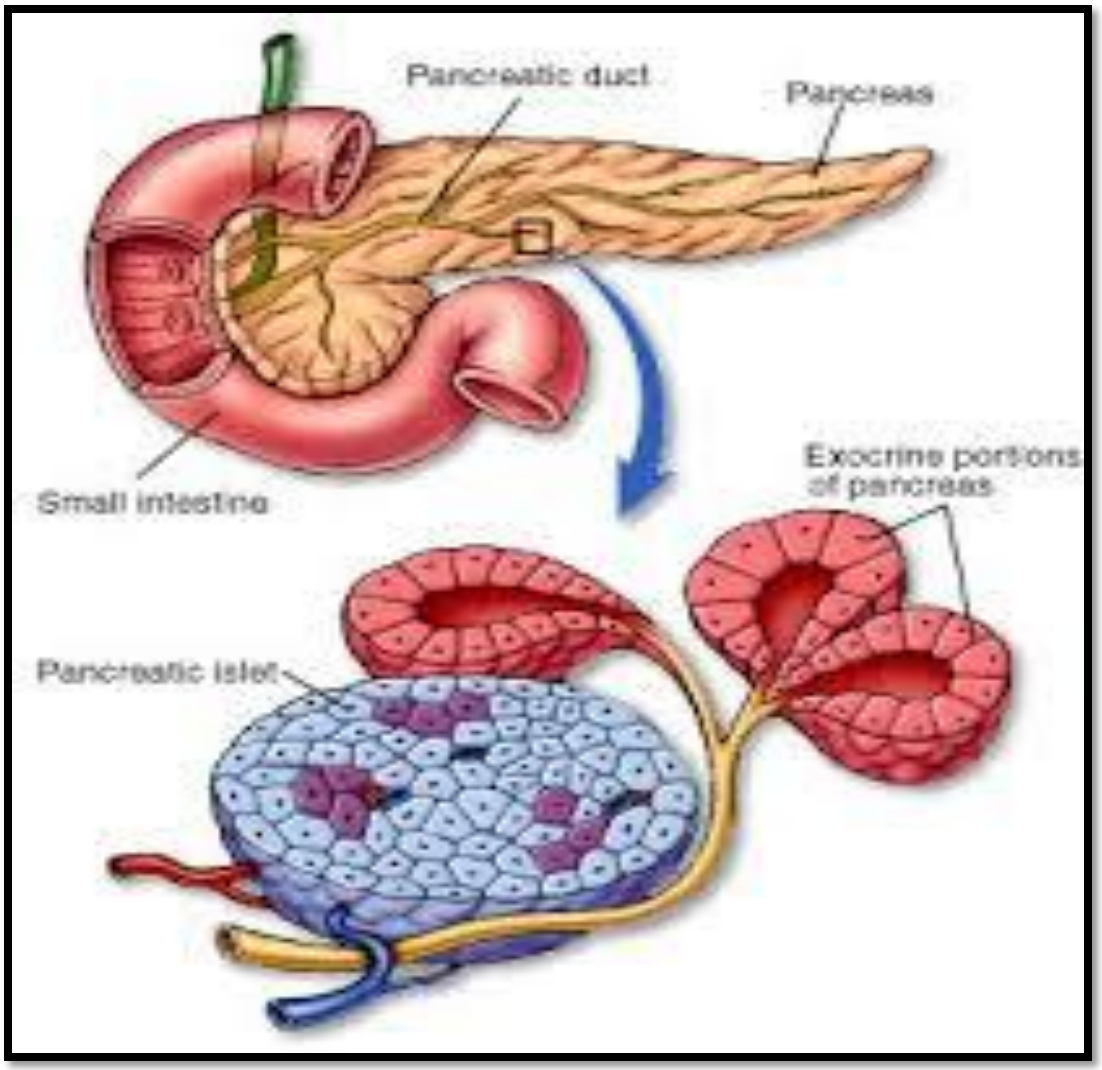
Mammary glands

Sweat glands

- The cells of **endocrine glands** can be arranged in **cords** or in **follicles.**
- The lumens of the follicles accumulate large quantities of secretions .

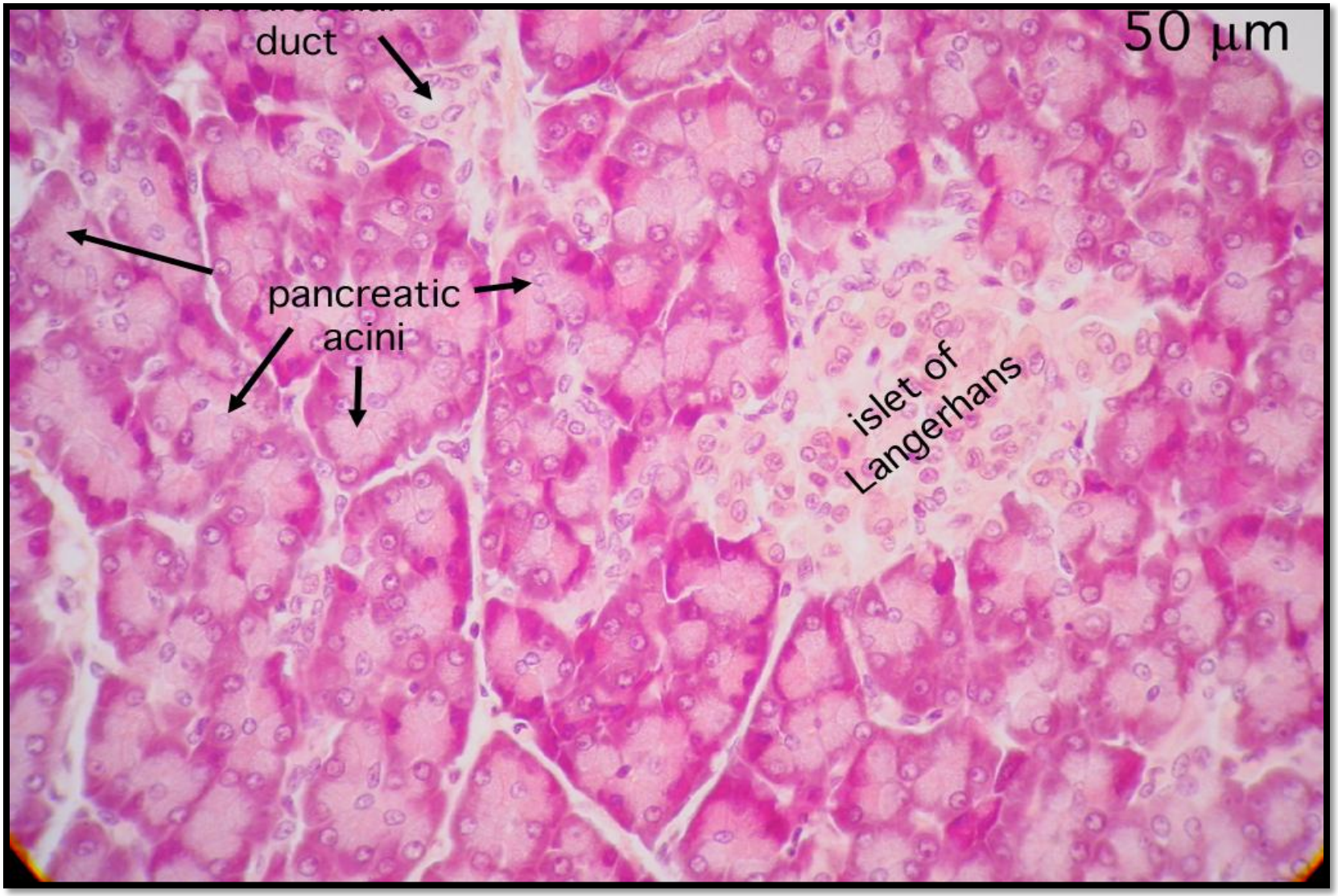


Mixed gland: Pancreas

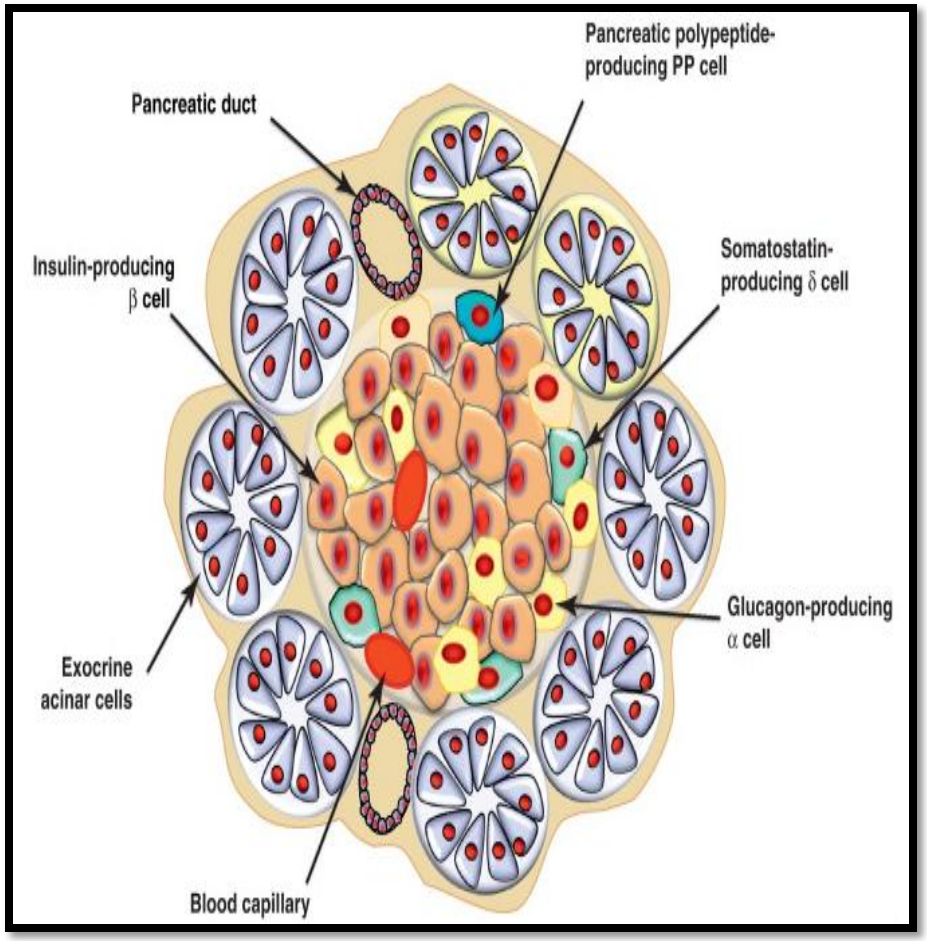


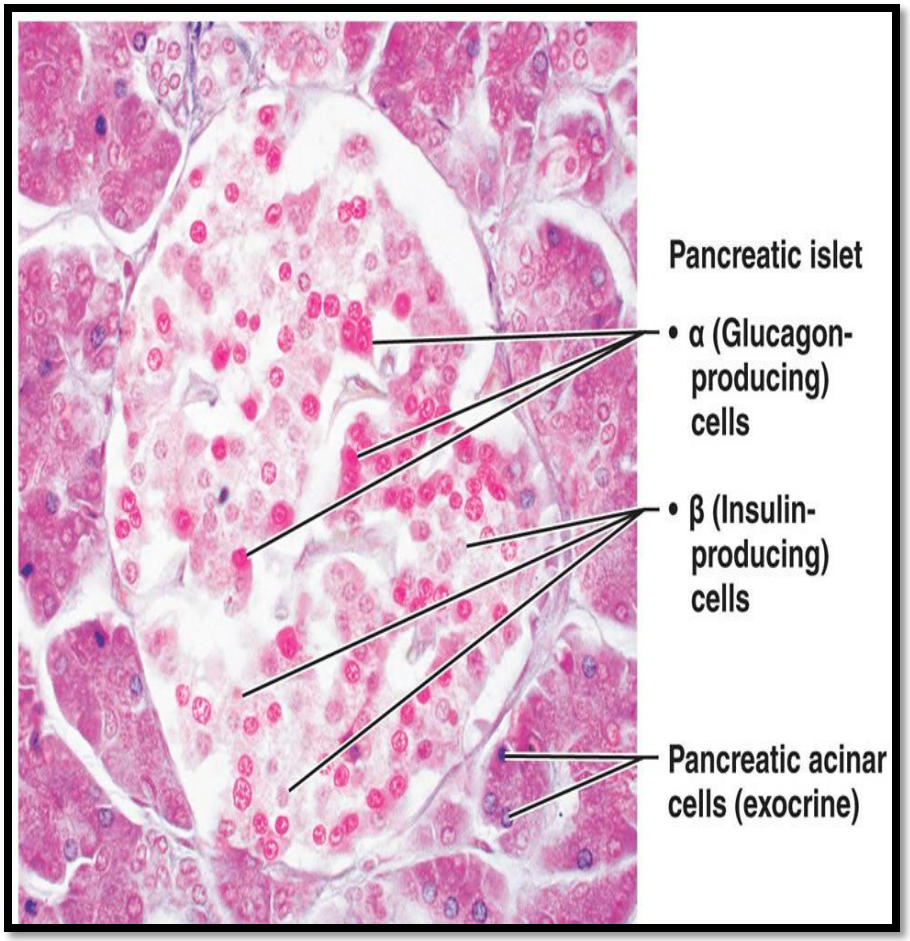
Contains both endocrine and exocrine parts.

