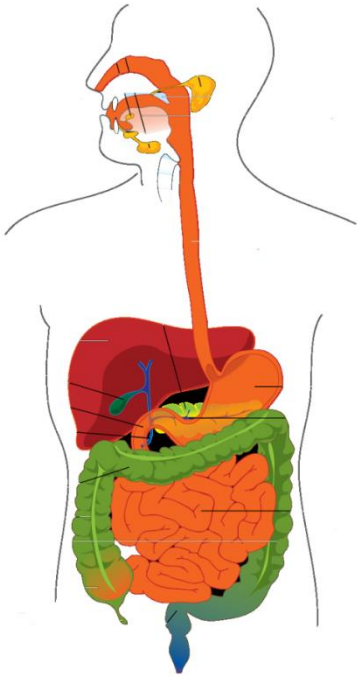
MUNI MED Ústav histologie a embryologie

MICROSCOPIC ANATOMY OF GIT

oral cavity
digestive tube



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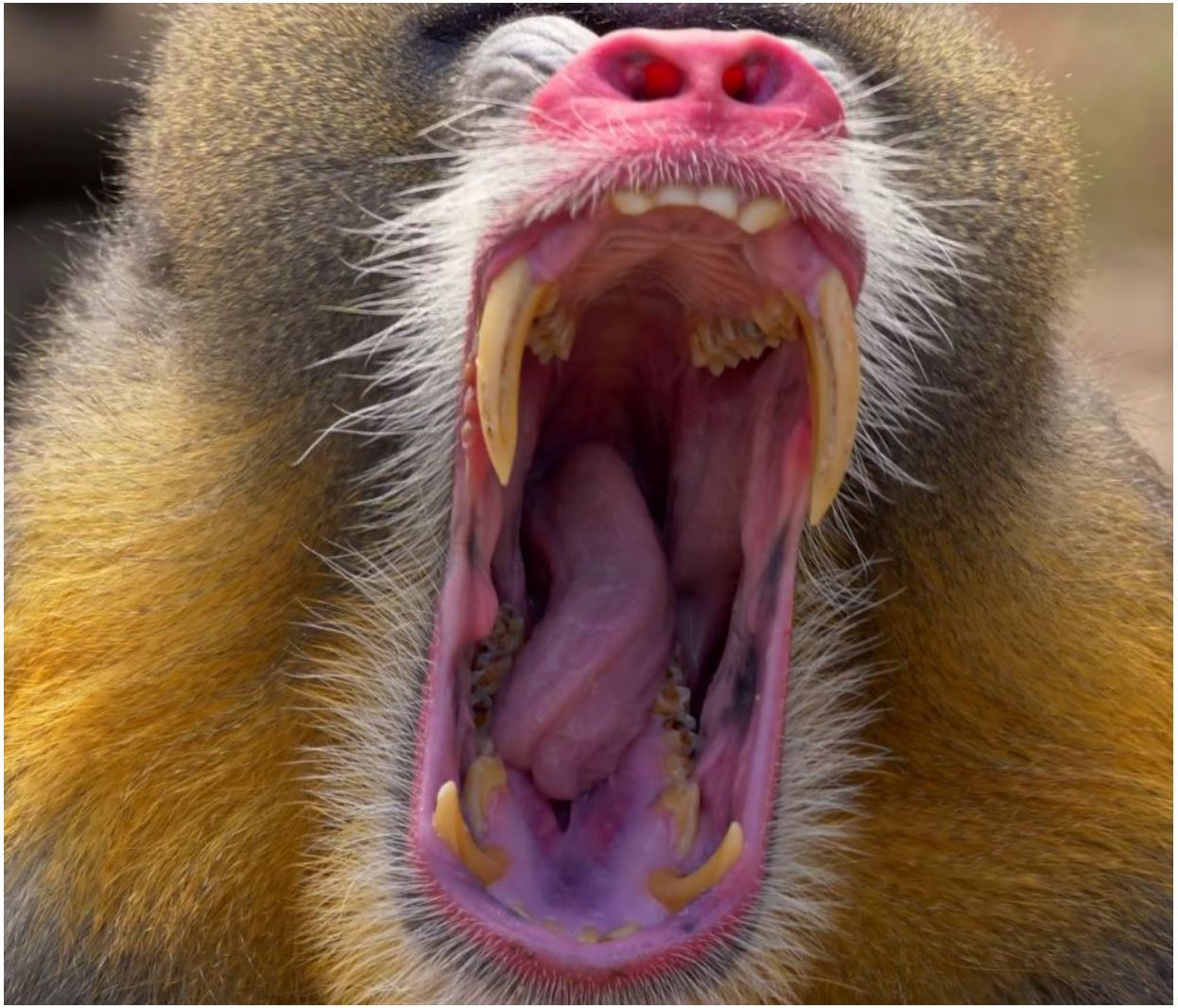
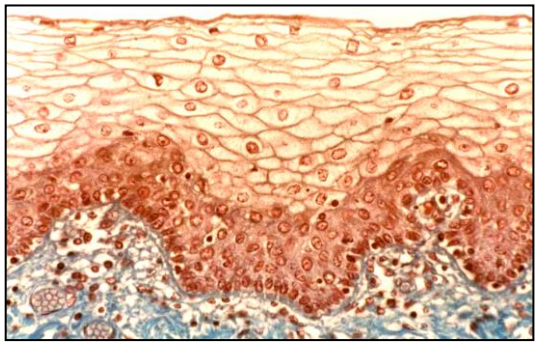
ORAL CAVITY



- Upper and lower lip
- Vestibulum oris
- Soft and hard palate
- Tooth and gingiva
- Tongue

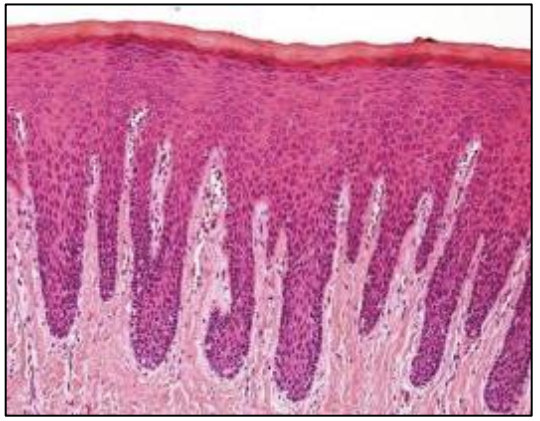
ORAL MUCOSA

- ***lamina epithelialis mucosae***
  stratified squamous epithelium
- ***lamina propria mucosae***
  loose collagen C.T.



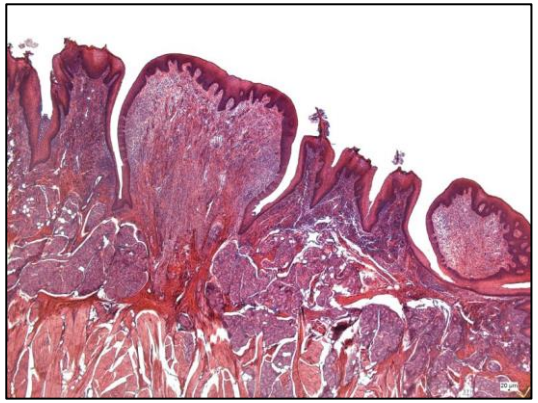
Types of oral mucosa

- **lining mucosa**
- mucosal and submucosal C.T.

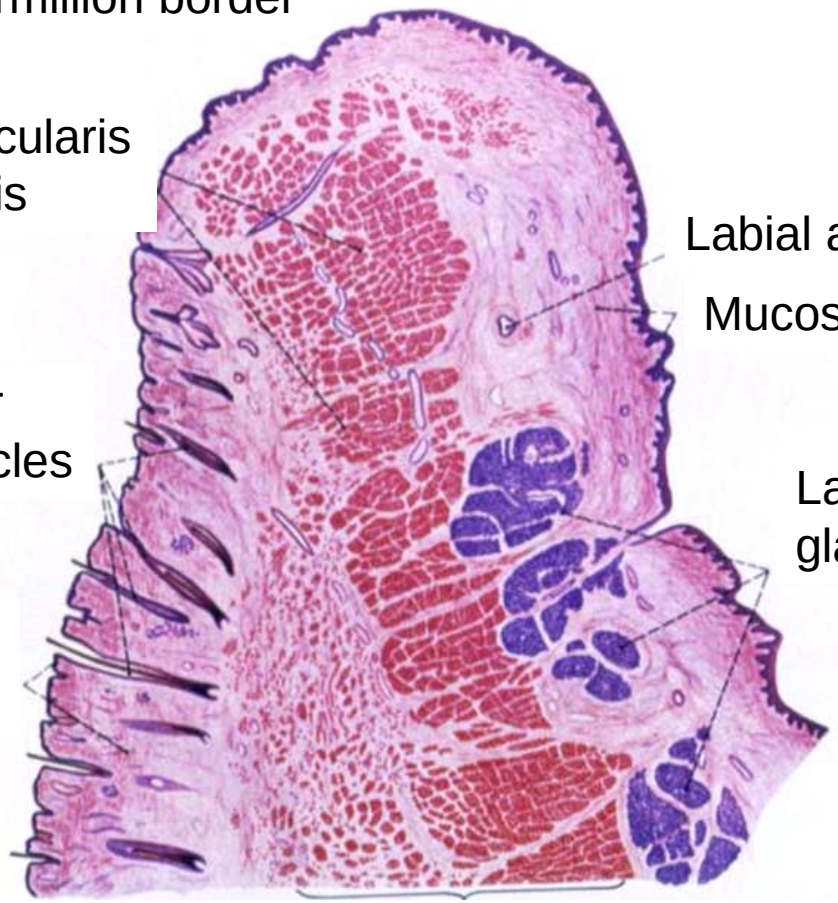


- **masticatory mucosa**
- parakeratinized epithelium
- directly on periost (mucoperiosteum)
- no submucosa

- **specialized mucosa**
- dorsum linguae – papillae



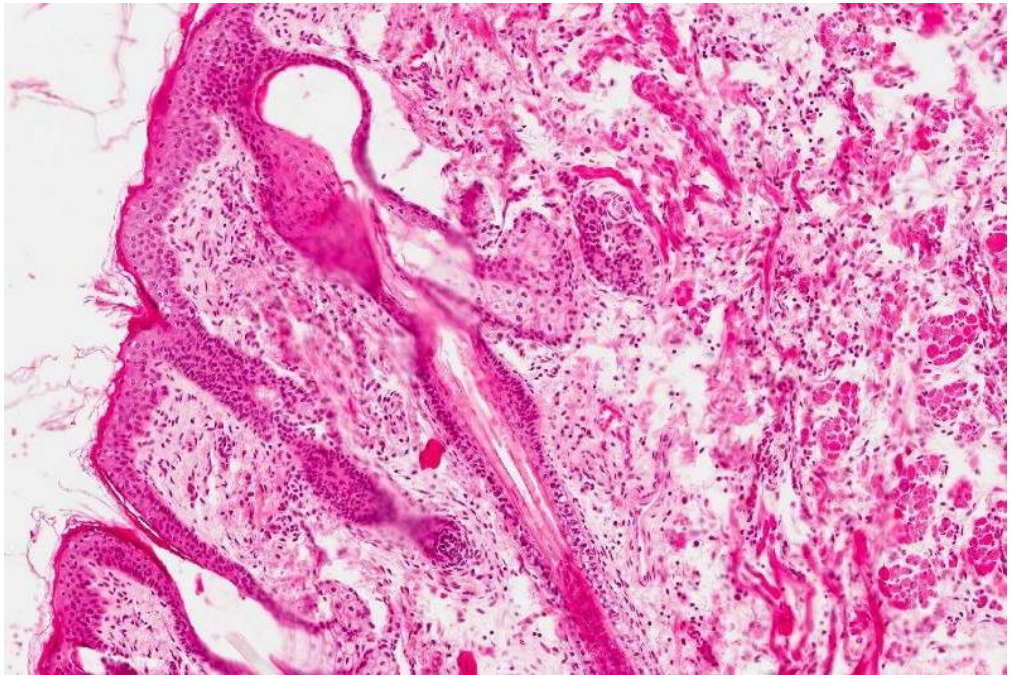
LIP


Vermillion border
M. orbicularis oris
Labial artery
Mucosa
Hair follicles
Labial glands
Labial skin
M. orbicularis oris


Dorsal
Ventral

LIP

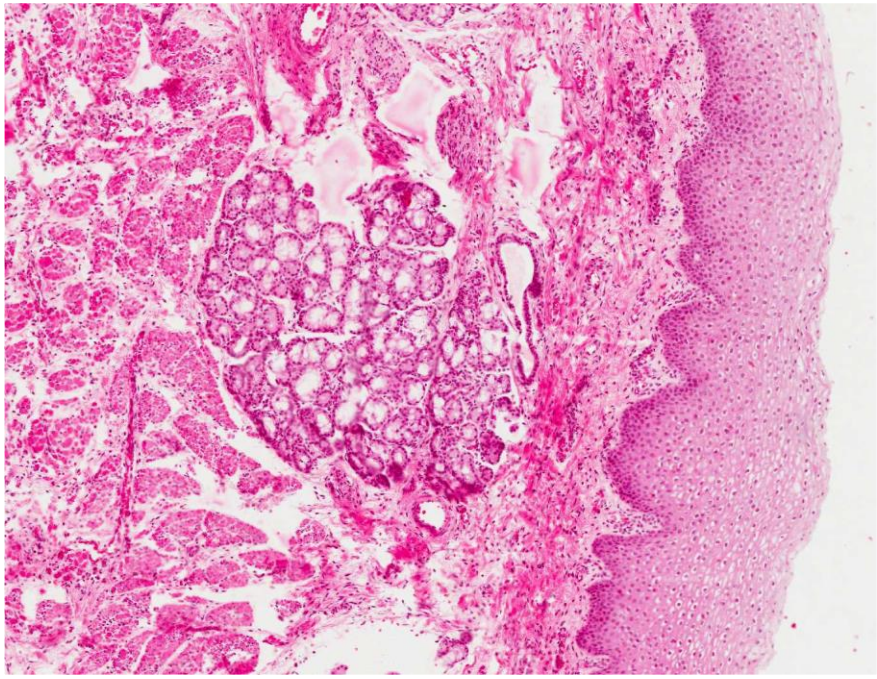
Skin side (ventral)



Epidermis
- Keratinized stratified squamous epithelium

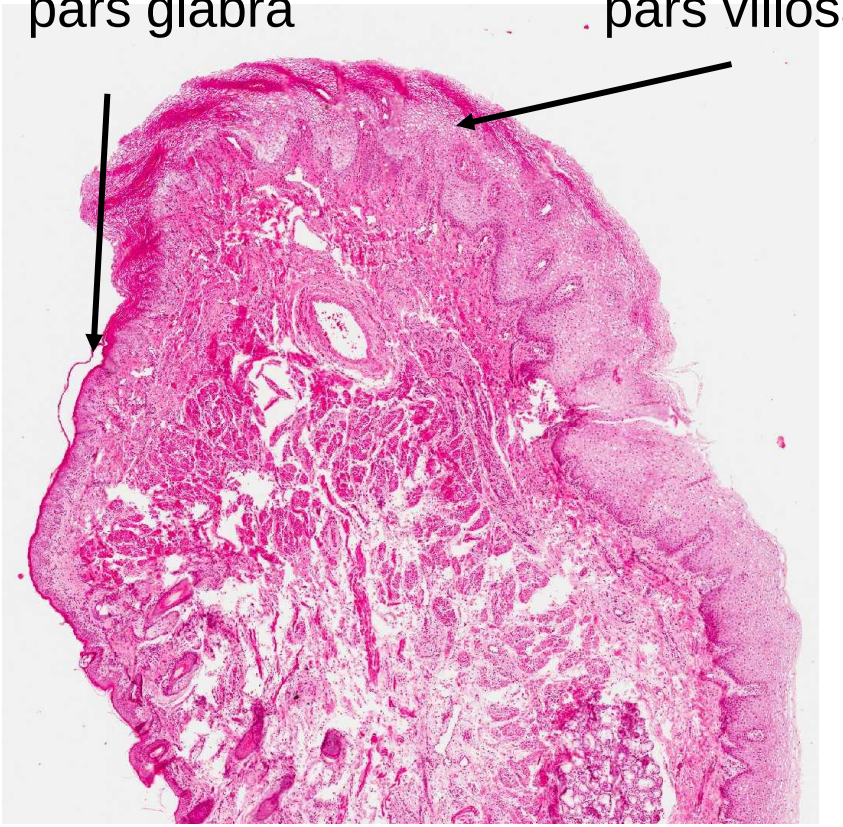
Dermis
- Loose collagen C.T.
- Hair follicles
- Sebaceous glands
- Sweat glands

Oral side (dorsal)



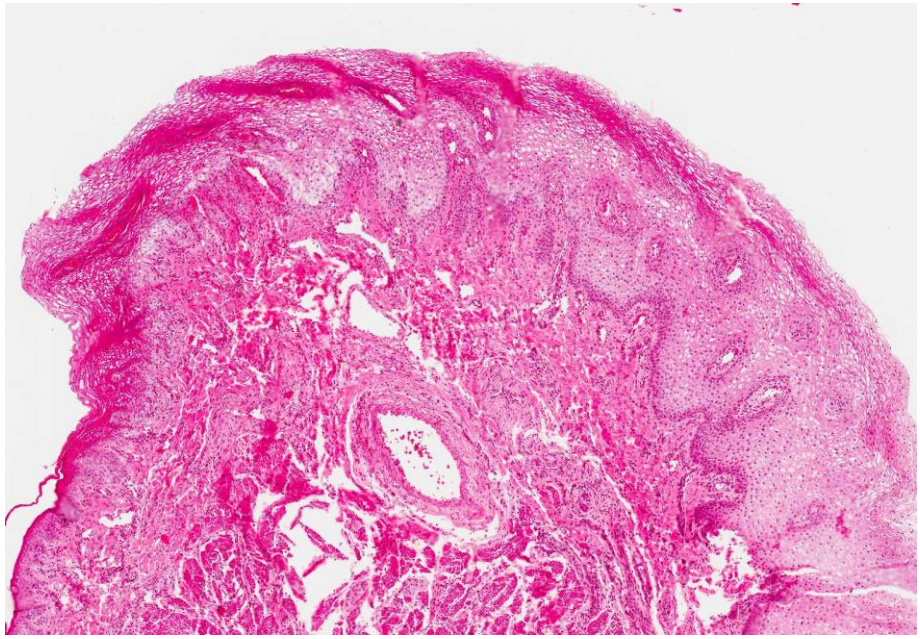
Oral mucosa
- Stratified squamous epithelium
- Loose collagen C.T.
- Small salivary labial mixed glands

LIP



newborns

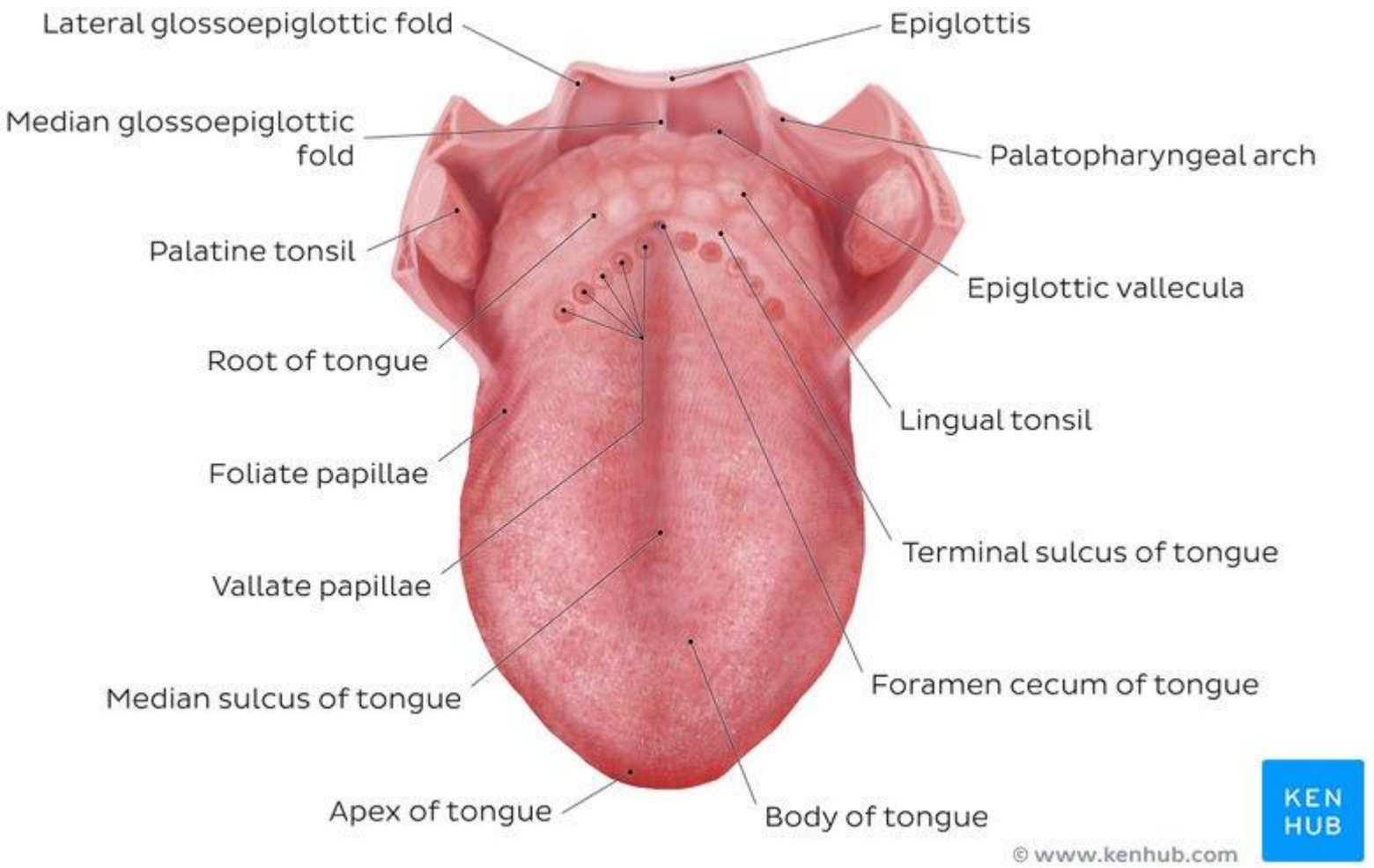
torus labialis



<u>Vermillion border</u>

- Eleidin protein
- salivary glands hair follicles, sweat glands absent
- high c.t. papillae, capillaries
- nerve endings, Meissner’s corpuscles

TONGUE


Lateral glossoepiglottic fold
Epiglottis
Median glossoepiglottic fold
Palatopharyngeal arch
Palatine tonsil
Epiglottic vallecula
Root of tongue
Lingual tonsil
Foliate papillae
Terminal sulcus of tongue
Vallate papillae
Median sulcus of tongue
Foramen cecum of tongue
Apex of tongue
Body of tongue
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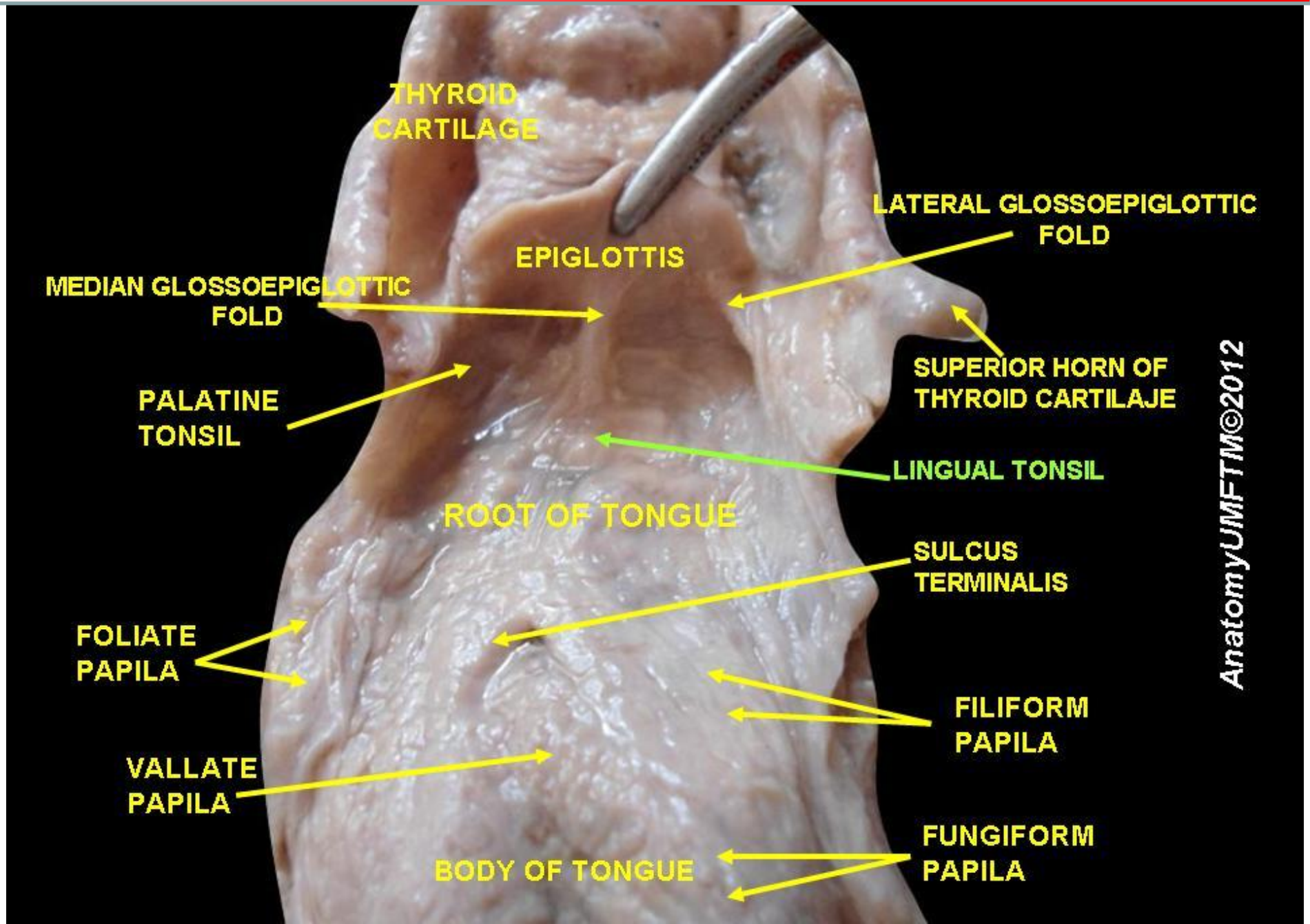
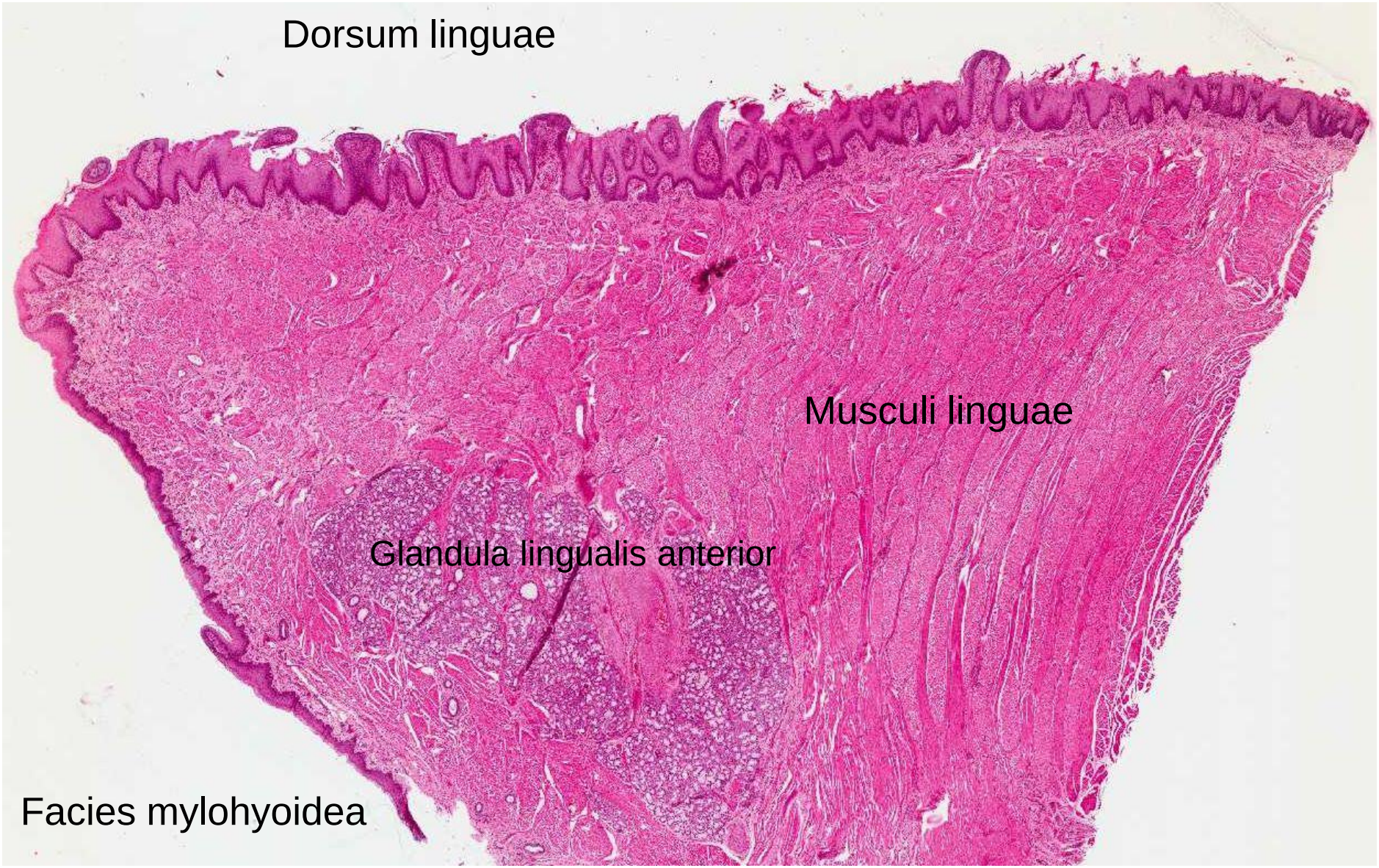
TONGUE

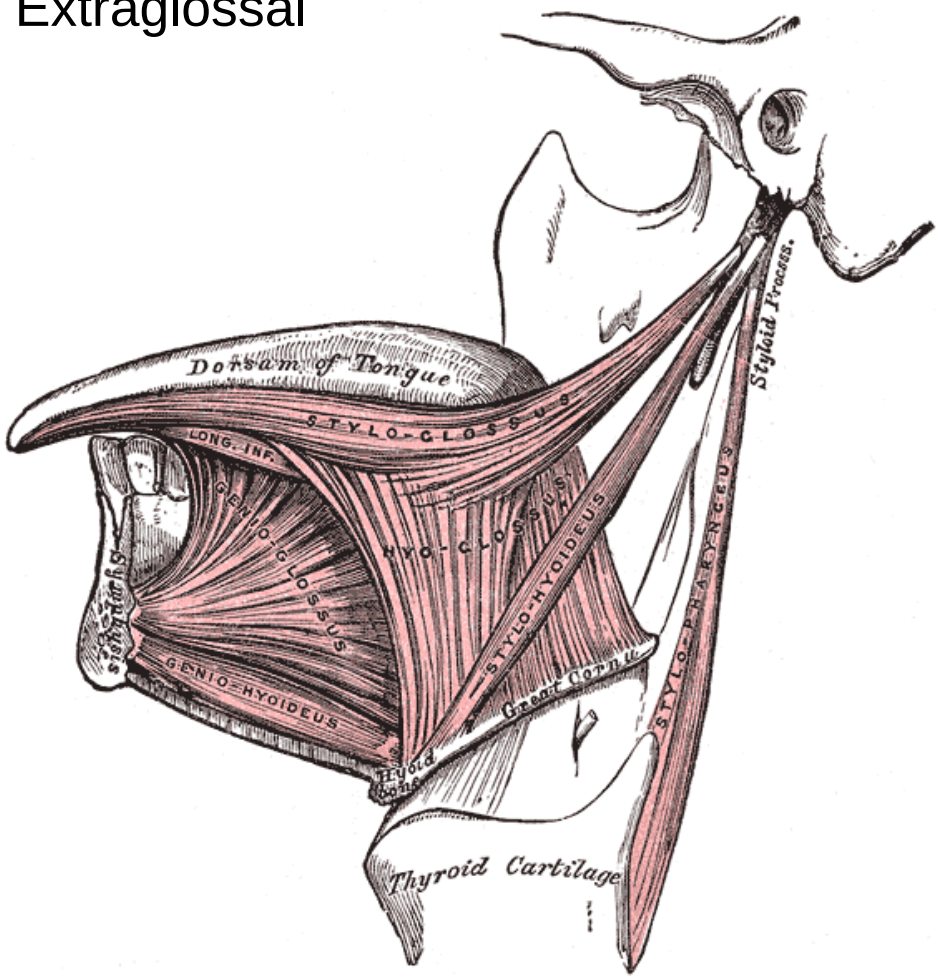

THYROID CARTILAGE
LATERAL GLOSSOEPIGLOTTIC FOLD
EPIGLOTTIS
MEDIAN GLOSSOEPIGLOTTIC FOLD
SUPERIOR HORN OF THYROID CARTILAJE
PALATINE TONSIL
LINGUAL TONSIL
ROOT OF TONGUE
SULCUS TERMINALIS
FOLIATE PAPILA
FILIFORM PAPILA
VALLATE PAPILA
FUNGIFORM PAPILA
BODY OF TONGUE
AnatomyUMFTM©2012

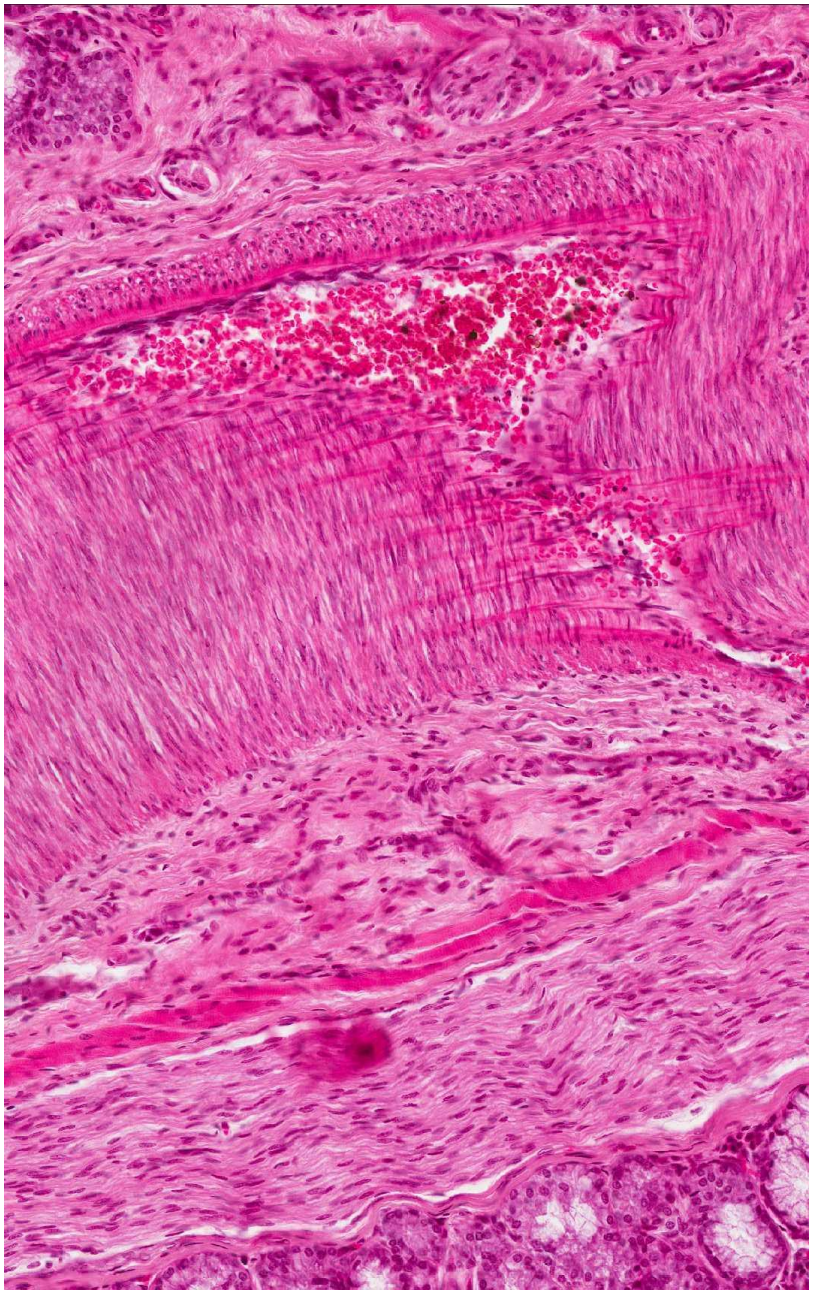
TONGUE – APEX LINGUAE



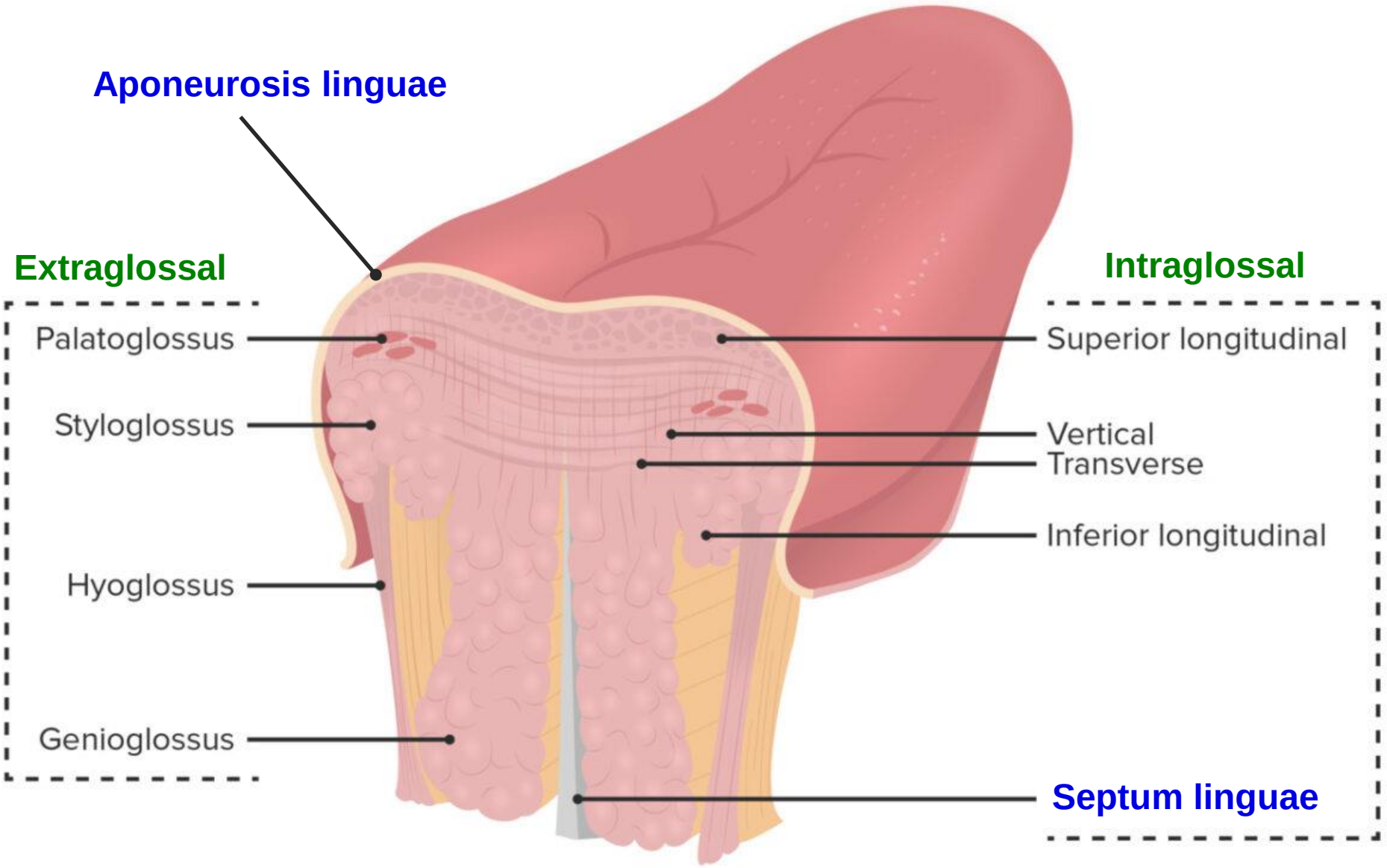
TONGUE – MUSCLES

- Intraglossal
- Extraglossal

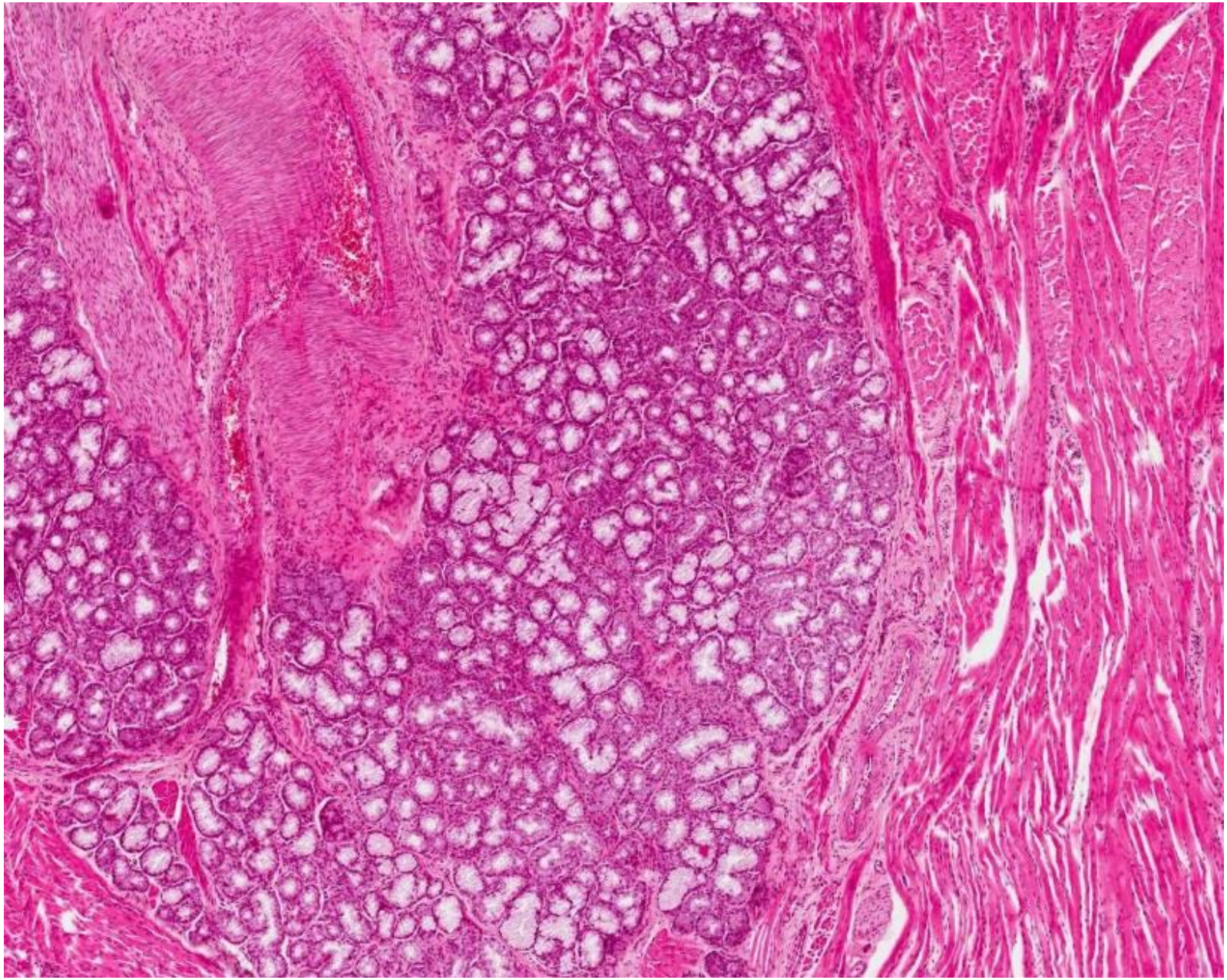




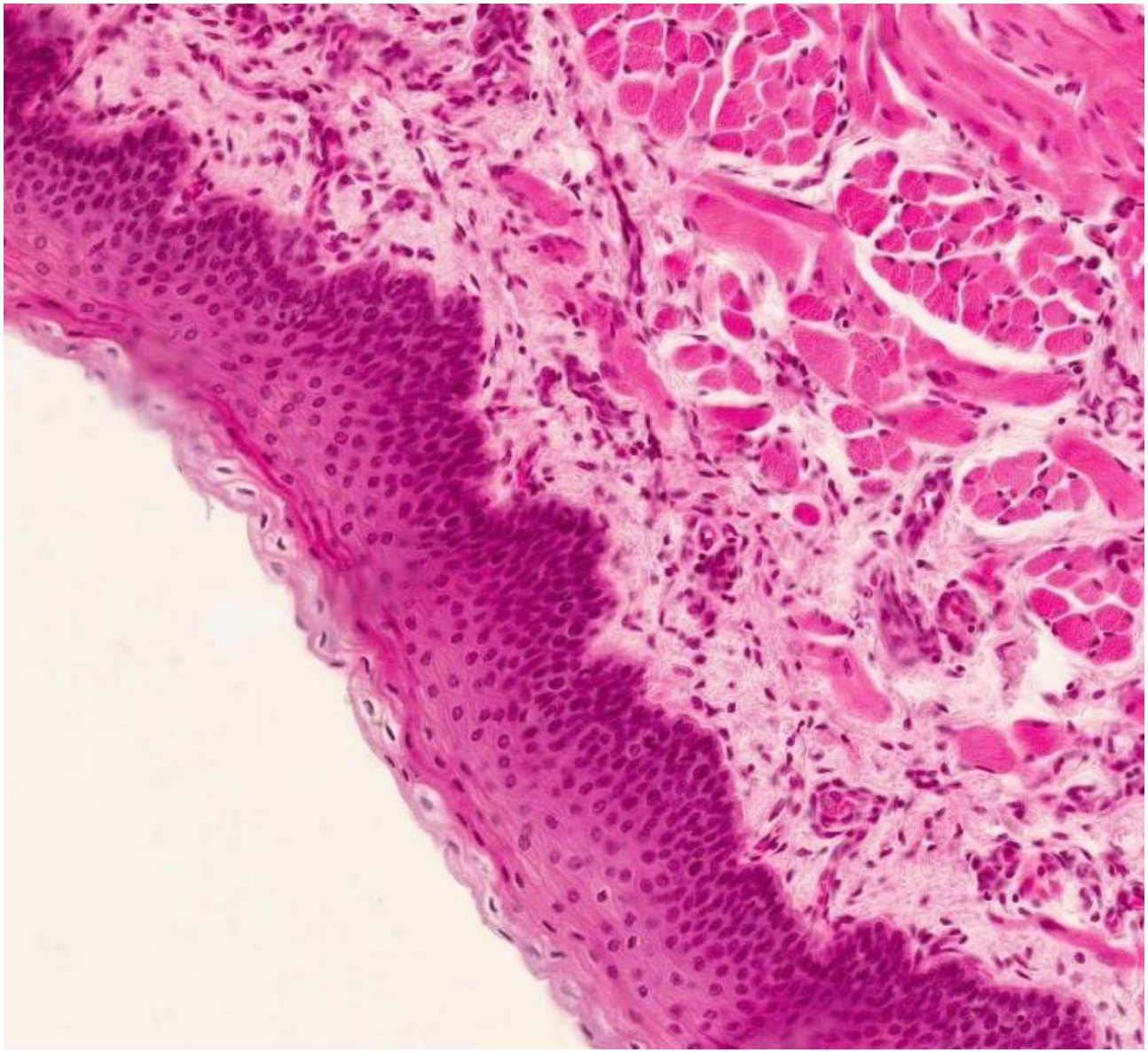
TONGUE – MUSCLES



TONGUE – GLL. LINGUALES ANTERIORES (BLANDINI)

