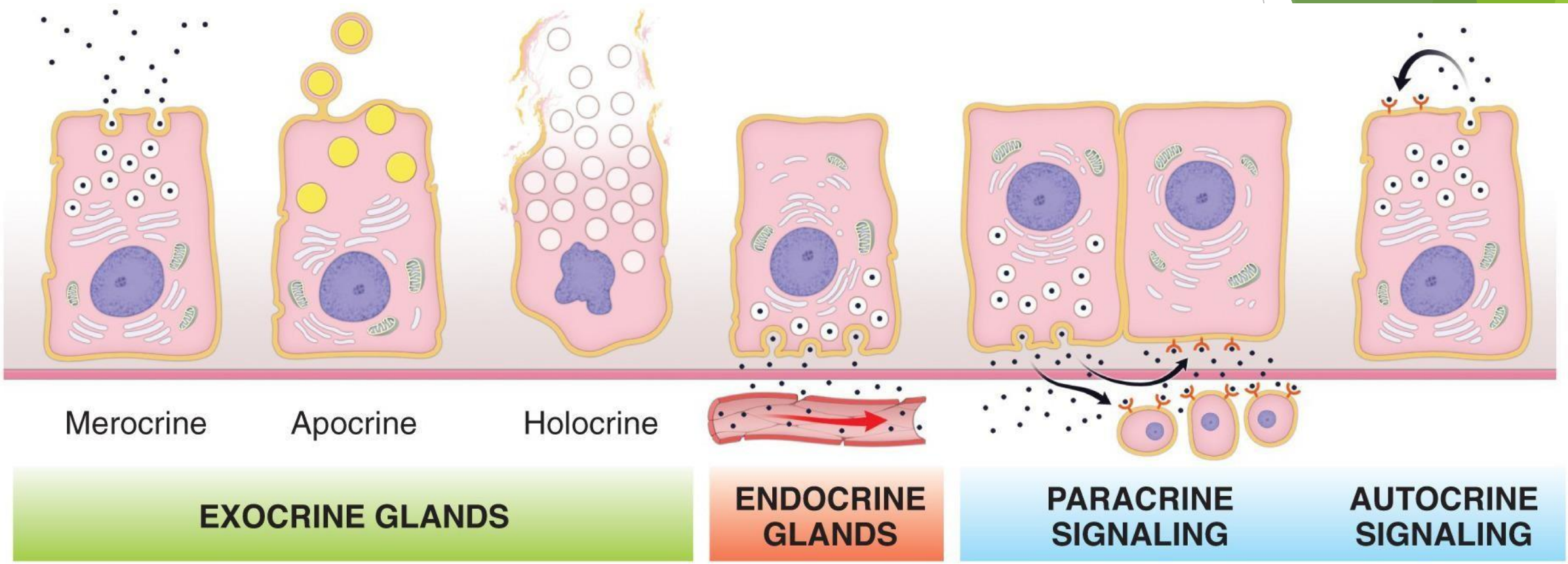
Classification of glands----cont'd

- In some epithelia, individual cells secrete substances that do not reach the bloodstream but rather affect other nearby cells. Such secretory activity is referred to as **paracrine signaling**. (paracrine secretion)
  *para means neighboring, so these cells produce materials that affect neighboring cells.
- In addition, a cell may secrete molecules that bind to receptors that are present on the same cell. This type of messaging is called **autocrine signaling**. In many cases, signaling molecules initiate negative feedback pathways to modulate their own secretion.

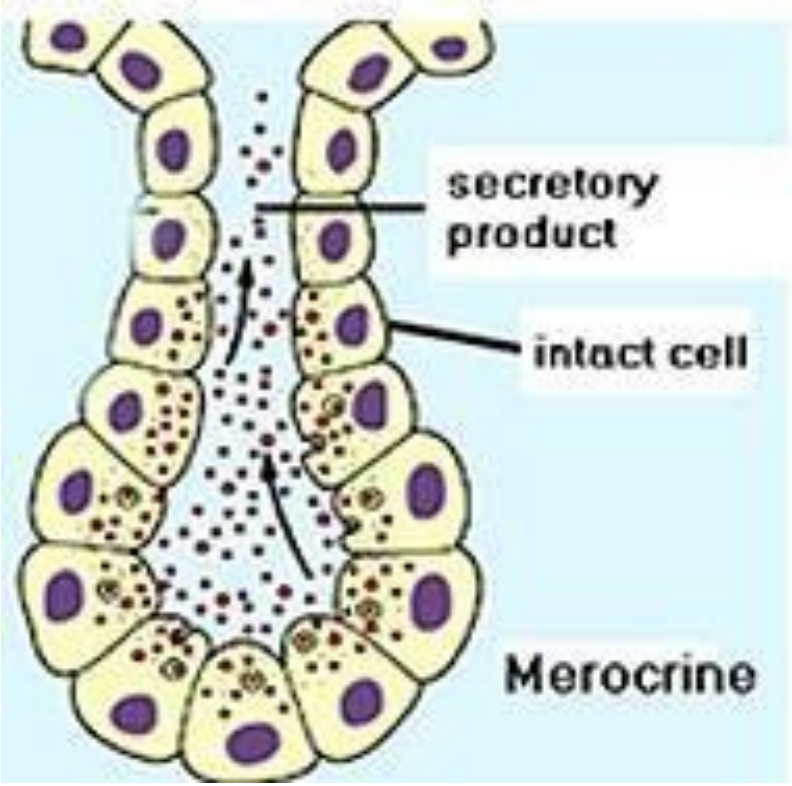
  *(Autocrine secretion), so these cells produce materials that affect the cell itself.

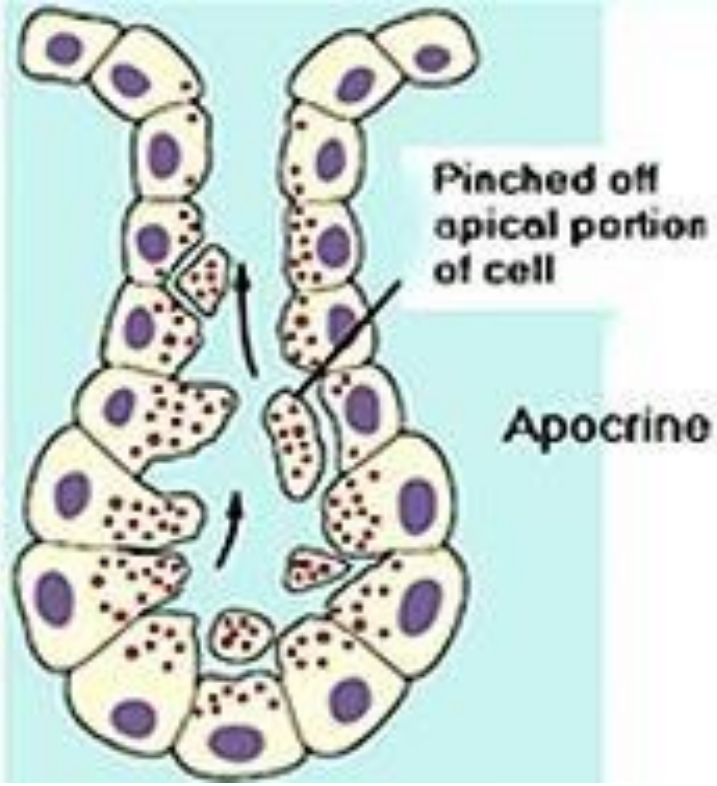


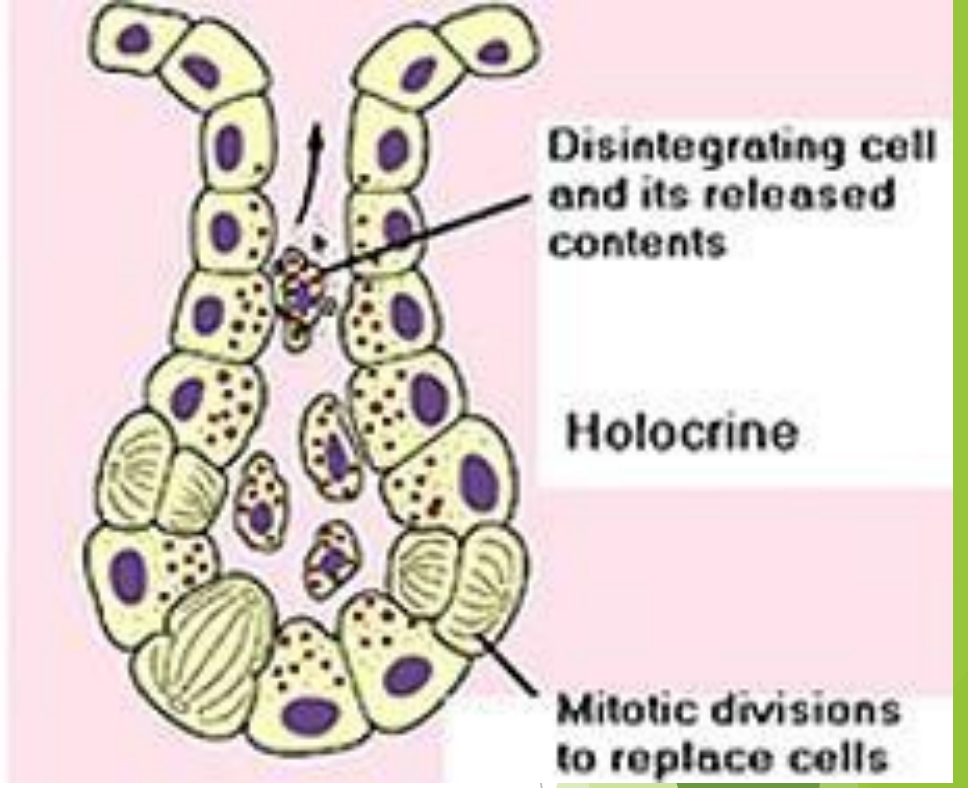
Classification on the basis of the mode of secretion (the way the cell secretes the products)

- 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 varieties:

1. Merocrine glands
2. Apocrine glands
3. Holocrine glands





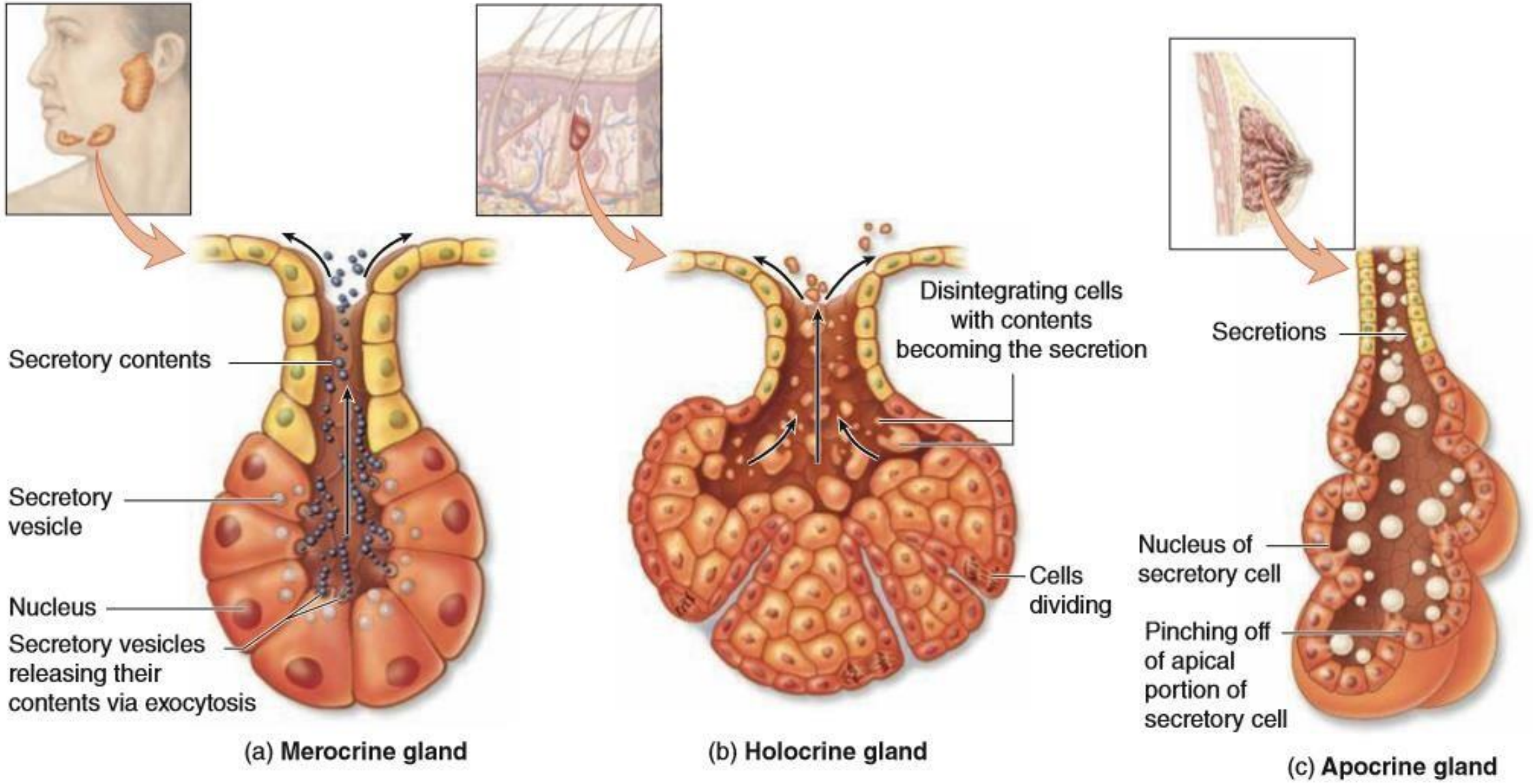


The secretory product is accumulated in vesicles, and then the vesicles fuse with the plasma membrane on the apical region and the products released to the lumen.

Here, the product will be part of the cell and covered by plasma membrane.
The whole apical region is separated from the cell and secreted as a whole.

Within this type, cells are dying off or bursting and this requires a high level of mitotic activity (division to replace lost cells).

The cell itself will disintegrate and the product
Will be within the lumen.



A) Salivary glands secrete by Merocrine mode	B) Sebaceous glands or oil glands (الغدد الدهنية) associated with hair secret by Holocrine mode.	C) Lactating or mammary glands secrete by Apocrine mode.

Merocrine secretion

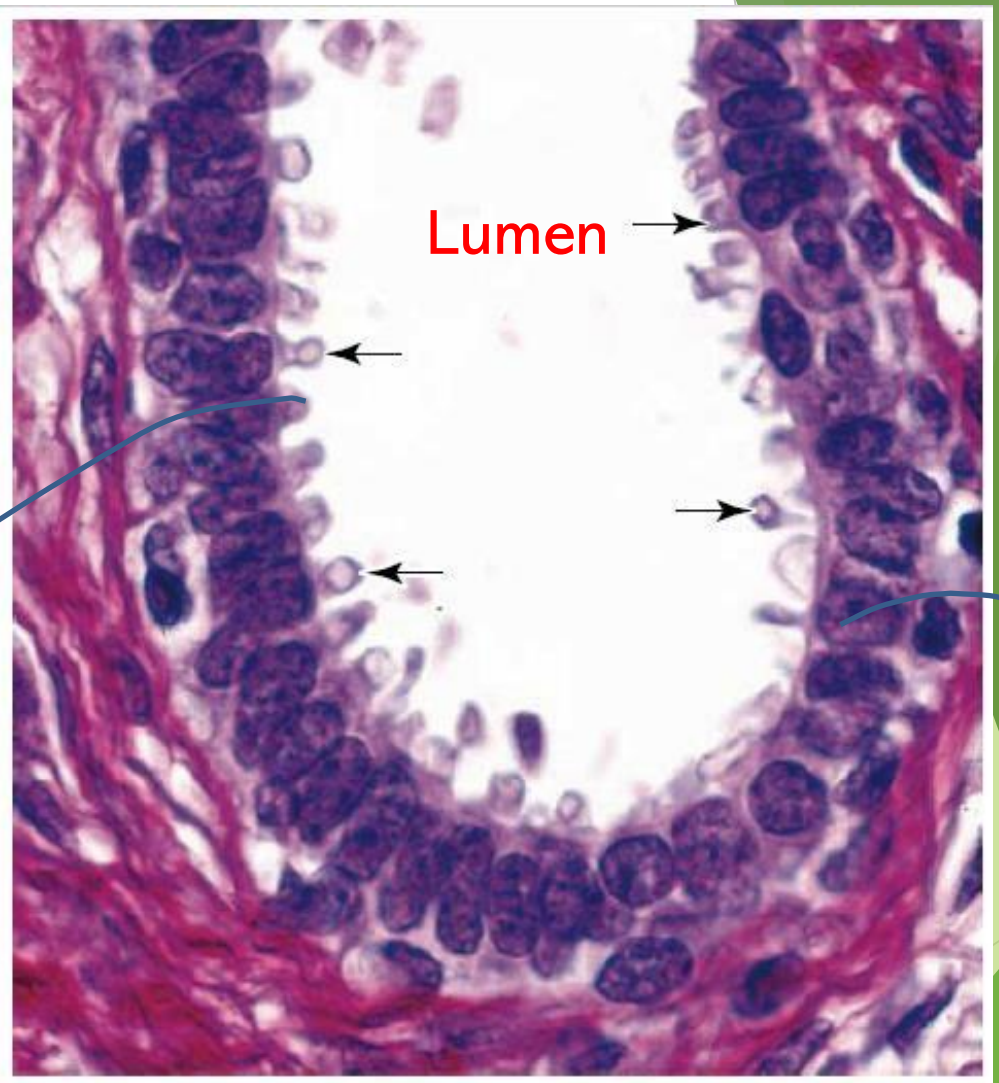
- This secretory product is delivered in **membrane-bounded vesicles** to the apical surface of the cell. Here, vesicles fuse with the plasma membrane and extrude their contents by exocytosis. This is the most common mechanism of secretion and is found, for example, in pancreatic acinar cells.

Apocrine secretion

- The secretory product is released in the apical portion of the cell, surrounded by a thin layer of cytoplasm within an envelope of plasma membrane. This mechanism of secretion is found in the **lactating mammary gland**, where it is responsible for releasing large lipid droplets into the milk.