Mixed gland: Pancreas

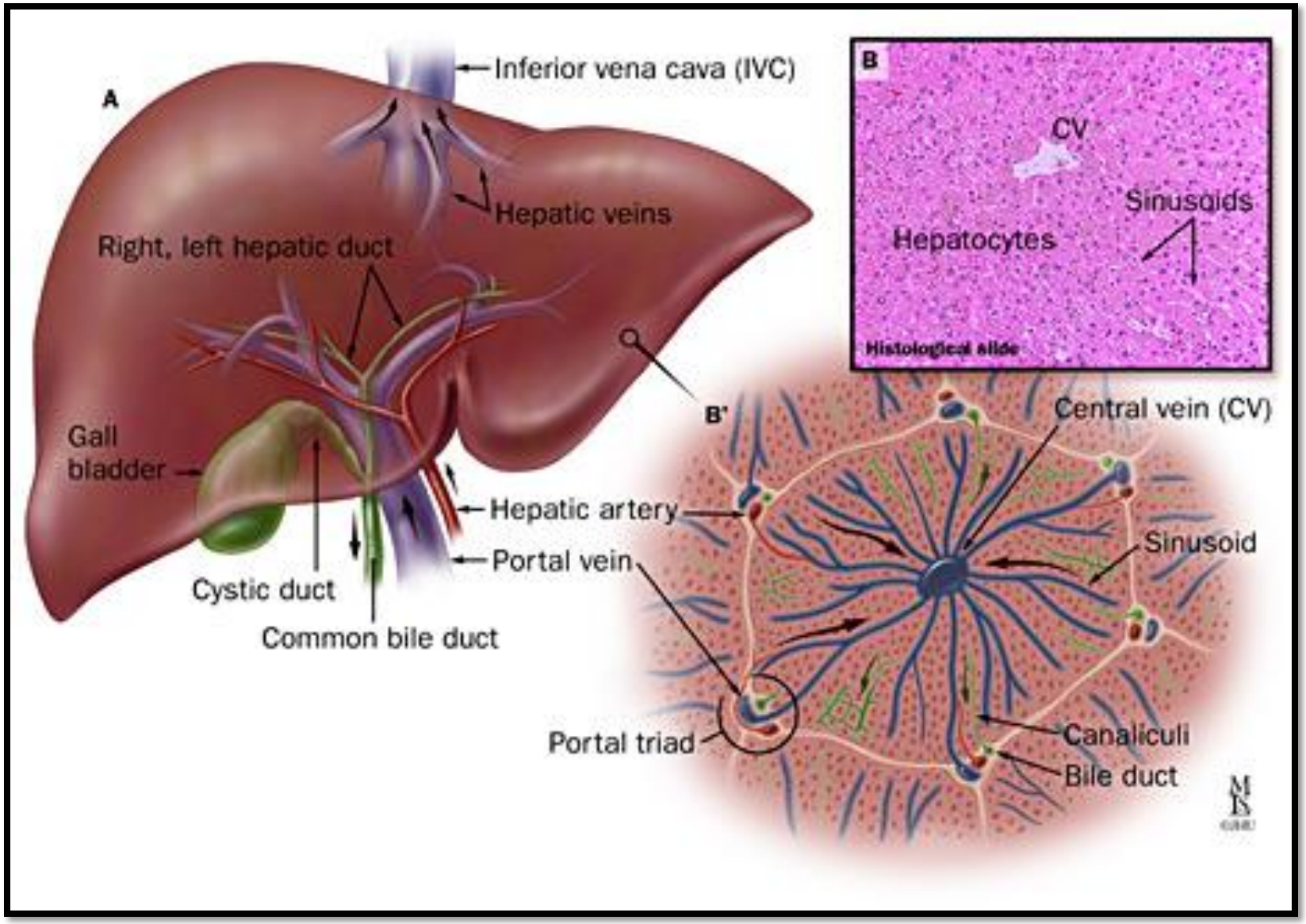


Mixed gland: Pancreas

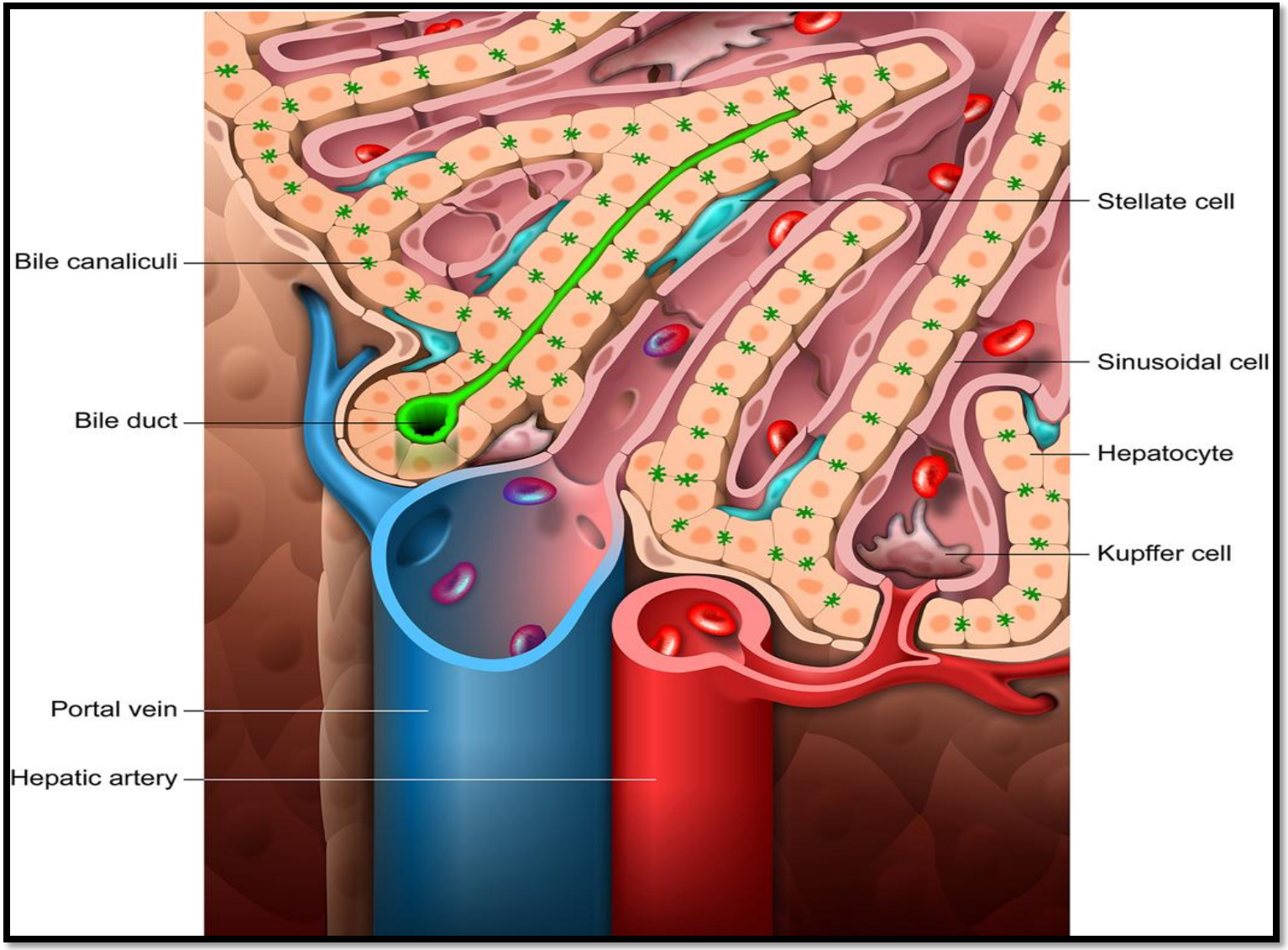




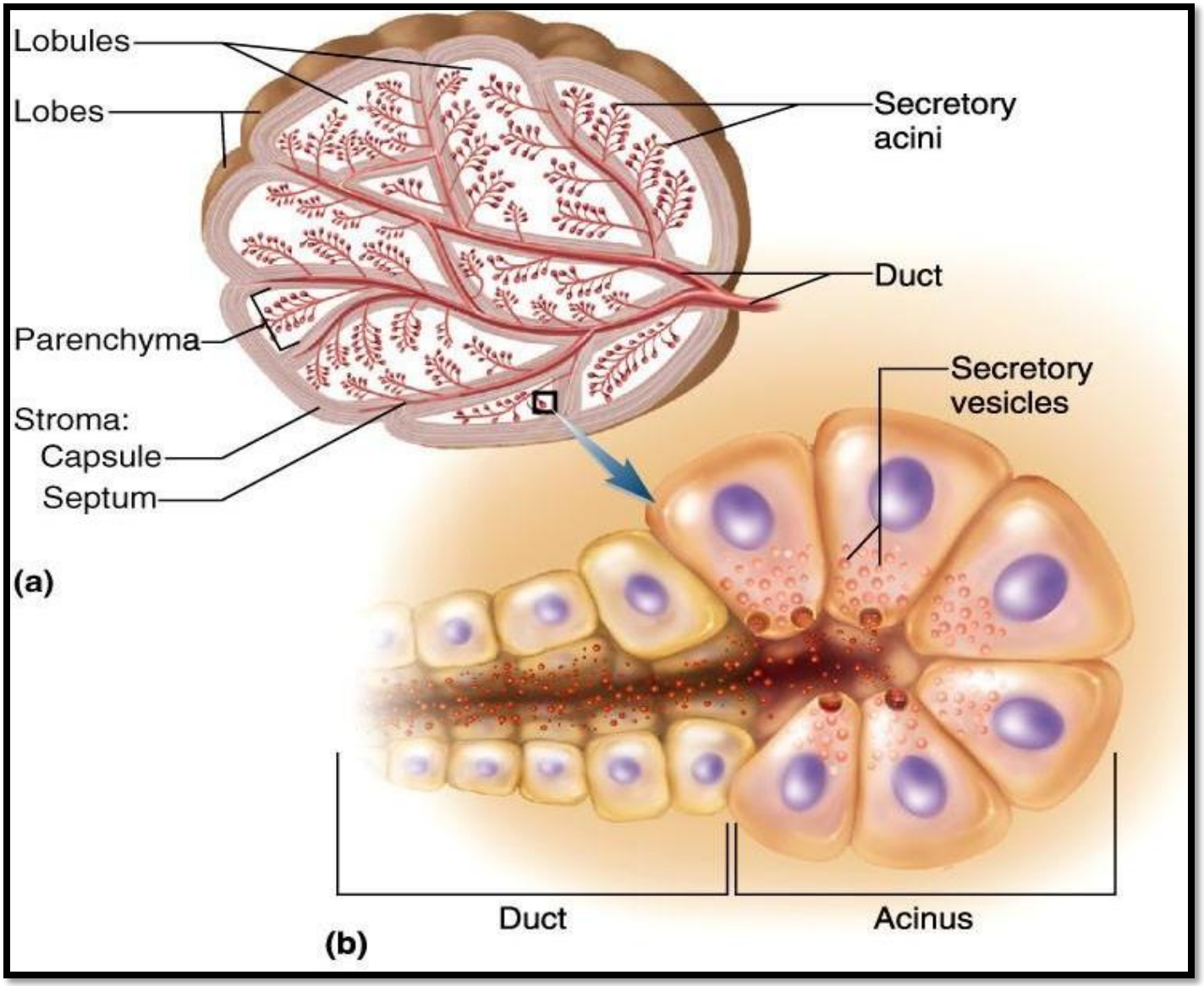
Mixed gland: Liver



Mixed gland: Liver



General histological structure of gland

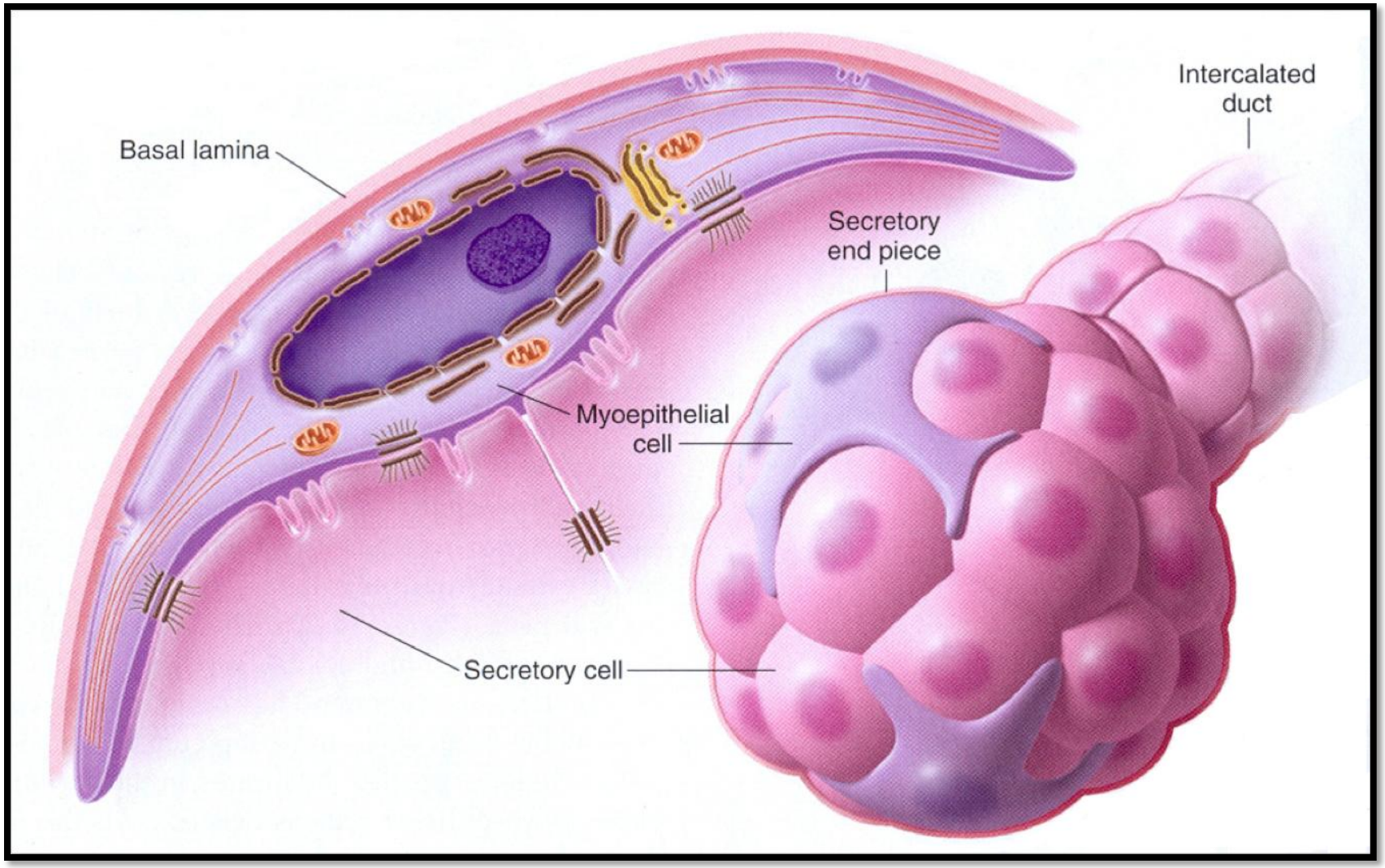


General histological structure of gland

- **Externally** a gland is surrounded by a dense layer of connective tissue which forms **capsule** of the gland.
- From the capsule connective tissue septa extend into the gland, thereby dividing its substance into a number of lobes.
- Thinner septa subdivide each lobe into smaller lobules.
- Blood vessels and nerves pass along the connective tissue septa to reach the secretory elements.

- The functional part of a gland, formed by its secretory cells, is known as **parenchyma of the gland**.
- The supporting elements of the gland, which consists mainly of connective tissue, are referred to as **stroma of the gland.**


Capsule



Myoepithelial cells: Rich in actin and myosin, Help to propel secretory product into duct system

Glands (Exocrine & Endocrine)

Might be classified according to the number of cells :

Unicellular glands: One Cell .

Examples:

- **Exocrine: Goblet cells** which are present in the lining epithelia of large intestine and the respiratory tract.
- **Endocrine: DNES (Diffuse Neuro-Endocrine Systems), or APUD (Amine Precursor Uptake and Decarboxylation) in small intestine.**

Multicellular glands : Number of cells.

- They form most of the glands of the body.

Examples:

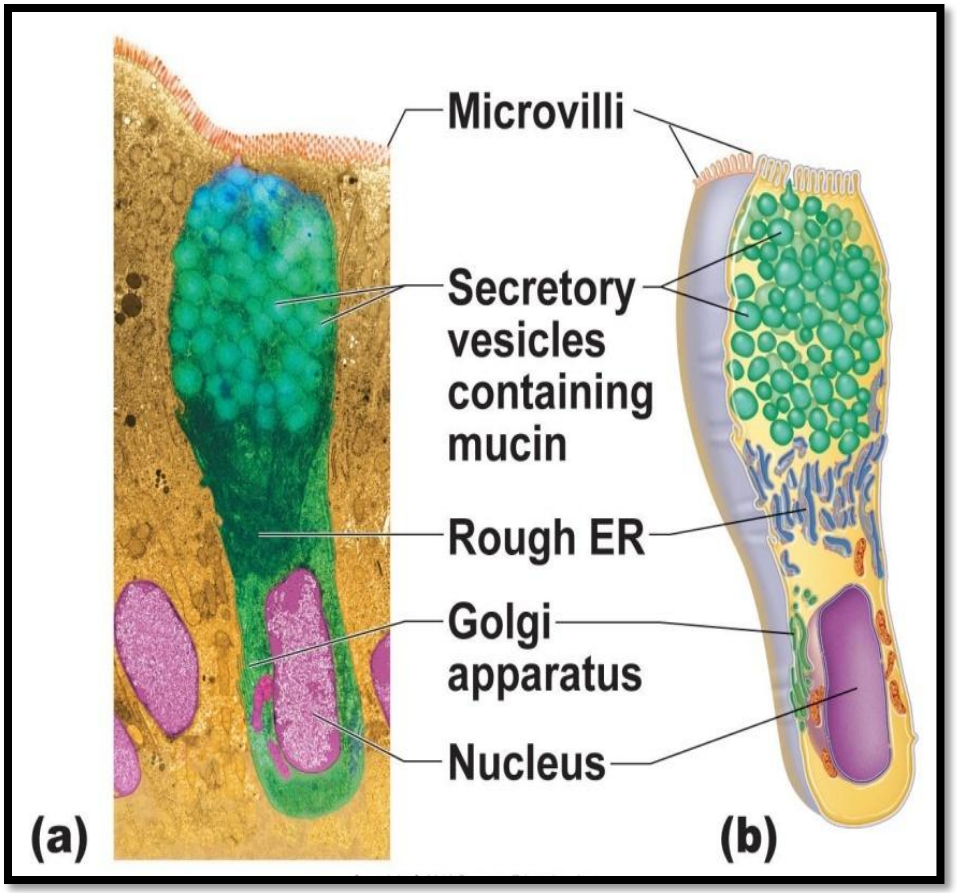
Exocrine: Salivary glands, lachrymal glands, sweat glands, ...

Endocrine: Thyroid gland, parathyroid glands, pituitary gland, ...

Unicellular gland -Goblet cell

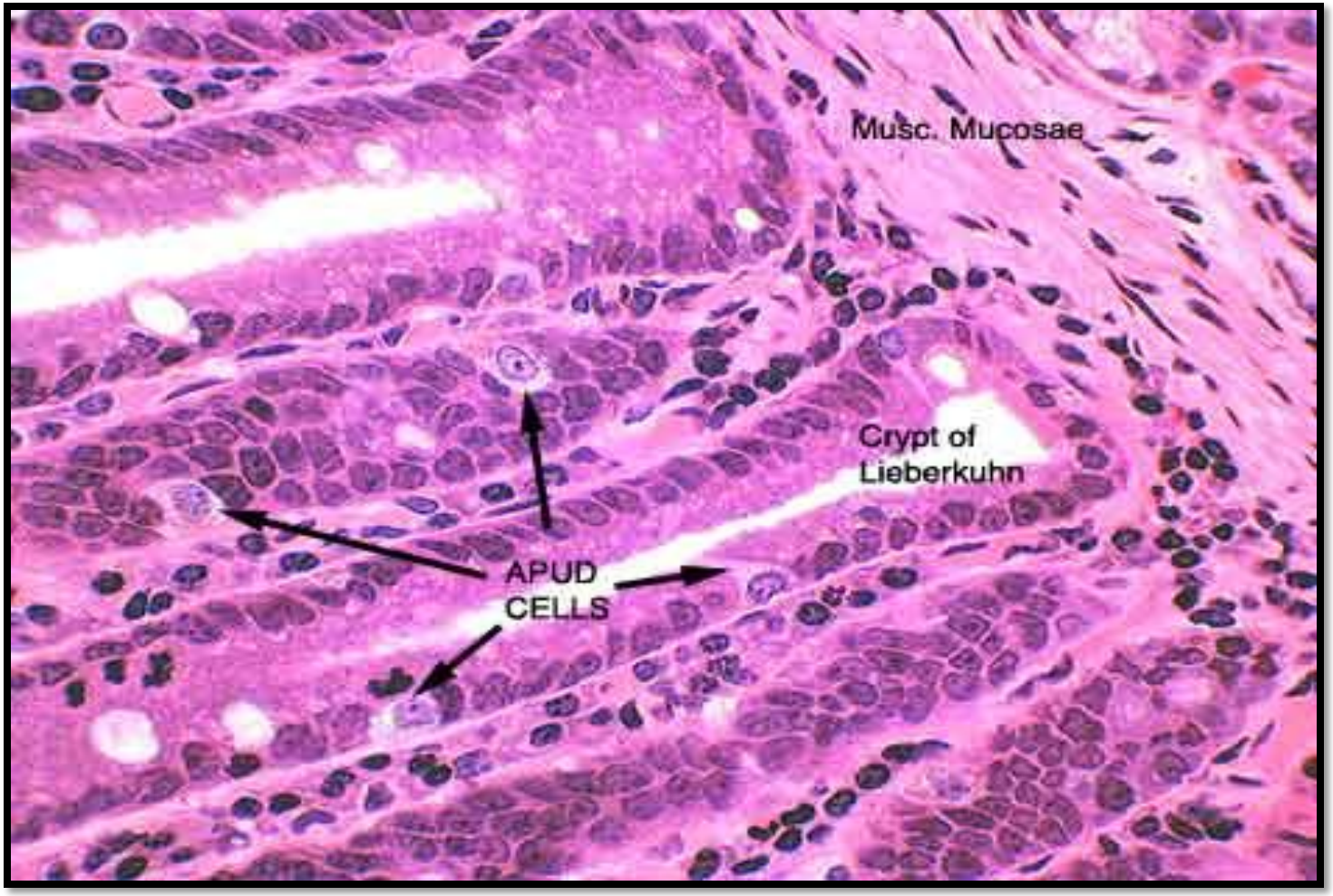
The goblet cell is **highly polarized** with the nucleus and other organelles concentrated at the base of the cell.

The remainder of the cell's cytoplasm is occupied by membrane-bound secretory granules containing **mucin.**



- **Goblet cells produce mucus (Mucin)**
- Mucin + water → mucus
- **Protects and lubricates** many internal body surfaces.

Unicellular gland - DNES

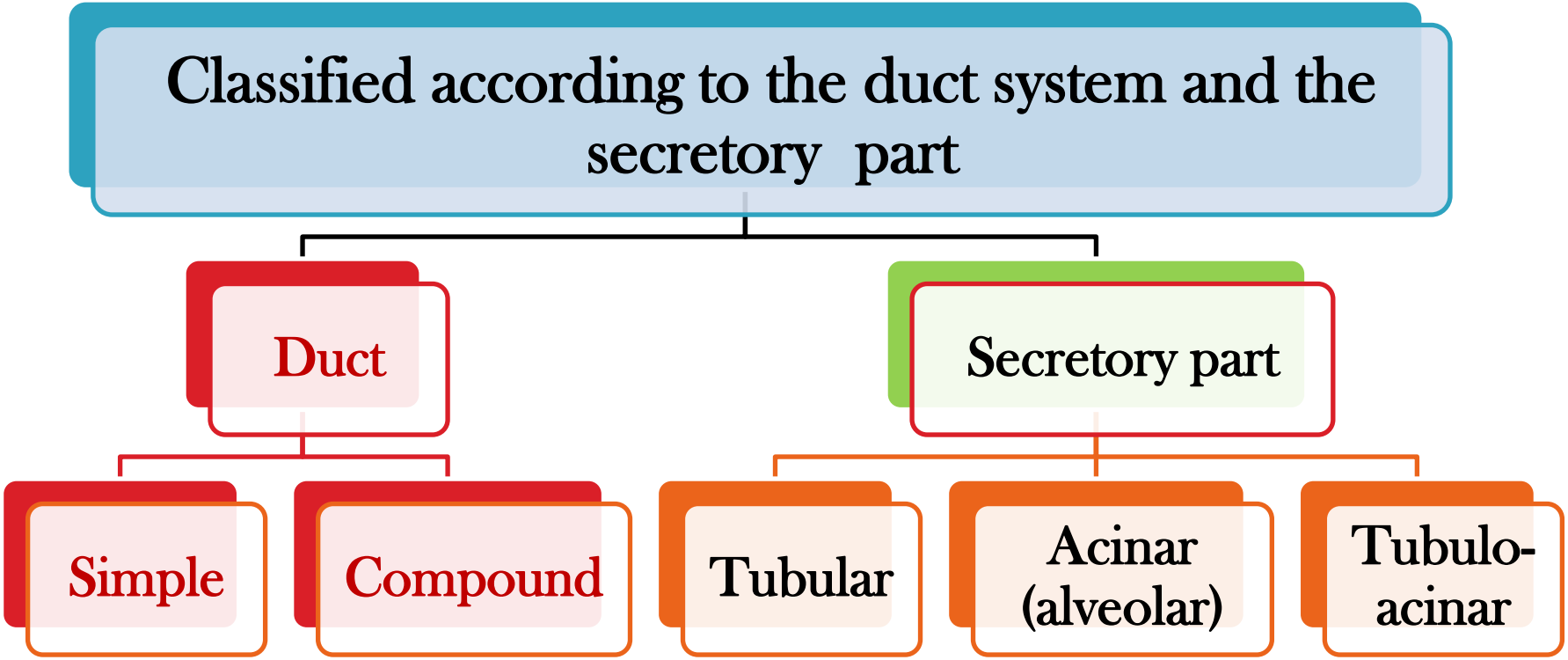


DNES (Diffuse Neuro-Endocrine Systems), or APUD

Exocrine glands

These can also be classified on the basis of:

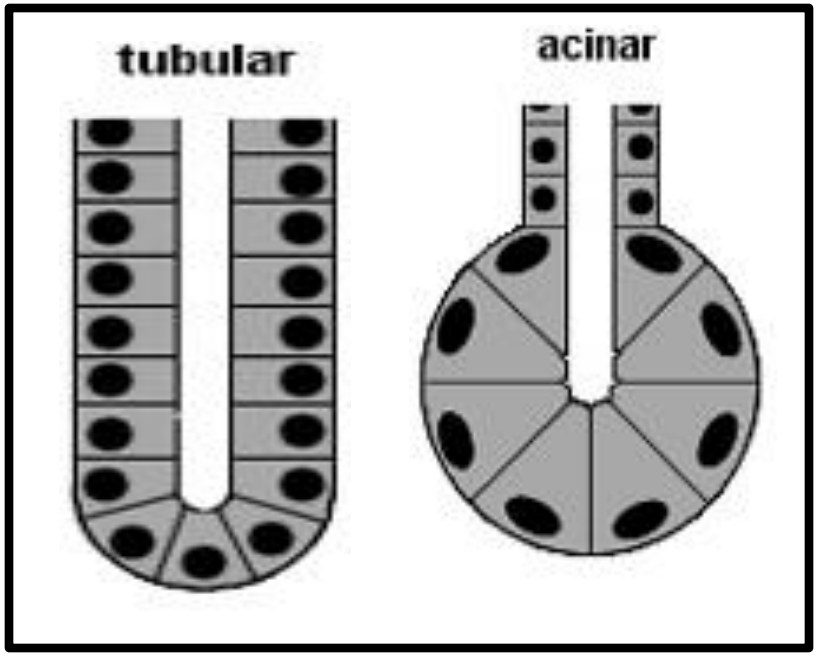
- Morphology of ducts and secreting portions.
- Nature of secretory product.
- Mode of secretion.


Classified according to the duct system and the secretory part
Duct
Secretory part
Simple
Compound
Tubular
Acinar (alveolar)
Tubulo-acinar

Morphology of ducts and secreting portions

- **Classified by structure of duct:**
  - **Simple :** "if a gland consists of a single secretory passage".
  - **Compound:** " if a gland containing a branched duct system".

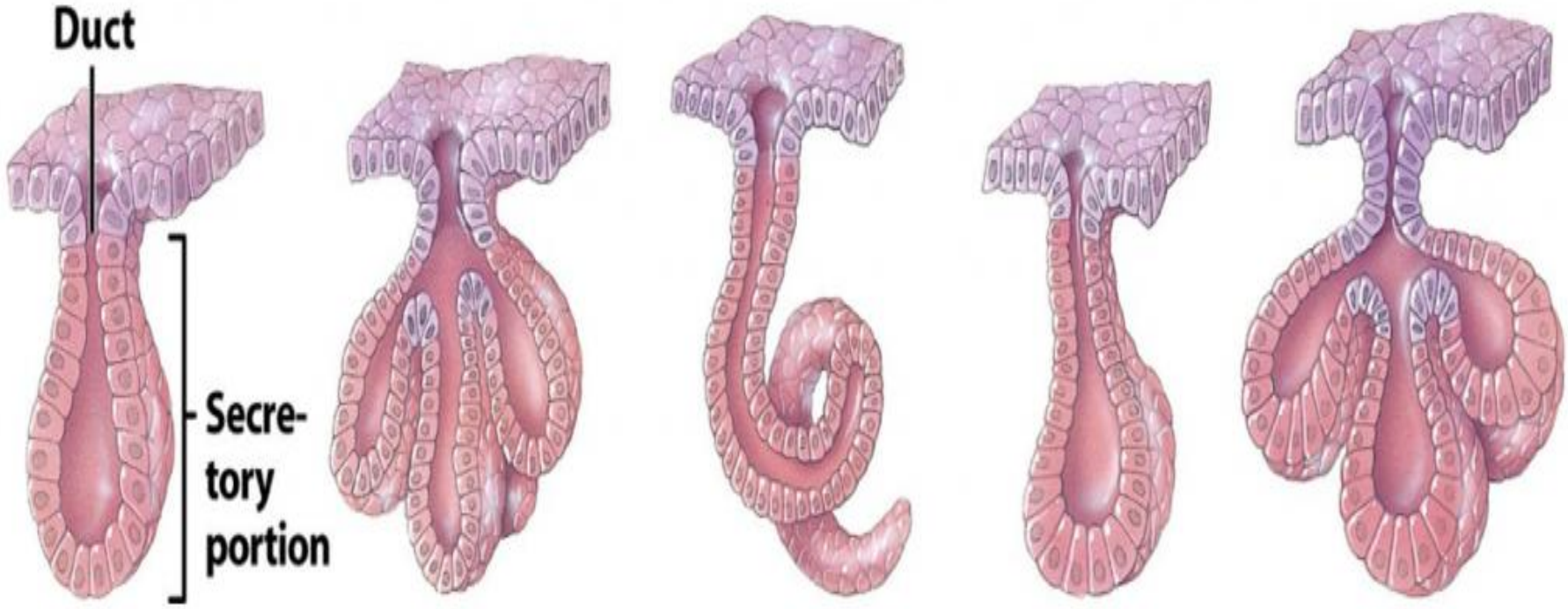
- **Categorized by shape of secretory unit:**



- **Tubular:** Glands whose glandular cells form tubes, the tubes may be straight or coiled.
- **Acinar or alveolar:** Glands whose glandular cells form sac-like pockets (called alveolus or acinus).
- **Tubulo- acinar:** In some glands when the secreting portions are neither typically tubular nor acinar, but combine certain features of both.

- A gland is **branched** if several secretory areas (tubular or acinar) share a duct.
- Note that "branched" refer to the glandular areas and not to the duct.

