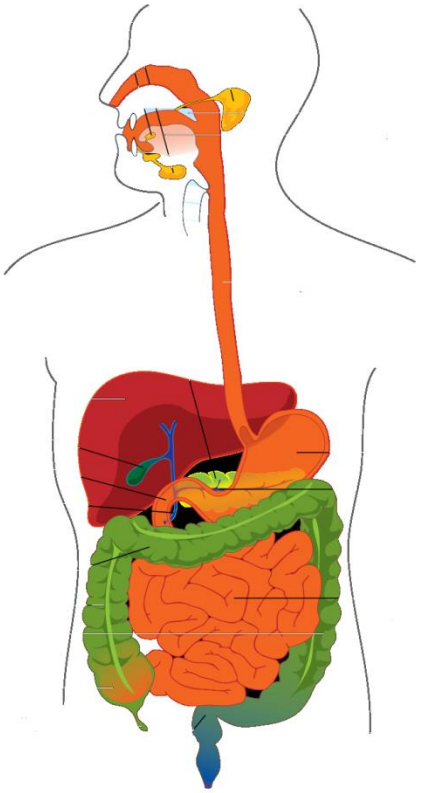
MICROSCOPIC ANATOMY AND DEVELOPMENT OF GIT I & II



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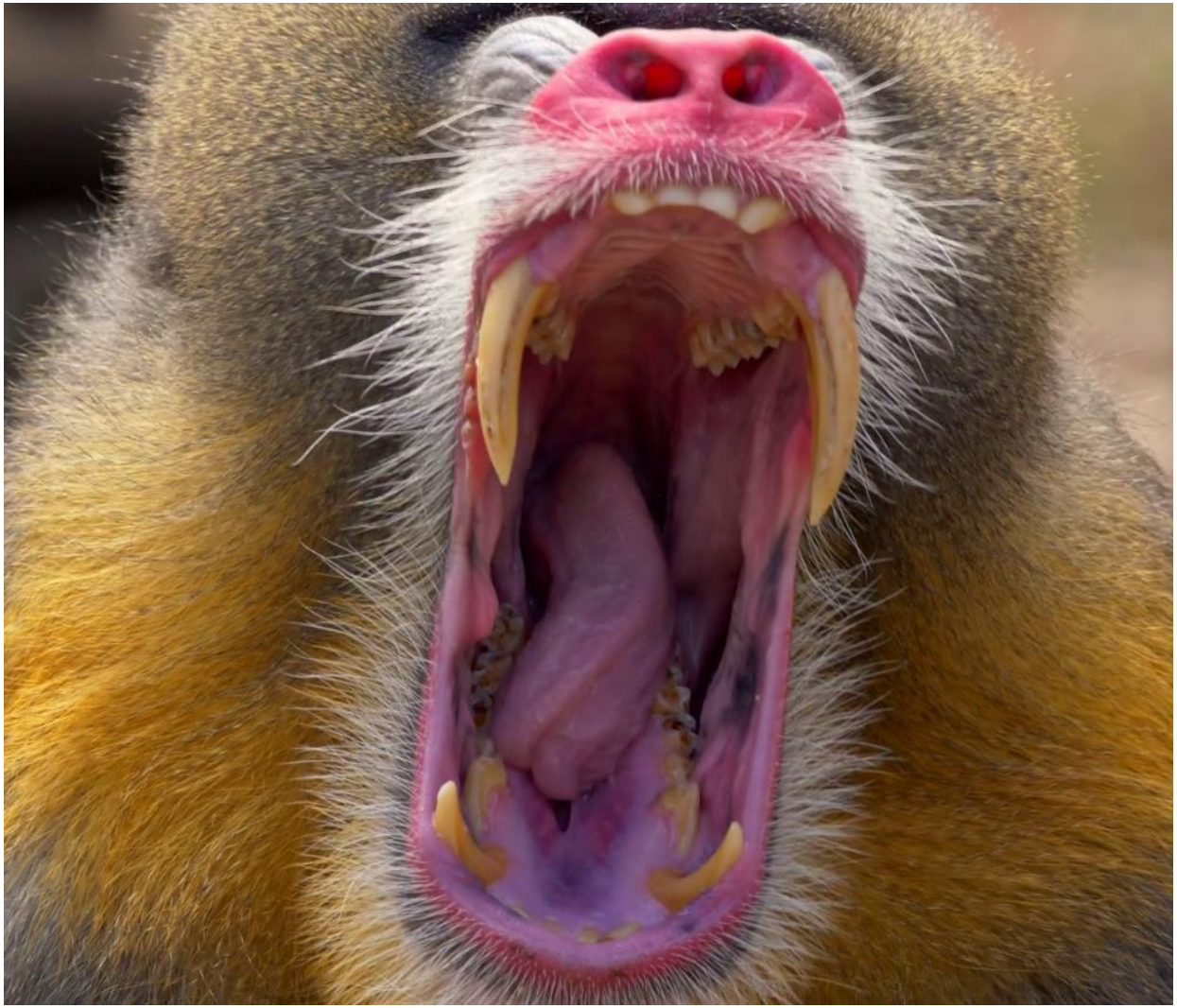
ORAL CAVITY



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

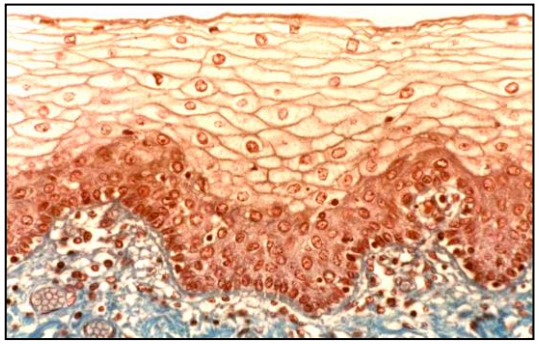
ORAL MUCOSA

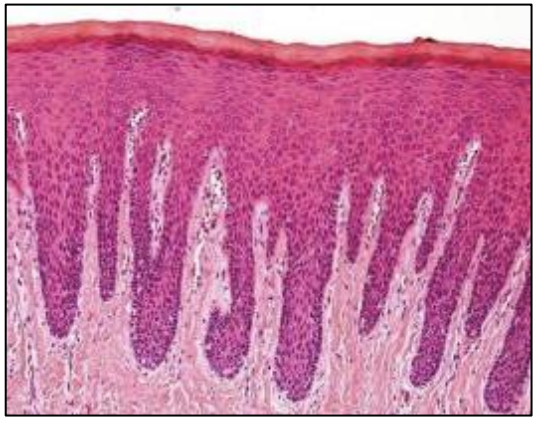
stratified squamous epithelium and **lamina propria mucosae**

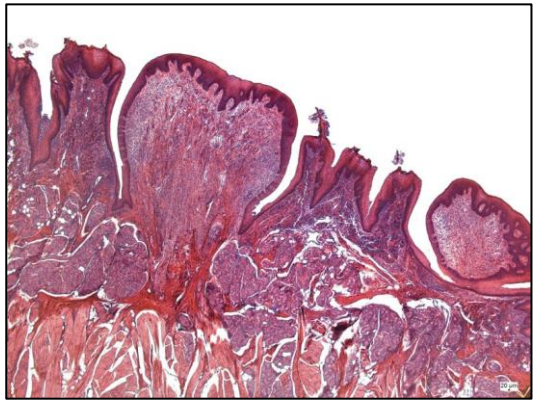
- **lining mucosa**
- submucosal C.T.

- **masticatory mucosa**
- directly on periost (mucoperiosteum)
- Submucose absent

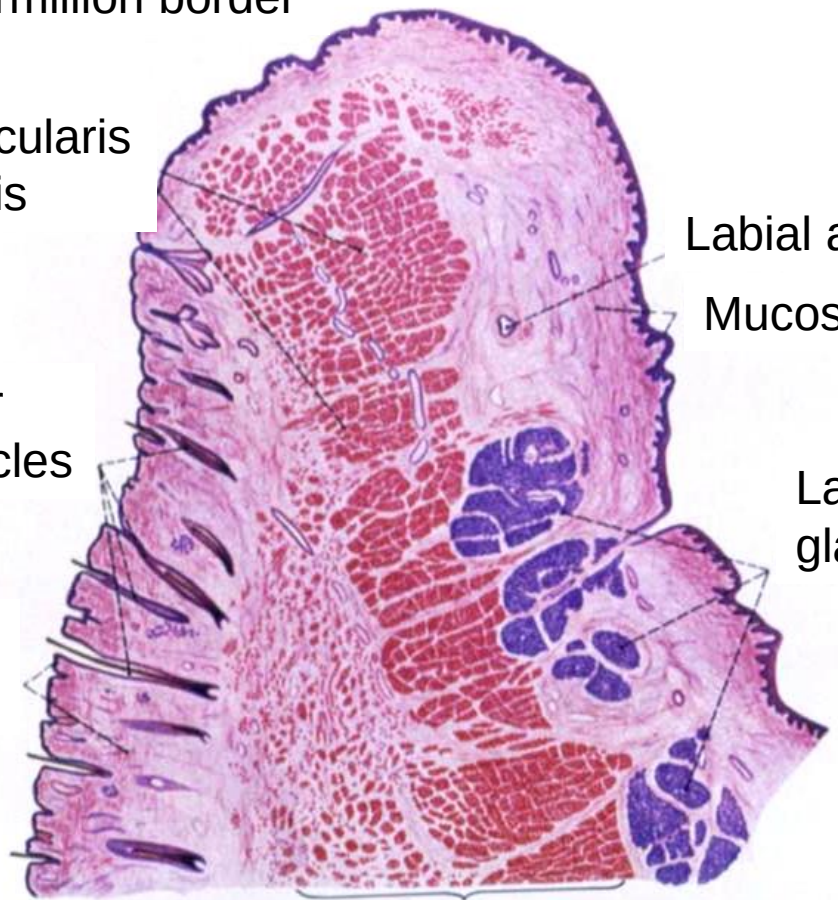
- **specialized mucosa**
- dorsum linguae – c.t. papillae







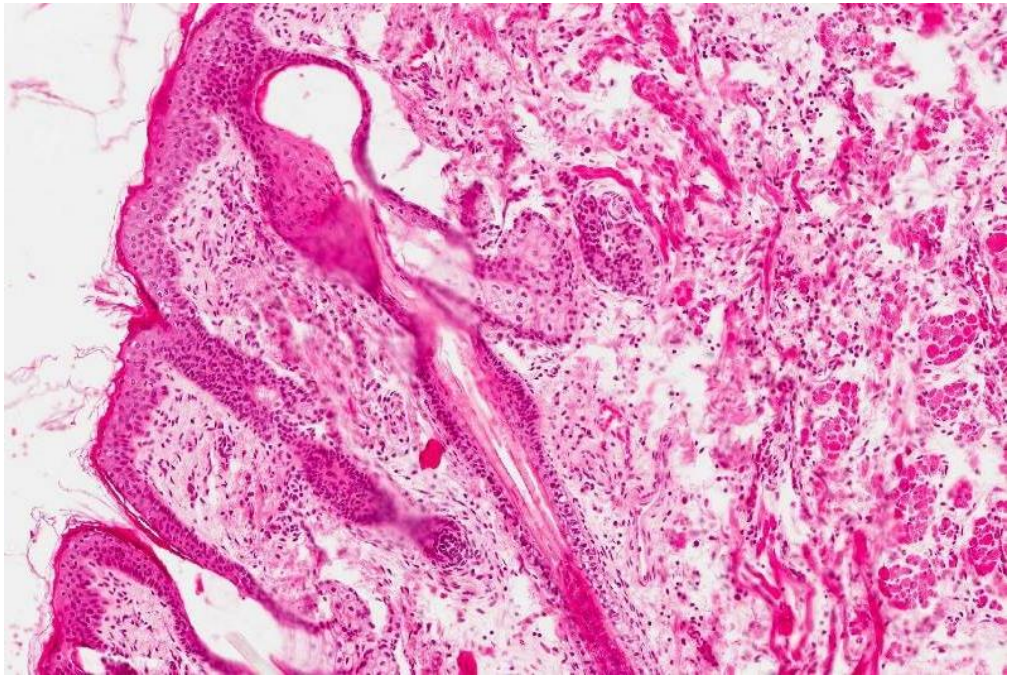
LIP


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


Dorsal
Ventral

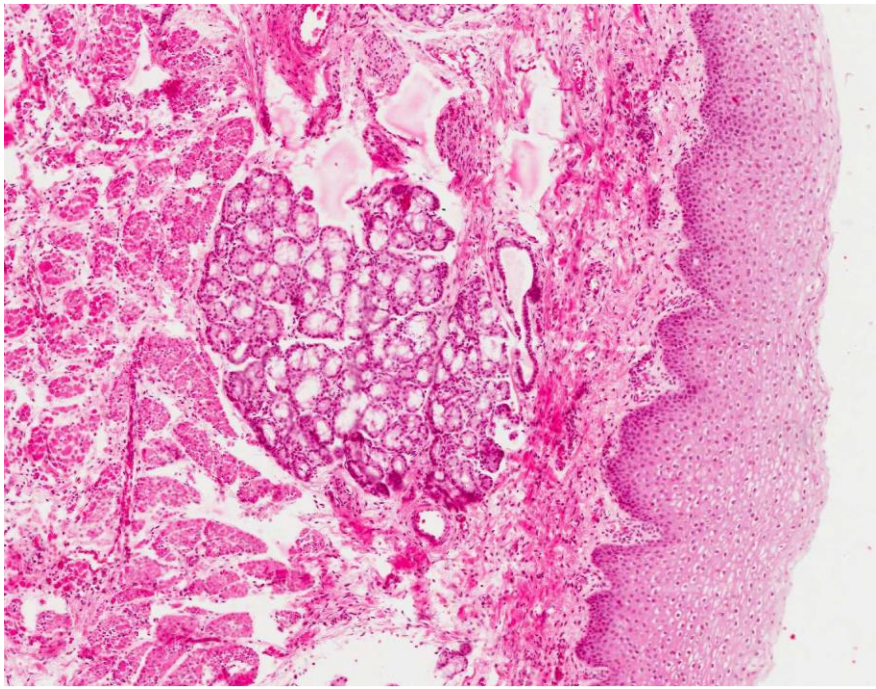
LIP

Skin side (ventral)



Epidermis
Hair follicles
Sebaceous glands
Sweat glands

Oral side (dorsal)