The main example of apocrine secretion

The secretory portions of a mammary gland demonstrate apocrine secretion, characterized by extrusion of the secretion product along with a bit of apical cytoplasm (**arrows**). The released portion of cell contains lipid droplet(s).



The way they secret that some parts of the apical portion are losing contact with the rest of cells.
The membrane of cells is dislodged as the secretion as the secretion itself. So, the mammary gland has an addition to the secretory products which it produces within the apical region, it's a lipid droplet which is the membrane itself.

Holocrine secretion

Here, the whole cells bursts off in a process of programmed cell death.

- The secretory product accumulates within the maturing cell, which simultaneously undergoes destruction orchestrated by **programmed cell death** pathways. Both secretory products and cell debris are discharged into the lumen of the gland. This mechanism is found in **sebaceous glands of skin**.

Sebaceous glands

In holocrine secretion, best seen in the sebaceous gland adjacent to hair follicles, entire cells fill with a lipid-rich product as they differentiate. Mature (terminally differentiated) cells separate and completely disintegrate, releasing the lipid that serves to protect and lubricate adjacent skin and hair. Sebaceous glands lack myoepithelial cells; cell proliferation inside a dense, inelastic connective tissue capsule continuously forces product into the duct.

Simple cuboidal on basal area

وظيفتهم انهم يعملوا تجديد للخلايا و يستبدلوا الخلايا الميتة

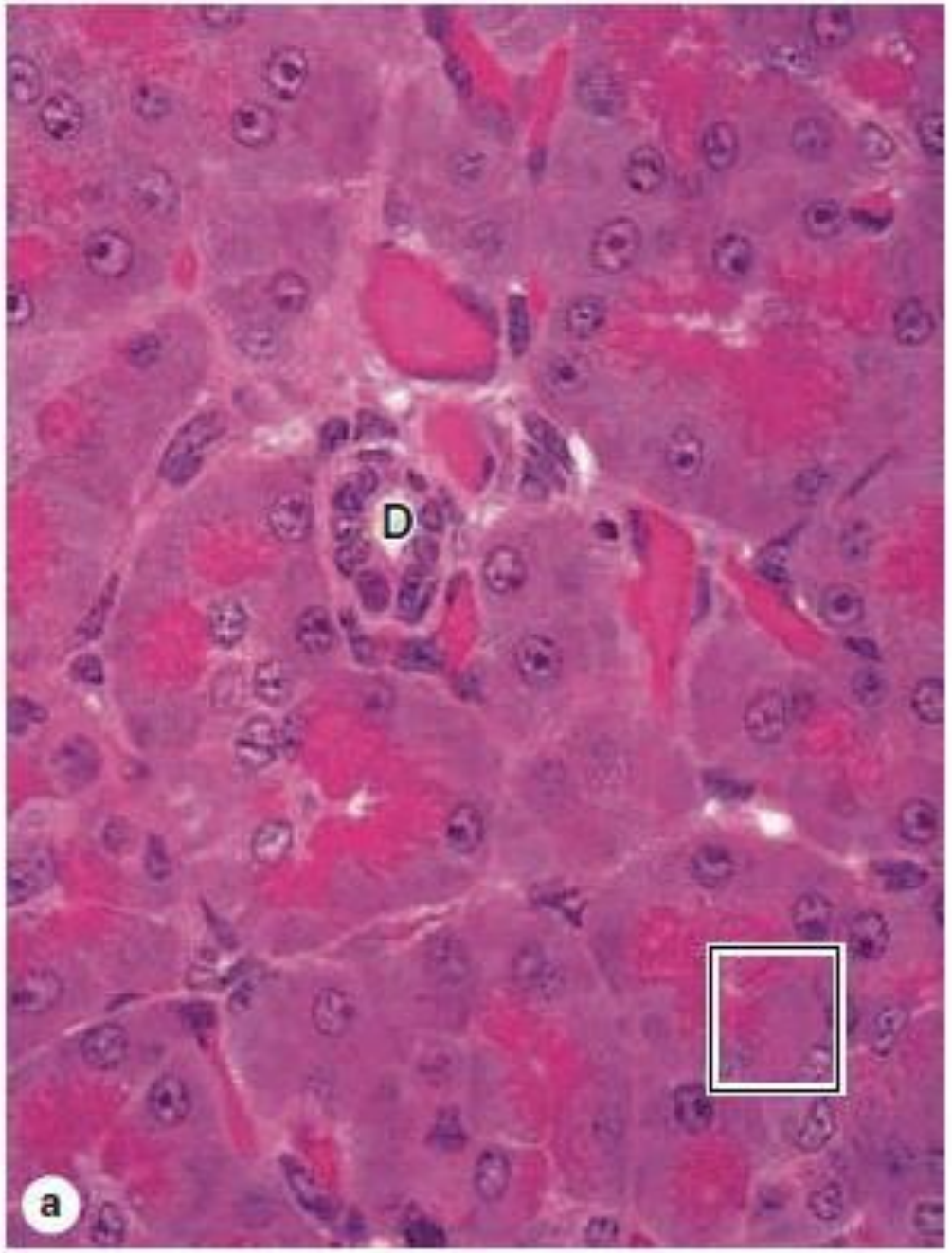
Classification according to secretions

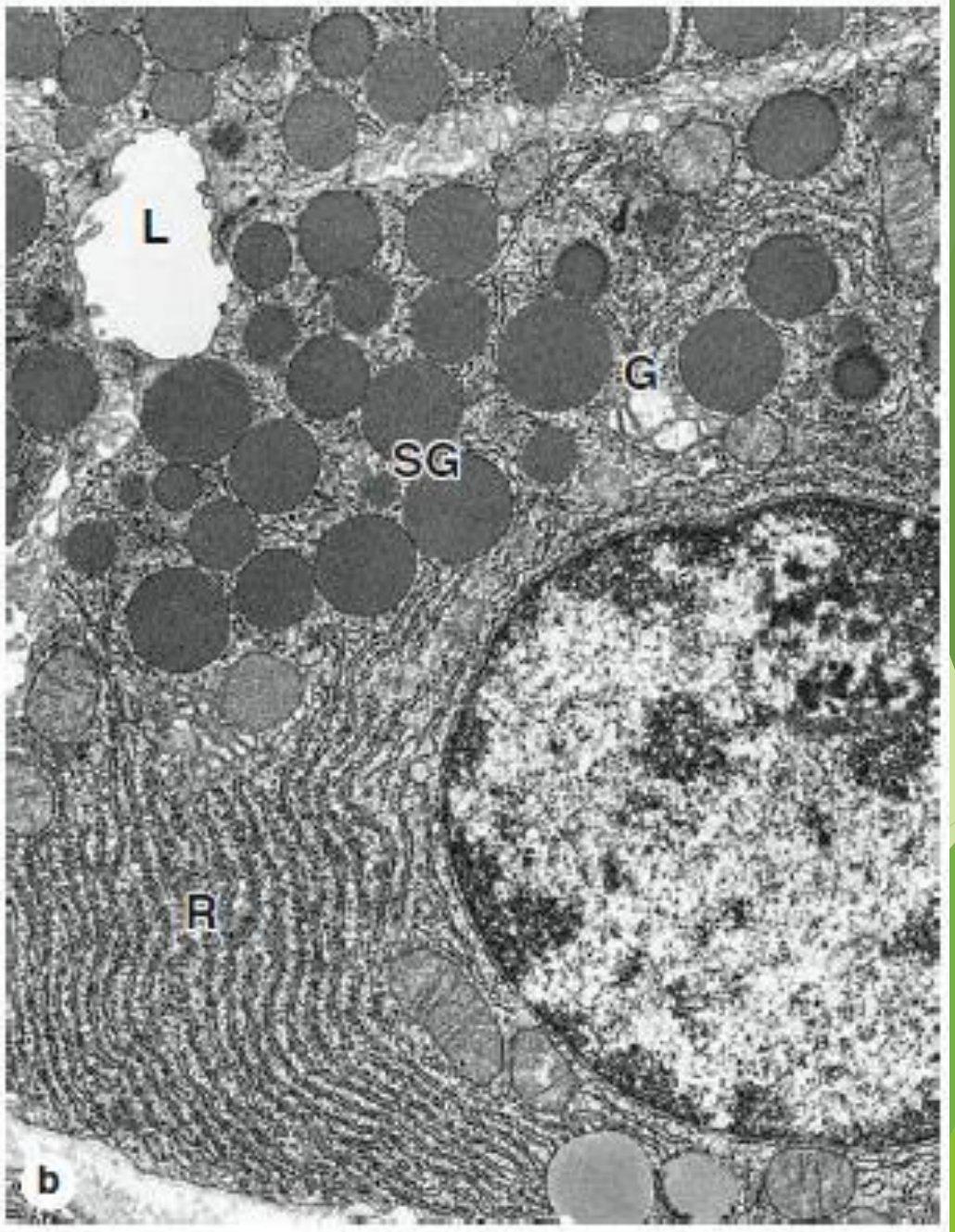
- Exocrine glands with merocrine secretion can be further categorized according to the nature of their secretory products, which give distinct staining properties to the cells
  - Serous-secreting: synthesize **proteins** that are mostly not glycosylated
  - Mucous-secreting: heavily glycosylated proteins called **mucins** **(like goblet cells)**
- Some salivary glands are mixed seromucous glands, having both serous acini and mucous tubules with clustered serous cells

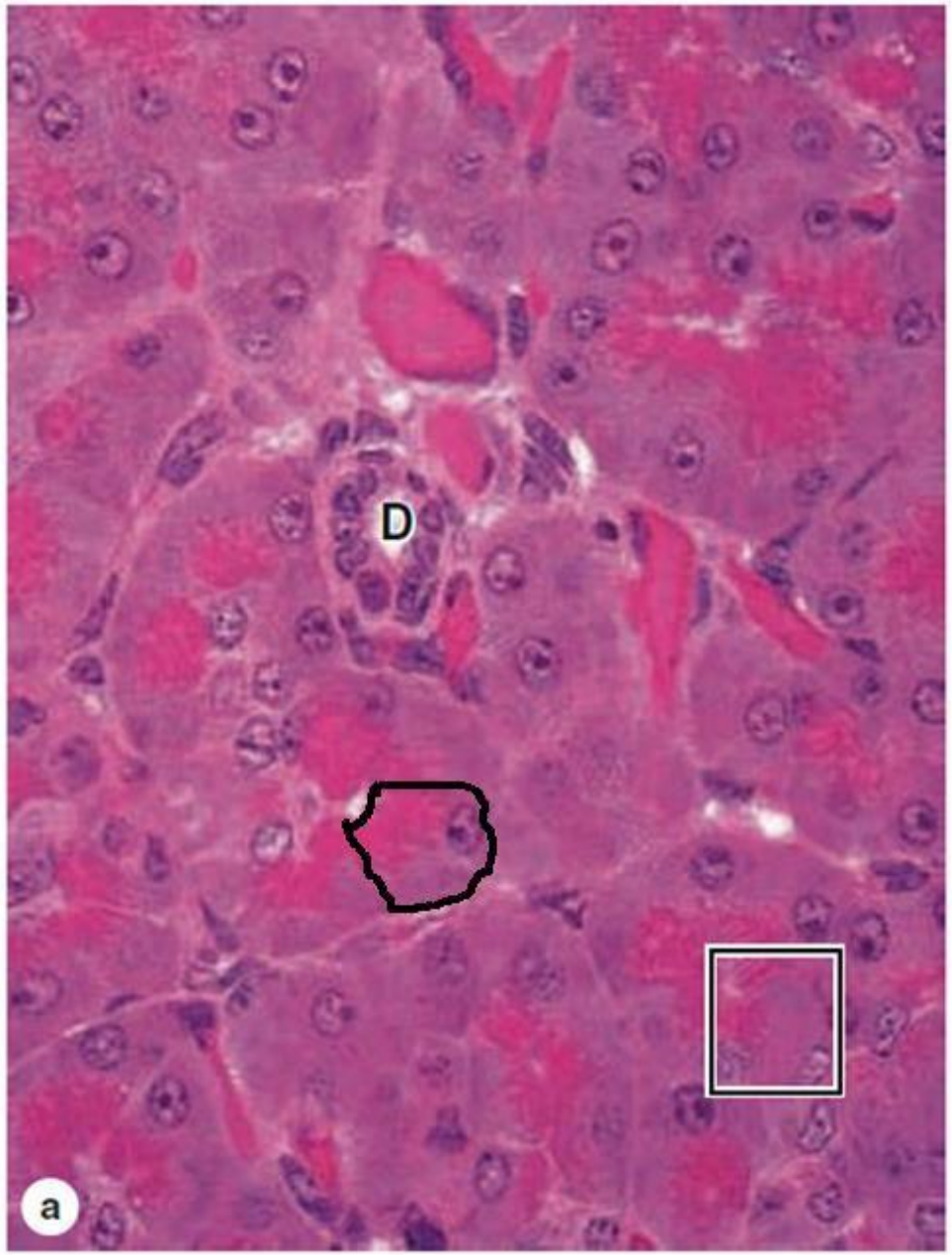
Serous-secreting glands (protein secreting glands)

Here, cells will have same characteristics of protein secreting glands such as RER and apically secretory granules that contains protein to be secreted.

- Serous cells synthesize **proteins** that are mostly not glycosylated, such as digestive enzymes.
- The cells have well-developed RER and Golgi complexes
- They are filled apically with secretory granules in different stages of maturation.
- Serous cells therefore stain intensely with basophilic or acidophilic stains. (In light microscope, RER in basal area will be stained with basophilic satin, and protein secretory granules in apical area will be stained by acidophilic satin)
- Acini of the pancreas and parotid salivary glands are composed of serous cells.


D
a


L
G
SG
R
b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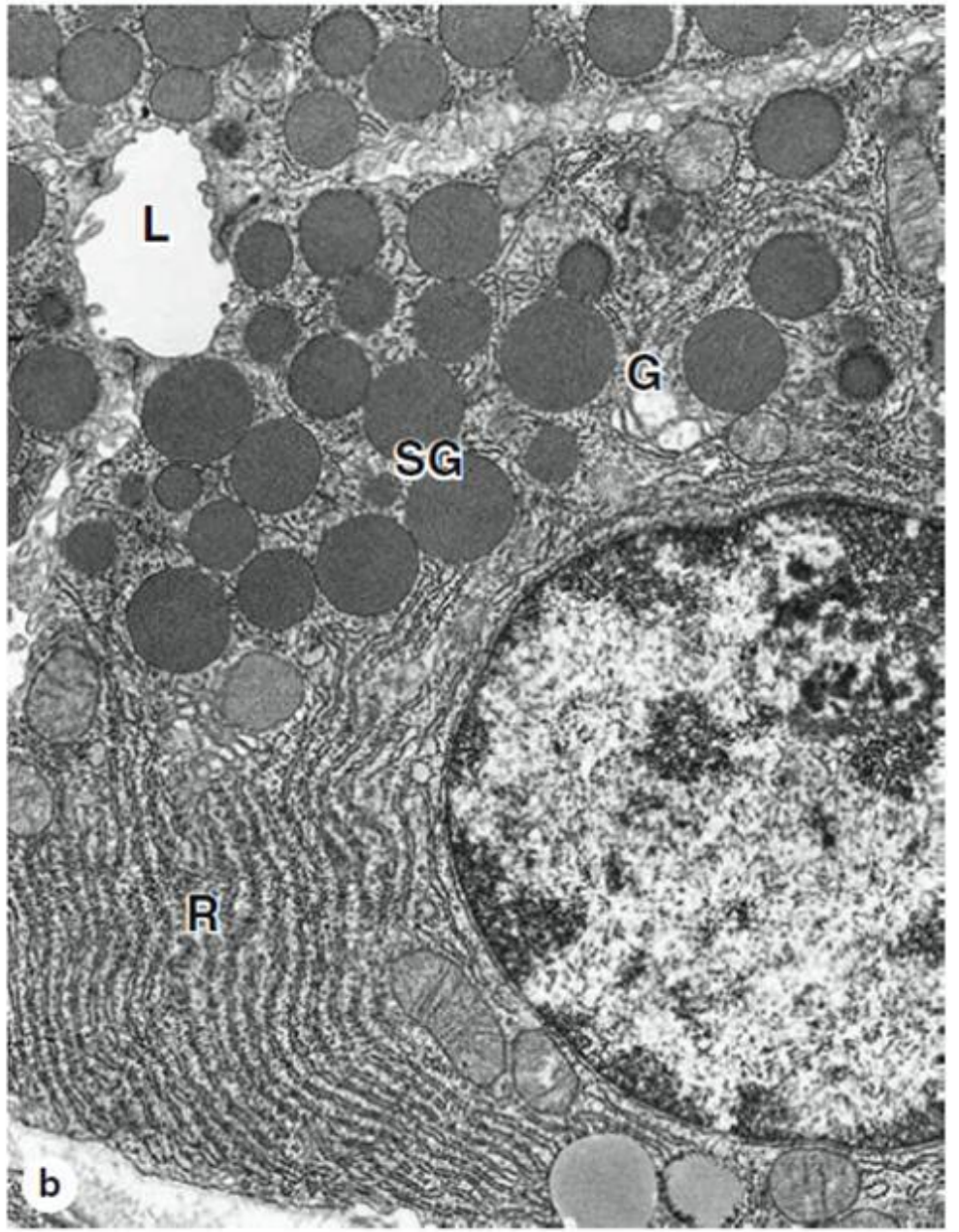
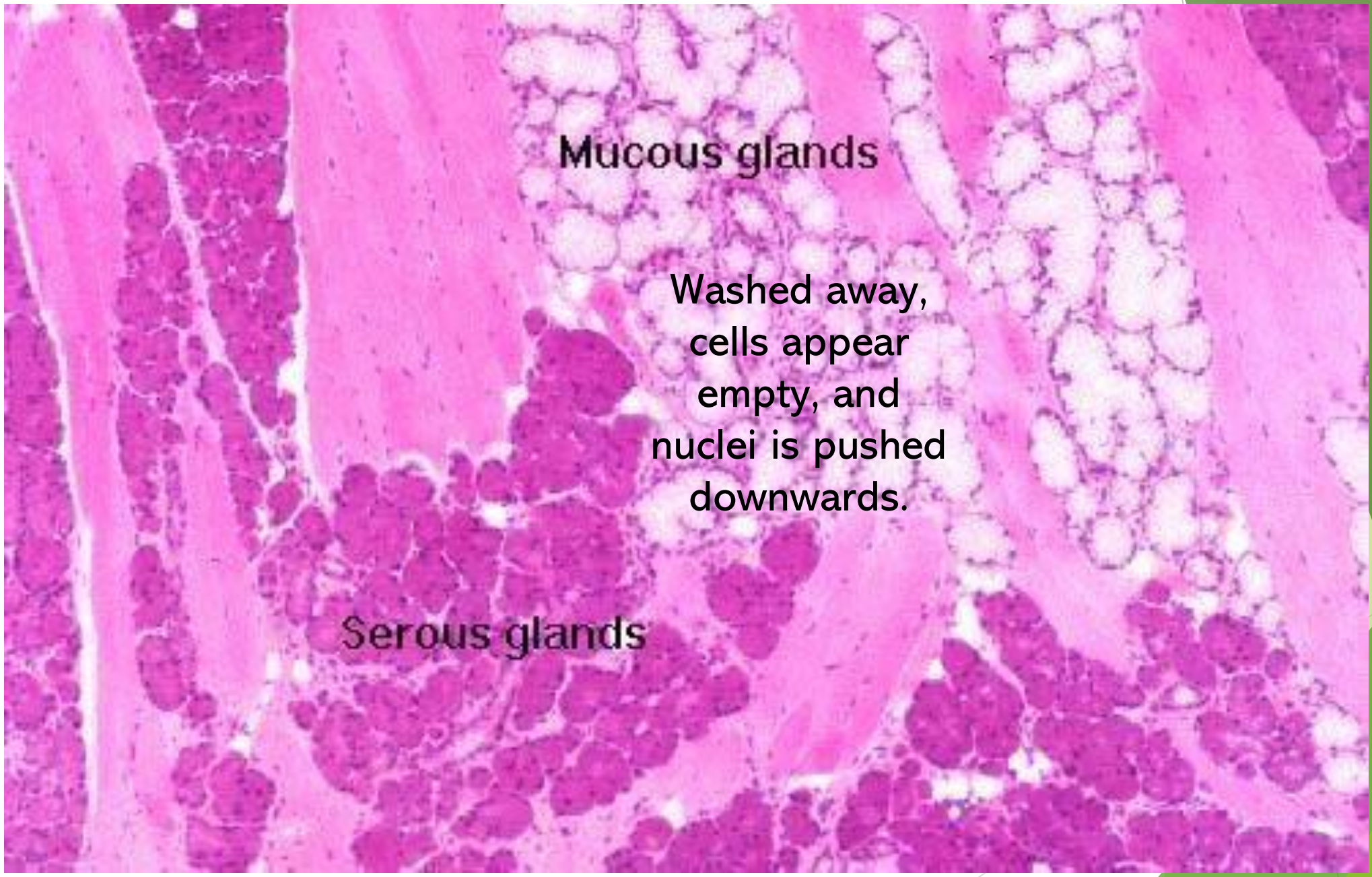