Simple exocrine glands



Simple tubular

Simple branched tubular

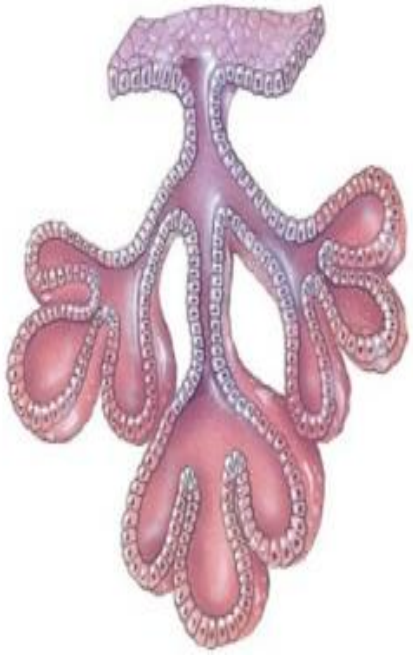
Simple coiled tubular

Simple acinar (alveolar)

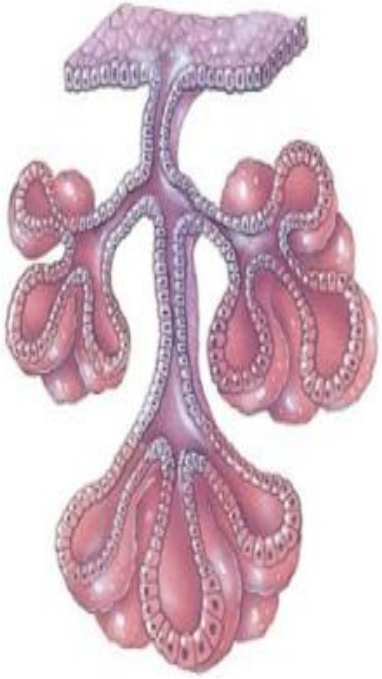
Simple branched Acinar (alveolar)

Compound exocrine glands

Compound tubular



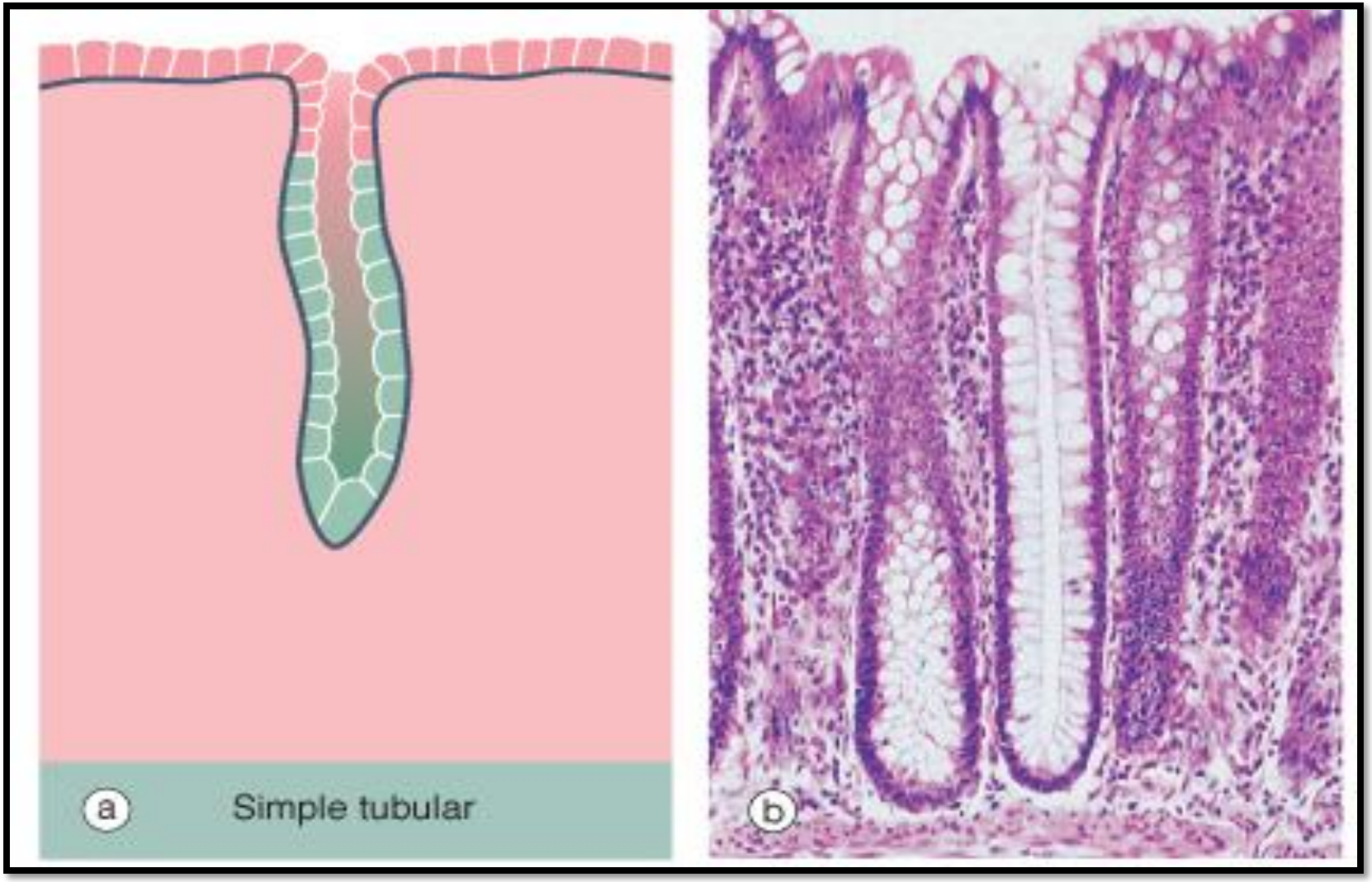
Compound acinar (alveolar)



Compound tubulo-acinar

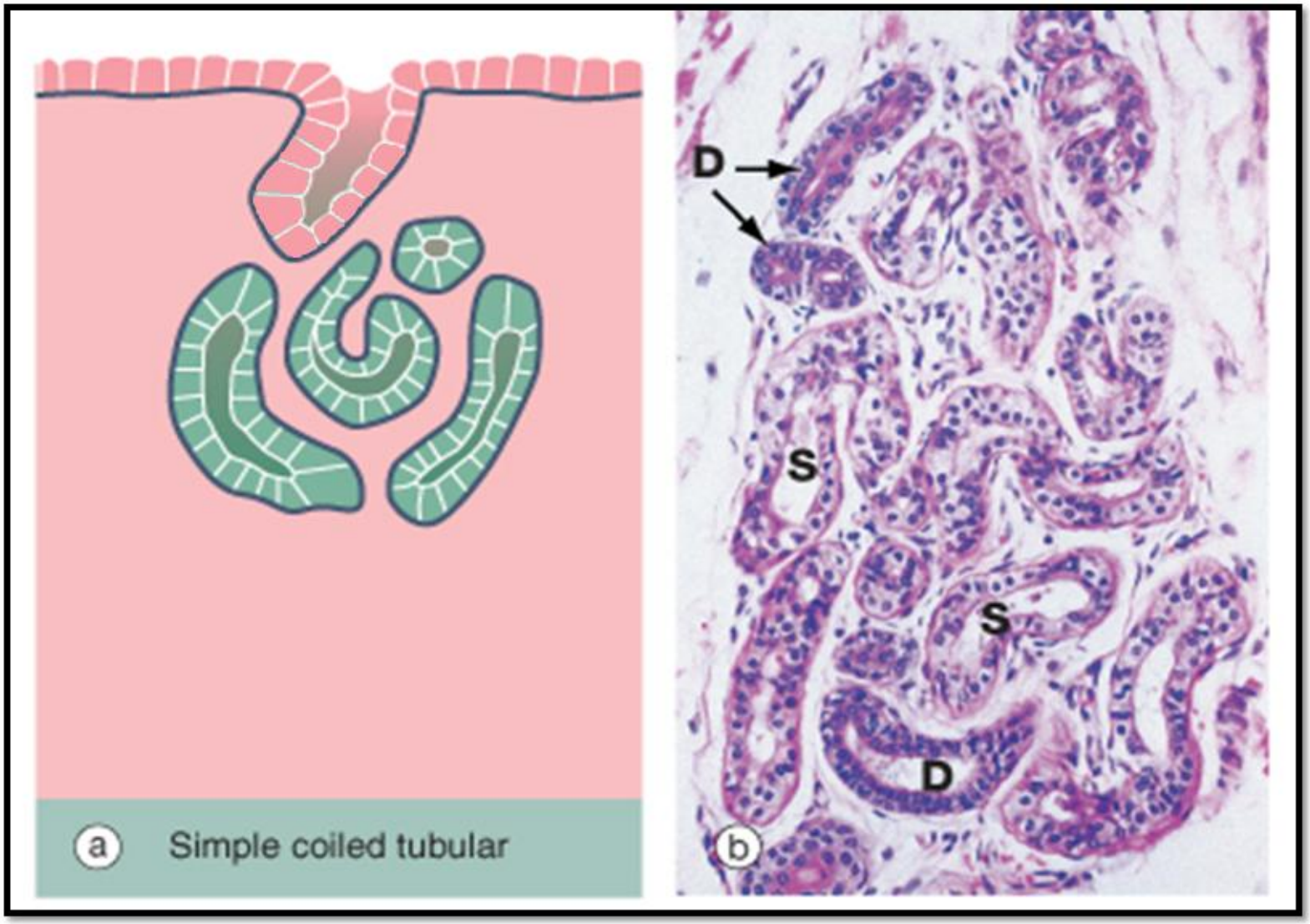
Simple exocrine glands

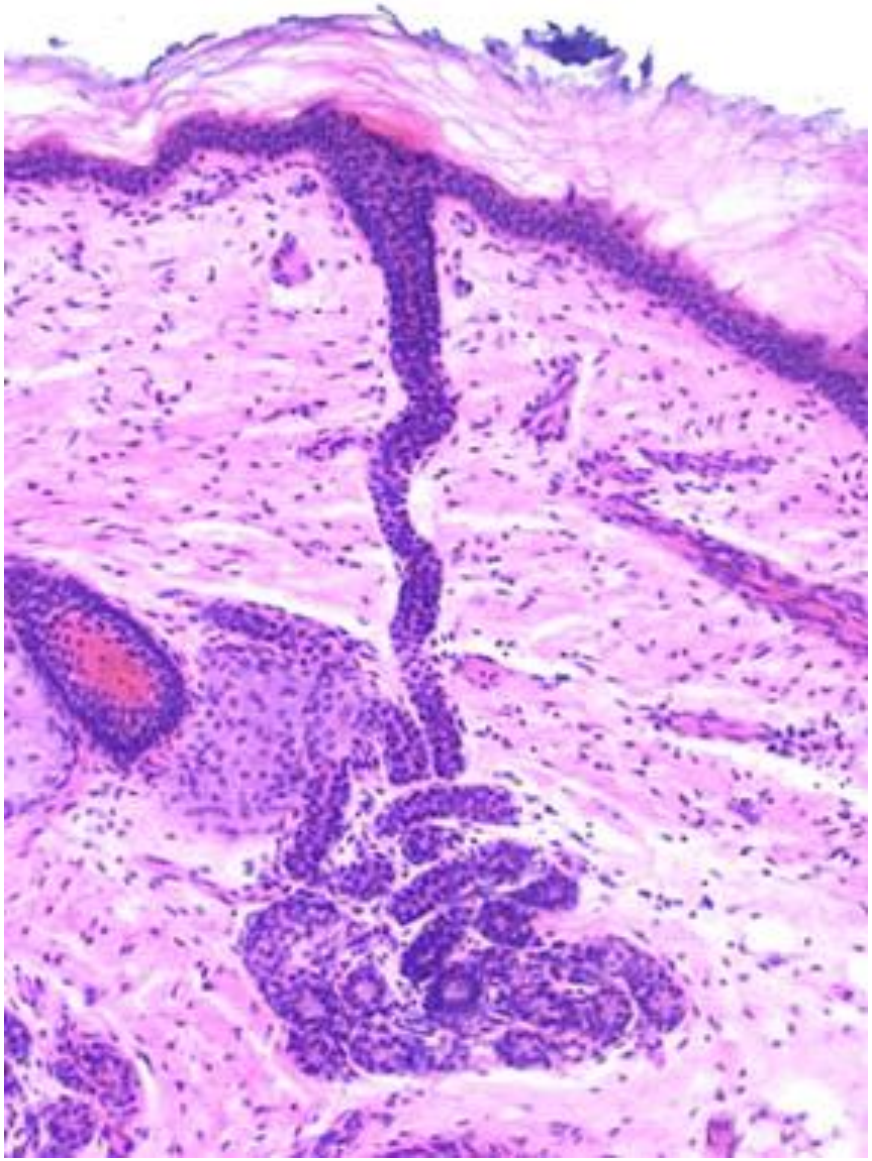
Simple tubular



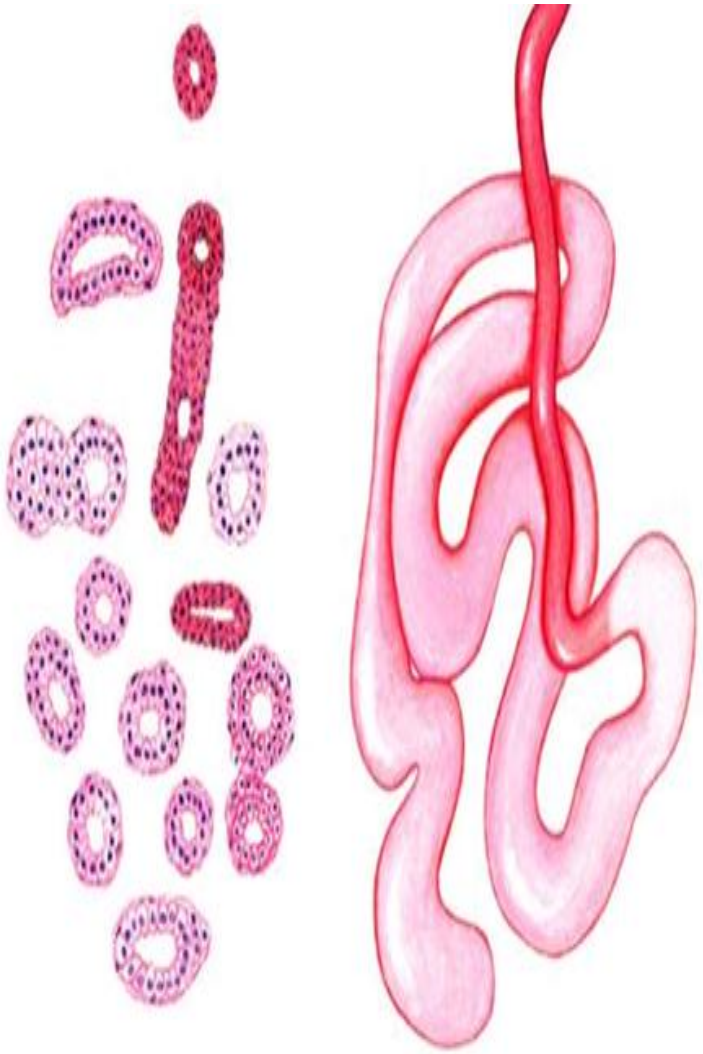
A single, straight tubular lumen into which the secretory products are discharged eg. mucus-secreting gland of the colon; **crypt of Lieberkühn**

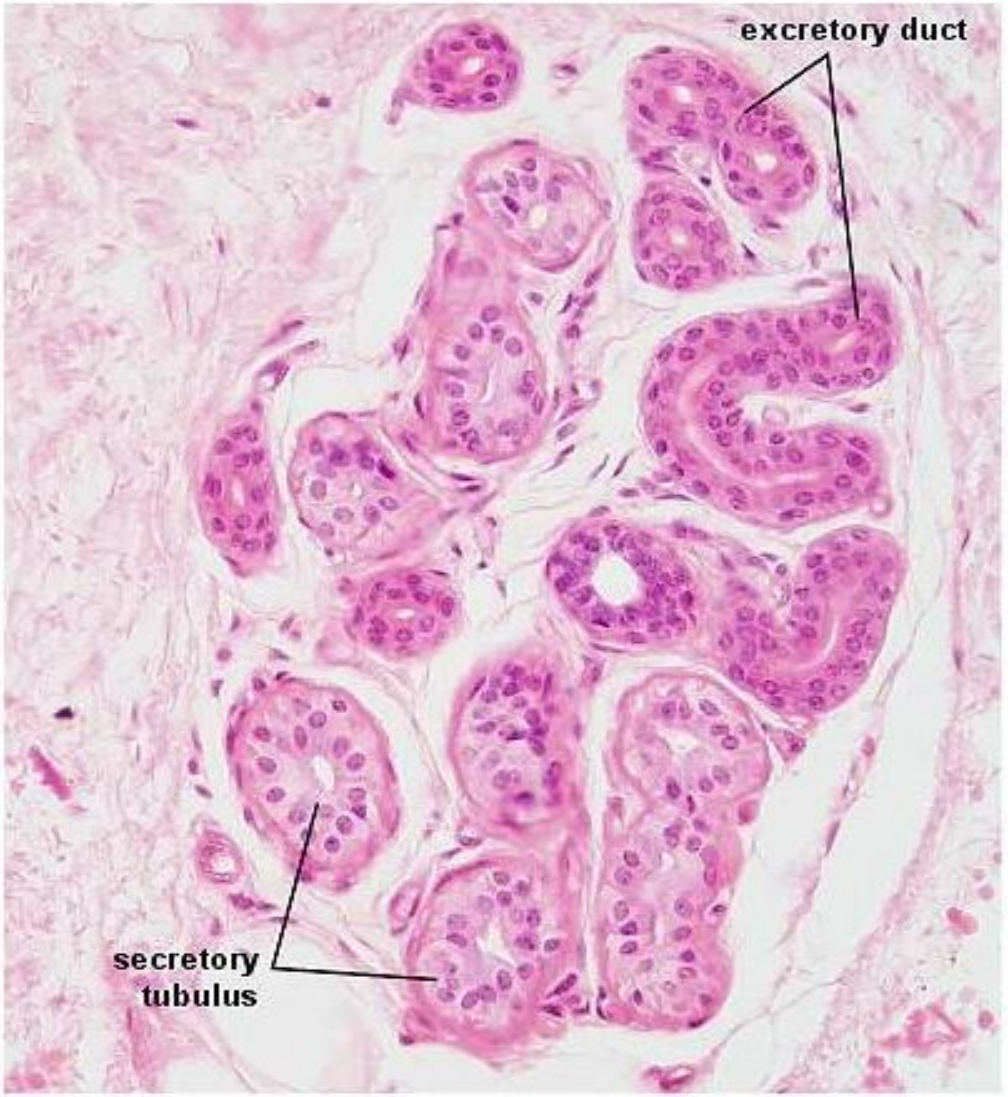
Simple coiled tubular





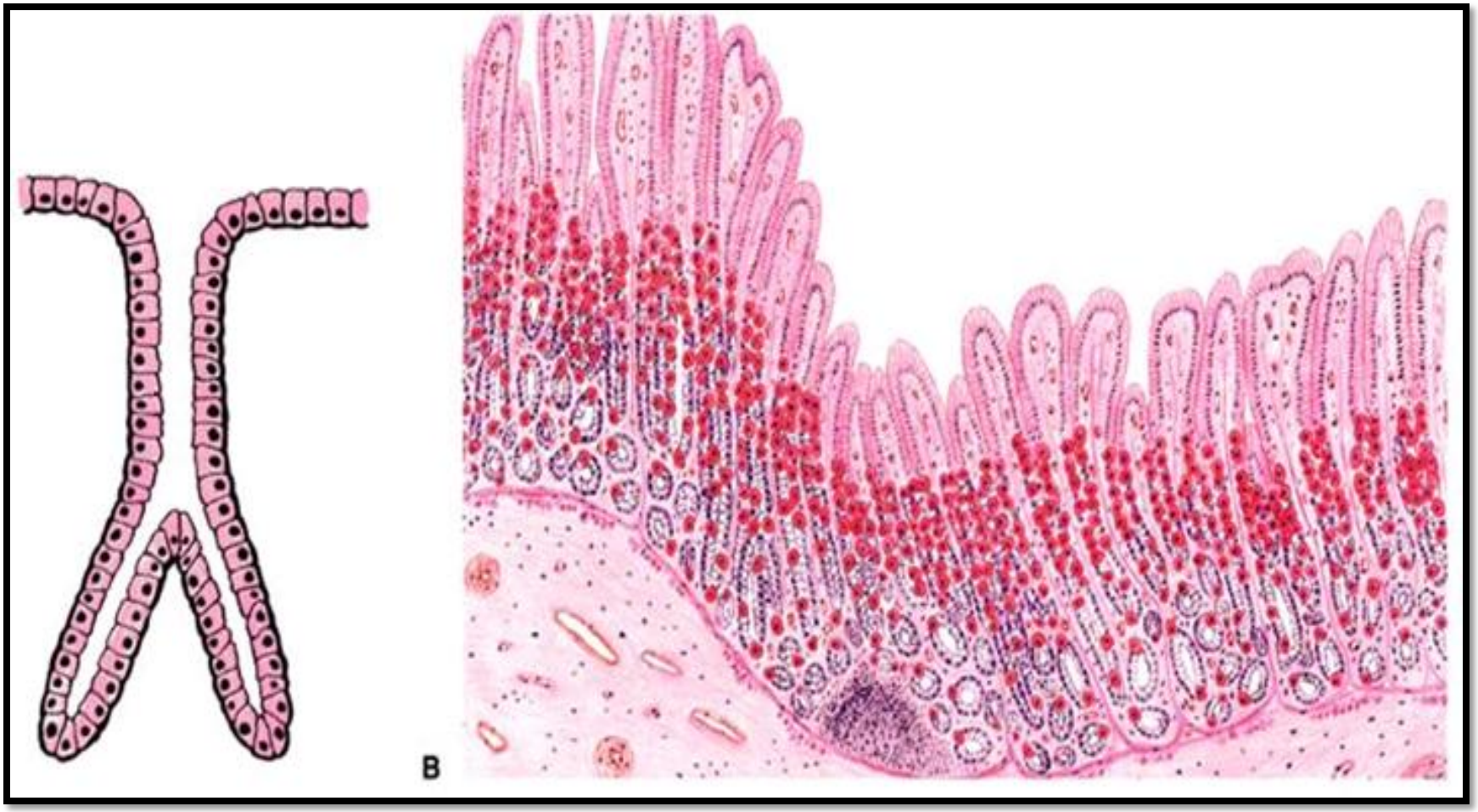
A single tube, tightly coiled in 3 dimensions eg. Sweat glands





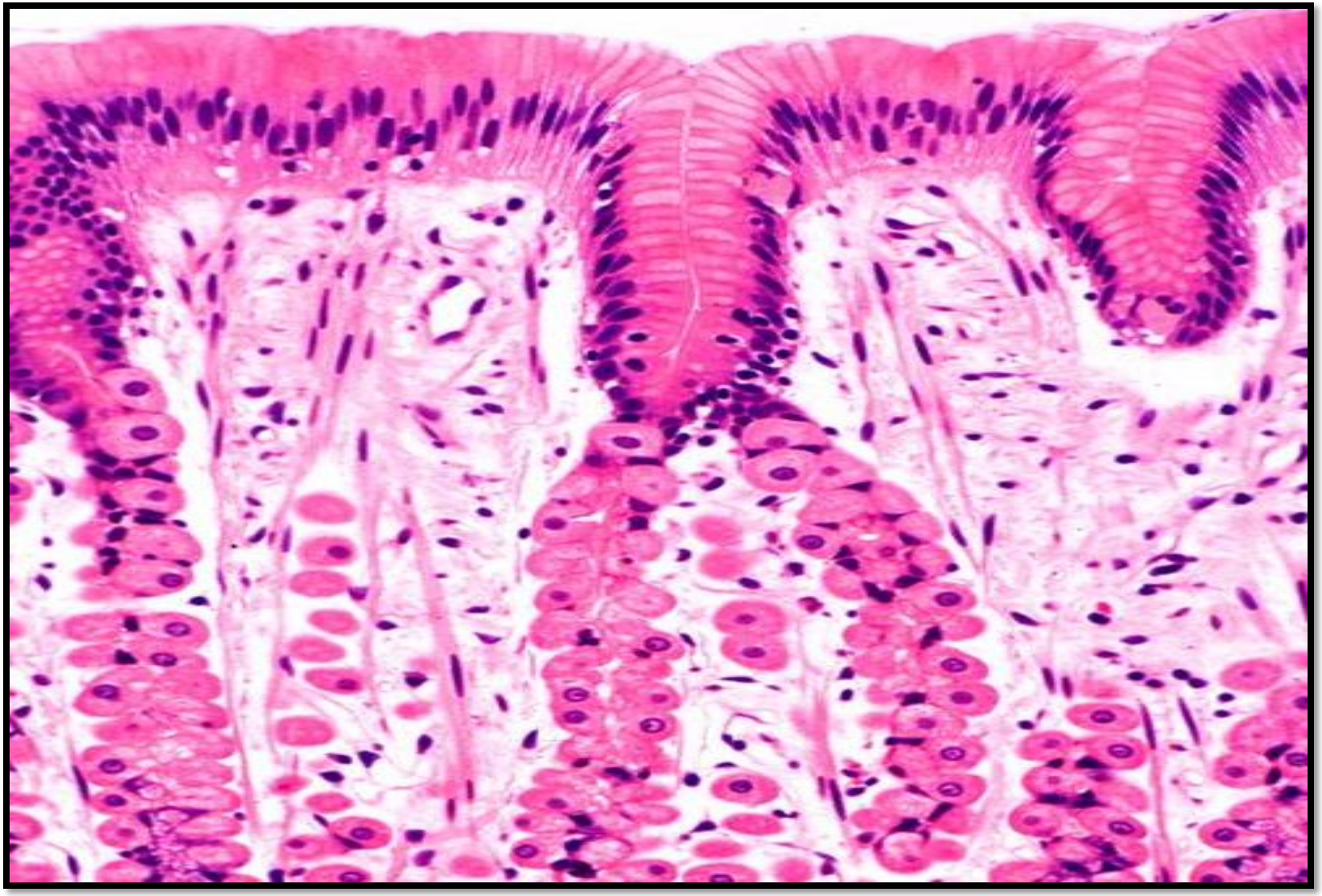
A single tube, tightly coiled in 3 dimensions eg. Sweat glands