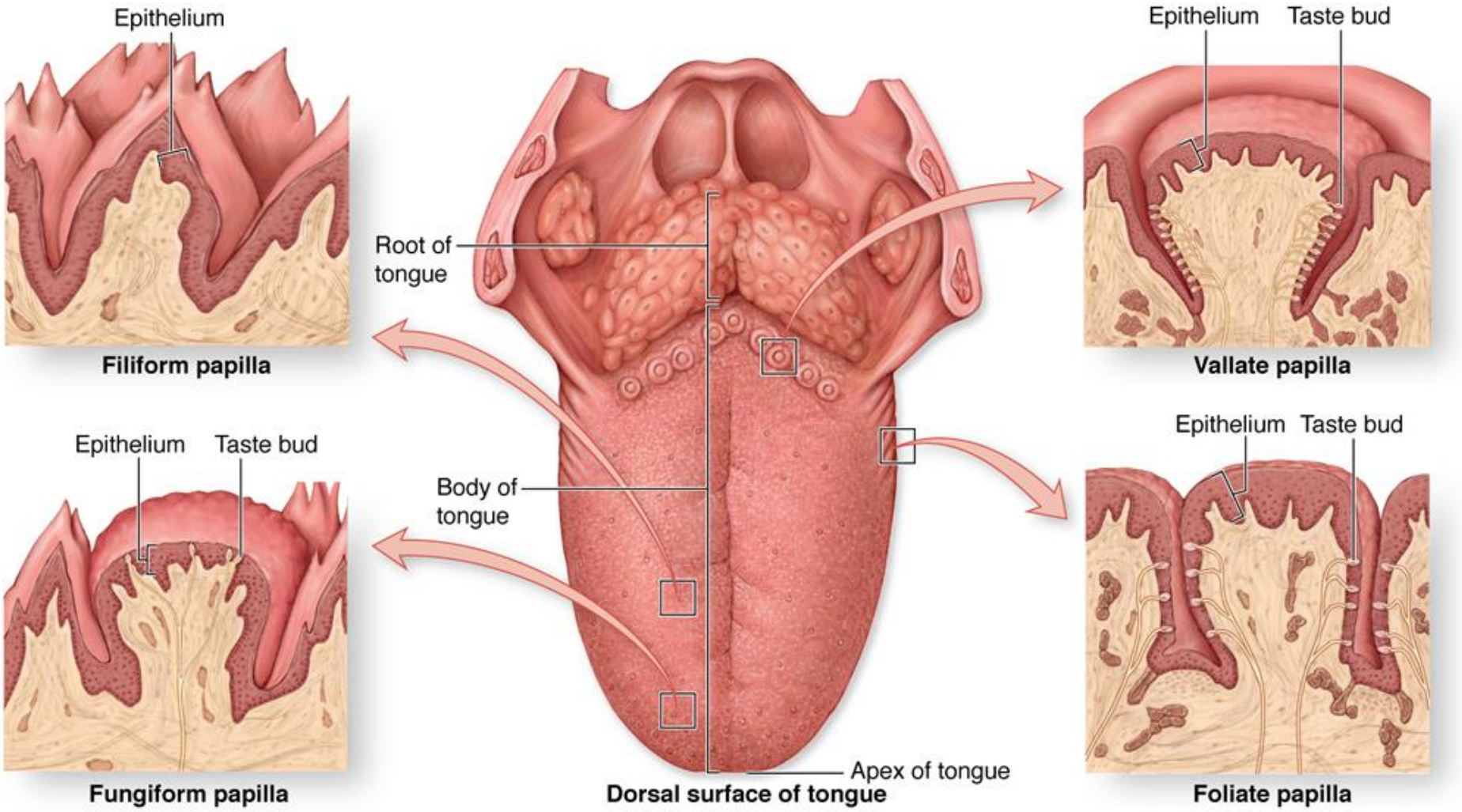


TONGUE – FACIES MYLOHYOIDEA

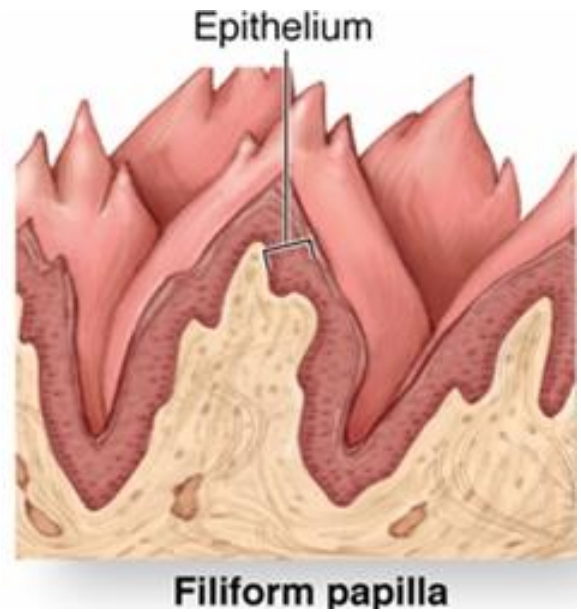


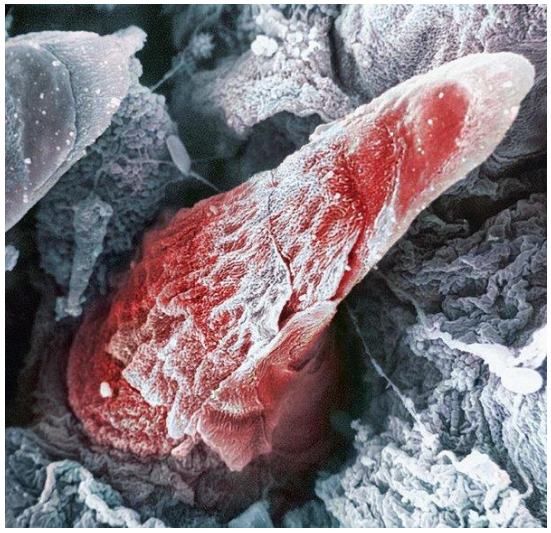
TONGUE – DORSUM LINGUAE

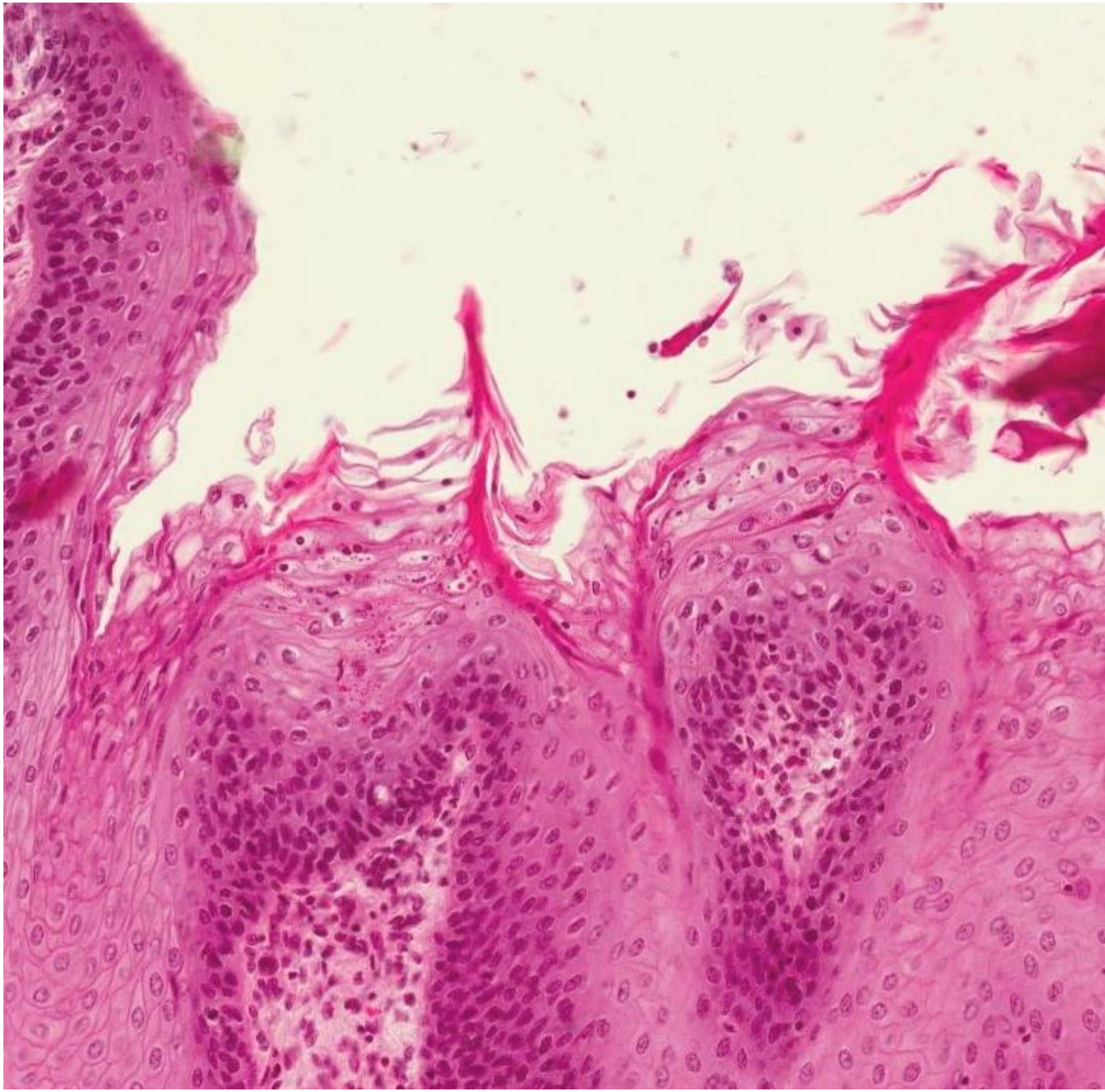
- specialized mucosal structures - **papillae**
- submucosal C.T. is absent



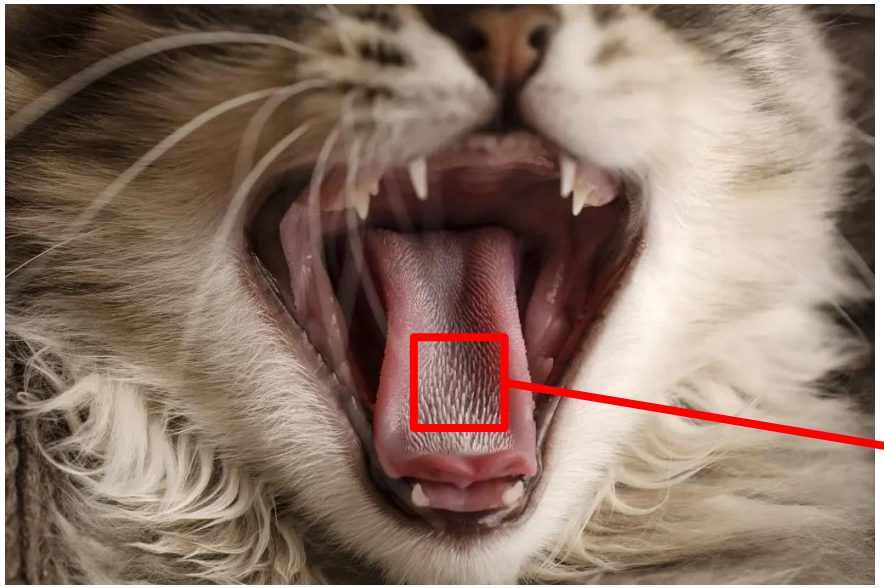
TONGUE – FILLIFORM PAPILLAE

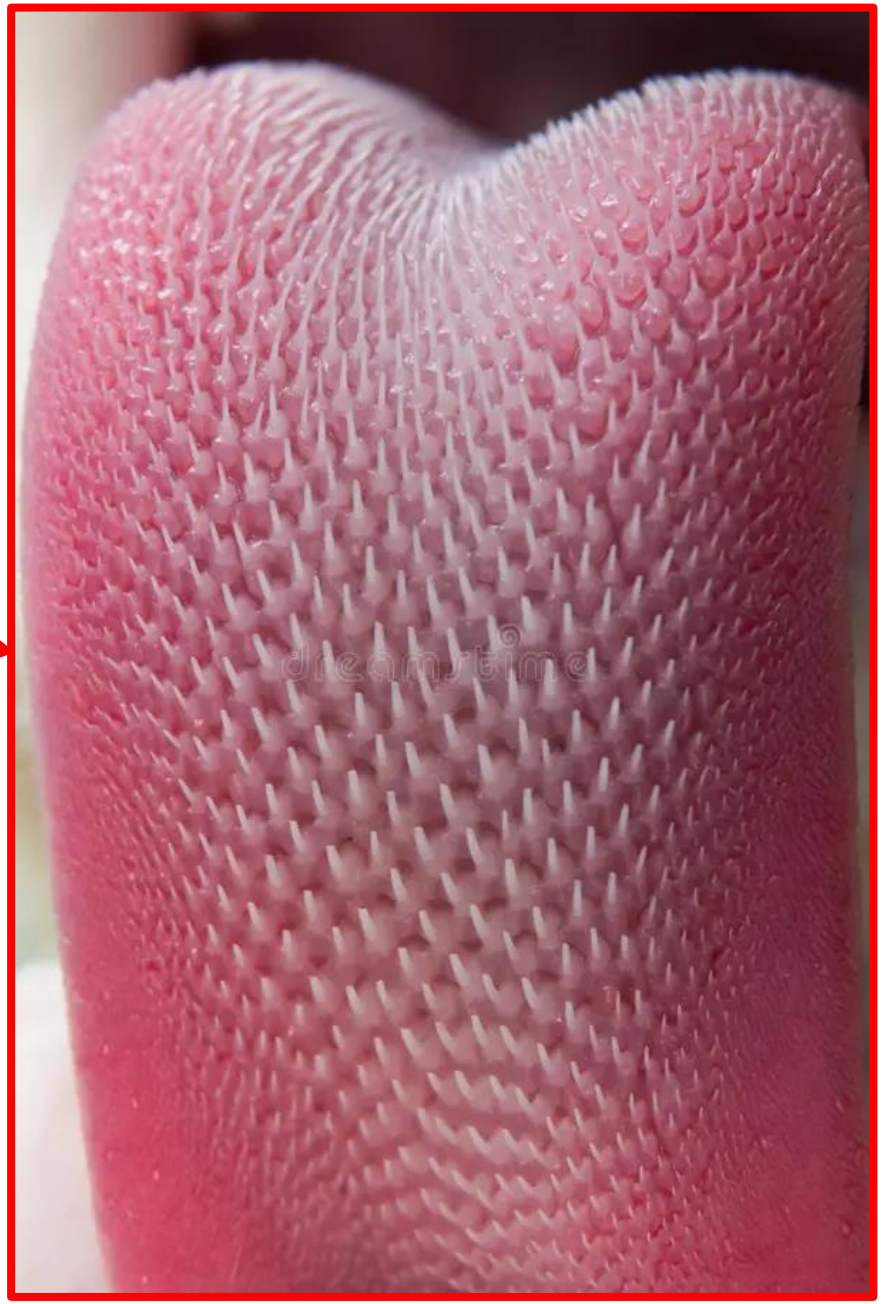




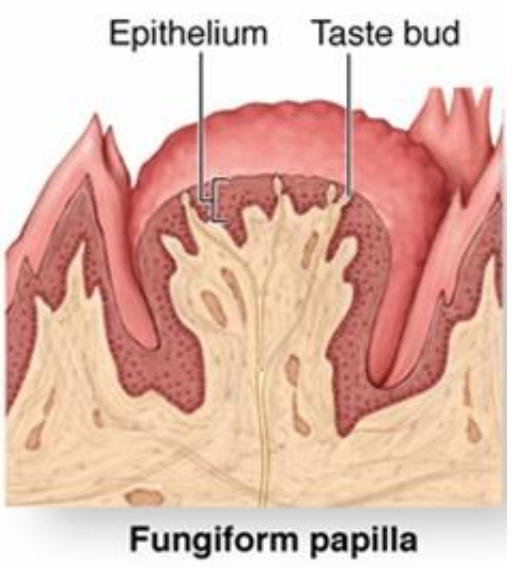


TONGUE – FILLIFORM PAPILLAE

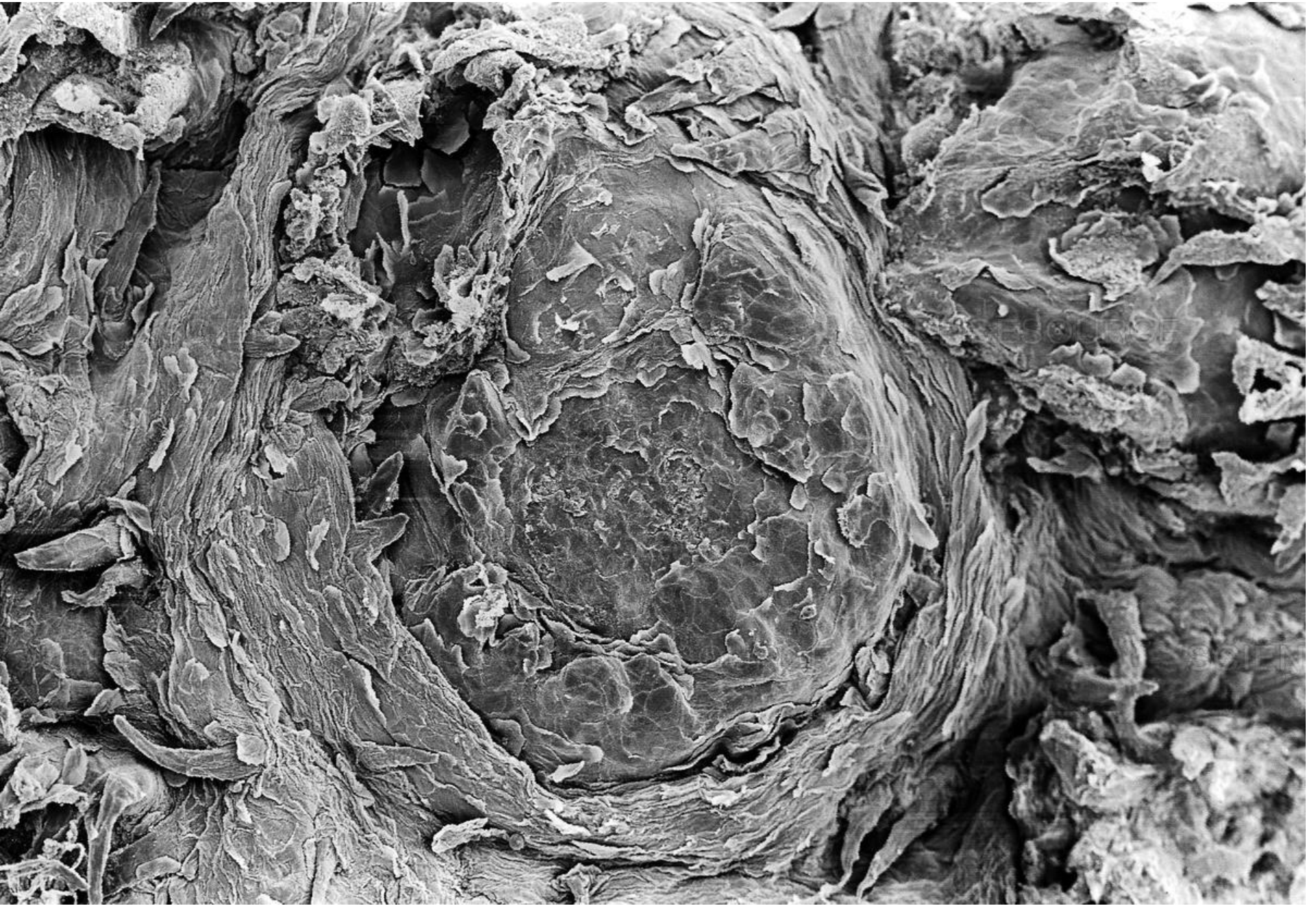




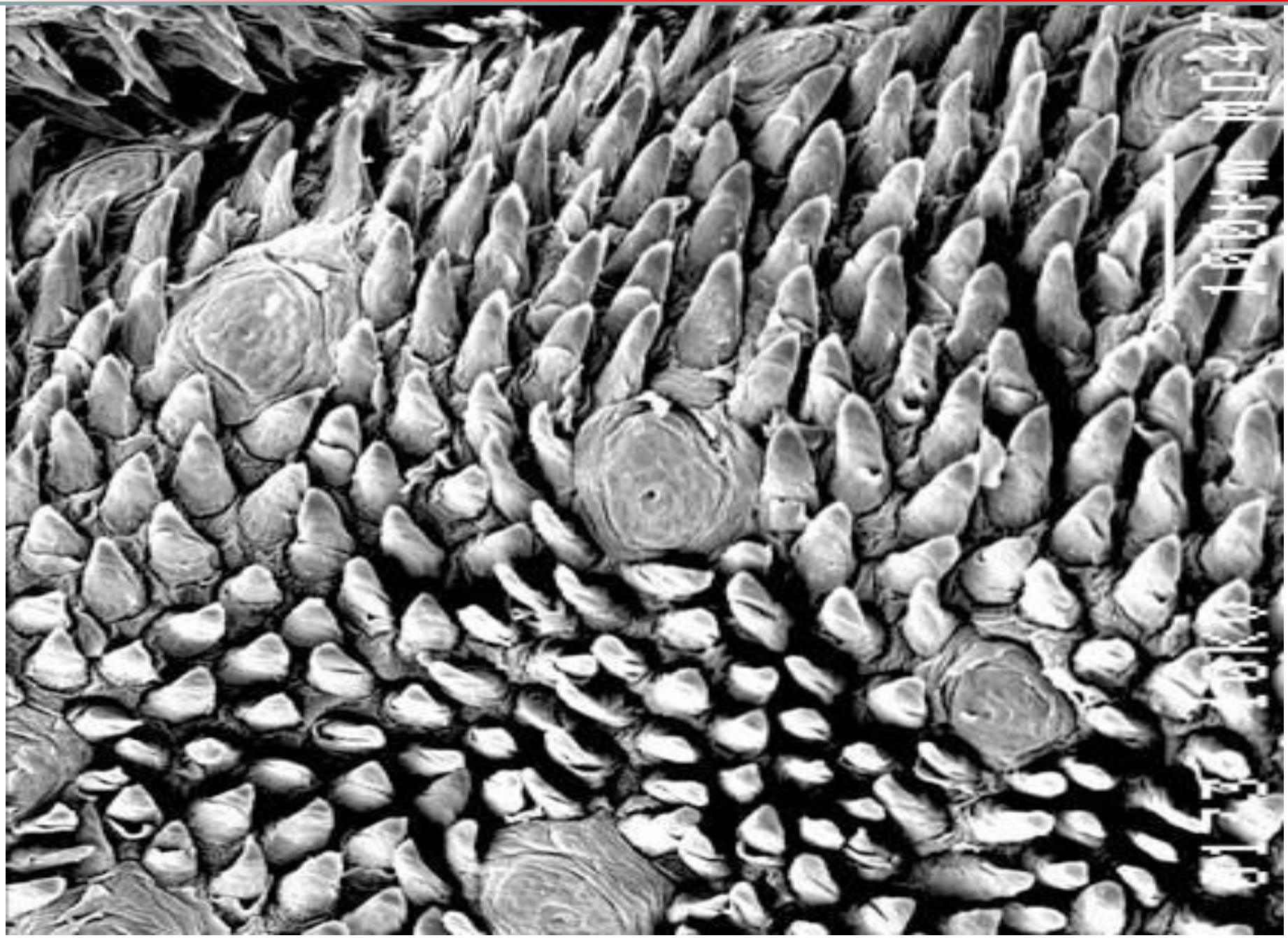
TONGUE – FUNGIFORM PAPILLAE



TONGUE – FUNGIFORM PAPILLAE

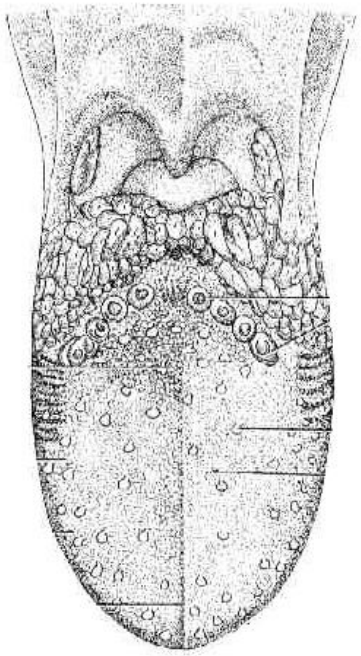


TONGUE – FILLIFORM AND FUNGIFORM PAPILLAE

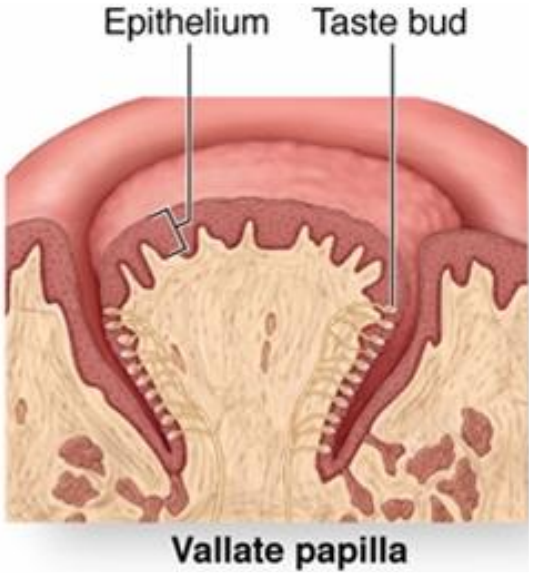


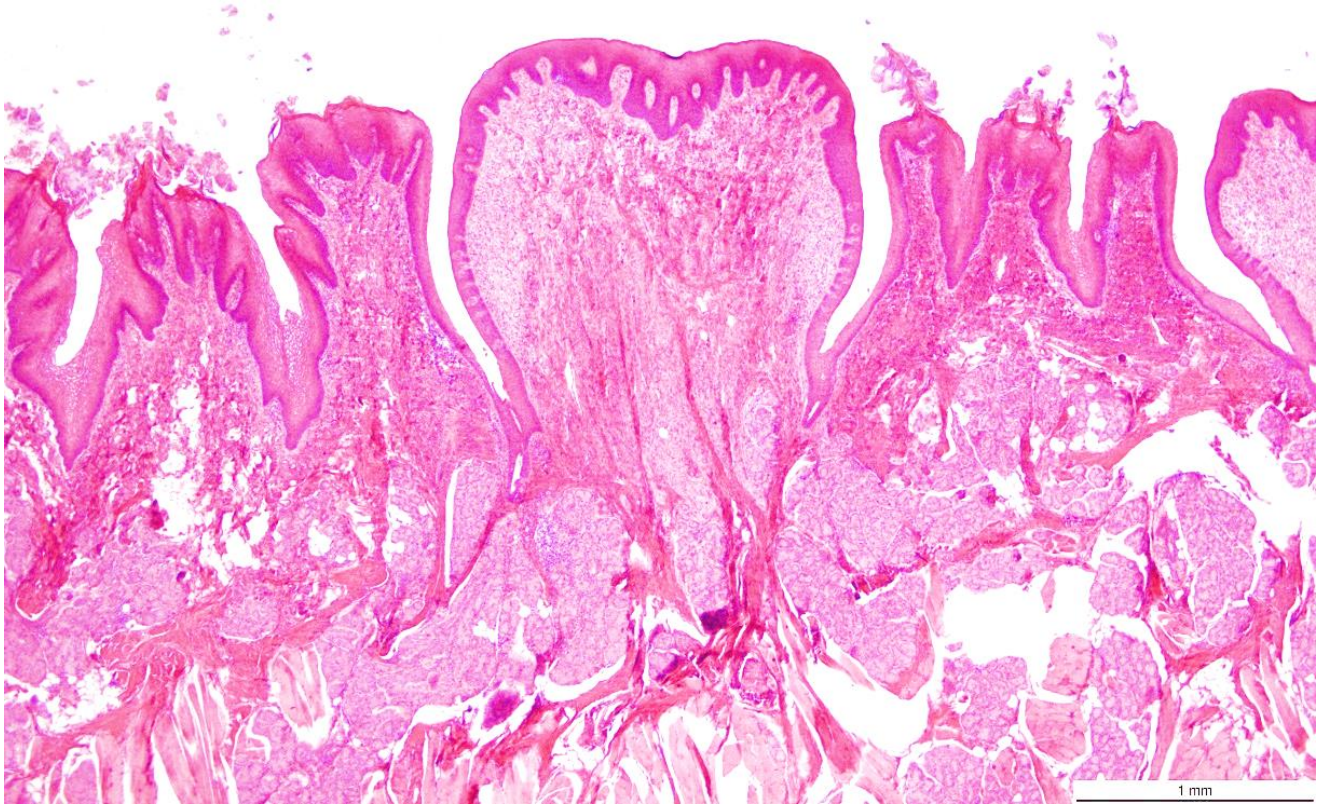
TONGUE – FOLIATE PAPILLAE

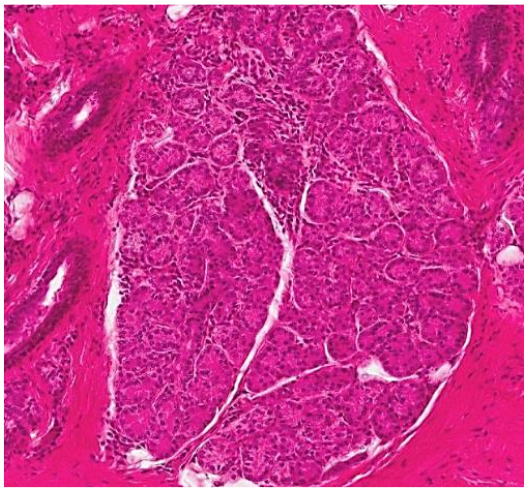
Foliate papilla



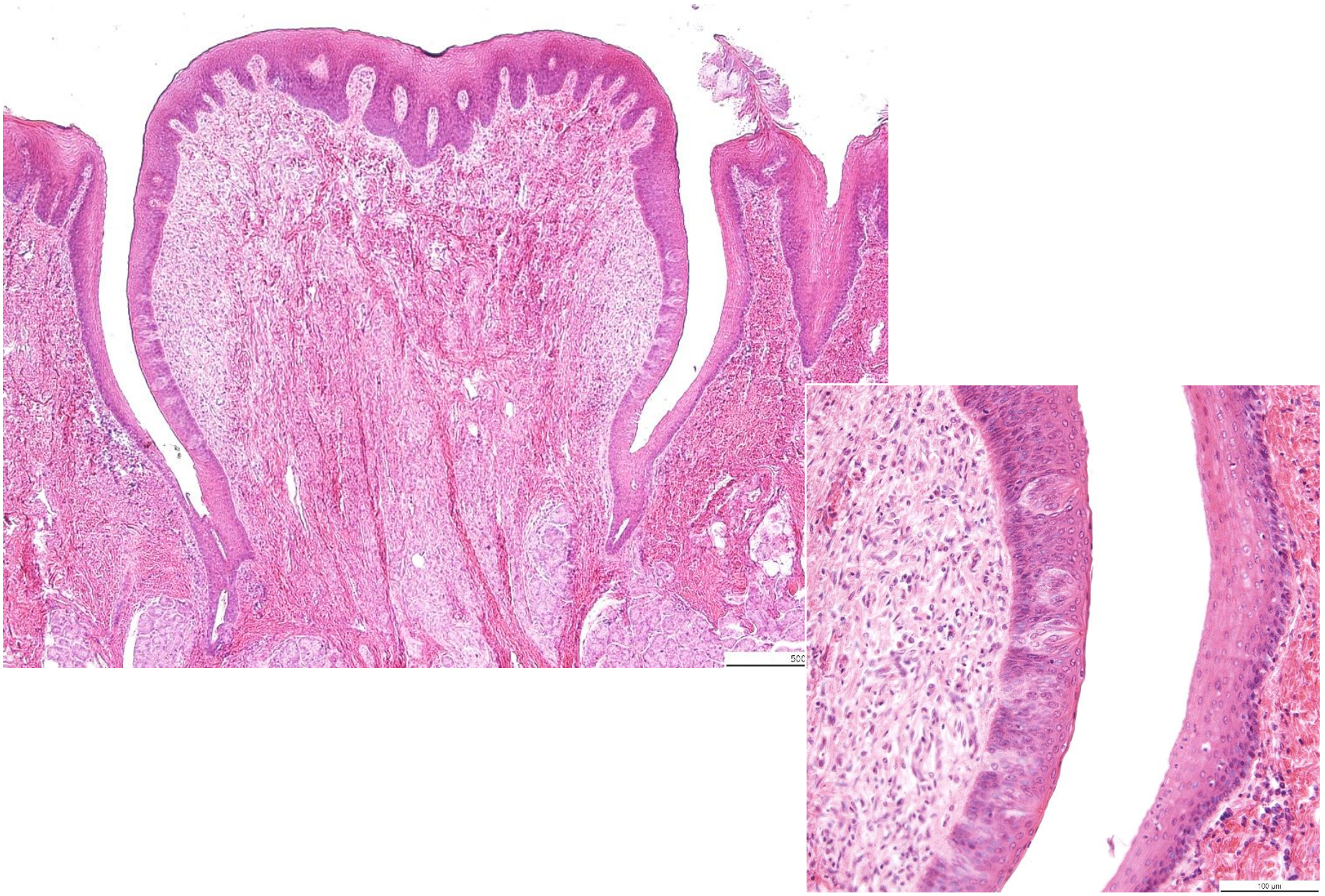
TONGUE – VALLATE PAPILLAE



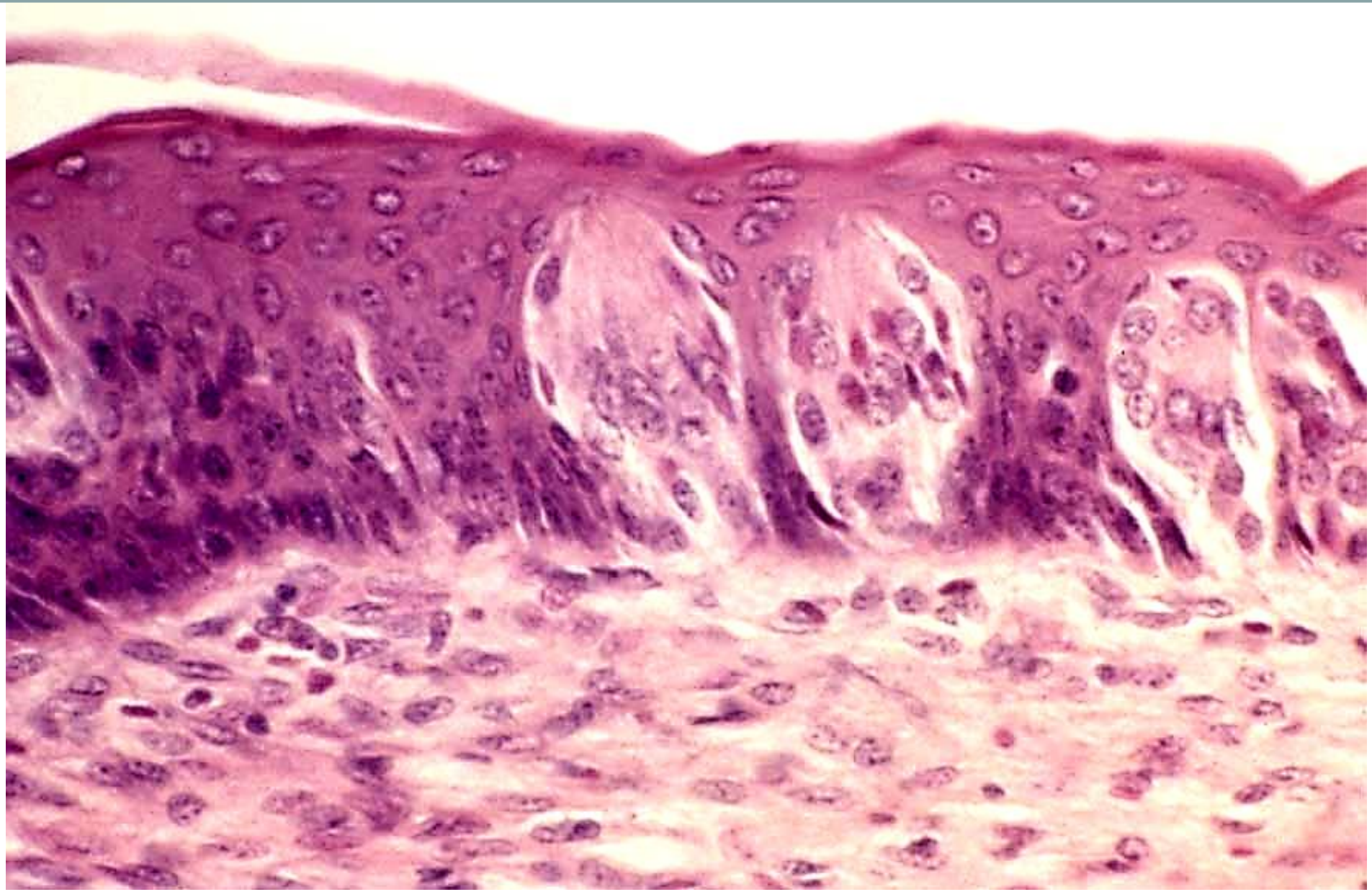




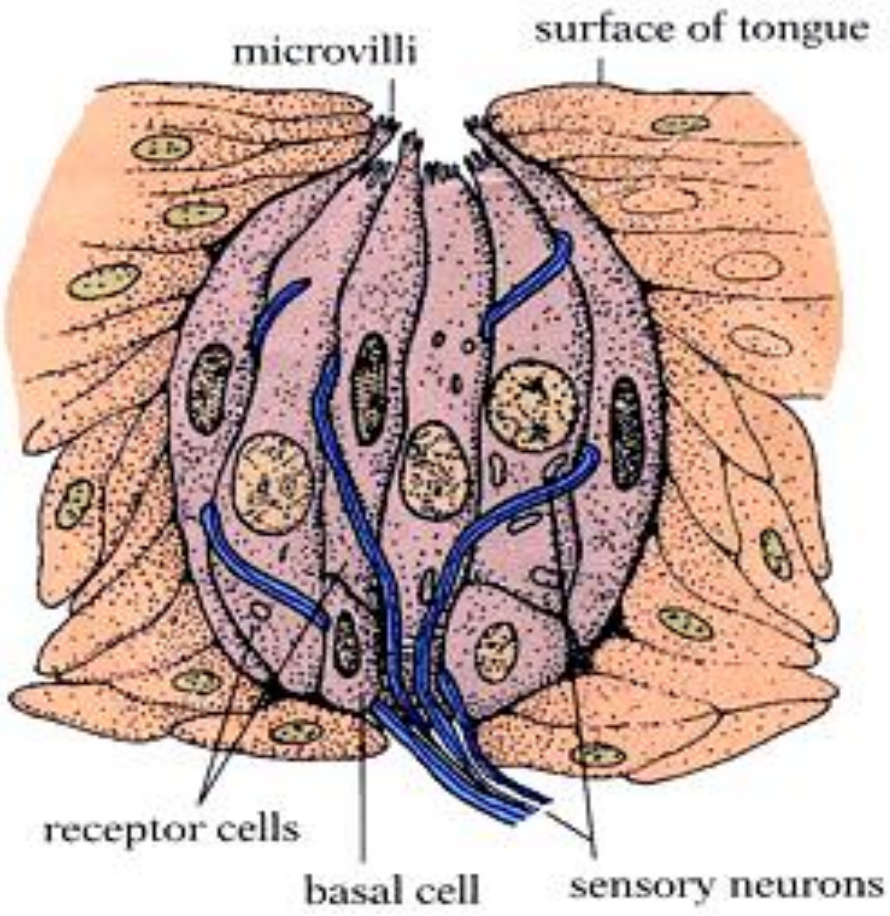
TONGUE – VALLATE PAPILLAE



TONGUE – TASTE BUDS

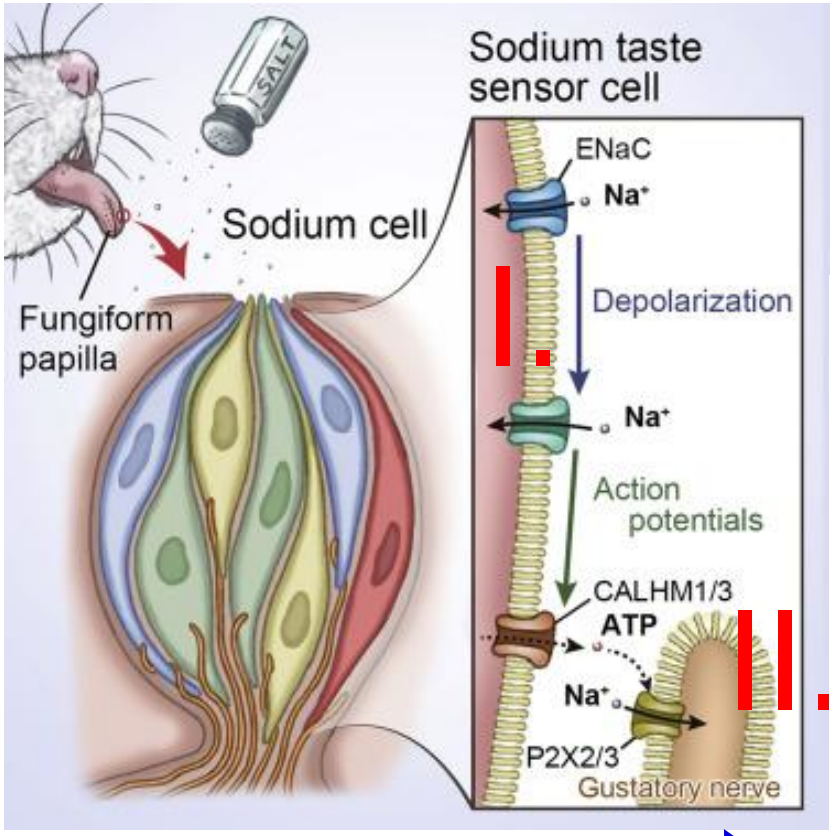


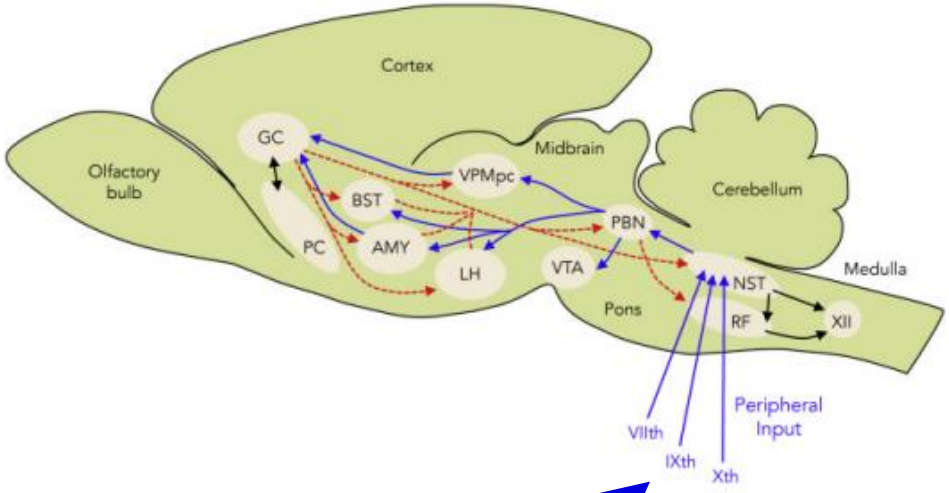
TONGUE – TASTE BUD



- Intraepithelial
- porus gustatorius
- 2000-8000 in oral cavity
- 60-80 cells
- 70-80 μm × 30-40 μm
- microvilli on sensory cells
- nerve fibers

TONGUE – TASTE BUD



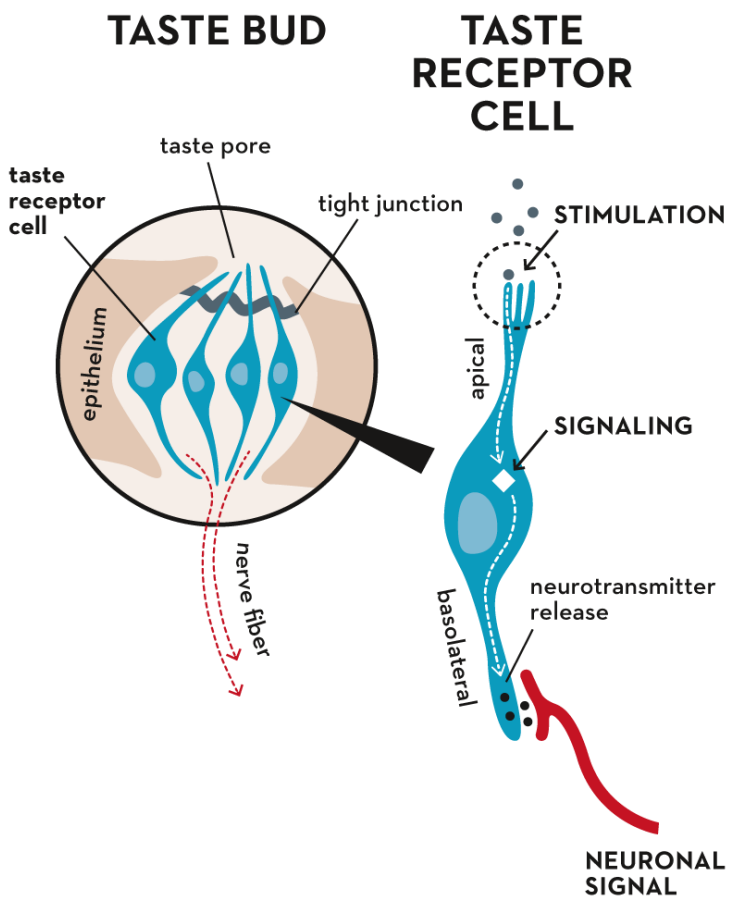


- secondary sensory epithelium

- n. vagus
- n. facialis
- n. glossopharyngeus

doi.org/10.1016/j.neuron.2020.03.006

TONGUE – TASTE BUD

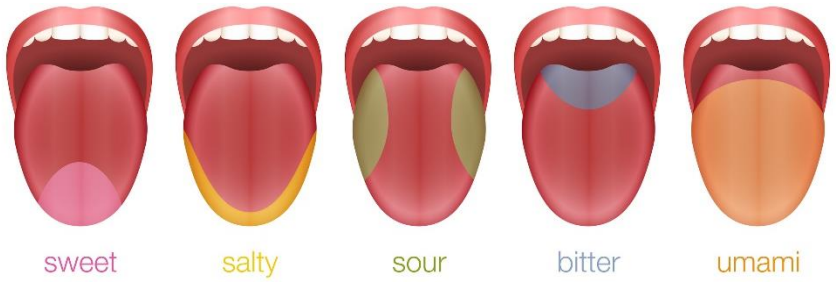


- bitter
- sweet
- umami (glutamate)
- G-protein-coupled receptors

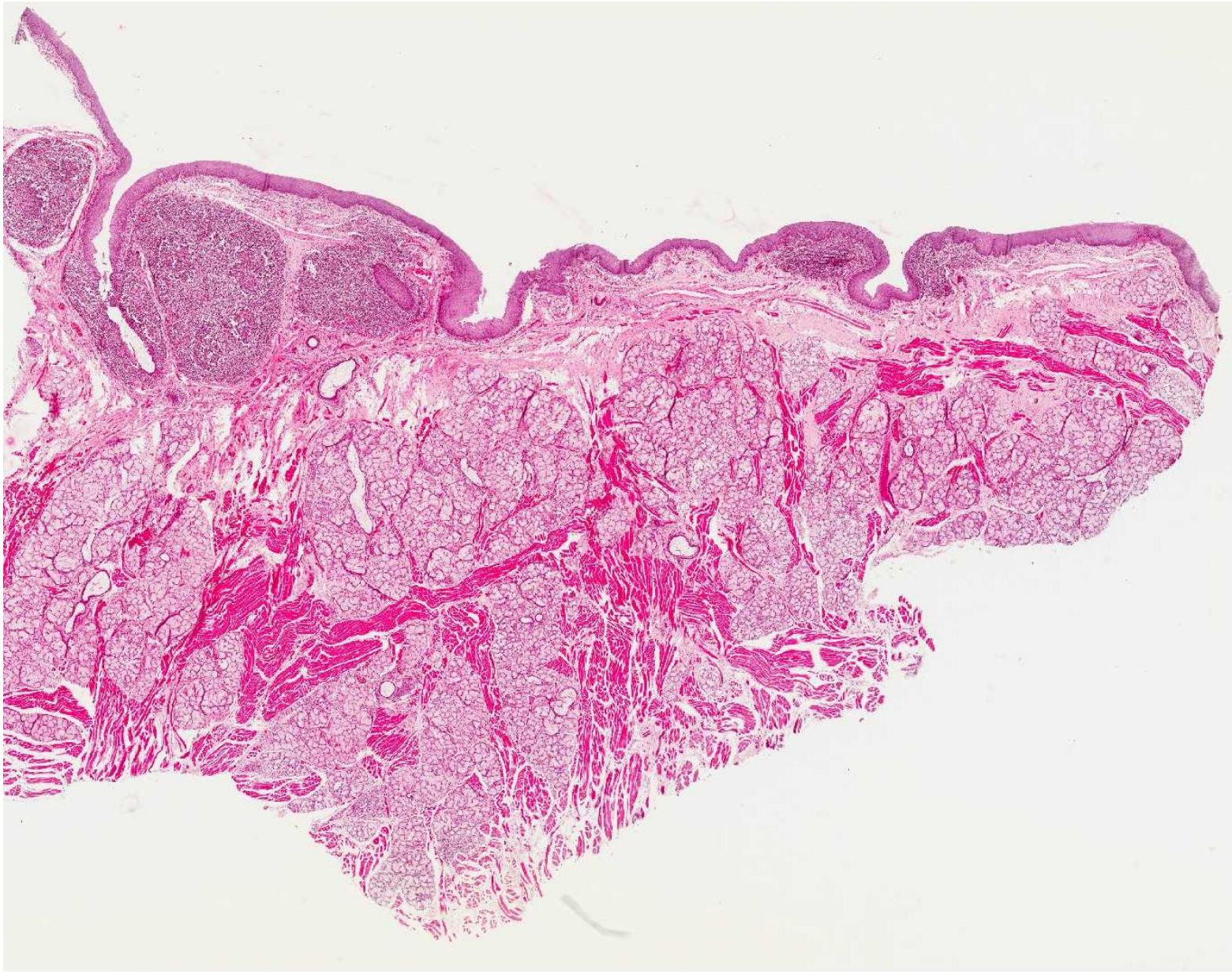
- salt
- acid
- ion channels

- CD36
- fatty acid transporter

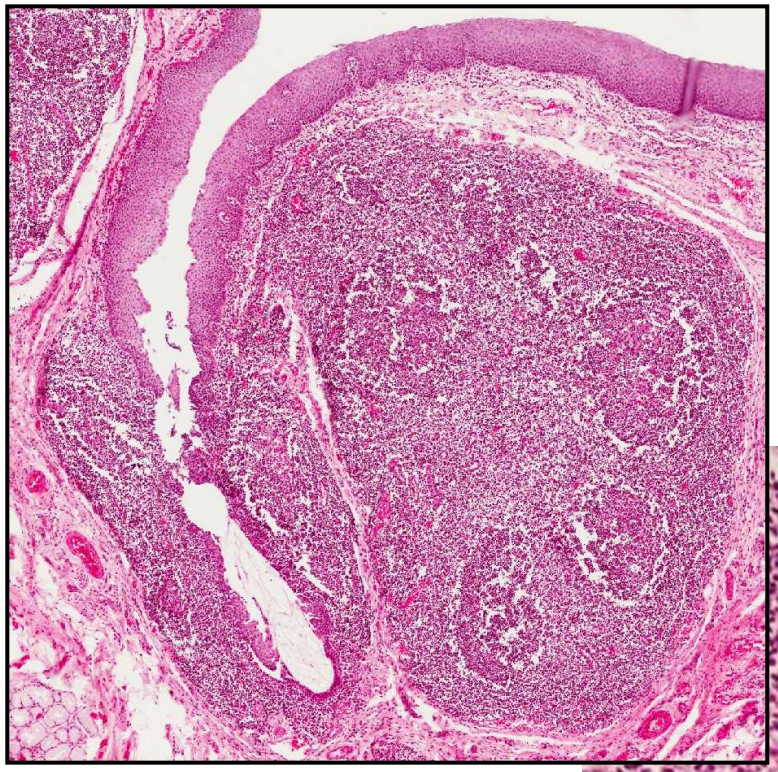
- in taste sensing olfactory epithelium is involved