L
G
SG
R
b

Mucous-secreting glands

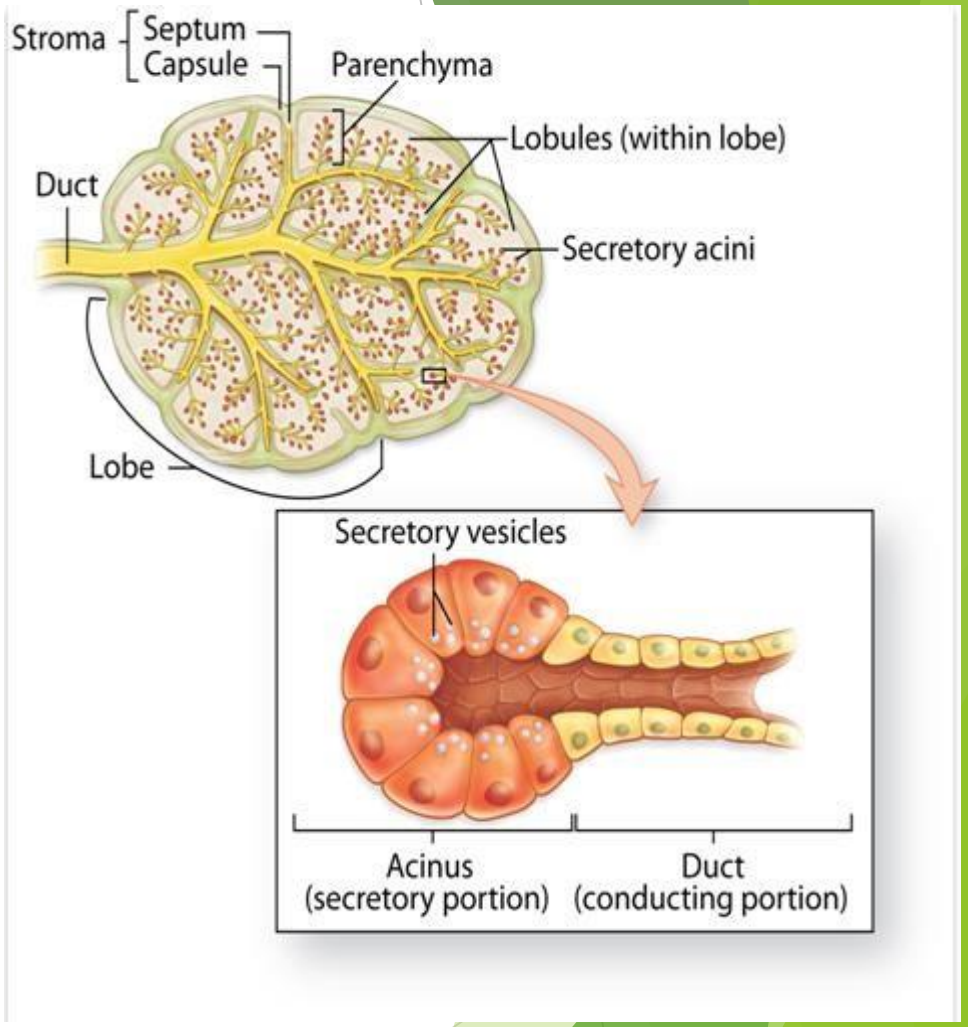
- Mucous cells, such as goblet cells, have RER and Golgi complexes.
- They are filled apically with secretory granules, that contain heavily glycosylated proteins called **mucins**.
- When mucins are released from the cell, they become hydrated (bound to water) and form a layer of **mucus**.
- The hydrophilic mucins are usually washed from cells during routine histological preparations, causing the secretory granules to stain poorly with eosin. (we can't see it by light microscope because mucin will be washed away during preparation, so instead we have to use a special stain. This stain is PAS method or any other stain that is specific to carbohydrates)
- Mucous cells can be stained by the PAS method.


Mucous glands
Washed away, cells appear empty, and nuclei is pushed downwards.
Serous glands

Multicellular Glands

They are organs, they have multiple tissues making up these glands.

- Generally the larger glands have the same structural pattern.
- Epithelia of exocrine glands are organized as a continuous system of many small **secretory portions** and **ducts** that transport the secretion out of the gland. This is called the paranchyma. (Tissues doing the function of the organ)
- The secretory units are supported by a stroma of connective tissue. (Stroma is a connective tissue supporting the organ, and it's arranged in a form of capsule surrounding the whole organ)
- 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**. (The whole organ is divided into separated compartments called lobules)



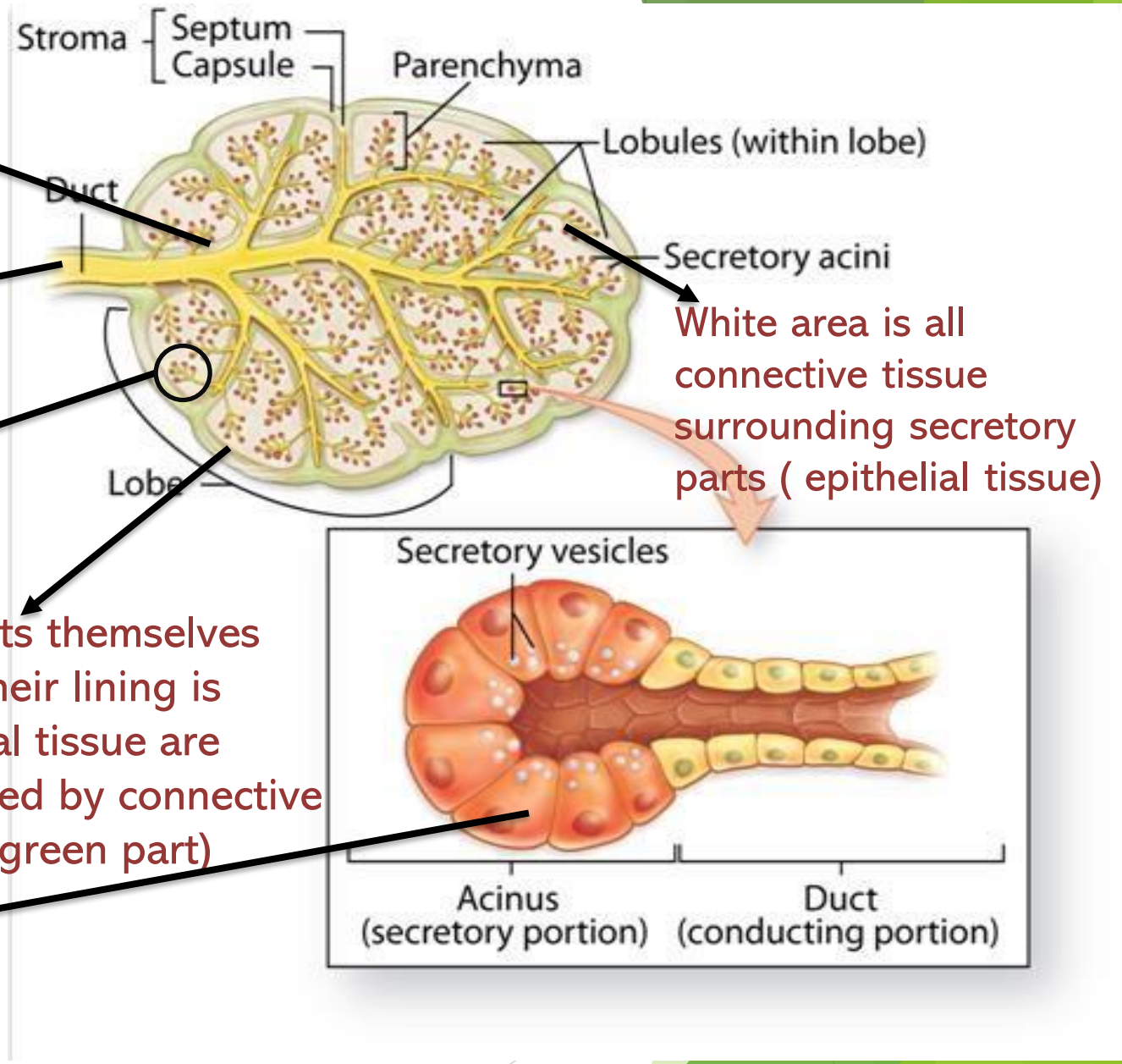
It's an organ, it has multiple tissues. Ducts are lined by epithelial tissue, and the whole organ is surrounded by connective tissue.

Main duct

Theses small red dots are the secretory parts

The ducts themselves which their lining is epithelial tissue are supported by connective tissue (green part)

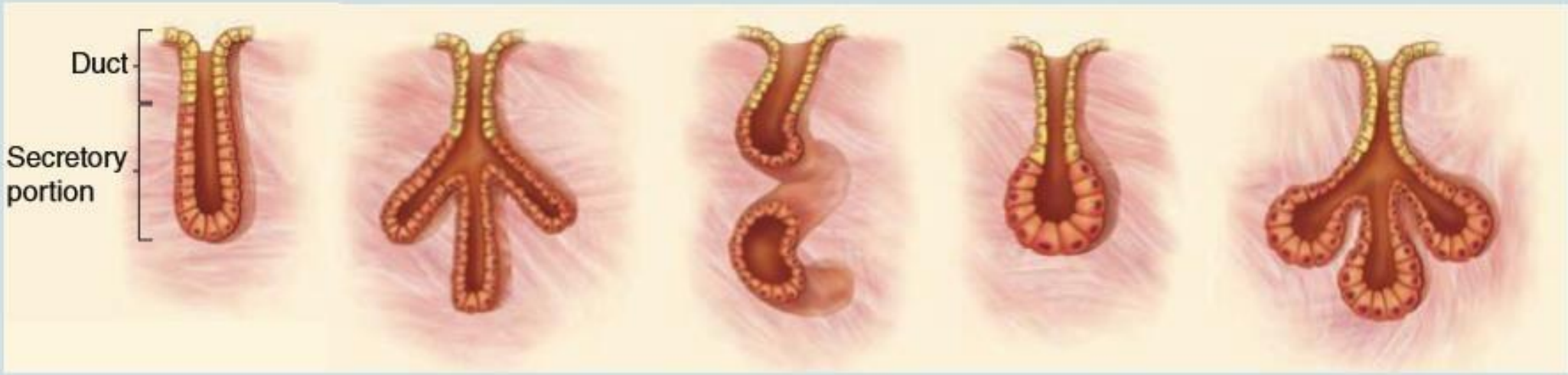
Epithelial cells capable of producing secretions, these secretions will go into the lumen of secretory part. Then the secretory product will be transported by a duct system, smaller ducts will open into larger and then larger ducts until it reaches the main duct.



Multicellular Exocrine Glands

- Have two basic parts
  - Secretory unit (Making secretion)
  - Epithelium-walled duct (ducts that transport these secretions)
- Classified according to structure of duct
  - Simple (one duct) called simple gland
  - Compound (multiple ducts like a tree called compound glands)
- Categorized according to secretory unit
  - Tubular (secretory portions look like tubes)
  - Acinar (Alveolar) (it has rounded structure)
  - Tubuloacinar (has both; tubules as well as acinar)

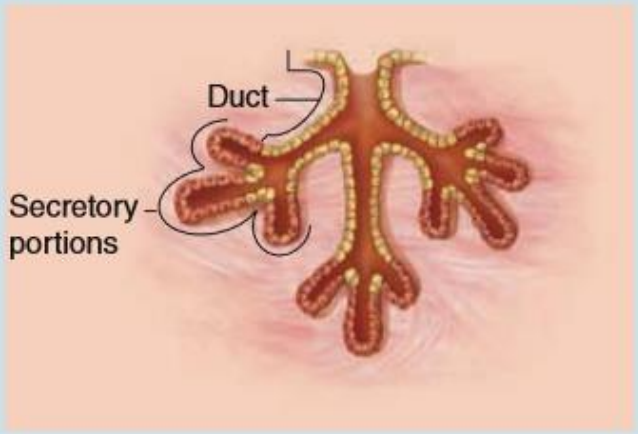
SIMPLE Glands (Ducts Do Not Branch)

Class	Simple Tubular	Branched Tubular	Coiled Tubular	Acinar (or Alveolar)	Branched Acinar
					
Features	Elongated secretory portion; duct usually short or absent	Several long secretory parts joining to drain into 1 duct	Secretory portion is very long and coiled	Rounded, saclike secretory portion	Multiple saclike secretory parts entering the same duct
Examples	Mucous glands of colon; intestinal glands or crypts (of Lieberkühn)	Glands in the uterus and stomach	Sweat glands	Small mucous glands along the urethra	Sebaceous glands of the skin

*Simple = has one duct (so when we say simple we look only at the ducts)

Tubular: it has tubule(s)

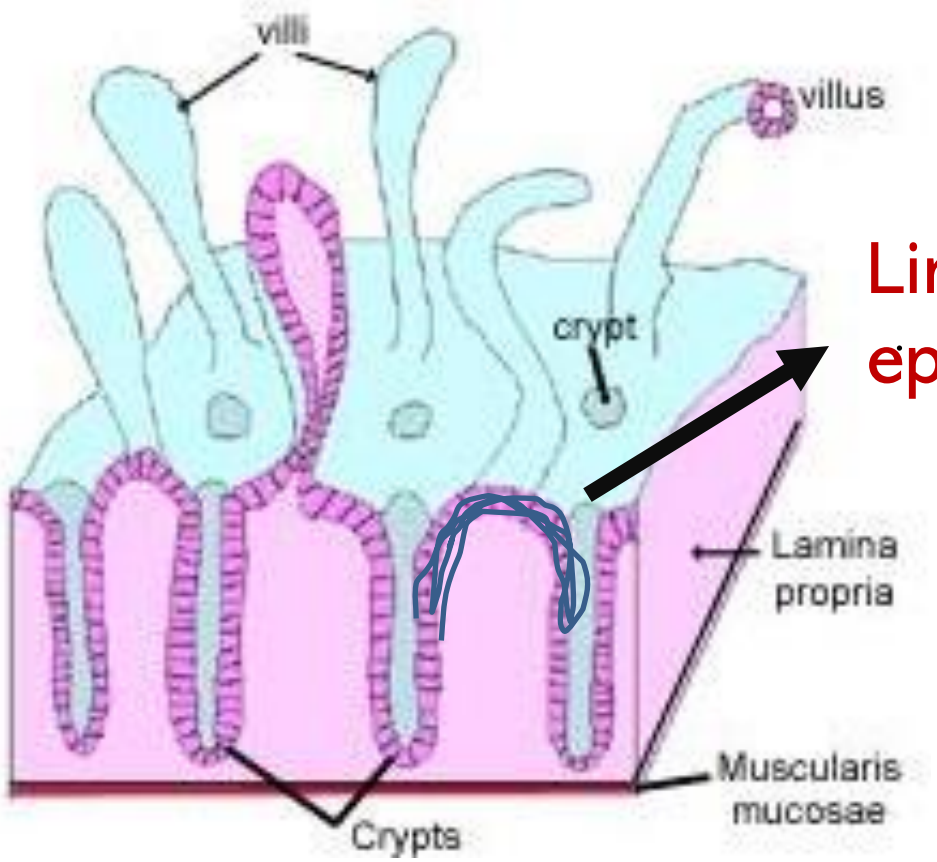
COMPOUND Glands (Ducts from Several Secretory Units Converge into Larger Ducts)

Class	Tubular	Acinar (Alveolar)	Tubuloacinar
			
Features	Several *elongated* coiled secretory units and their ducts converge to form larger ducts	Several *saclike* secretory units with small ducts converge at a larger duct	Ducts of both tubular and acinar secretory units converge at larger ducts
Examples	Submucosal mucous glands (of Brunner) in the duodenum	Exocrine pancreas	Salivary glands