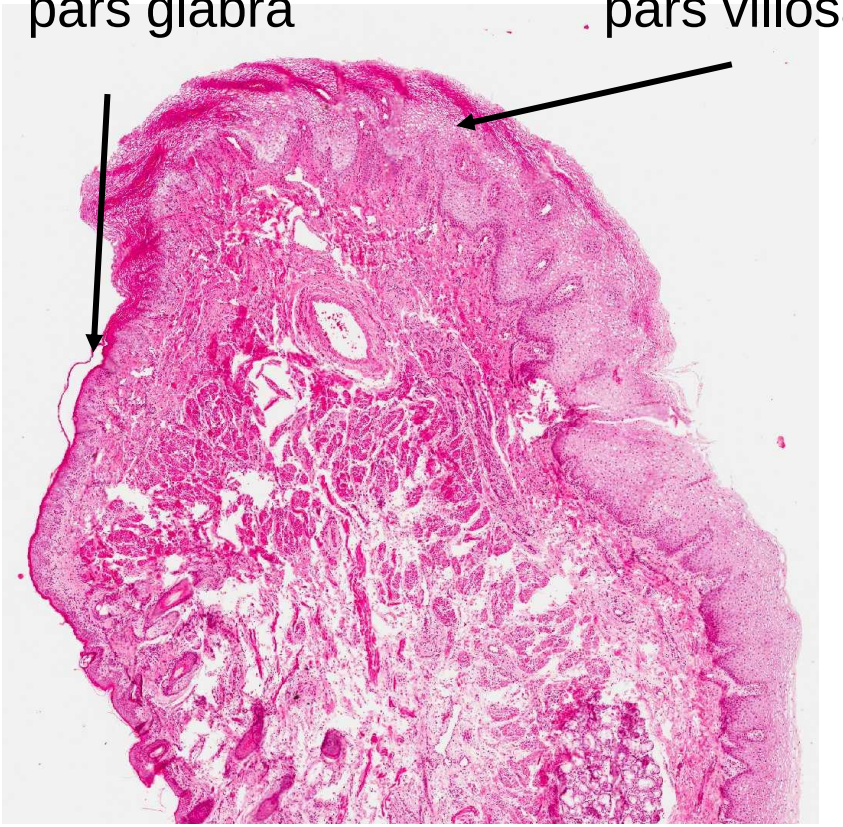


Oral mucosa
Small salivary glands

LIP

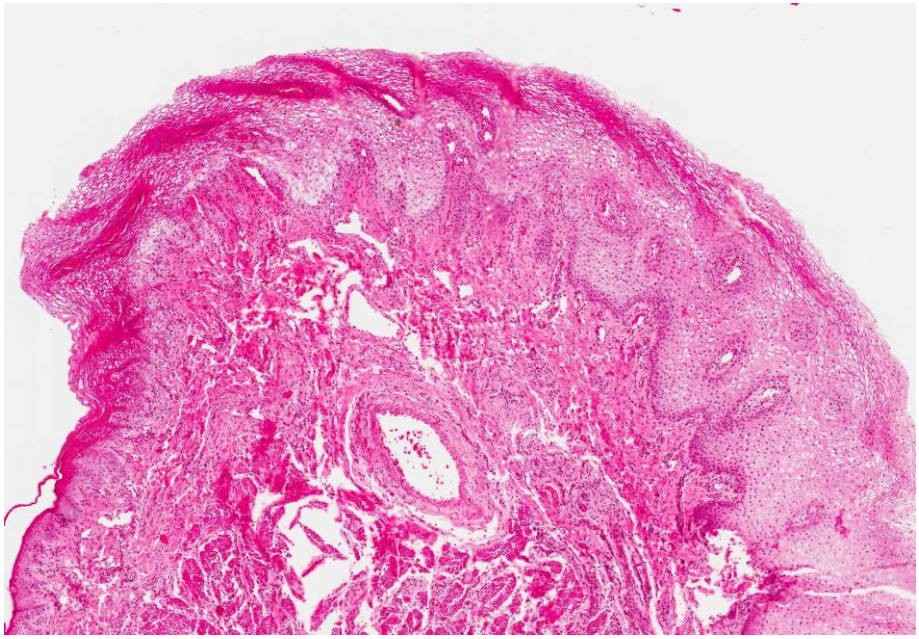
pars glabra

pars villosa



newborns

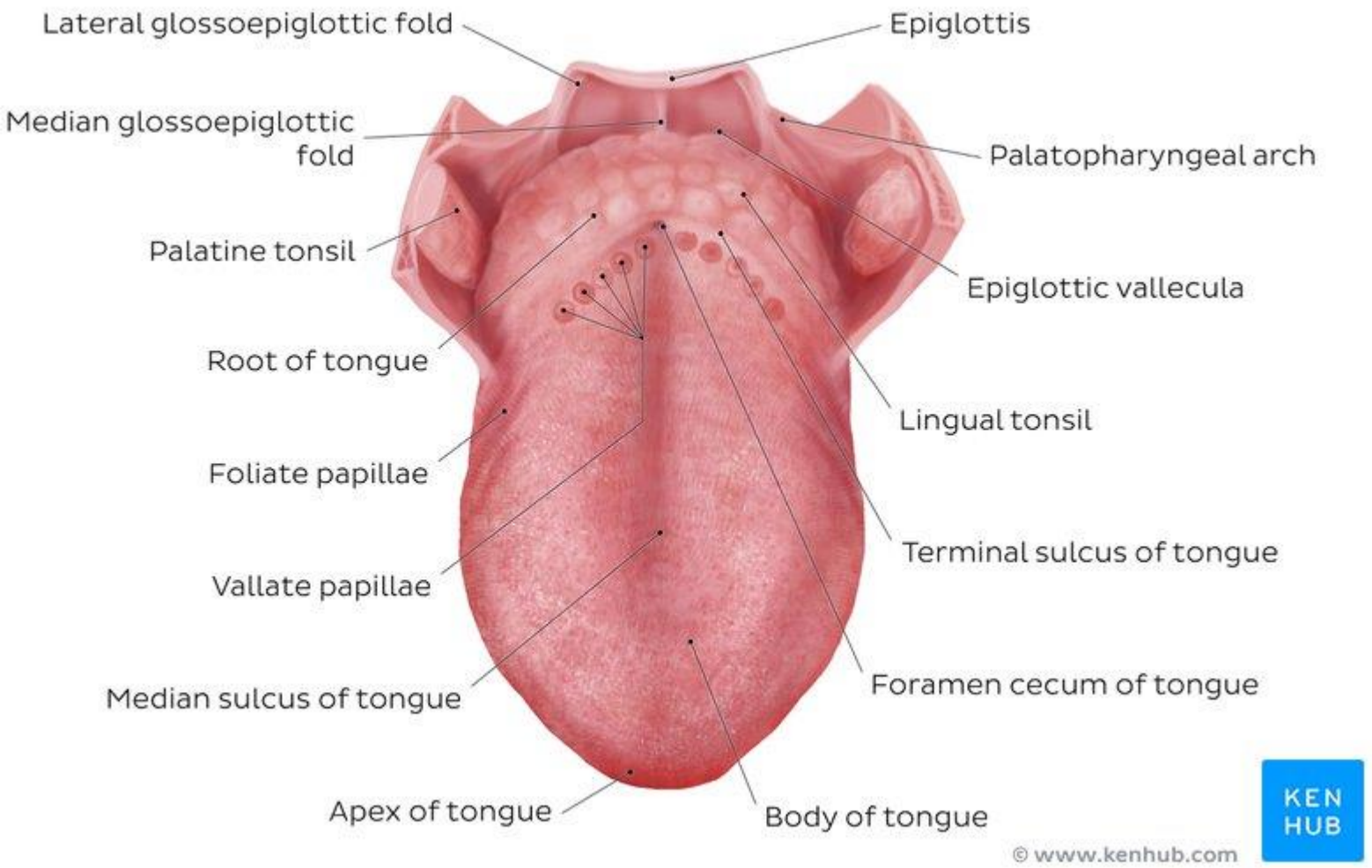
torus labialis



<u>Vermillion border</u>

- Eleidin
- 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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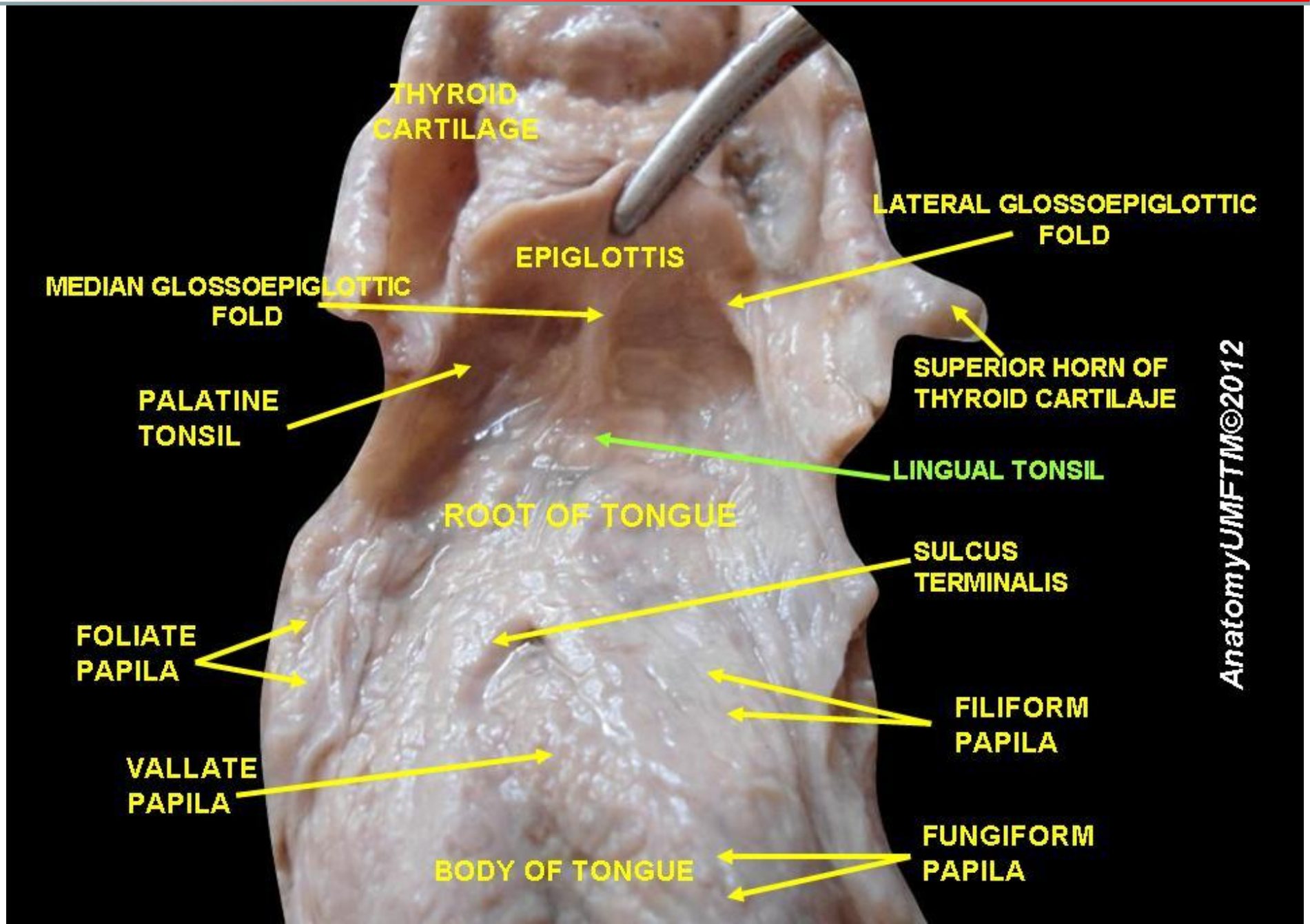
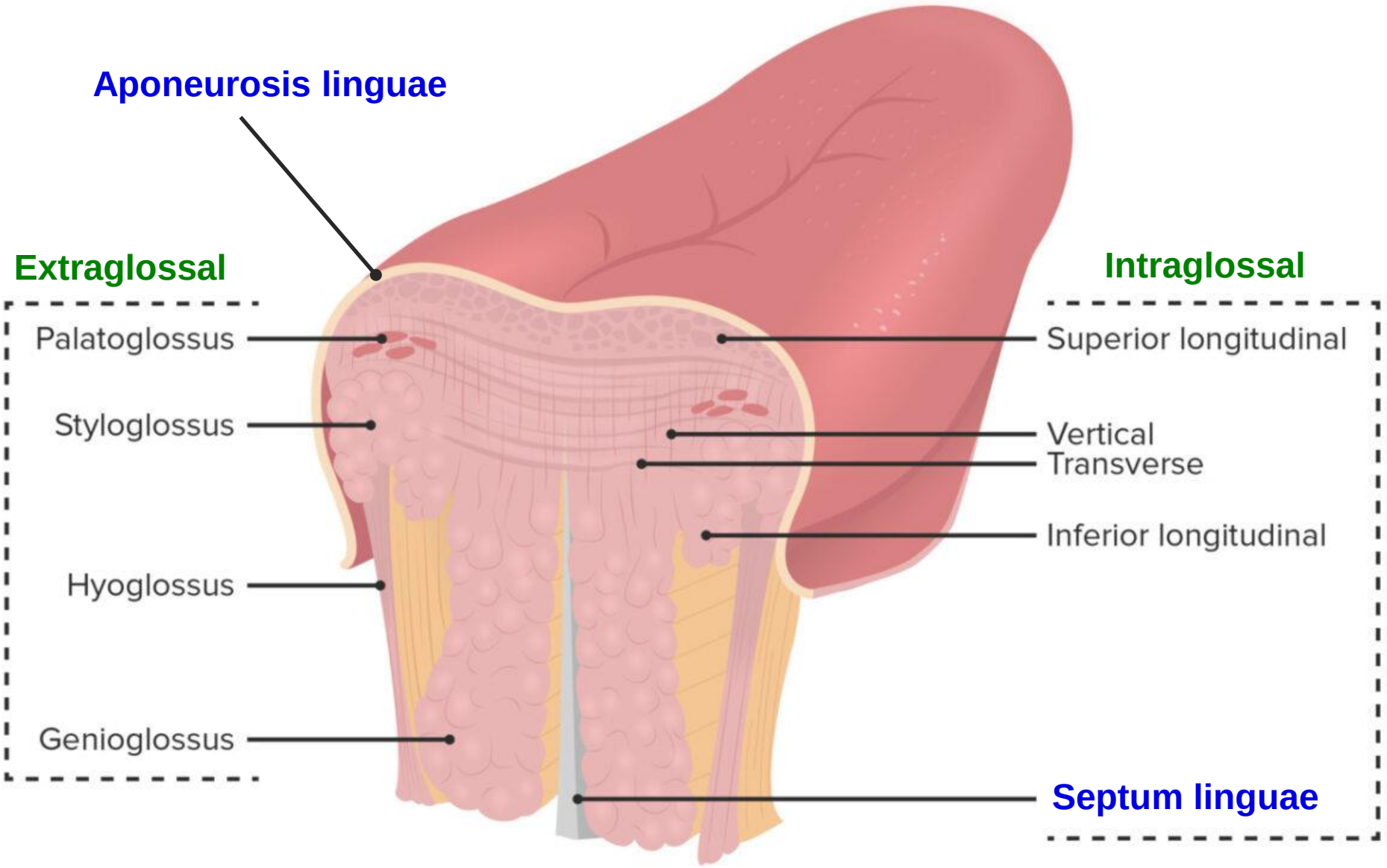
TONGUE