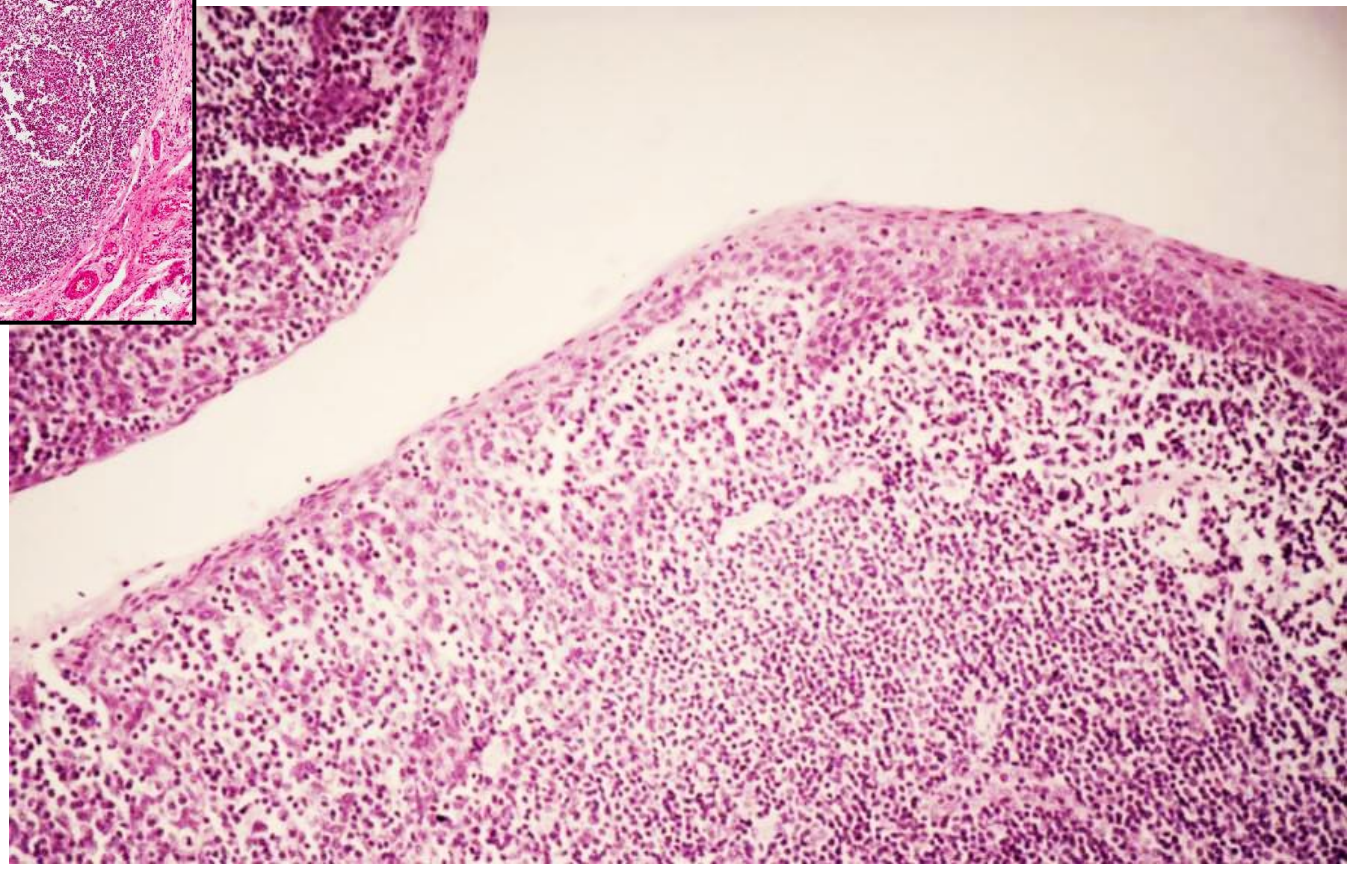


TONGUE – RADIX, TONSILLA LINGUALIS

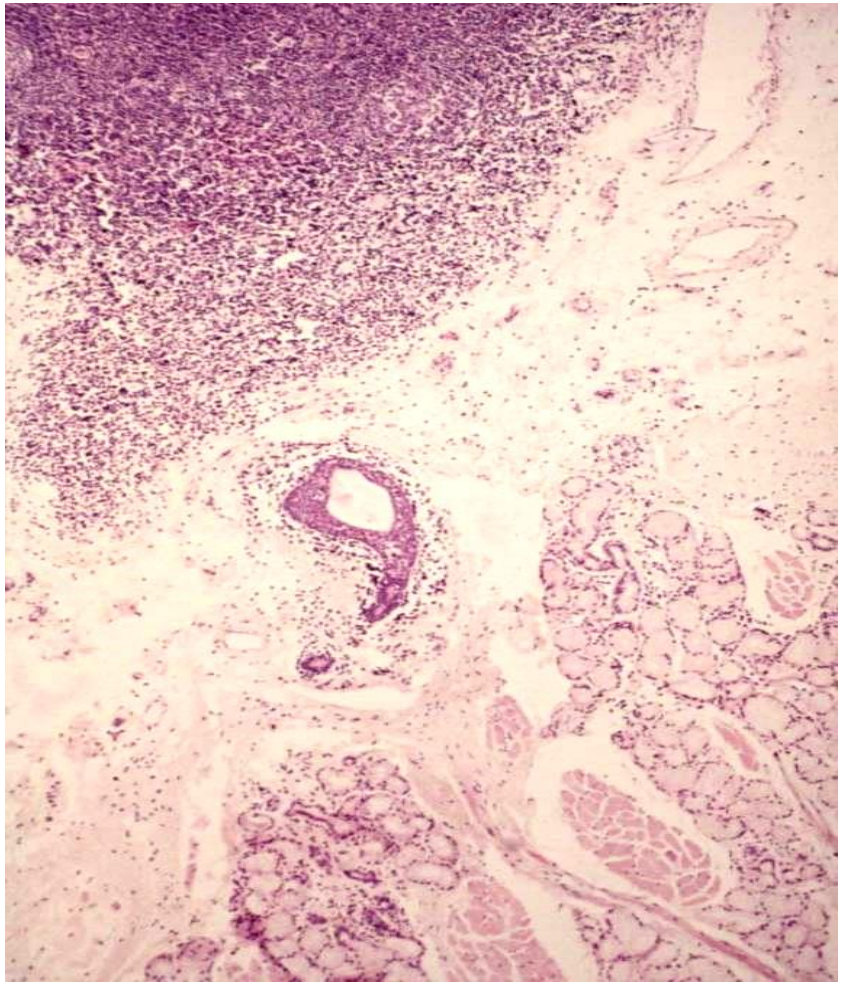


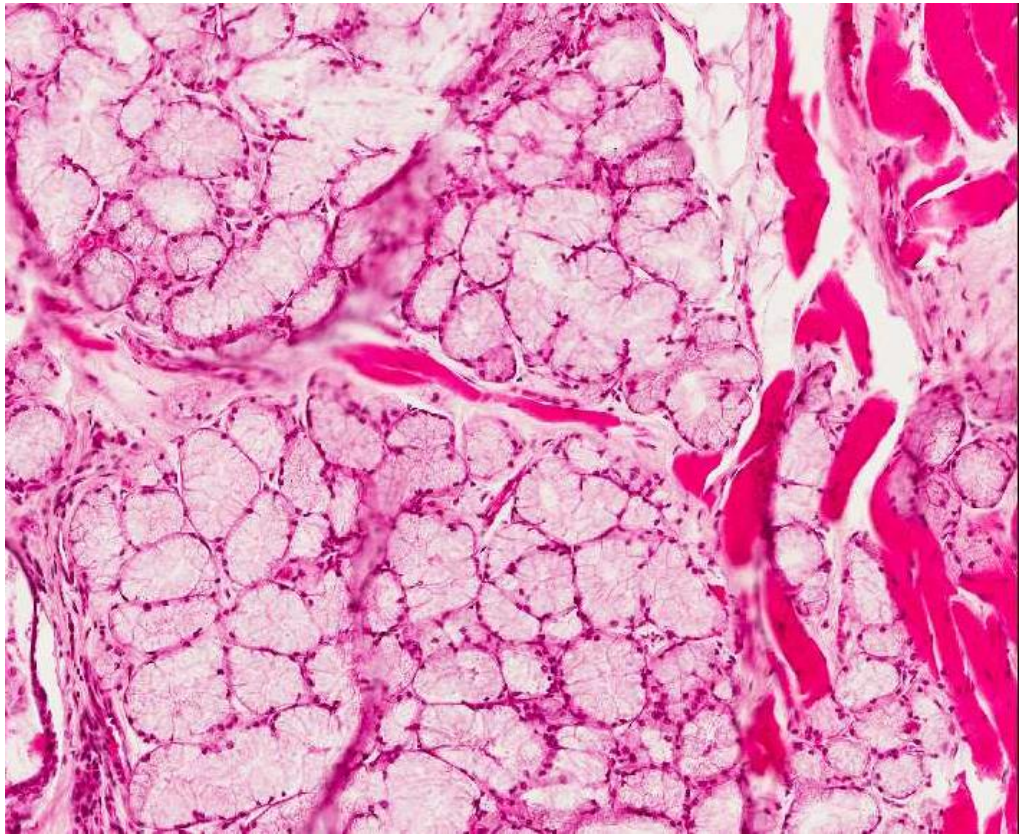
TONGUE – RADIX, TONSILLA LINGUALIS



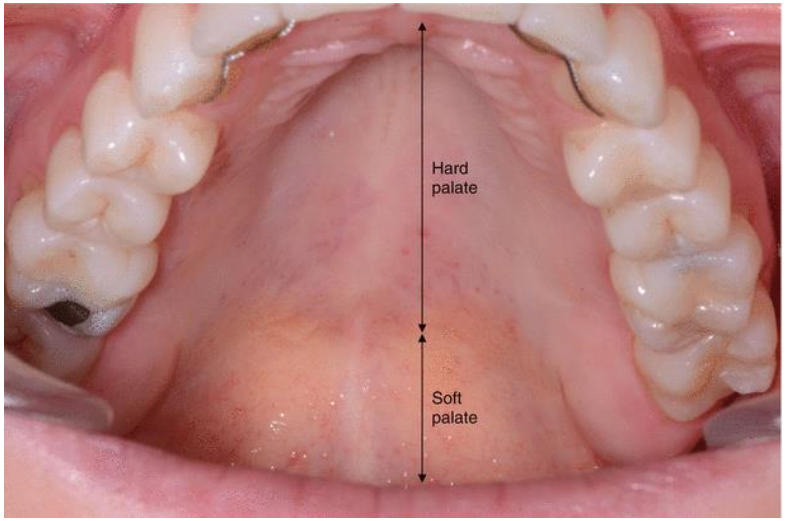


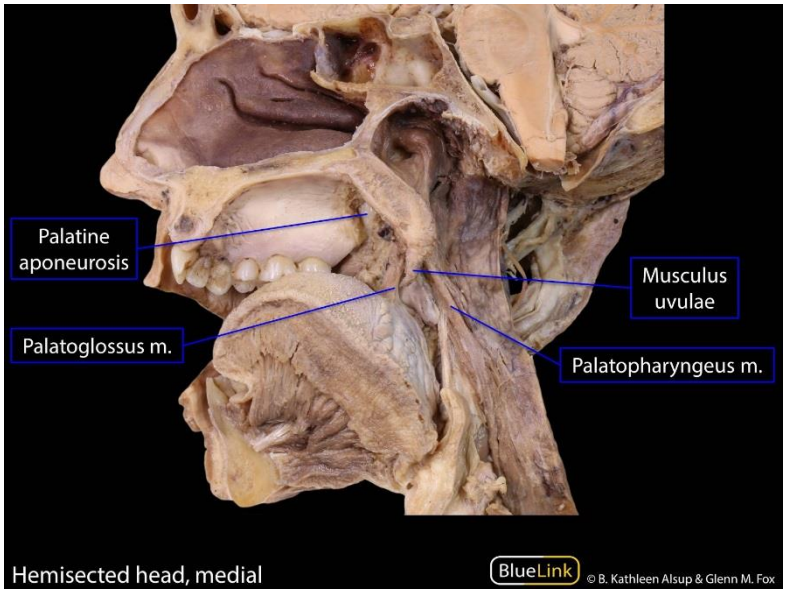
TONGUE – RADIX, TONSILLA LINGUALIS, WEBER'S GLANDS

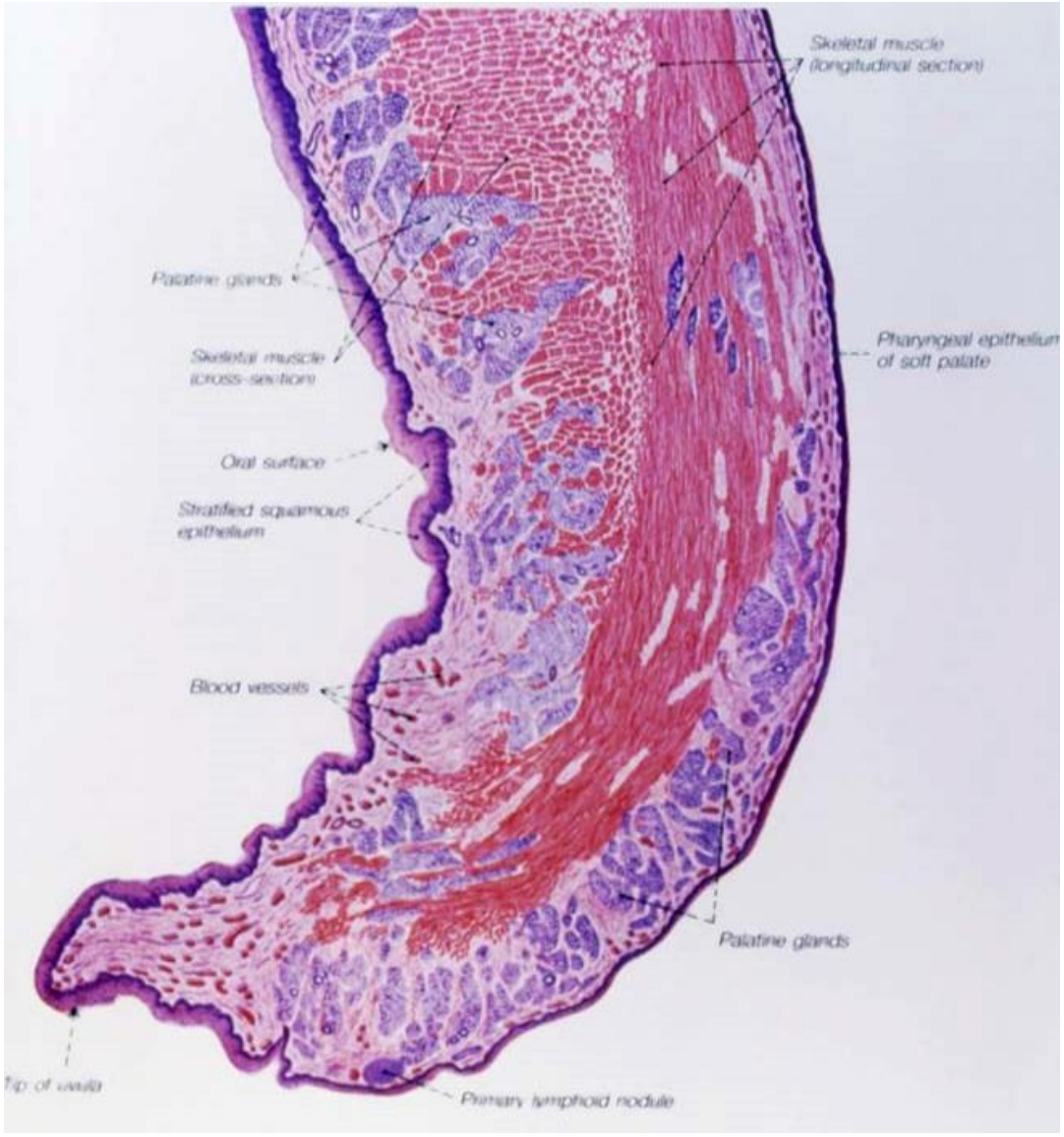




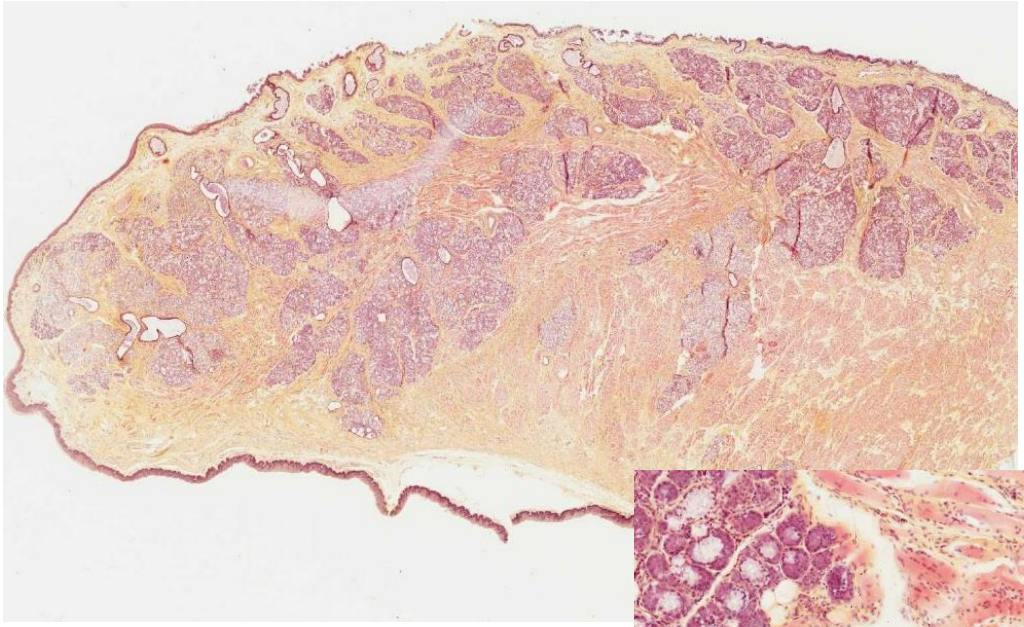
PALATE

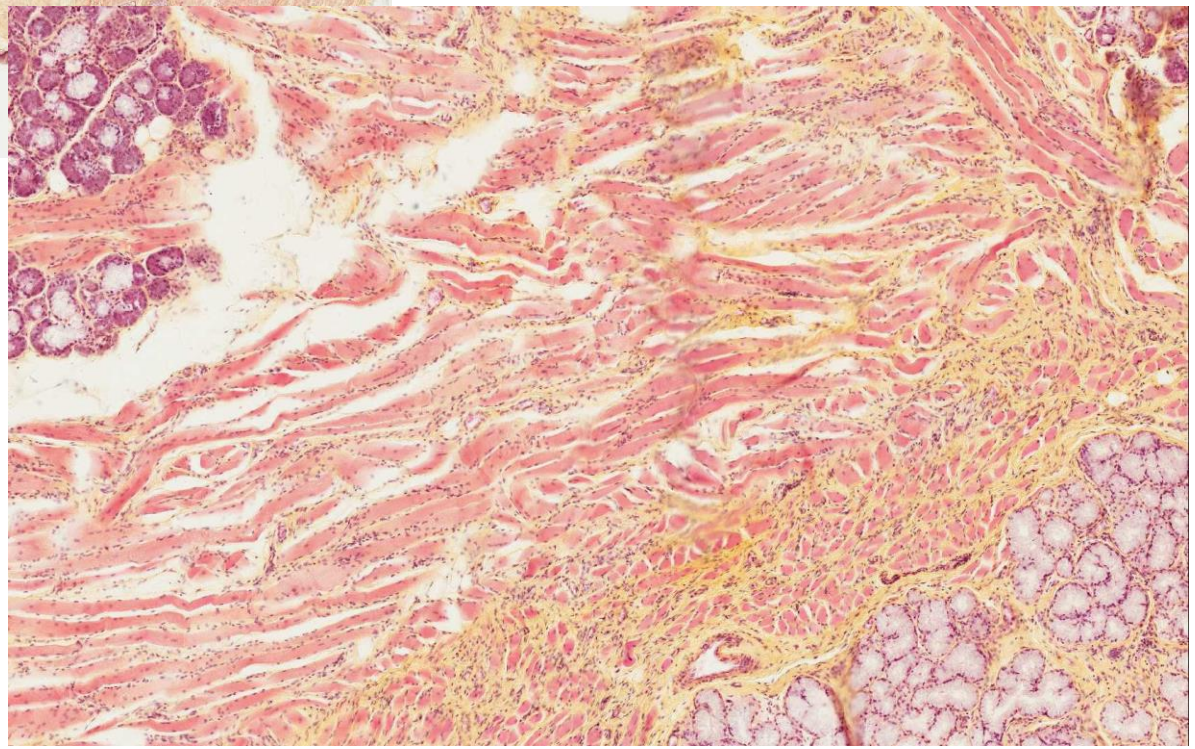

Hard palate
Soft palate


Palatine aponeurosis
Musculus uvulae
Palatoglossus m.
Palatopharyngeus m.
Hemisected head, medial
BlueLink
© B. Kathleen Alsup & Glenn M. Fox

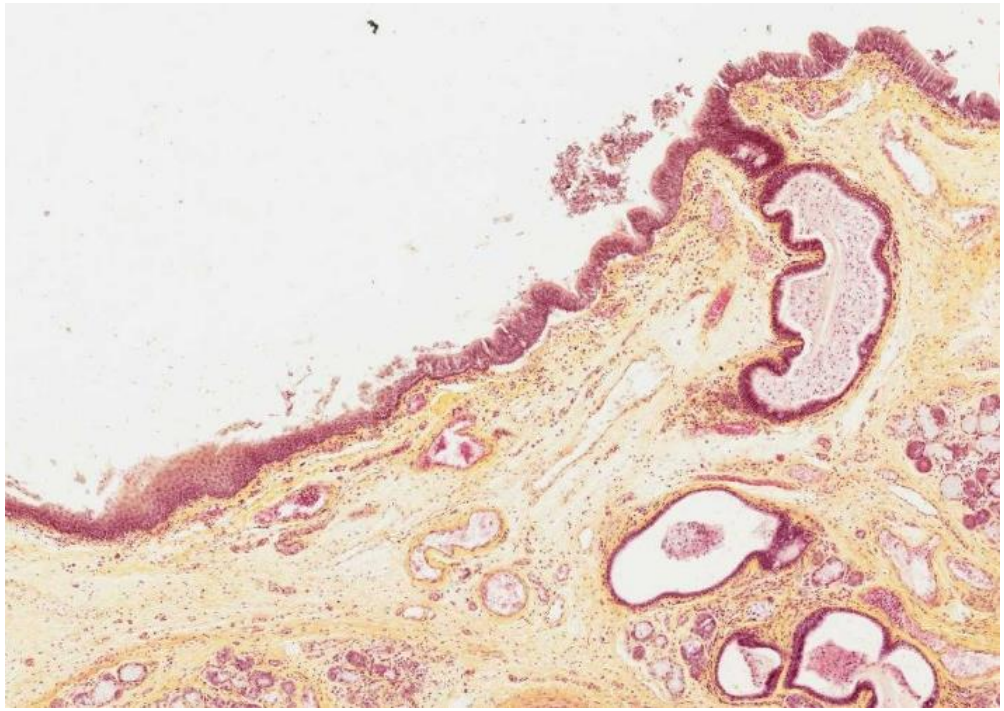

Skeletal muscle (longitudinal section)
Palatine glands
Skeletal muscle (cross-section)
Pharyngeal epithelium of soft palate
Oral surface
Stratified squamous epithelium
Blood vessels
Palatine glands
Primary lymphoid nodule

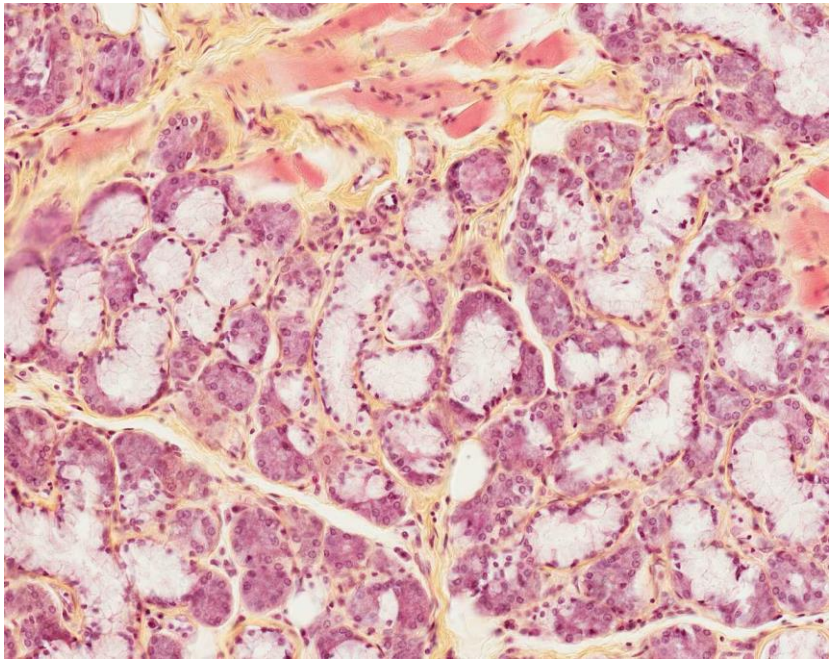
SOFT PALATE

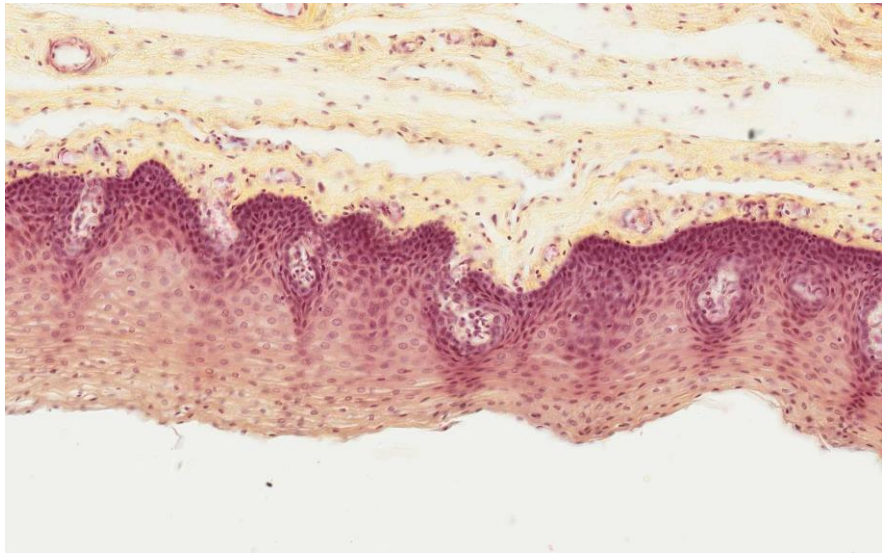


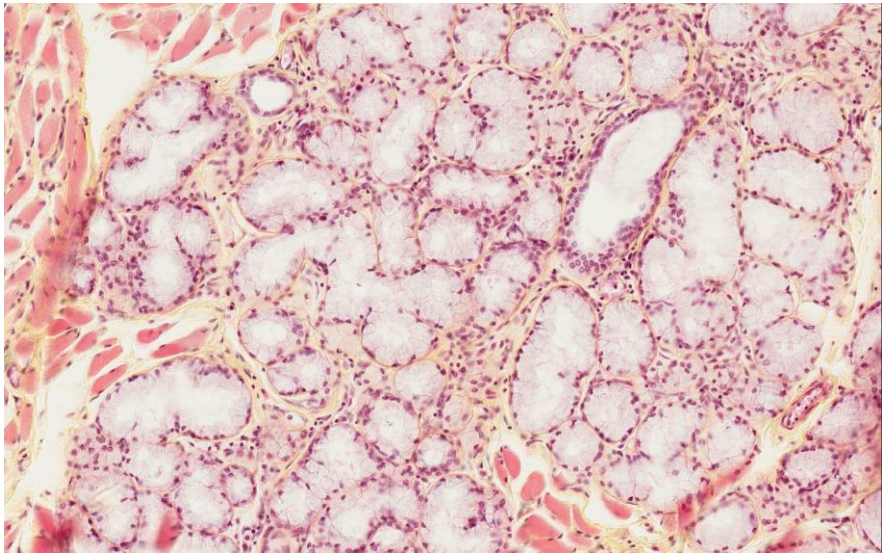


SOFT PALATE

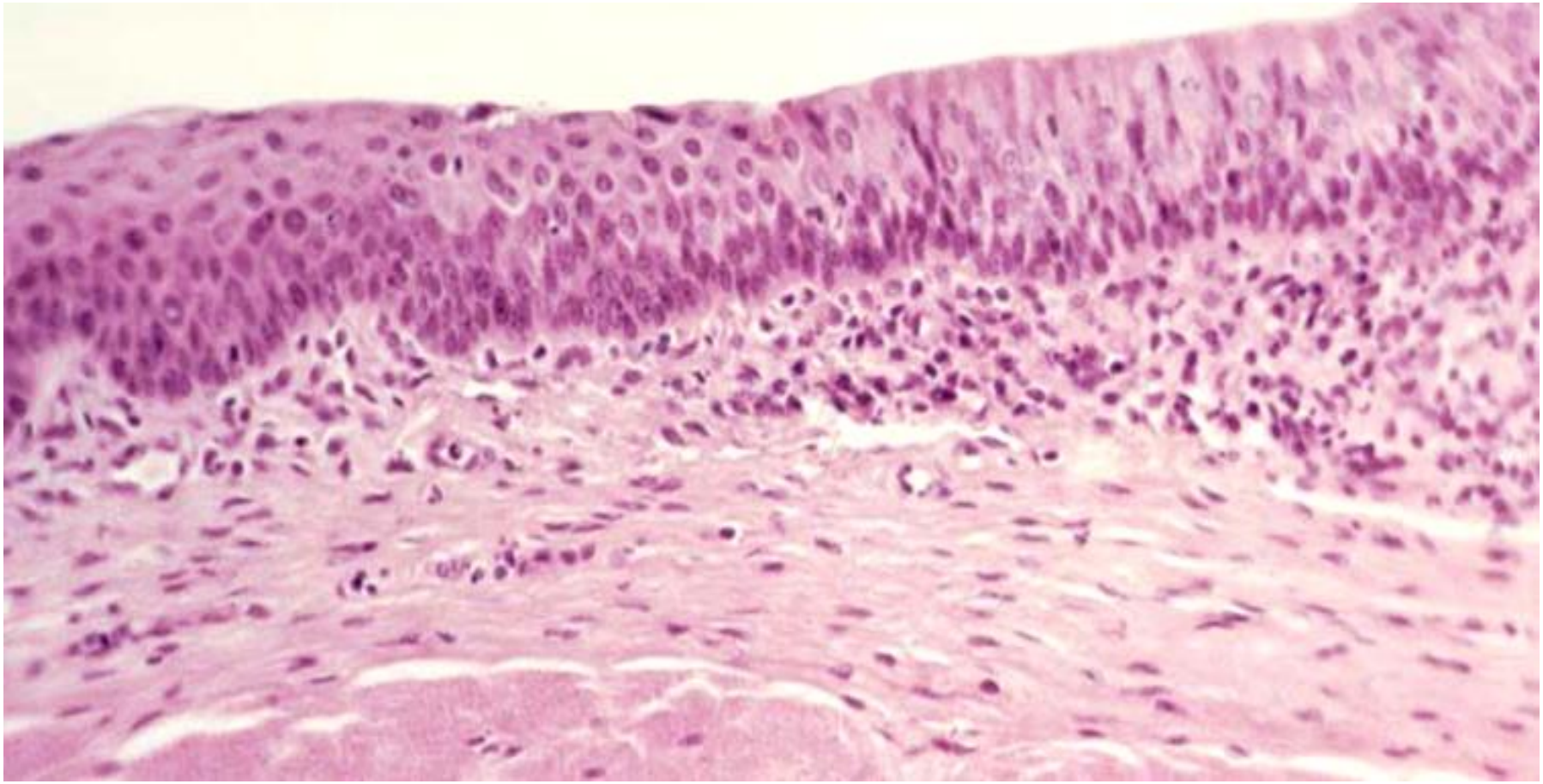




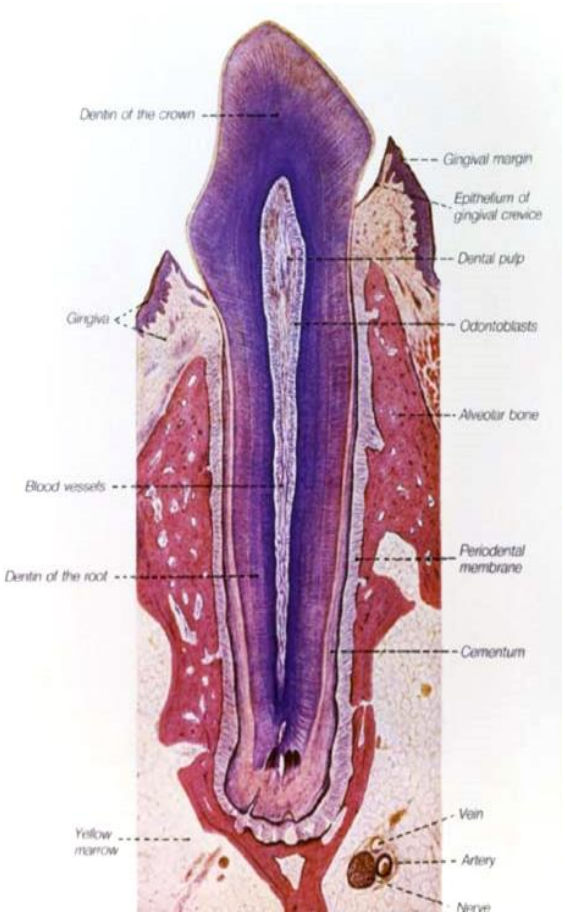




SOFT PALATE – EPITHELIAL CHANGE

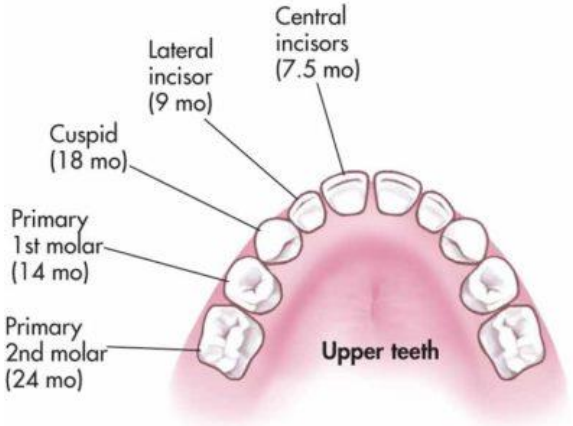


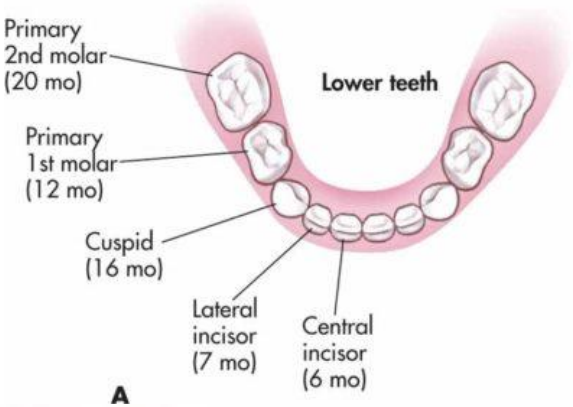
TOOTH



- Anatomical × clinical crown
- Neck (cementoenamel junction)
- Root

DECIDUAL AND PERMANENT TEETH





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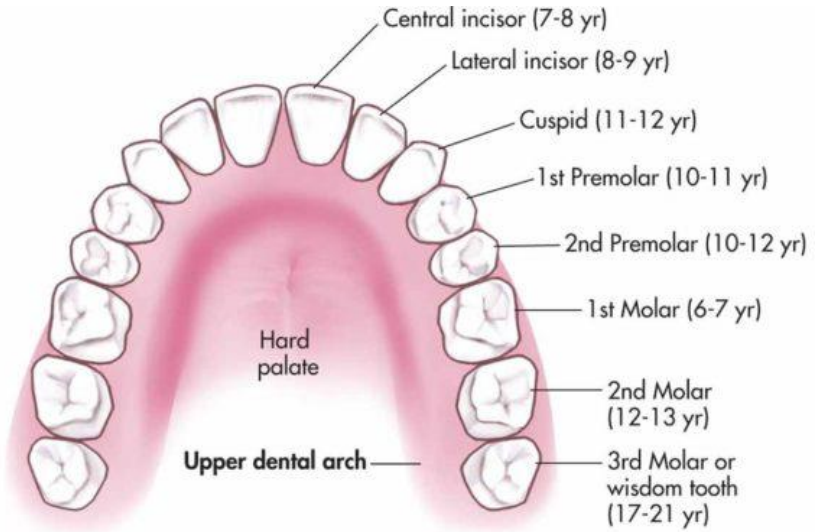
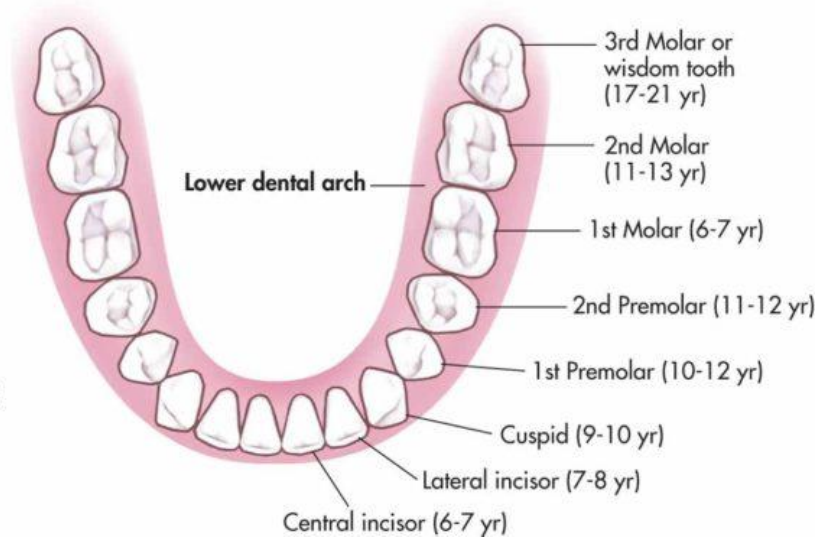




B

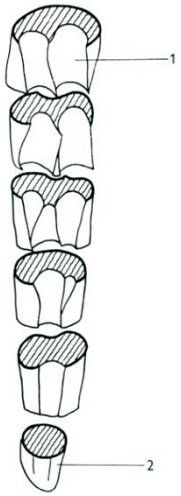
Vzorec mléčného chrupu:

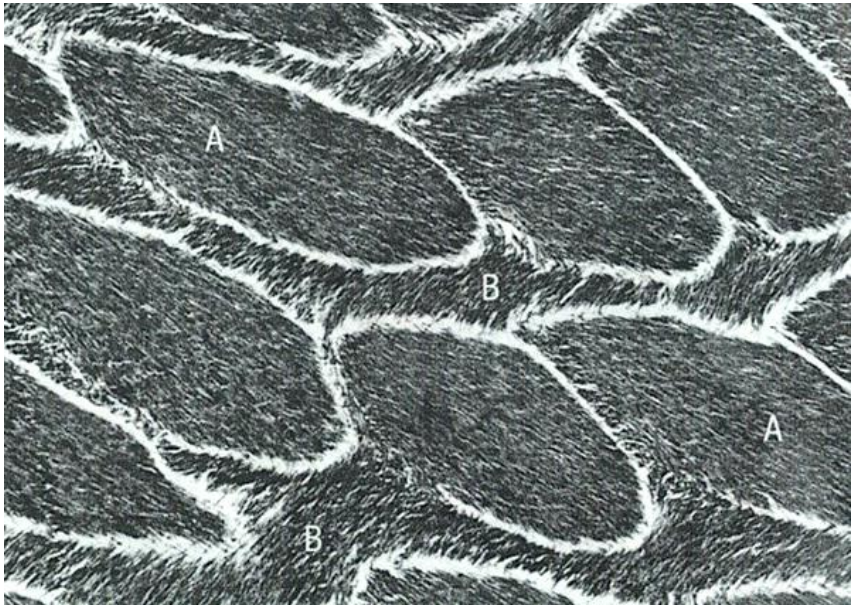
$m_2\ m_1\ c\ i_2\ i_1$	$i_1\ i_2\ c\ m_1\ m_2$
$m_2\ m_1\ c\ i_2\ i_1$	$i_1\ i_2\ c\ m_1\ m_2$

Vzorec definitivního chrupu:

$M_3\ M_2\ M_1\ P_2\ P_1\ C\ I_2\ I_1$	$I_1\ I_2\ C\ P_1\ P_2\ M_1\ M_2\ M_3$
$M_3\ M_2\ M_1\ P_2\ P_1\ C\ I_2\ I_1$	$I_1\ I_2\ C\ P_1\ P_2\ M_1\ M_2\ M_3$

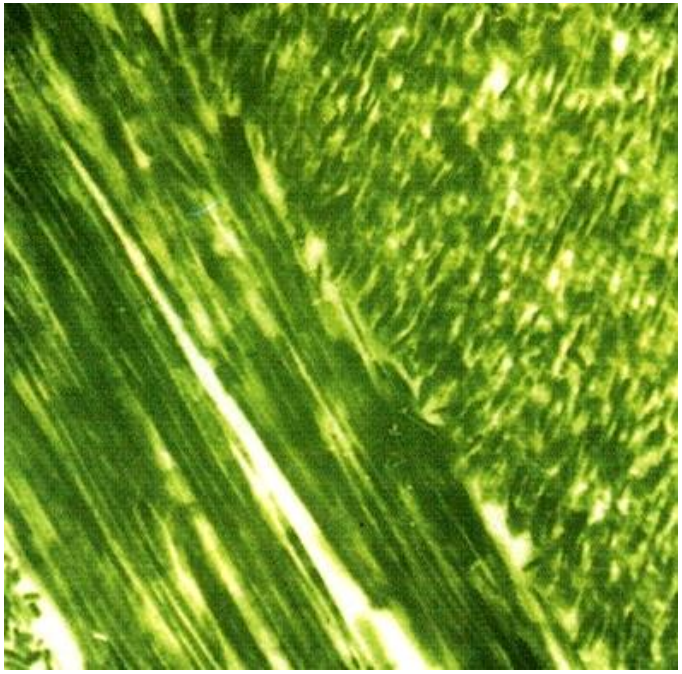
TOOTH – ENAMEL



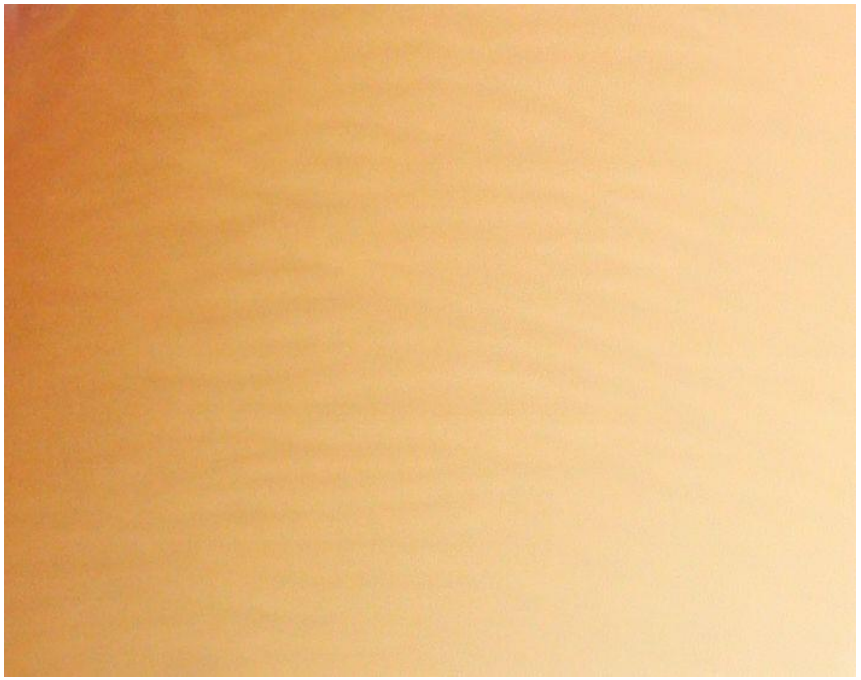


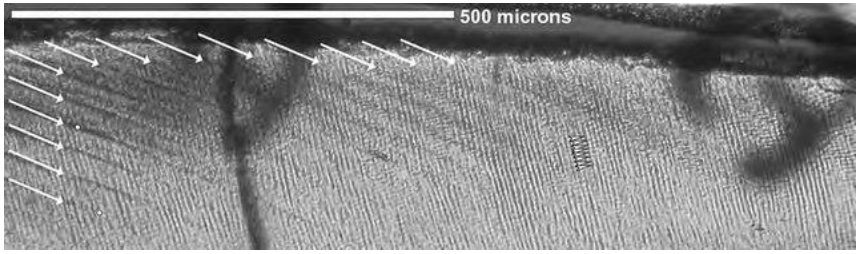
<u>Enamel</u>, 1-2 mm

- Covers the crown
- Made by ameloblasts, but after eruption acellular
- No regeneration
- 96% Ca-hydroxyapatite, enamel prisms
- Enamelins, amelogenins, ameloblastins
- Striae of *Retzius* (incremental growth lines)



TOOTH – ENAMEL





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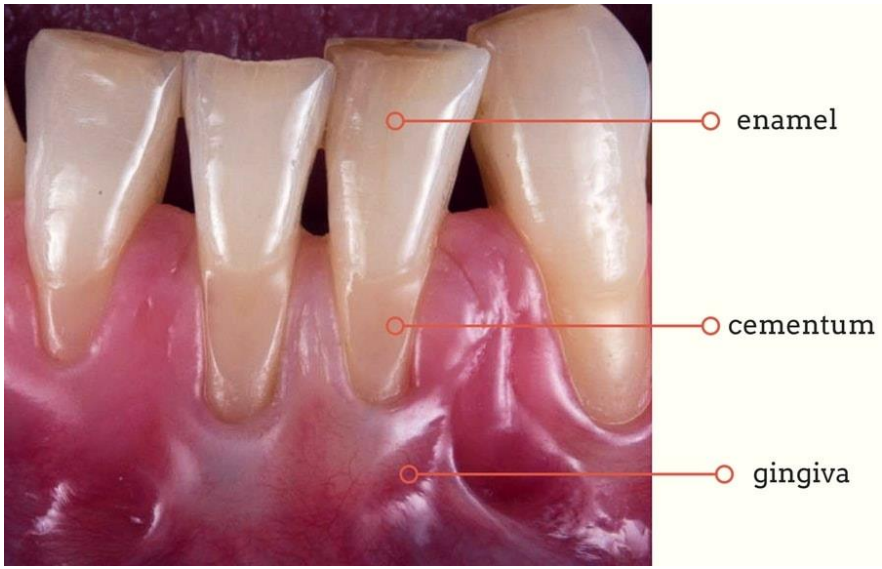
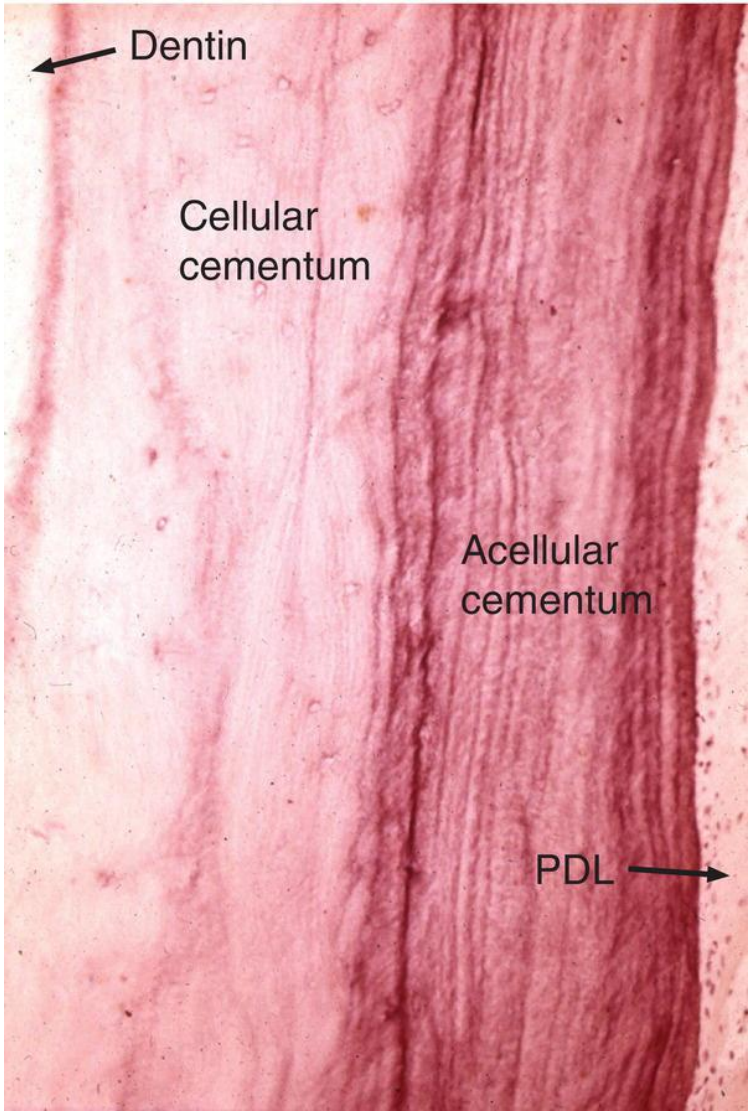
TOOTH – CEMENTUM