*compound = the ductal system is branched (more than one duct)

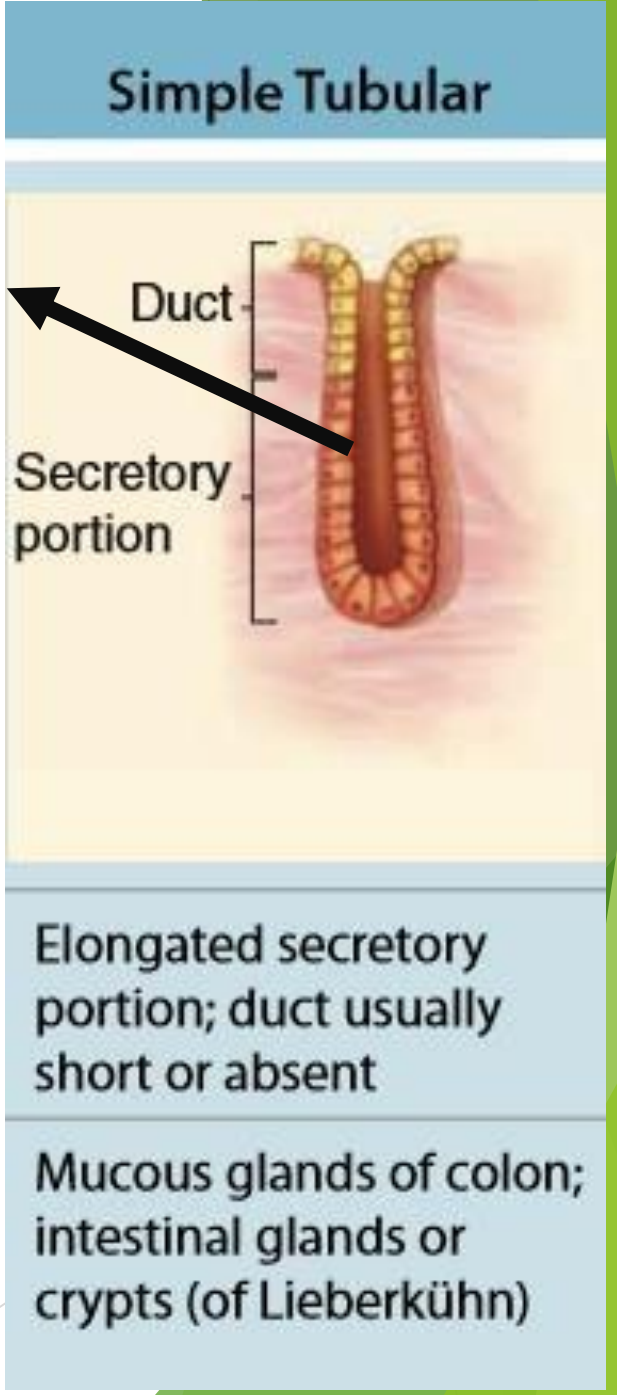
Simple tubular

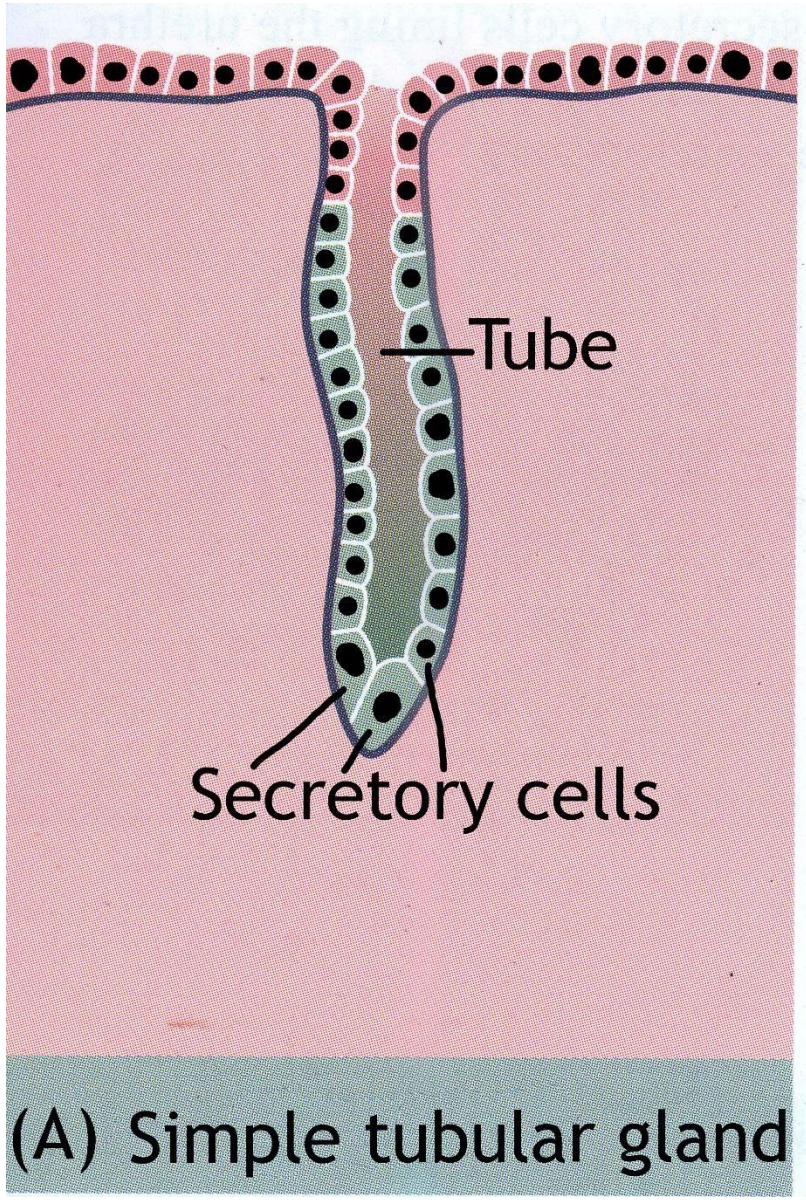
Notice that the duct and the secretory portion are continuous, Only that the duct cannot produce, just transport, while the lower part produces mucous.

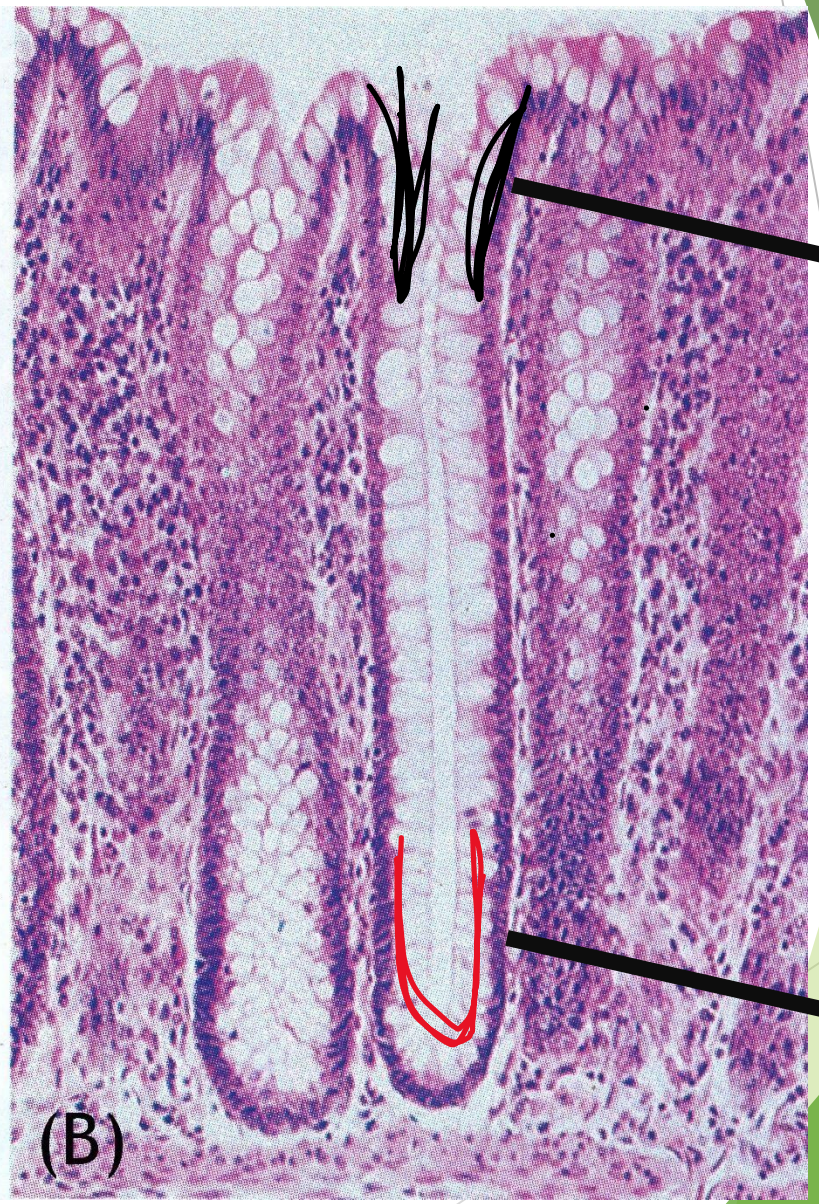


Lining epithelium

Example :