Simple branched tubular

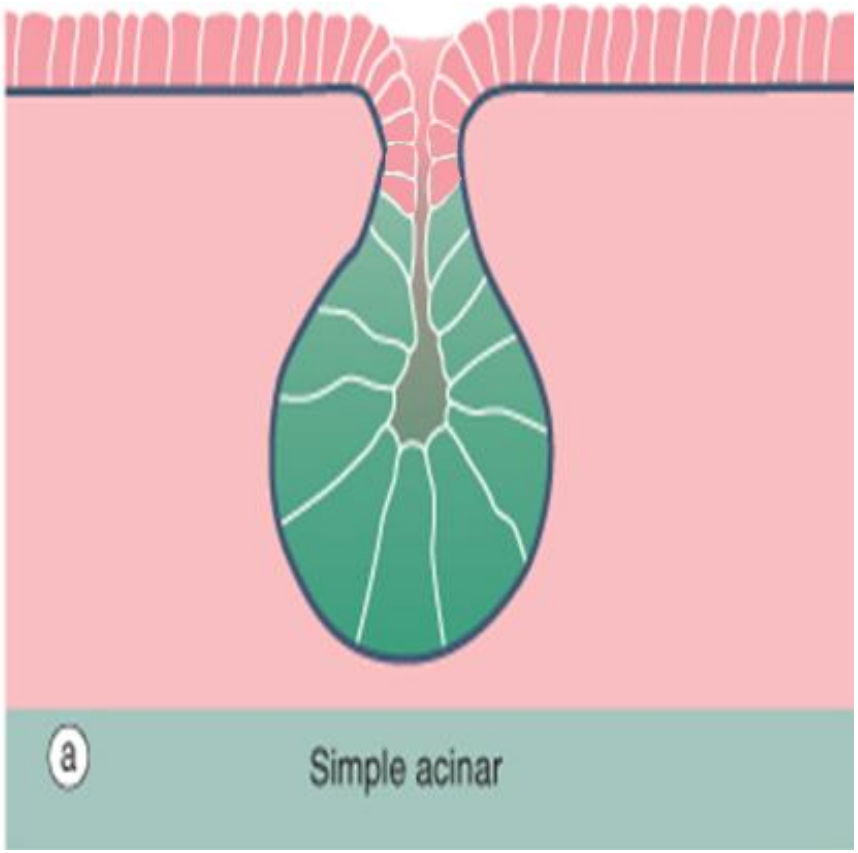


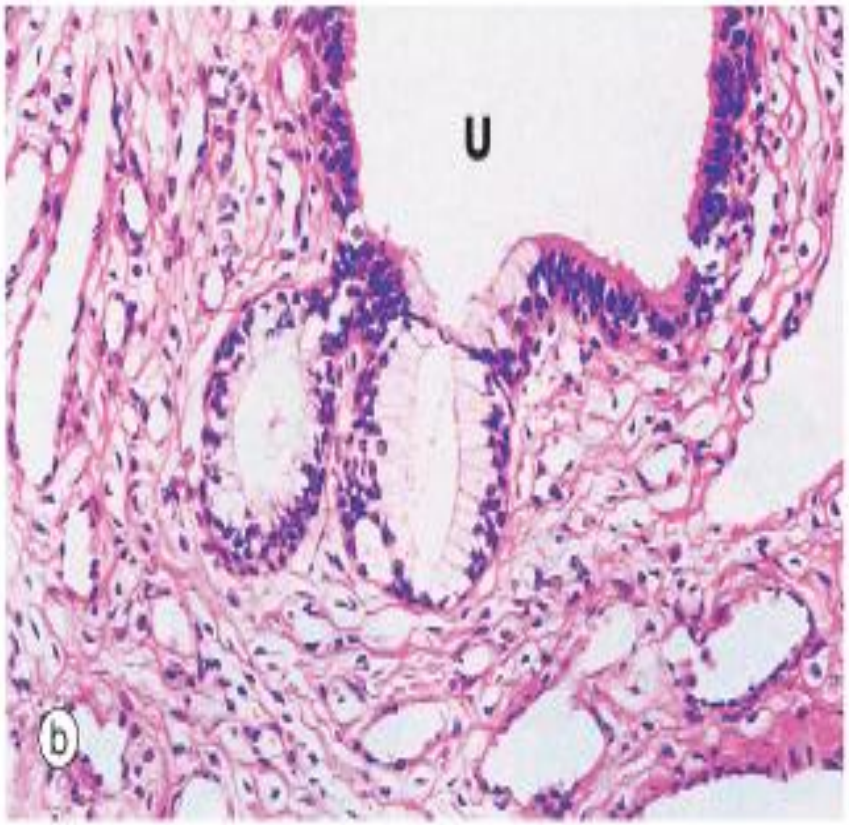
Several tubular secretory portions converge onto a single unbranched duct.
eg. Mucus-secreting gland of **the stomach** and **uterus**

Simple branched tubular



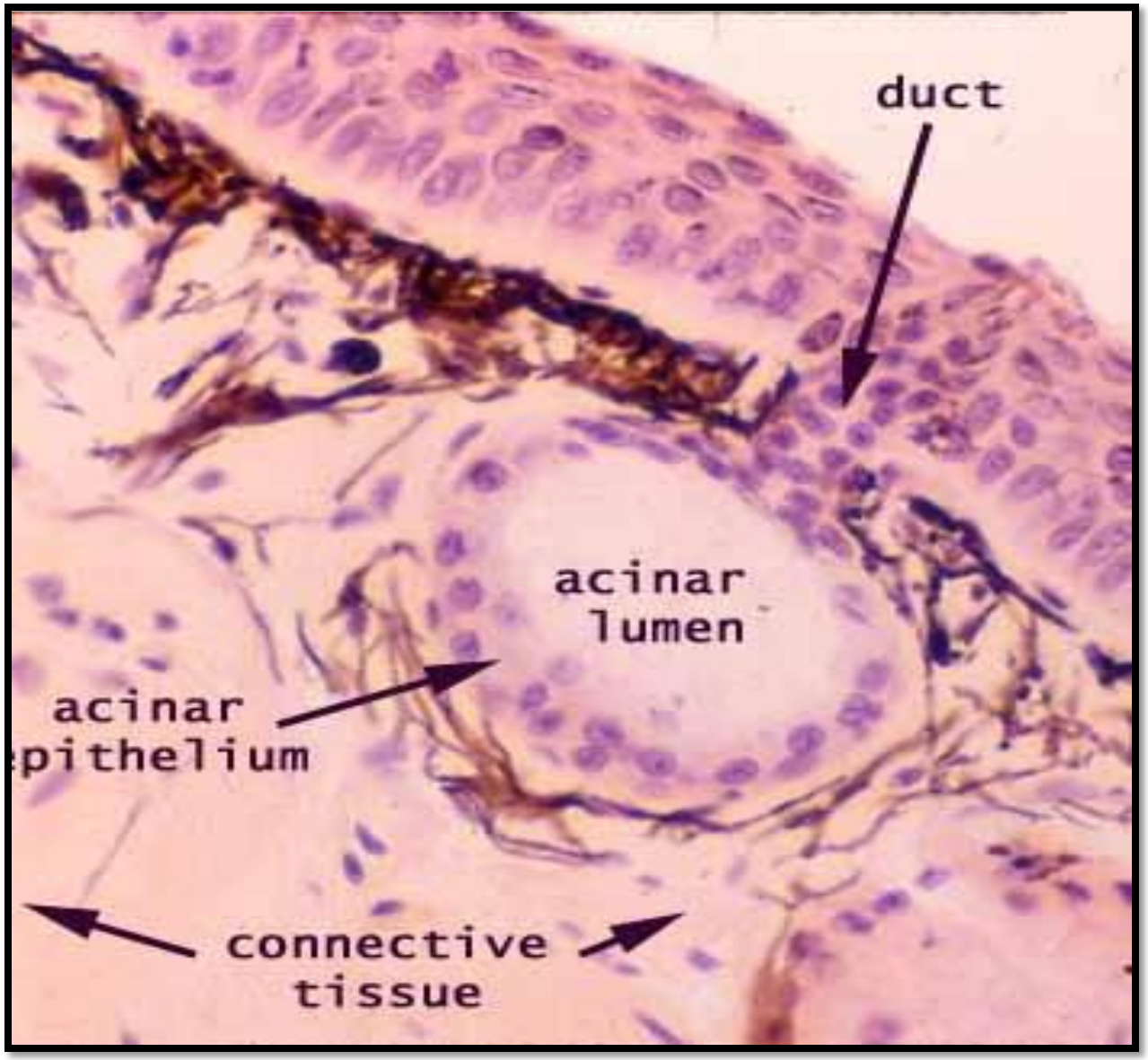
Simple acinar



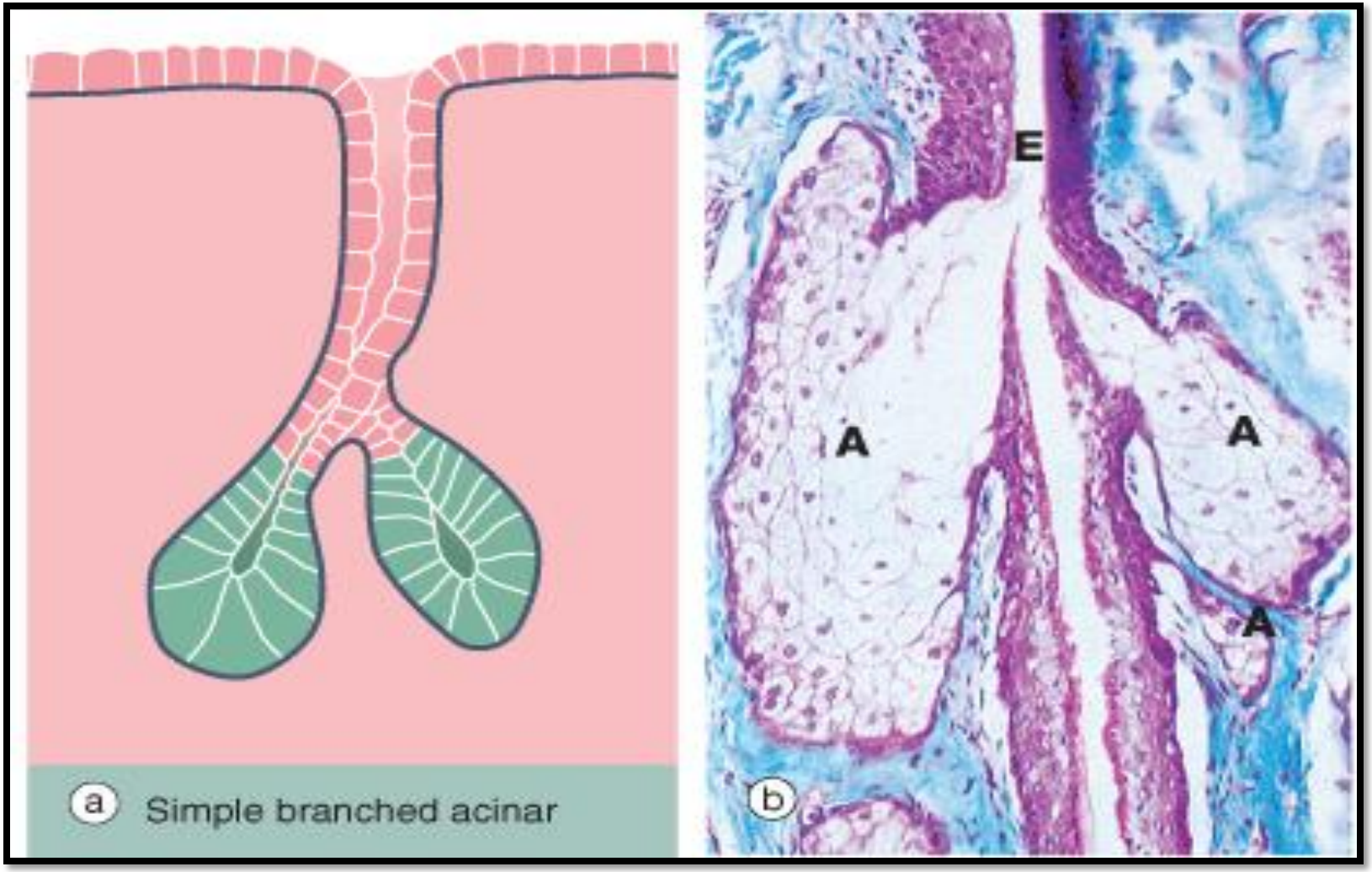


Occur in the form of pockets in epithelial surfaces. Lined by secretory cells eg. Small mucous glands along the **urethra.**

Simple acinar



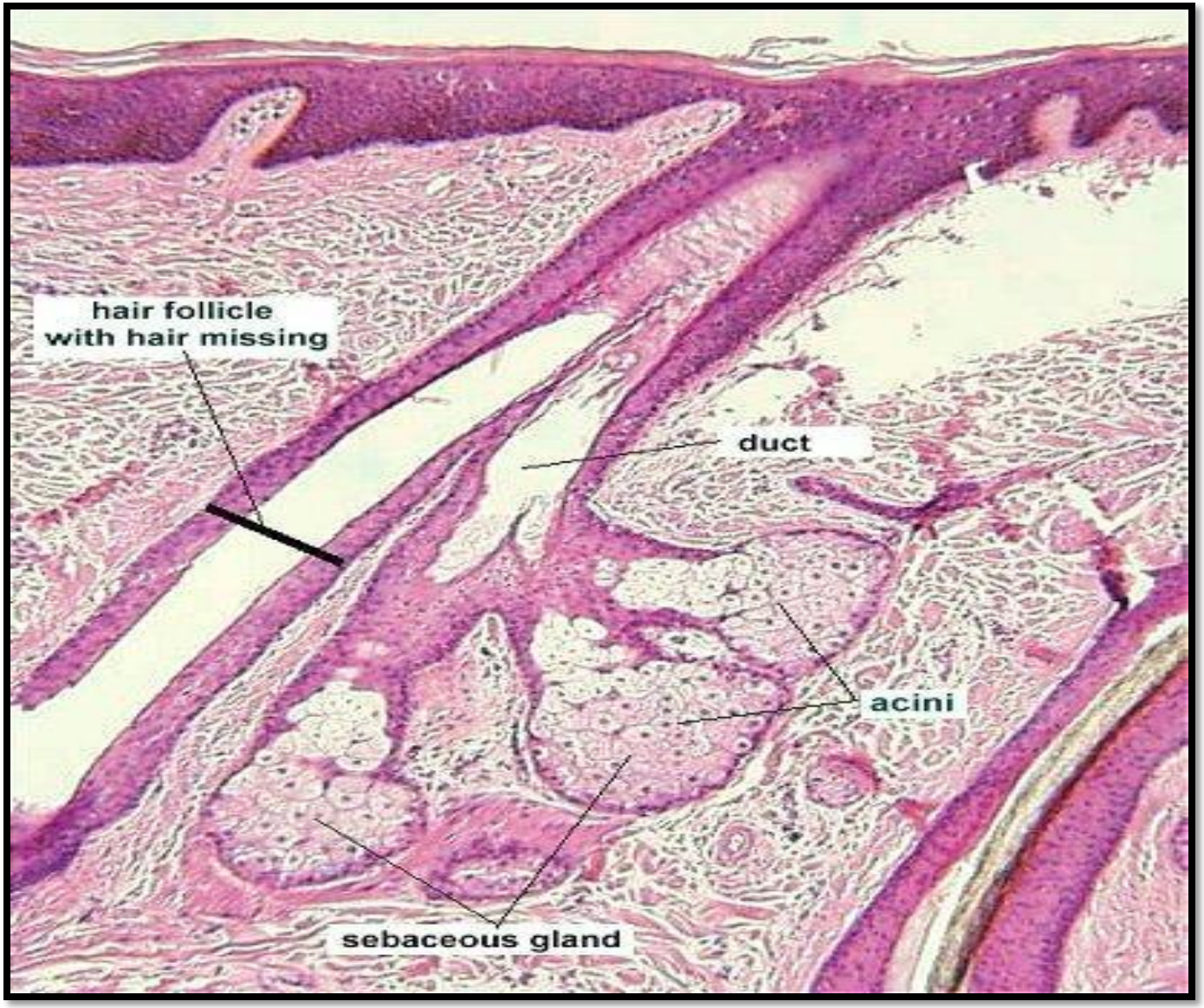
Simple branched acinar



Each gland consists of several secretory acini (A) that empty into a single excretory Duct eg. **Sebaceous glands**, sebum secretion