<u>Cementum</u>, 100-500 µm

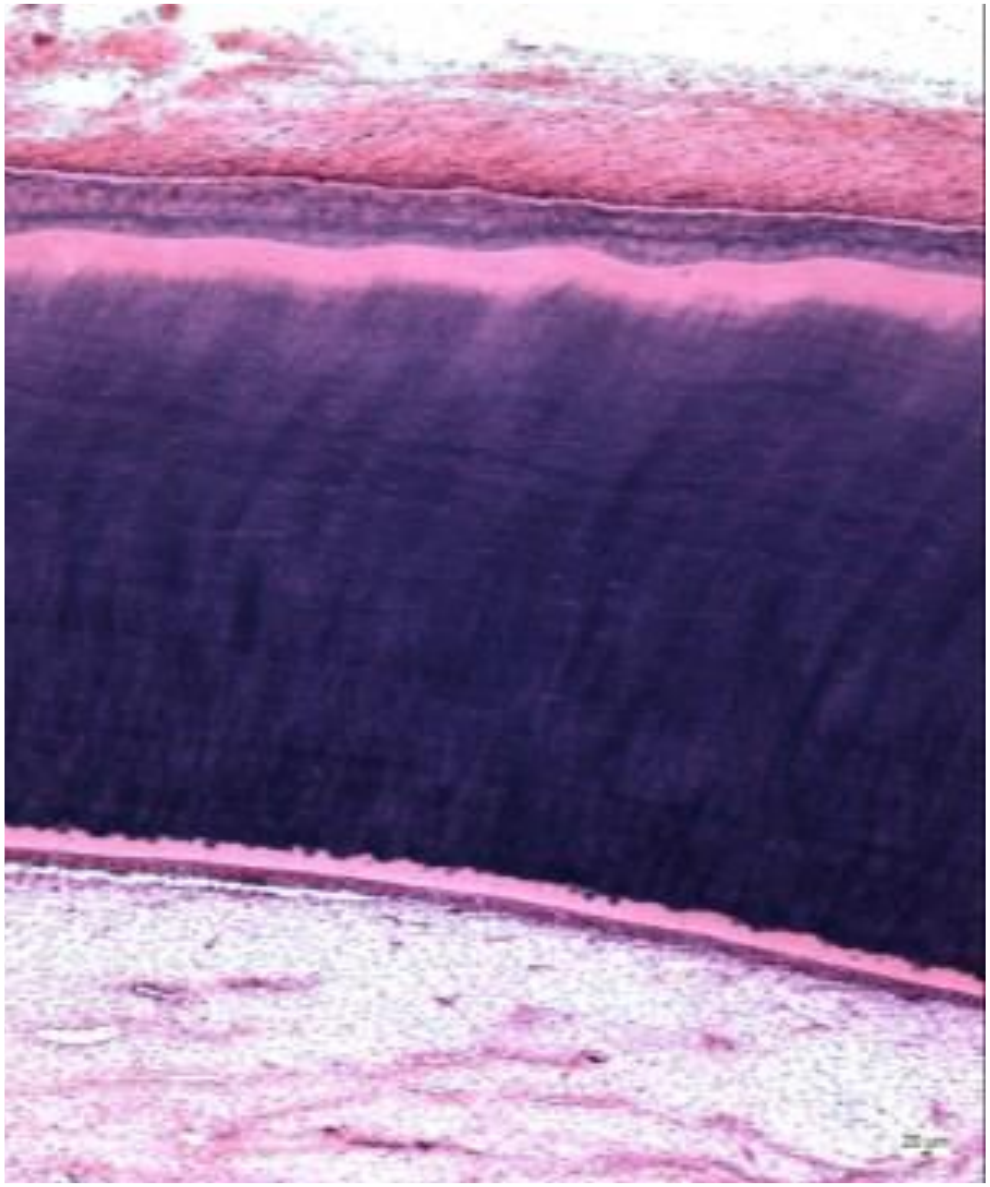
- Covers root and neck
- Cementoblasts/cementocytes
- Regenerates
- 50% Ca-hydroxyapatite
- Collagen I, III, XII, GAGs, proteoglycans
- Sharpey's fibers – fibrilal cementum
- Periodontal ligaments – tooth alveolus

TOOTH – CEMENTUM

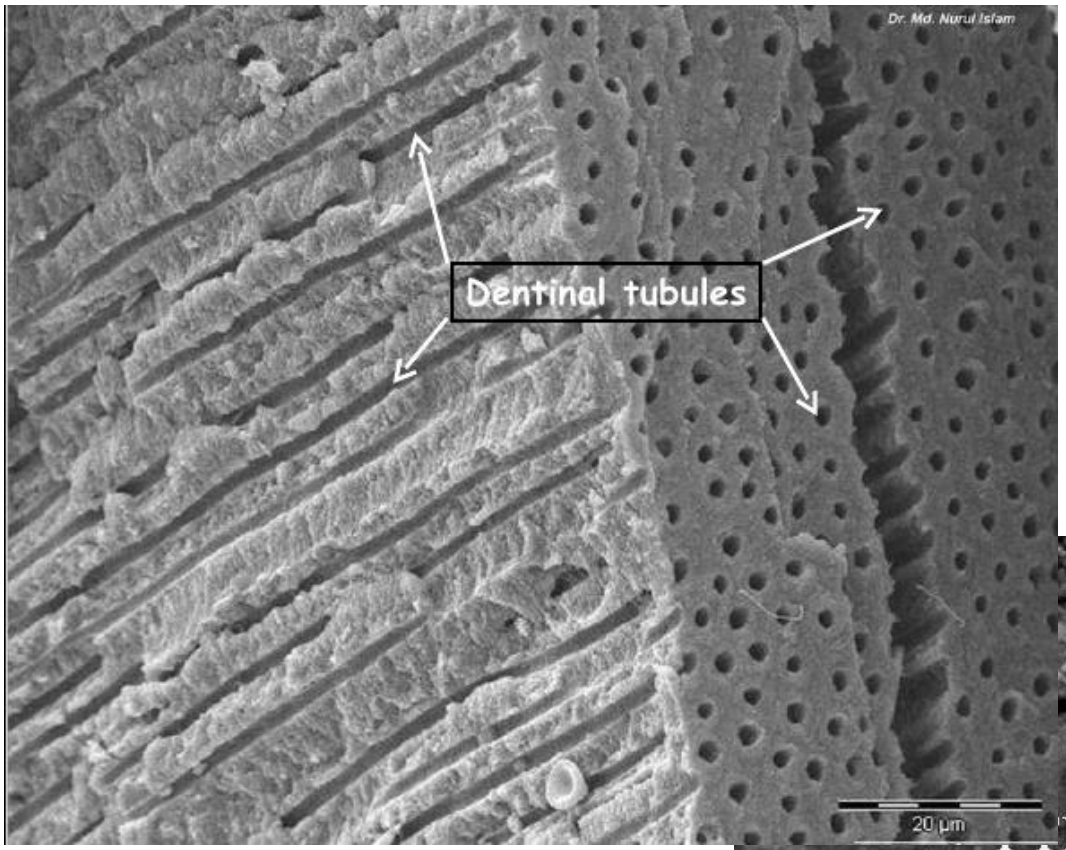
TOOTH – DENTIN

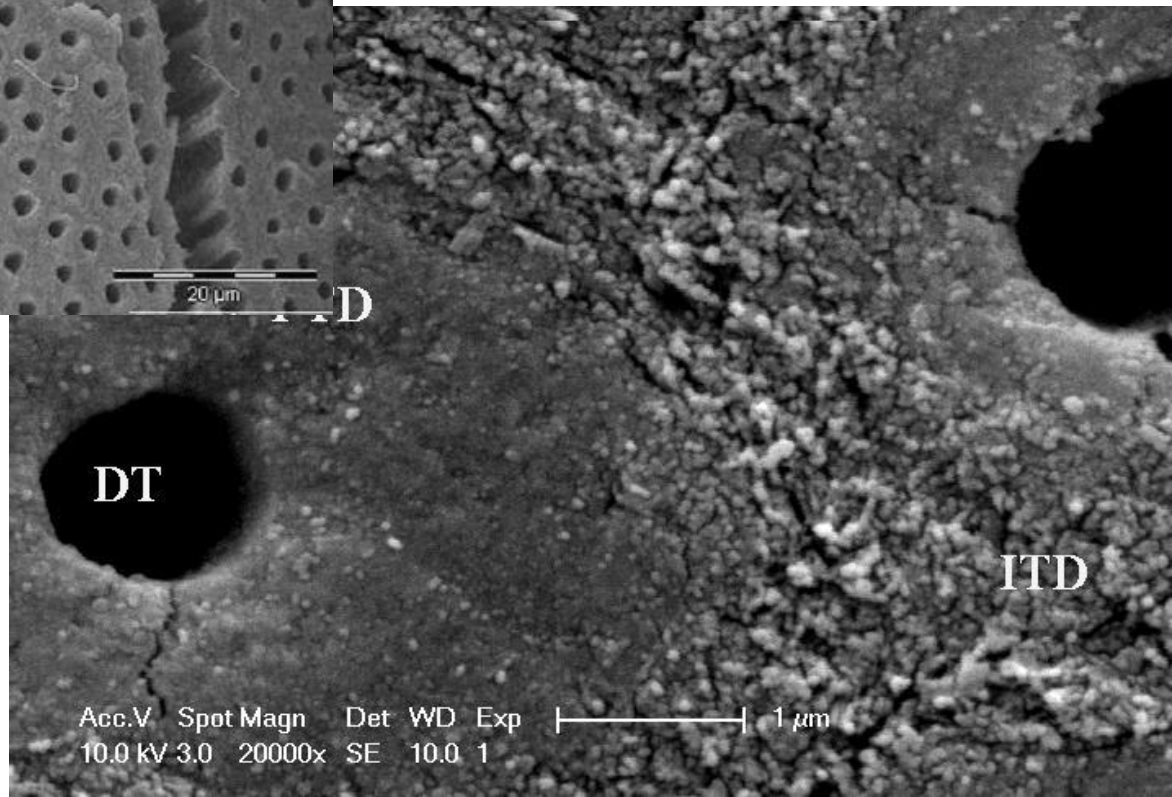
Dentin

- Odontoblasts
- Regenerates
- 70% Ca-hydroxyapatite
- Collagen I, glykoproteins, proteoglycans
- Odontoblast processes –Tomes' fibers
- Owen's lines
- Von Ebner's lines (incremental)
- Nerve fibers

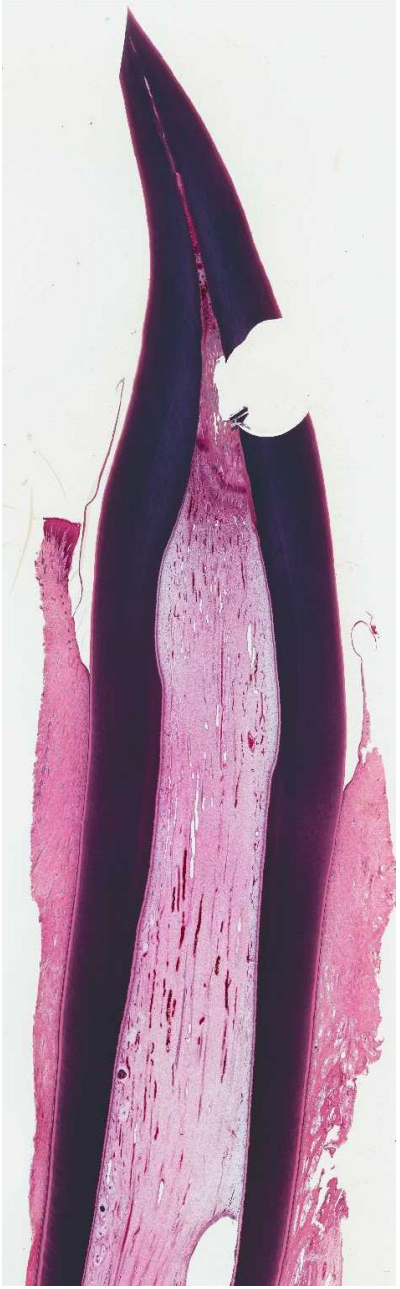


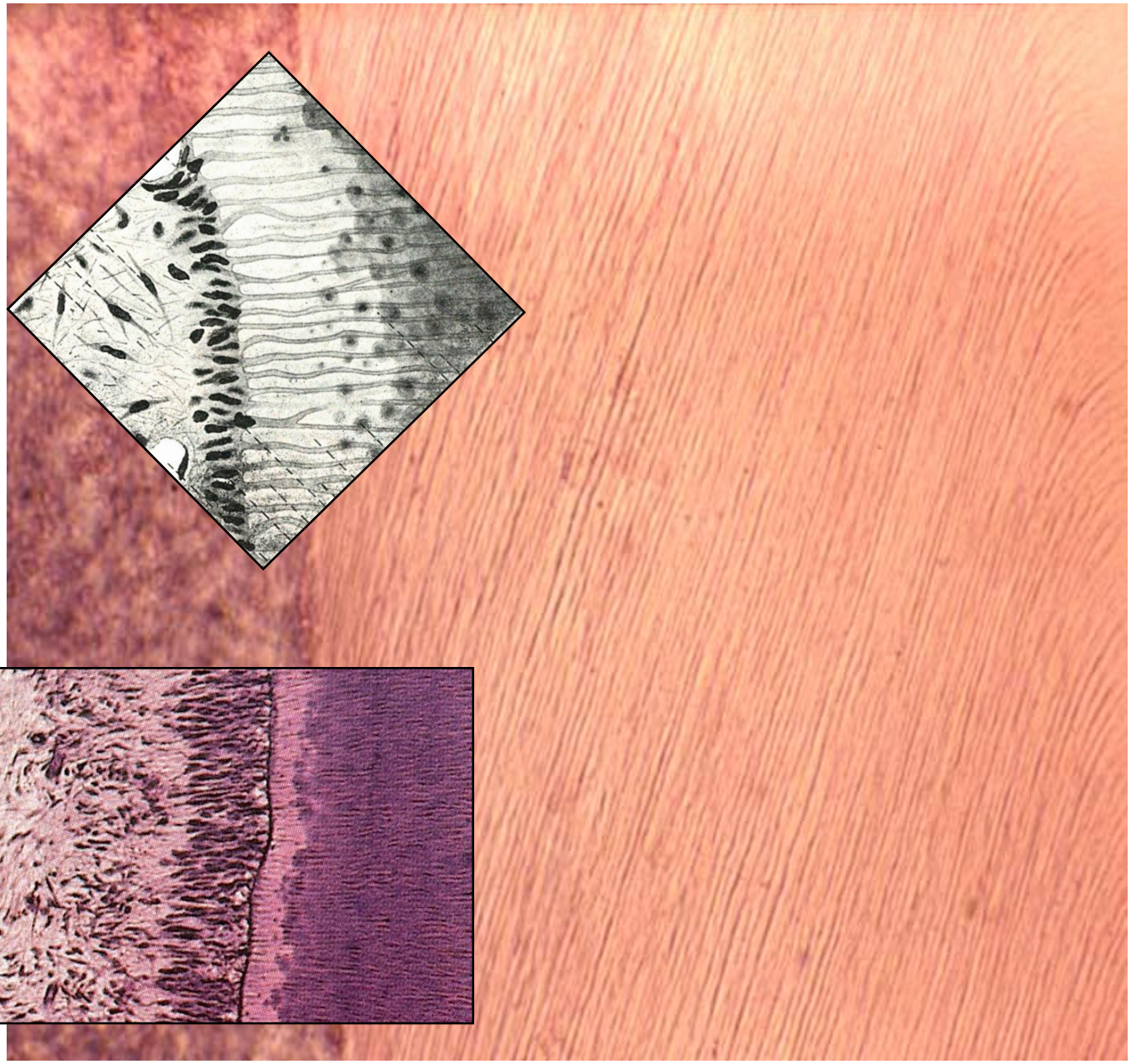
TOOTH – DENTIN



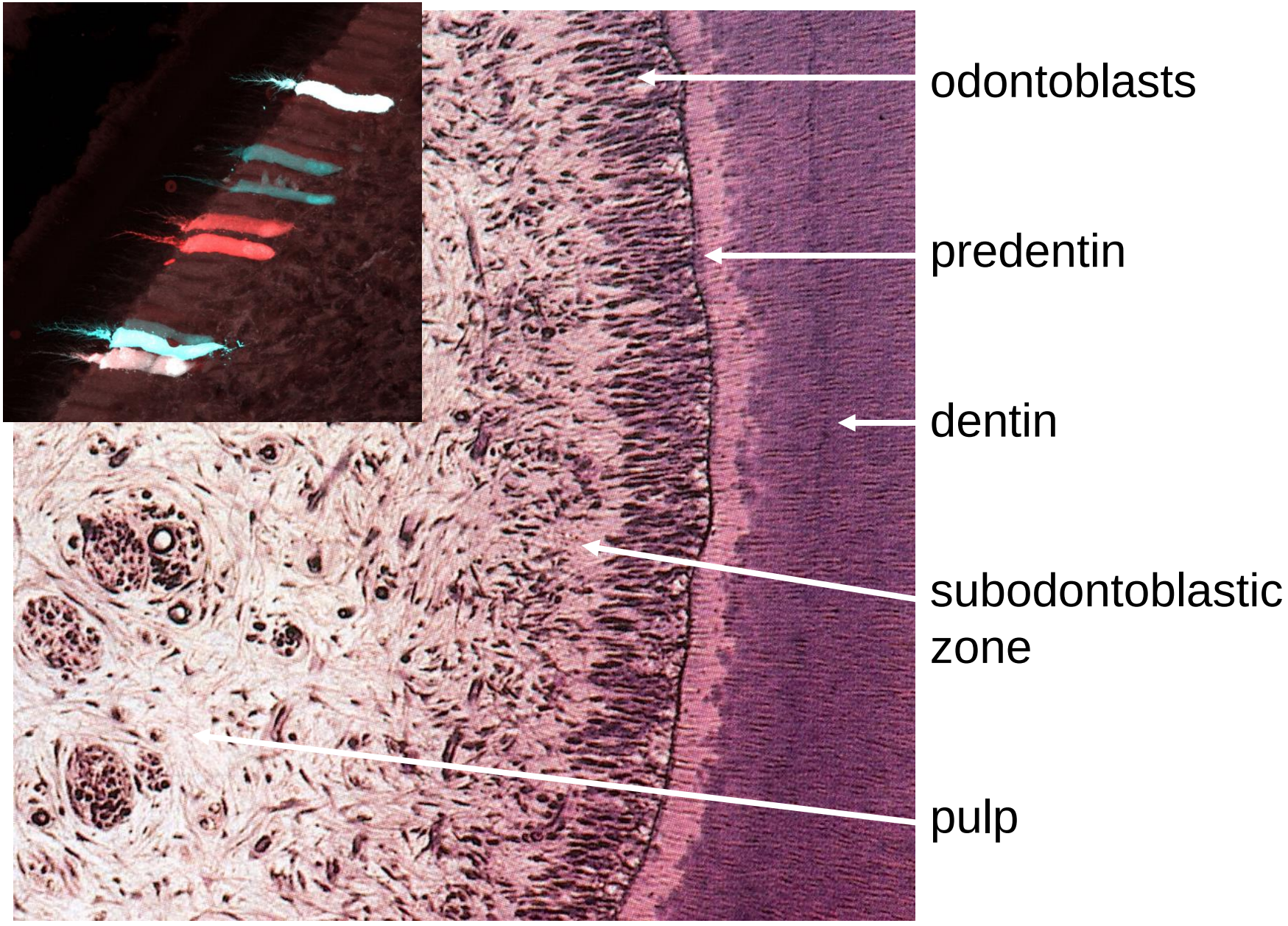


TOOTH – ODONTOBLASTS





TOOTH – ODONTOBLASTS

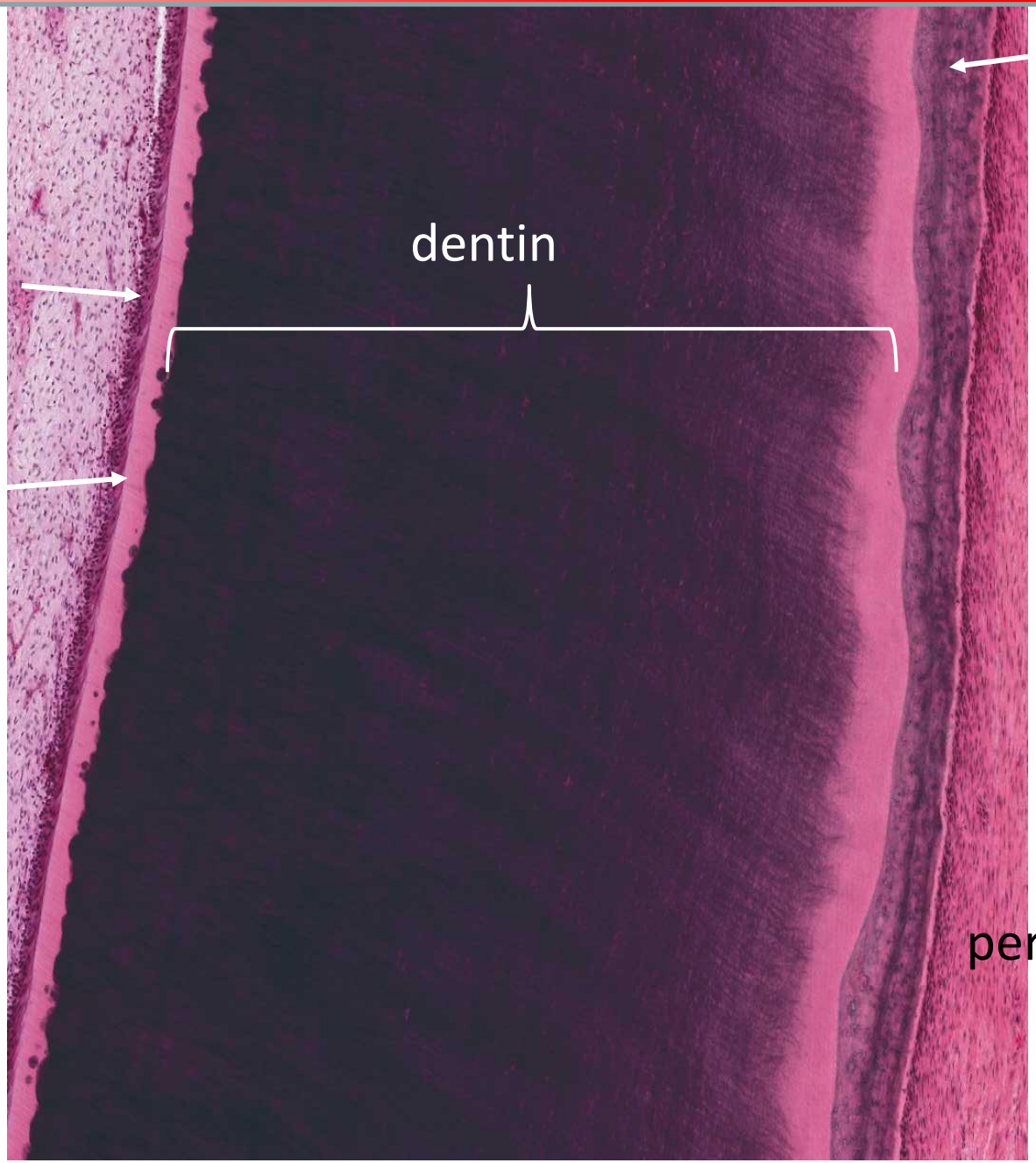


TOOTH – DENTIN

pulp

odontoblasts

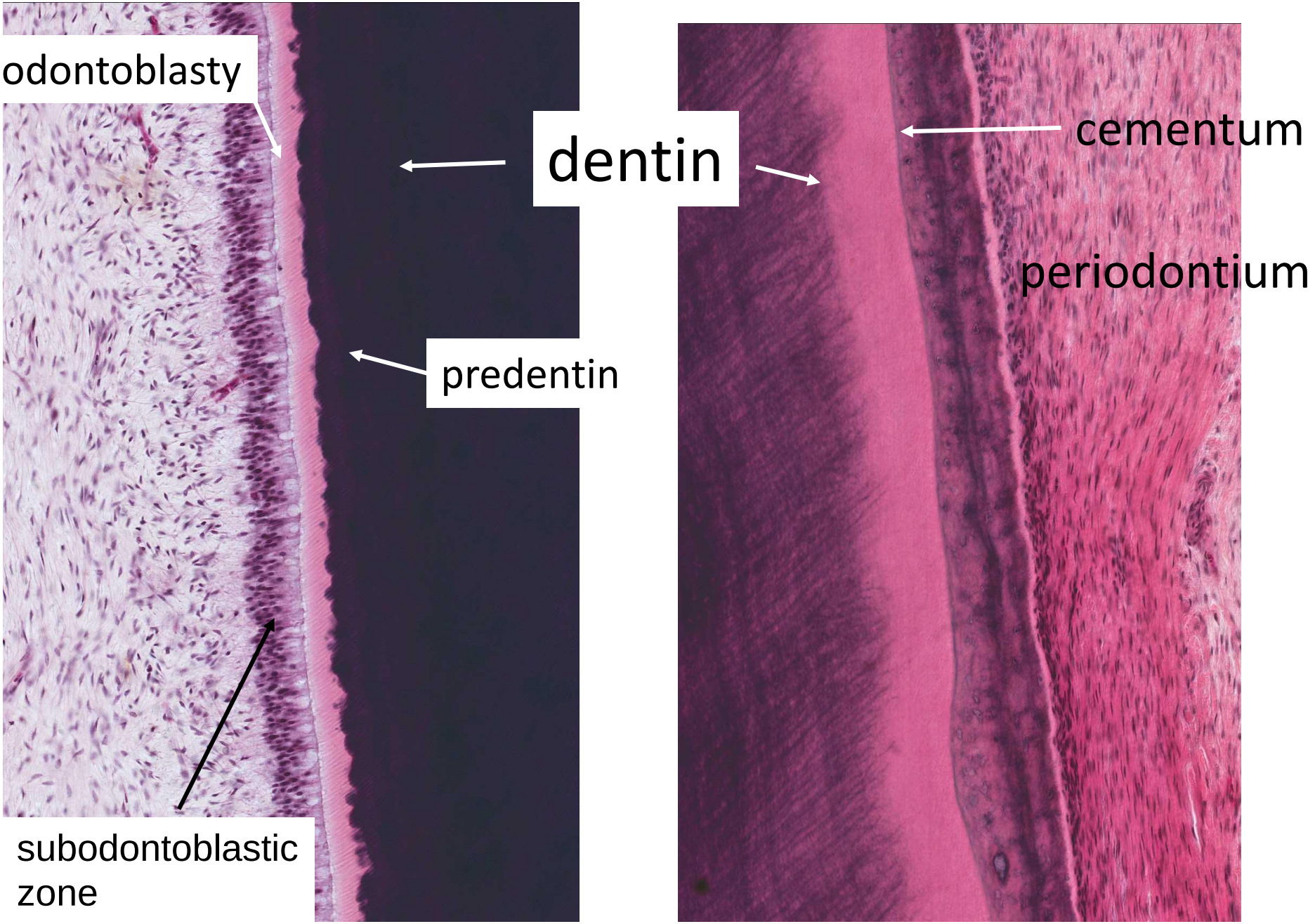
predentin



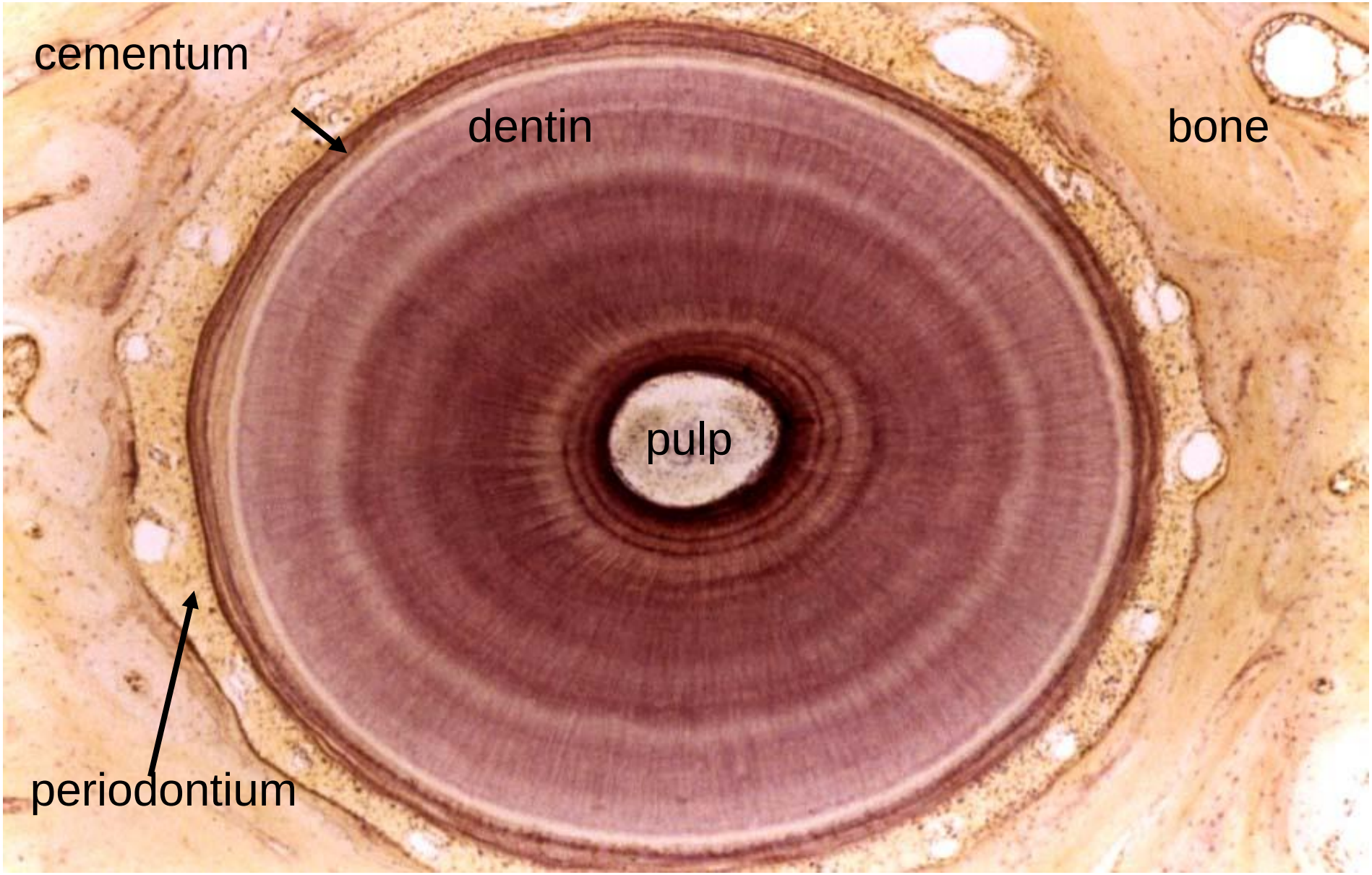
cementum

periodontium

TOOTH

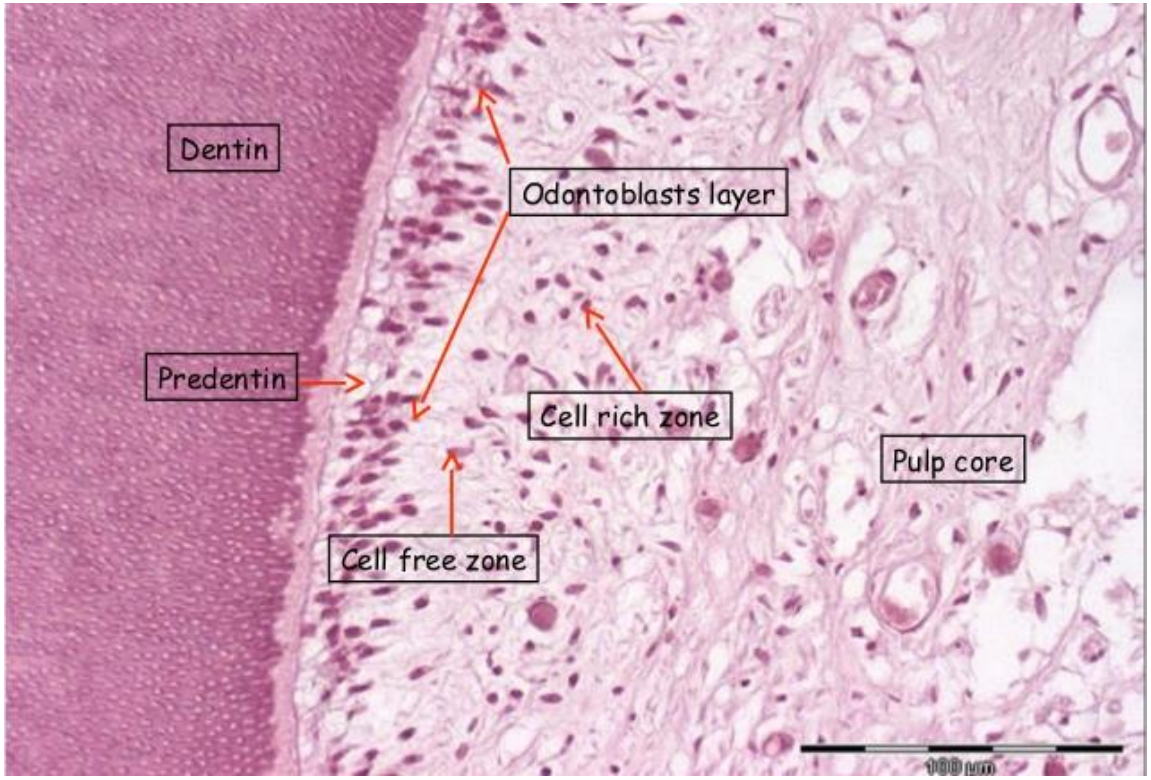

odontoblasty
dentin
predentin
subodontoblastic zone
cementum
periodontium

TOOTH



TOOTH – PULP

- soft connnective tissue similar to embryonic mesenchyme
- rich vascularisation and innervation
- crown pulp and rooth canal
- foramen apicale - periodontium
- odontoblasts
- nociceptive nerve plexus (plexus Raschkowi)



https://www.slideshare.net/hesham63/pulp-15597098

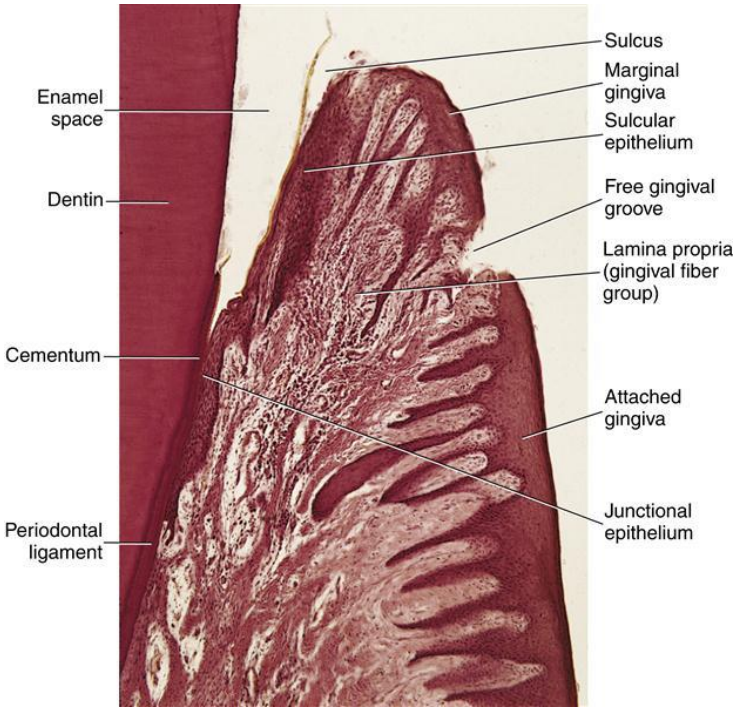
TOOTH – PERIODONTIUM AND GINGIVA

Gingiva

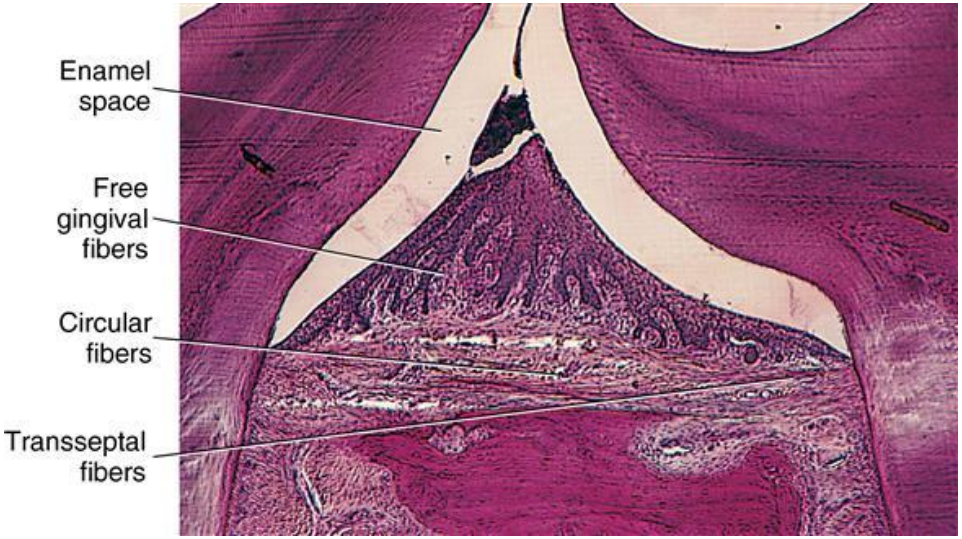
- free (marginal, g. libera)
- attached (g. affixa)
- paramarginal groove (outer gingival groove)
- sulcus gingivalis
- gingivodental junction of Gotlieb

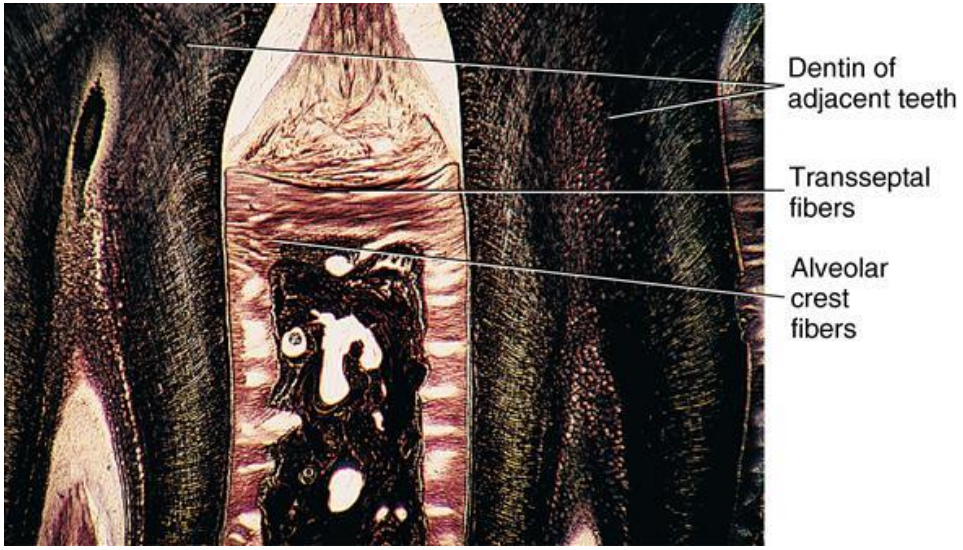
- stratified squamous epithelium
- lamina propria mucosae – dense collagen c.t.

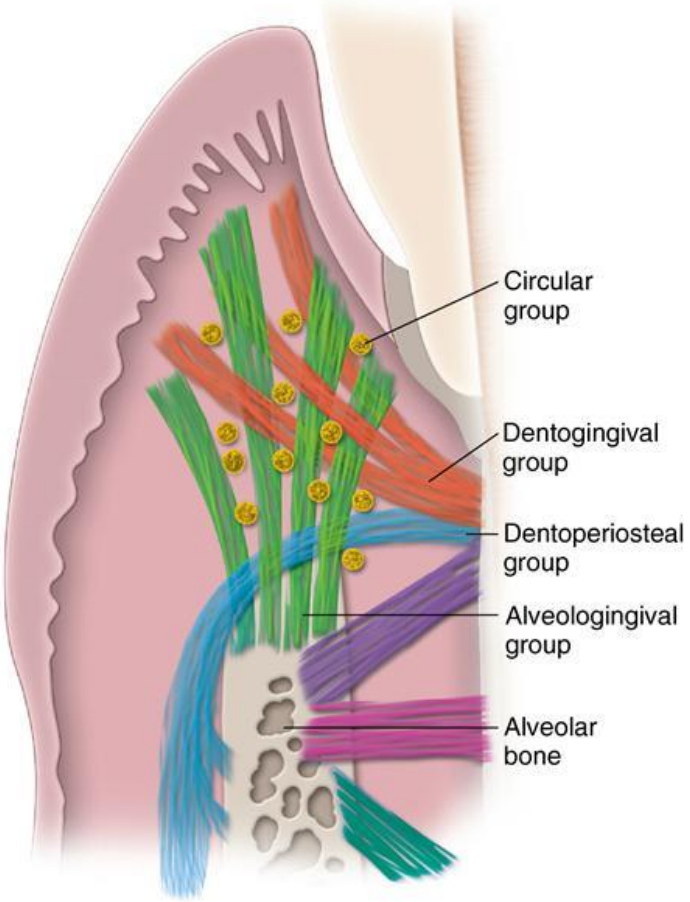
Obr. 8. Schéma gingivy. 1 — volná gingiva, 2 — připojená gingiva, 3 — alveolární sliznice, 4 — vestibulární sliznice



TOOTH – PERIODONTIUM AND GINGIVA

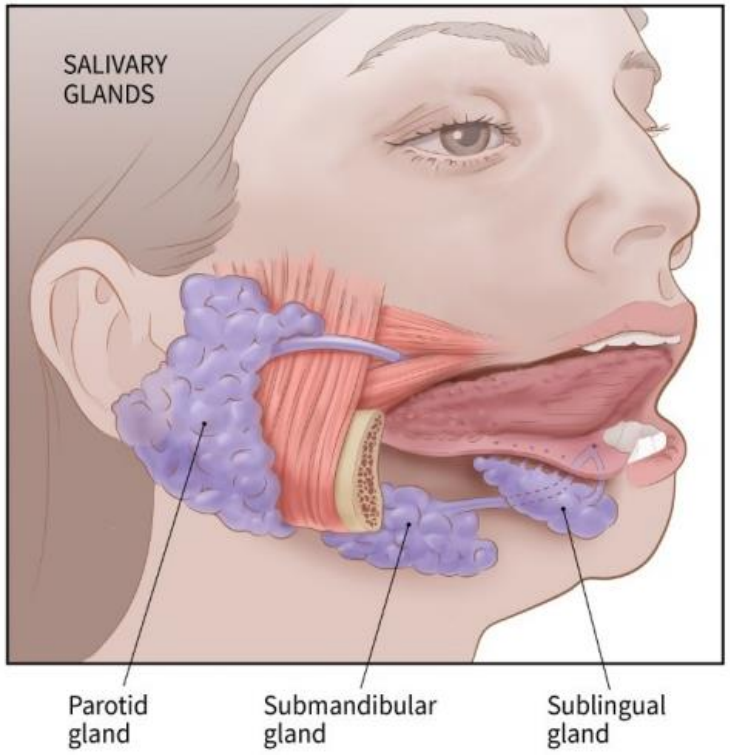






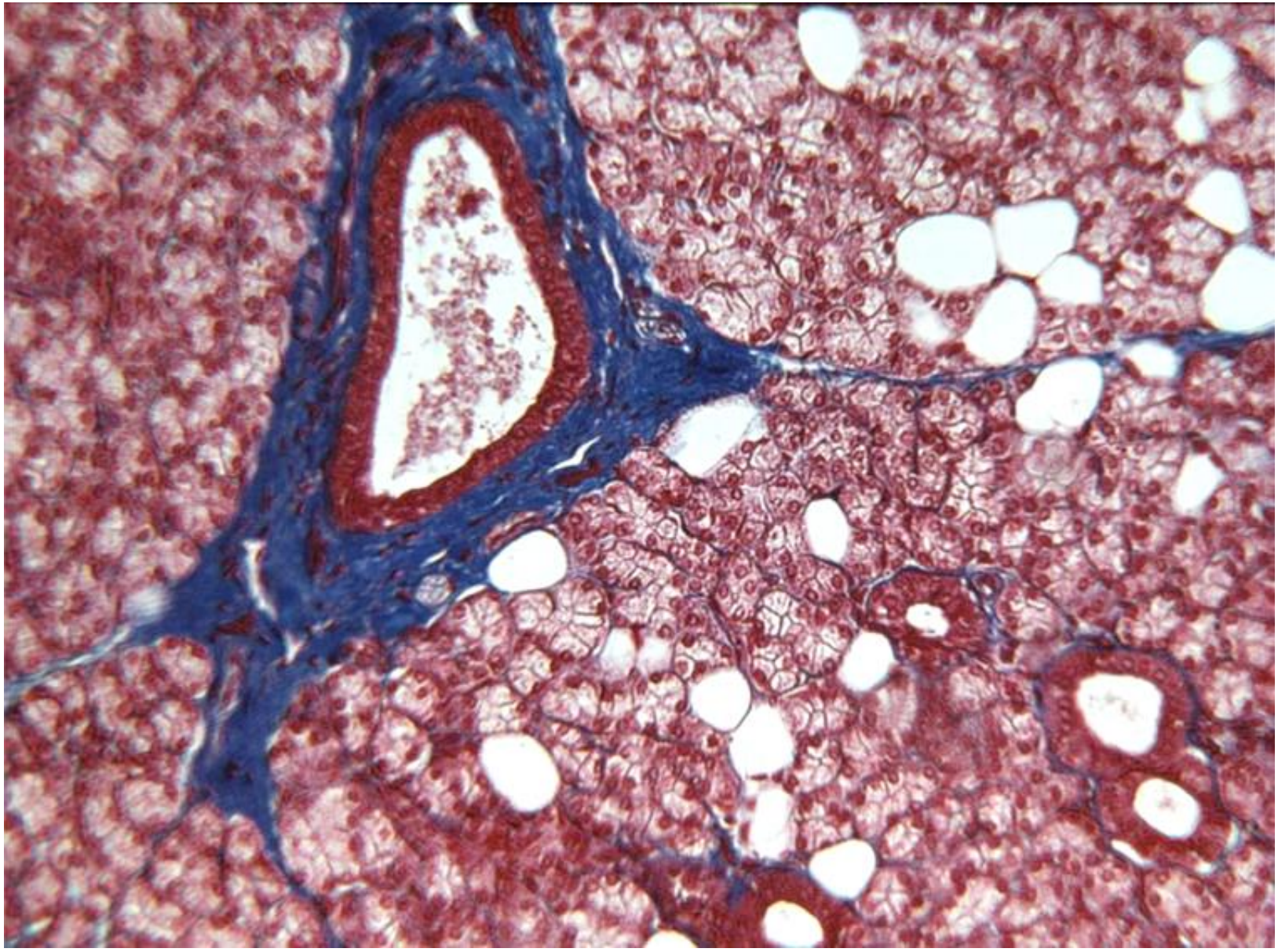
SALIVARY GLANDS

- **small** (gll. labiales, buccales, retromolares, palatinae, gll. lingualis anterior, gll. Ebneri, gll. Weberi)
- **large** (gl. parotis, gl. submandibularis, gl. sublingualis)