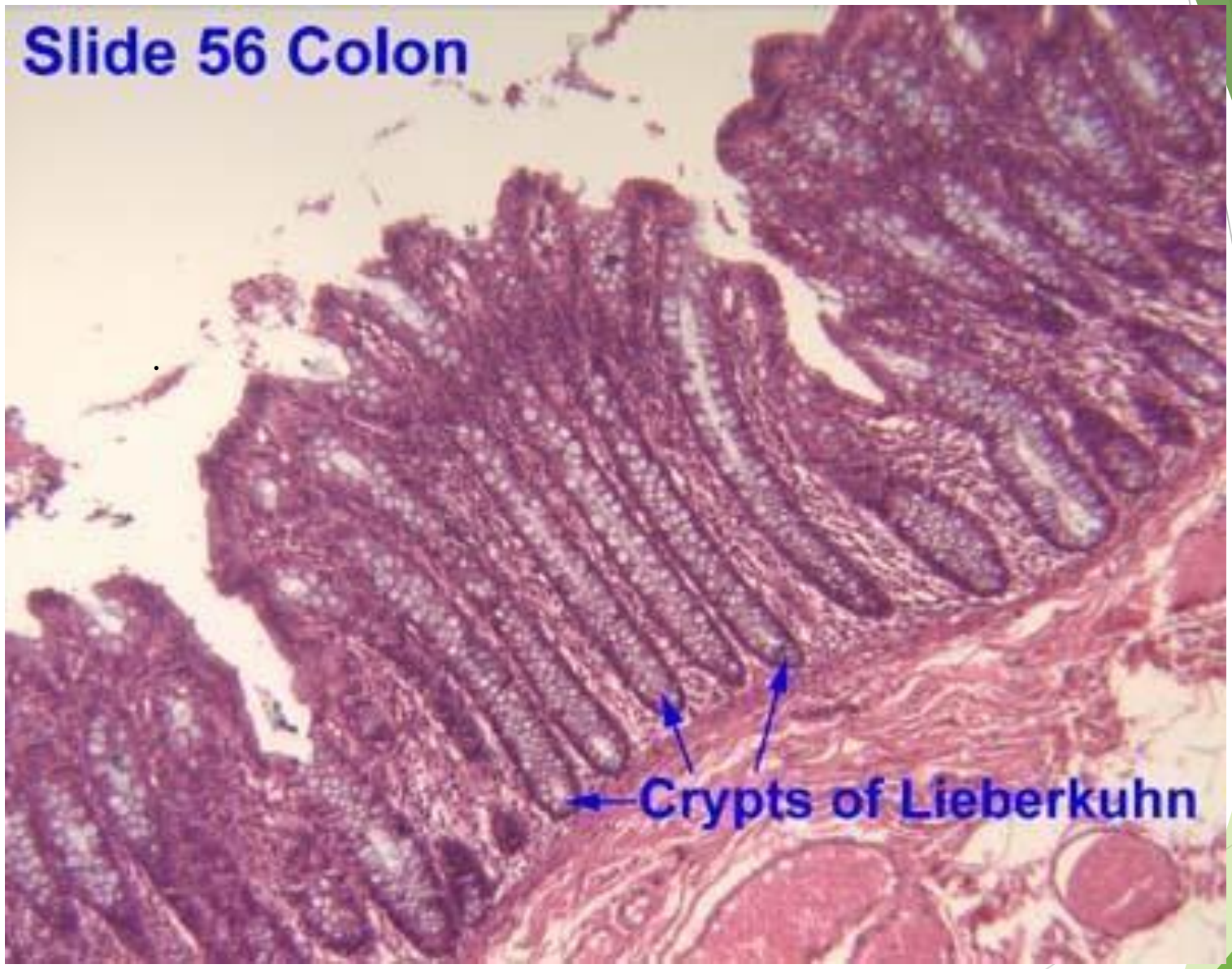


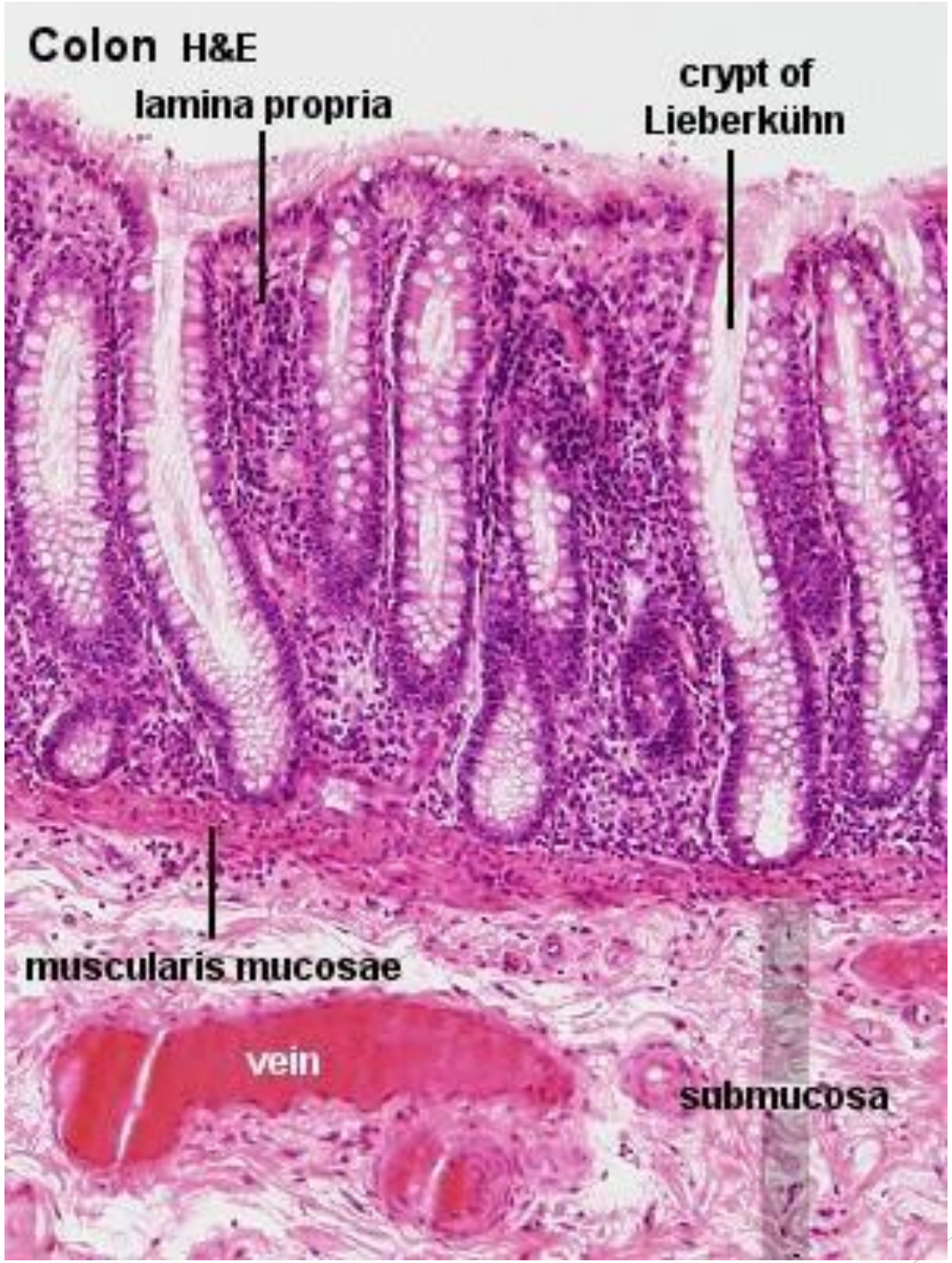




Ductal portion

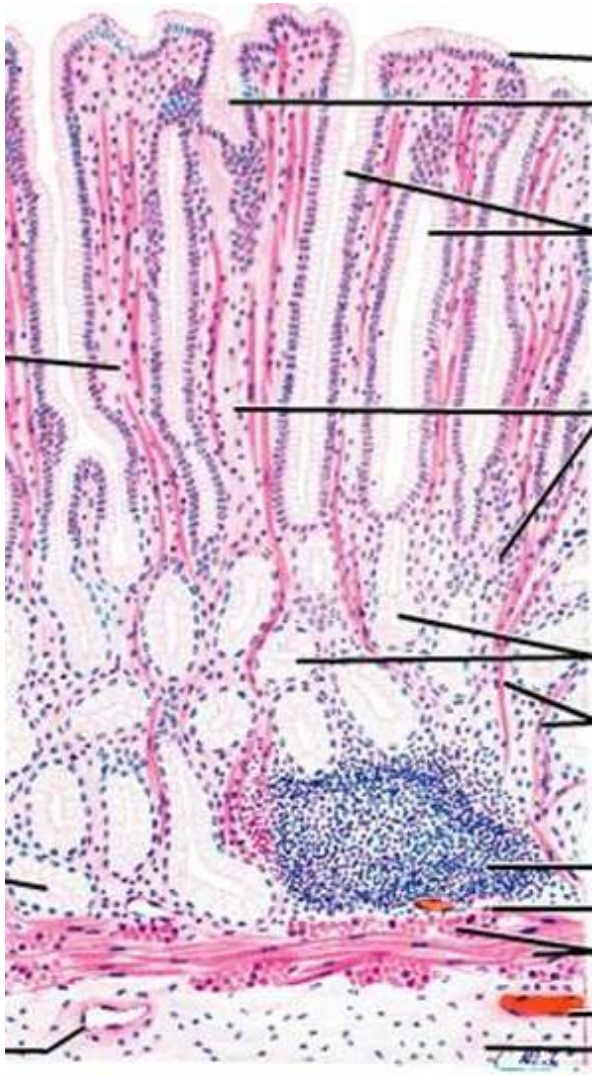
Mucous secreting cells

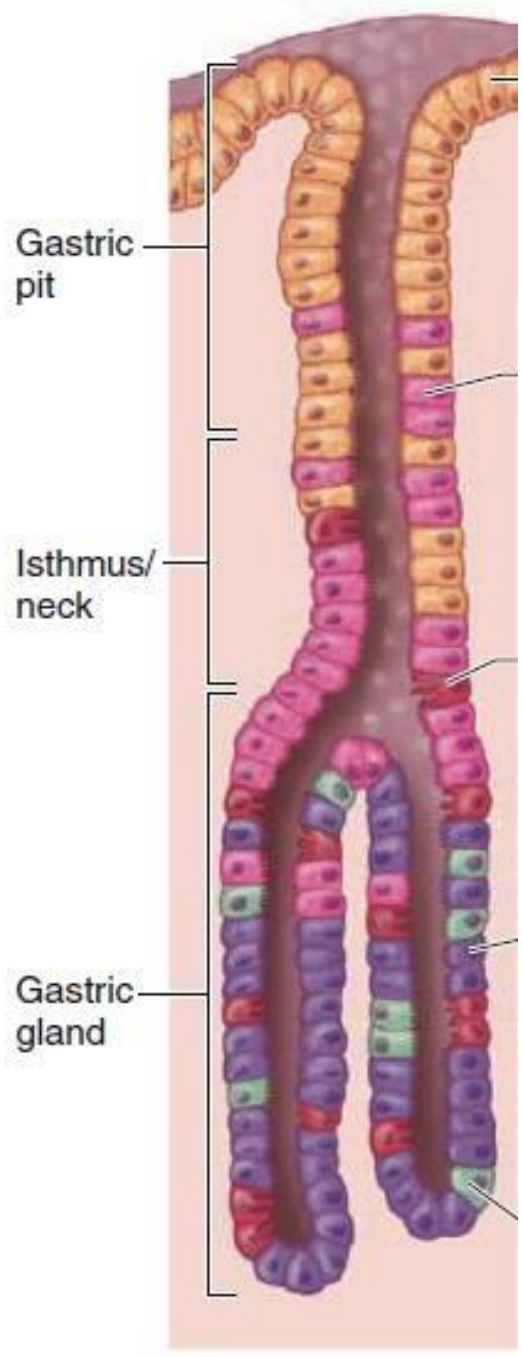

Slide 56 Colon
Crypts of Lieberkuhn



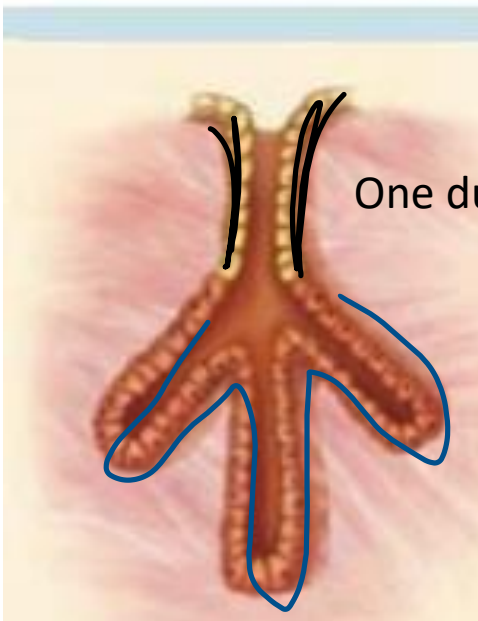
Most commonly found in colon and intestine and we call them crypt of Lieberkuhn

Branched tubular



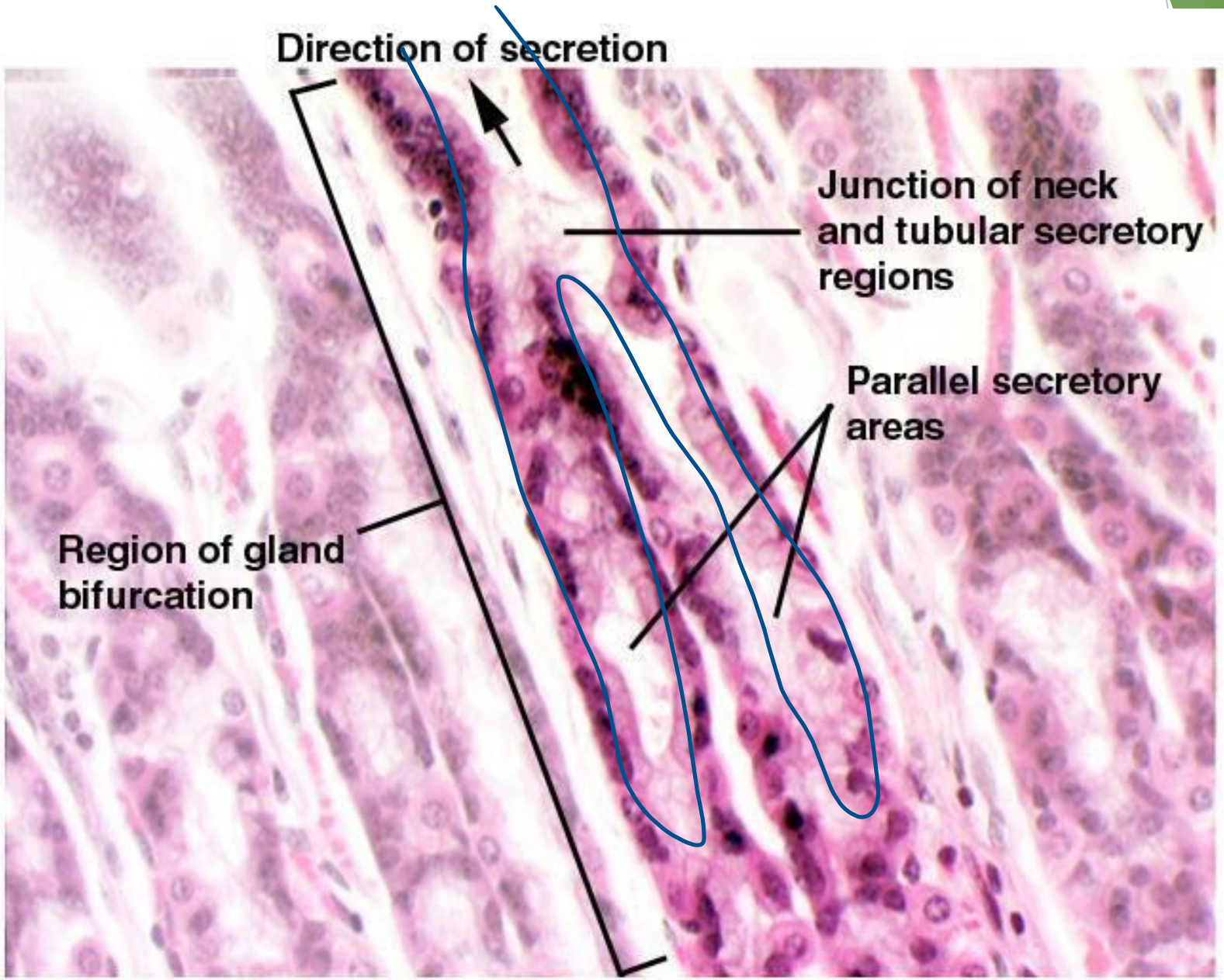


Branched Tubular

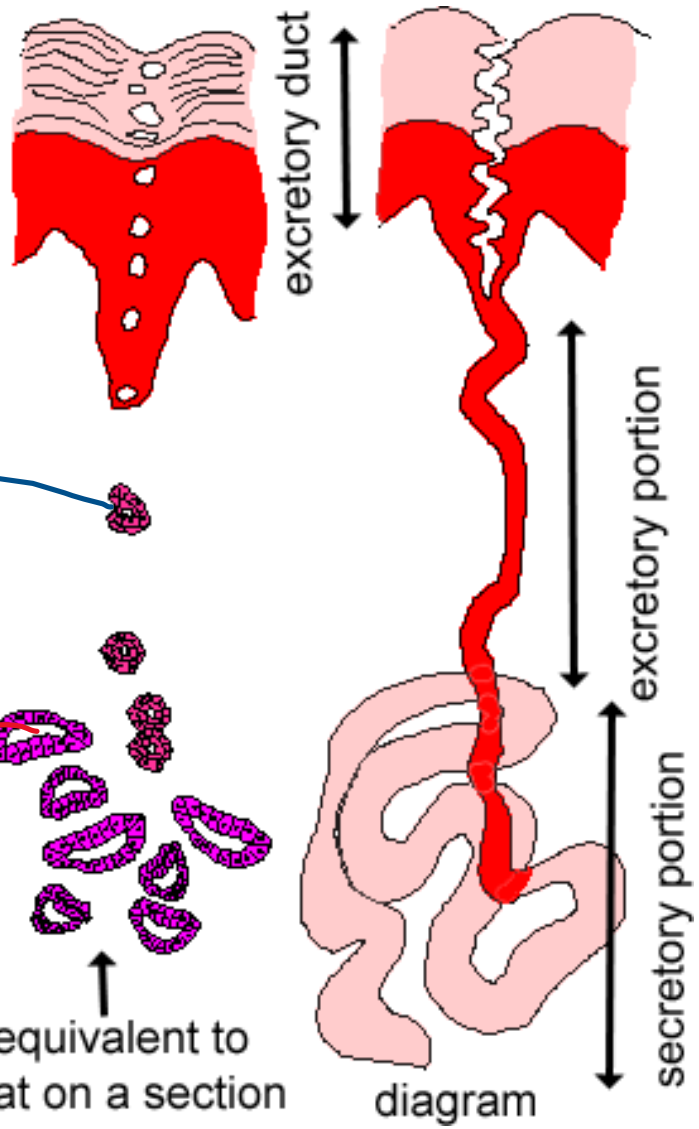


Several long secretory parts joining to drain into 1 duct

Example : Glands in the uterus and stomach


Direction of secretion
Junction of neck and tubular secretory regions
Parallel secretory areas
Region of gland bifurcation

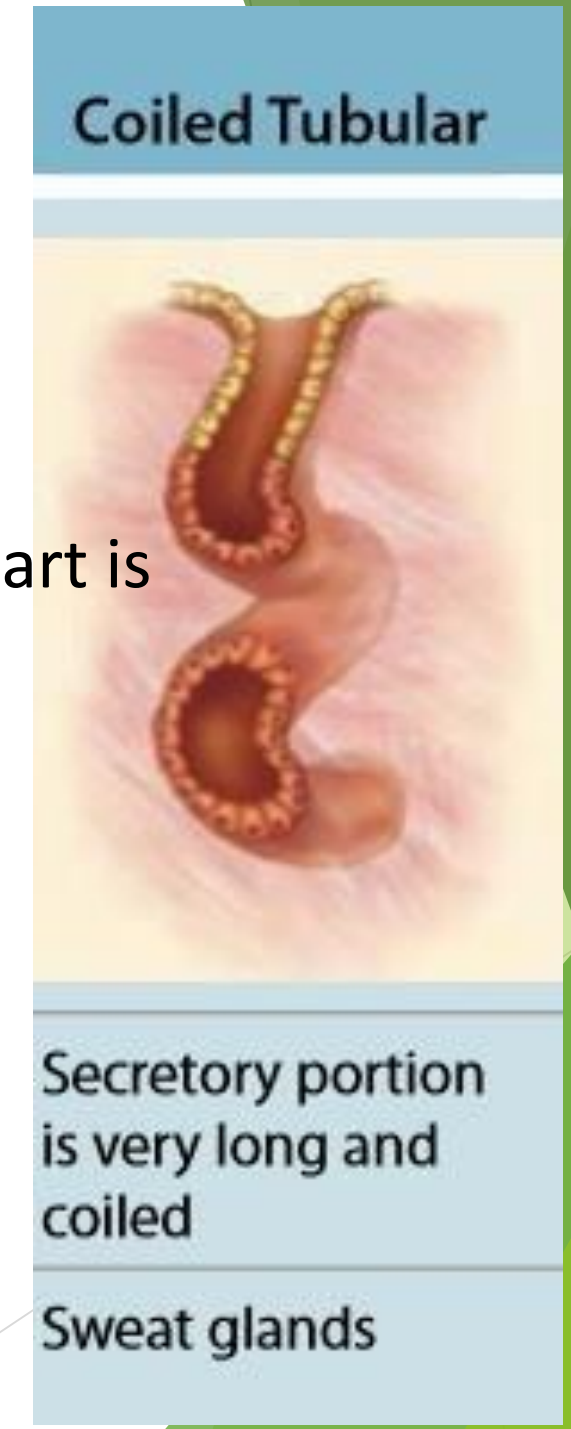
Coiled Tubular



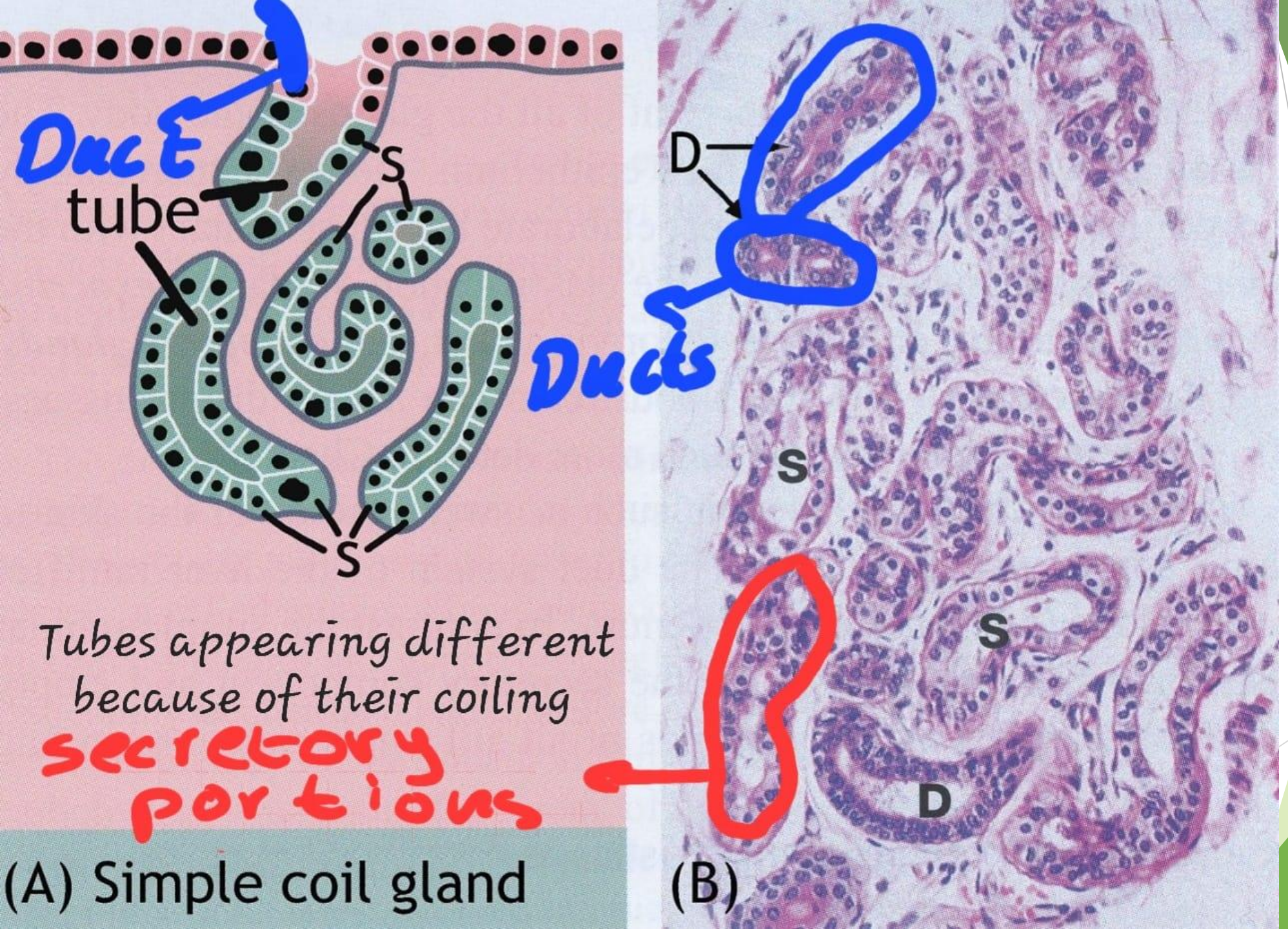
Ductal area

Secretory area

Tube part is coiled



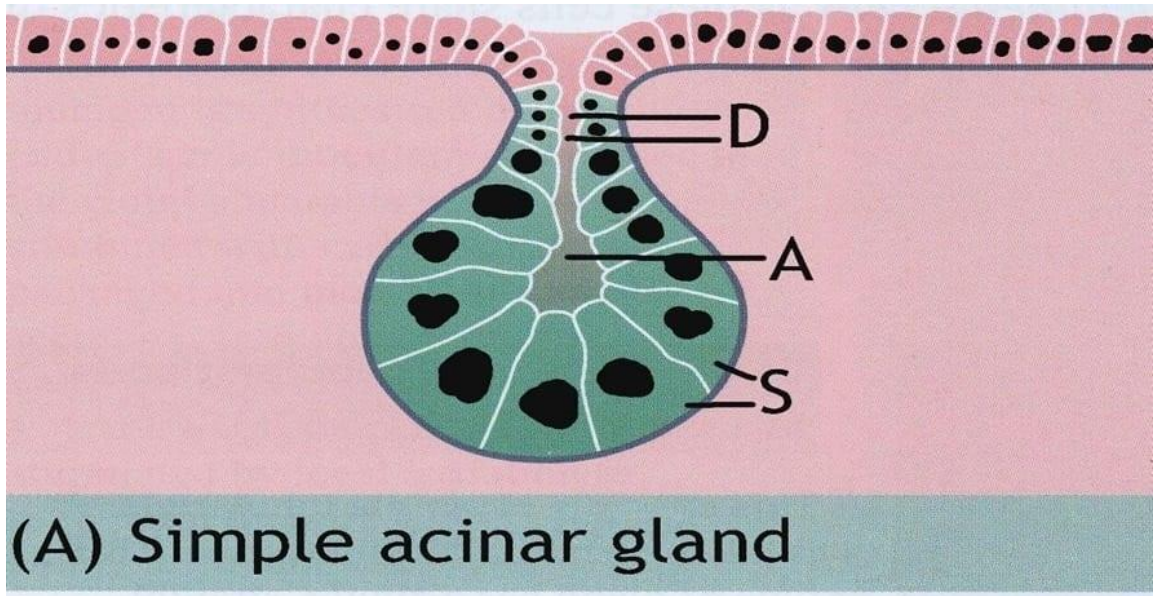
Notice that the secretory areas appear like circles or oval shape