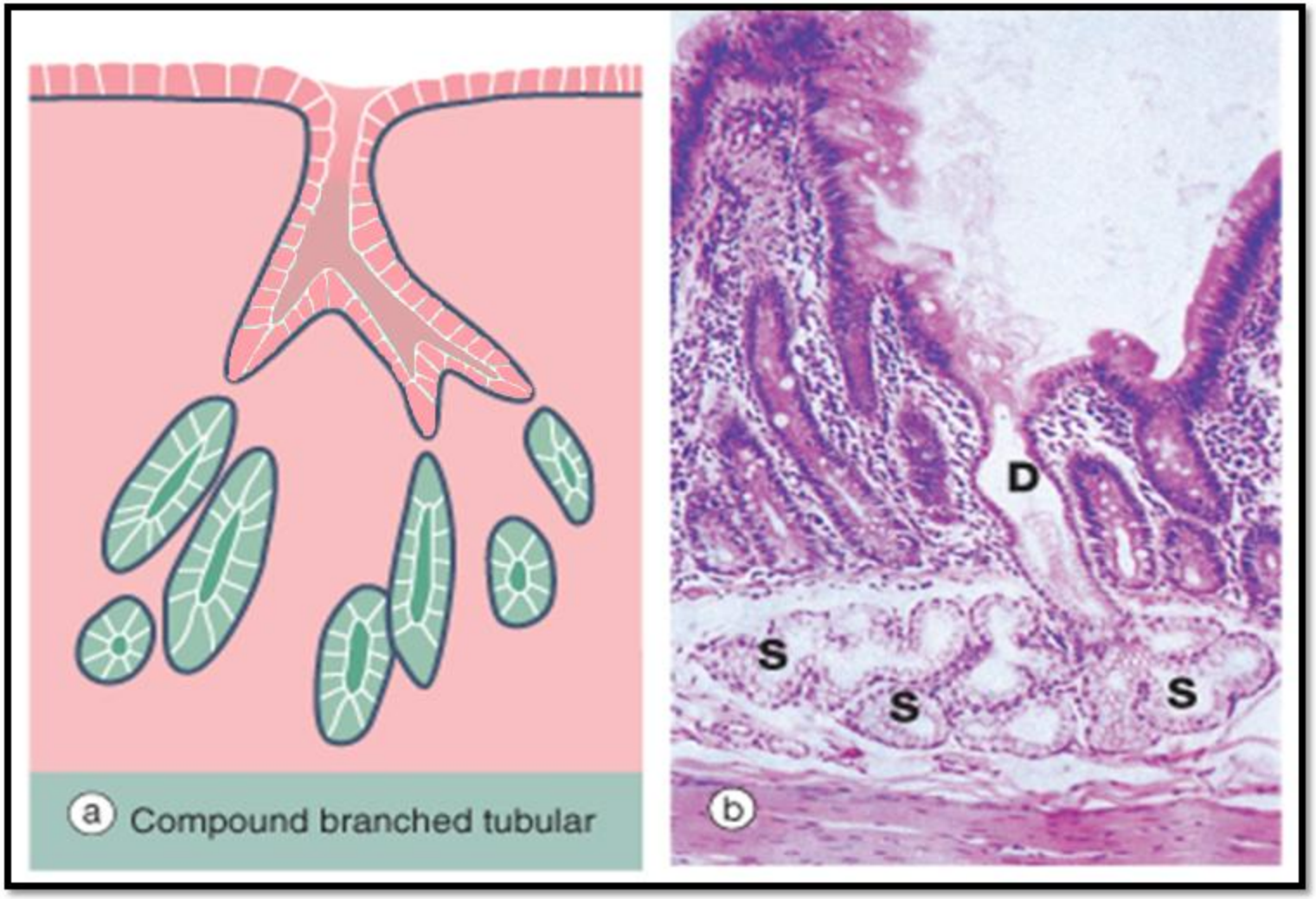
Simple branched acinar

Simple branched acinar



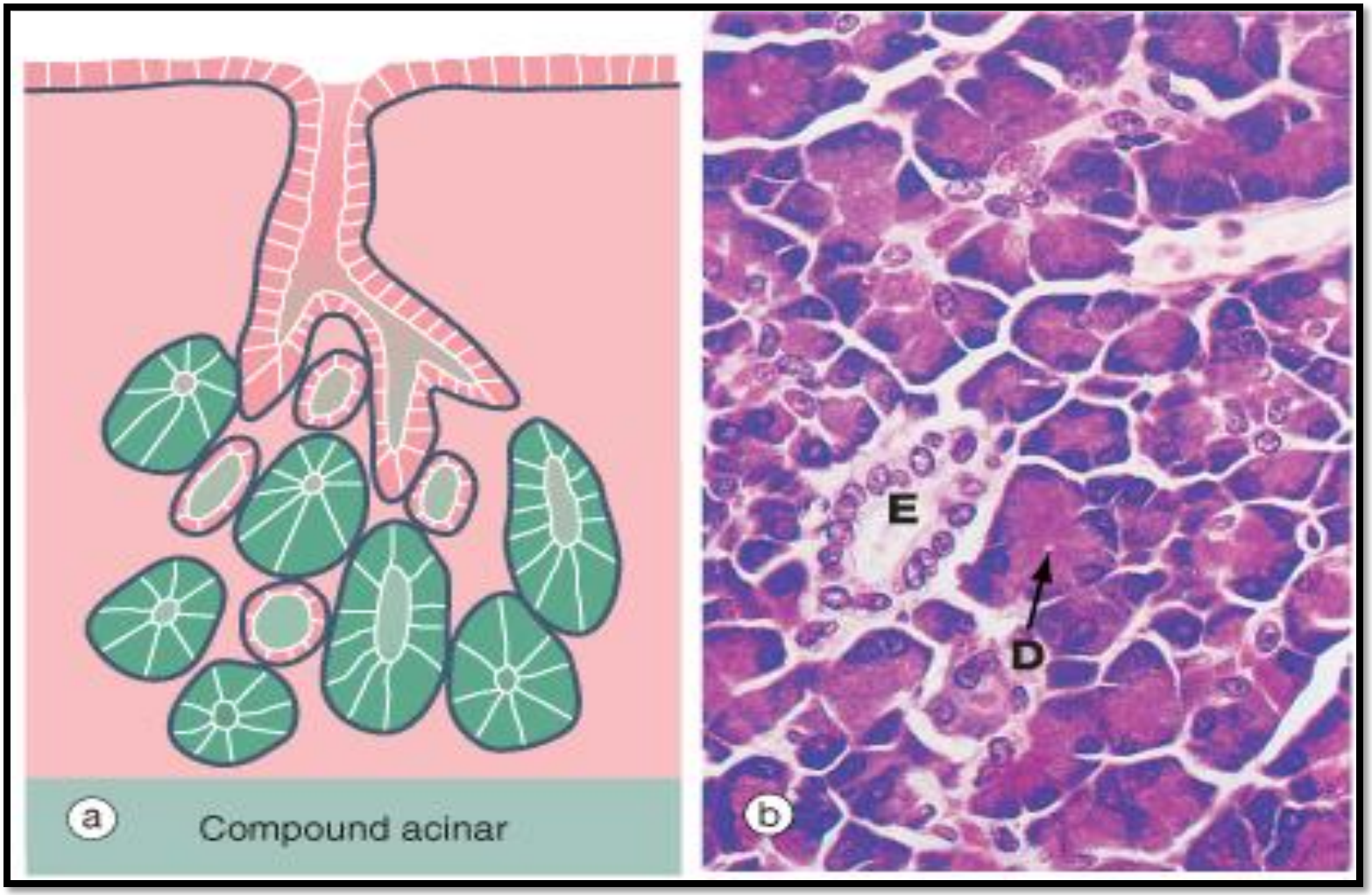
Compound exocrine glands

Compound tubular



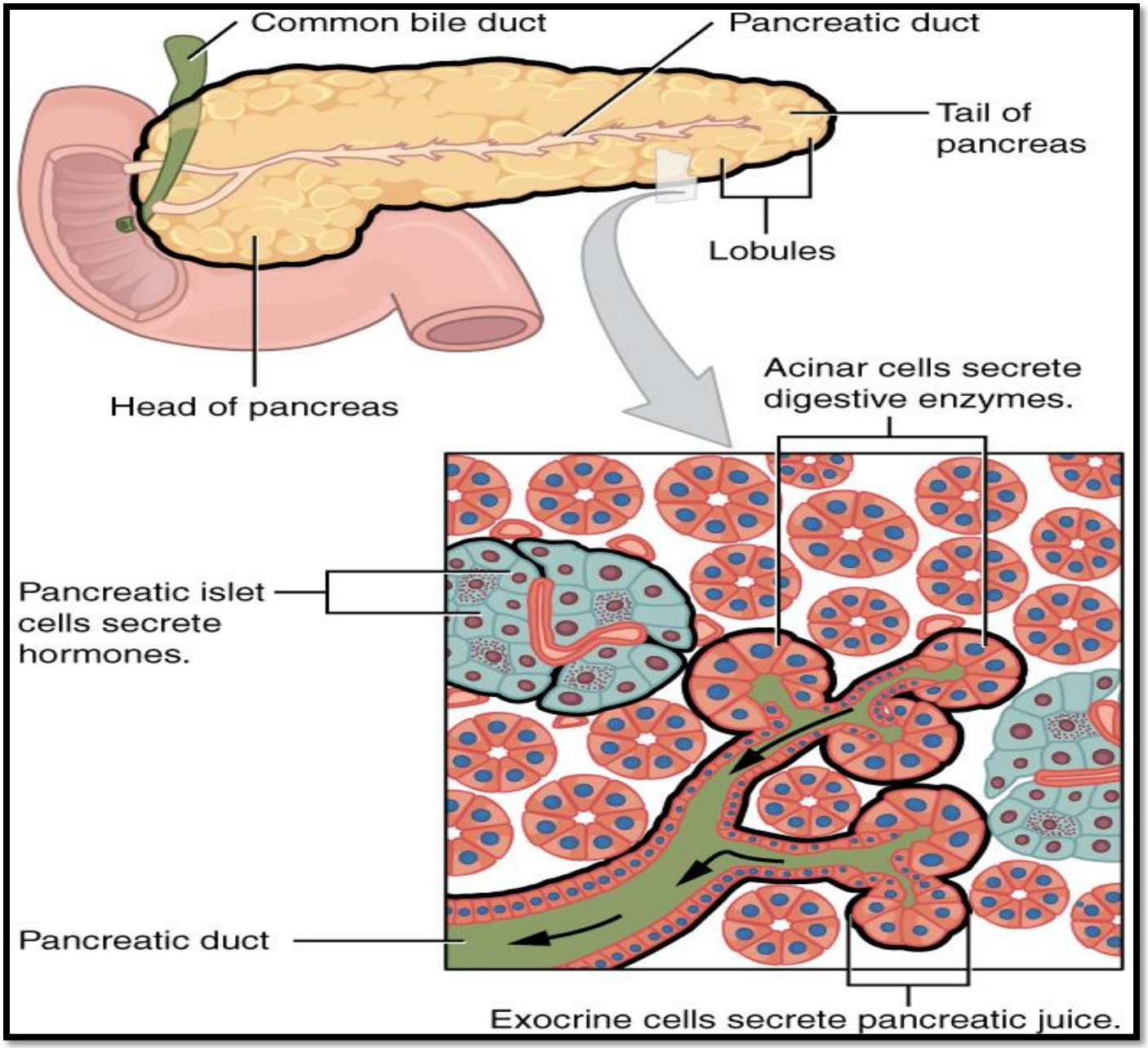
Secretory portion is branched and coiled and the duct system is also Branched (difficult to visualise) eg. **Brunner's gland of the duodenum**

Compound acinar

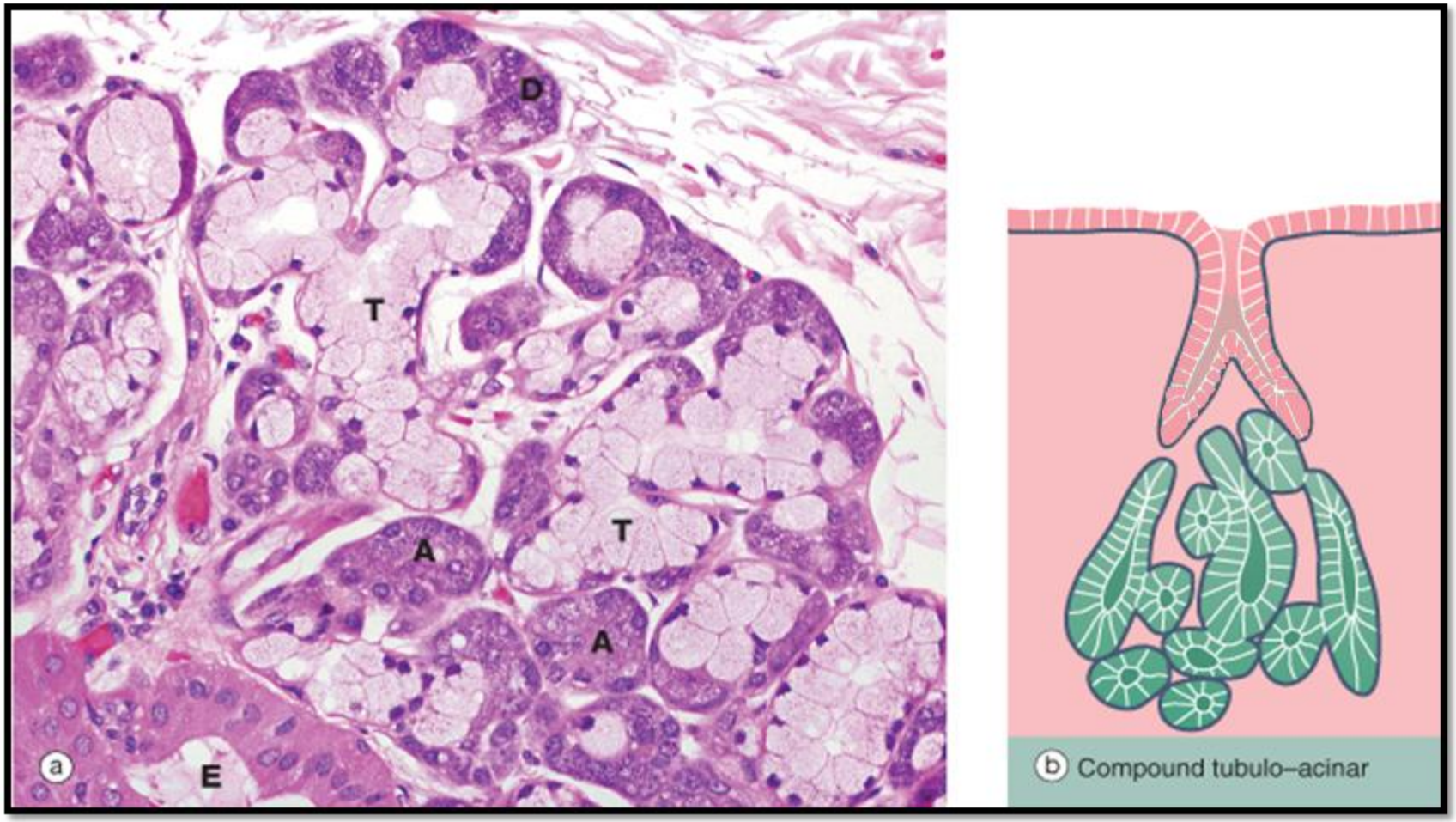


Secretory units are acinar and drain into a branched duct system

eg. **Exocrine pancreas, Parotid salivary gland.**


Common bile duct
Pancreatic duct
Tail of pancreas
Lobules
Head of pancreas
Acinar cells secrete digestive enzymes.
Pancreatic islet cells secrete hormones.
Pancreatic duct
Exocrine cells secrete pancreatic juice.

Compound tubulo - acinar



3 types of secretory units:
Branched tubular, branched acinar and branched tubular with acinar end-pieces called demilunes eg. **Sublingual & Submandibular salivary gland.**

Classification on the basis of nature of secretory product

Classification on the basis of nature of secretory product

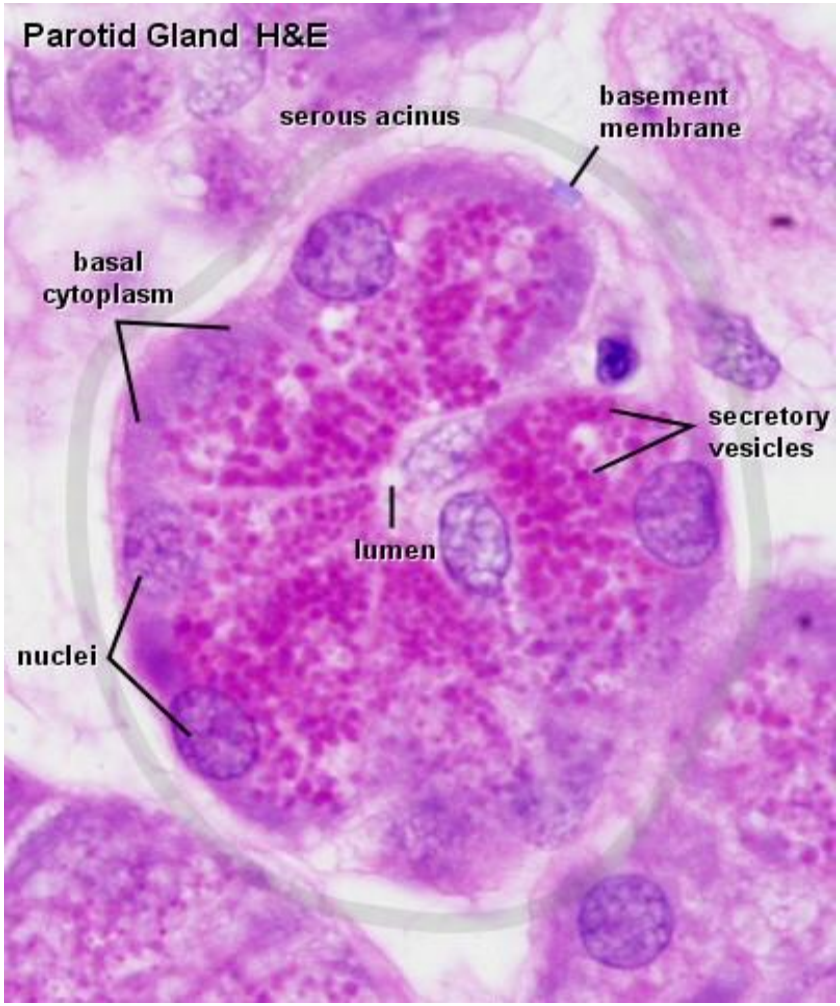
1. **Mucous glands:** these glands produce a viscid, slimy, carbohydrate-rich secretion which is called mucus,

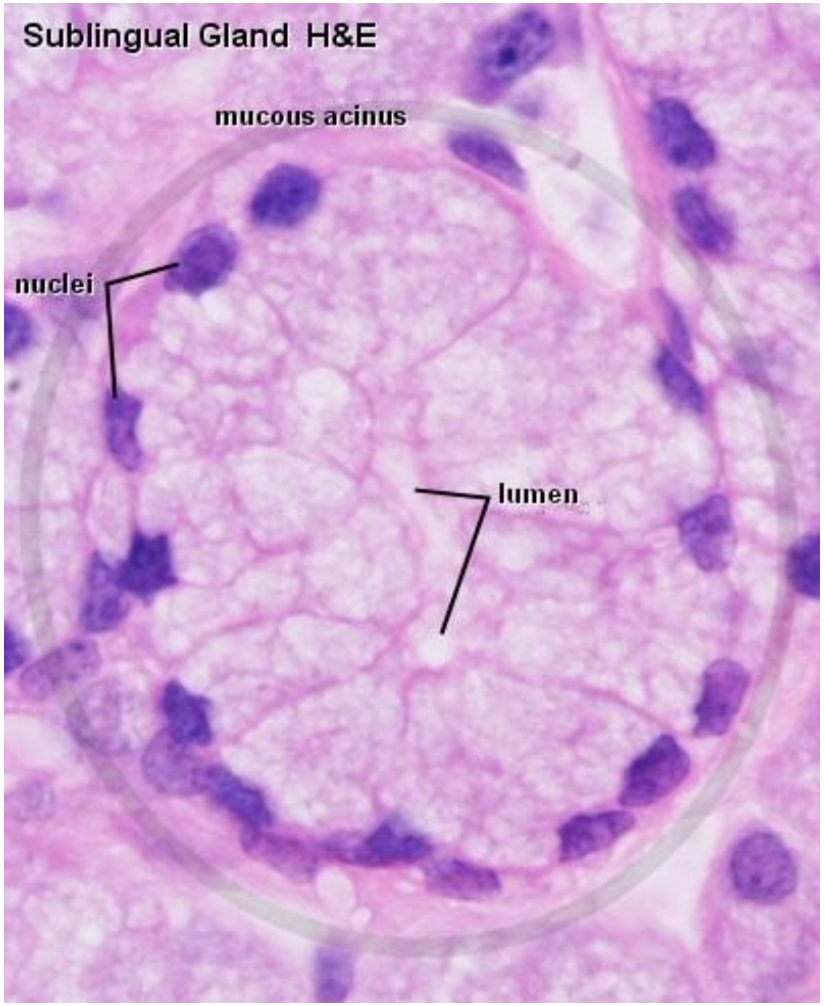
   e.g; **Pyloric glands of stomach**

2. **Serous glands:** these glands produce a thin, watery, protein-rich secretions, often high in enzymatic activity e.g; **Exocrine pancreas**, the **parotid salivary gland**.

3. **Mixed glands:** these glands produce both mucous and serous secretions e.g; the **sublingual** and **submandibular salivary** glands.

Serous cell and Mucous cell



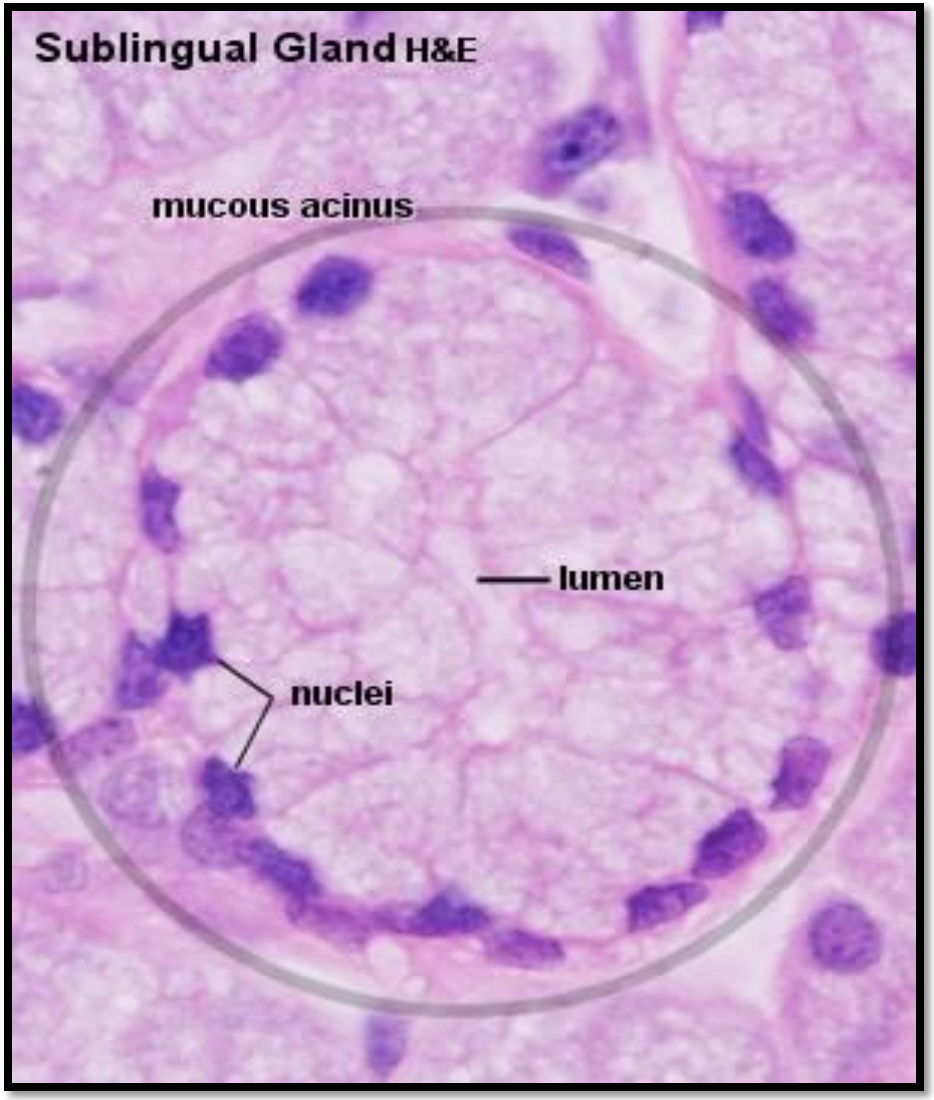


Mucous Cells

Mucous cells are larger than serous cells, with flattened basal nuclei.

Most of the cytoplasm is filled with secretory granules containing mucinogen like that of goblet cells.

The RER and Golgi complexes of mucous cells produce heavily glycosylated glycoproteins with water-binding properties.