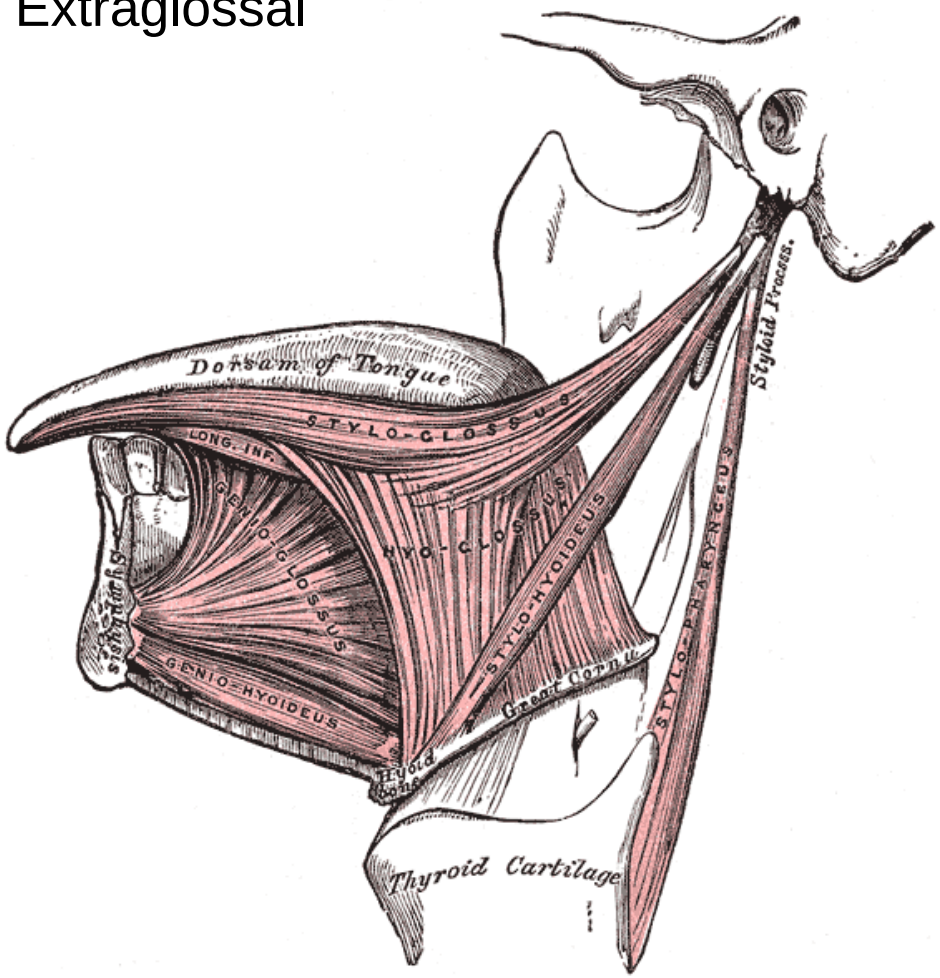

THYROID CARTILAGE
LATERAL GLOSSOEPIGLOTTIC FOLD
EPIGLOTTIS
MEDIAN GLOSSOEPIGLOTTIC FOLD
SUPERIOR HORN OF THYROID CARTILAJE
PALATINE TONSIL
LINGUAL TONSIL
ROOT OF TONGUE
SULCUS TERMINALIS
FOLIATE PAPILA
FILIFORM PAPILA
VALLATE PAPILA
FUNGIFORM PAPILA
BODY OF TONGUE
AnatomyUMFTM©2012