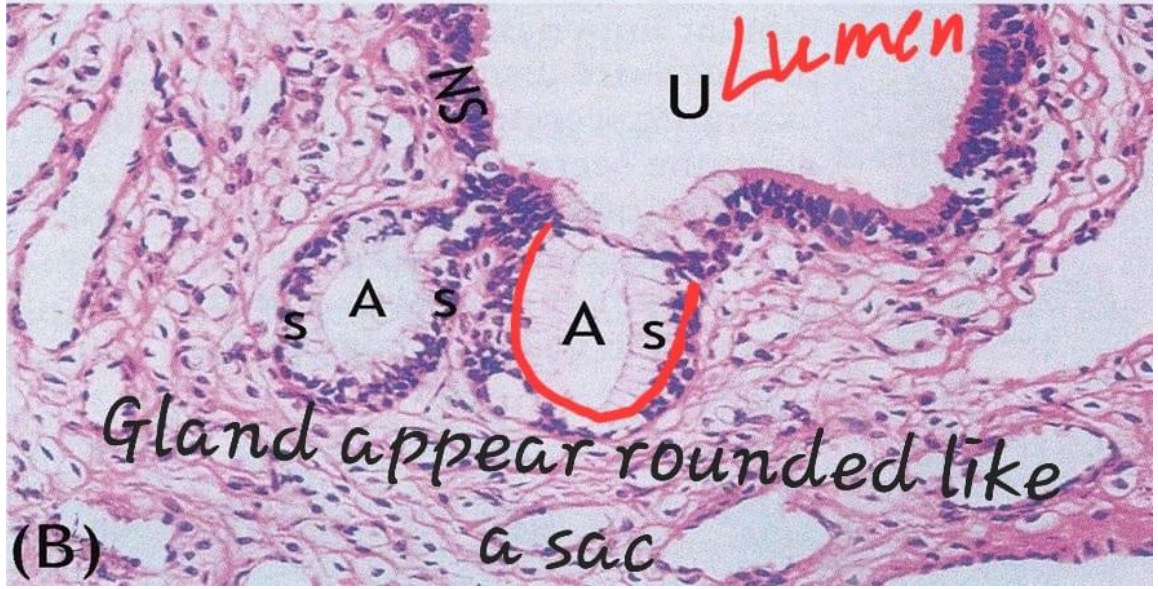
Notice that ducts appear darker while lumen appear smaller

In secretory portions, the lumen appears larger and cells appear lighter

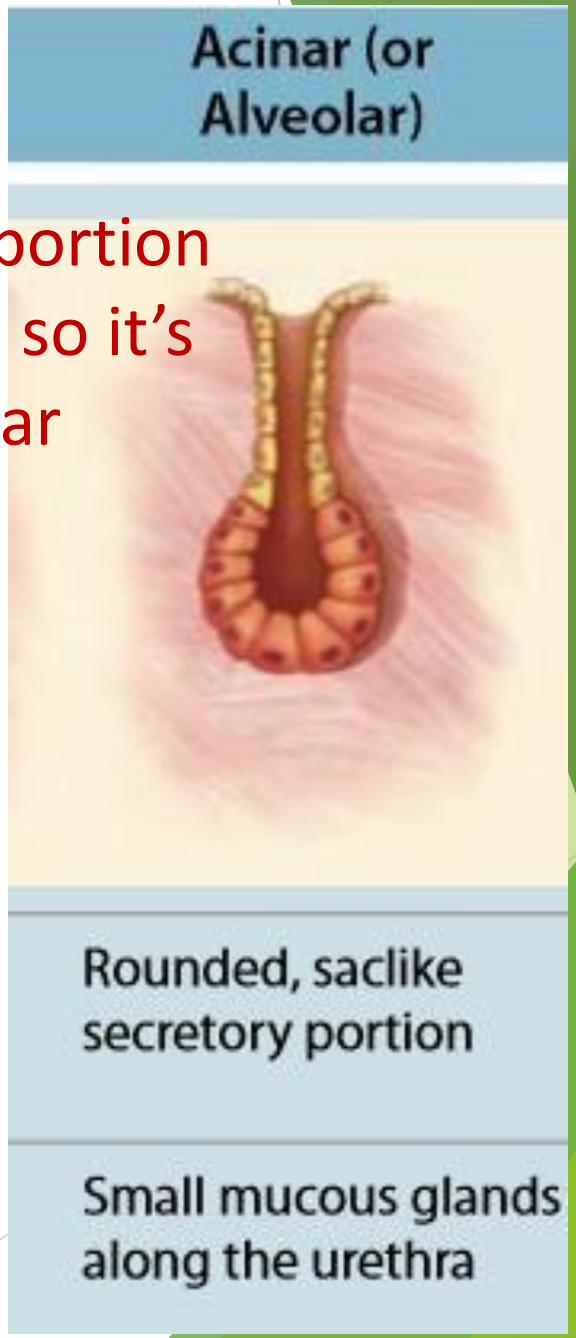
Simple acinar (alveolar)



(A) Simple acinar gland

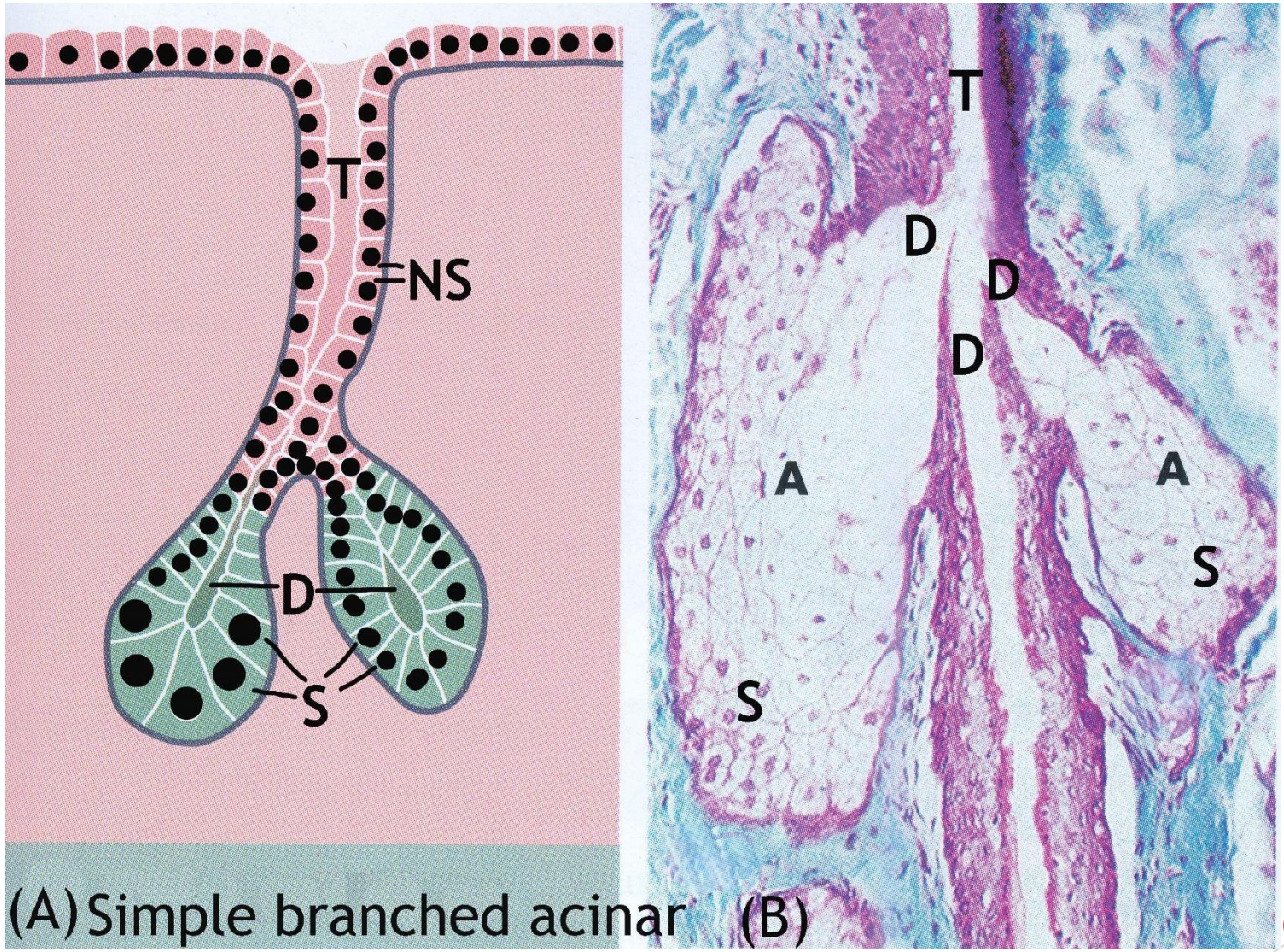


Secretory portion is rounded so it's called acinar



Example:

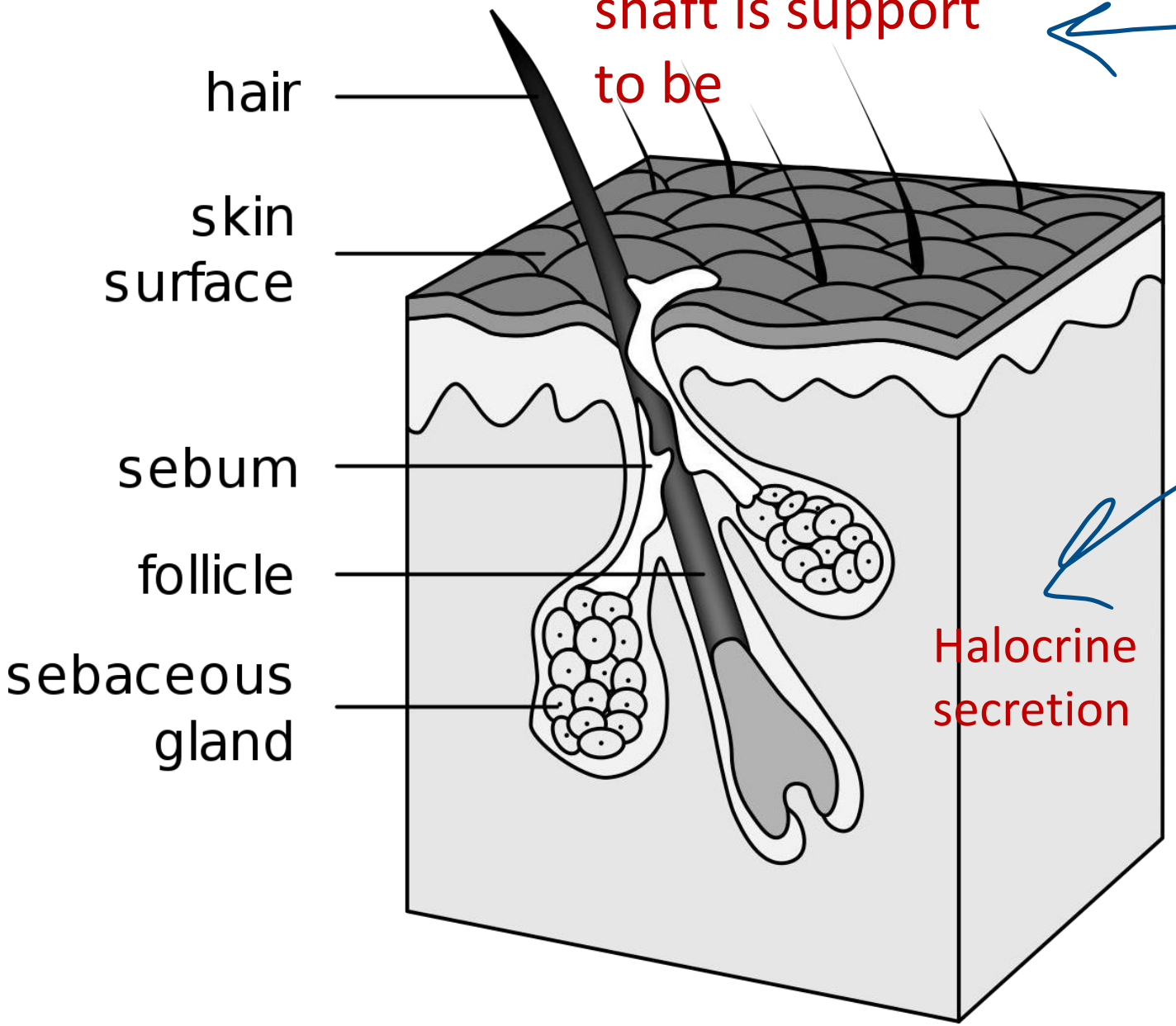
Branched acinar



(A) Simple branched acinar (B)

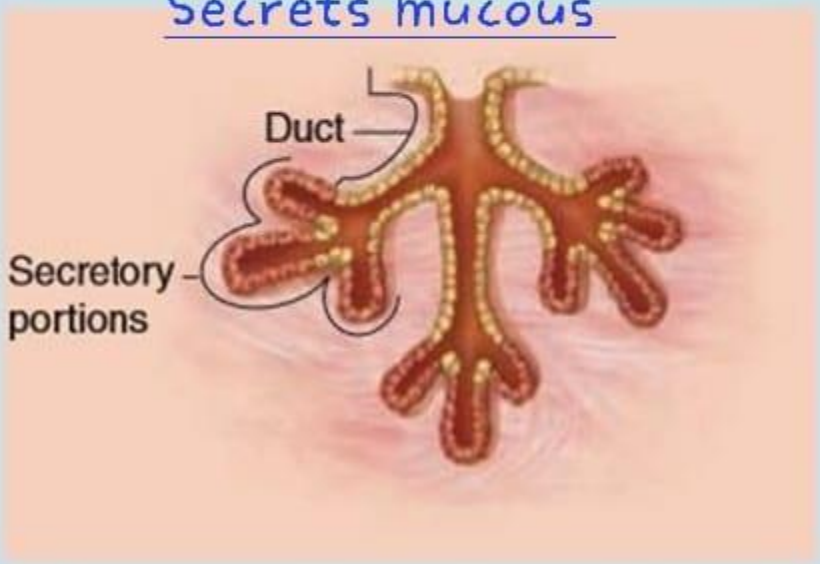
Opening to hair shaft, sebaceous means oil