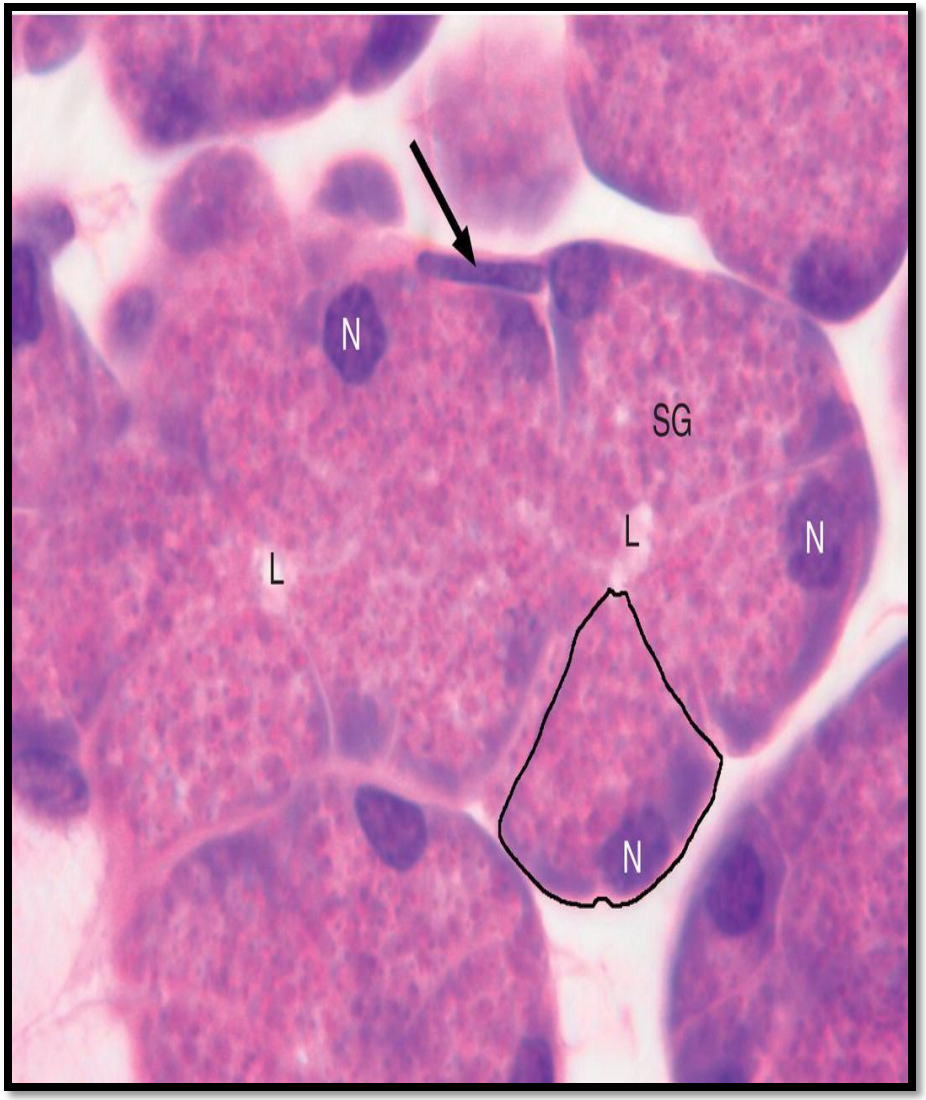


Mucous tubules

Serous Cells

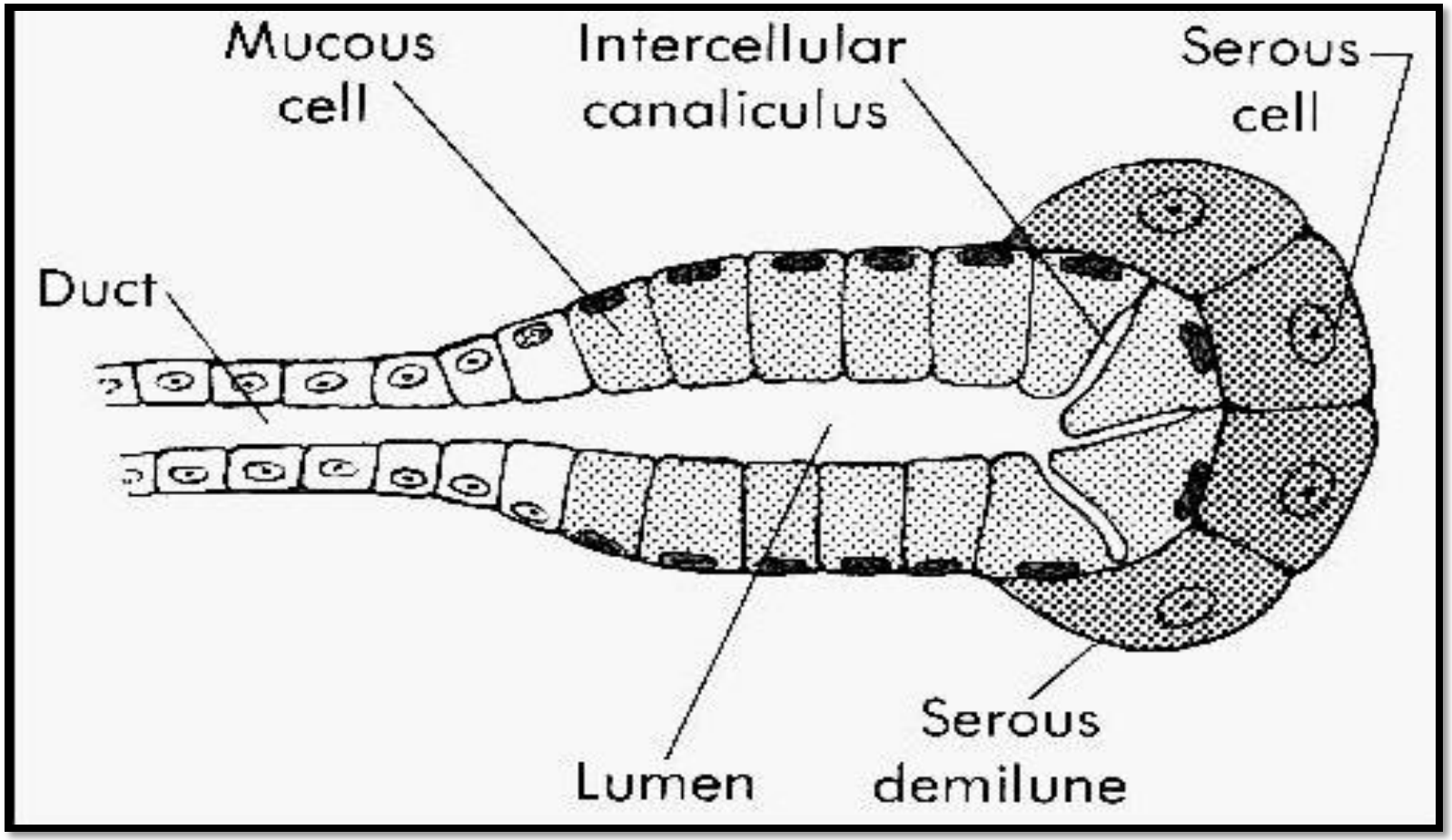
The lumens **of mucous tubules** are larger than those of serous acini.

Much **connective tissue** surrounds the mucous tubules and ducts.