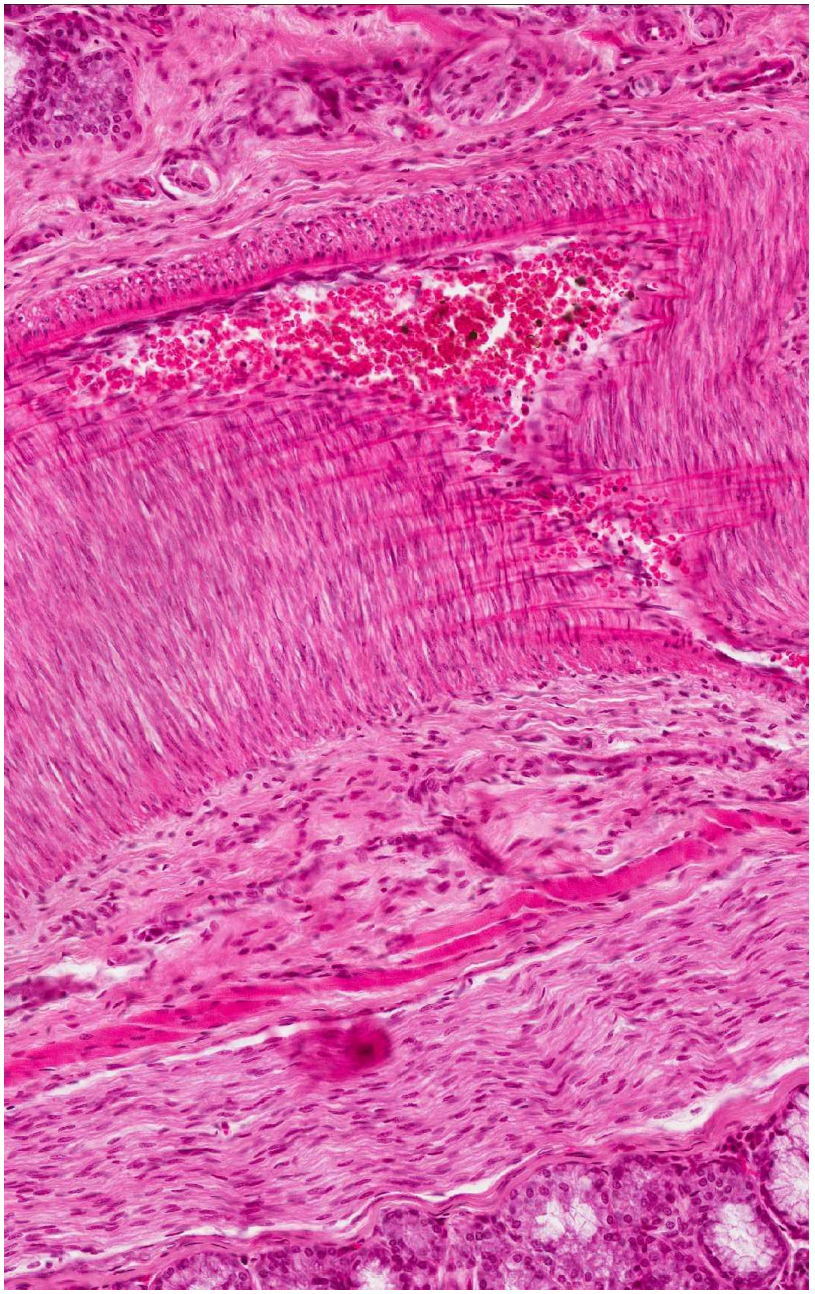
TONGUE – MUSCLES AND LIGAMENTS



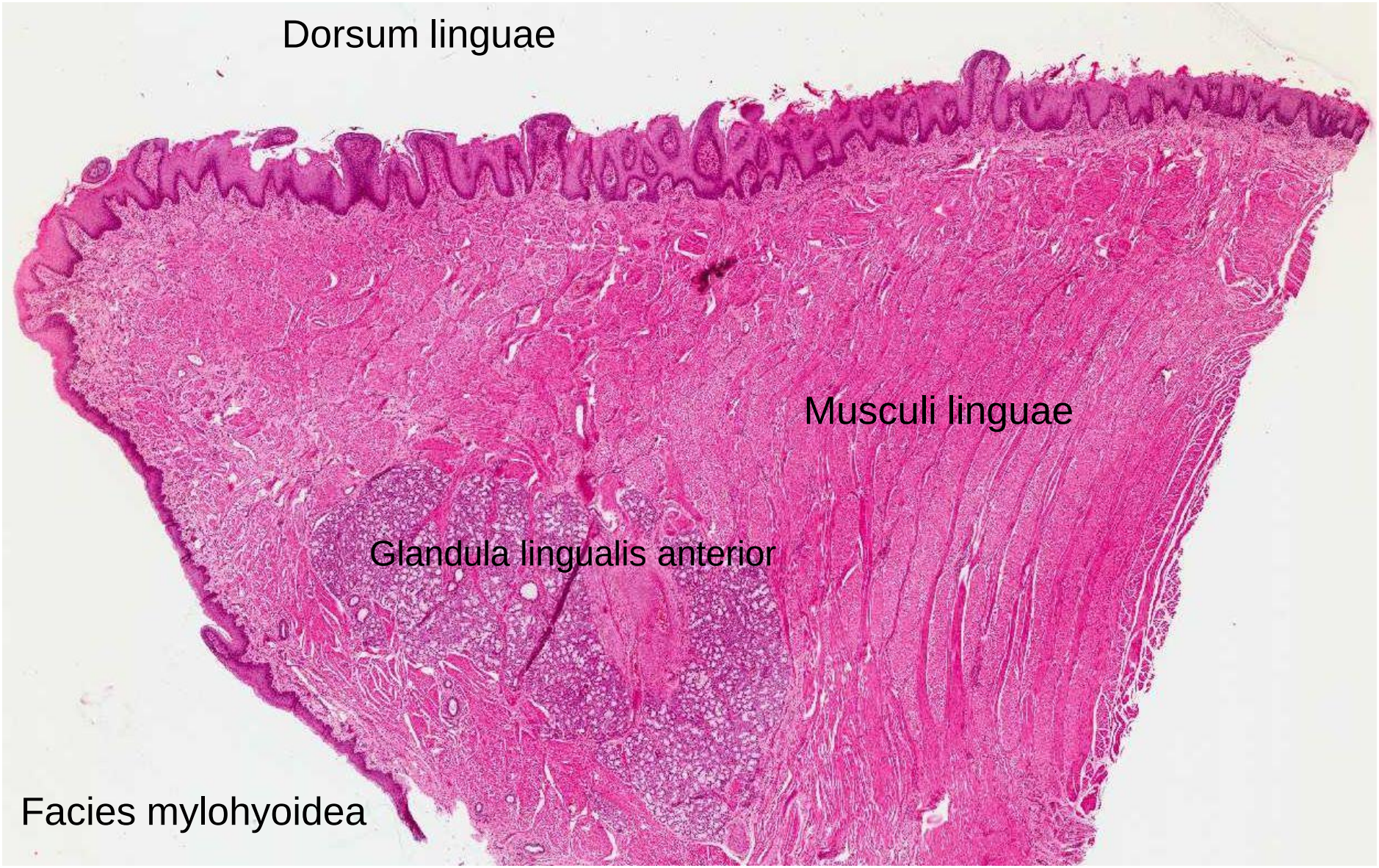
TONGUE - MUSCLES

- Intraglossal
- Extraglossal

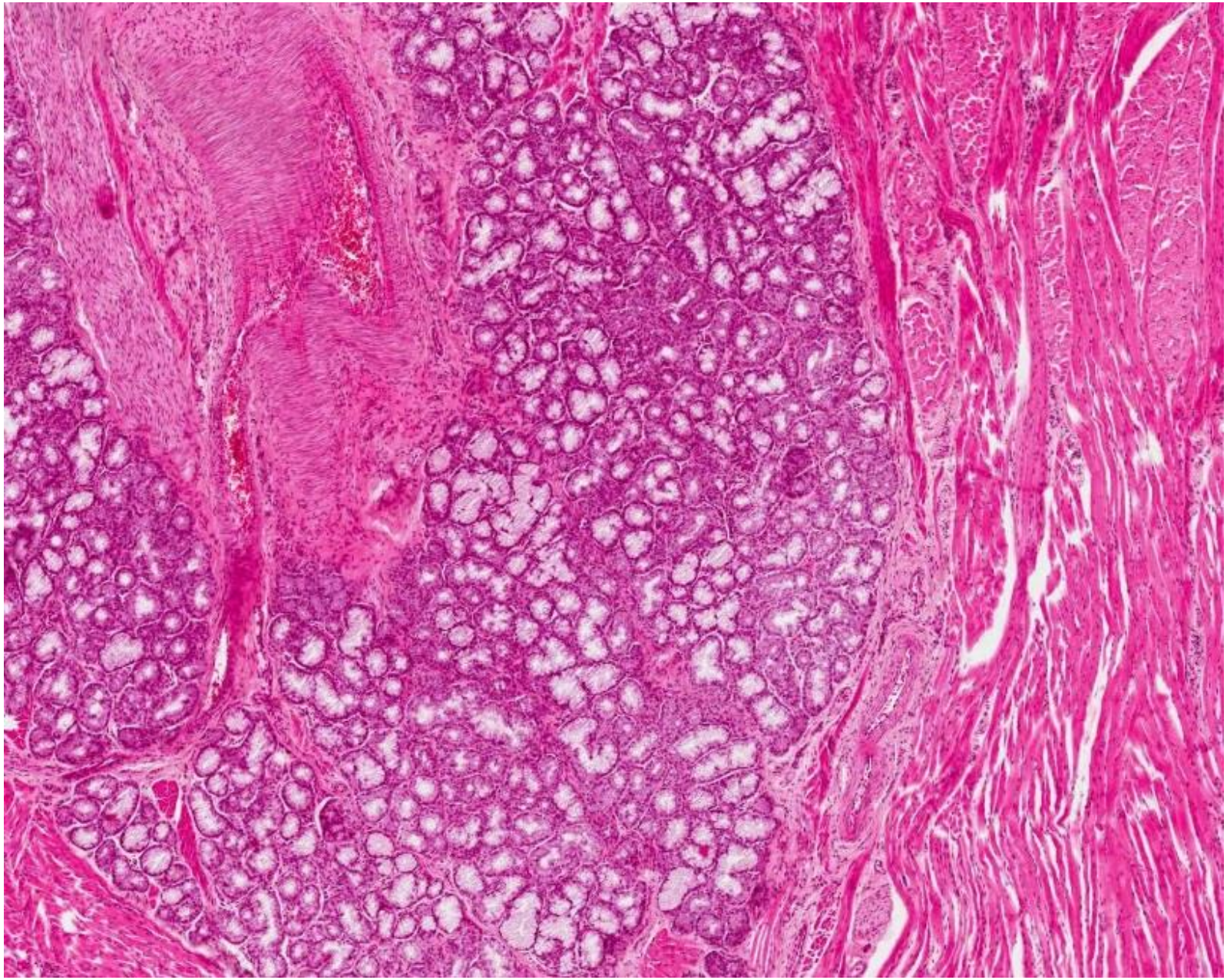




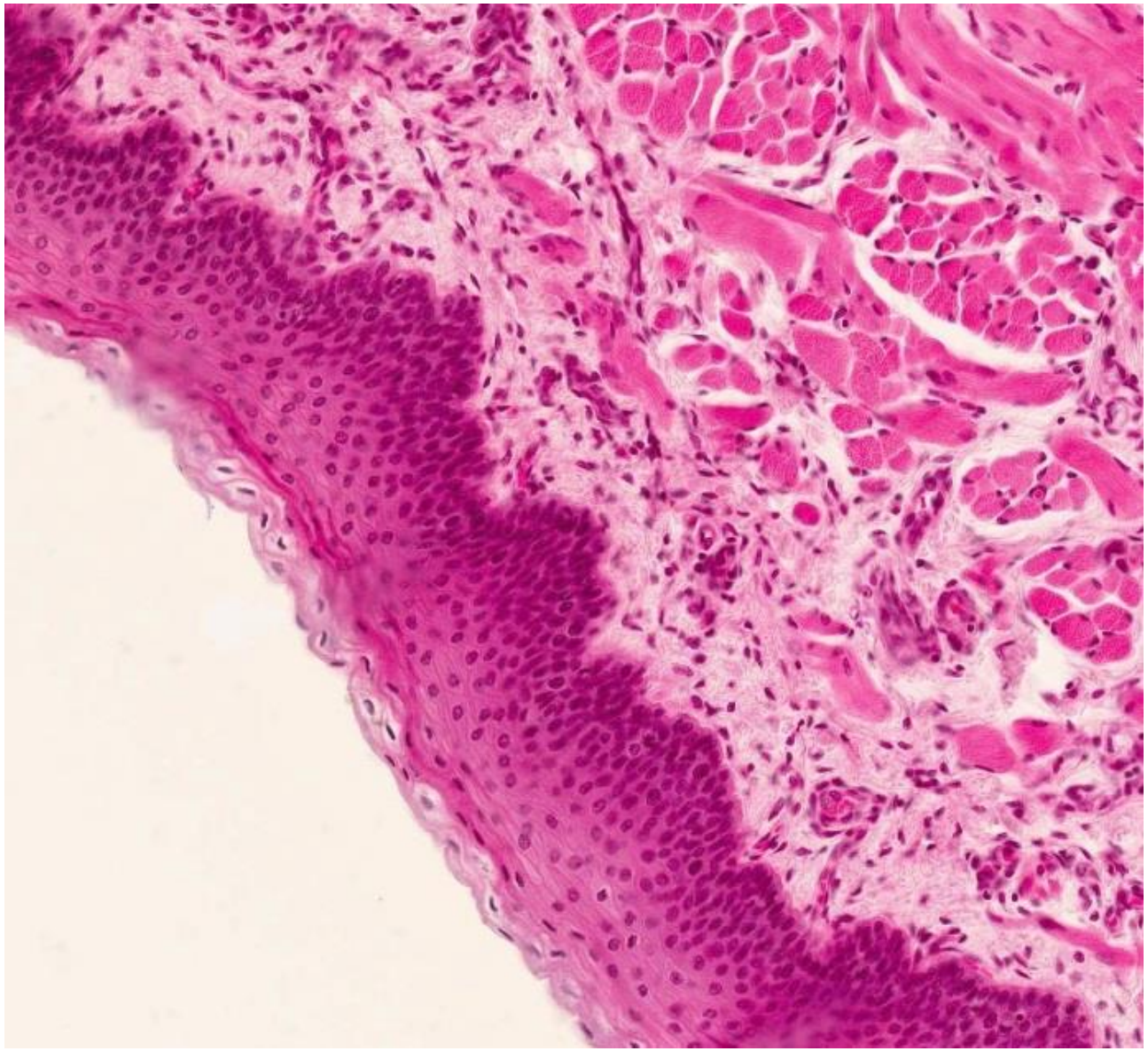
TONGUE – APEX LINGUAE



TONGUE - GLL. LINGUALES ANTERIORES (BLANDINI)



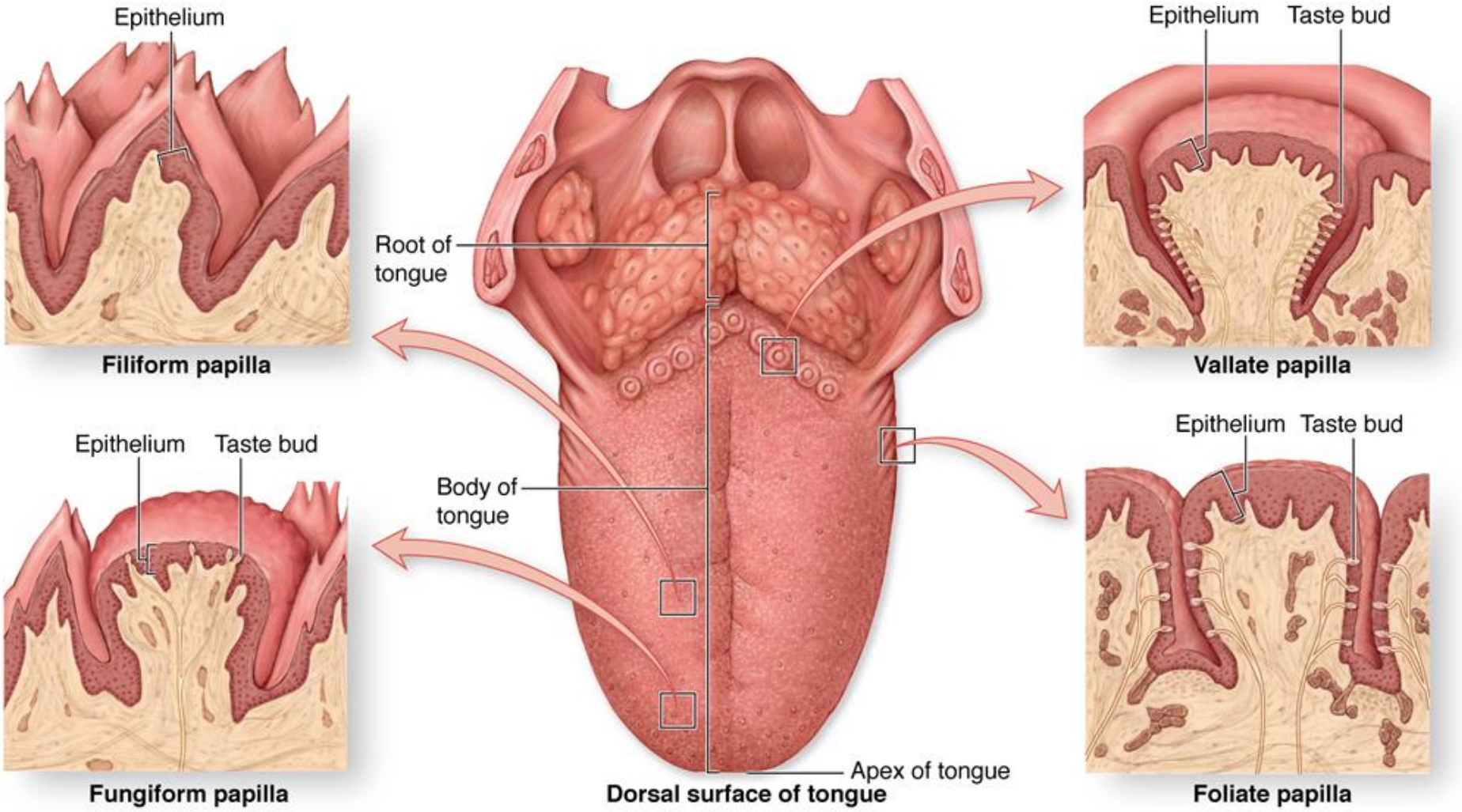
TONGUE - FACIES MYLOHYOIDEA



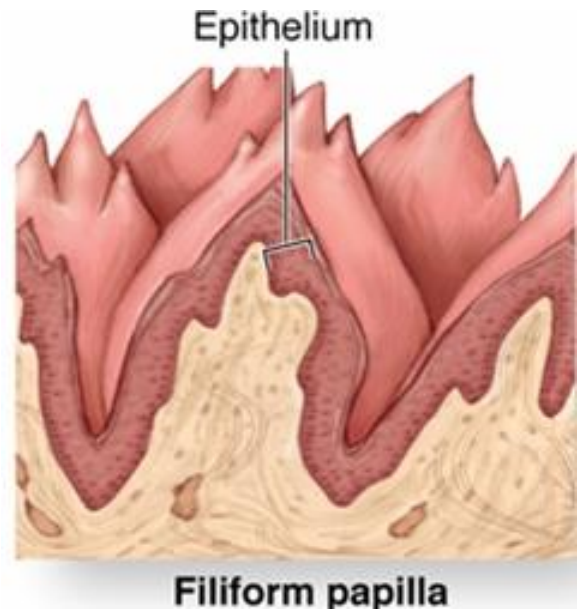
TONGUE – DORSUM LINGUAE

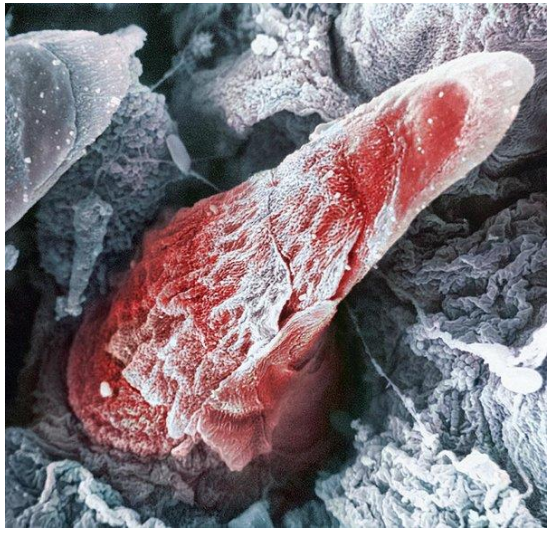
specialized mucosal structures - **papilale**