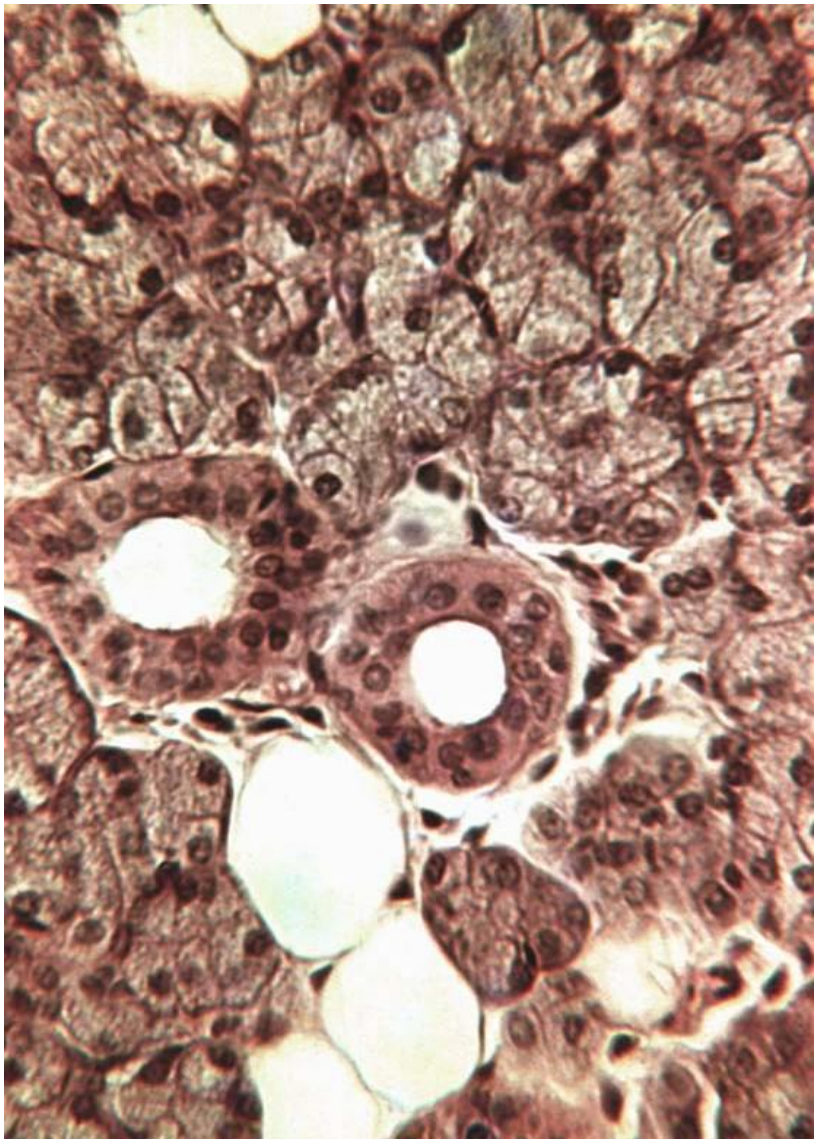


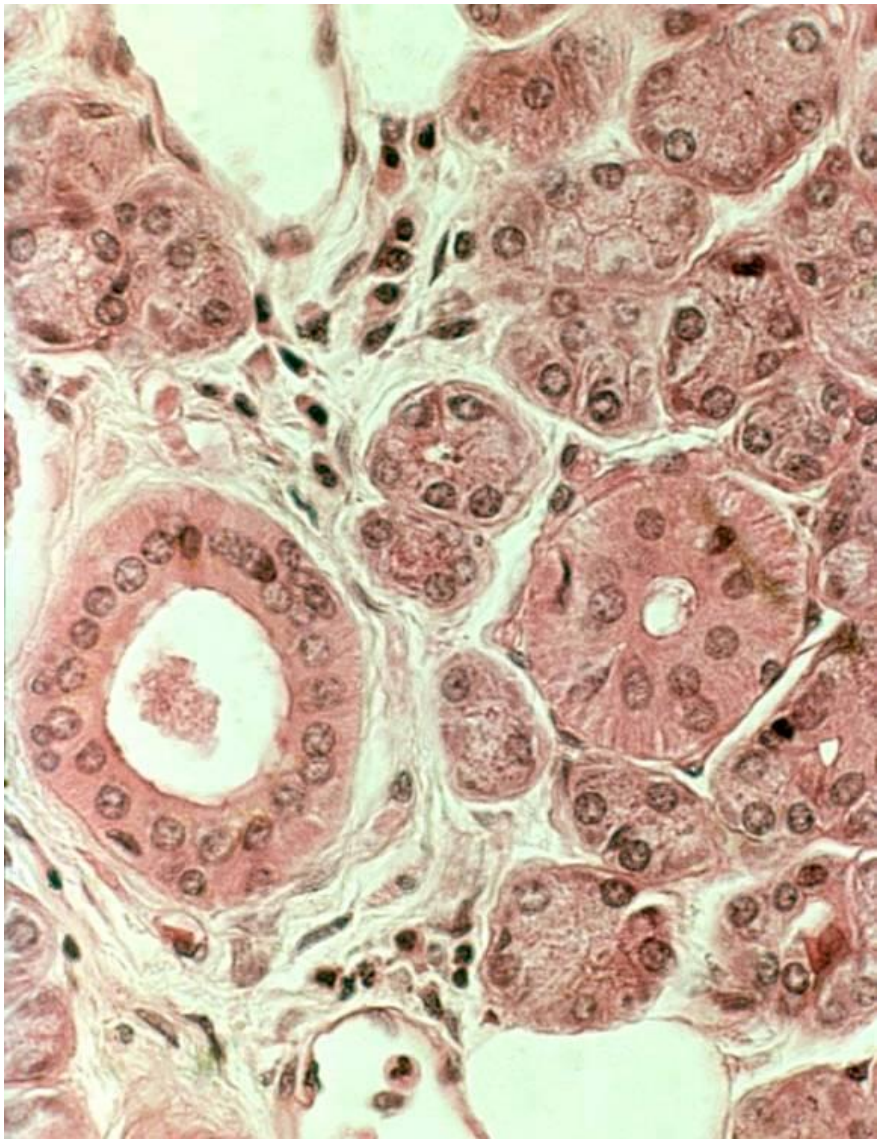
see next lecture

SALIVARY GLANDS – GL. PAROTIS

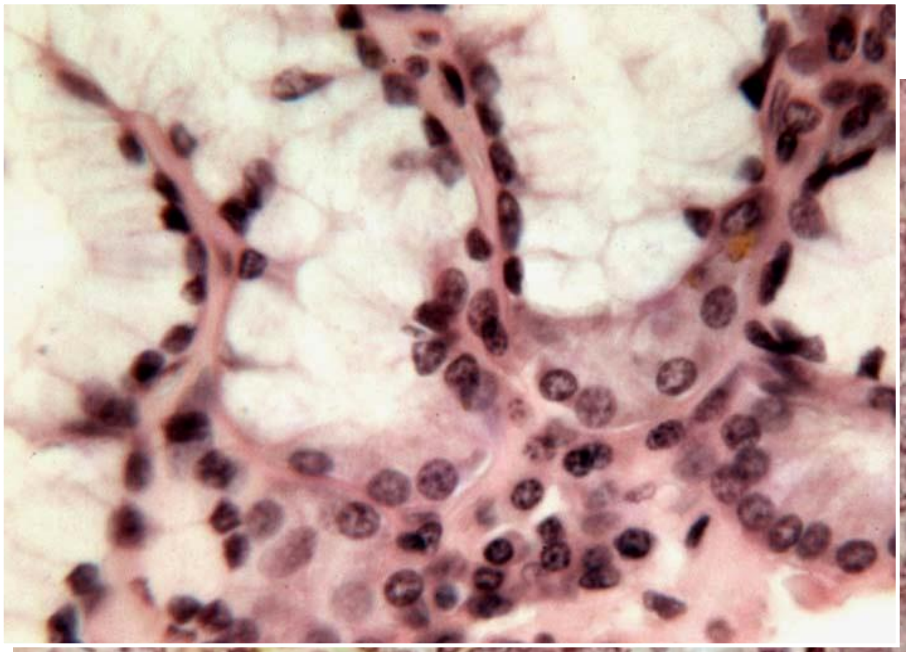


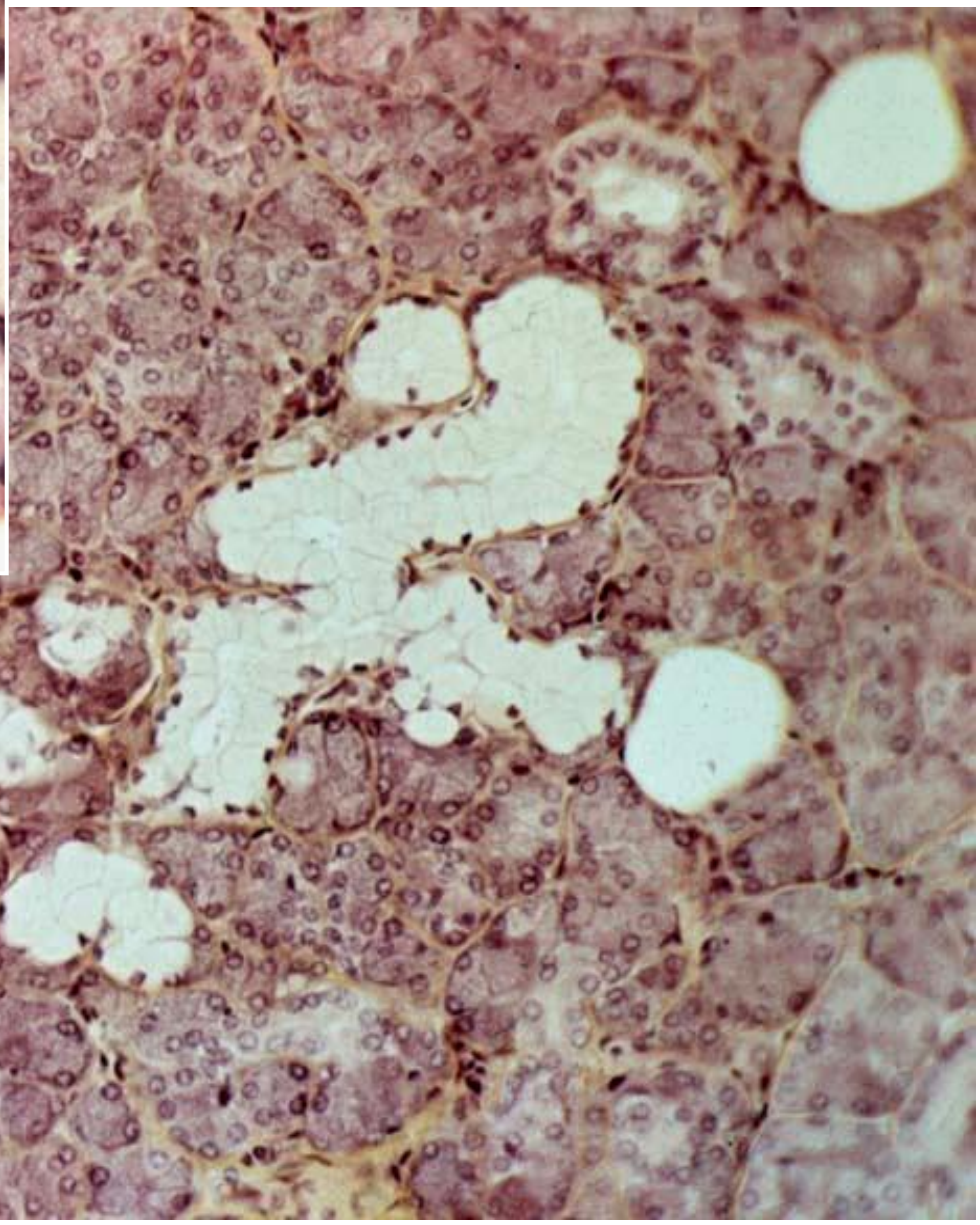
SALIVARY GLANDS – GL. PAROTIS



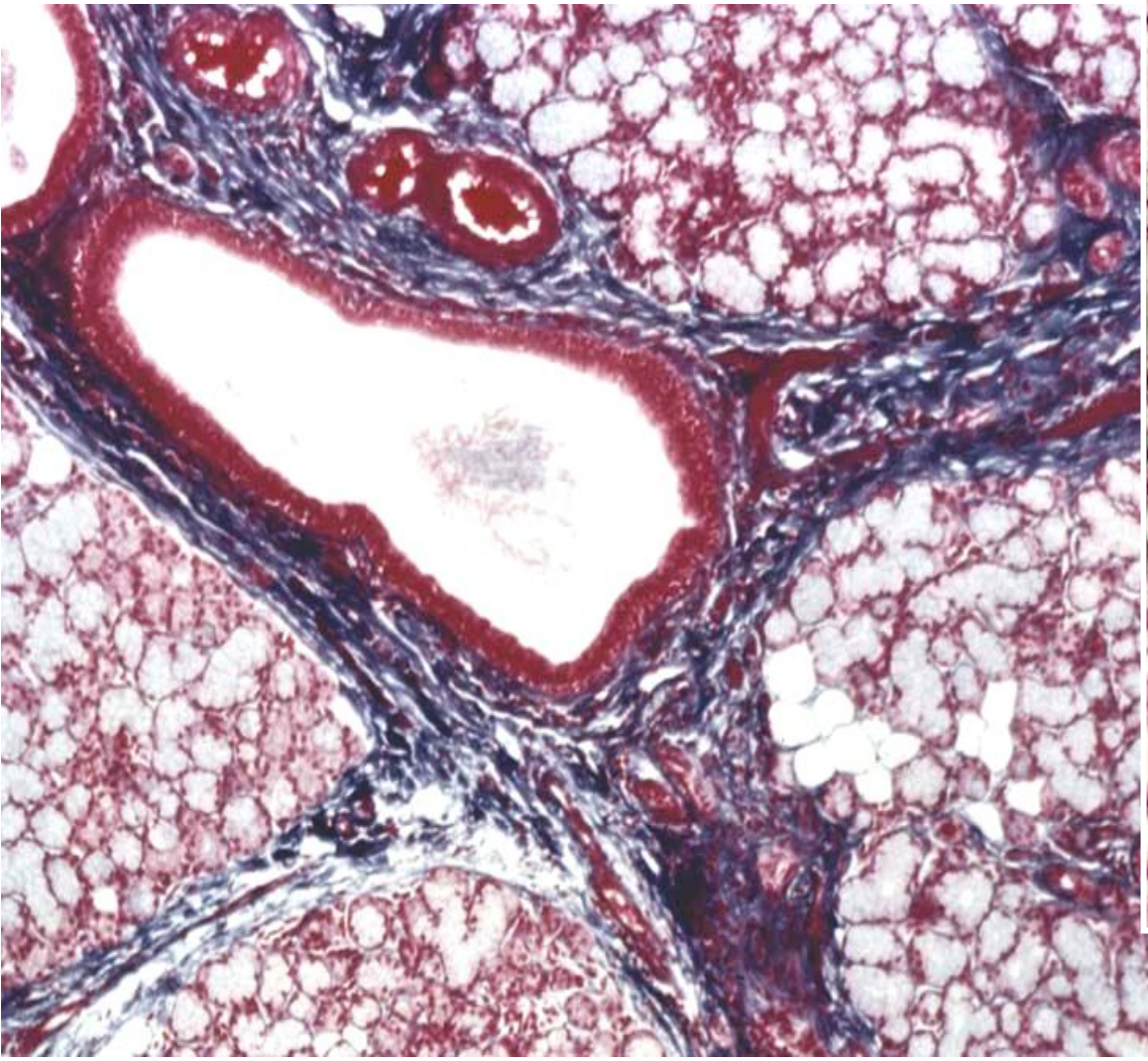


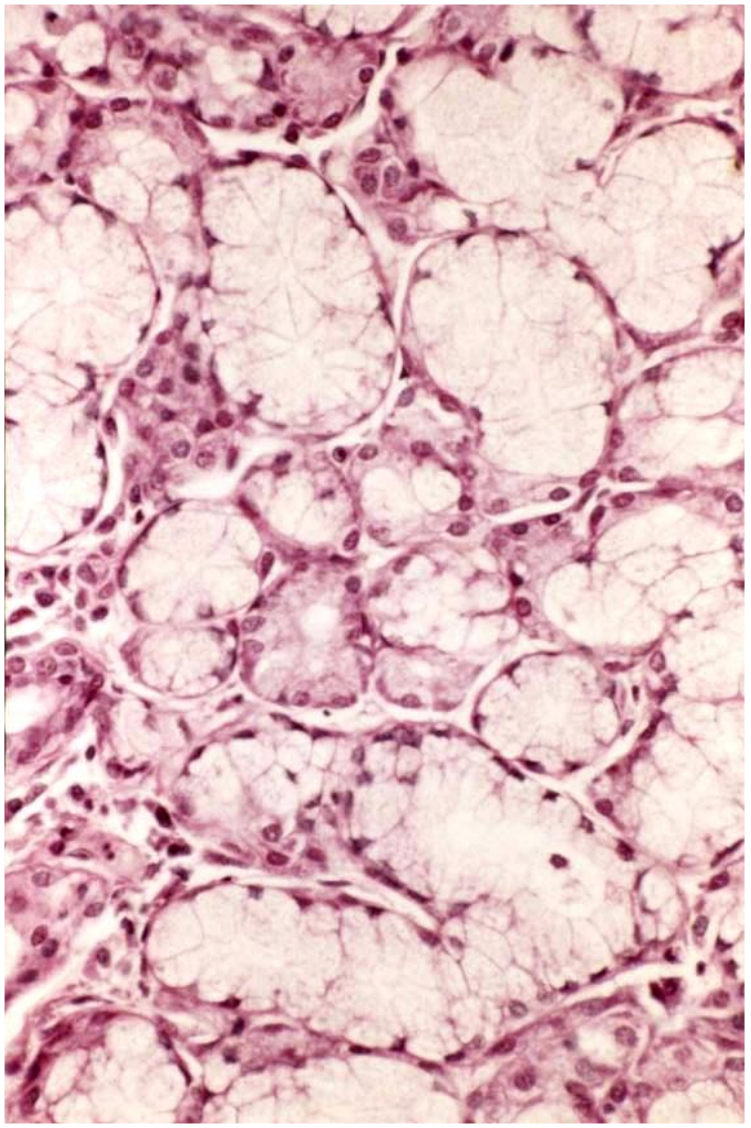
SALIVARY GLANDS – GL. SUBMANDIBULARIS



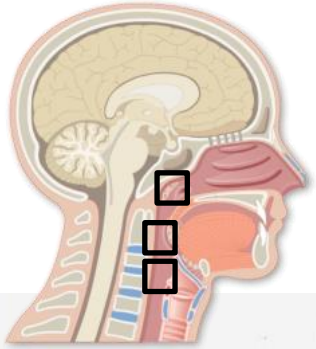


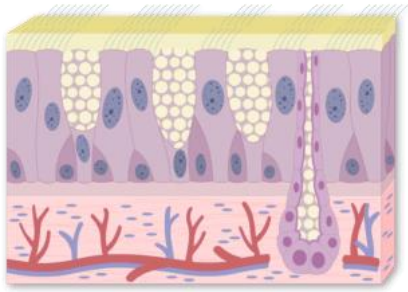
SALIVARY GLANDS – GL. SUBLINGUALIS



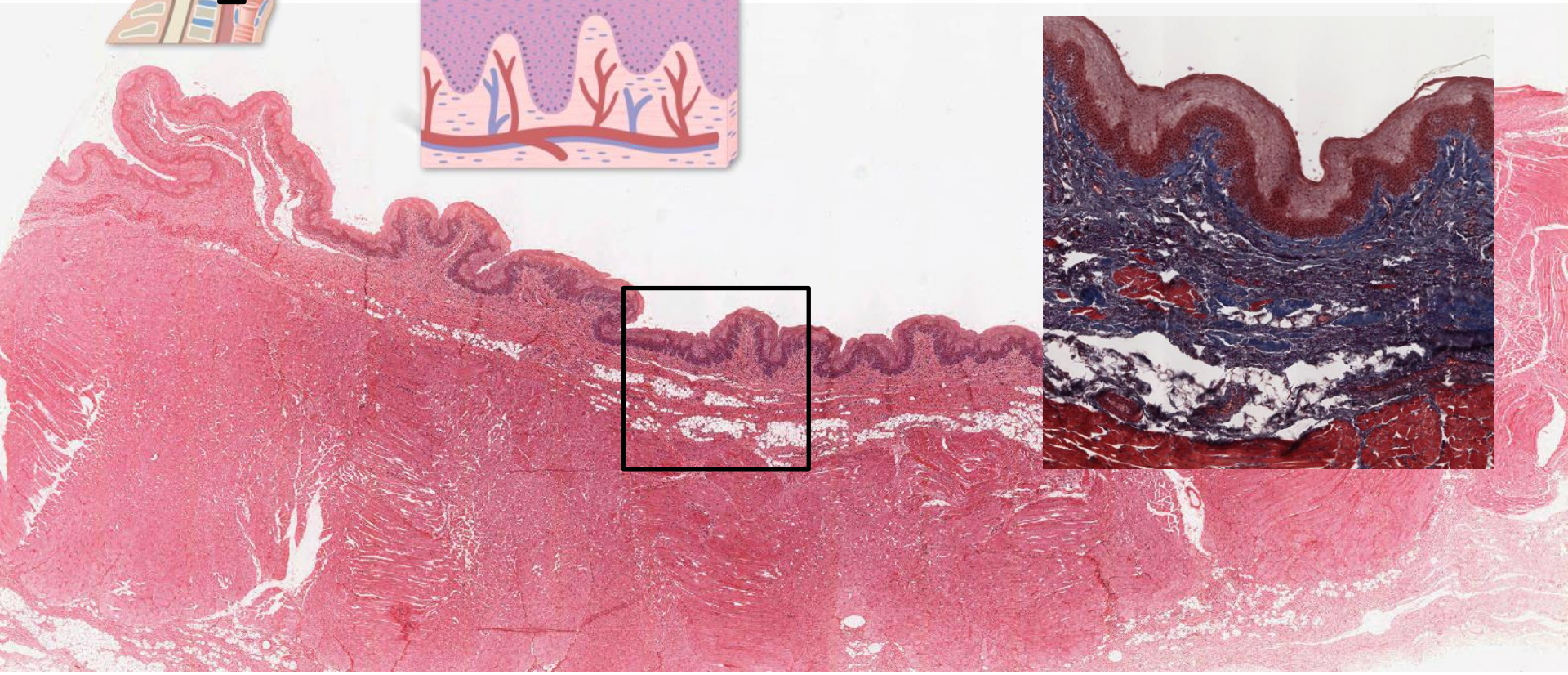


PHARYNX

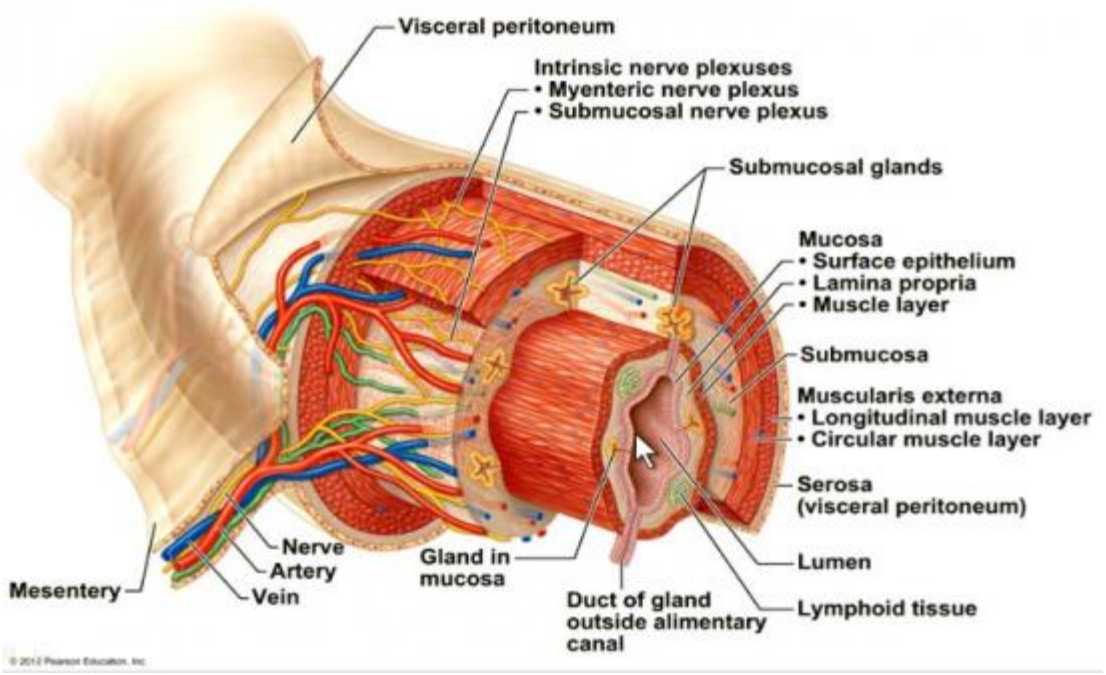




- nasopharynx
- oropharynx
- laryngopharynx



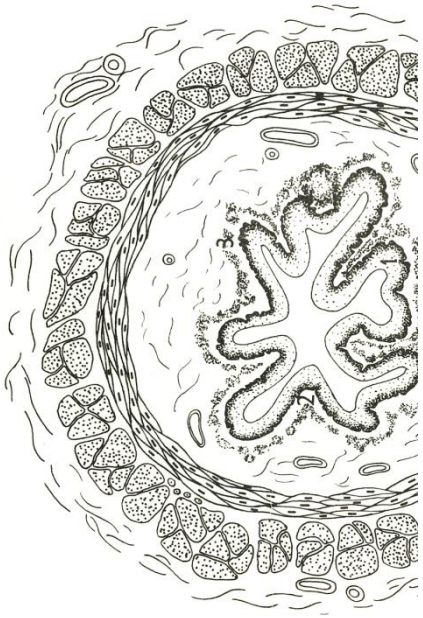
ALIMENTARY CANAL

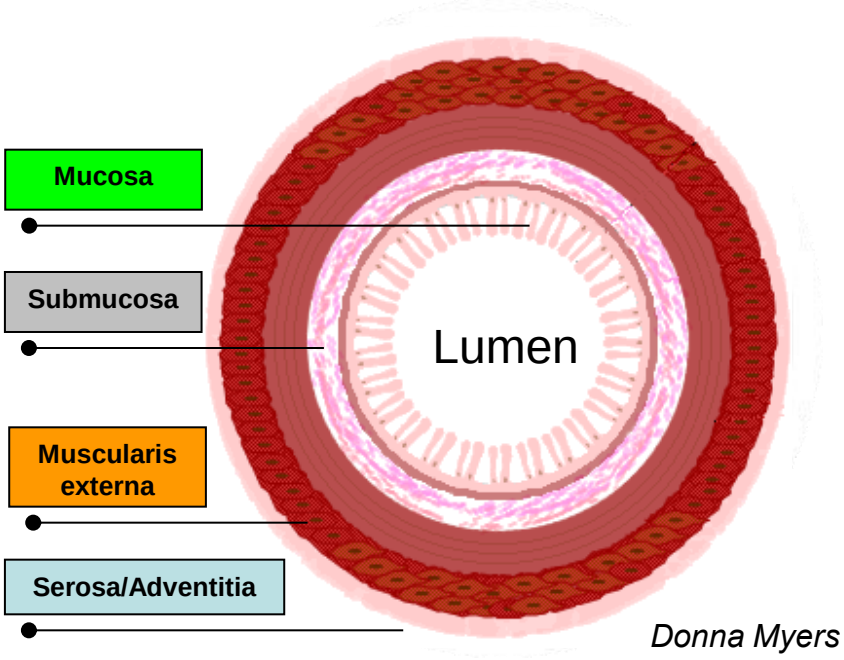


GENERAL ARCHITECTURE OF HOLLOW ORGANS

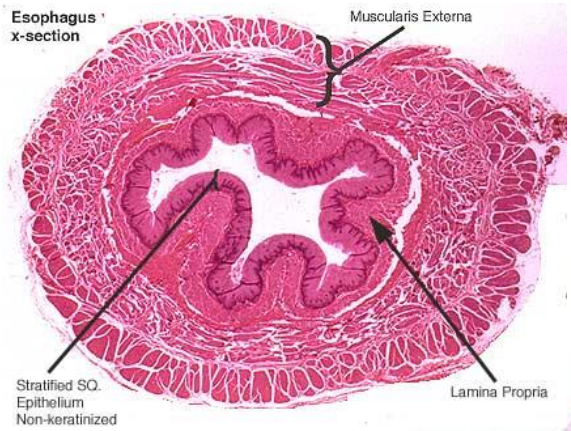
GENERAL ARCHITECTURE OF HOLLOW ORGANS

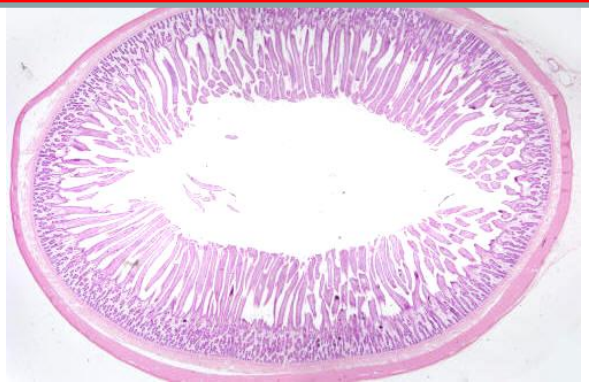
1. **Mucosa** (Tunica mucosa)
2. **Submucosa** (Tela submucosa)
3. **Tunica muscularis externa**
4. **Serosa/adventitia**

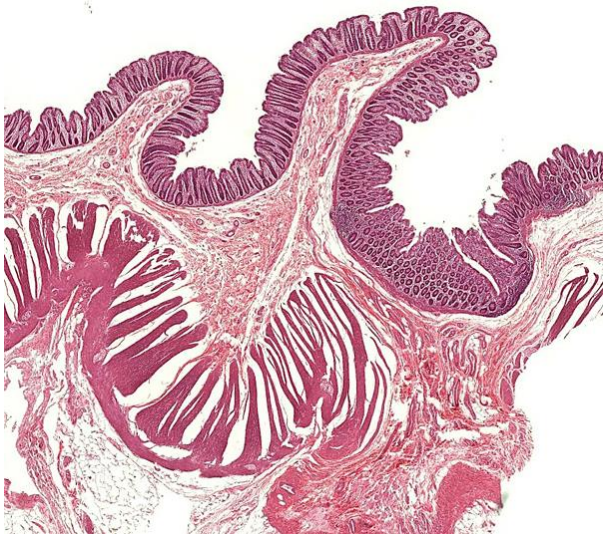


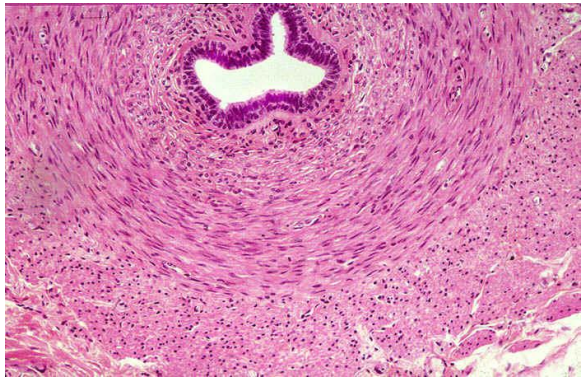


GENERAL ARCHITECTURE OF HOLLOW ORGANS

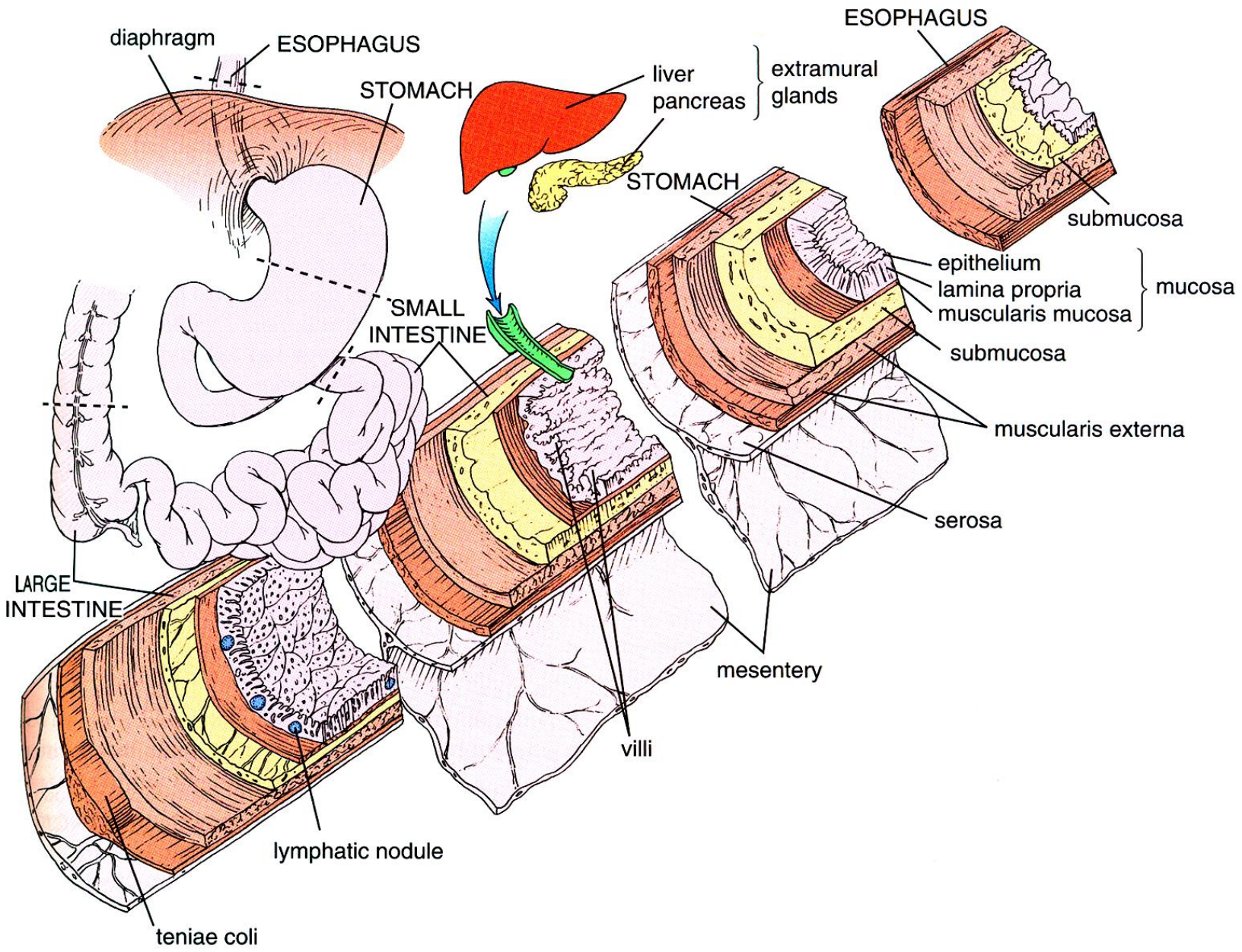








GENERAL ARCHITECTURE OF HOLLOW ORGANS

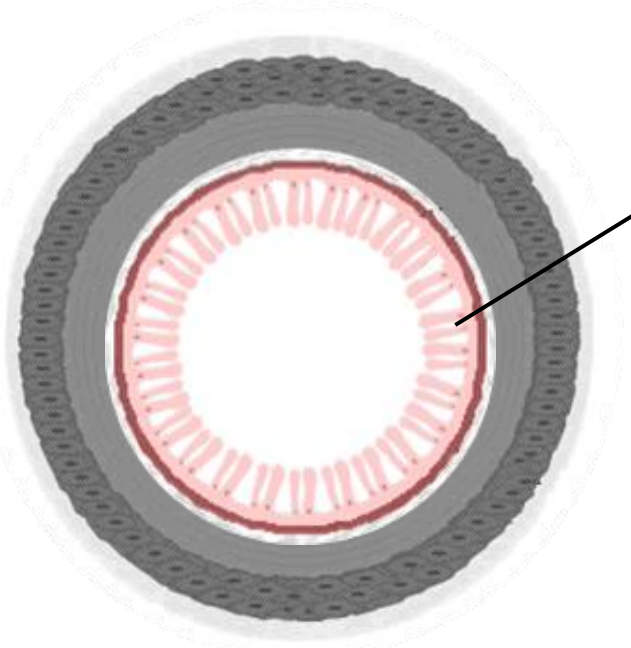


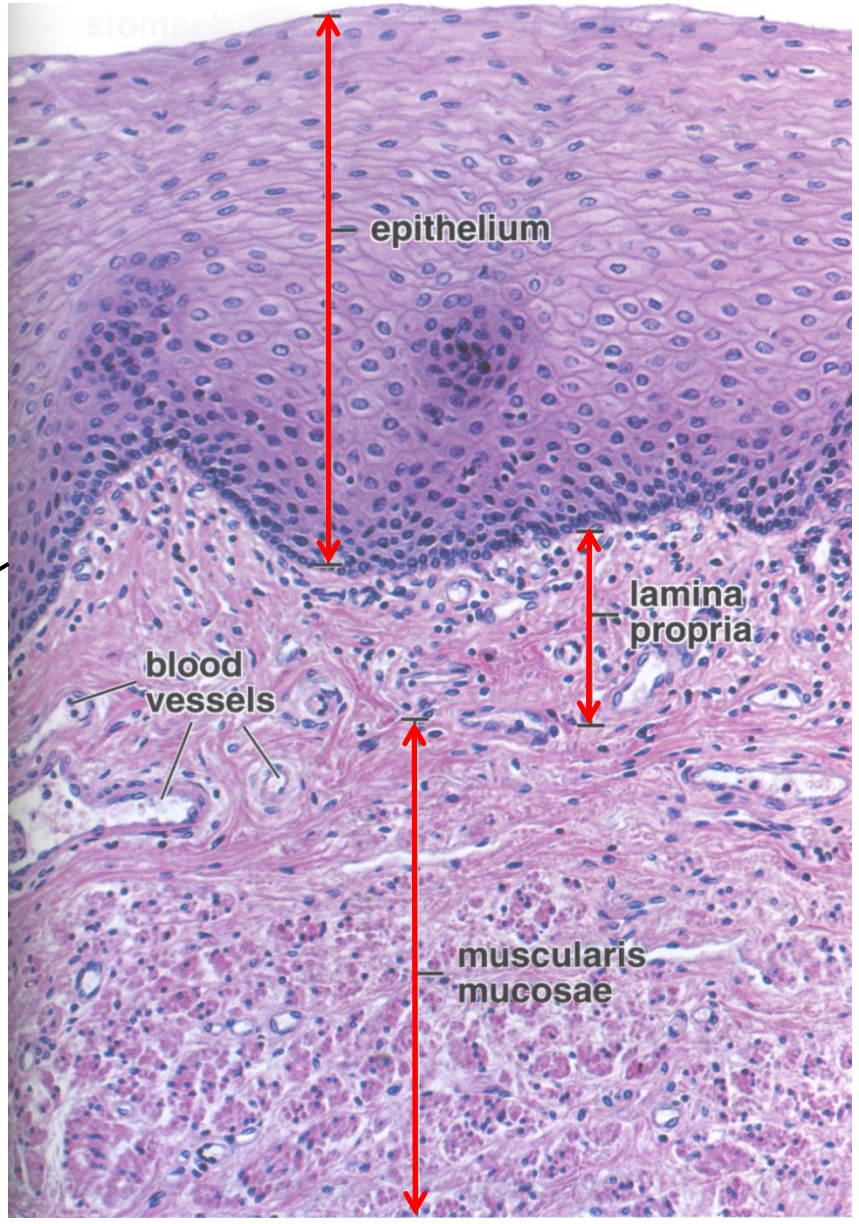
GENERAL ARCHITECTURE OF HOLLOW ORGANS

Mucosa (Tunica mucosa)

- inner layer of digestive tube
- protection, absorption and resorption
- microscopic structure depending on localization

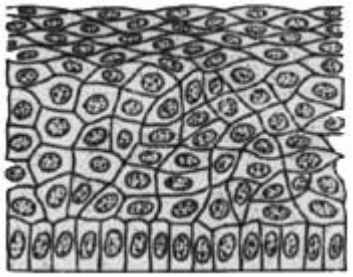
- **Lamina epithelialis** mucosae
- **Lamina propria** mucosae
- **Lamina muscularis** mucosae





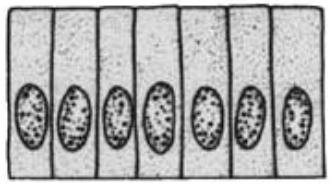
GENERAL ARCHITECTURE OF HOLLOW ORGANS

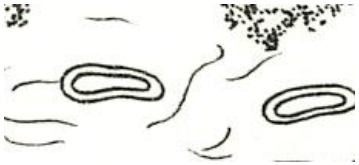
Mucosa (Tunica mucosa)



Lamina epithelialis mucosae

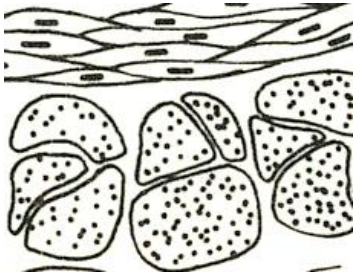
- epithelium type corresponding to function of gut tube
- oral cavity, pharynx, esophagus, anus – **stratified squamous ep.**
- stomach, intestine – **simple columnar**
- **mucus** - secreted by mucosal or submucosal glands (oral cavity, esophagus), secretory epithelium (stomach) or goblet cells (intestine)





Lamina propria mucosae

- Layer of mucosal connective tissue – loose collagen
- Fenestrated blood capillaries – transport of metabolite (intestine)
- mucosal glands in some regions /esophagus)
- innervations, immune system

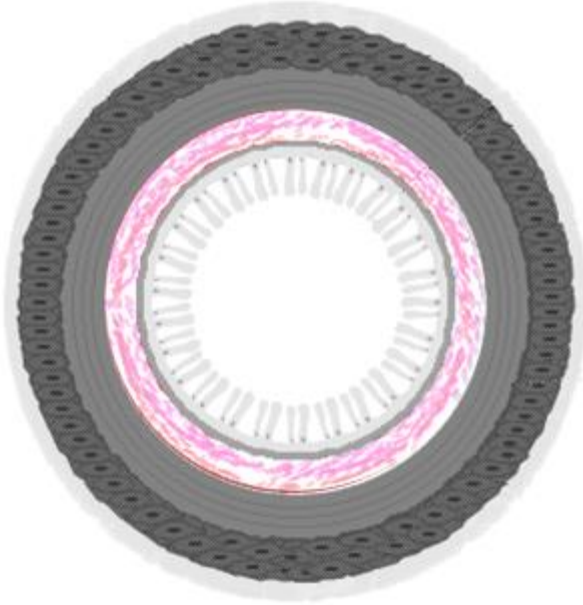


Lamina muscularis mucosae

- smooth muscle cells in several layers with variable orientation
- small mechanical movements of mucosa facilitating secretion and absorption independently on peristaltic movements.

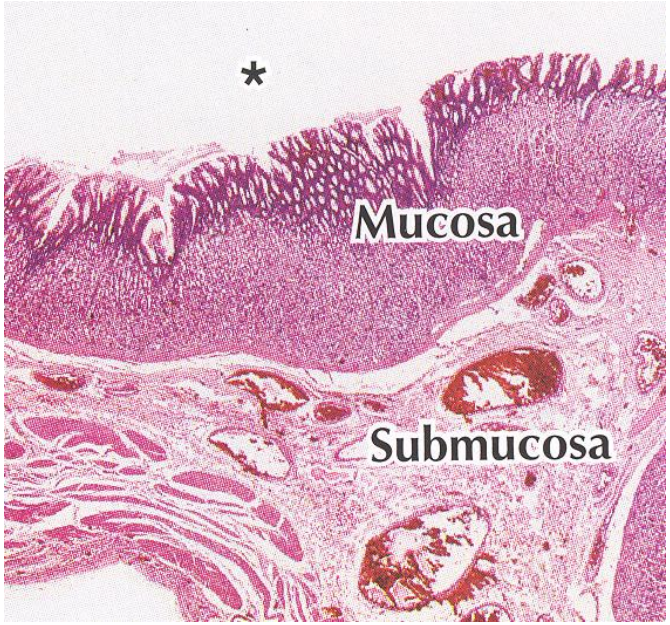
GENERAL ARCHITECTURE OF HOLLOW ORGANS

Submucosa (Tela submucosa)



- distinct layer of loose connective tissue
- defines shape of mucosa (rugae, plicae)
- larger blood and lymph veins nourishing mucosa, muscularis externa and serosa
- **innervation** – nerve plexus - **plexus submucosus Meissneri**
  = groups of multipolar neurons and small ganglions, visceral sensory fibers (sympaticus) and fibers and terminal ganglions of parasympaticus (enteric nerve system)

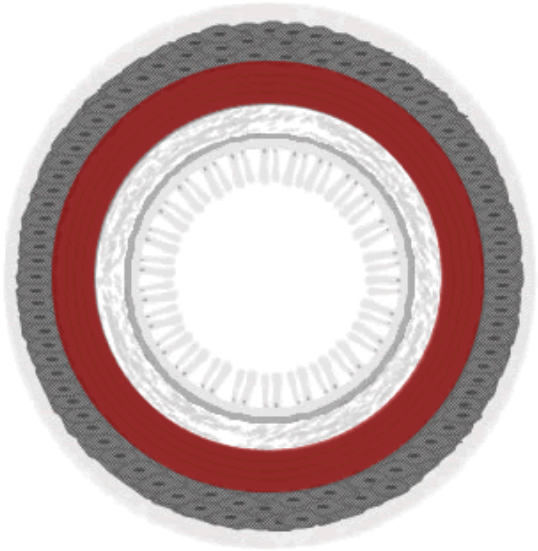
- glands – different in different regions
  - protective function



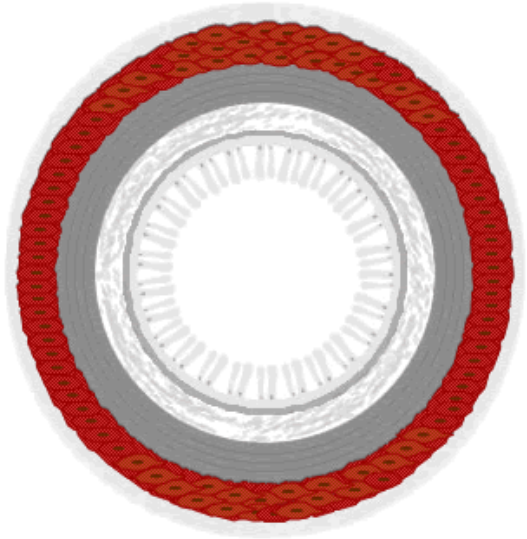
GENERAL ARCHITECTURE OF HOLLOW ORGANS

Outer muscular layers (Tunica muscularis externa)

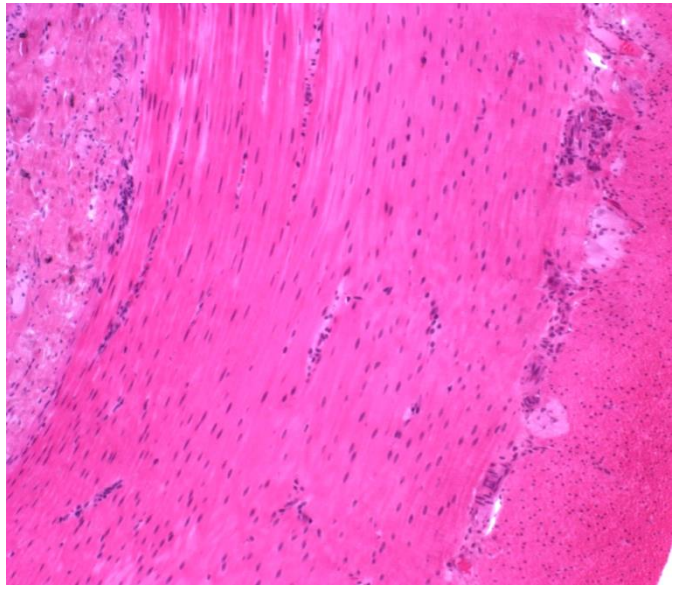
- Two concentric, thick layers of smooth muscle, separated by thin layer of connective tissue
- Inner – **circular**, outer – **longitudinal** (spiral)
- Myenteric (Auerbach) plexus
- Peristaltic – passage through the gut tube
- **Local modifications of m.e**.
    - pharyngoesophagal sphincter + external anal sphincter – skeletal muscles
    - stomach – third – oblique layer
    - taenie coli – thickened part of longitudinal layer in colon



Circular



Longitudinal

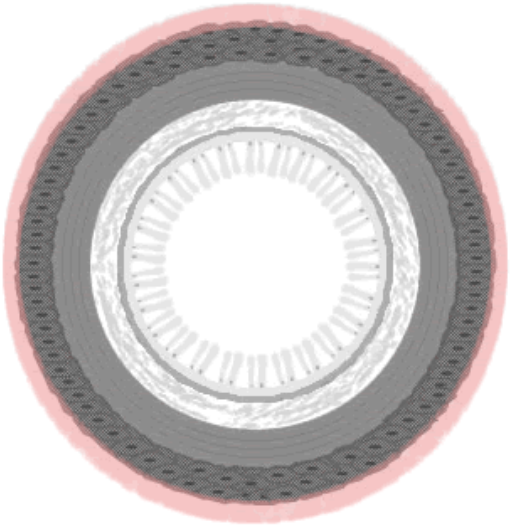


GENERAL ARCHITECTURE OF HOLLOW ORGANS

Serosa/Adventitia (Tunica serosa/adventitia)

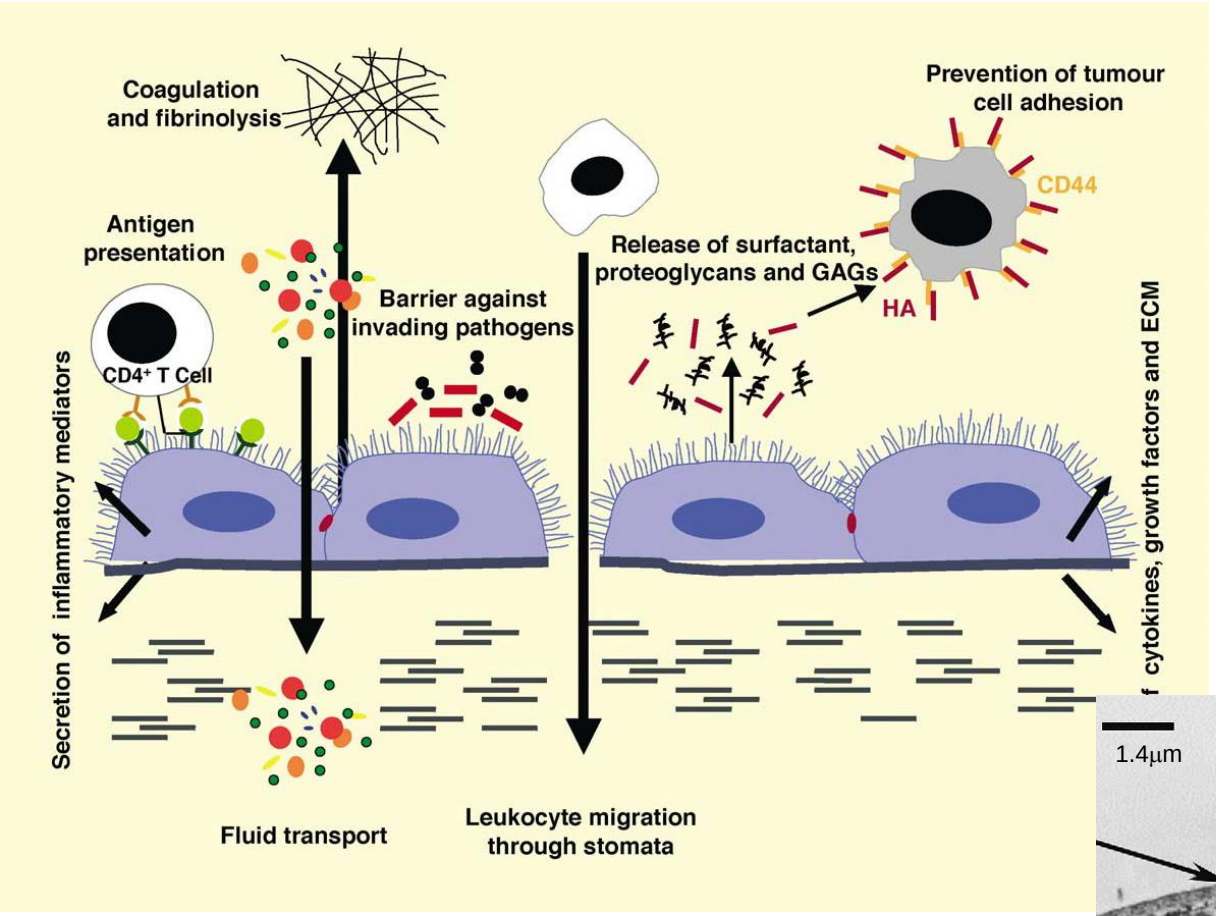
- outermost layer of gut tube
- **Serosa**
  - serous membrane of loose connective tissue (Lamina propria serosae) and single layer squamous epithelium (L. epithelialis serosae)
  - syn. mesothelium, visceral peritoneum
  - continuous with mesenterium
  - barrier against various pathogens , antiadhesive properties – intracoelomic movements, immune functions (Ag presentation), ECM production, etc.