Here where hair shaft is support to be

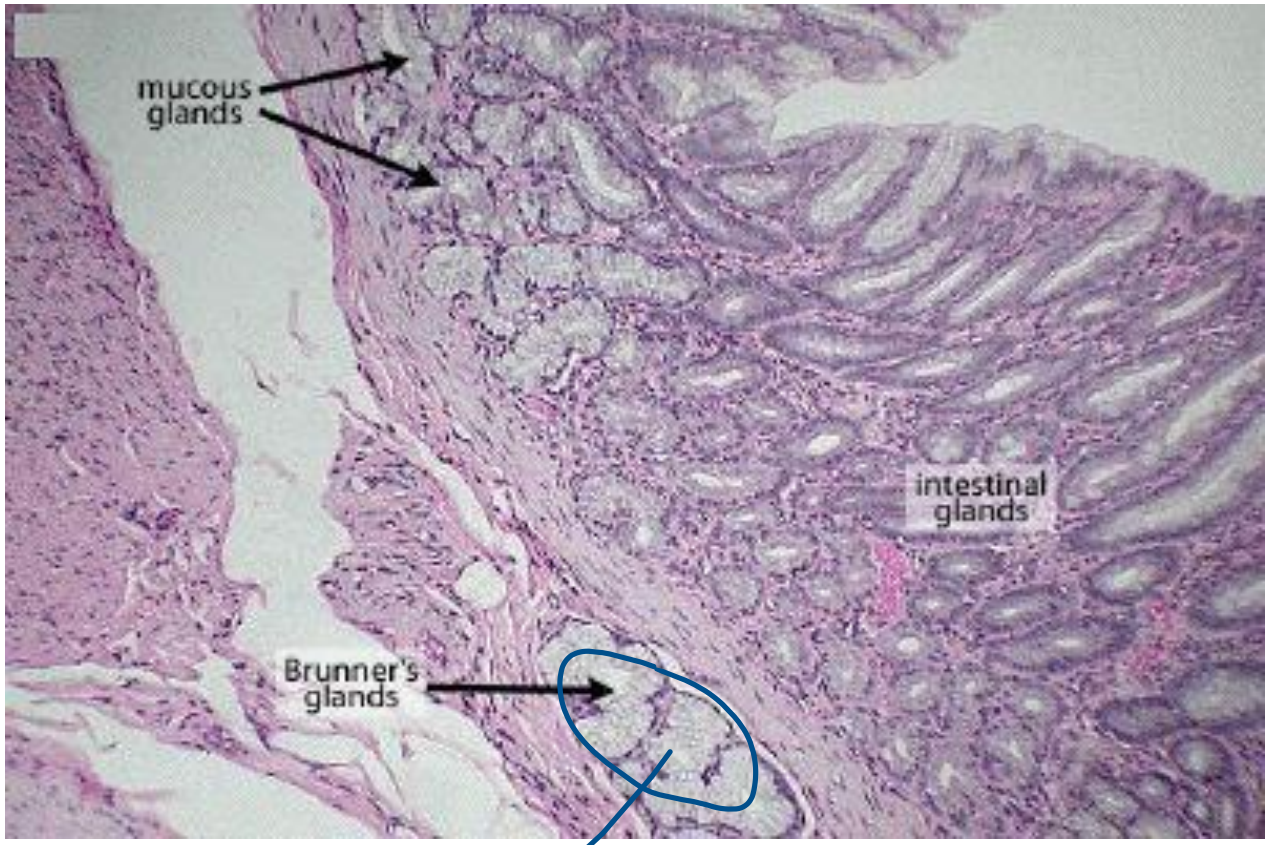


Halocrine secretion

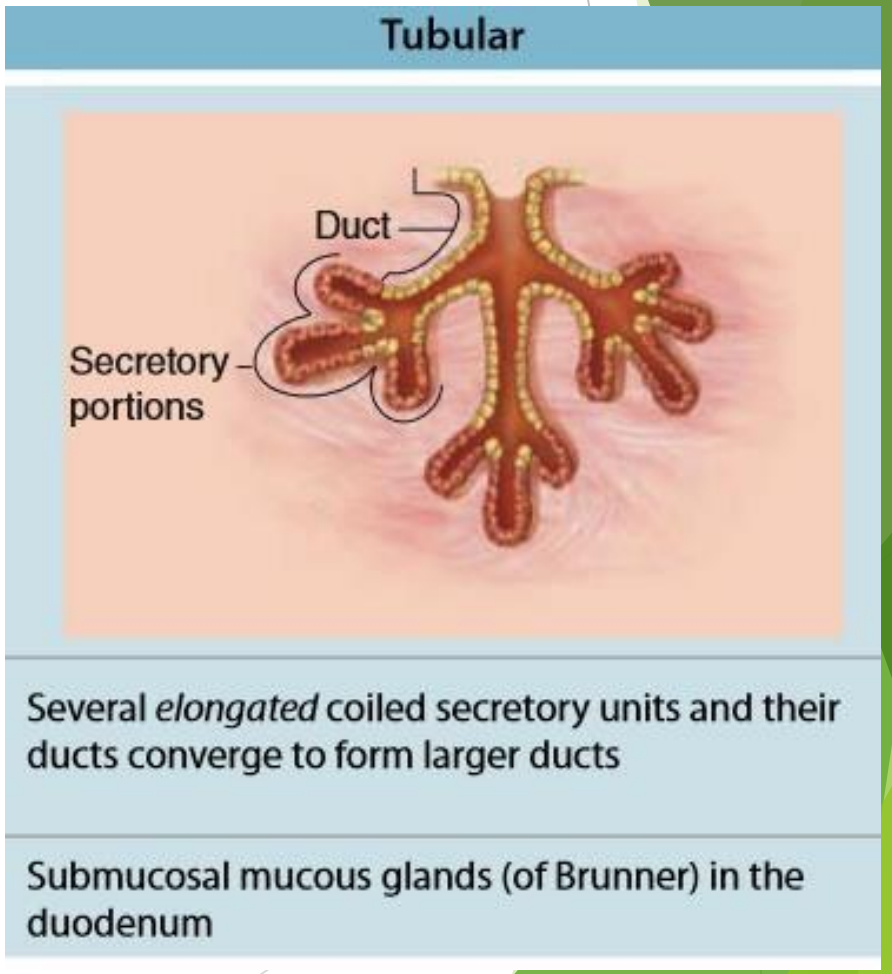
COMPOUND Glands (Ducts from Several Secretory Units Converge into Larger Ducts)

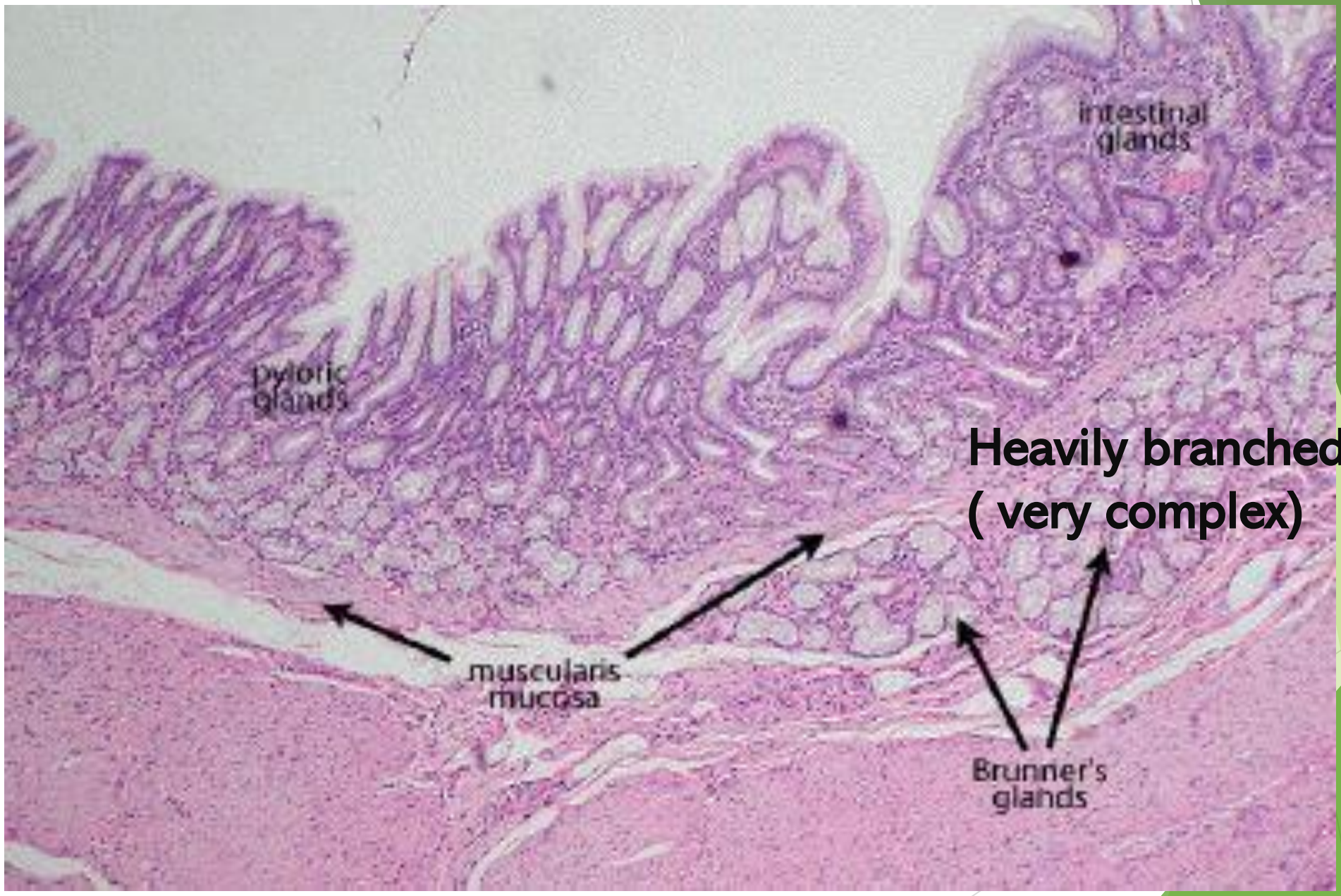
Class	Tubular	Acinar (Alveolar)	Tubuloacinar
	Secrets mucous 	Secrets serous 	secrets both 
Features	Several *elongated* coiled secretory units and their ducts converge to form larger ducts	Several *saclike* secretory units with small ducts converge at a larger duct	Ducts of both tubular and acinar secretory units converge at larger ducts
Examples	Submucosal mucous glands (of Brunner) in the duodenum	Exocrine pancreas	Salivary glands

Compound tubular

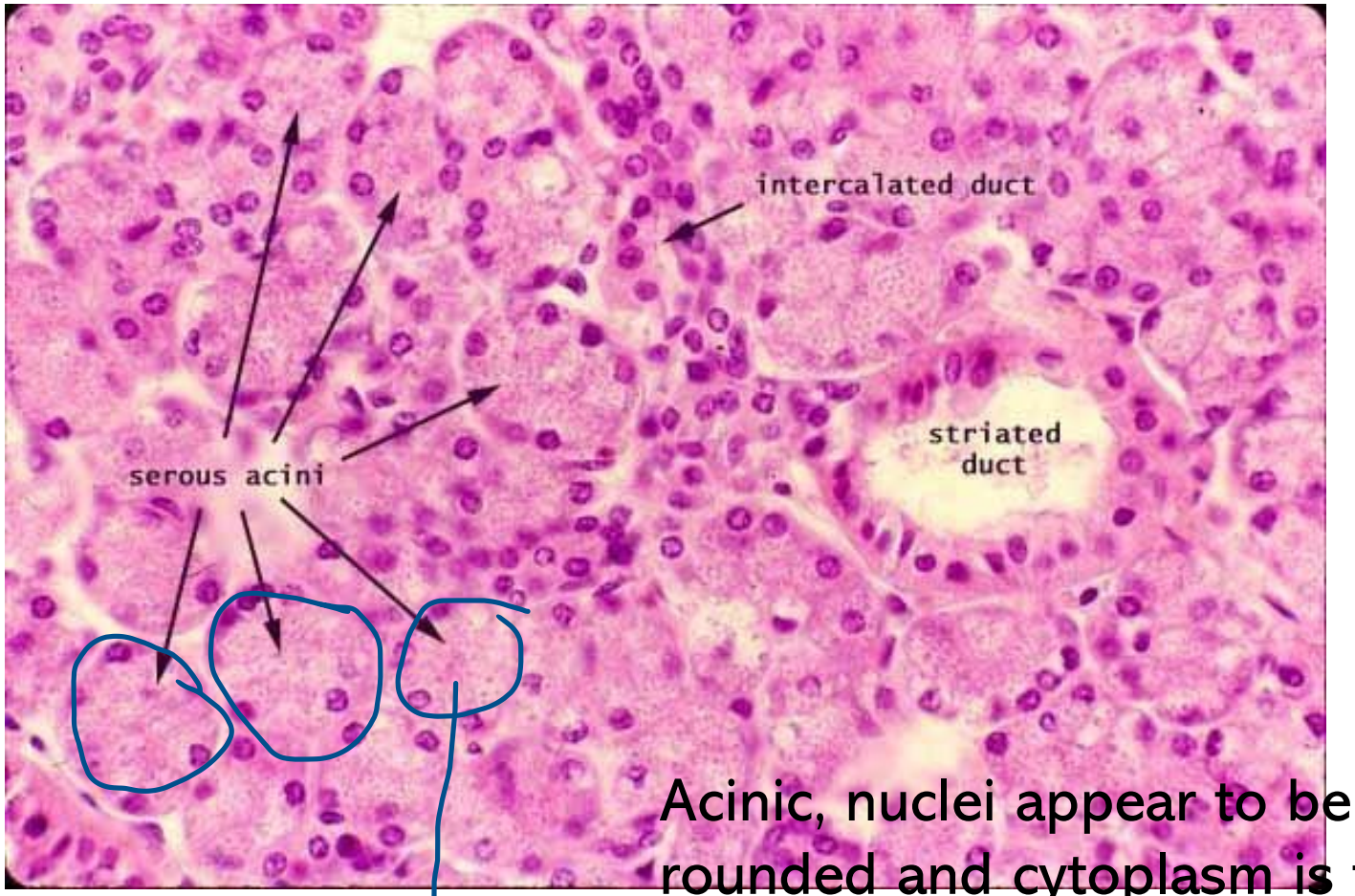


Mucous secreting gland cells are appearing empty apically and the nuclei is flattened and pushed downwards

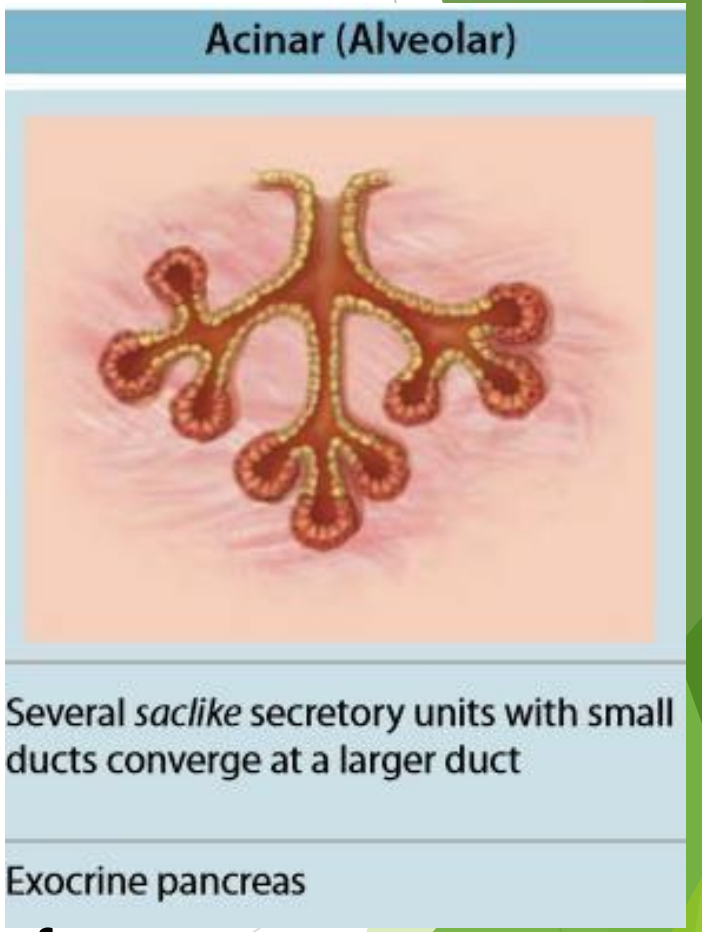



intestinal glands
pyloric glands
Heavily branched
(very complex)
muscularis mucosa
Brunner's glands

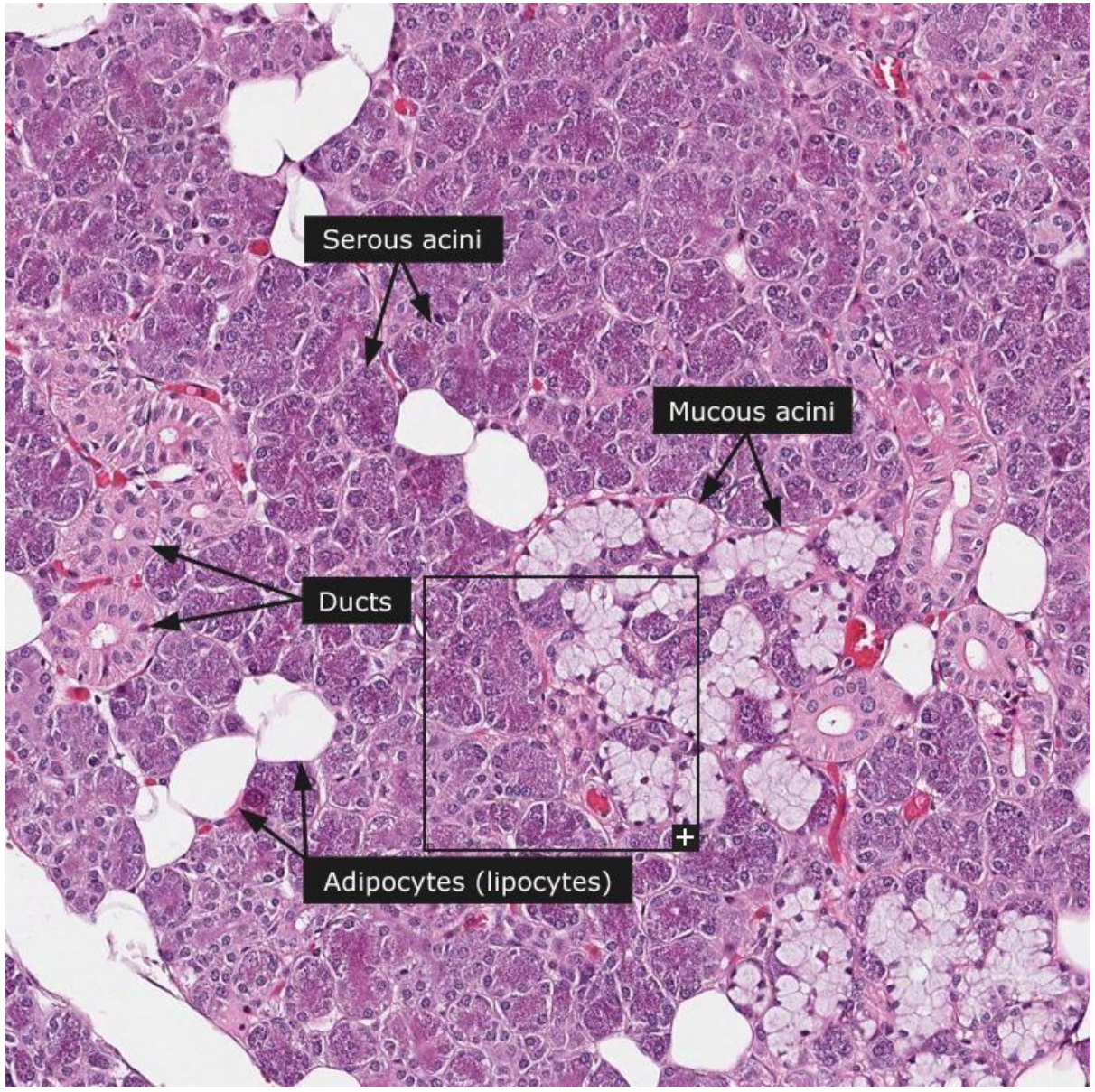
Compound acinar (alveolar) Usually produce protein