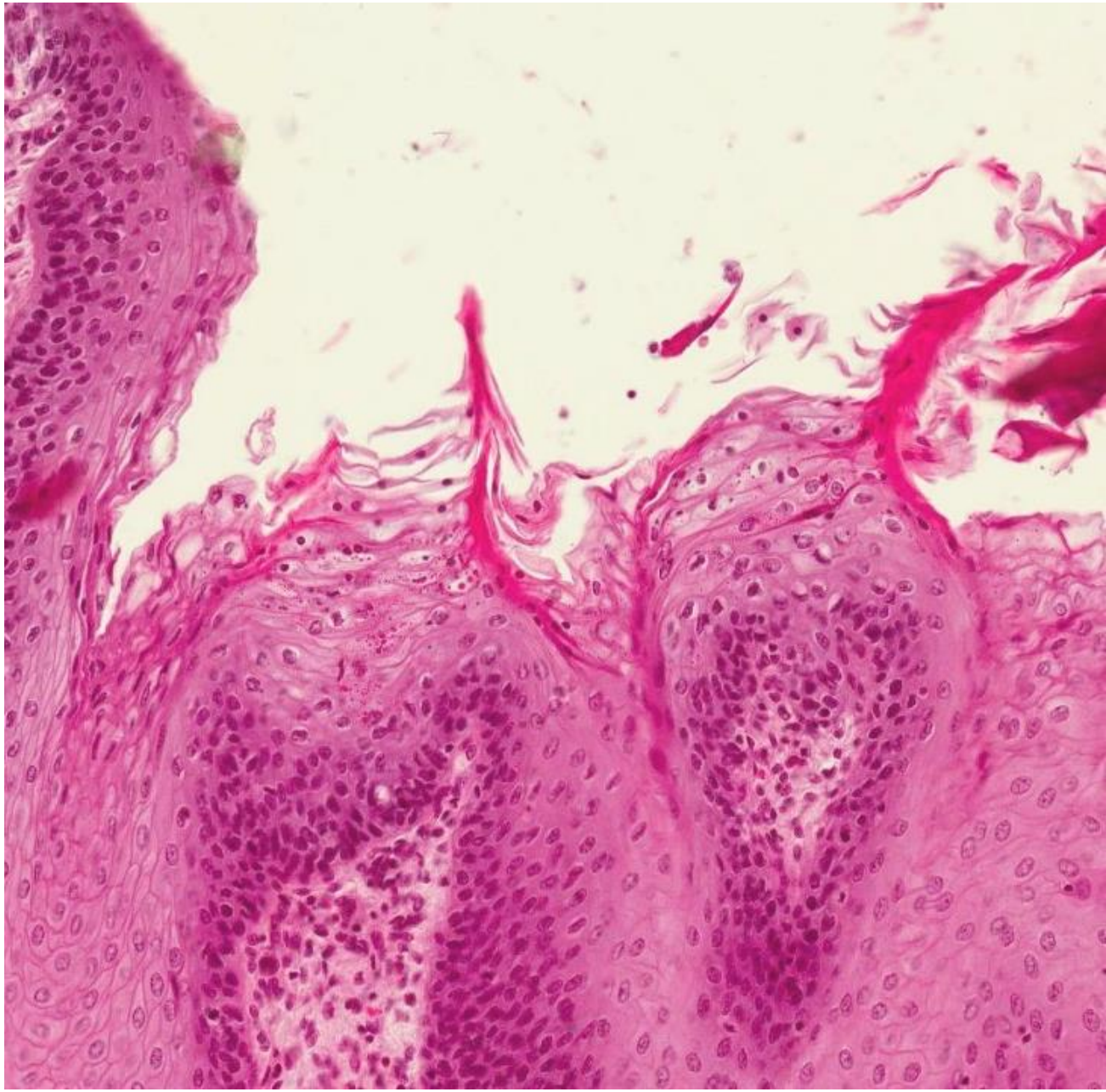
submucosal C.T. is absent



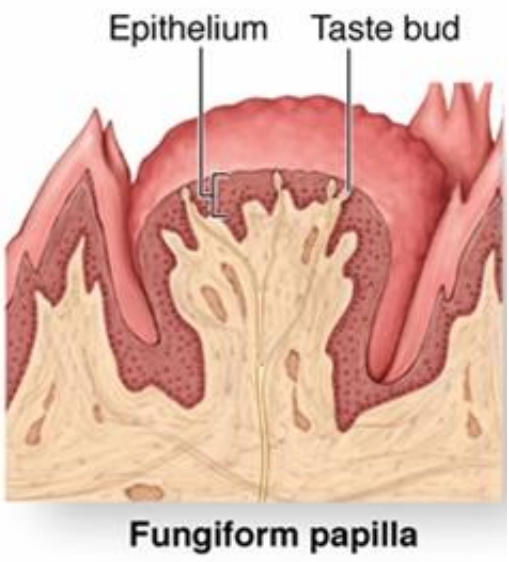
TONGUE – FILLIFORM PAPILLAE



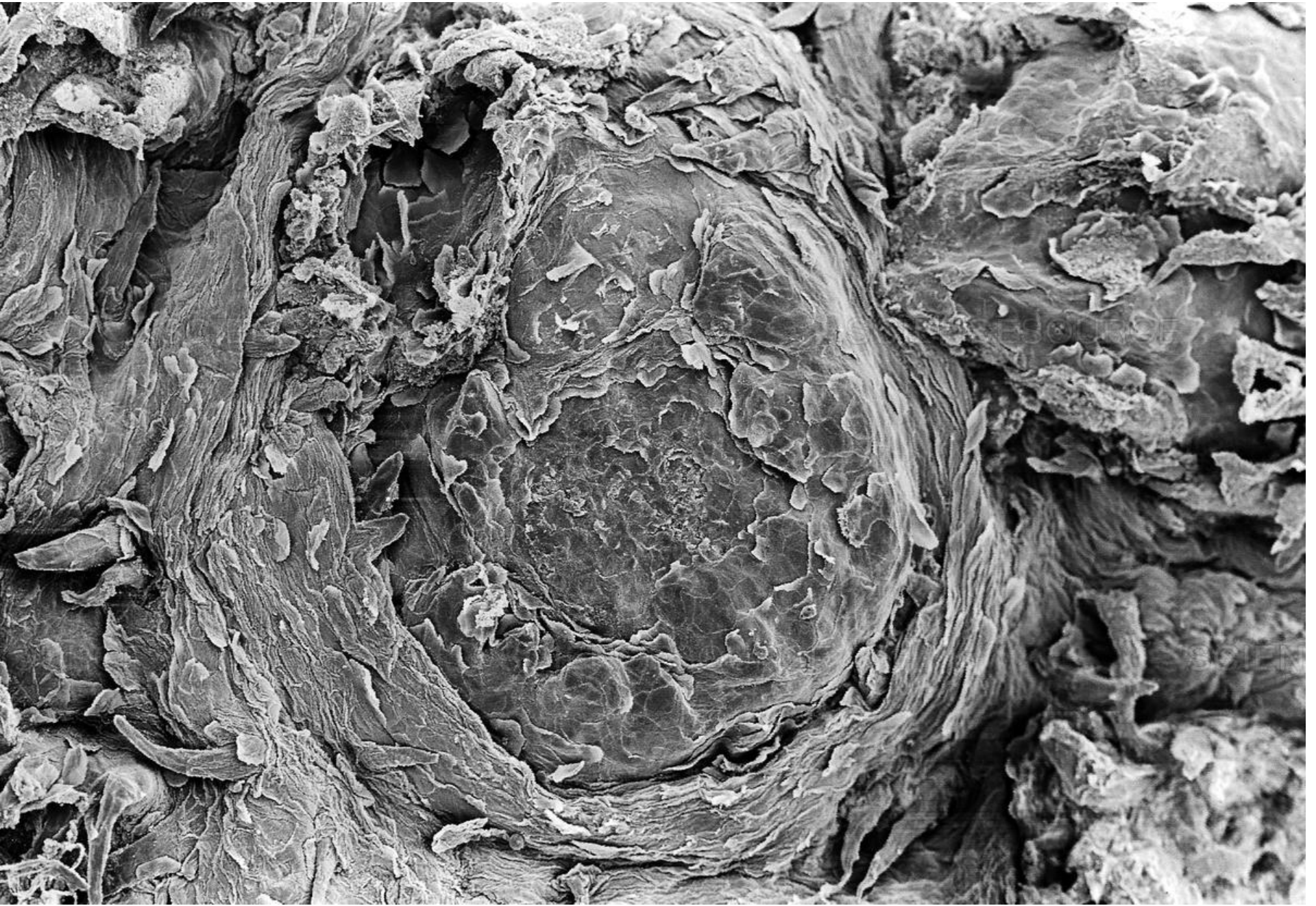




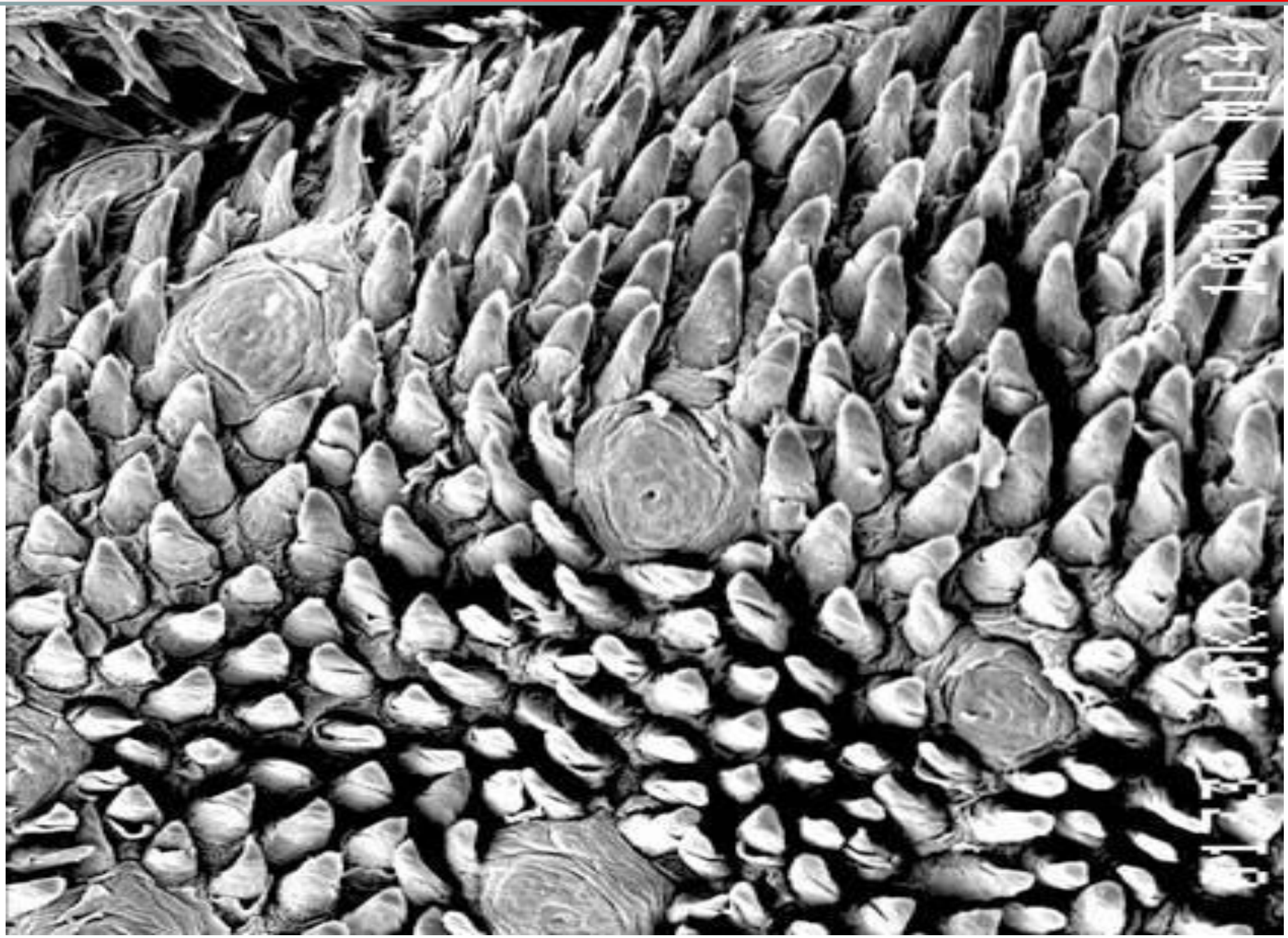
TONGUE – FUNGIFORM PAPILLAE



TONGUE – FUNGIFORM PAPILLAE

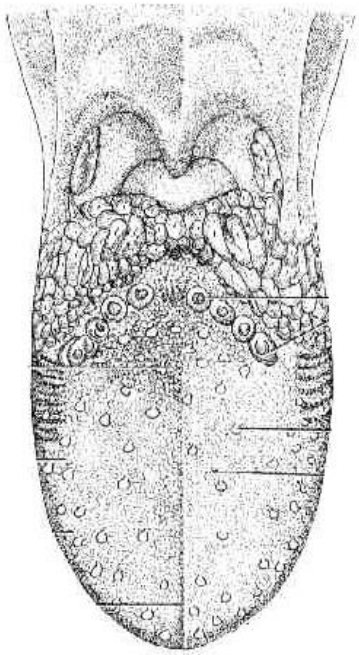


TONGUE – FILLIFORM AND FUNGIFORM PAPILLAE

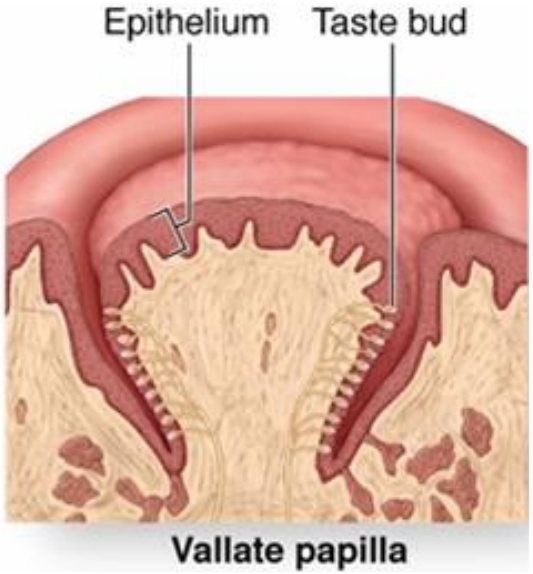


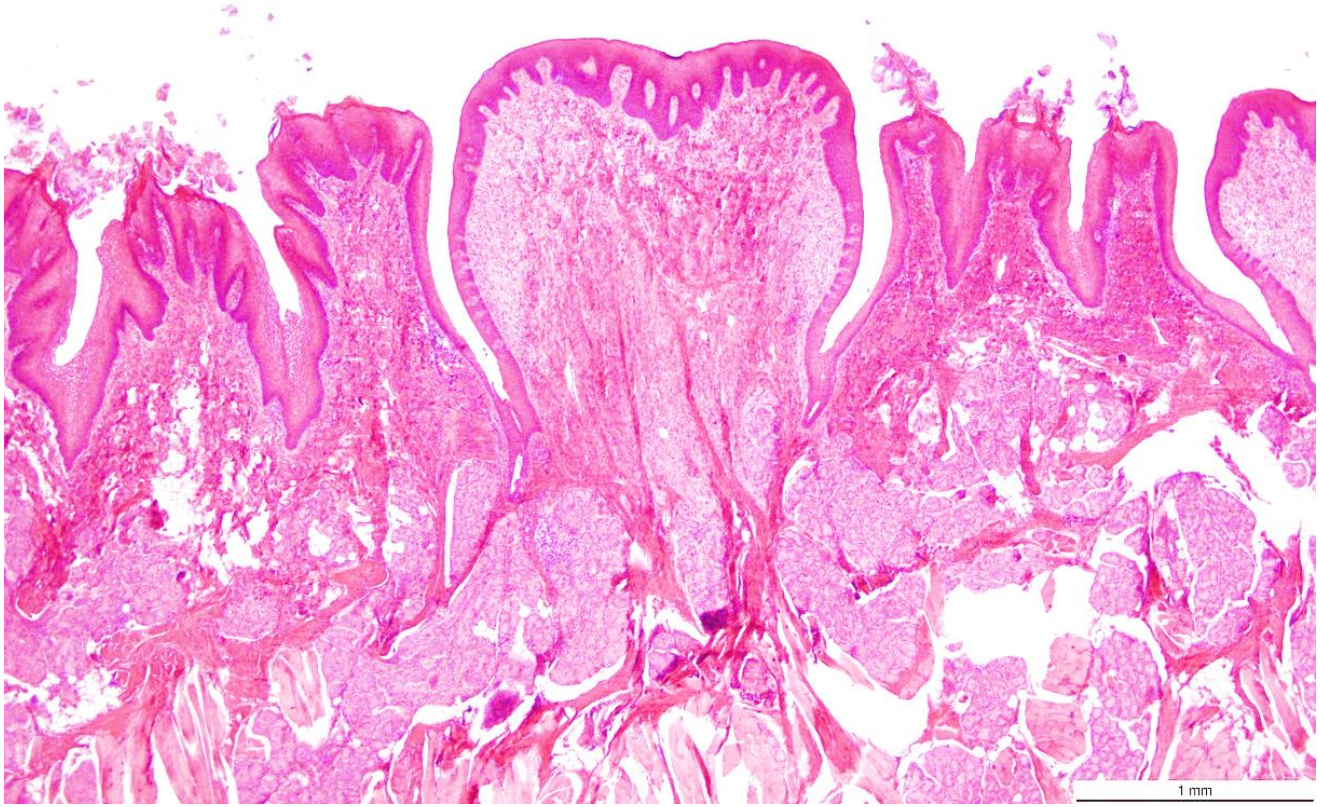
TONGUE – FOLIATE PAPILLAE