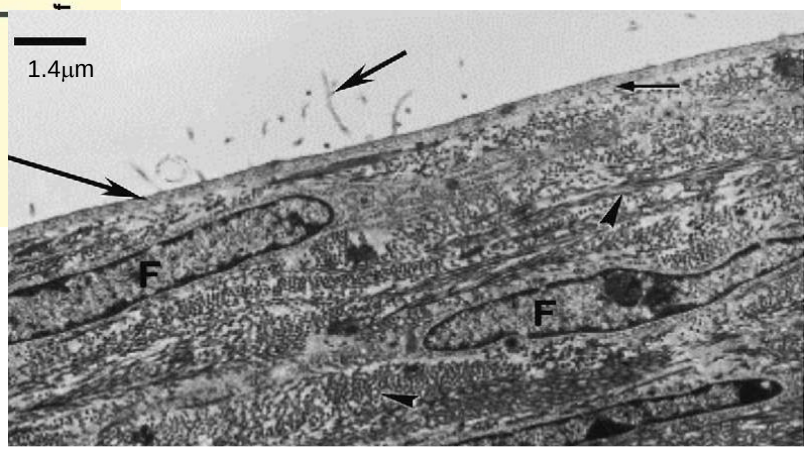
- **Adventitia**
  - some parts of the tube are not covered with epithelium
  - esophagus in thorax, parts of digestive system in peritoneal cavity in walls (duodenum, part of colon, rectum, anal canal)
  - connective tissue only continuous with connective tissue of the walls



GENERAL ARCHITECTURE OF HOLLOW ORGANS

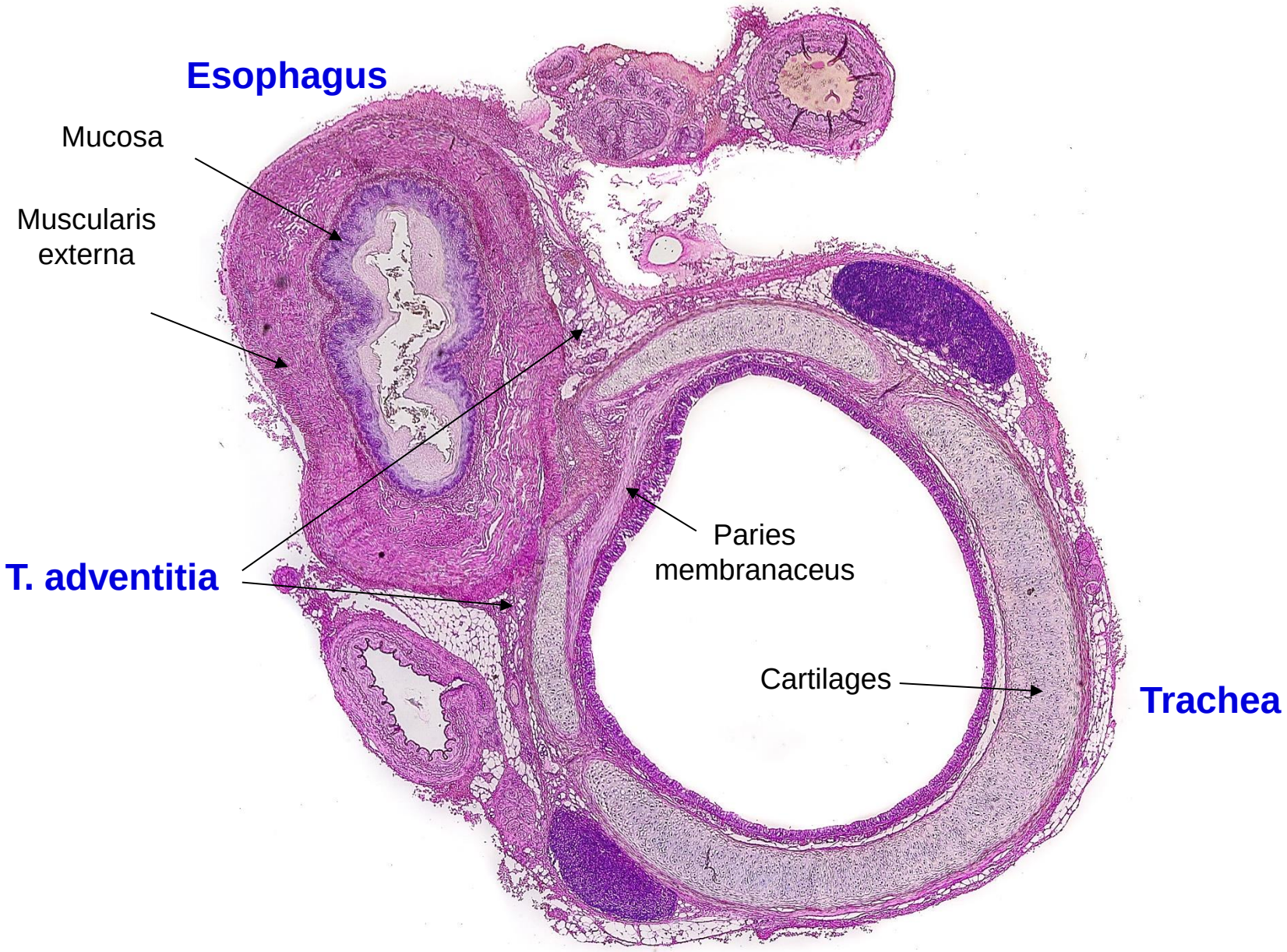
Serosa/Adventitia (Tunica serosa/adventitia)





S.E. Mutsaers / The International Journal of Biochemistry & Cell Biology 36 (2004) 9–16

GENERAL ARCHITECTURE OF HOLLOW ORGANS

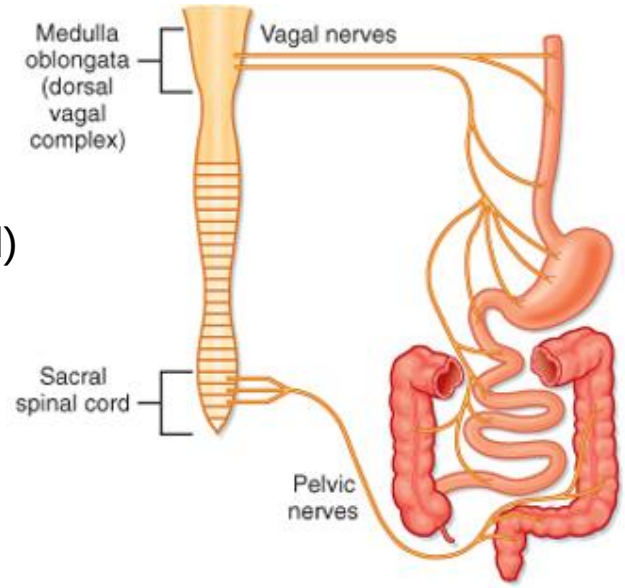


https://hmb302.ca/chapters/respiratory-system/

Innervation of the digestive tube

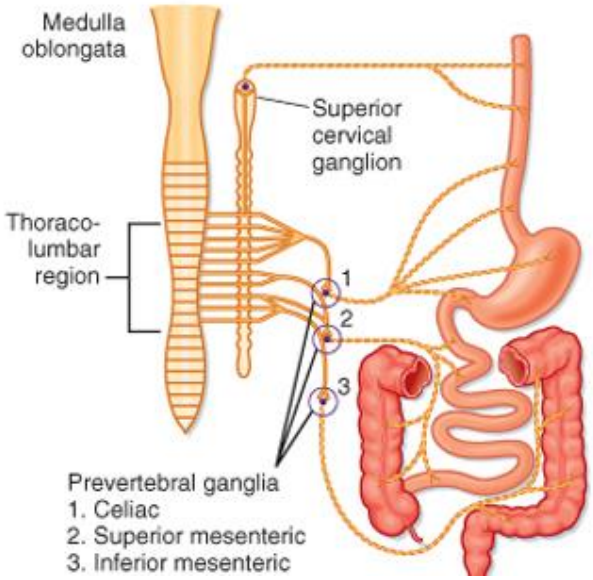
Enteric nervous system

- self-contained nervous system
- numerous ganglia, 100 x10^6 neurons (more than in spinal cord)
- Meissner submucosal plexus and Auerbach myenteric plexus
- peristaltic motility, secretory function, mucosal movements, regulation of blood flow
- sensory components



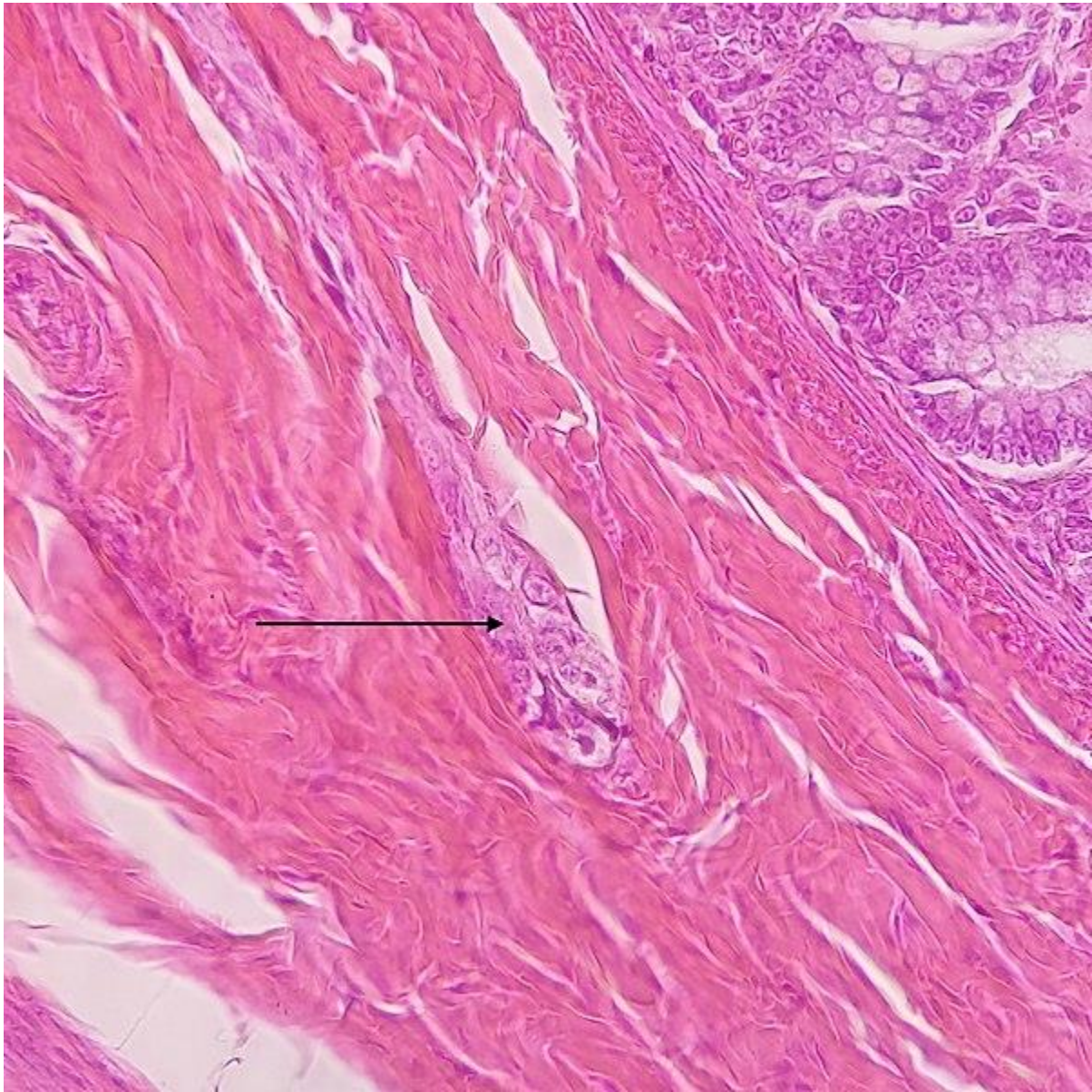
Parasympathetic and sympathetic supply

- **parasympathetic supply** mostly by vagus nerve (cranial X), colon and rectum by sacral spinal nerves
- vagus nerve – mostly sensory fibers (information from mucosa and back)
- secretion from glands, smooth muscle contractions
- *inhibits sphincters, stimulates peristaltics and secretion*
- **sympathetic supply** by splanchnic nerves
- vasomotor fibers – control of blood flow
- *activates sphincters, inhibits peristaltics and secretion*



Enteric nervous system

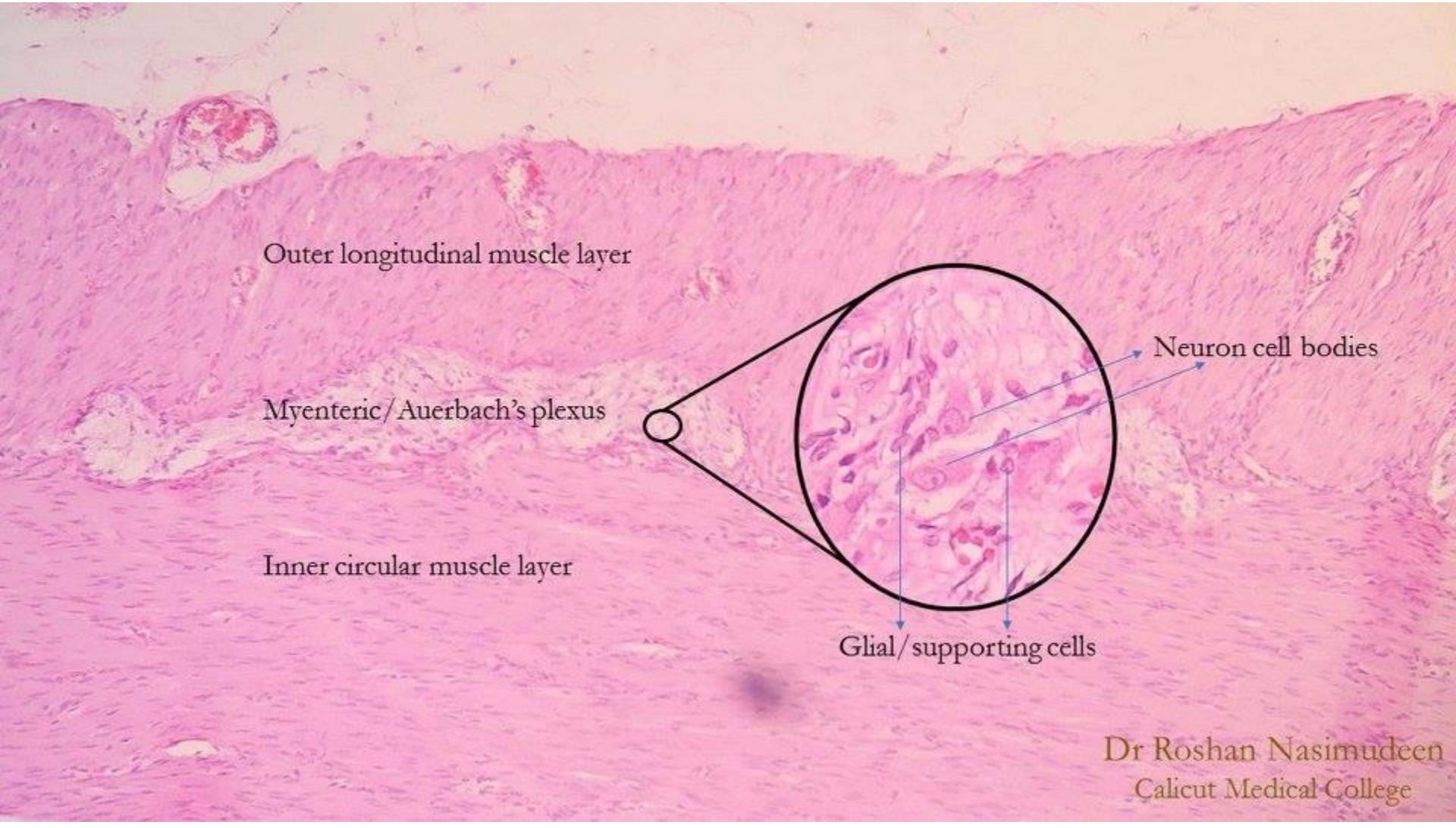
Plexus submucosus (Meissneri)



GENERAL ARCHITECTURE OF HOLLOW ORGANS

Enteric nervous system

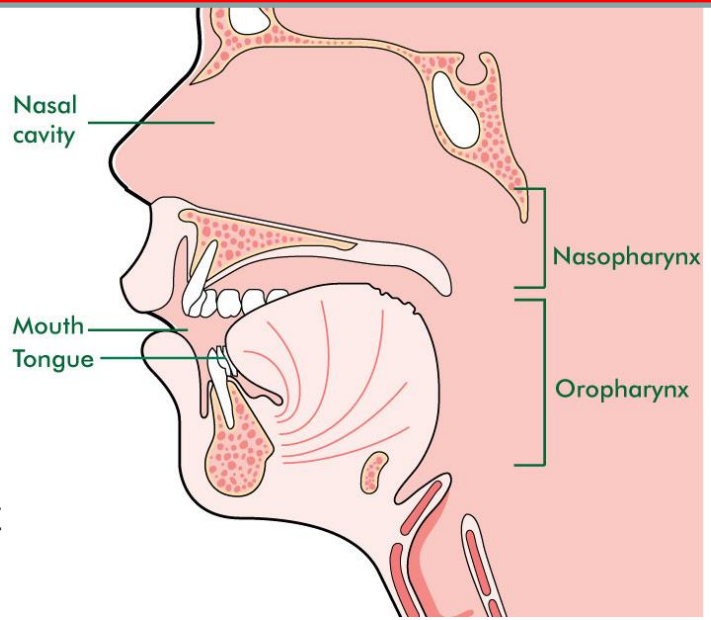
Plexus myentericus (Auerbachii)

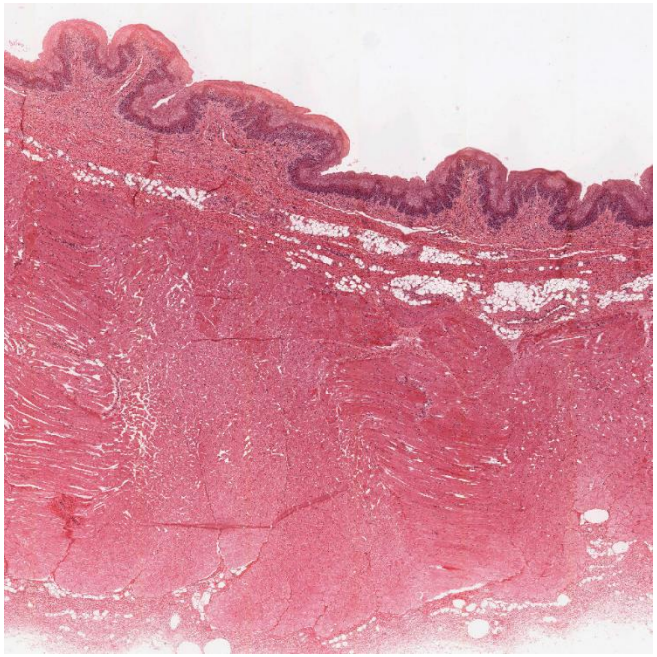


MICROSCOPIC ANATOMY OF GIT

PHARYNX

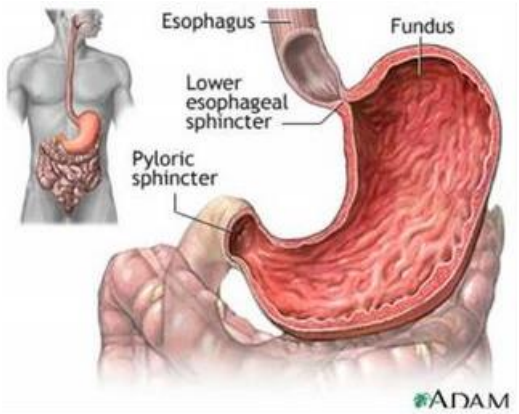
- **pars nasalis**
  - pseudostratified columnar ciliated epithelium
  - seromucous glands
- **pars oralis et laryngea**
  - nonkeratinized stratified squamous epithelium
  - mucous glands
- collagen c.t. (lamina propria), typical tela submucosa absent
- skeletal muscles

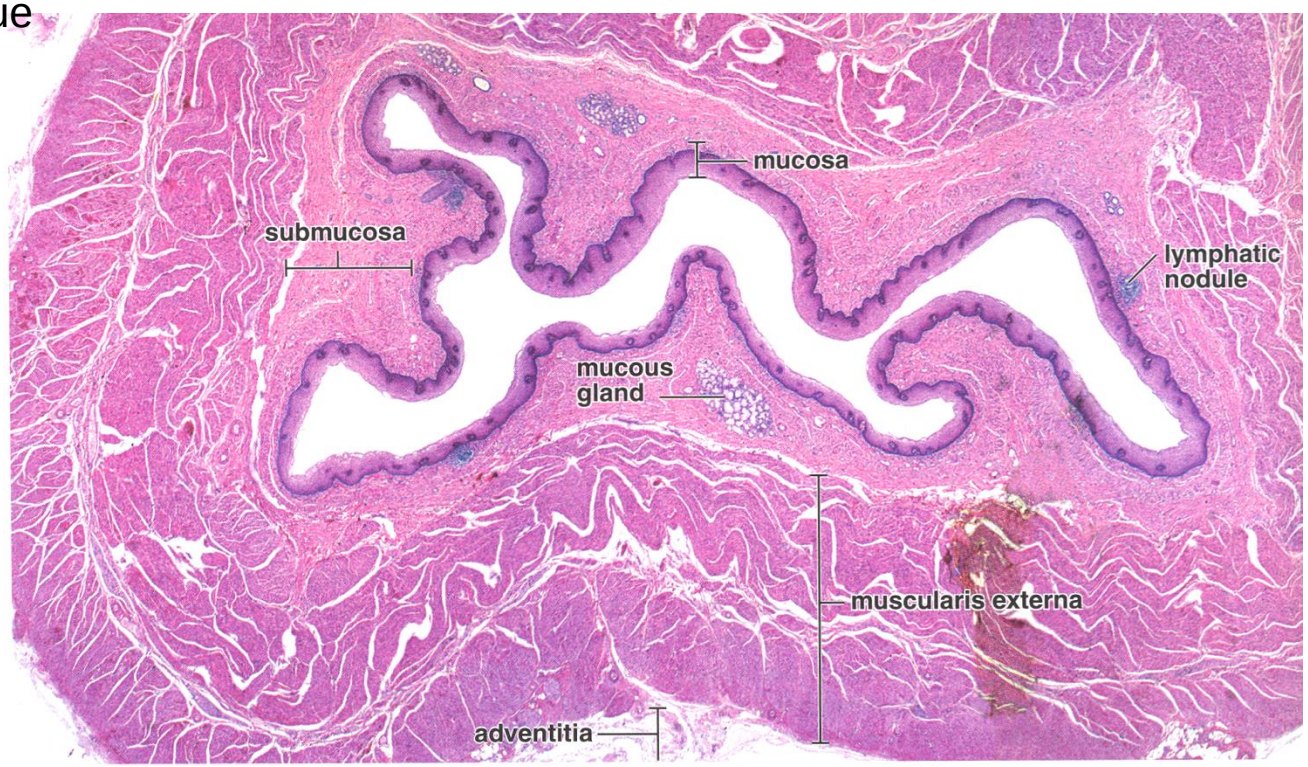




ESOPHAGUS (OESOPHAGUS)

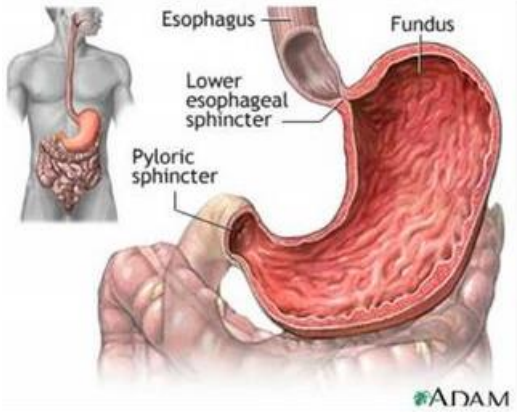
- **Mucosa**
  - nonkeratinized stratified squamous epithelium → mechanically protects esophageal tissue
  - l. propria contains cardial glands (tubular mucinous) and diffuse lymphatic tissue
- **Submucosa**
  - loose collagen connective tissue, defines shape of mucosa
  - blood and lymph veins, plexus submucosus Meissneri
  - submucosal glands (tubular mucinous)
  - diffuse lymphatic tissue

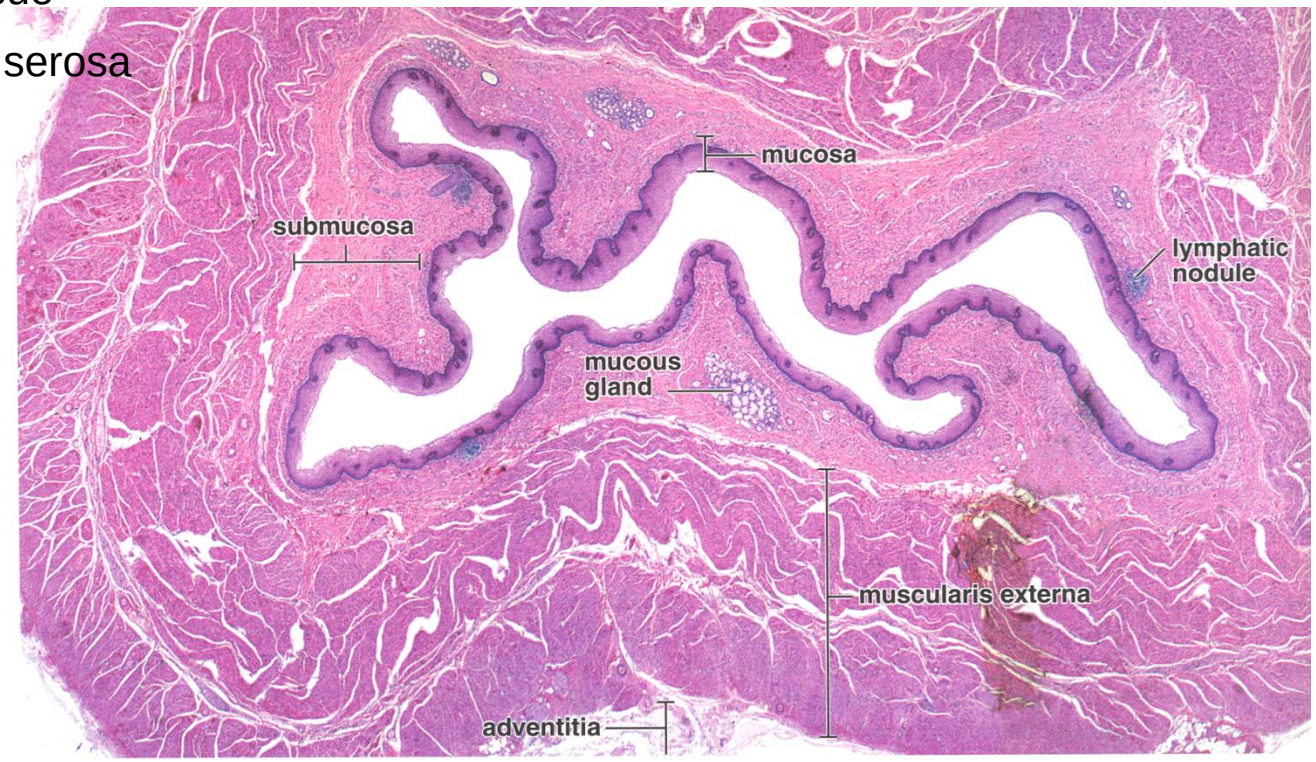




ESOPHAGUS (OESOPHAGUS)

- **Muscularis externa**
  - inner circular and outer longitudinal layer
  - plexus myentericus Auerbachi
  - upper third – skeletal muscle, mid third – mixed smooth and skeletal, lower third – smooth muscles only
- **Adventitia**
  - neck and chest – connects esophagus with surrounding tissue
  - loose connective tissue
  - in peritoneal cavity - serosa

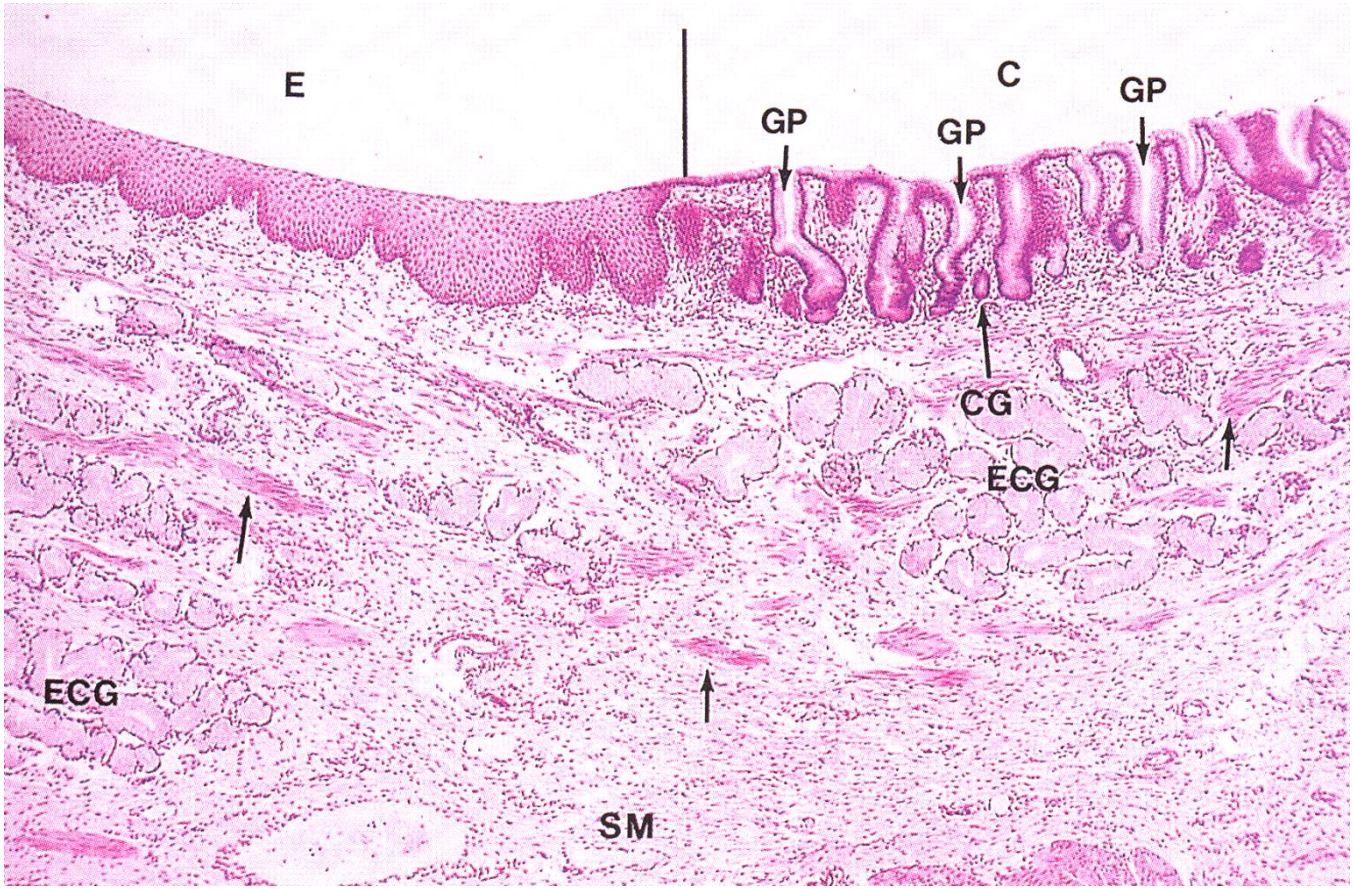




CARDIO-ESOPHAGEAL JUNCTION

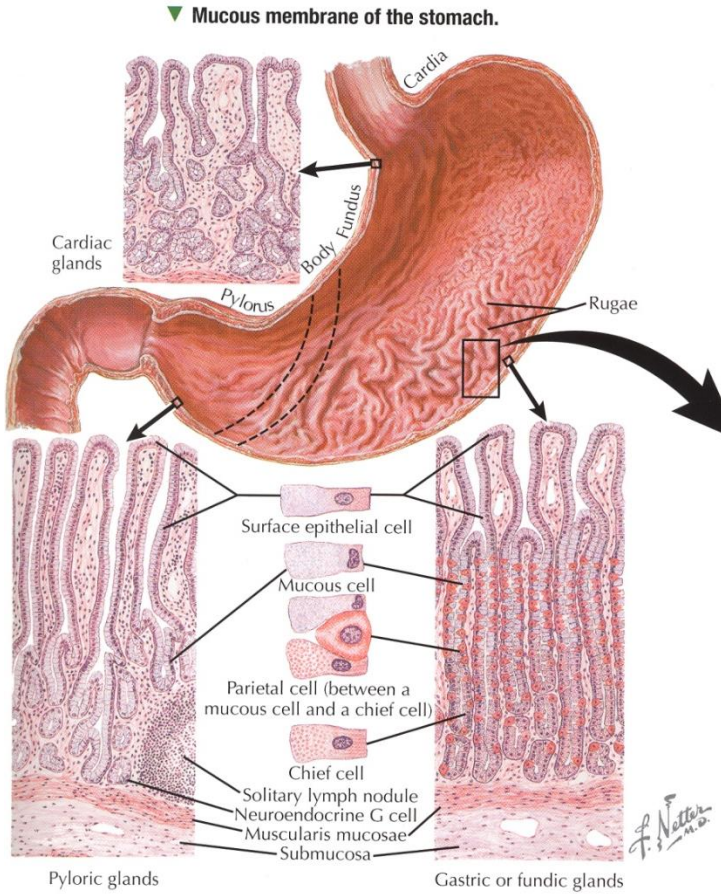
Cardia of stomach – connection with esophagus

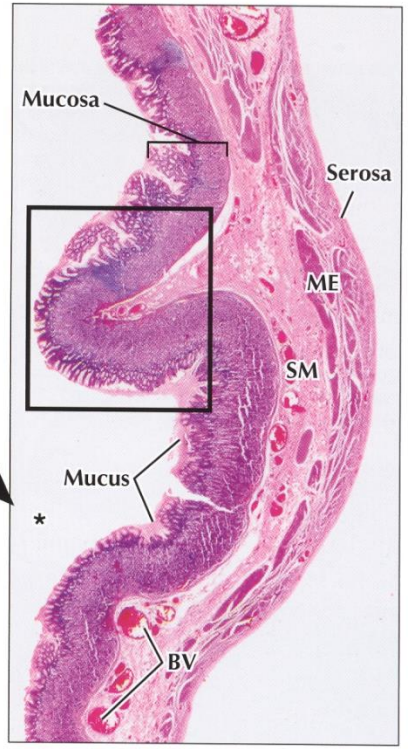
- Non-keratinized stratified squamous epithelium → simple columnar epithelium
- Change of mucosal architecture



Stomach anatomy and microanatomy

- general anatomy of hollow tube
- anatomical regions differ in histologic structure – glands
- *rugae gastricae* (submucosa)





▲ **Light micrograph (LM) of the stomach wall showing four concentric layers at low magnification.** A thick mucosa (formed mostly of tightly packed gastric glands) lines the lumen (*). The rectangle indicates a ruga consisting of a submucosal connective tissue core covered by mucosa. A thick layer of mucus secreted by surface cells forms a barrier over the mucosa for protection of tissues from acid and proteolytic enzymes in the lumen. The submucosa (**SM**) has prominent blood vessels (**BV**). Serosa covers the muscularis externa (**ME**) externally. 10×. *H&E.*

STOMACH (VENTRICULUS, GASTER)

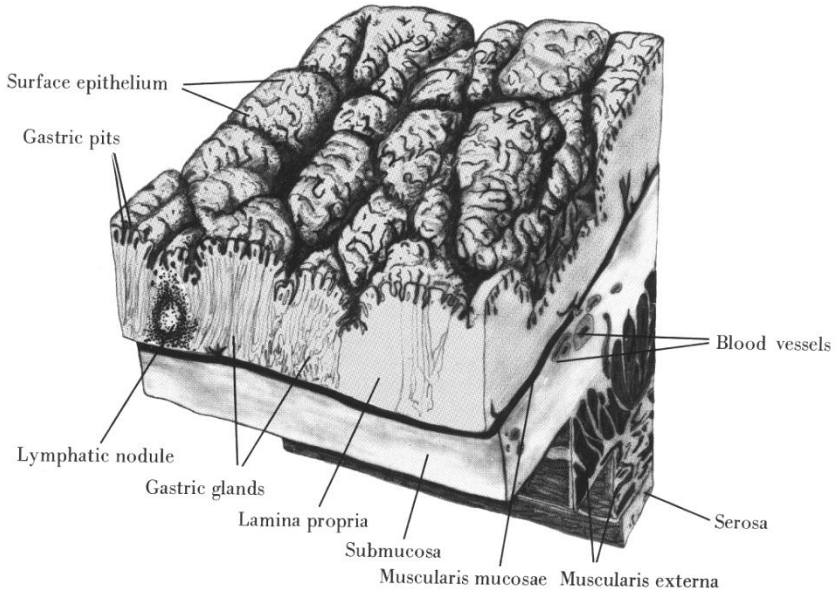
Gastric mucosa

- simple columnar epithelium
- surface epithelium produces mucus

(mucinogenic granules, high content of HCO_3^-, K^+)

= protective function

- areae gastricae, foveolae gastricae



STOMACH (VENTRICULUS, GASTER)

Gastric mucosa

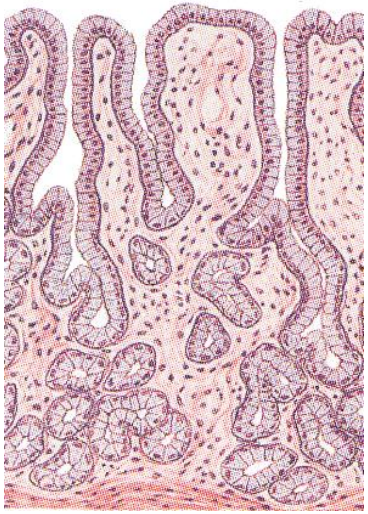
- L. propria contains large amount of glands

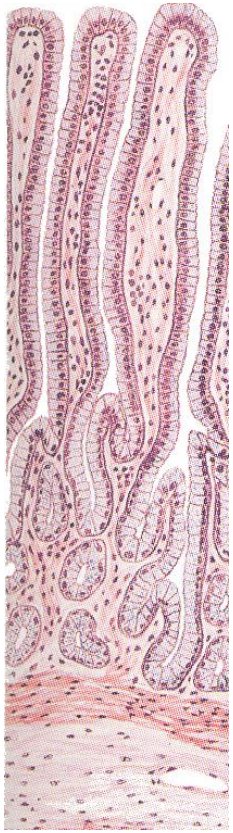
- **Gl. cardiacae**
- **Gl. pyloricae**

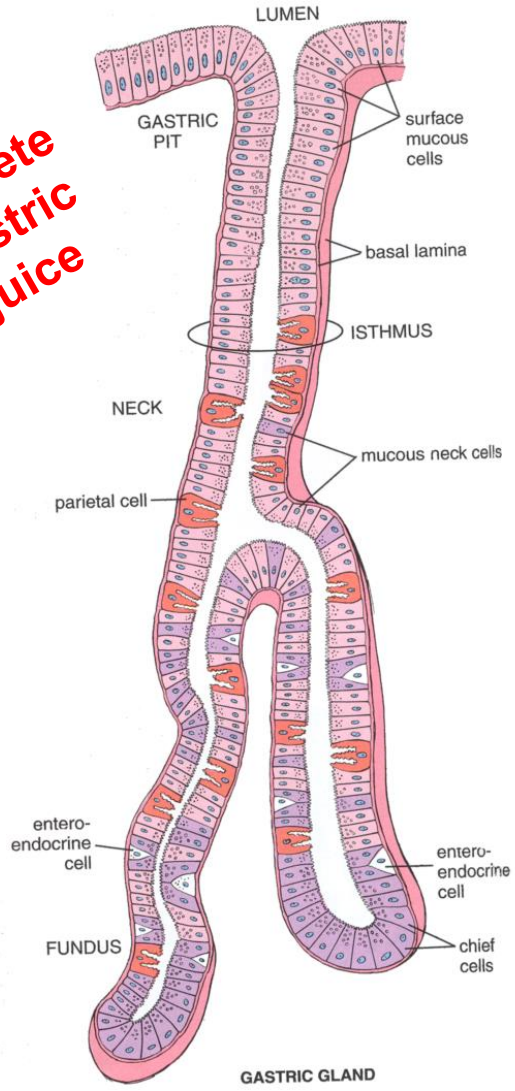
} **Mucous**

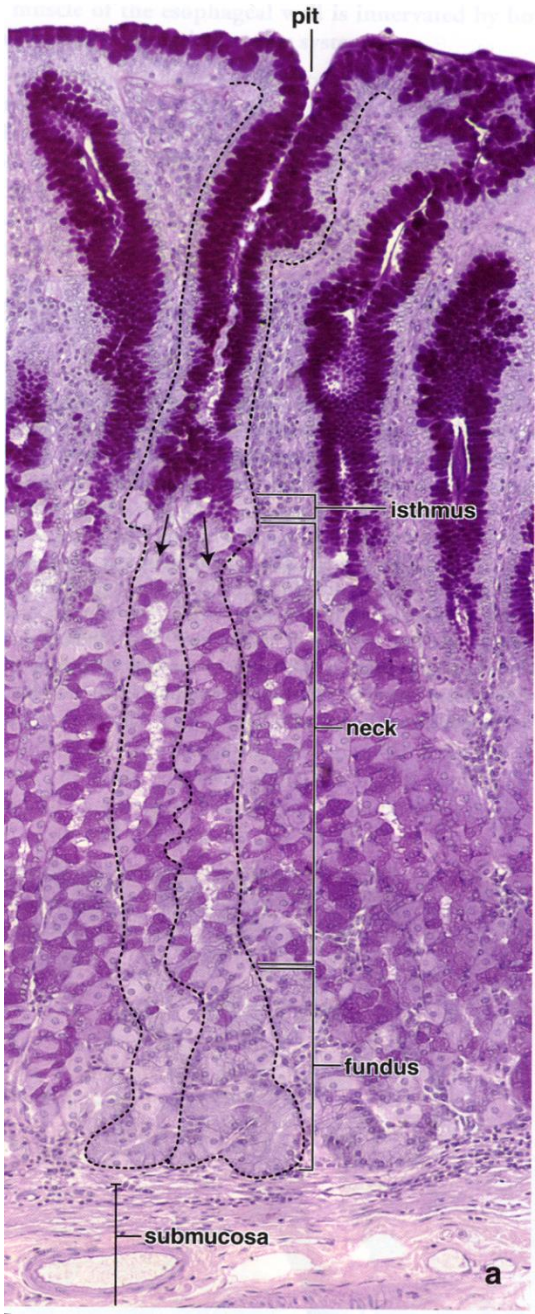
- **Gl. gastricae propriae**

Secrete gastric juice







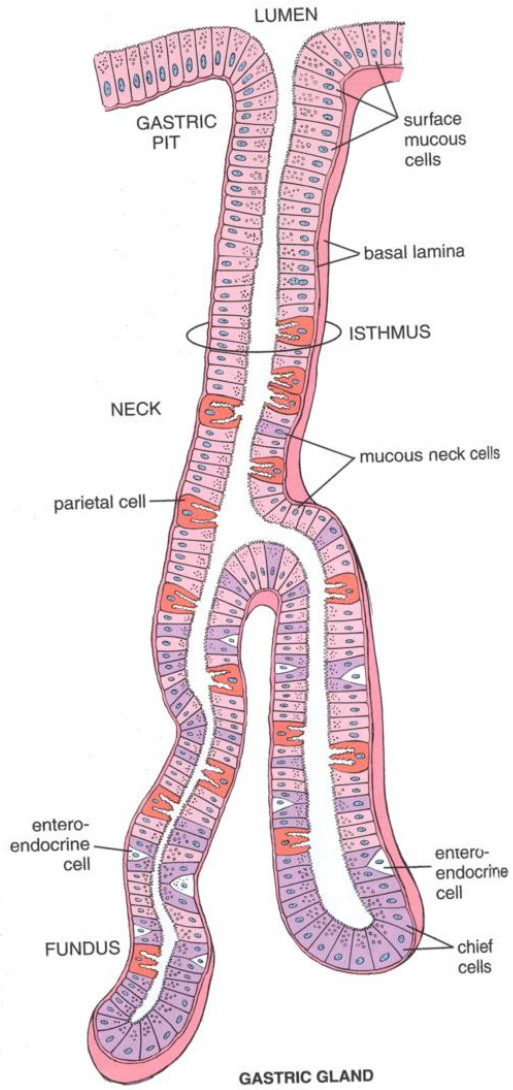


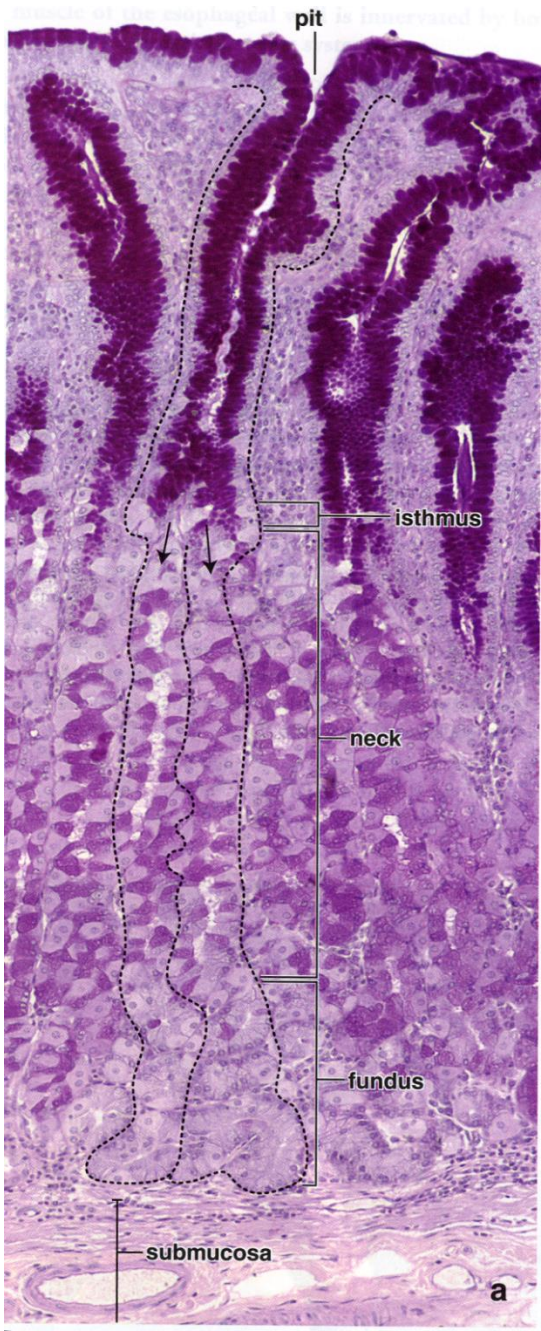
STOMACH (VENTRICULUS, GASTER)

Gl. gastricae propriae

- glands of fundus and body
- simple tubular or branched
- 2-4 opens to the gastric pits

- **four cell types of gl. gastricae propriae**



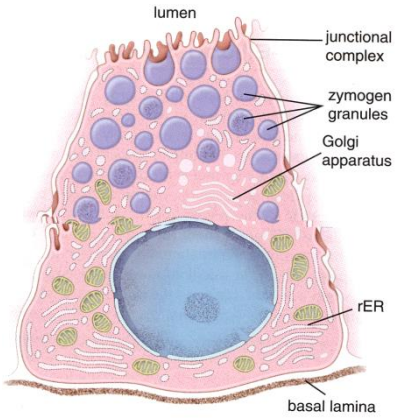


STOMACH (VENTRICULUS, GASTER)