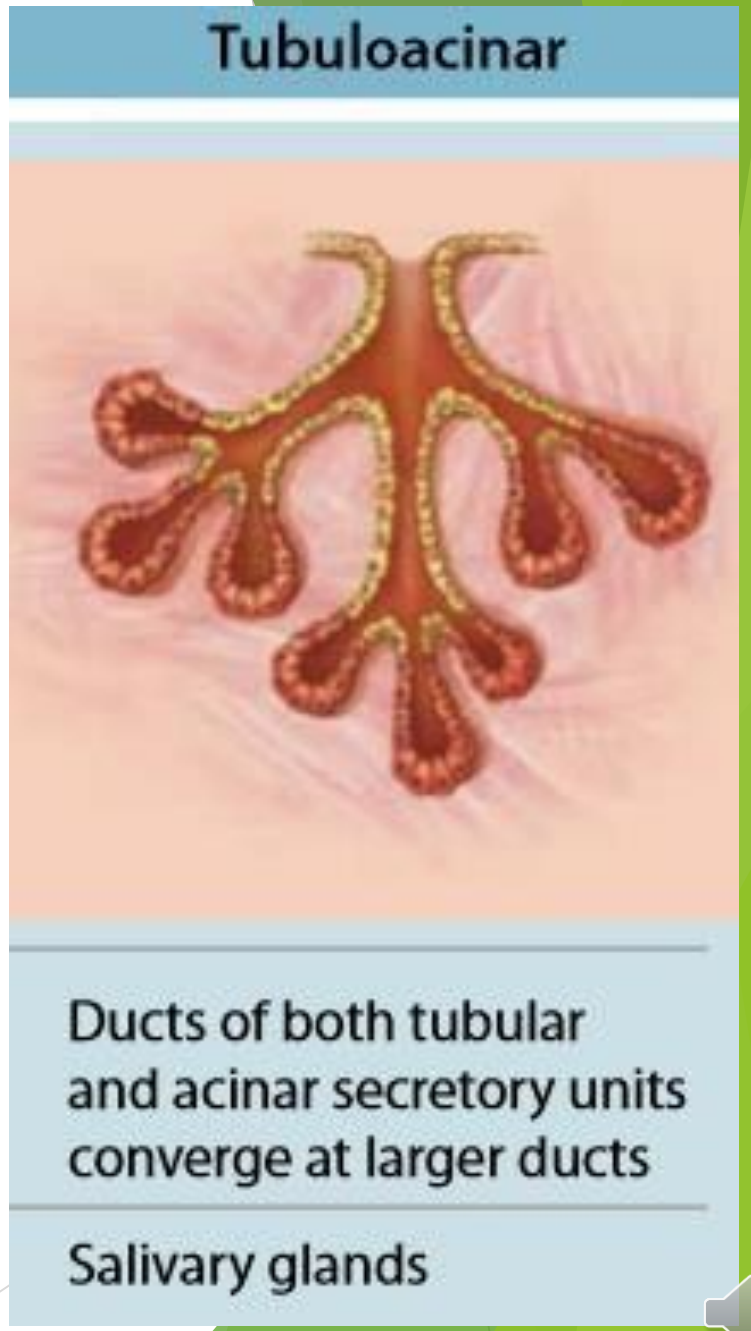


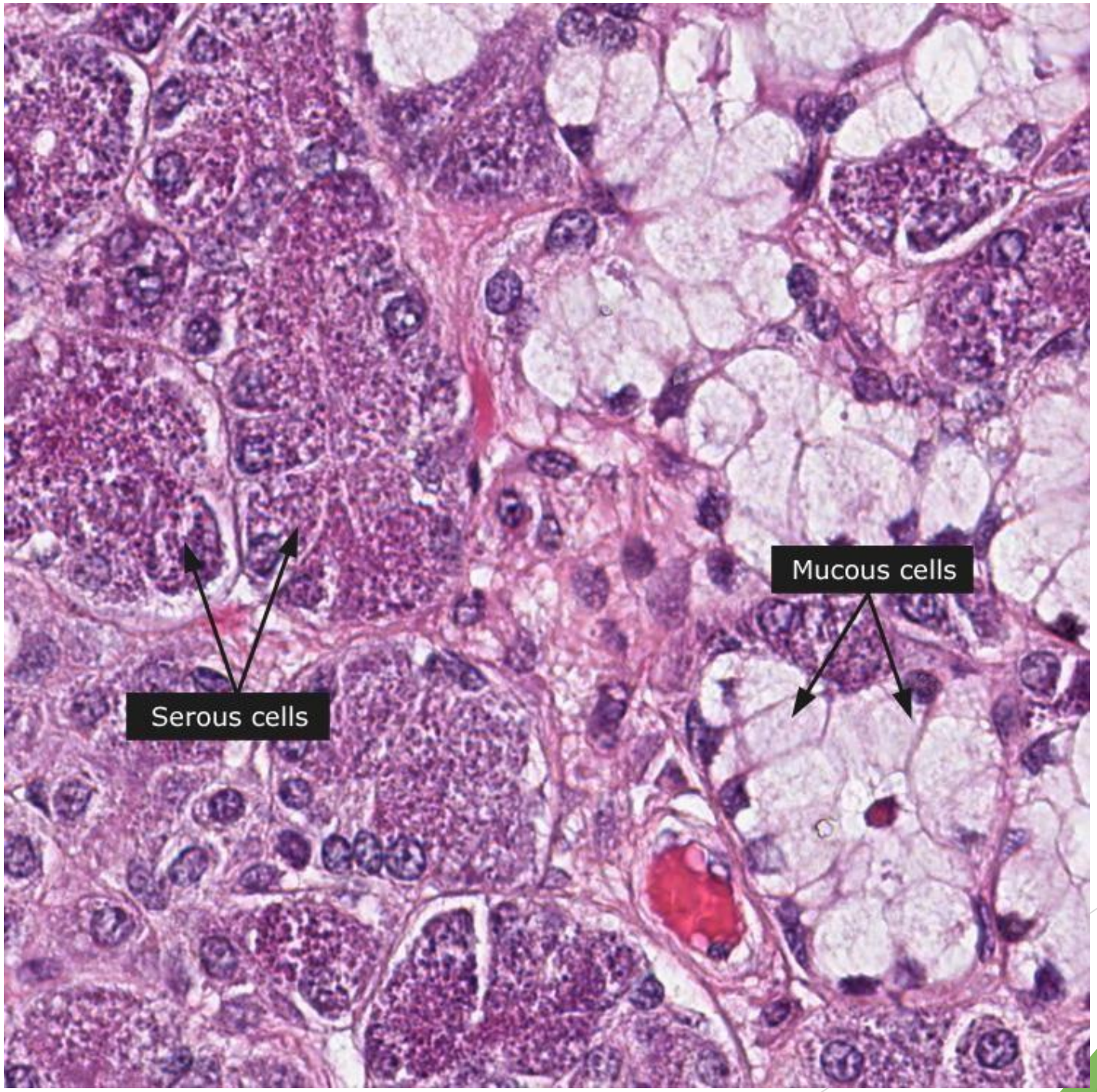
Acinic, nuclei appear to be rounded and cytoplasm is full of small granules that produce protein



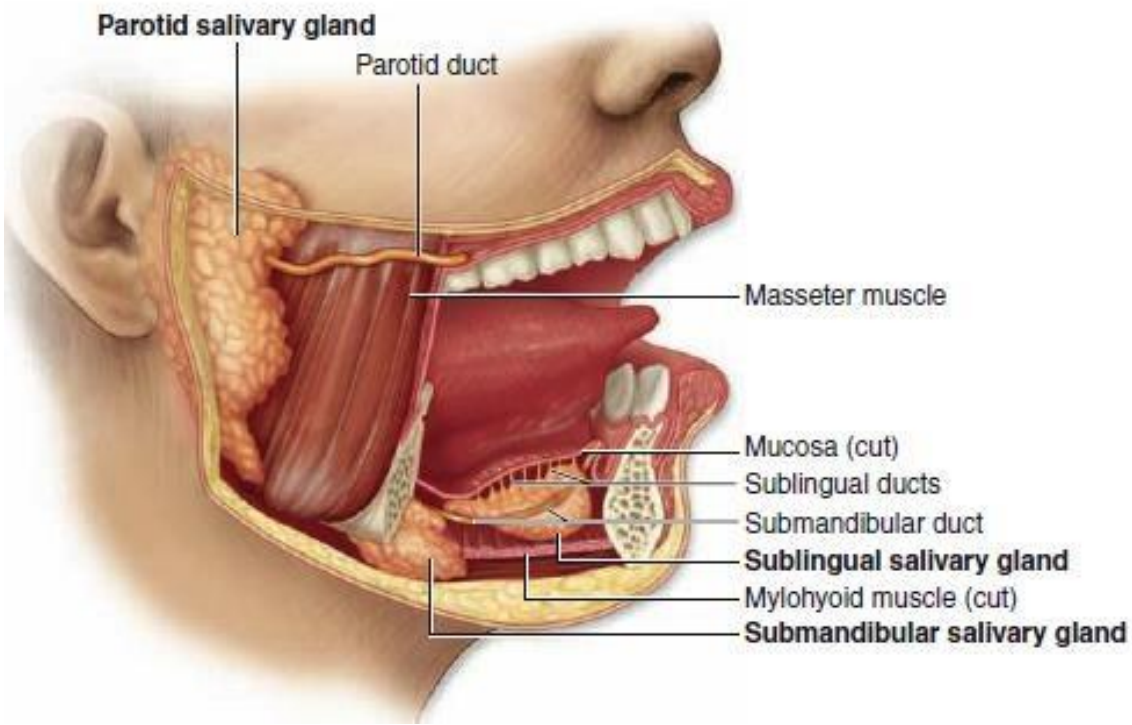
Compound tubuloacinar



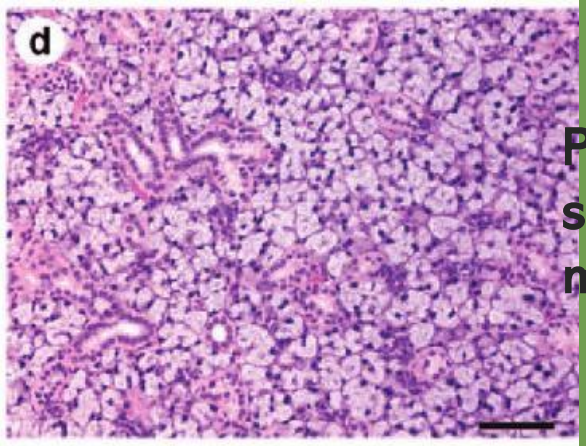



Serous cells
Mucous cells

Comparison between salivary glands

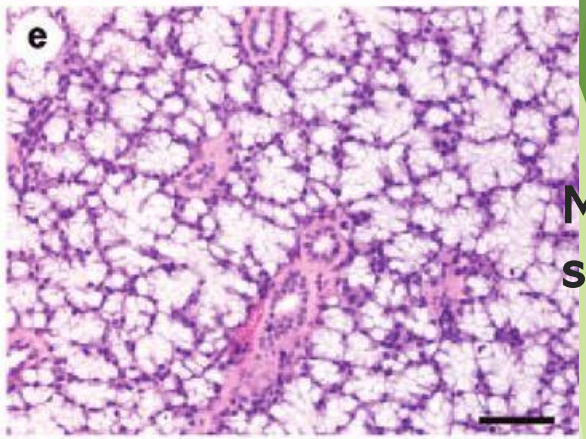


Sub-mandibular



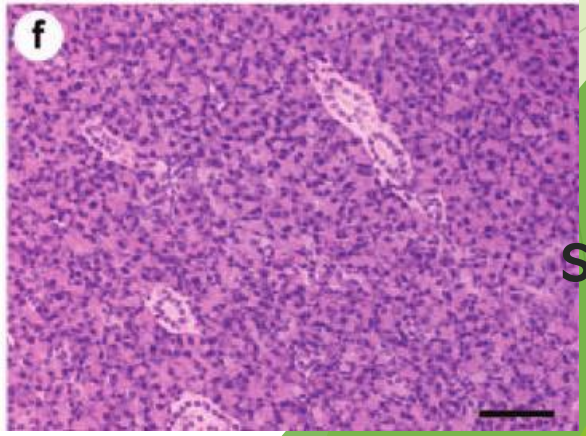
Produces both, serous and mucous

Sublingual



Mostly mucous secreting

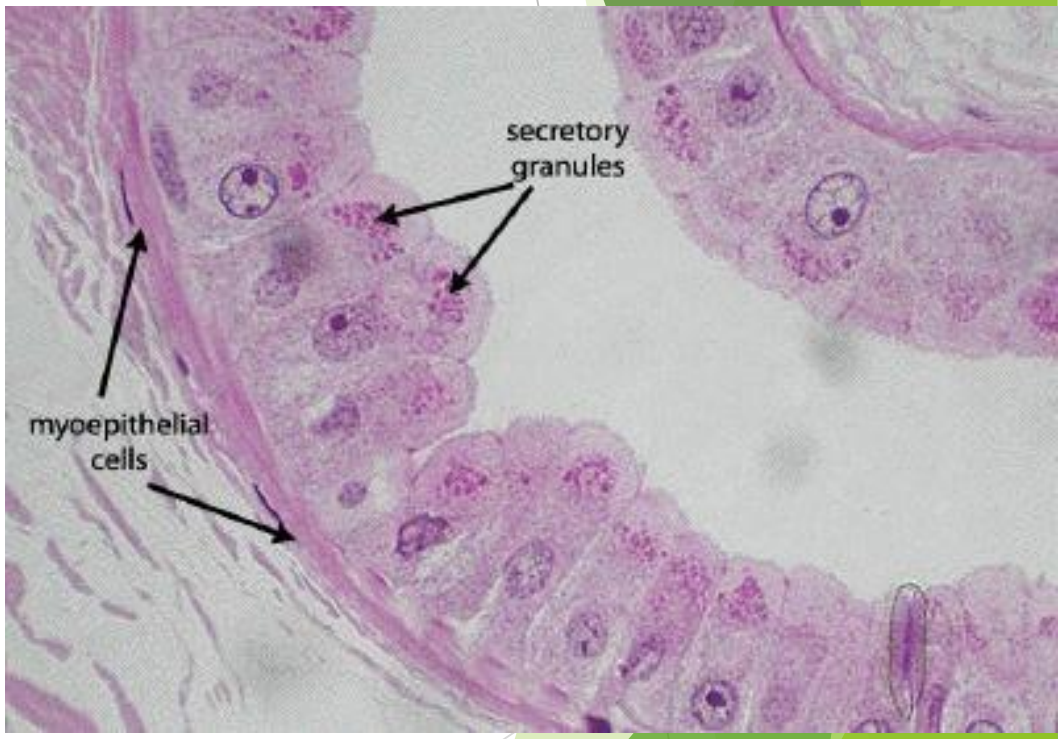
Parotid

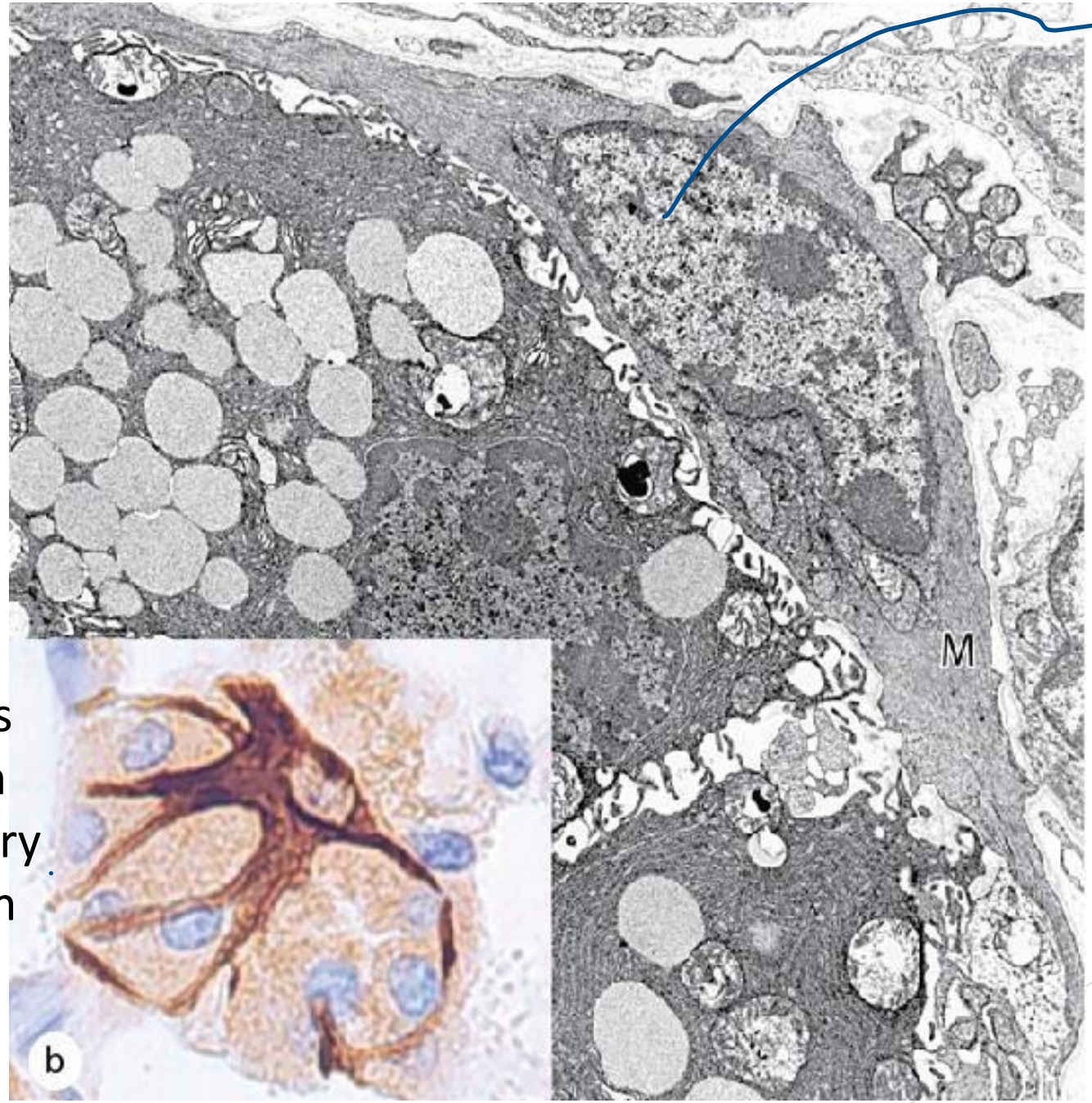


Serous secreting

Myoepithelial Cells epithelial cells that can contract, when they contract, they help to push the secretory material into the ductal system

- Located between the secretory cells and the basement membrane
- These cells are rich in actin and myosin
- When myoepithelial cells contract, they help to extrude the glands' contents
- Each myoepithelial cell has long cytoplasmic processes which wrap around a secretory unit





Nucleus appears to be little bit flattened

Here there are multiple processes that looks like arm surrounds secretory portions and when they contract the squeeze the secretions out