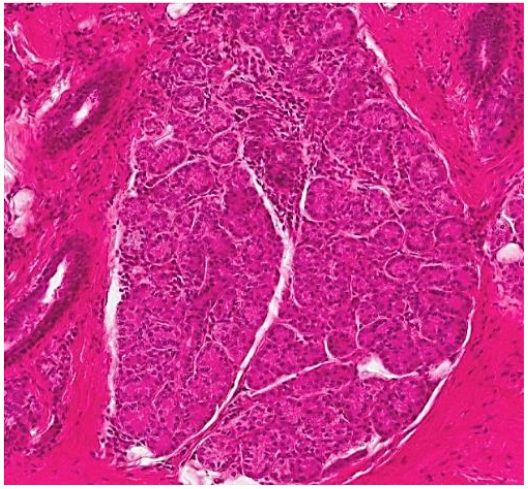
Foliate papilla



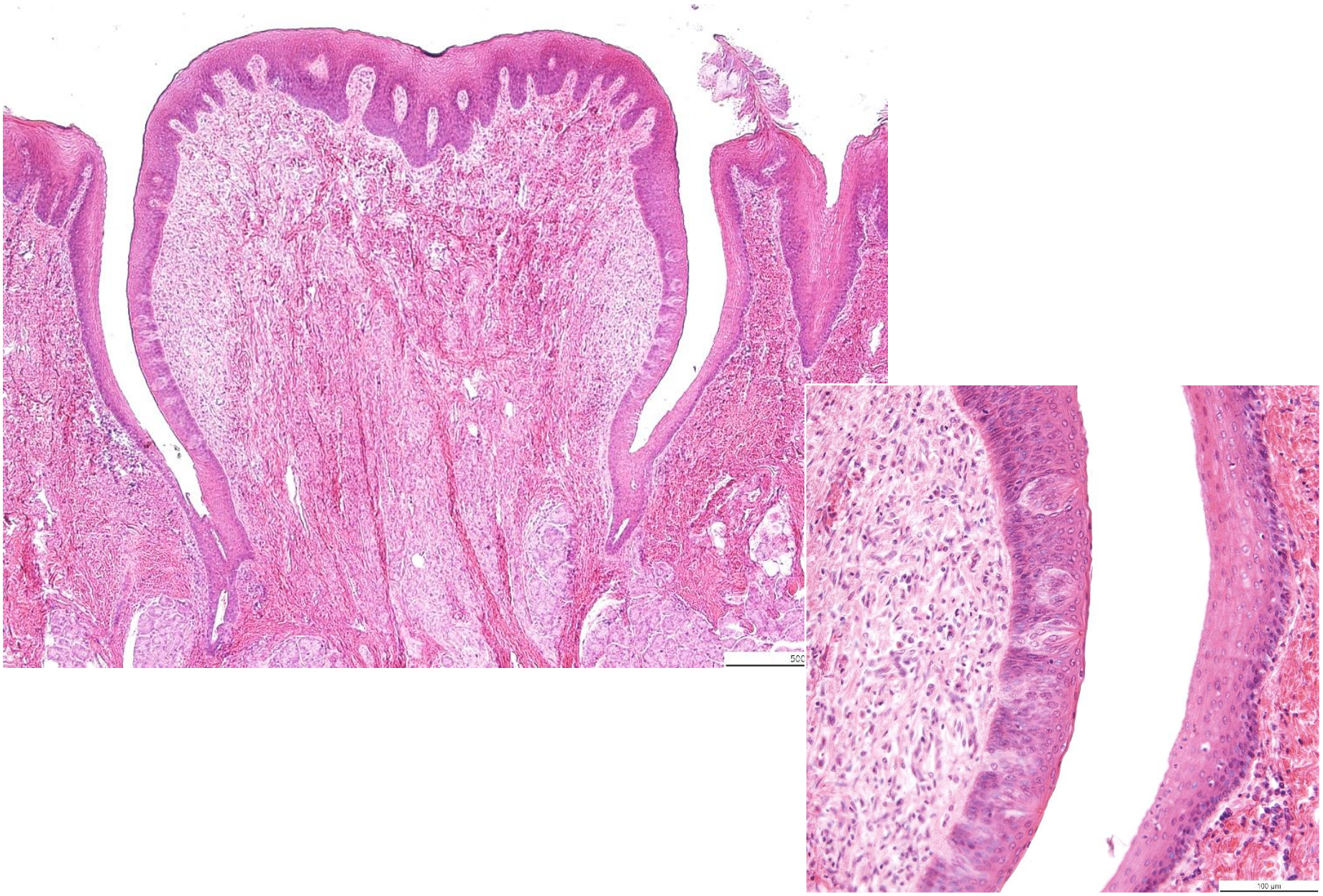
TONGUE – VALLATE PAPILLAE



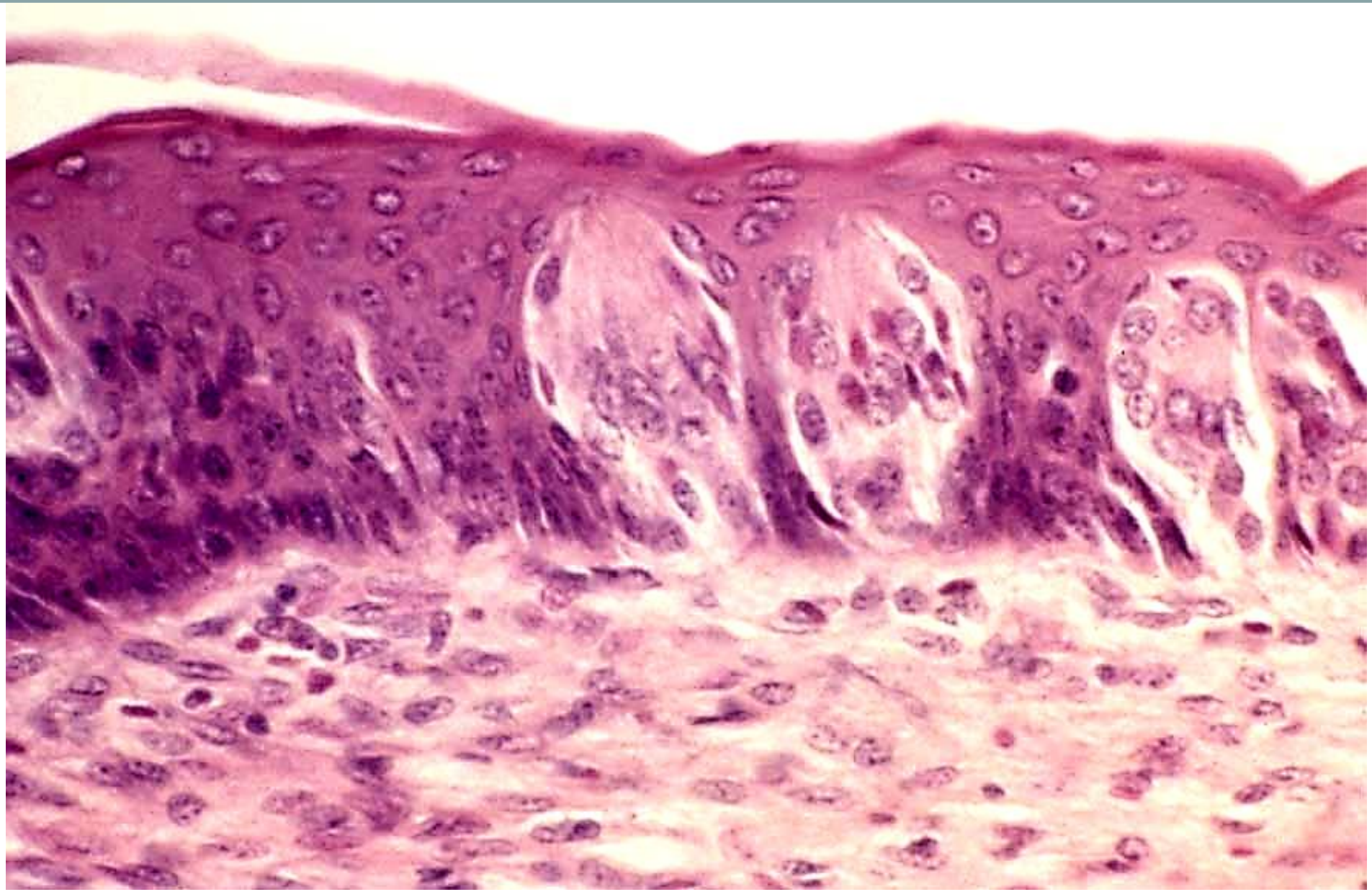




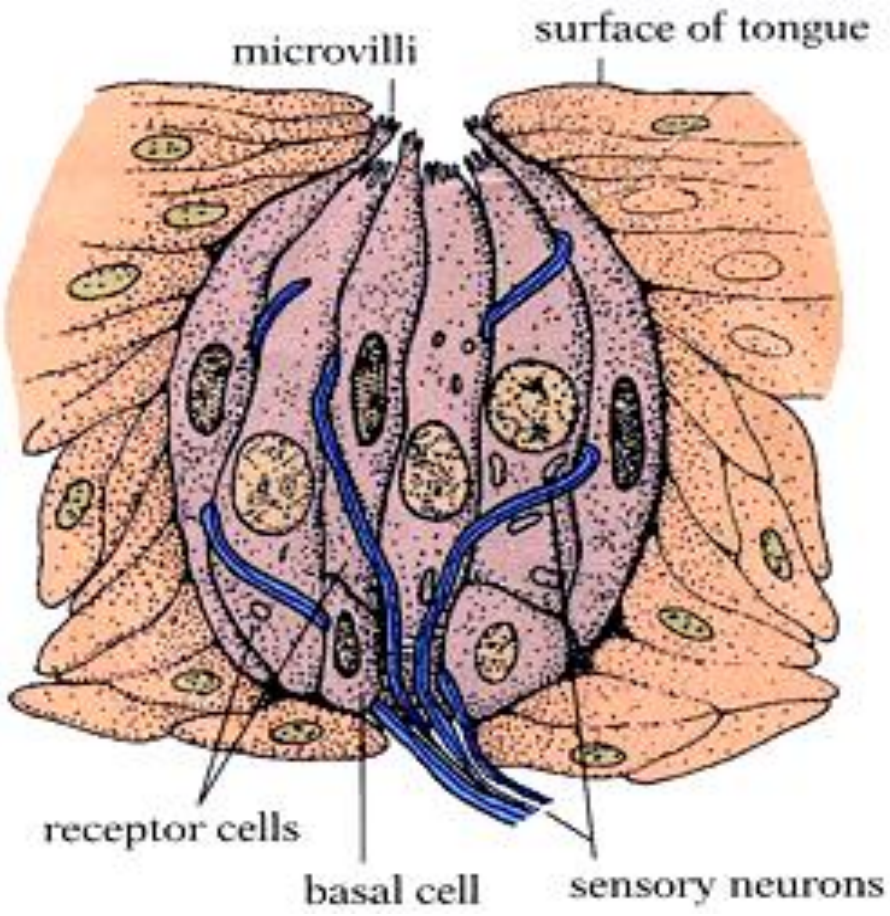
TONGUE – VALLATE PAPILLAE



TONGUE – TASTE BUDS

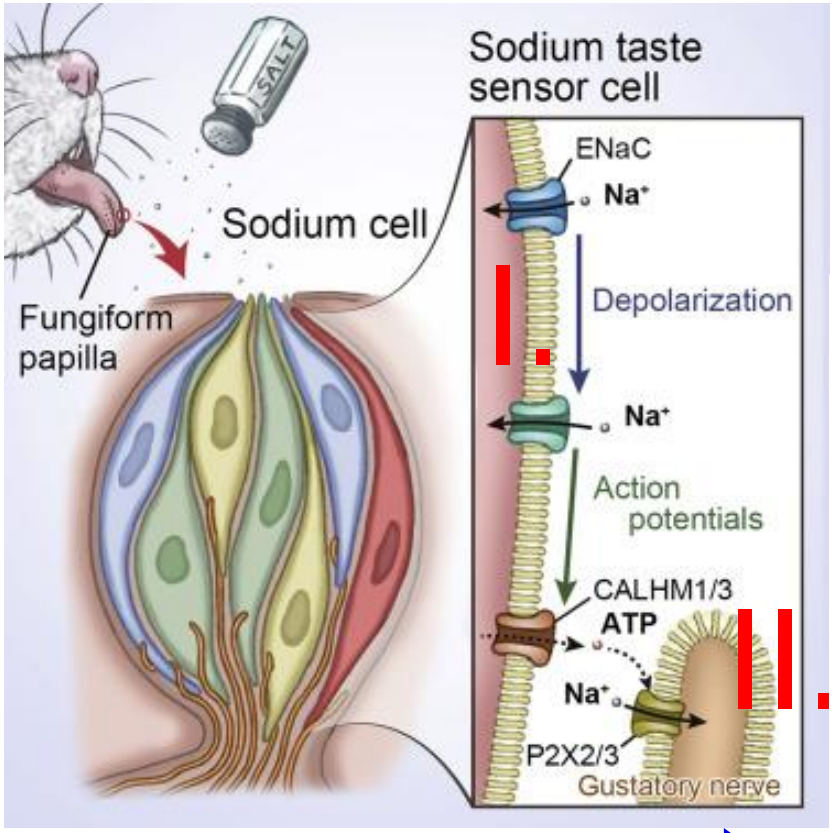


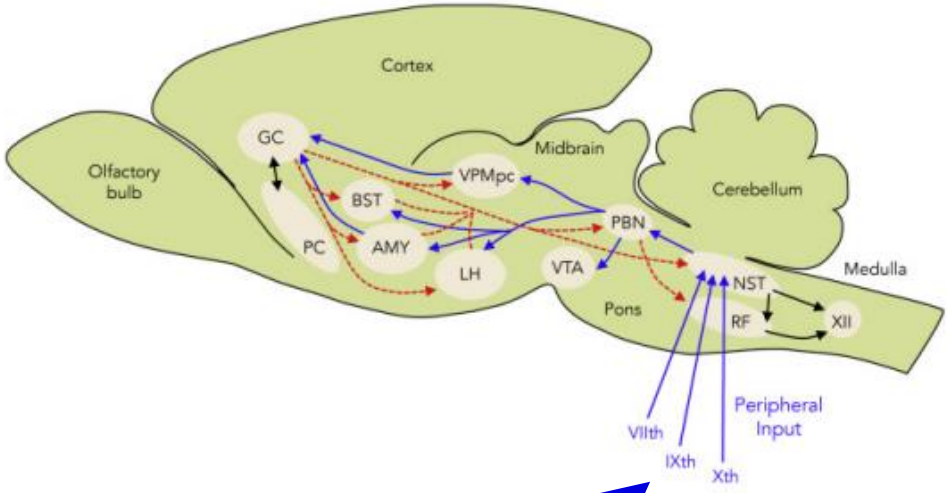
TONGUE – TASTE BUD



- **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



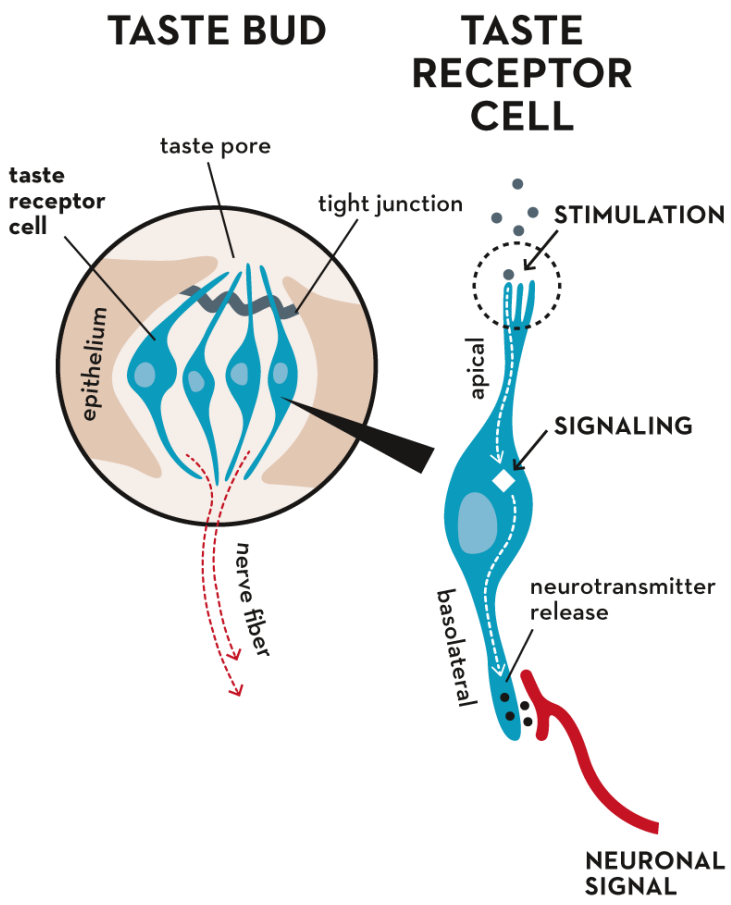