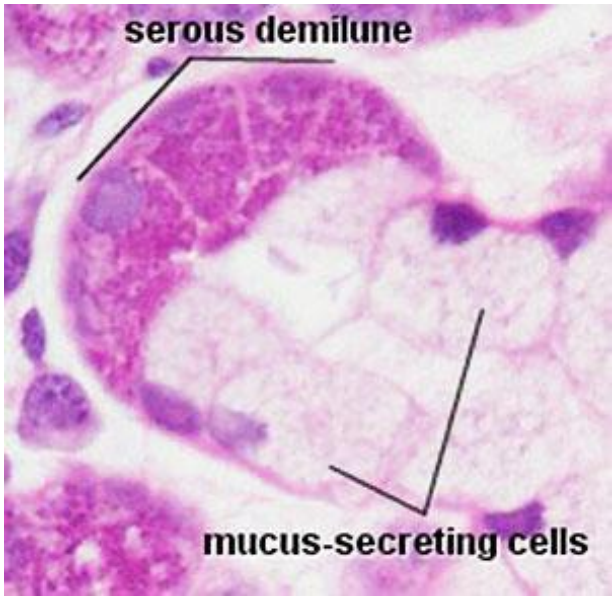


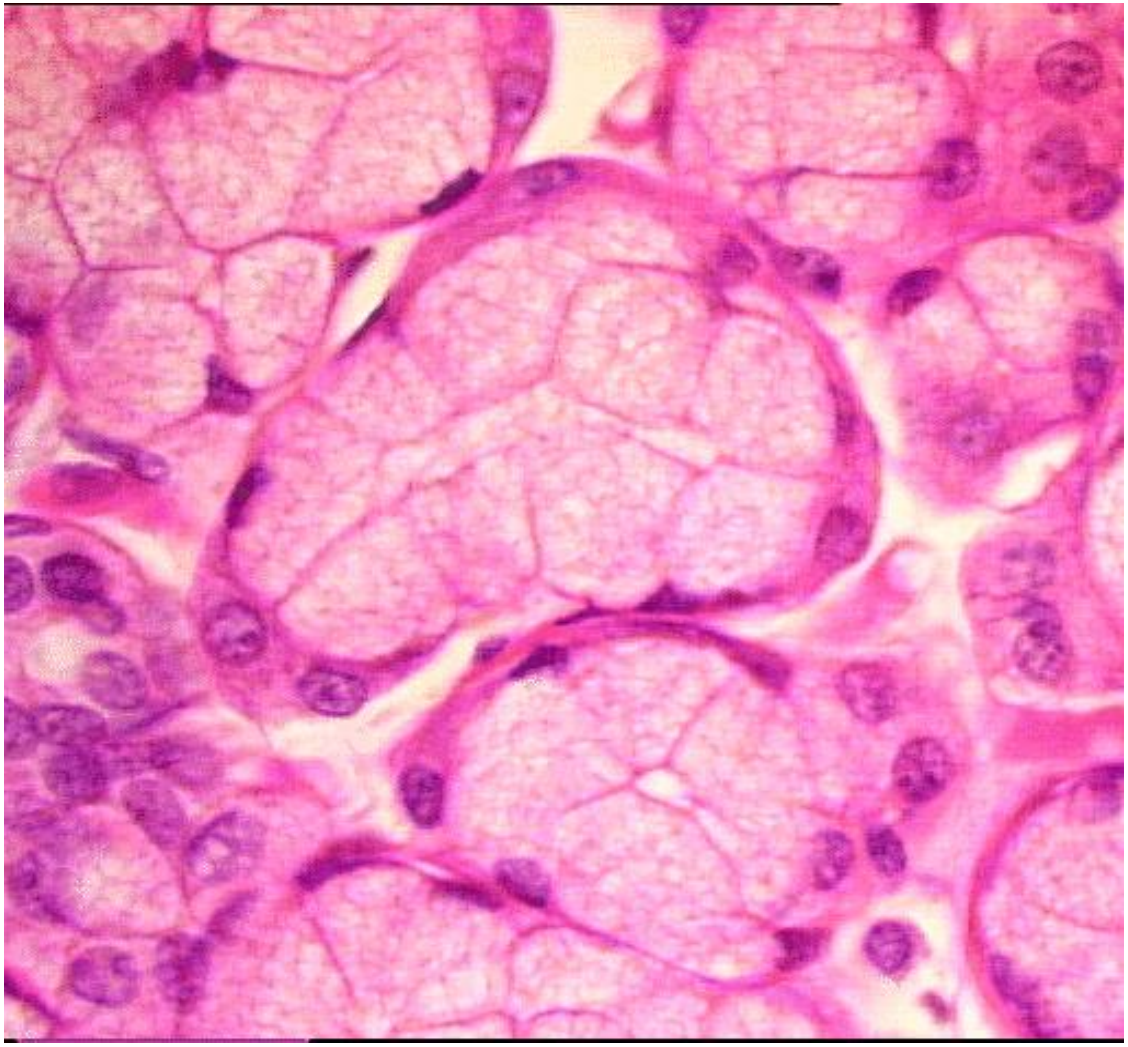
Serous acini

Serous demilune



Serous demilune



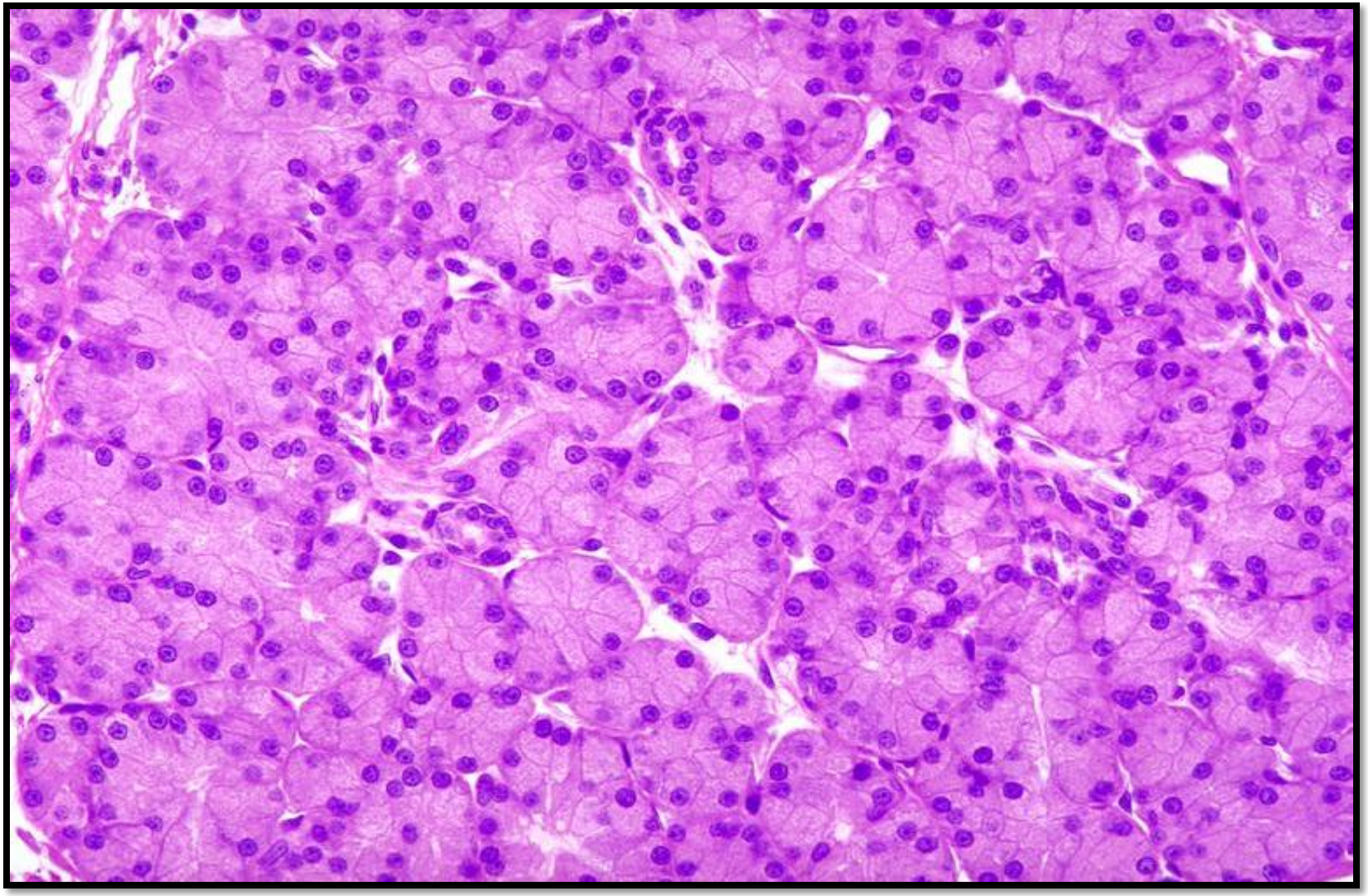


Mucous gland

Esophagous gland

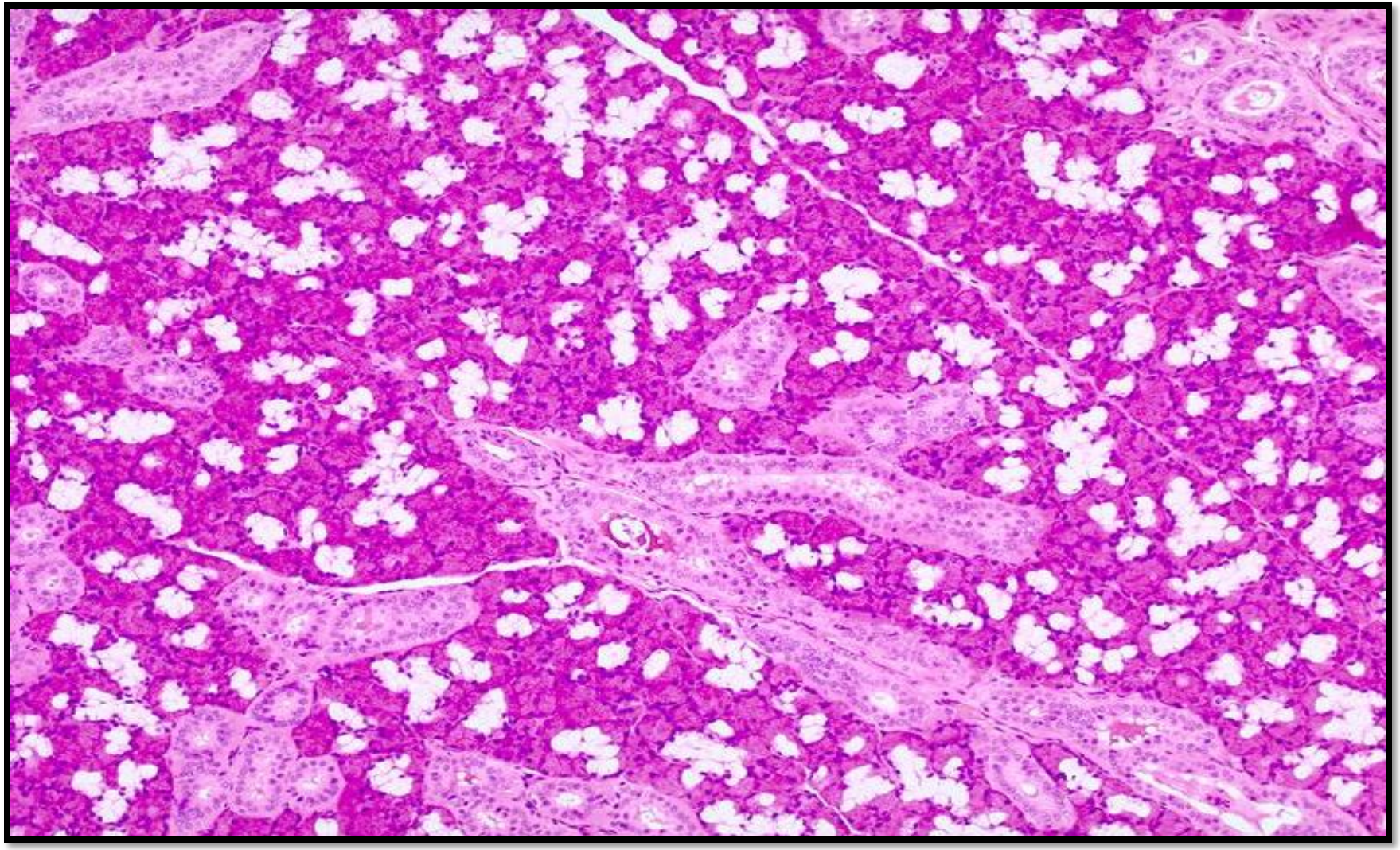
Mucous gland

Serous gland



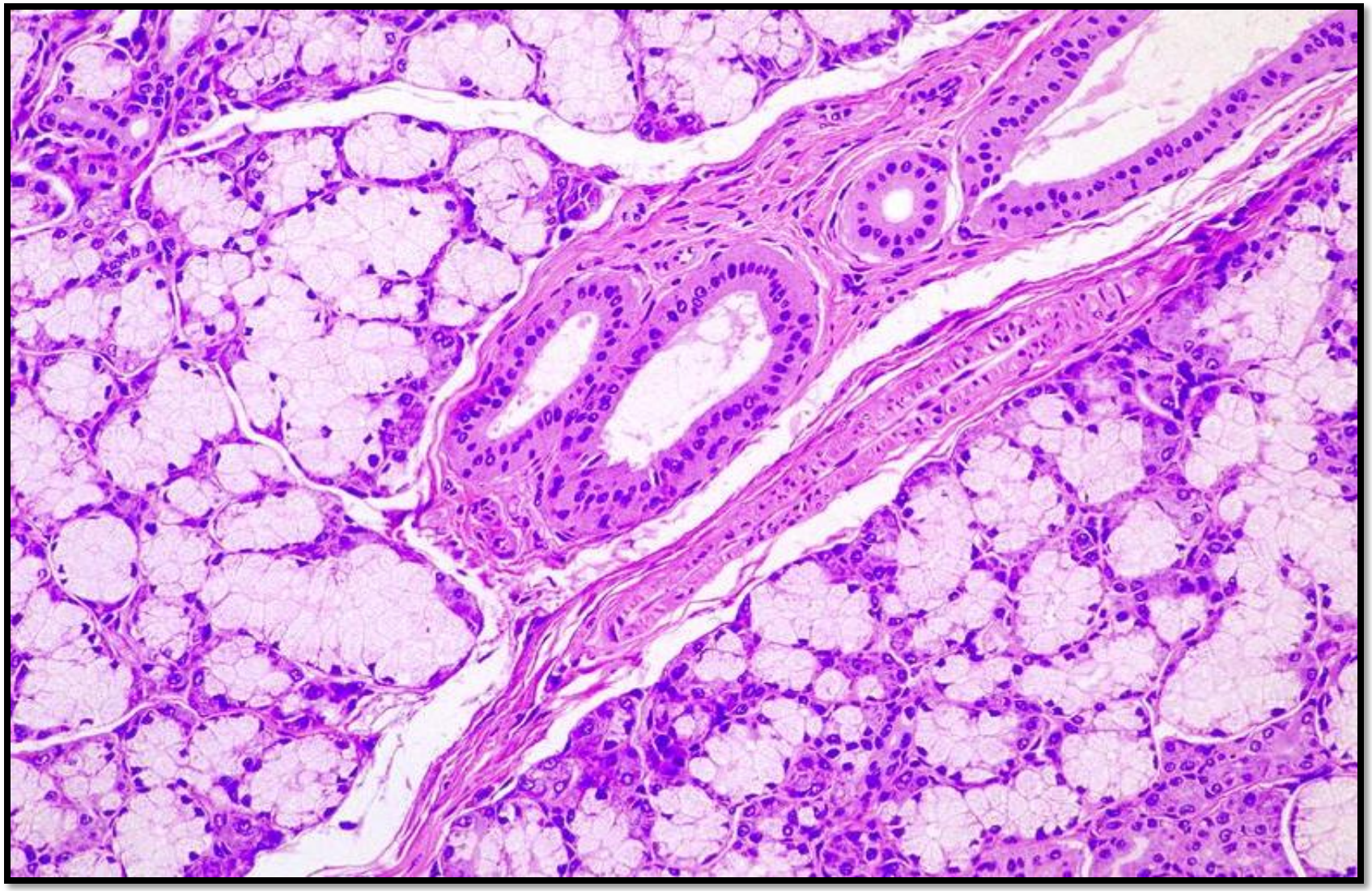
Parotid gland

Mixed gland : Seromucous gland

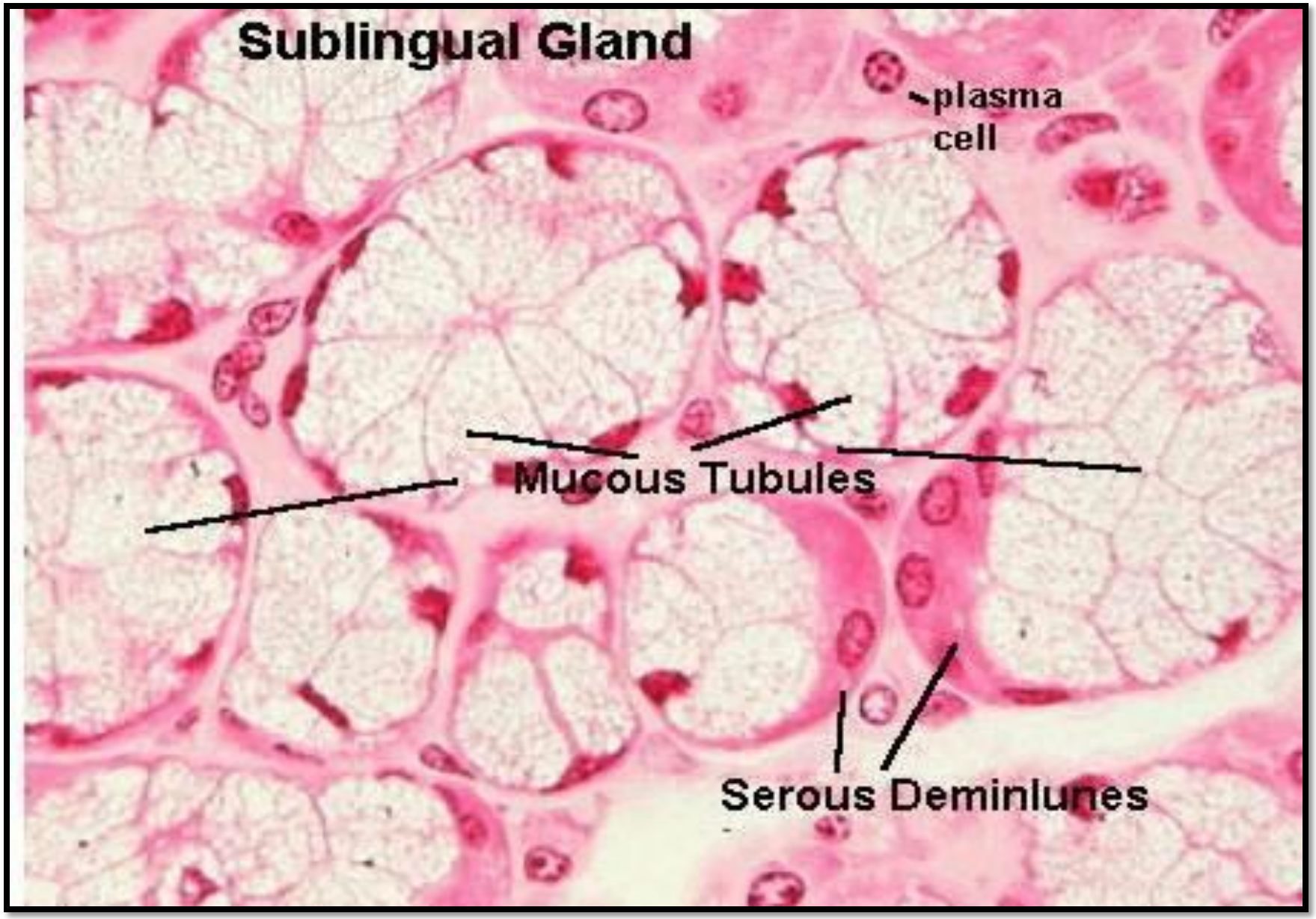


Submandibular gland

Mixed gland : Mucoserous gland



Sublingual gland


Sublingual Gland
plasma cell
Mucous Tubules
Serous Deminlunes

Classification on the basis of the mode of secretion

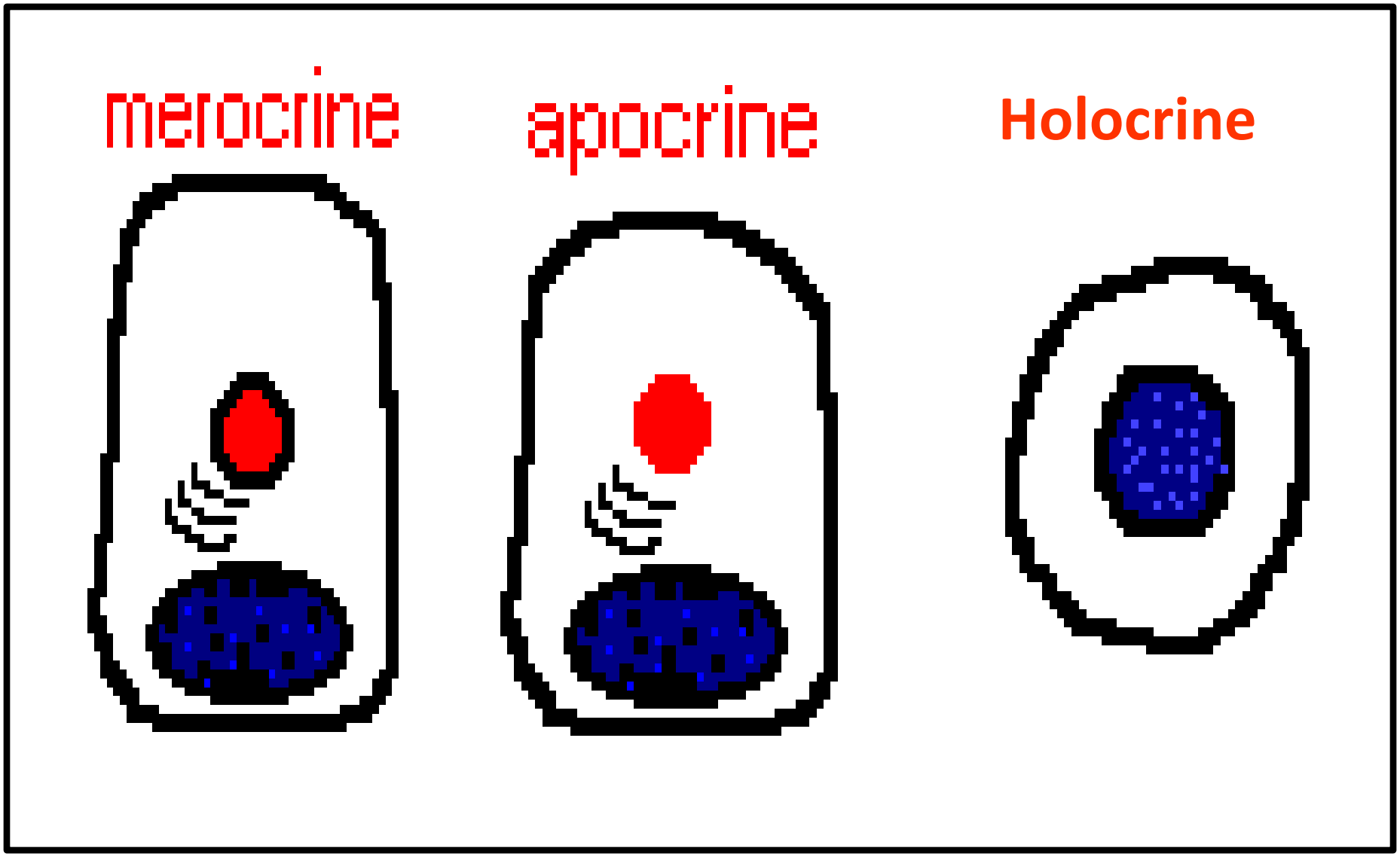
Classification on the basis of the mode of secretion:

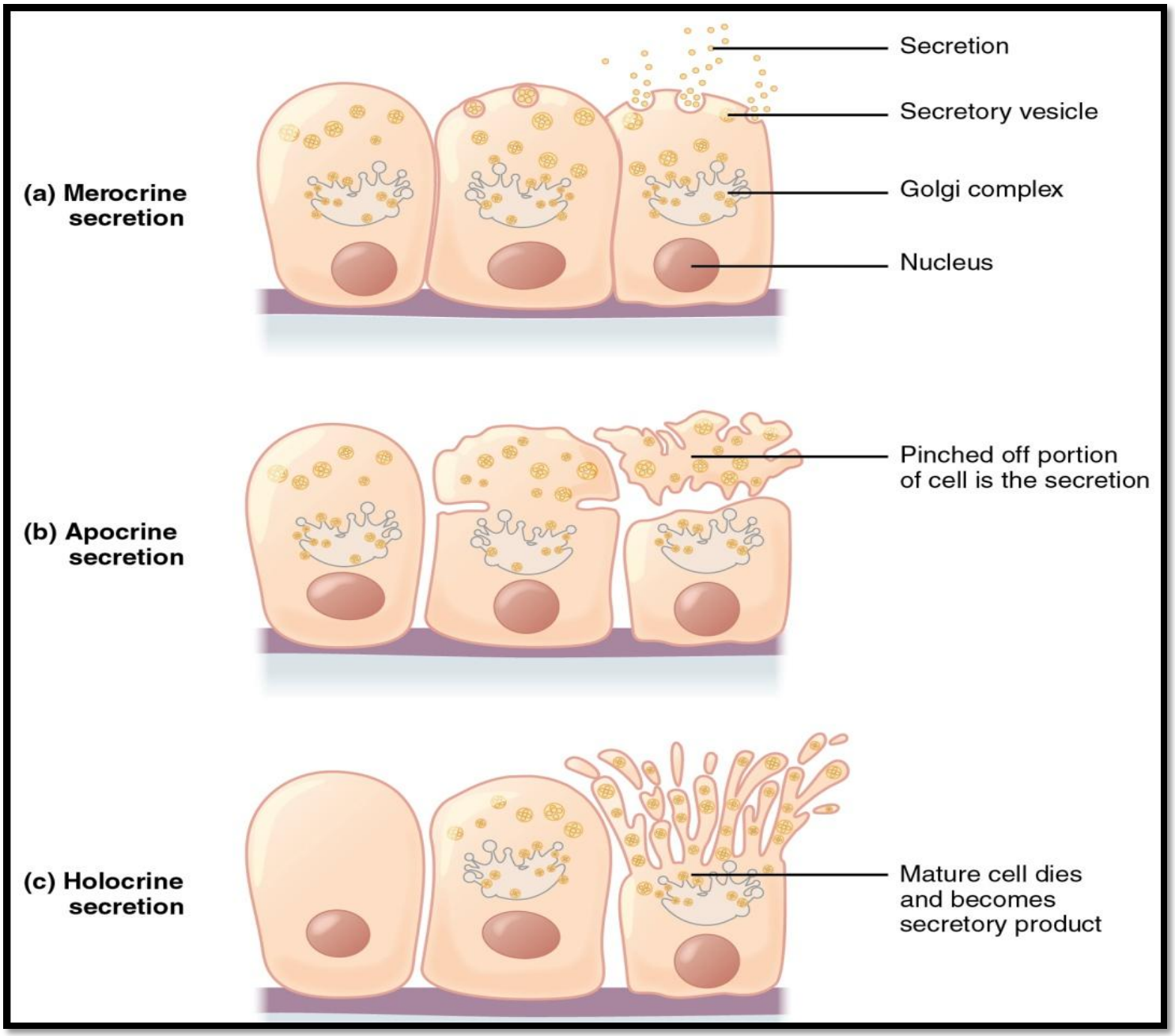
- Depending on their **mode of secretion** i.e; the manner in which the secretory product is elaborated.

- The exocrine glands are classified into the following:

1. **Merocrine (eccrine) glands**
2. **Apocrine glands**
3. **Holocrine glands**

Mode of Secretion

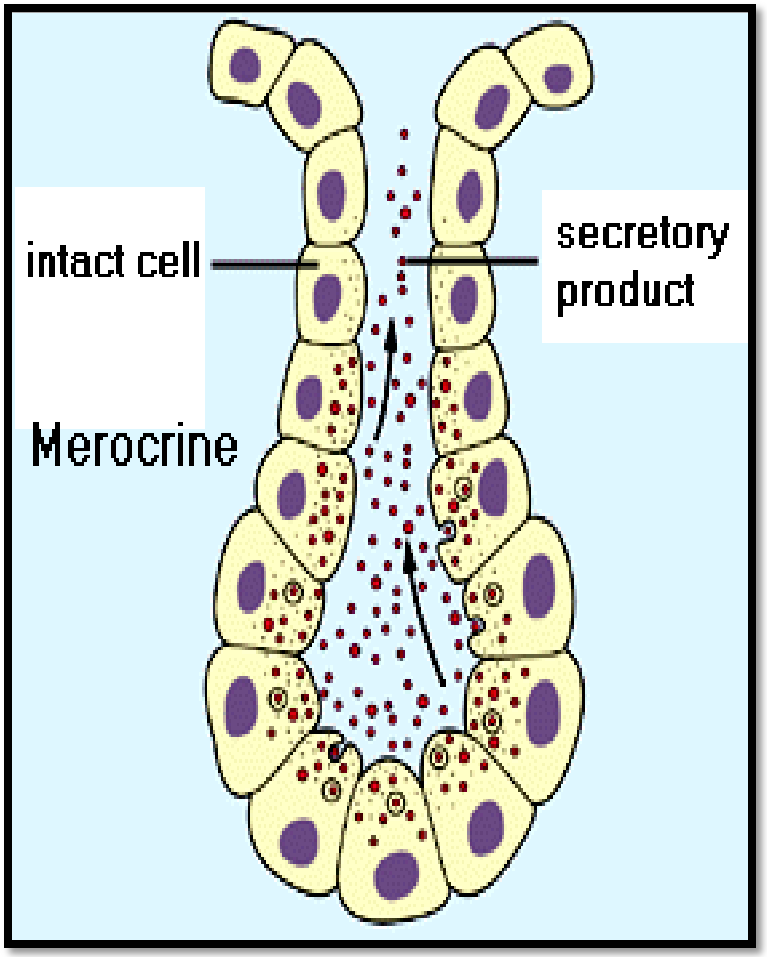


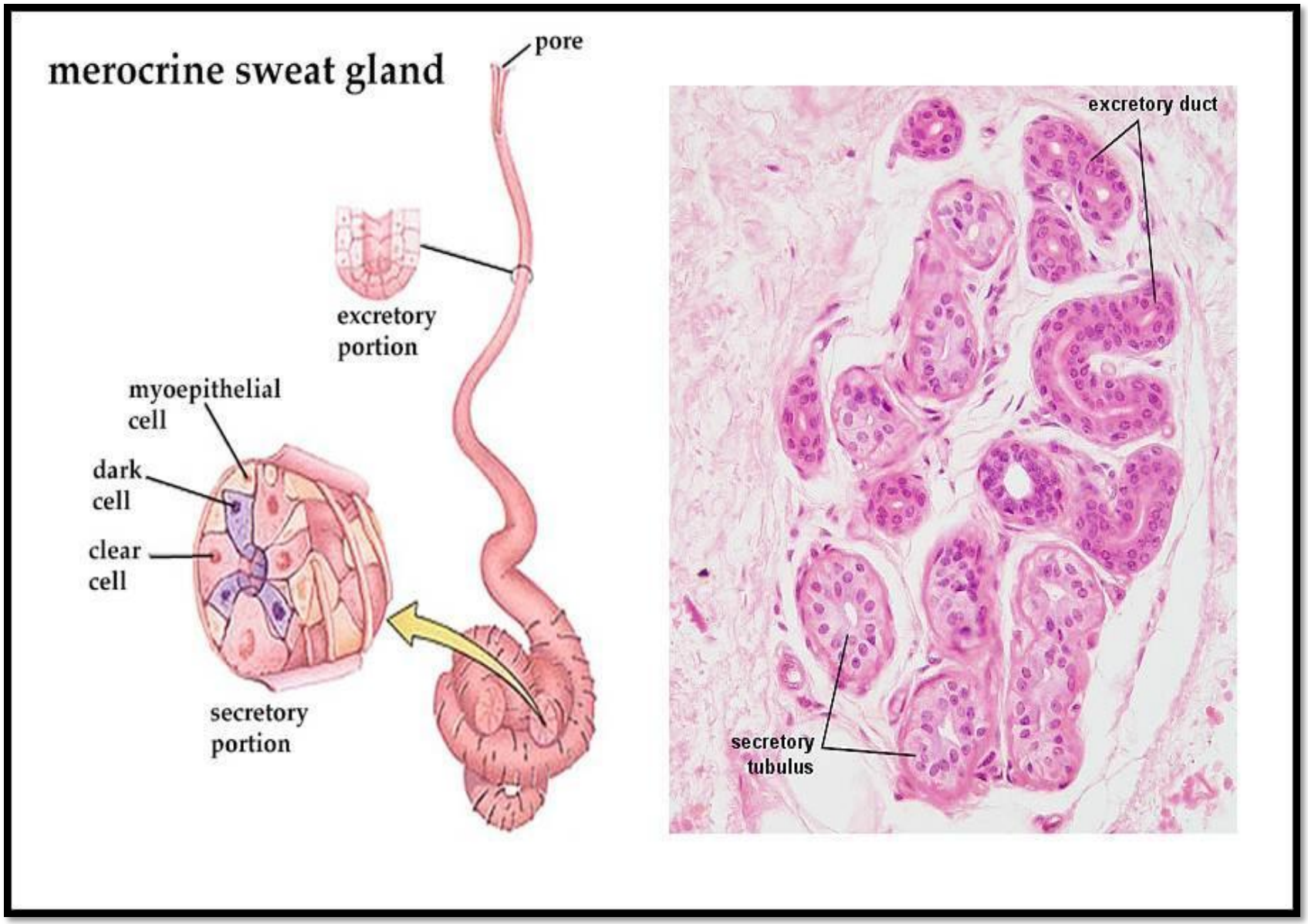

(a) Merocrine secretion
Secretion
Secretory vesicle
Golgi complex
Nucleus
(b) Apocrine secretion
Pinched off portion of cell is the secretion
(c) Holocrine secretion
Mature cell dies and becomes secretory product

Merocrine glands

Merocrine glands :

The secretory product is delivered in membrane-bounded vesicles to the apical surface of the cell. Here, vesicles fuse with the plasma membrane and extrude their contents by **exocytosis.**





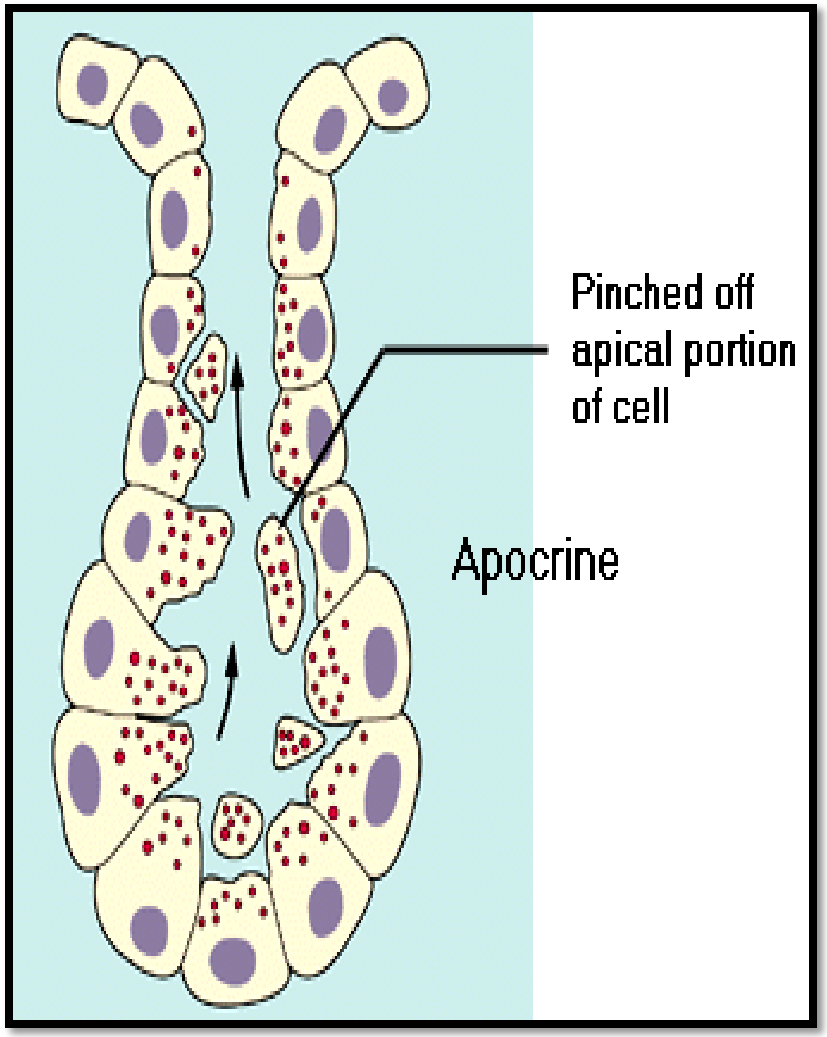
Example: Sweat gland, Pancreas and salivary glands.

Apocrine glands

Apocrine glands :

In these glands part of the apical cytoplasm is lost along with the secretory material.

1. Lactating mammary glands,
2. Special sweat glands located in axilla , perianal area & areola of nipples.
3. Ceruminous glands of the external auditory meatus (ear)



Apocrine glands

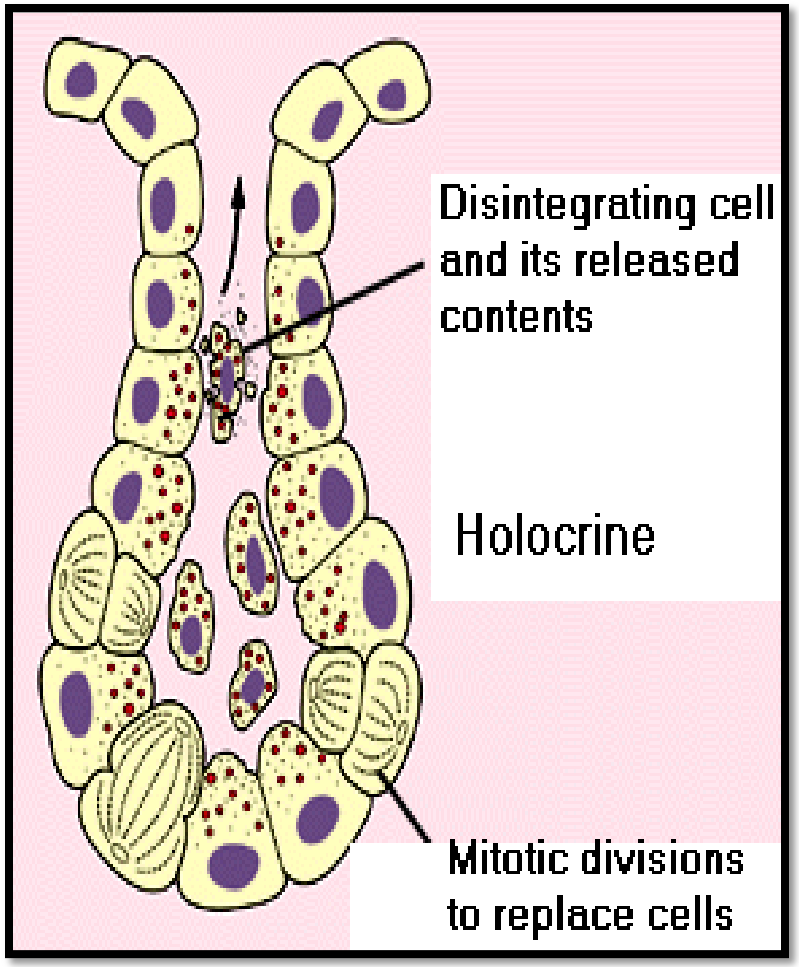
Mammary glands

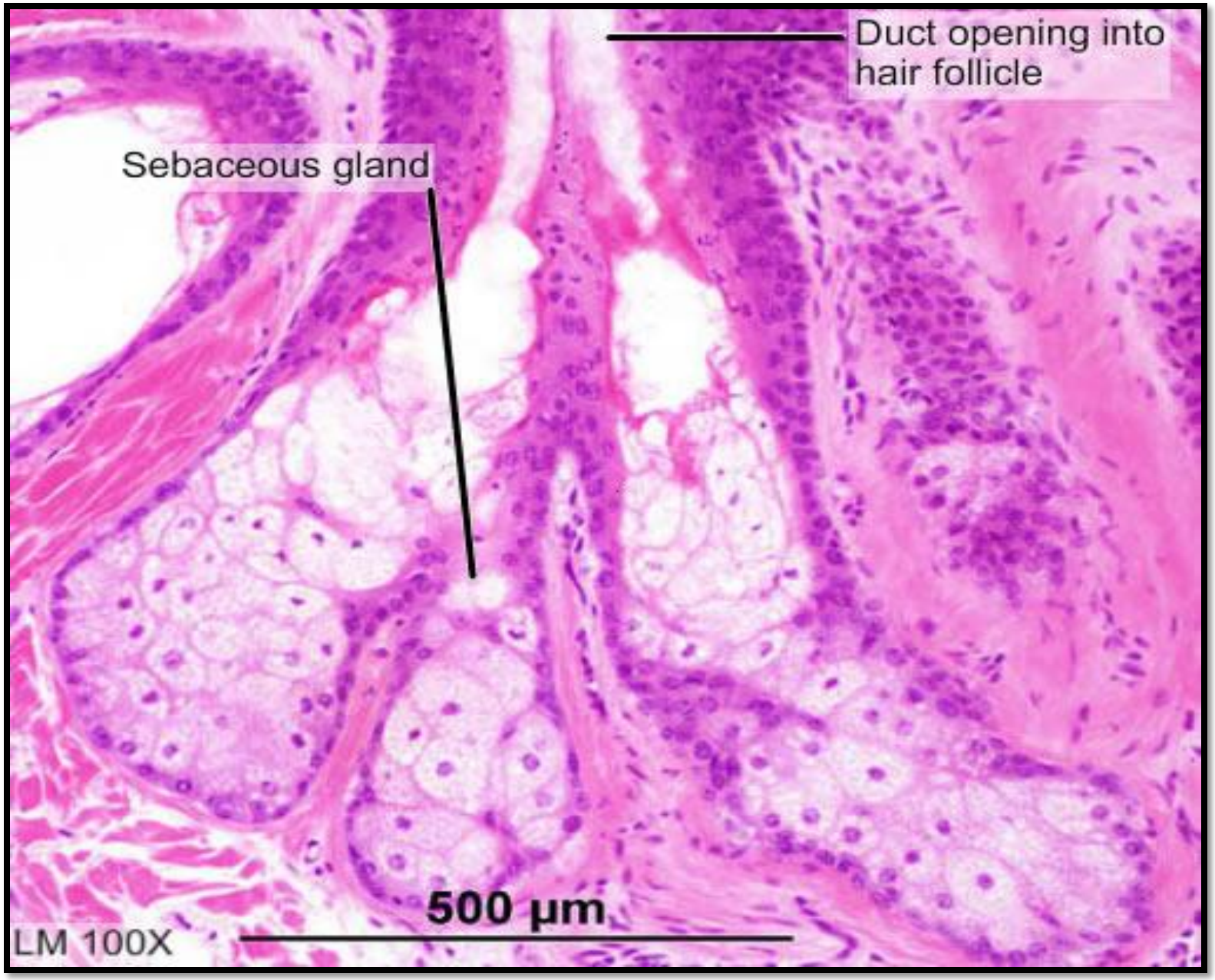
Holocrine glands

Holocrine glands:

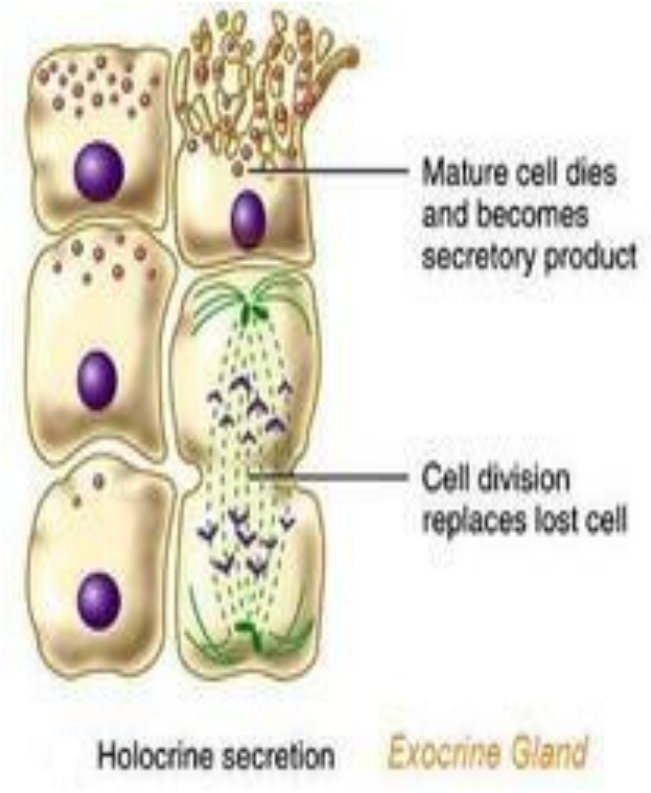
In these glands entire cells laden with secretory material disintegrate and all of the cellular contents are discharged from the gland as secretions.