Gl. gastricae propriae

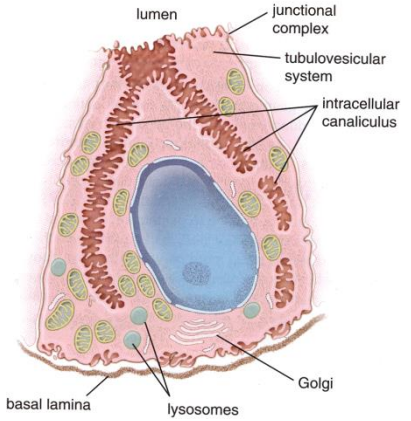
chief

- most abundant, lower part of body and fundus of the gland
- pyramidal shape, basophilic cytoplasm, RER, pepsinogenic granules



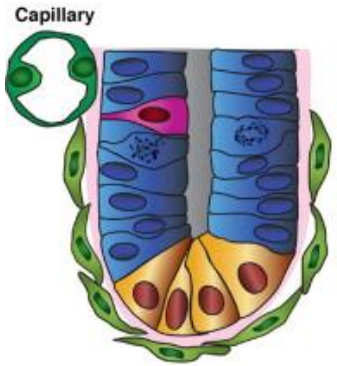
parietal

- neck-body junction
- eosinophilic cytoplasm, high numbers of mtch., SER
- complex and dynamic ultrastructure
- intracellular canals in apical part with microvilli – membrane bound enzyme complexes producing H^+ a Cl^- (<u>HCl originates extracelullarly</u>)



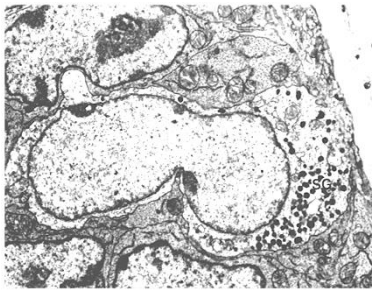
neck cells

- cubic, mucinous
- capable of regeneration of all cell types in gastric epithelium



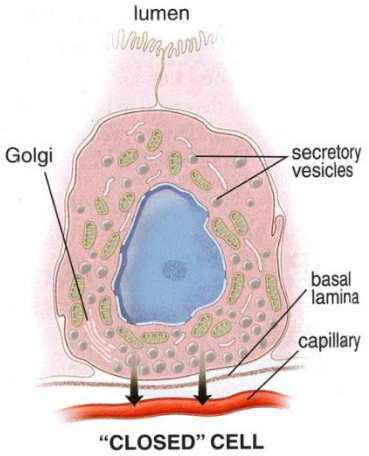
STOMACH (VENTRICULUS, GASTER)

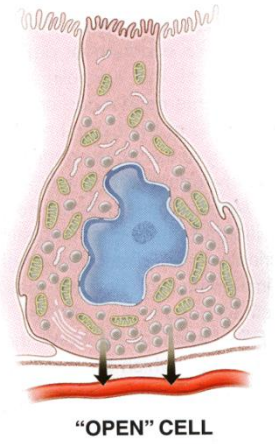
Gl. gastricae propriae



enteroendocrine

- minor, secretion
- granules
- different cell types with different sensitivity to various histological stainings
- secretion of various biologically active compounds
- DNES/APUD
- GIT chemosensing

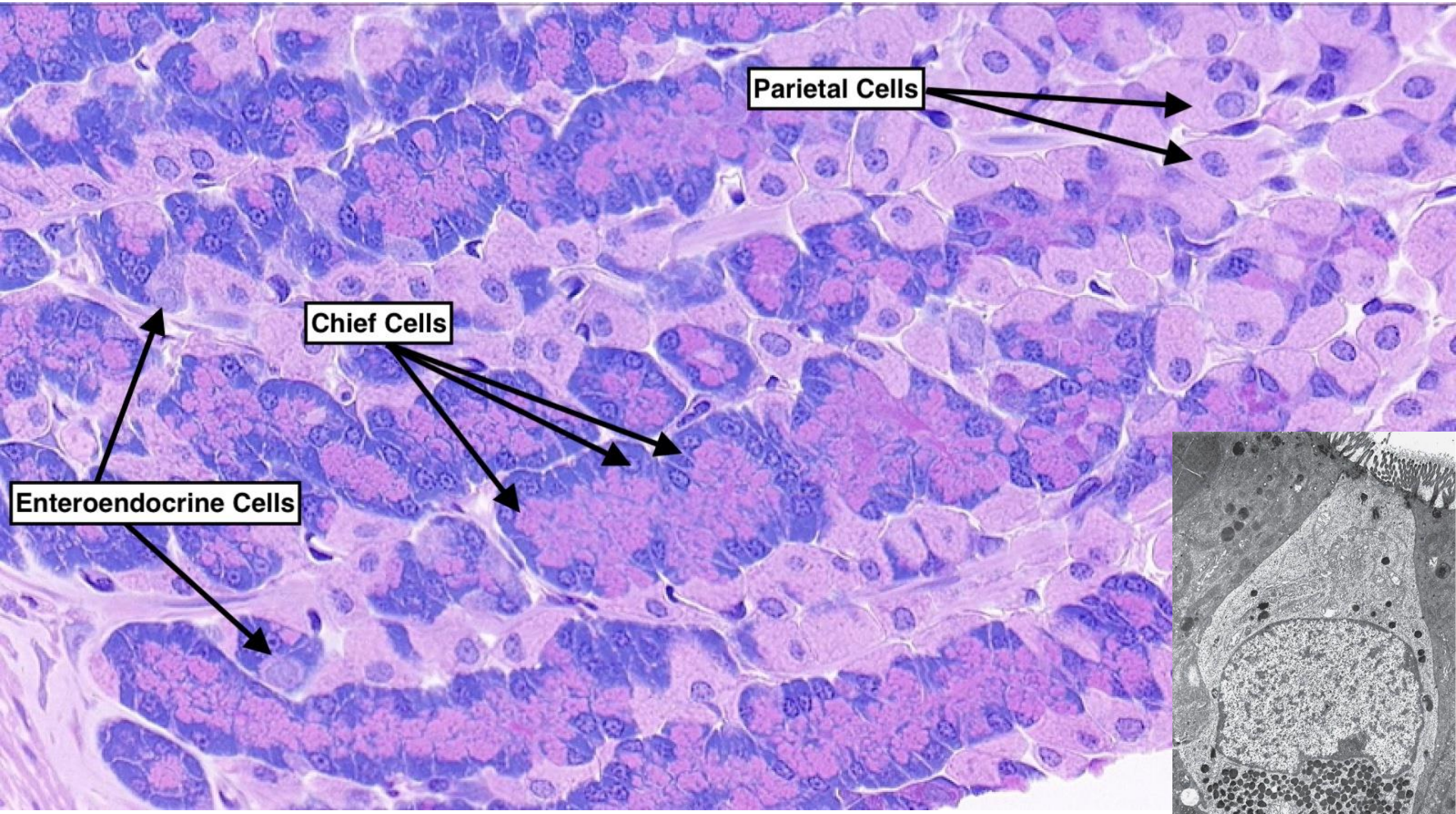


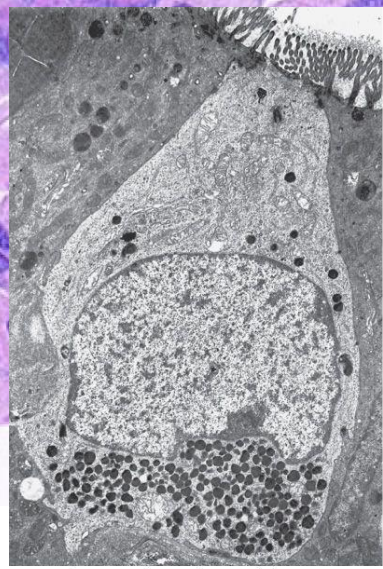


Type	Hormone	Localization/Function
D cells	Somatostatin	- Stomach, intestine, hepatic and pancreatic ducts
EC cells	Serotonin	- Stomach, gallbladder, intestine - Peristaltics
ECL cells	Histamin	- Stomach - HCl secretion
G cells	Gastrin	- Pars pylorica, duodenum - HCl, pepsin secretion
L (EG) cells	Enteroglucagon	- Stomach, intestine - attenuates secretion of pancreatic enzymes and peristaltics

STOMACH (VENTRICULUS, GASTER)

Enteroendocrine system





Lumen

MV

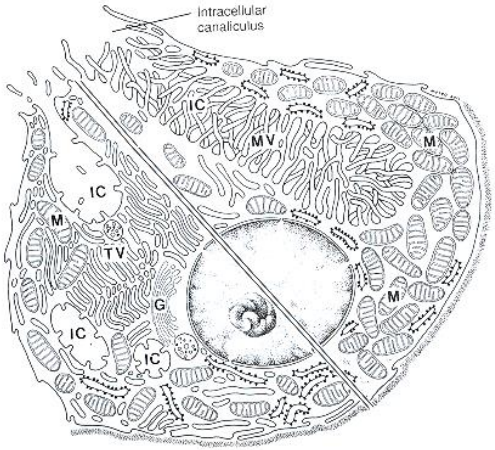
M

MV

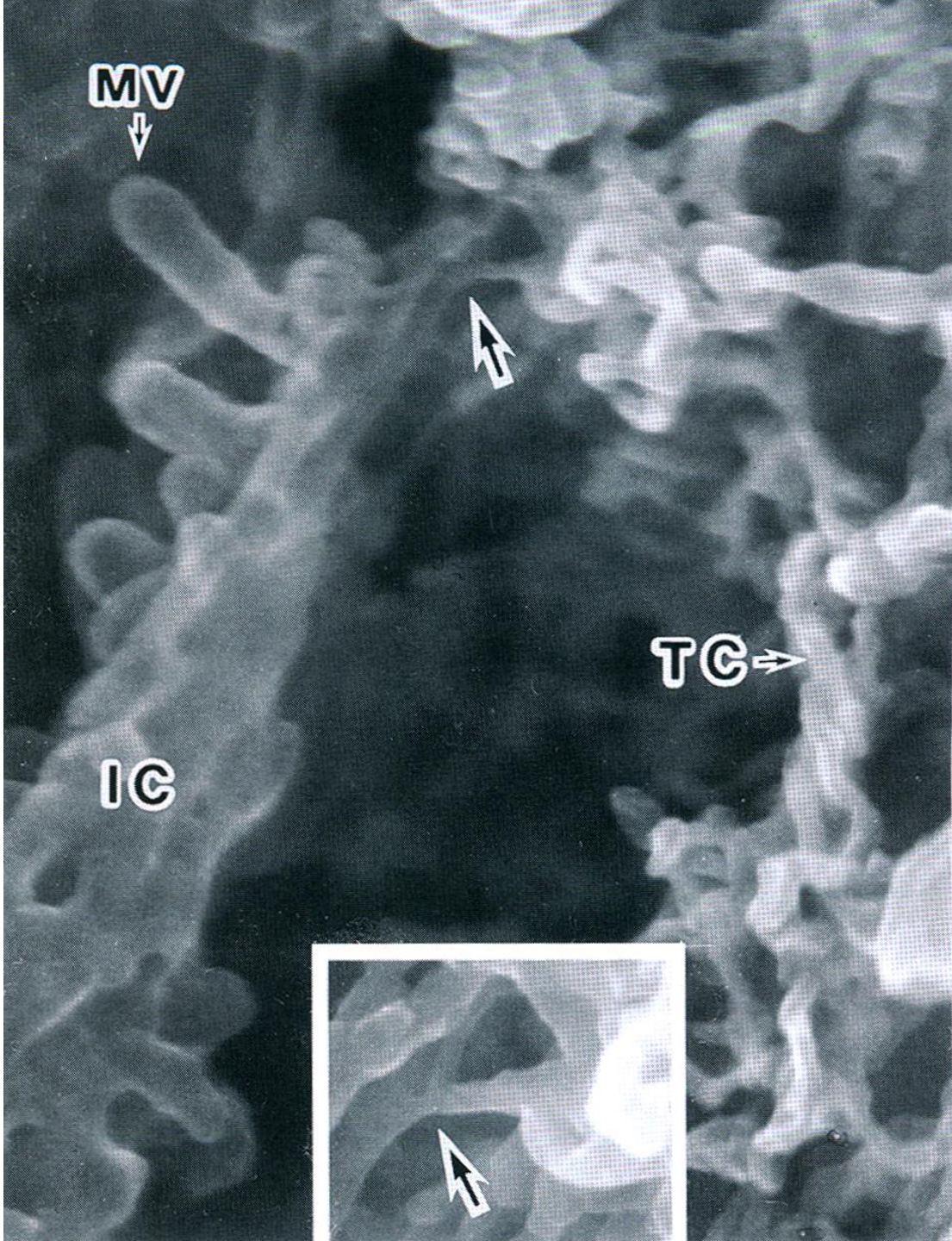
M

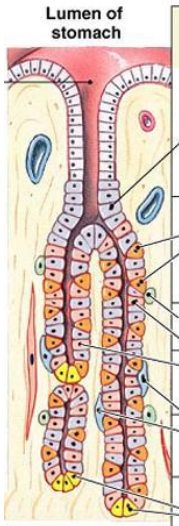
Parietal cell

×10200

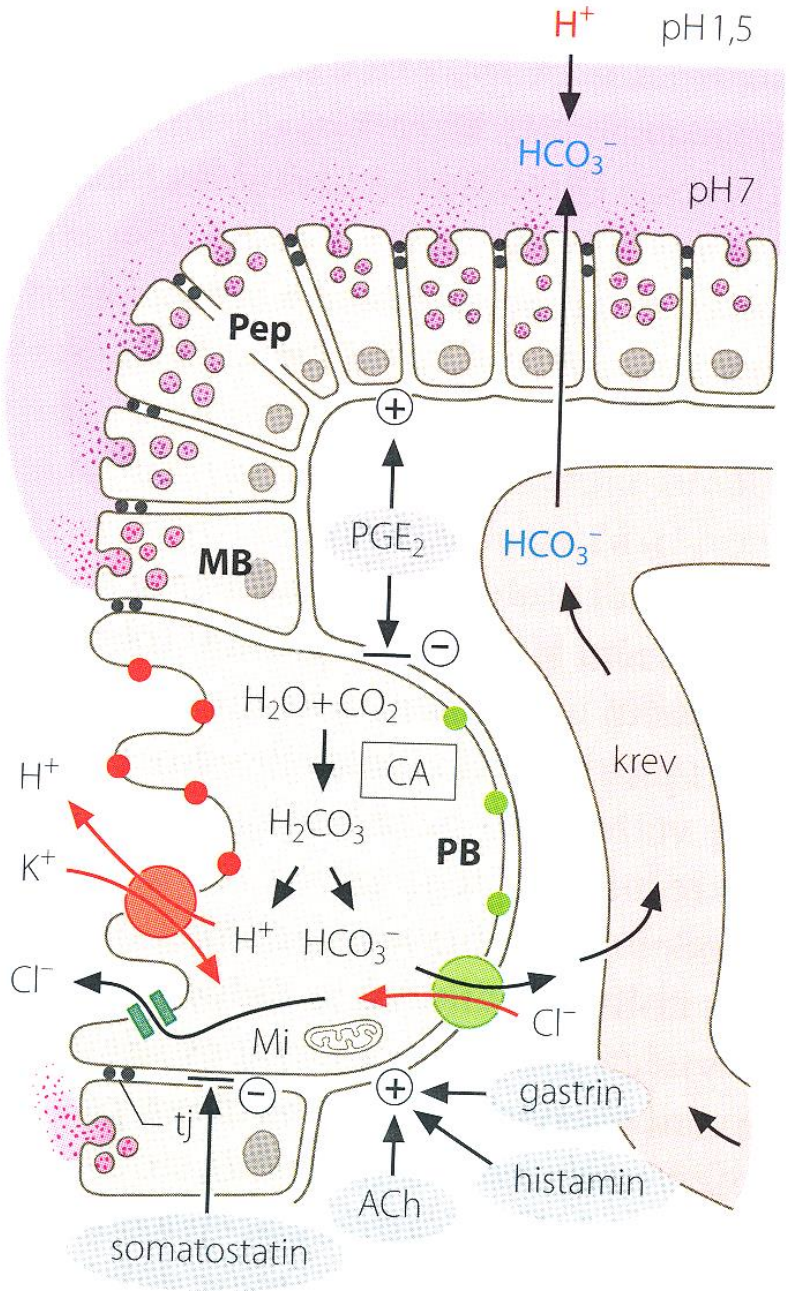


Parietal cell
×100 000

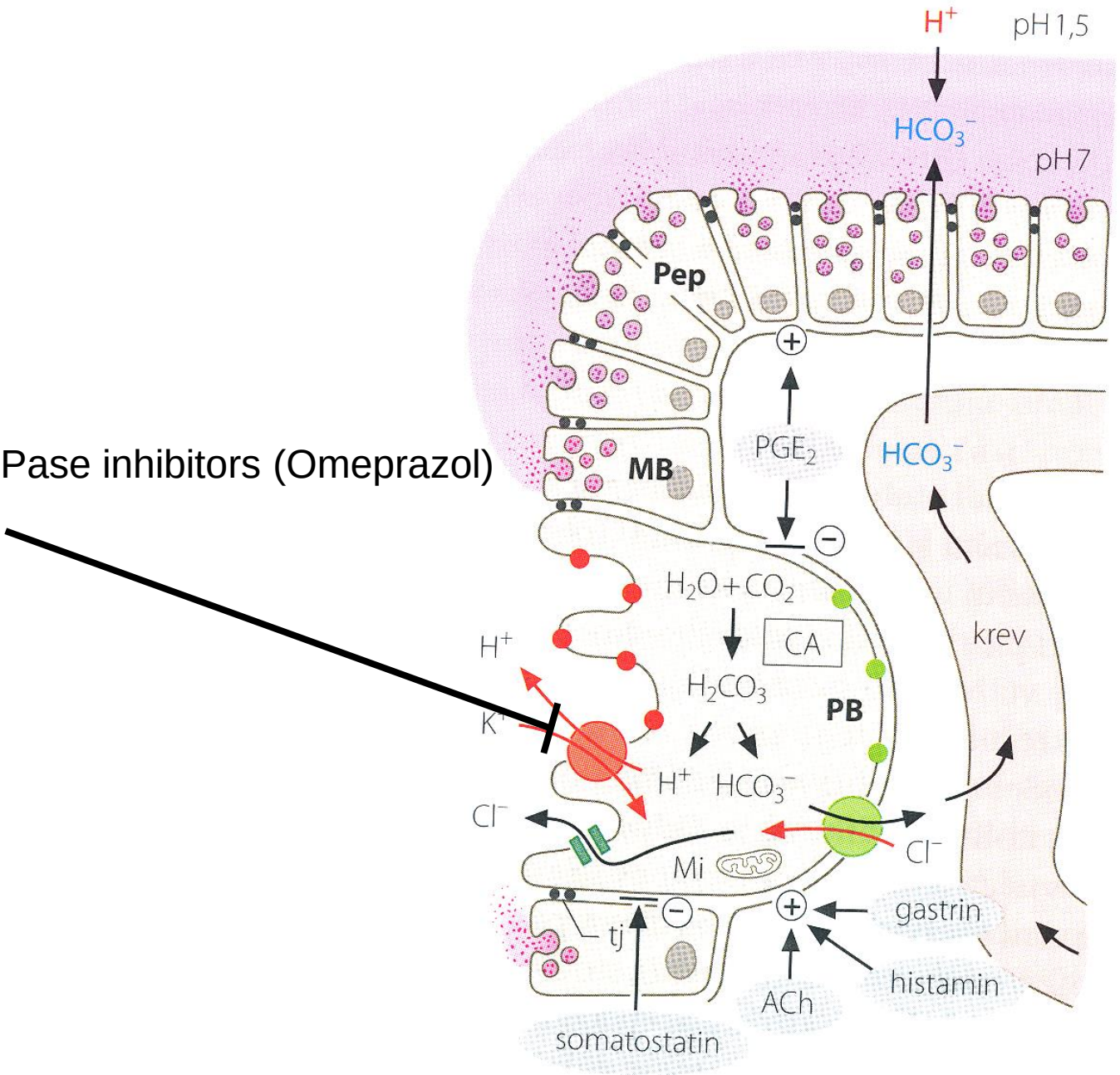




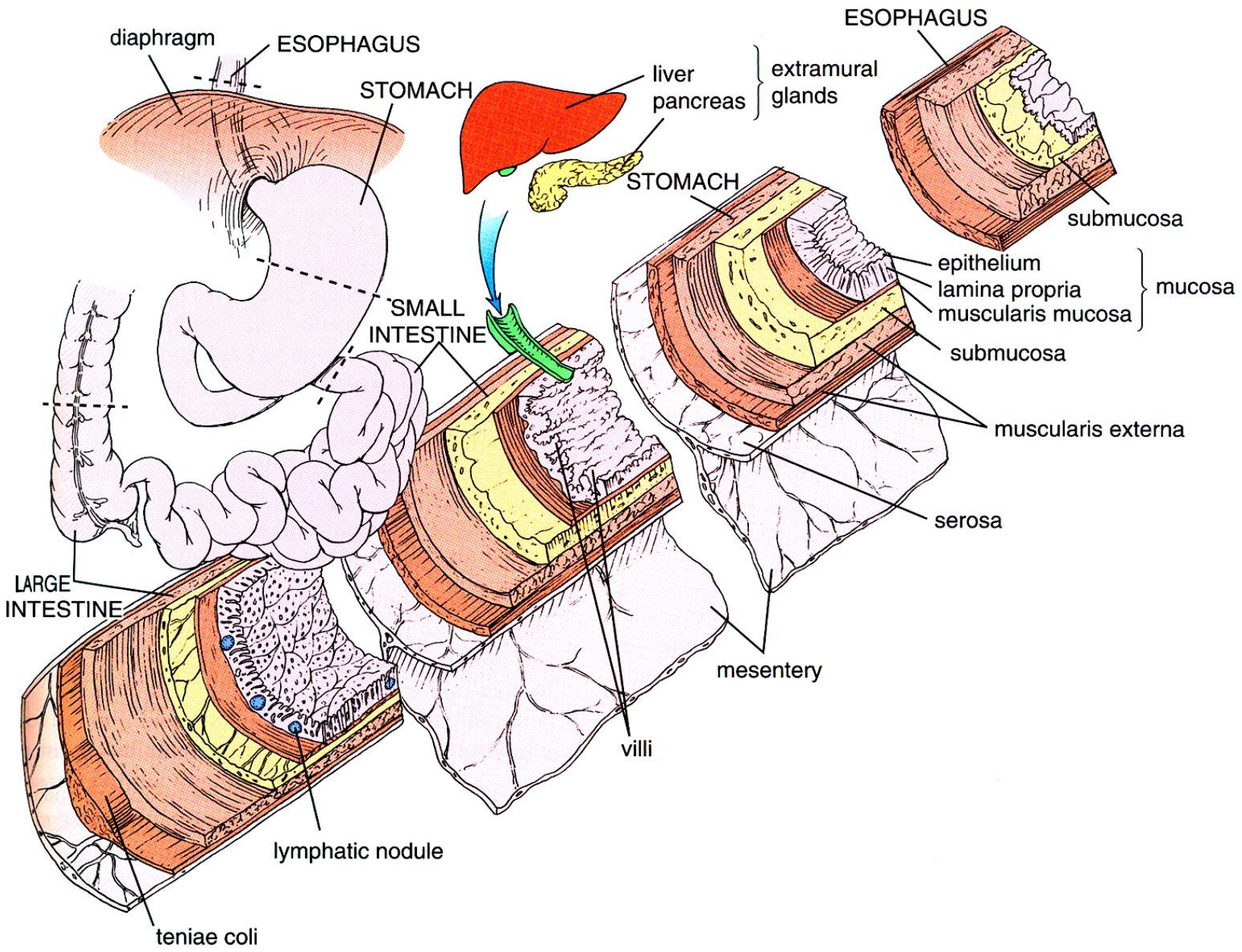
Cell Types	Substance Secreted
Mucous neck cell	Mucus (protects lining)
	Bicarbonate
Parietal cells	Gastric acid (HCl)
	Intrinsic factor (Ca++ absorption)
Enterochromaffin-like cell	Histamine (stimulates acid)
Chief cells	Pepsin(ogen)
	Gastric lipase
D cells	Somatostatin (inhibits acid)
G cells	Gastrin (stimulates acid)



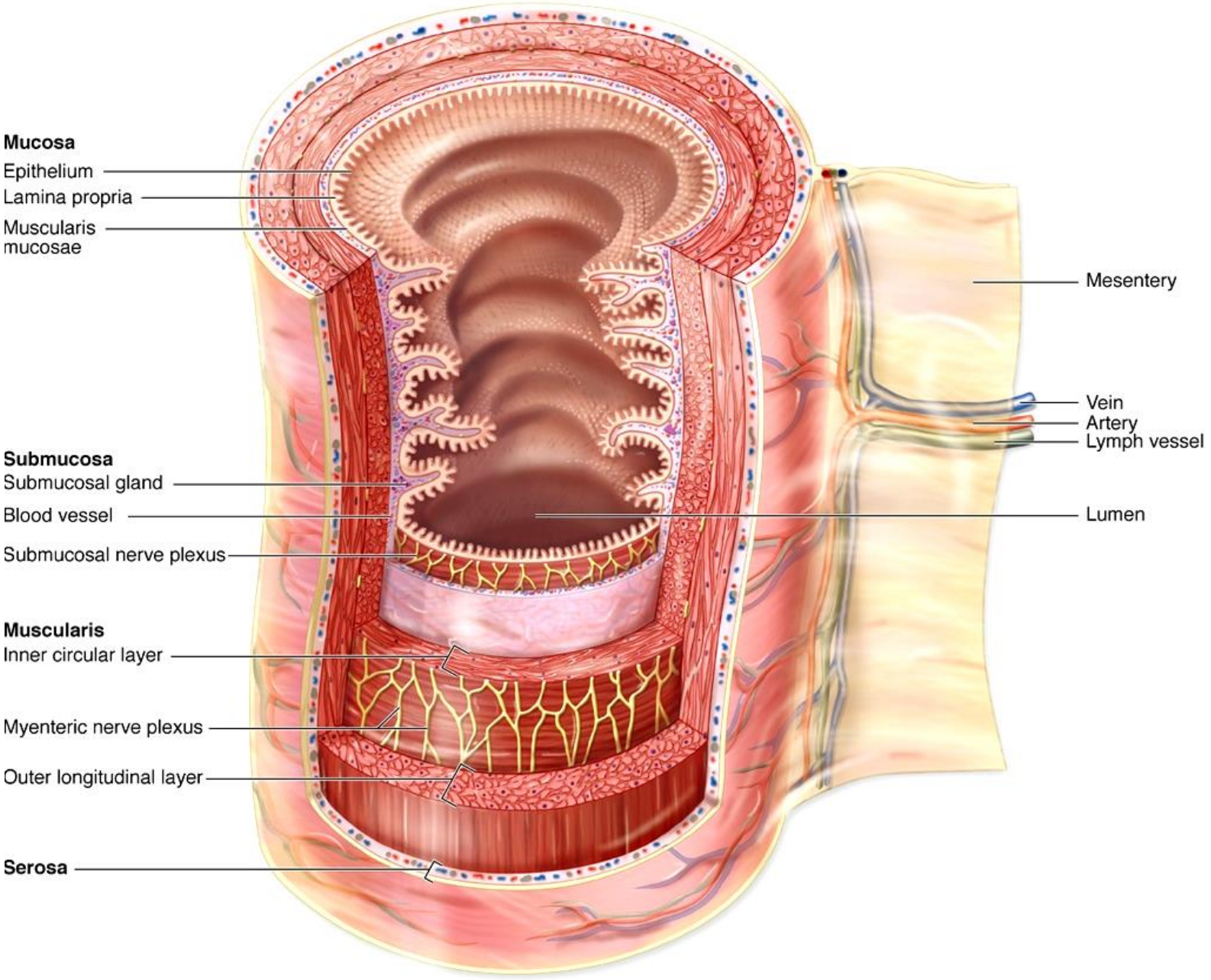
H+/K+ ATPase inhibitors (Omeprazol)



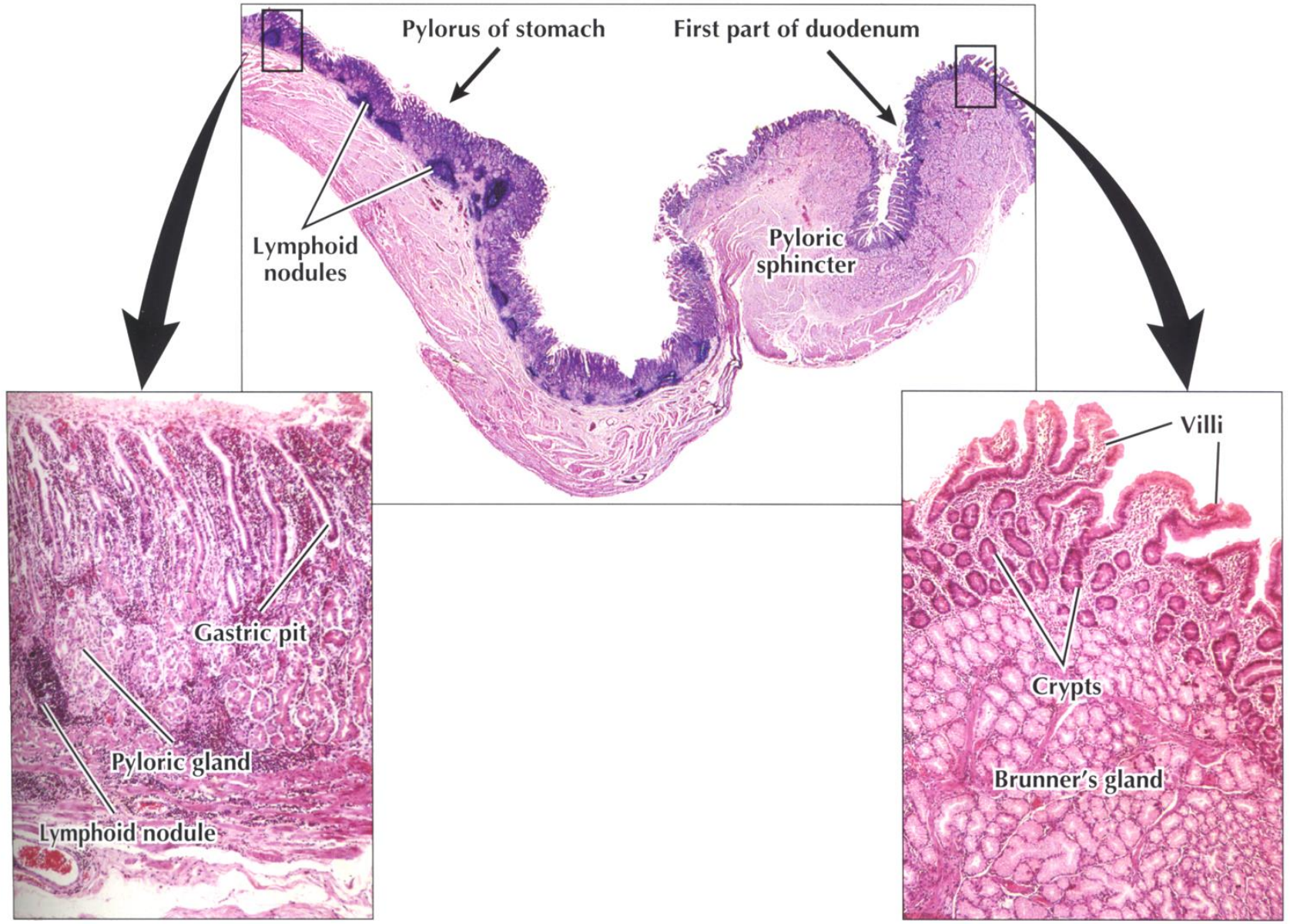
GENERAL ARCHITECTURE OF HOLLOW ORGANS



GENERAL ARCHITECTURE OF HOLLOW ORGANS



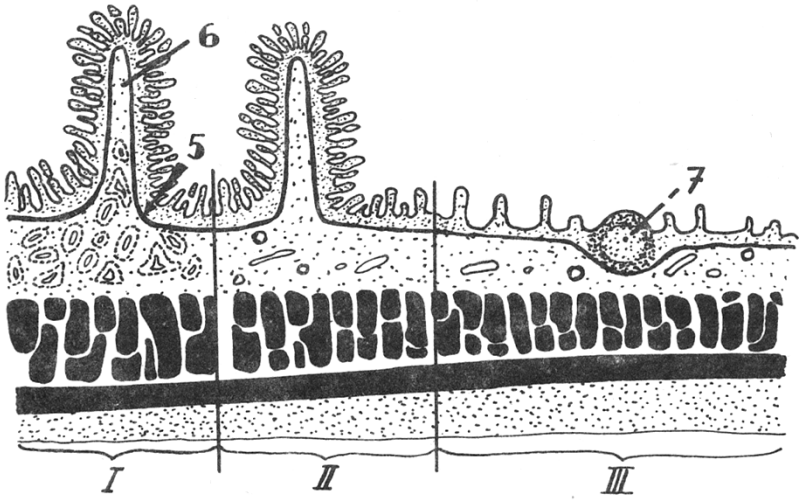
GASTRO-DUODENAL JUNCTION



SMALL INTESTINE – ADAPTATION TO EFFICIENT RESORPTION

Four basic layers: **mucosa, submucosa, muscularis externa, serosa**
mucosa and submucosa maximise the resorptive area

- **plicae circulares** (Kerckringi) – mucosa + submucosa, ca 800, increase **2-3x**, distal region of duodenum



- **villi** (villi intestinales) – mucosa (l. propria + epithelium) 0,5-1,5 mm long, 10-40/mm^2 , 4 000 000, increase **5-10x**

- **microvilli** – apical part of enterocytes – 1- 2 μm long, 0,1 μm wide, 100 mil./mm^2, increase **20x**

SMALL INTESTINE – ADAPTATION TO EFFICIENT RESORPTION

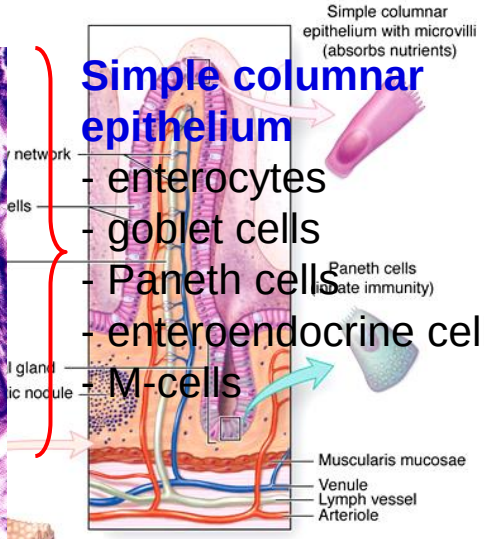
Intestinal mucosa

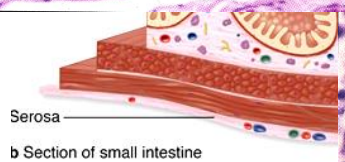
plicae circulares (Kerc
– **2-3x**

villi (villi intestinales)
– **5-10x**

microvilli (striated border)
– **20x**

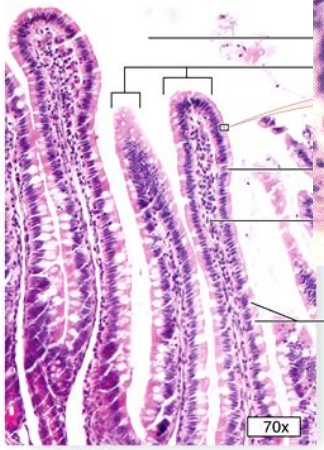
Simple columnar epithelium
- enterocytes
- goblet cells
- Paneth cells
- enteroendocrine cells
- M-cells





b Section of small intestine

Crypts of Lieberkühn



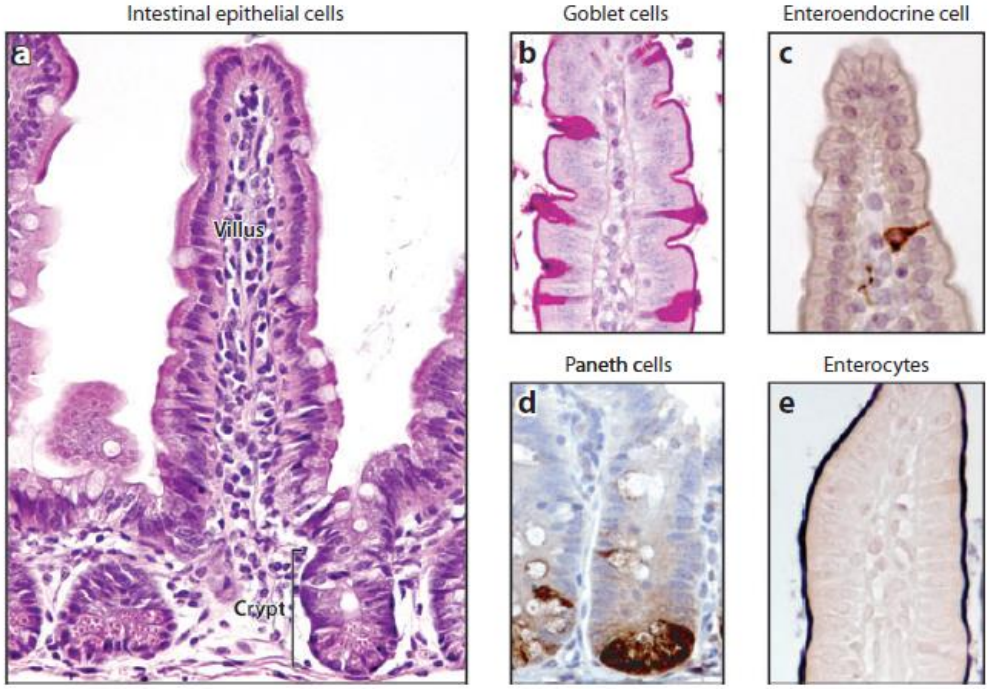
d Intestinal villi

e Microvilli

200-600x

CRYPTS OF LIEBERKÜHN (GL. INTESTINALES)

- simple tubular structures of intestinal mucosa, depth 0,3-0,5 mm
- pass through l. propria and open to lumen
- different cell types
  - secretion of digestive enzymes
  - epithelial renewal
  - enteroendocrine cells
  - immune response



CELLS OF INTESTINAL MUCOSA

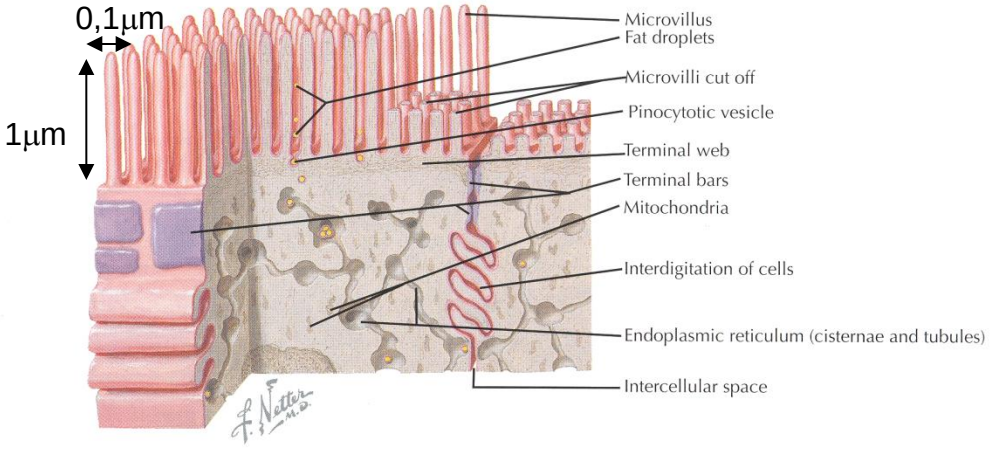
Enterocytes

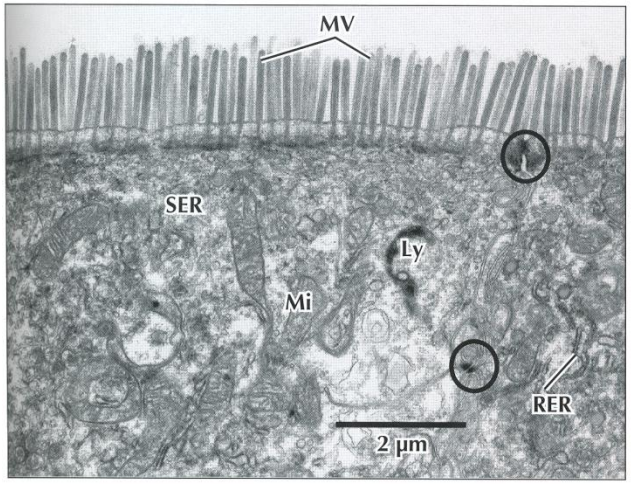
- tall, columnar cells
- nucleus located in basis of the cell
- apical surface modified- microvilli (3000) + glycocalyx (0,5μm) = *striated border (cuticle)*
- tight intercellular connections, interdigitations

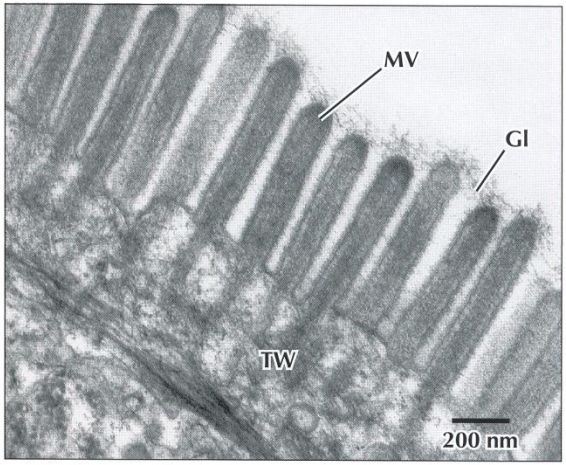
Function:

- digestion – enzymatic complexes on microvilli membrane
- absorption and transport – passive, facilitated i active
- lipid uptake - chylomicrons

▼ **Three-dimensional scheme of striated border of intestinal epithelial cells.**



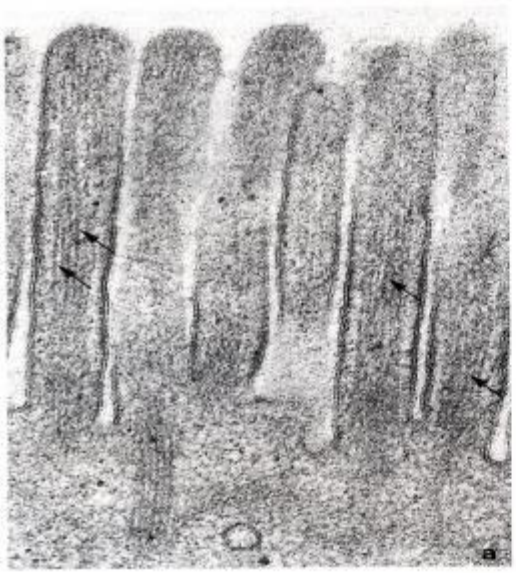


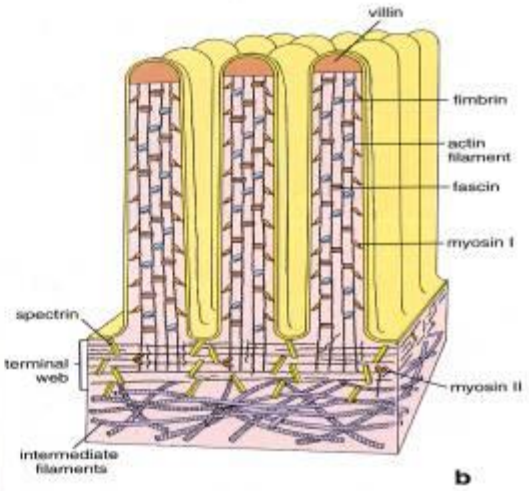


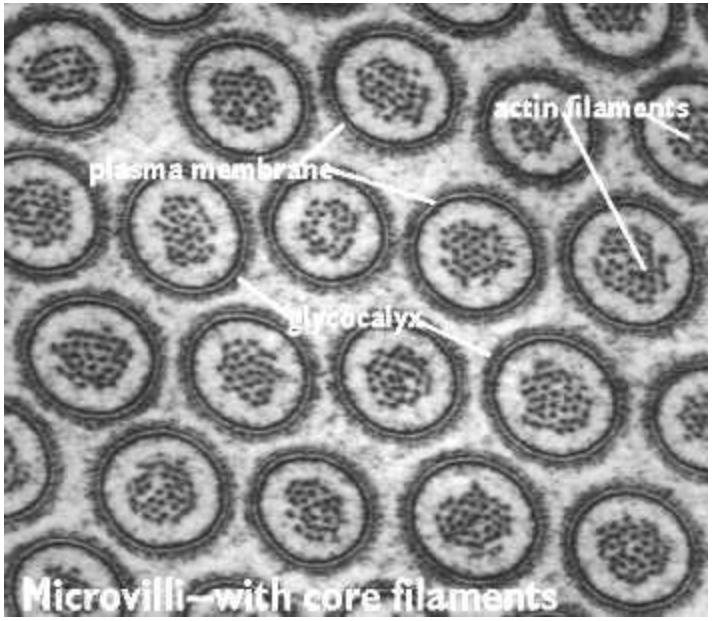
▲ **EMs of enterocytes at low (Left) and high (Right) magnification.** Apical microvilli (**MV**) make up a striated border and extend from free surfaces of the cells. A fuzzy glycocalyx (**Gl**) covers them. A terminal web (**TW**) of actin filaments in the apical cytoplasm reaches into microvilli. Intercellular junctions (**circles**) are between adjacent cells. The cytoplasm contains mitochondria (**Mi**), lysosomes (**Ly**), and smooth (**SER**) and rough (**RER**) endoplasmic reticulum. **Left:** 10,000×; **Right:** 50,000×.