- Secondary sensory epithelium

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

doi.org/10.1016/j.neuron.2020.03.006

TONGUE – TASTE BUD

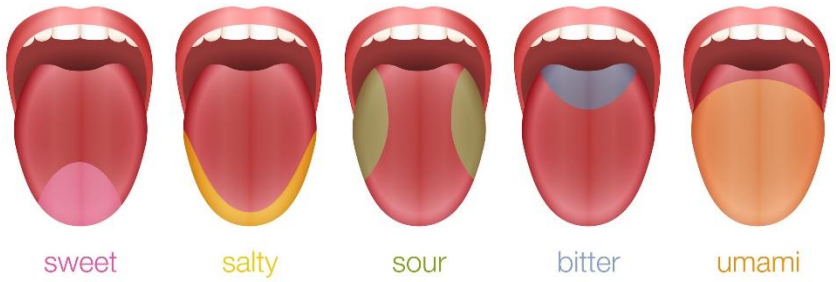


- bitter
- sweet
- umami (glutamate)
- G-protein-coupled receptors

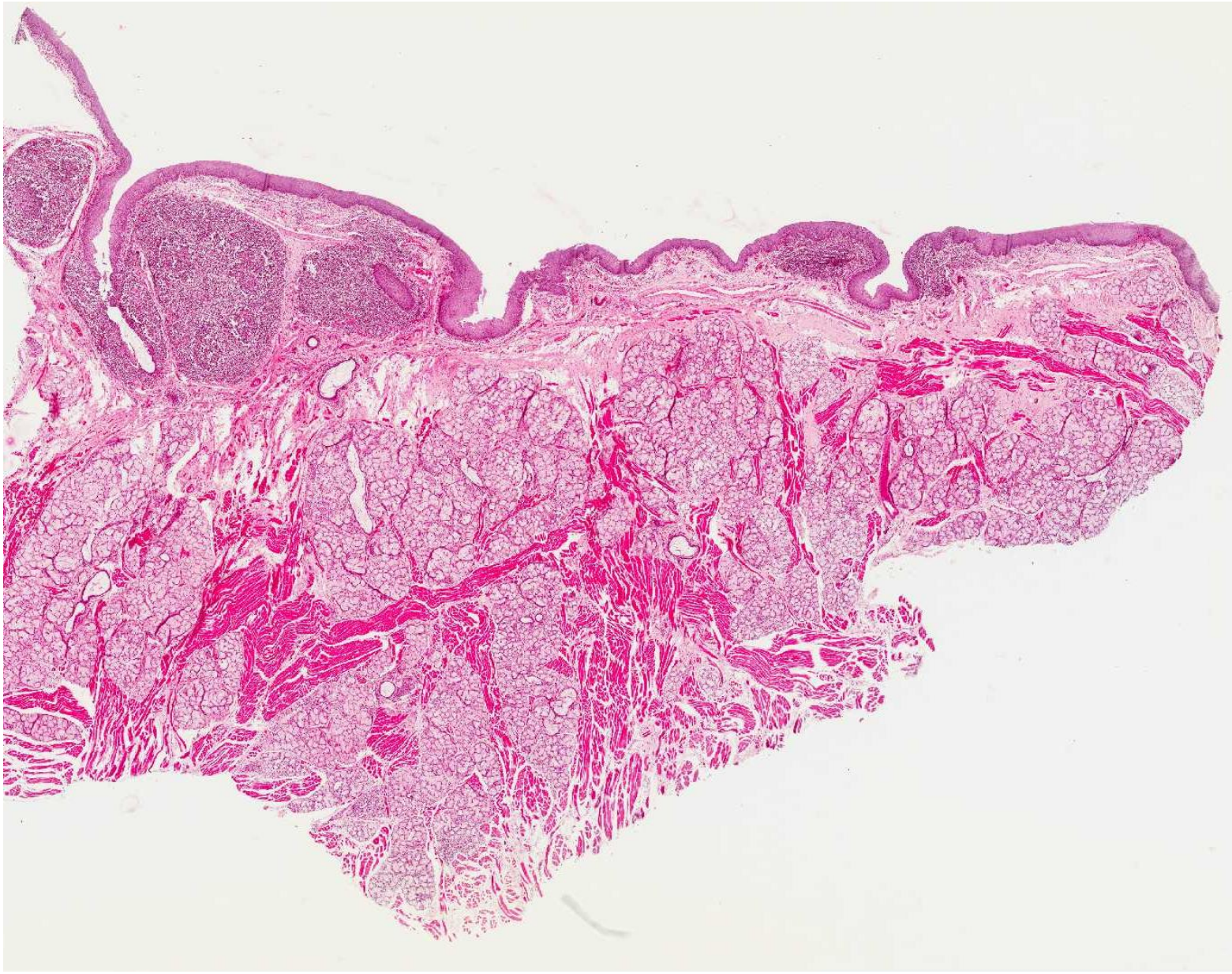
- salt
- acid
- ion channels

- CD36
- fatty acid transporter

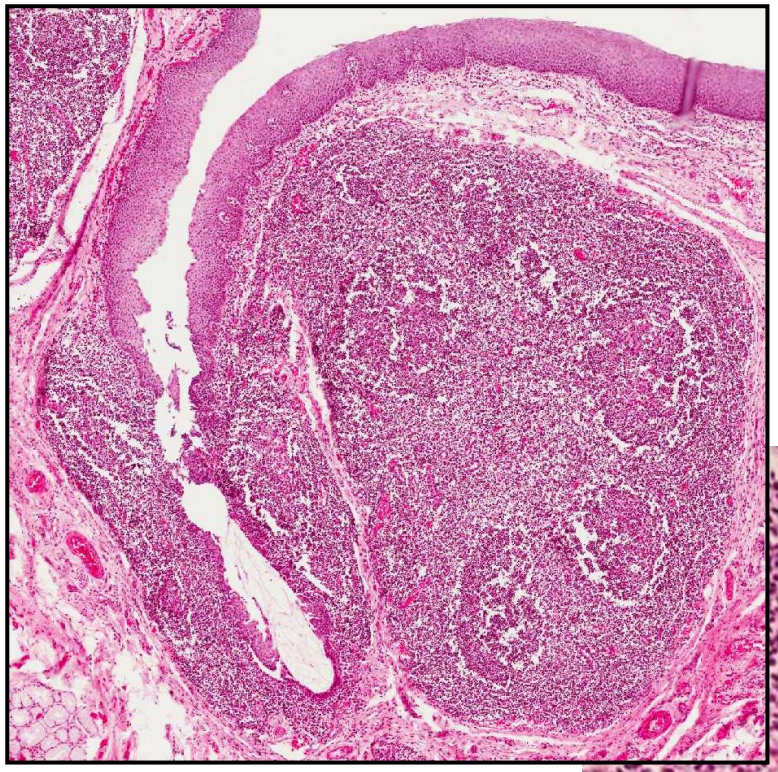
- in taste sensing olfactory epithelium is involved