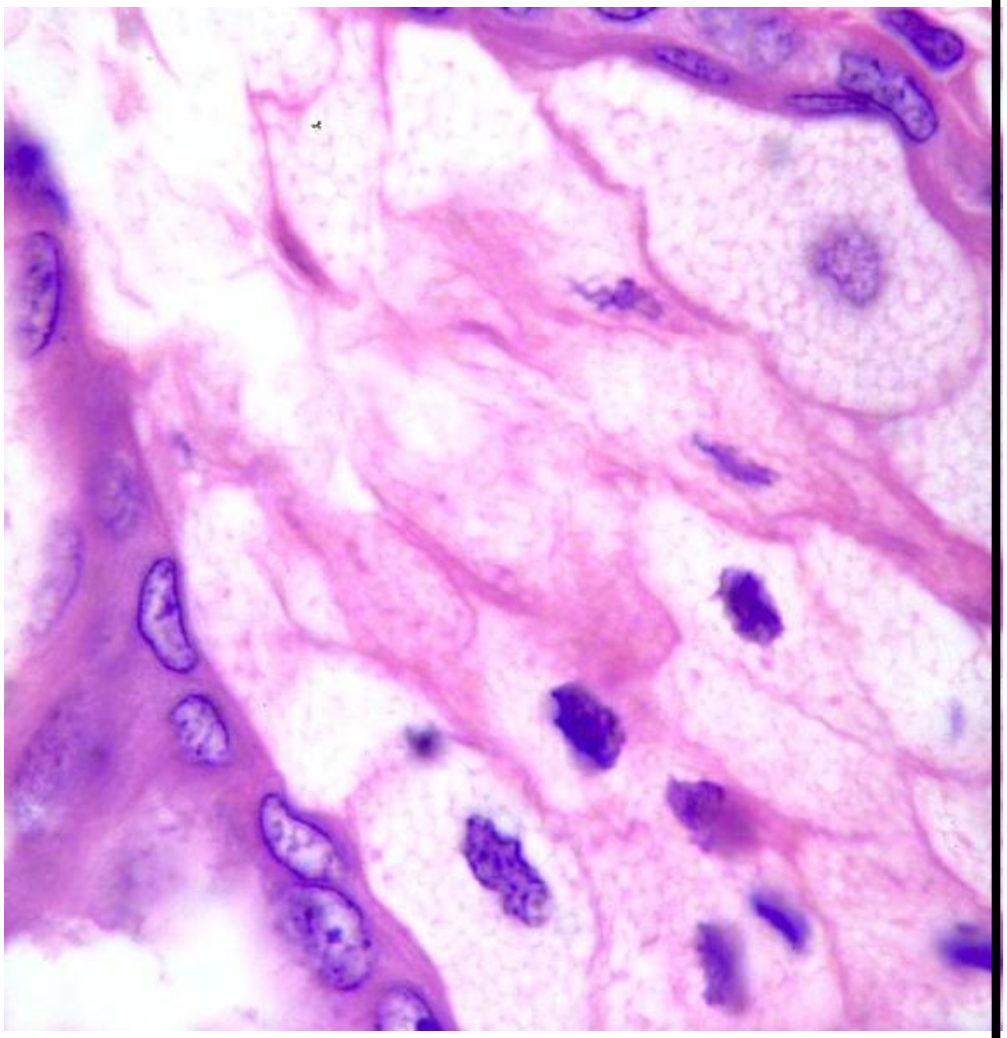
e.g; the **sebaceous glands** of skin




Duct opening into hair follicle
Sebaceous gland
500 µm
LM 100X

Holocrine glands





Sebaceous glands

Sebaceous gland

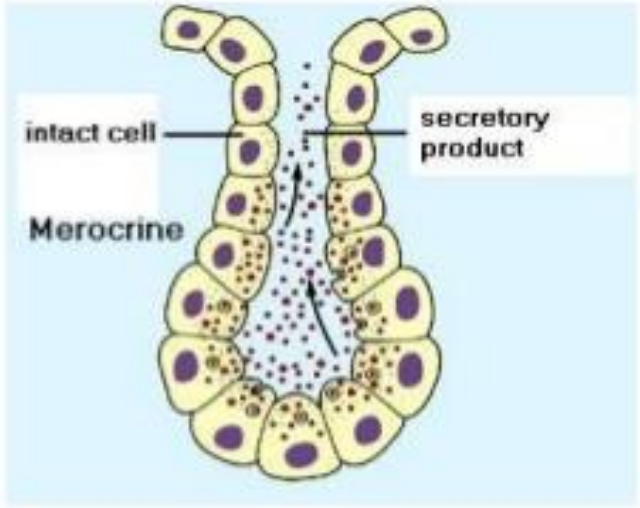
Rounded cells filled with sebum.

Basal undifferentiated cells

Types of sweat glands

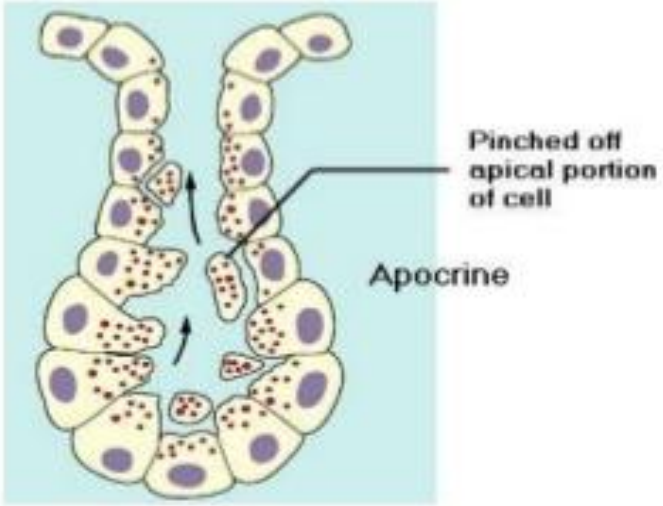
Eccrine sweat gland

- Merocrine secretion
- Empty directly onto skin surface
- Location: most all over body (esp. abundant on palms & soles: ~ 500/cm^2)
- Clear, watery secretion (99% H_2O; rest NaCl + some waste products

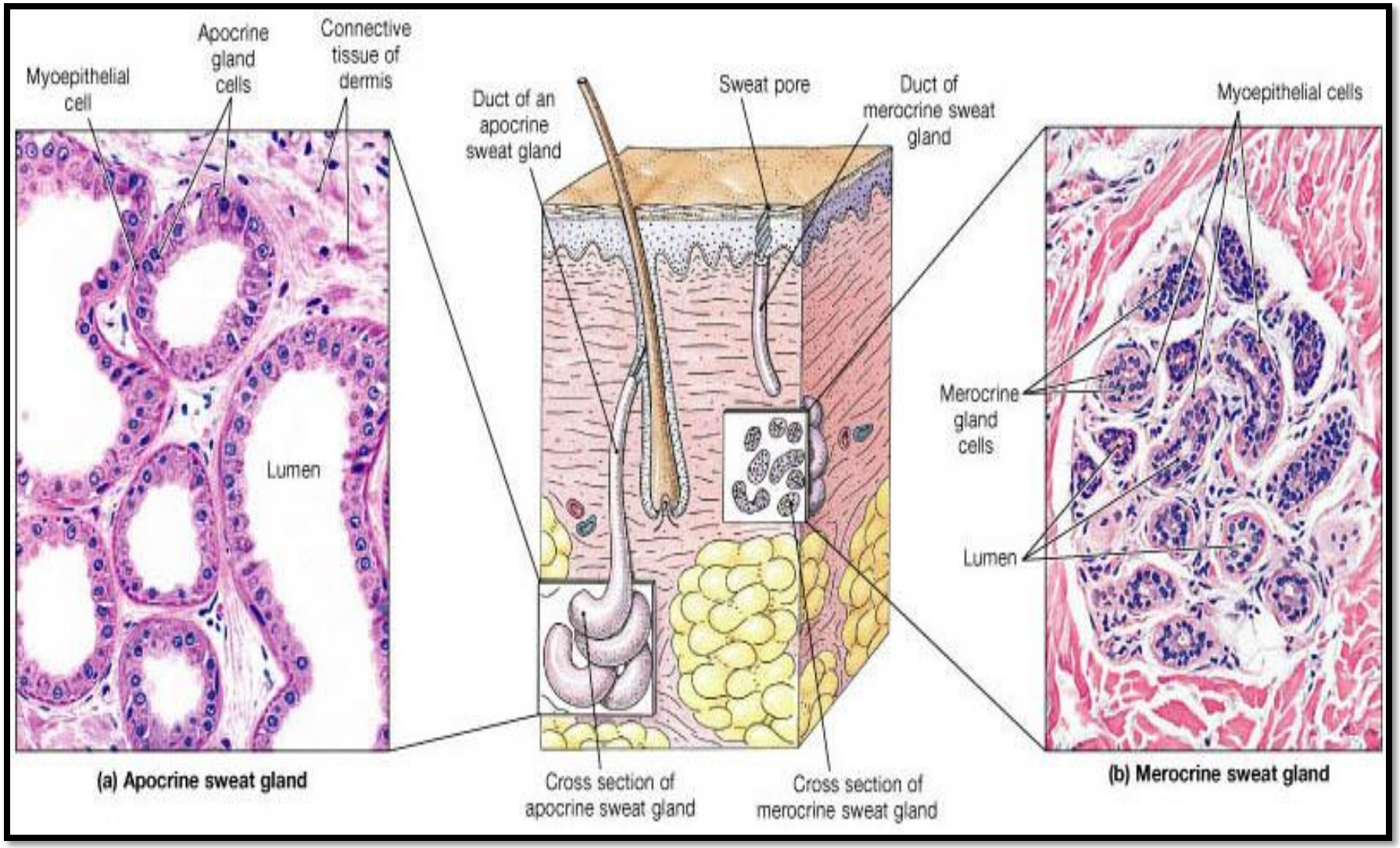


Apocrine sweat gland

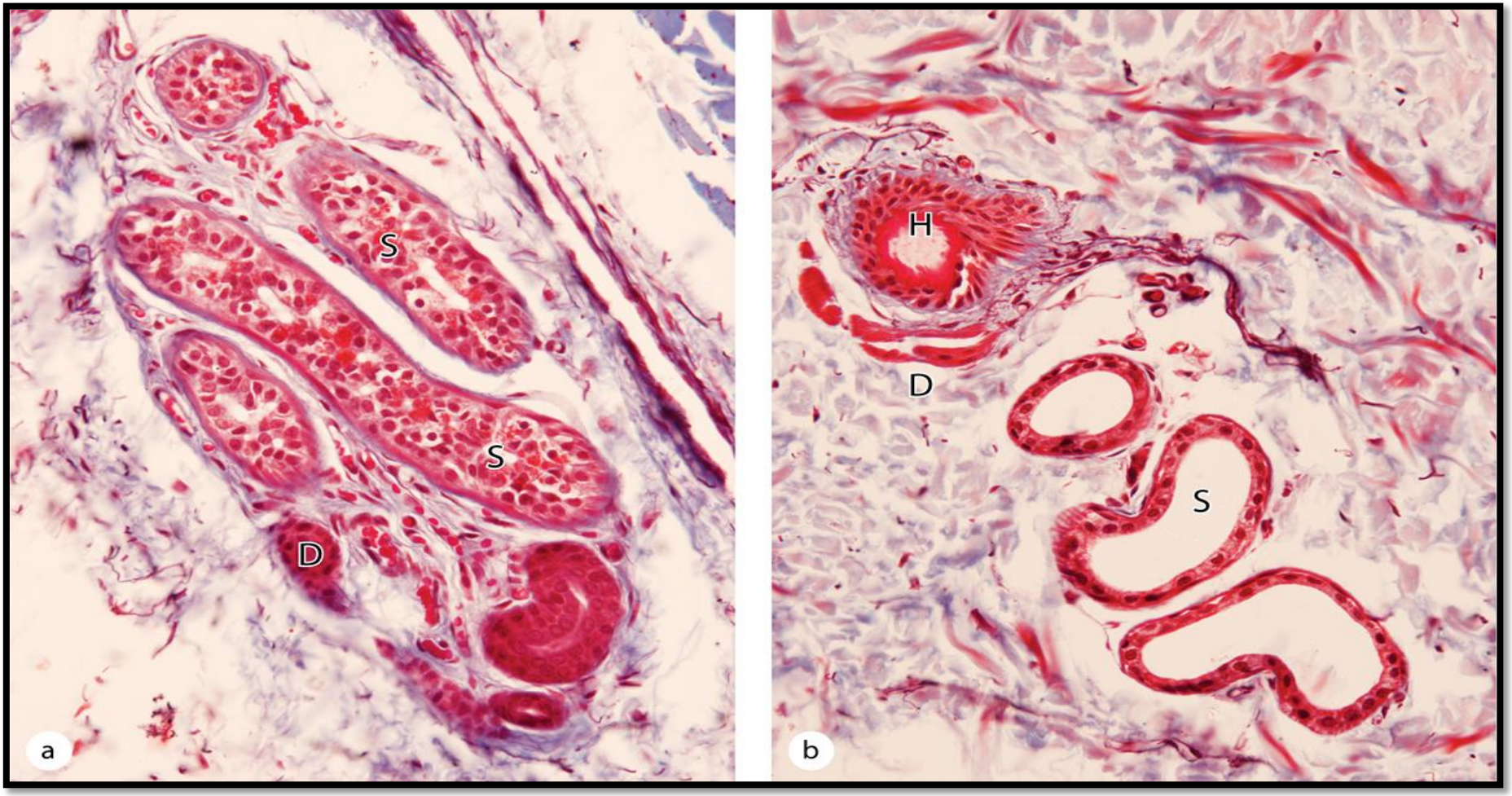
- Empty into hair follicle
- Location: armpits, groin, nipples
- Viscous, cloudy secretion → good nutrient source for bacteria (odor !!)
- Secretion may contain Pheromones
- Secretion begins at puberty and is stimulated during emotional distress



Sweat glands

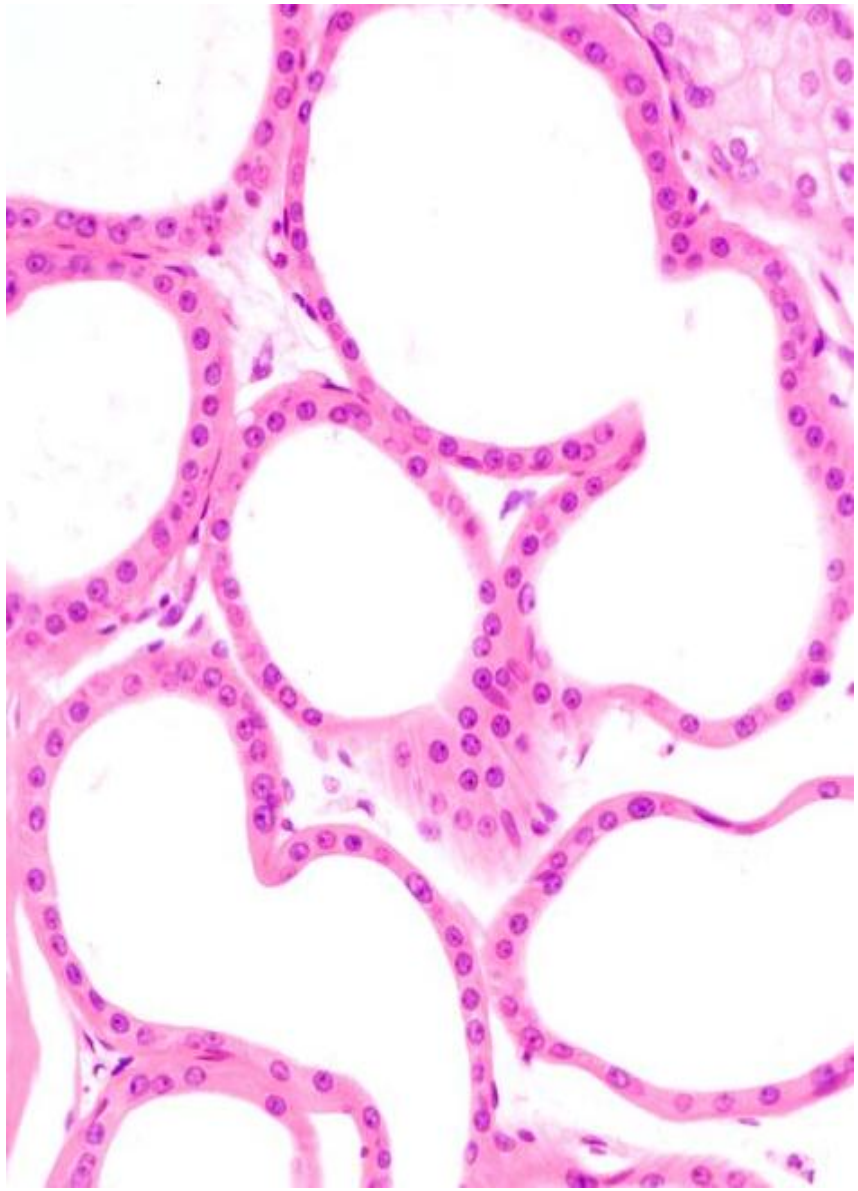


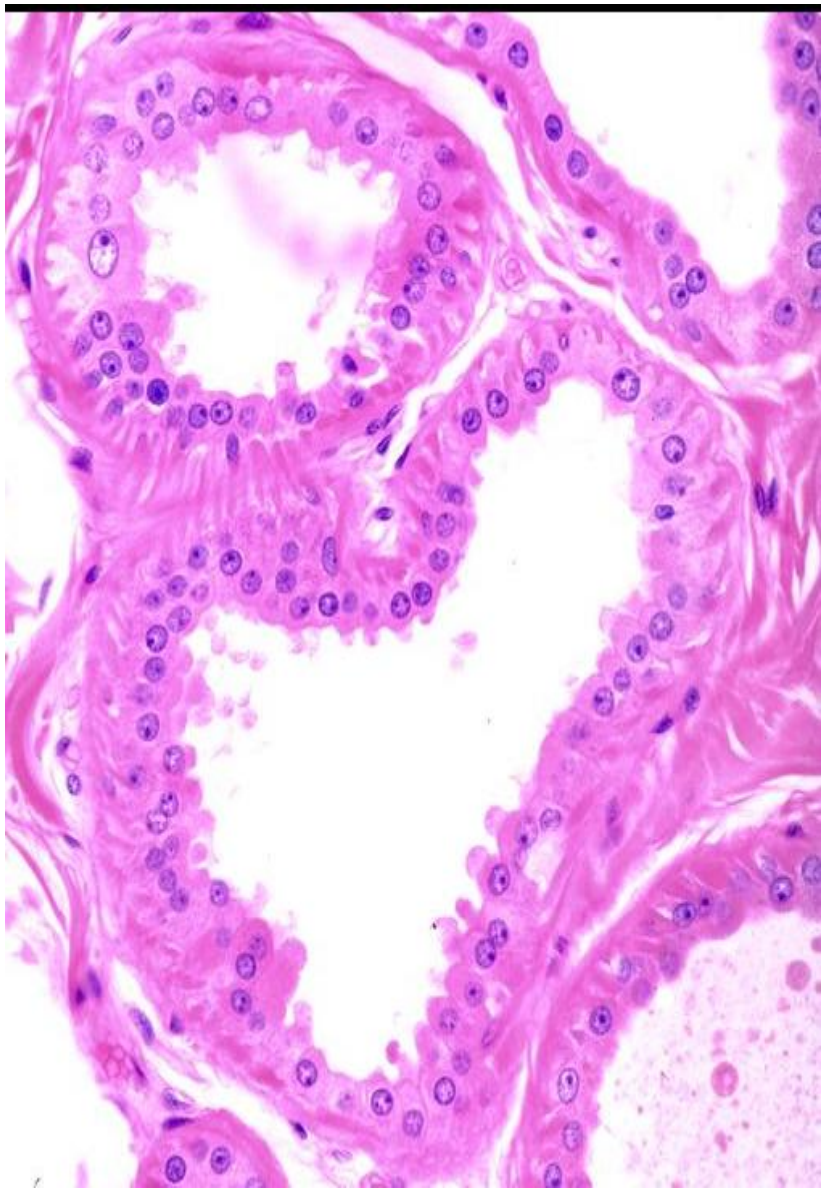
Merocrine and apocrine sweat glands



(a) Merocrine sweat glands

(b) Apocrine sweat glands





Apocrine sweat glands