CELLS OF INTESTINAL MUCOSA

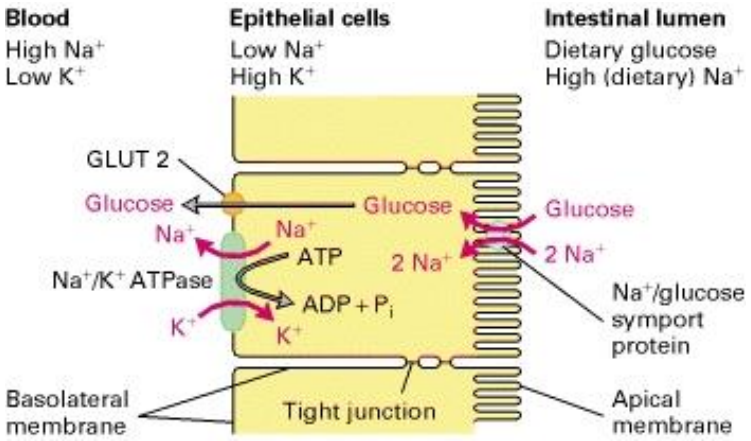
Microvilli

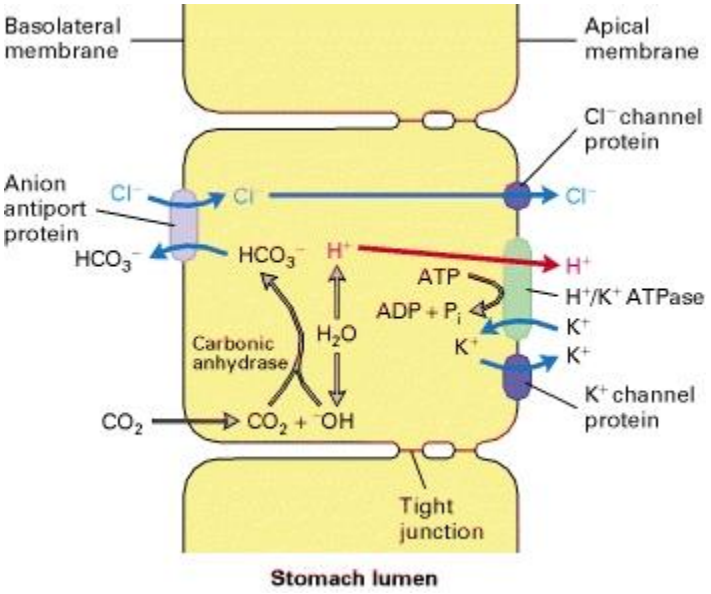






Transportion and resorption





Transport of glucose from intestinal lumen to blood stream

Na^+/K^+ ATPase - basolateral surface - concentration gradient Na^+ and K^+

K^+ gradient generates negative membrane potential

Na^+/glucose symport on apical surface

Facilitated diffusion by glucose uniporter (GLUT2) in basolateral membrane

Acidification of stomach fluid by parietal cells

Apical membrane - H^+/K^+ ATPase + Cl^- a K^+ canals

Basolateral membrane – anion antiporter HCO_3^- and Cl^- ions

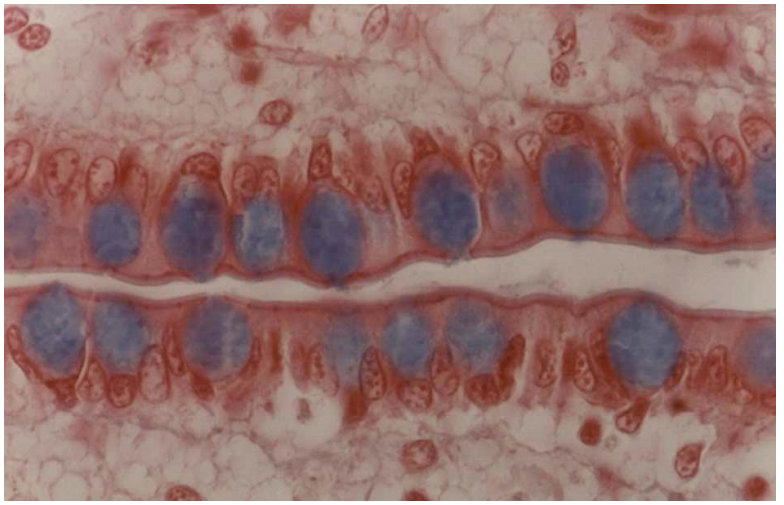
Combined activity of ion channels a cells keeps the electroneutrality and neutral cytoplasmic pH while reaching high extracellular concentration of H^+ and Cl^- in lumen of stomach

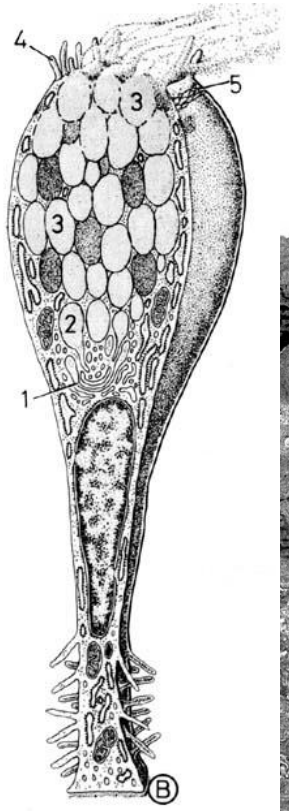
http://www.ncbi.nlm.nih.gov/books/NBK21502/

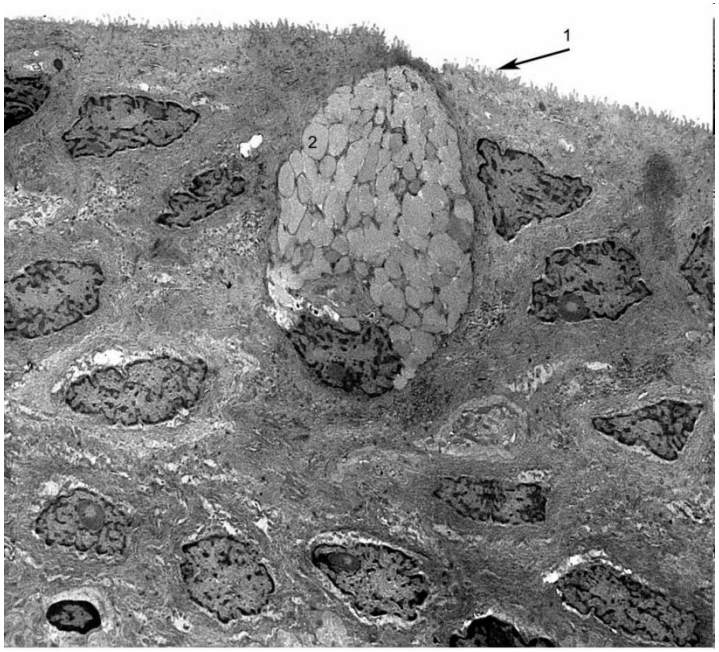
CELLS OF INTESTINAL MUCOSA

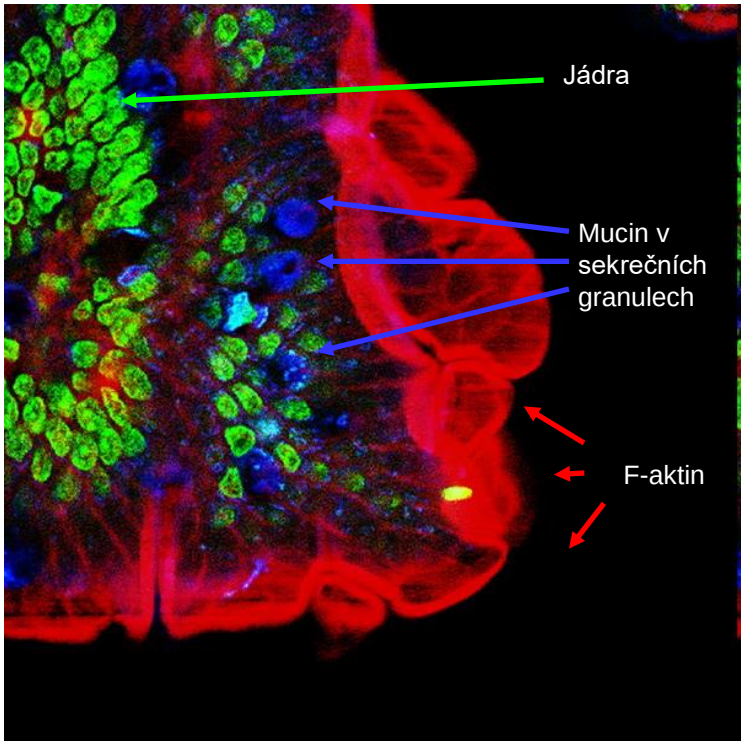
Goblet cells

- Cylindrical glandular epithelial cells
- Apical surface – apocrine/merocrine secretion of mucin
- Basal part – RER, GA, nucleus, mitochondria
- Mucinogenic granules



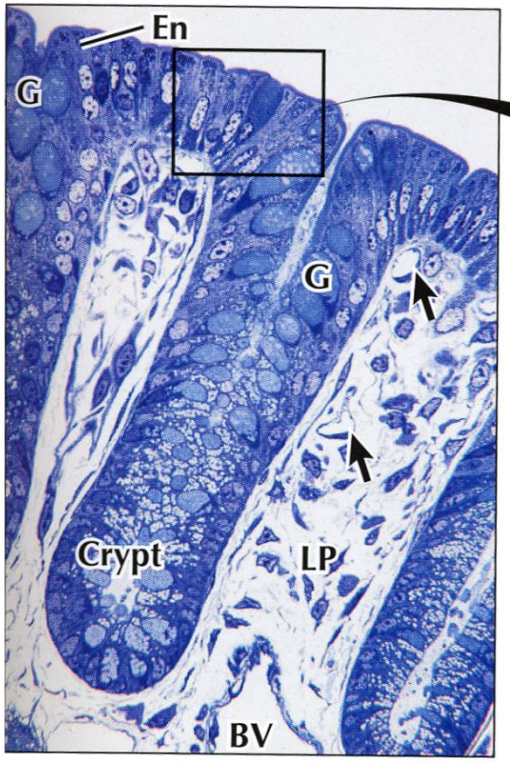




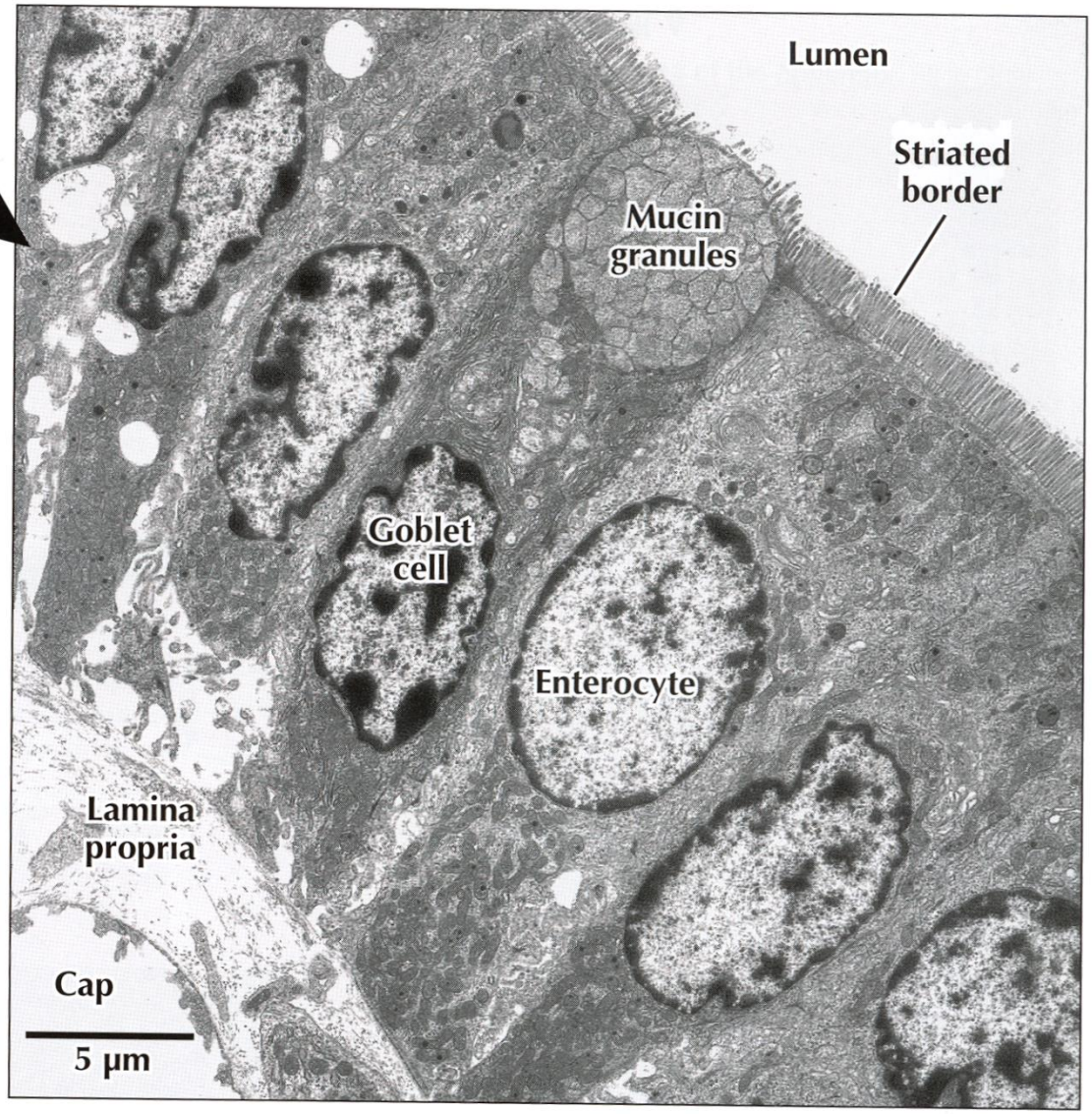


CELLS OF INTESTINAL MUCOSA

Goblet cells

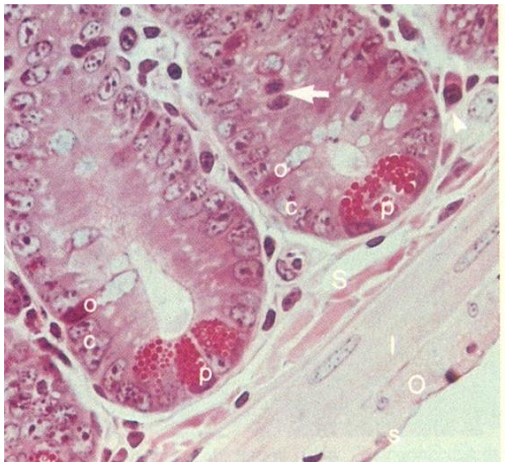


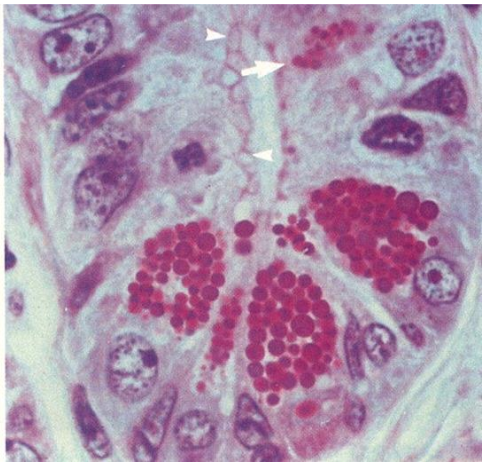
▲ **LM of the colonic mucosa.** Surface epithelium containing goblet cells (**G**) and enterocytes (**En**) invaginates to form an intestinal crypt. The lamina propria (**LP**), with capillaries (**arrows**) and larger blood vessels (**BV**), is richly cellular. 600×. *Toluidine blue.*



CELLS OF INTESTINAL MUCOSA

Paneth cells

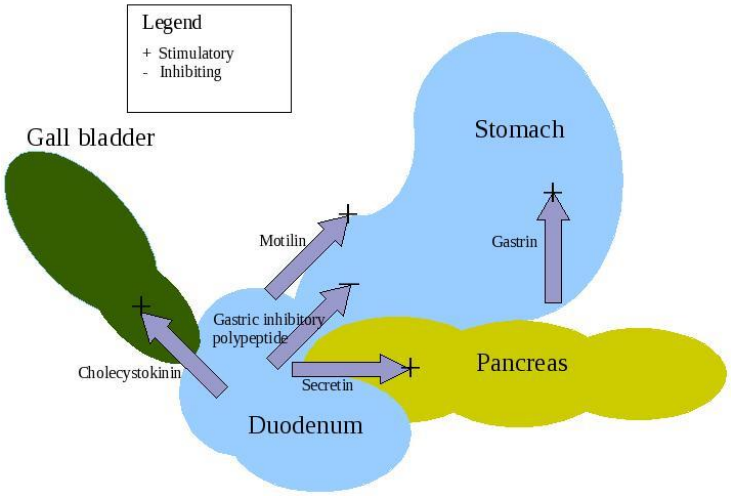




- basal part of crypts of Lieberkühn
- basophilic cytoplasm
- GA located above nucleus
- acidophilic (red) granules
- immune system
- secretion granules contain biologically active substances e.g. lysozym)
- influence intestinal microflora

Enteroendocrine cells

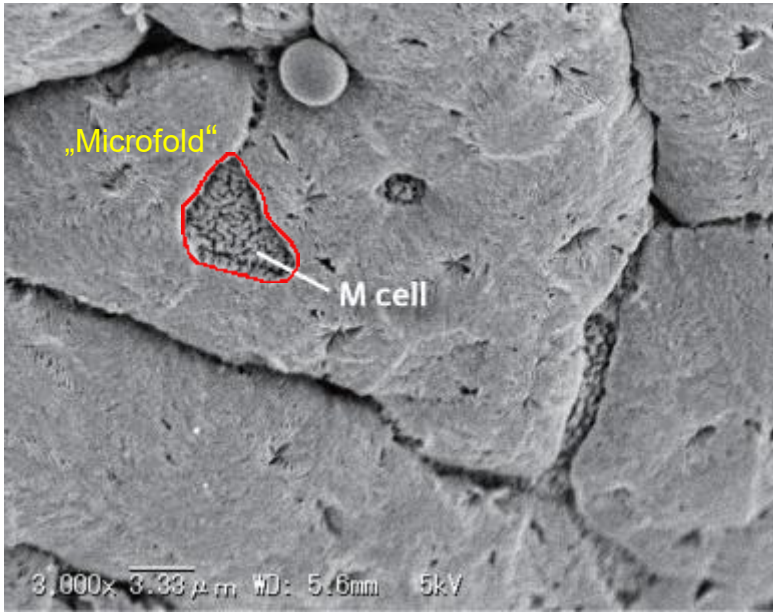
- similar to gastric enteroendocrine cells
- regulate pancreatic secretions
- homeostatic axis (brain-intestine-adipose tissue)
- cholecystokinin, secretin, GIP, motilin, neurocrine peptides etc.

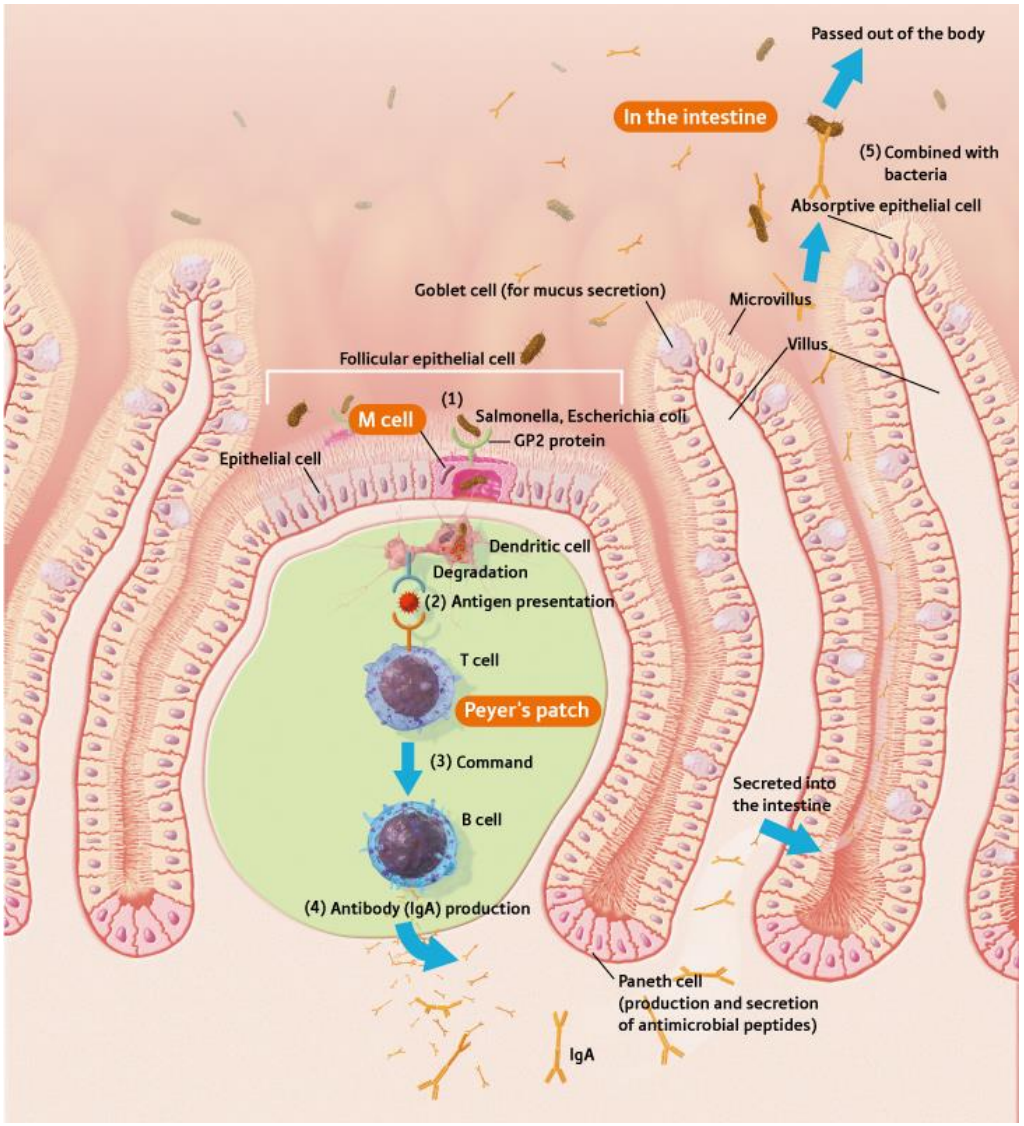


CELLS OF INTESTINAL MUCOSA

M cells (microfold)

- epithelial cells above Peyer's patches and lymphatic nodules
- no microvilli
- induces immune response
- MHCII
- antigen presentation to dendritic cells and lymphocytes

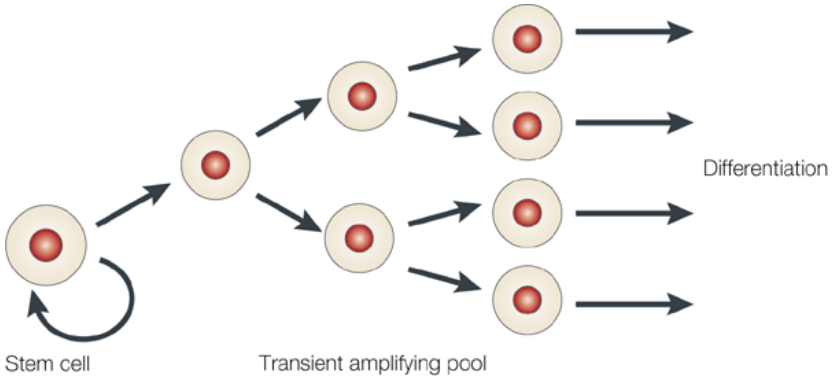




CELLS OF INTESTINAL MUCOSA

Intestinal stem cells

- bottom of crypts of Lieberkühn
- epithelial renewal (4-5 days)
- stem cell niche
- role in cancer



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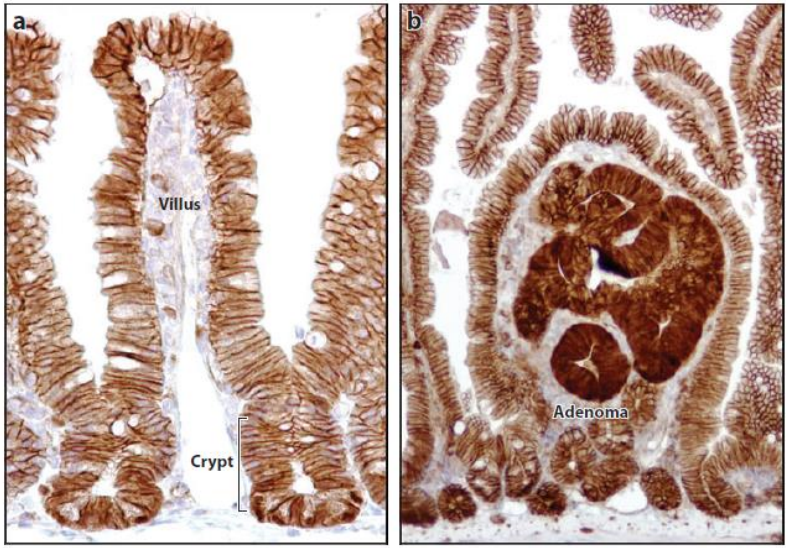
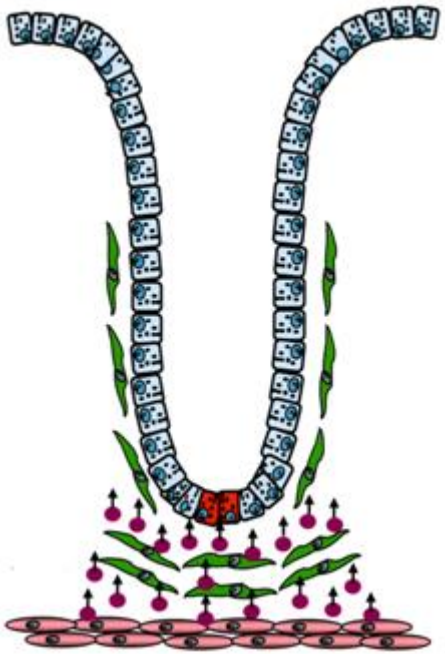
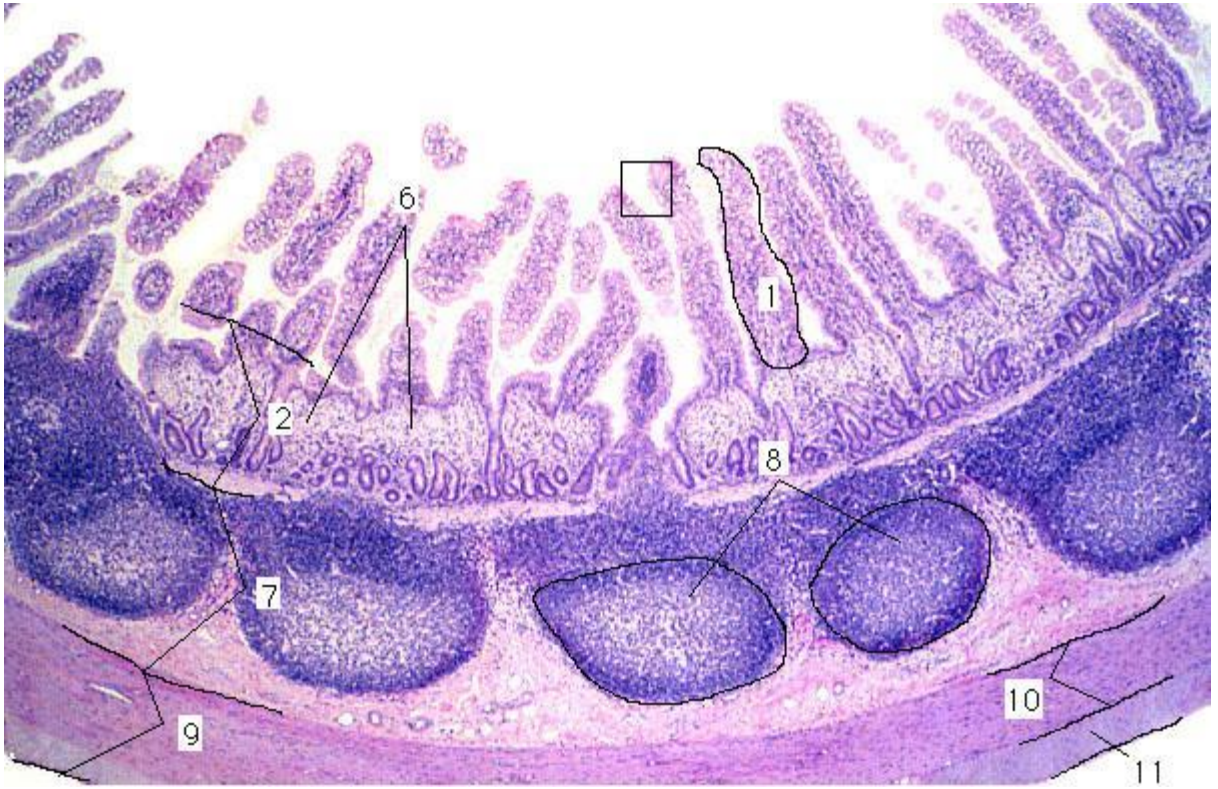




INTESTINAL MUCOSA

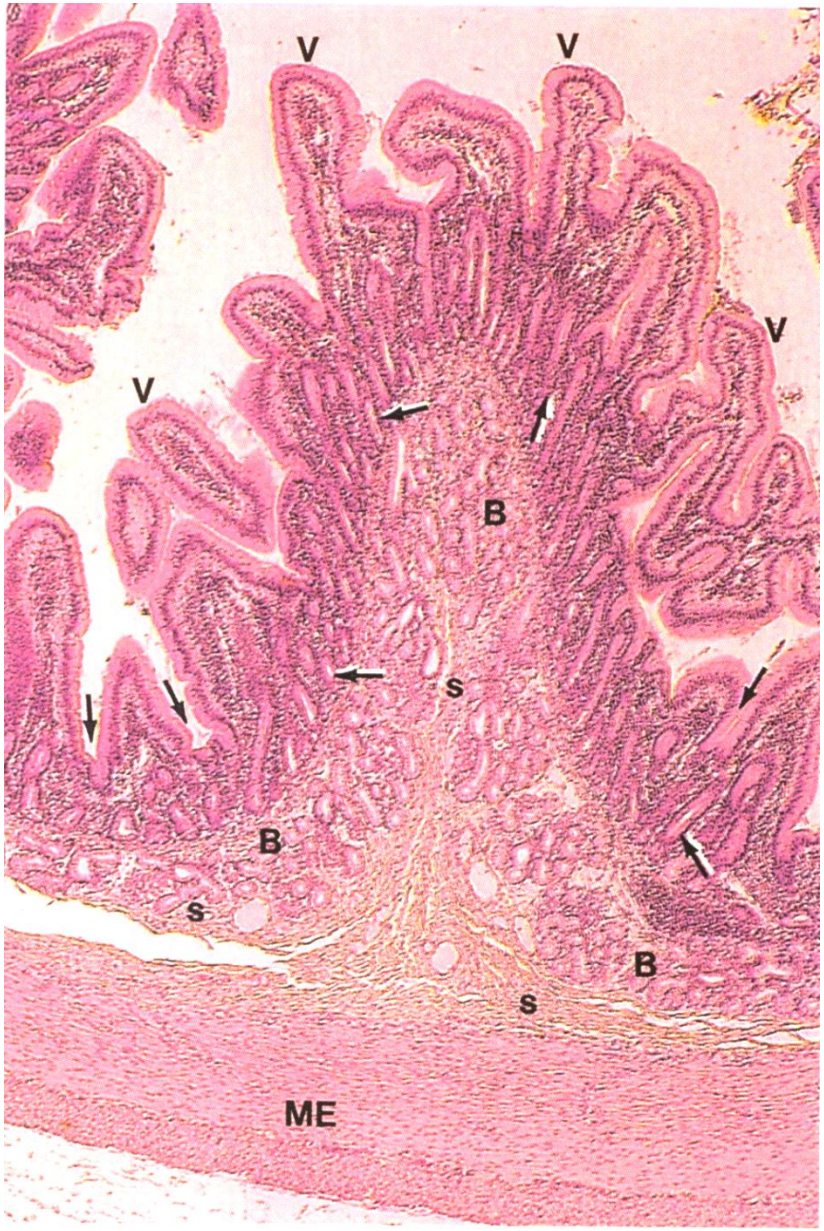
L. propria

- immune system – GALT
- abundance of reticular fibers
- immunologic barrier
- Peyer’s patches



Brunner's glands

- gl. duodenale Brunneri
- branched tuboalveolar glands
- columnar mucinous cells
- alkaline secretion
- connective tissue reduced to thin septa between glandular lobules
- open to crypts of Lieberkühn



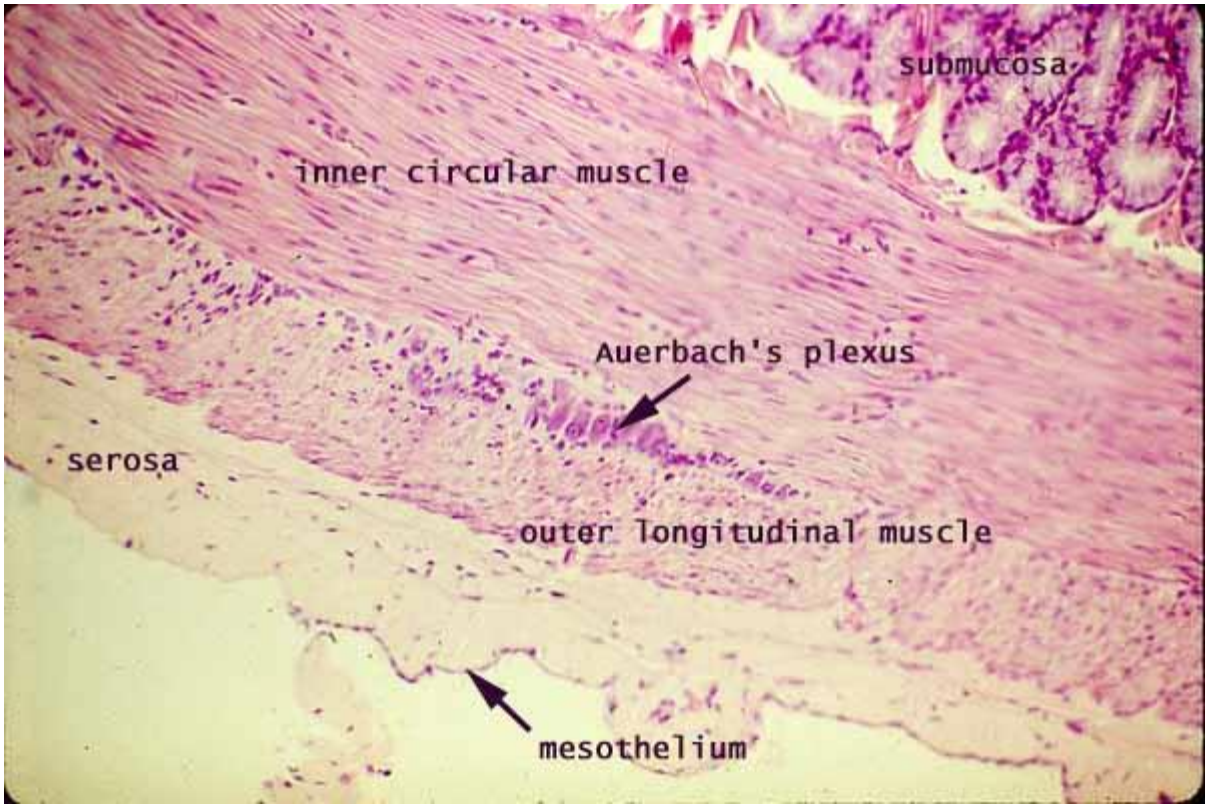
OUTER LAYERS OF INTESTINAL WALLS

Muscularis externa

- two layers of smooth muscle (inner circular, outer longitudinal)
- plexus myentericus Auerbachi

Serosa

- loose collagen connective tissue + simple squamous epithelium (mesothelium)

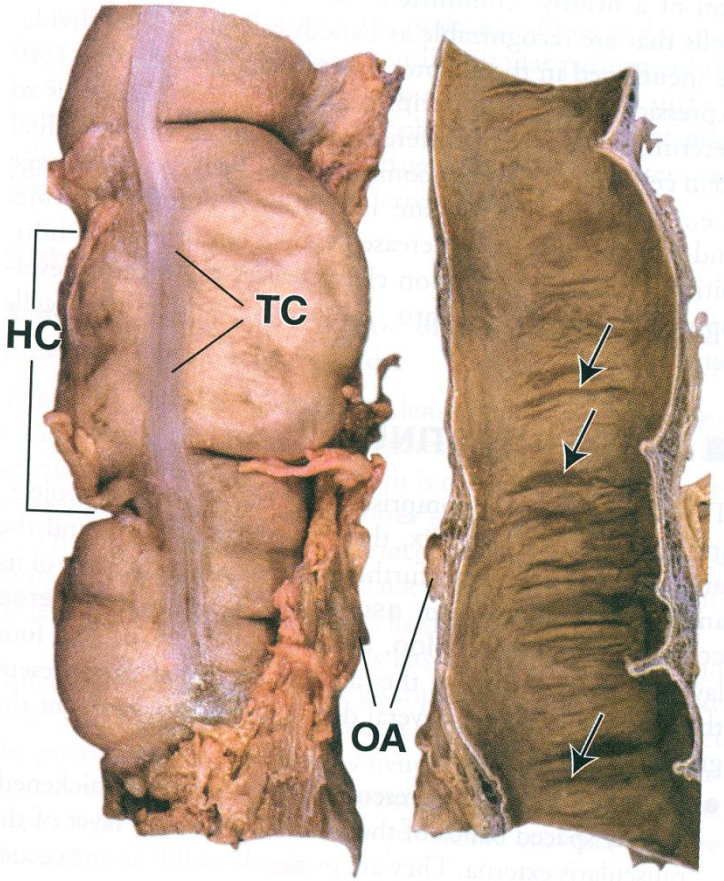


INTESTINUM CRASSUM – COLON

Intestinum crassum vs. intestinum tenue

- plicae of Kerckring and villi absent
- muscularis externa – longitudinal layer – **taenie coli**
- surface serosa – **appendices epiploicae** (adipose)

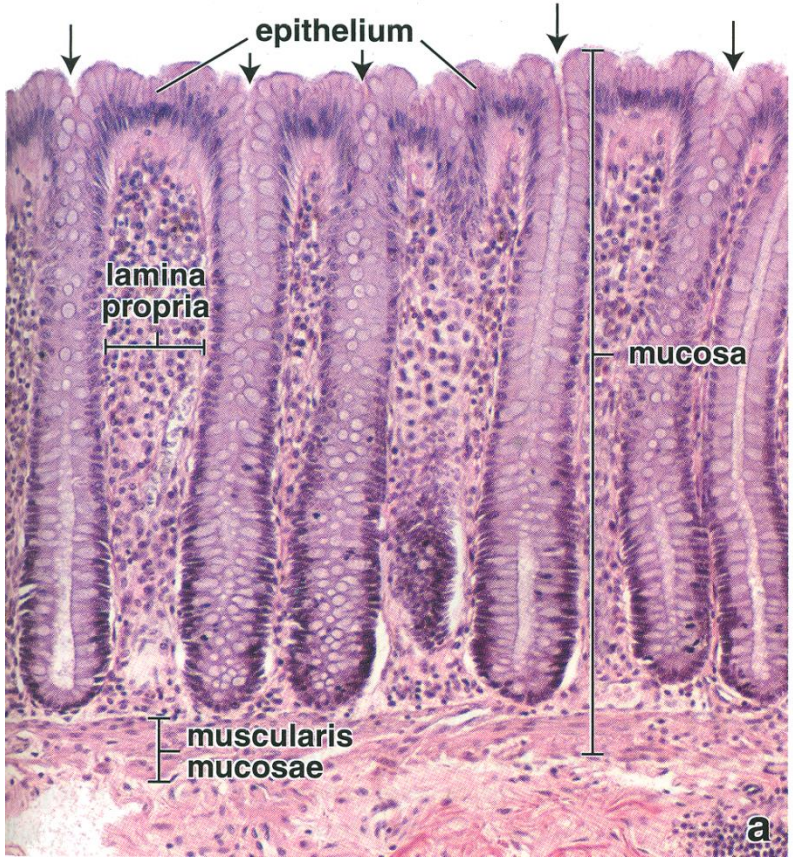
Small intestine

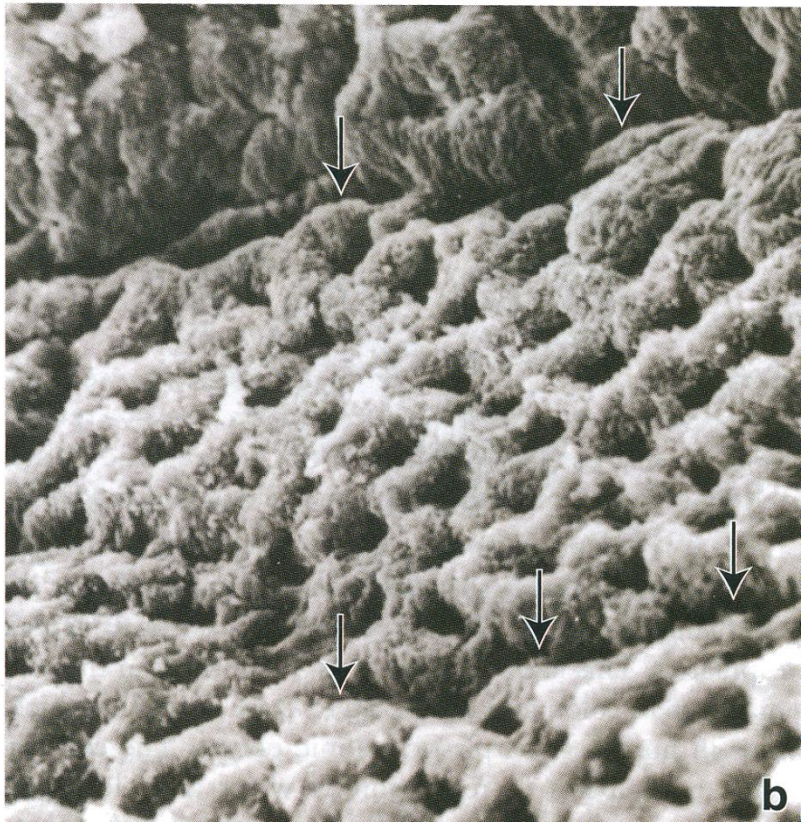


Colon

INTESTINUM CRASSUM – COLON

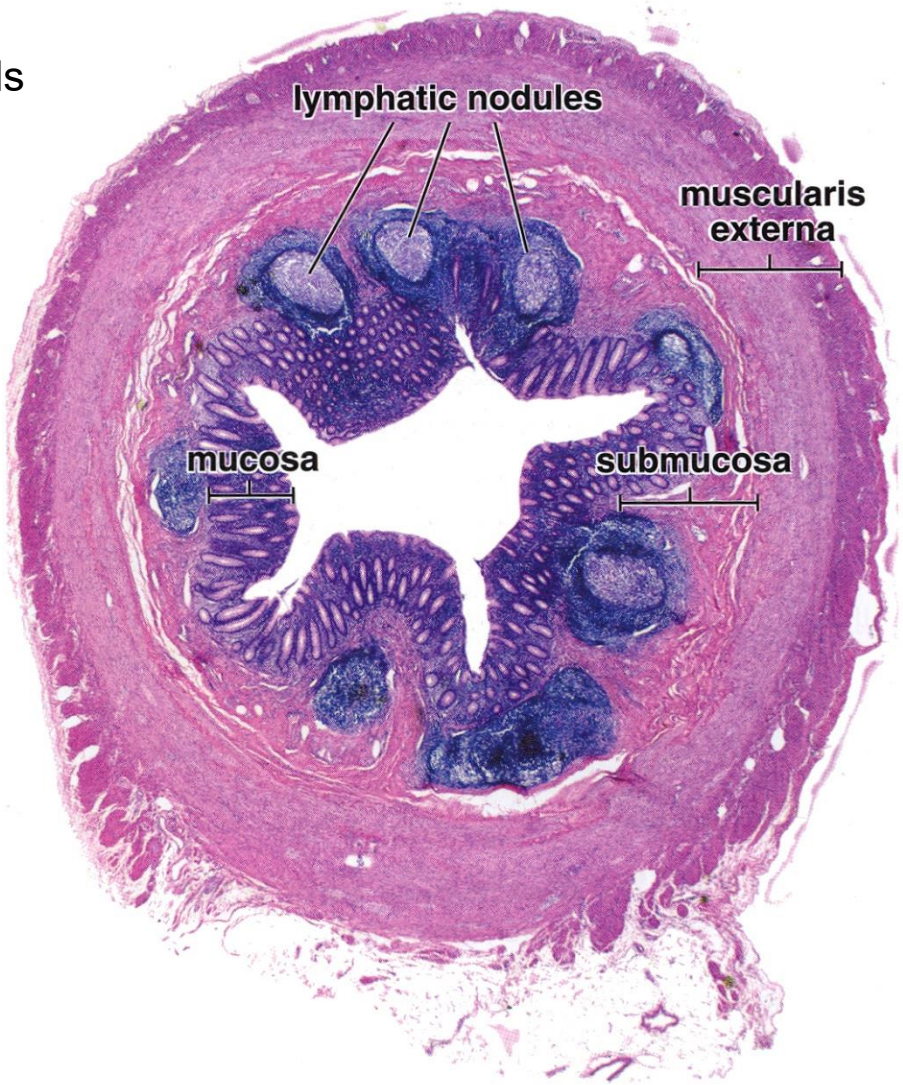
- absorption of water, electrolytes
- deeper crypts of Lieberkühn, no Paneth cells
- abundant goblet cells
- abundant lymphatic follicles in l. propria (GALT)





INTESTINUM CRASSUM – APPENDIX

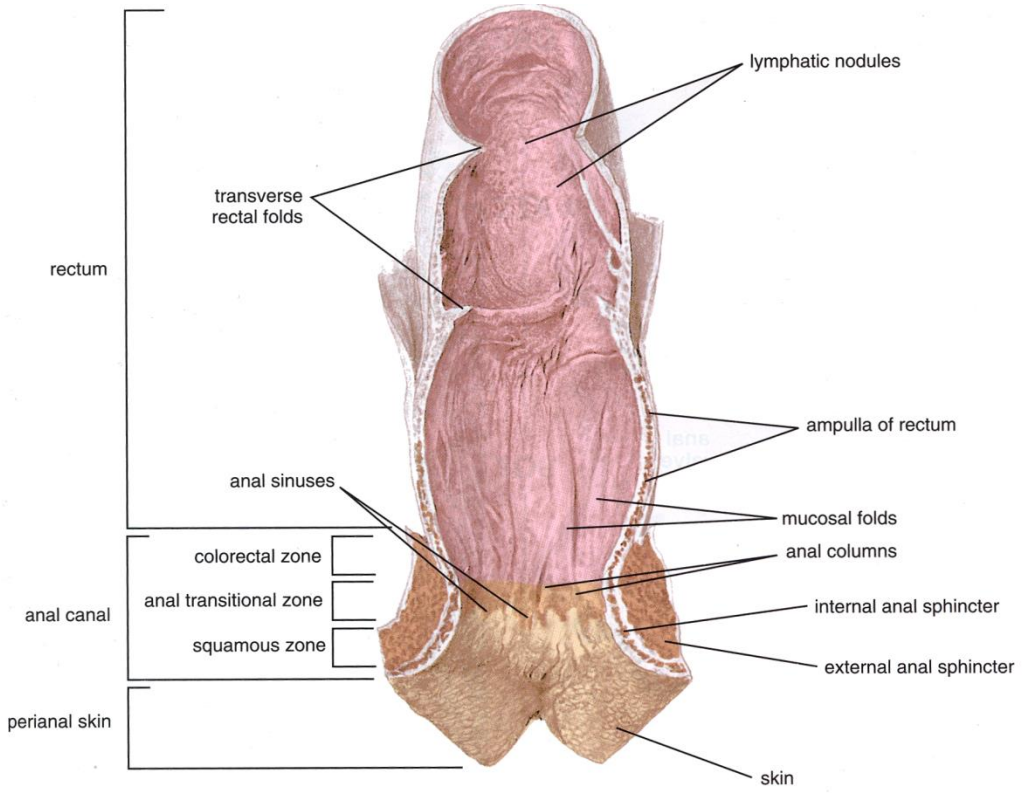
- develops from and is connected to caecum 8-10 cm (0,5-1cm)
- continuous longitudinal layer of m. externa
- lymphatic follicles reaching submucosa
- irregular crypts of Lieberkühn with Paneth cells



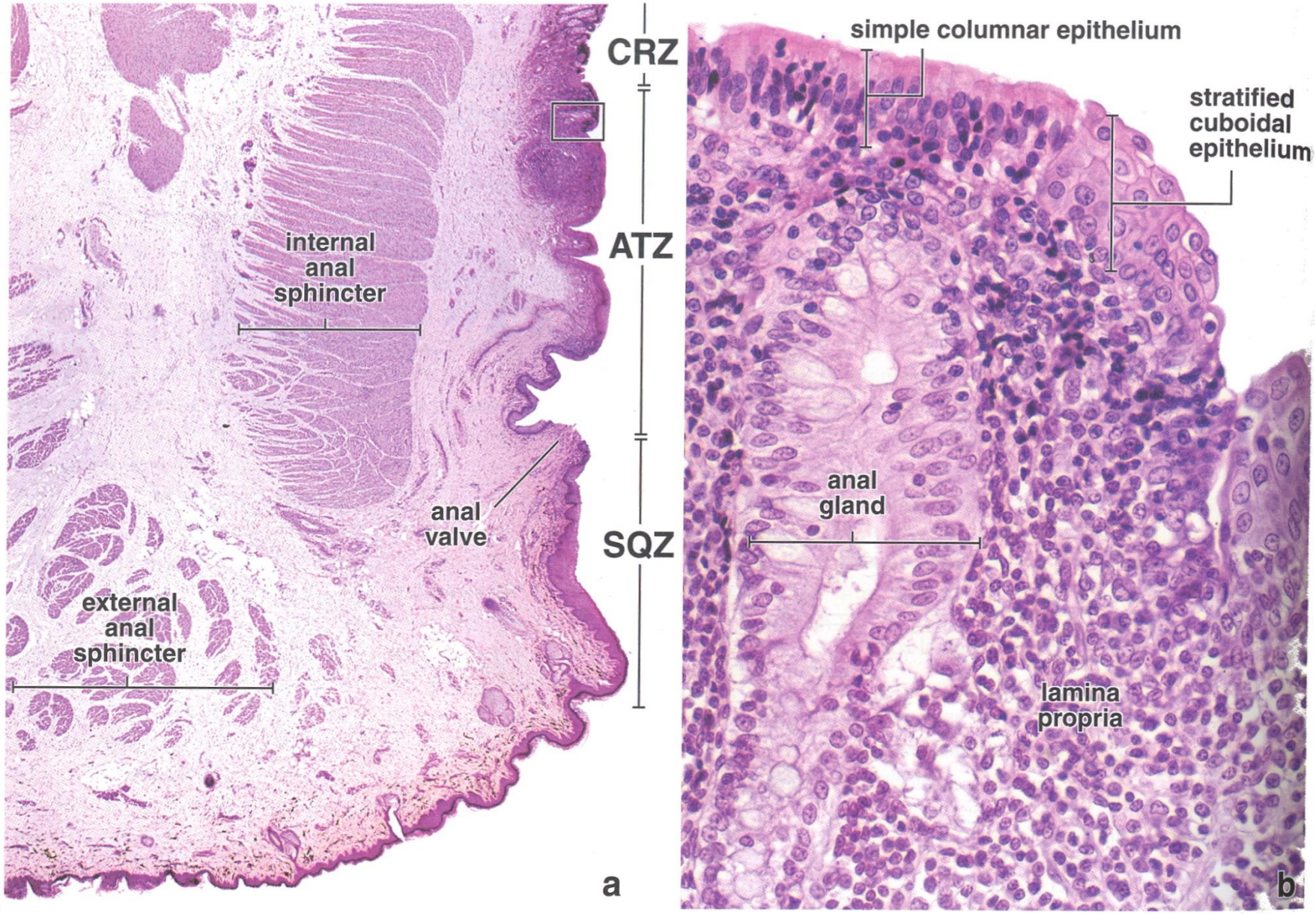
RECTUM AND ANAL CANAL

- **Pars pelvina**
  - *plicae transversae recti*
  - histological architecture identical to colon

- **Canalis analis**
  - anulus hemorhoidalis – no L. crypts, simple columnar epithelium gradually replaced by stratified squamous epithelium
  - rich venous plexus
  - *columnae rectales*
  - *sinus rectales* and *valvulae rectales*
  - *zona cutanea* – typical skin



RECTUM AND ANAL CANAL



Organ	Region	Mucosa			Submucosa	Muscularis externa	Serosa/ Adventitia
		LEM	LPM	LMM			
Esophagus	1/3	stratified squamous e.		full	gll. oesophageales	skeletal	A
	2/3		glandulae oesophageae cardiacae			both	
	3/3					smooth	S
Stomach	cardia	simple columnar e.	gll. cardiacae	full		three layers oblique, circular, longitudinal	S
	fundus/ corpus		gll. gast. prop.				
	pylorus		gll. pyloricae				
Small intestine	duoenum	simple columnar e. brush border goblet cells	L. crypts villi	full	gll. duodenales Brunneri		A+S
	jejunum		Peyer's plaque		plicae circulares		S
	ileum						
Colon and rectum	apendix	simple columnar e. brush border goblet cells	lymph. follicles	partial	lymph. nodes	full	S
	caecum		villi absent	full		taeniae coli	A+S
	colon						A+S
	rektum	columnae rectales					A
Canalis analis	anorectal/ anocutaneous	stratified squamous e. non-keratinized	venous plexus	partial-absent	mucosal folds venous plexus	inner anal sphincter	A
	zona cutanea	stratified squamous e. keratinized	hair follicles, sweat glands				

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