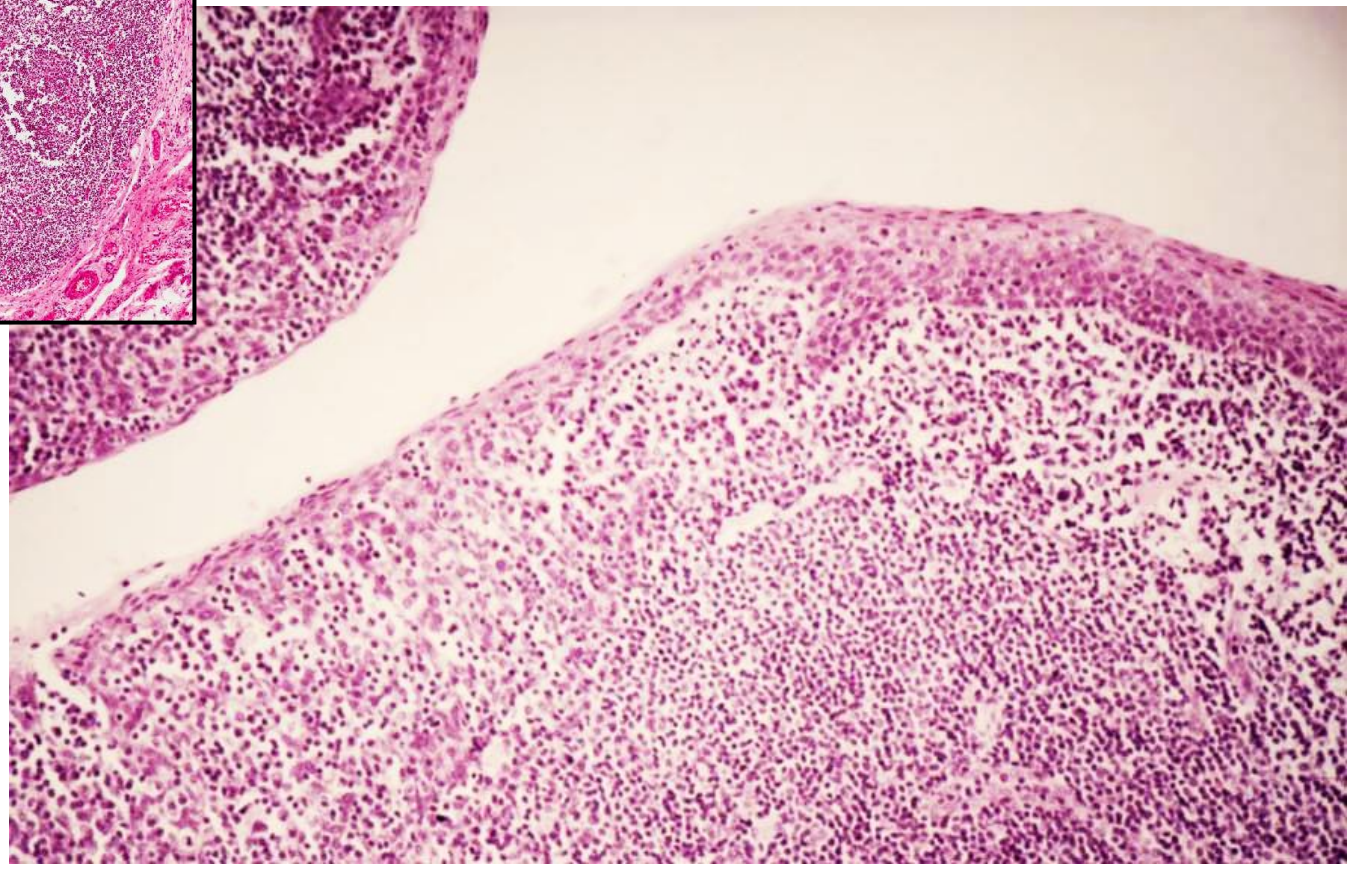


TONGUE – RADIX, TONSILLA LINGUALIS

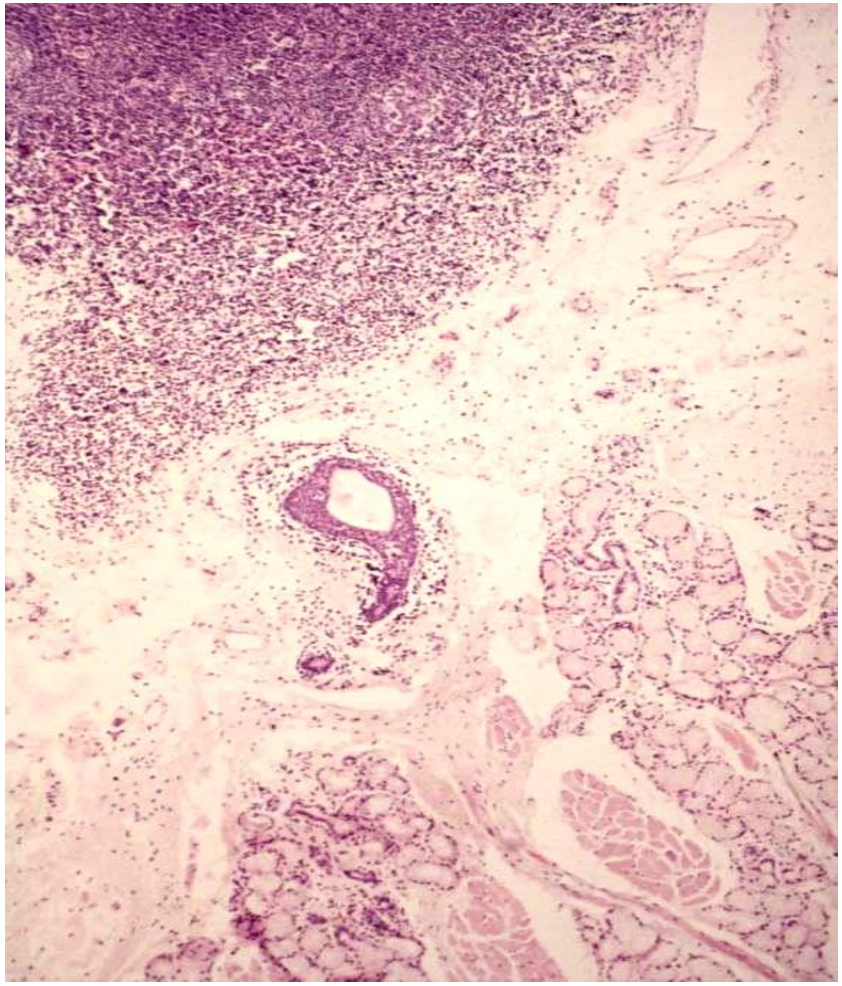


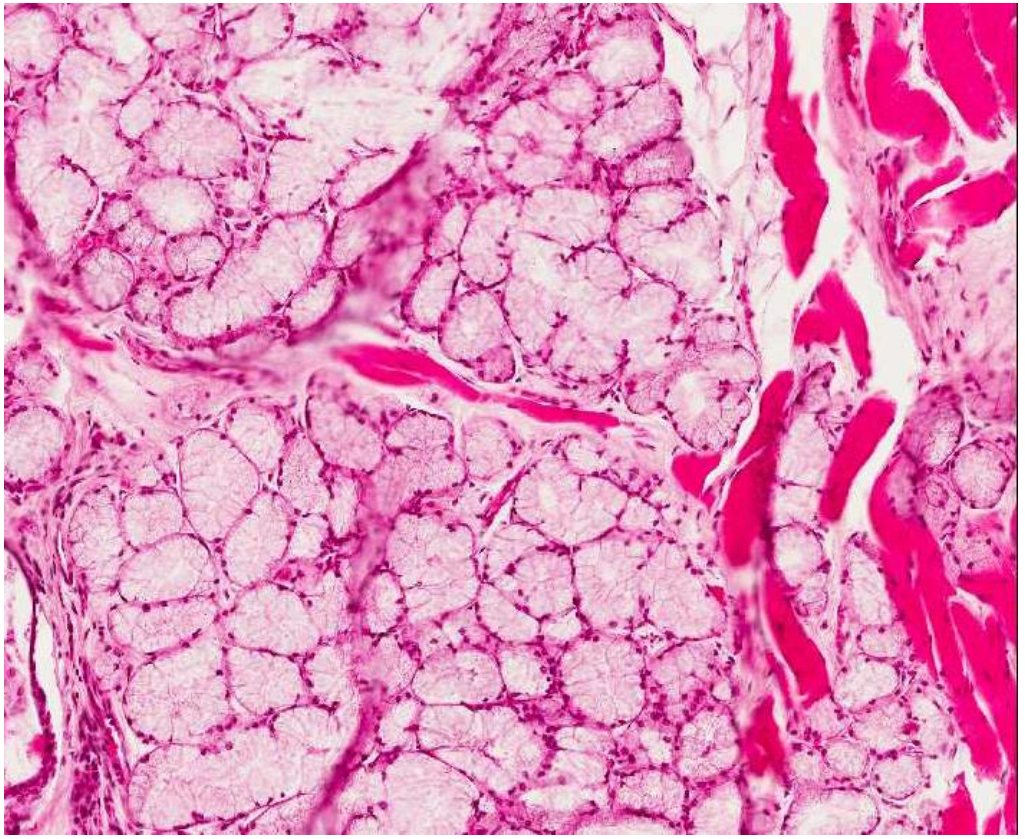
TONGUE – RADIX, TONSILLA LINGUALIS



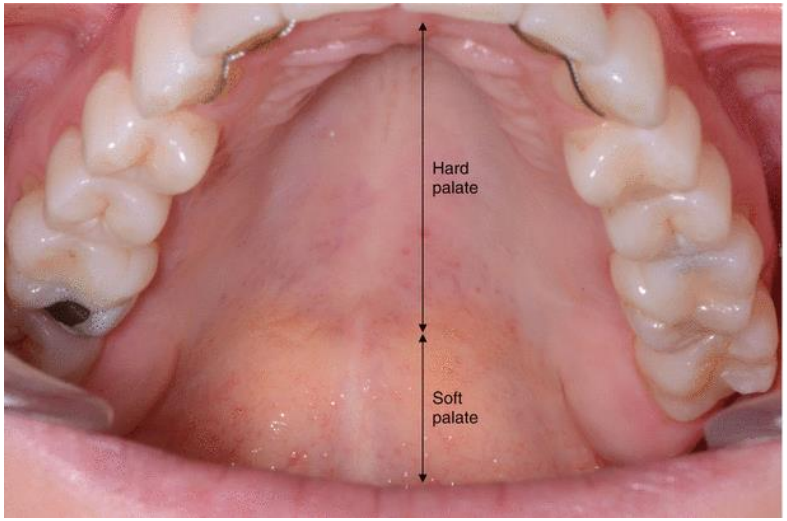


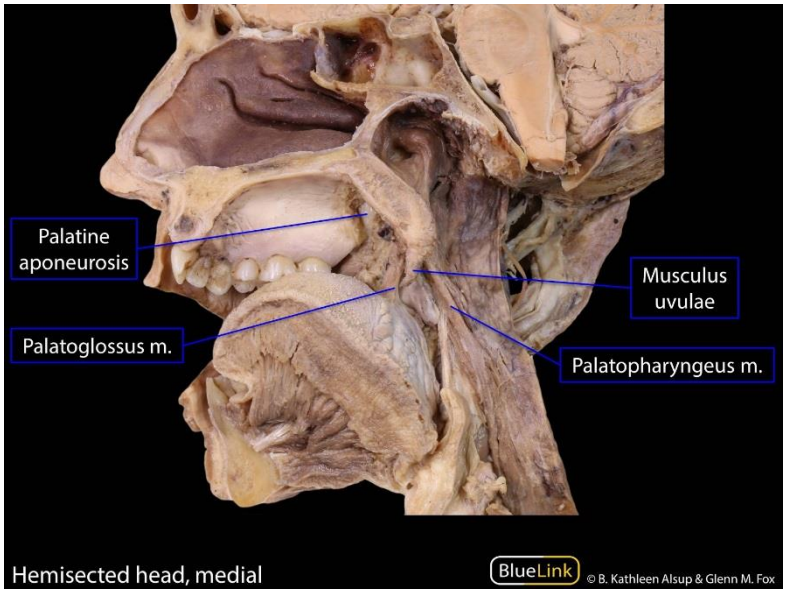
TONGUE – RADIX, TONSILLA LINGUALIS, WEBER'S GLANDS

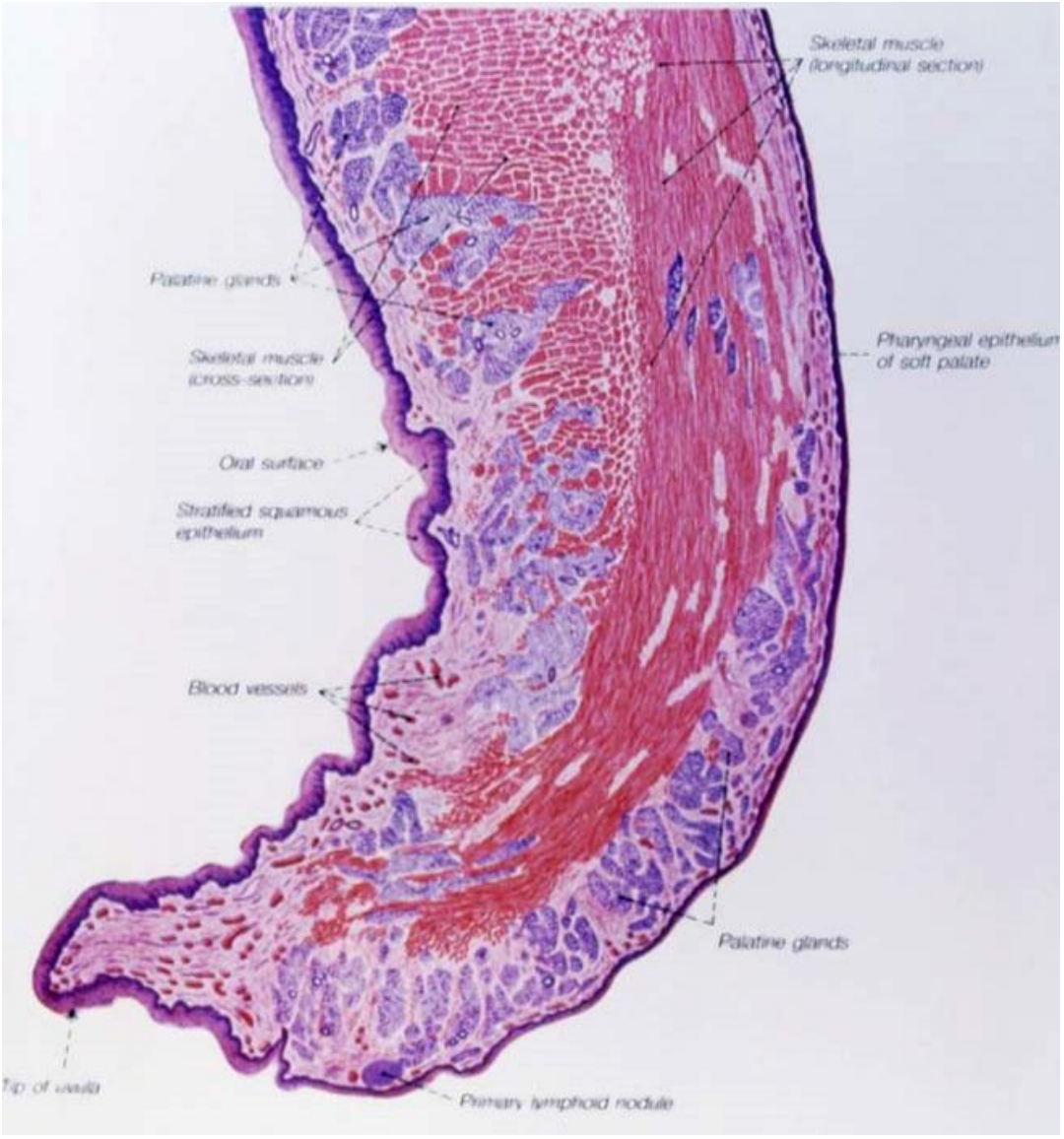




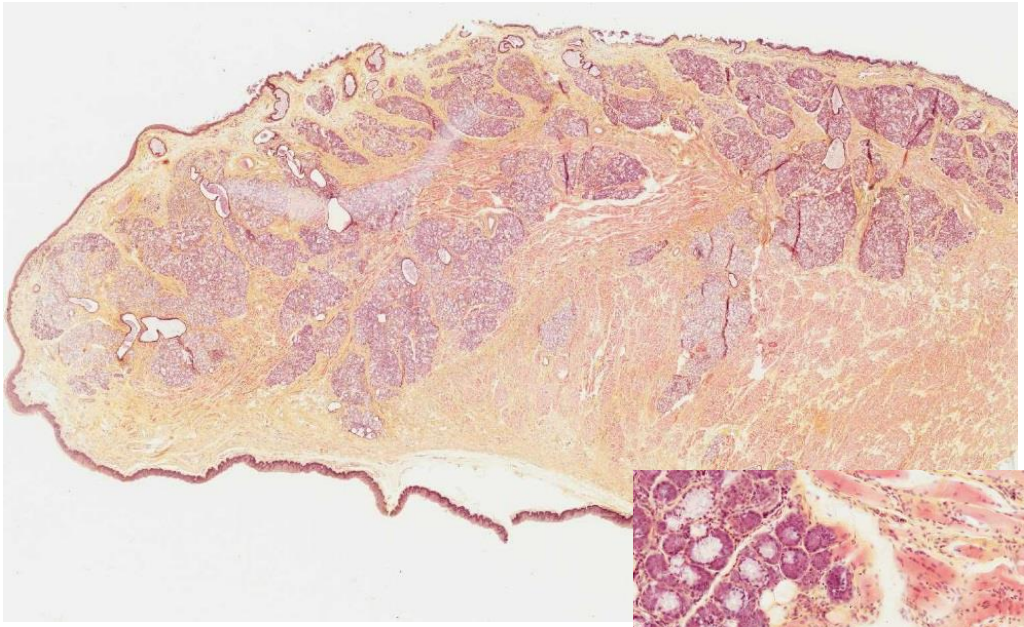
PALATE

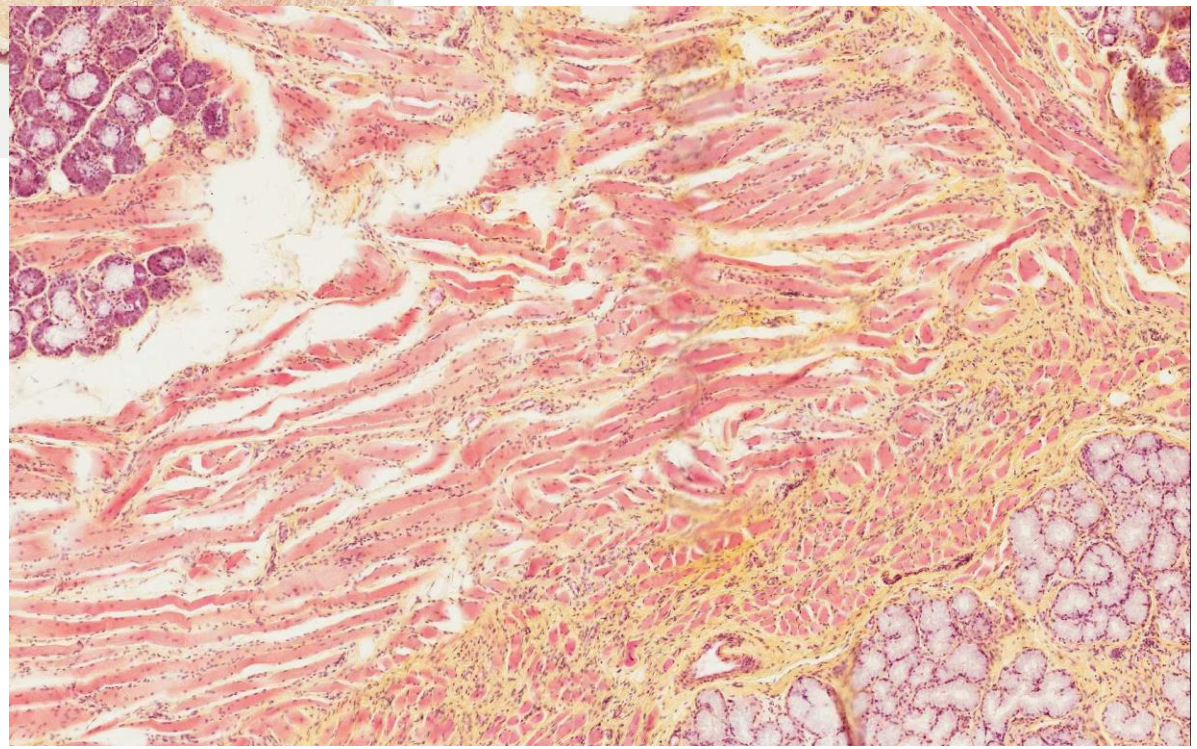

Hard palate
Soft palate


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

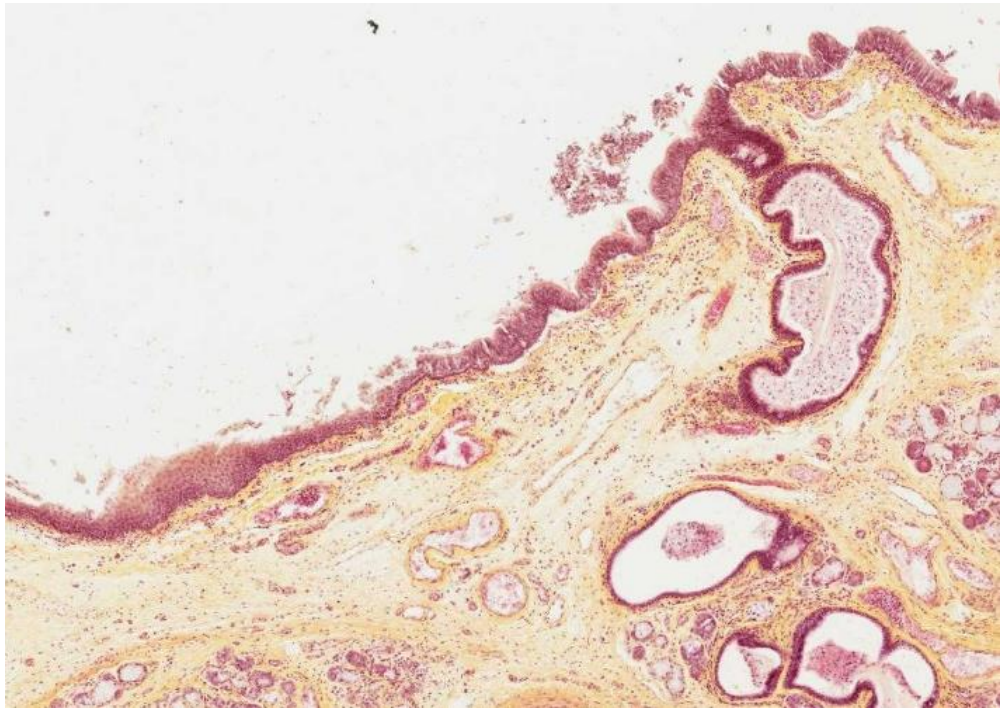

Skeletal muscle (longitudinal section)
Palatine glands
Skeletal muscle (cross-section)
Pharyngeal epithelium of soft palate
Oral surface
Stratified squamous epithelium
Blood vessels
Palatine glands
Primary lymphoid nodule

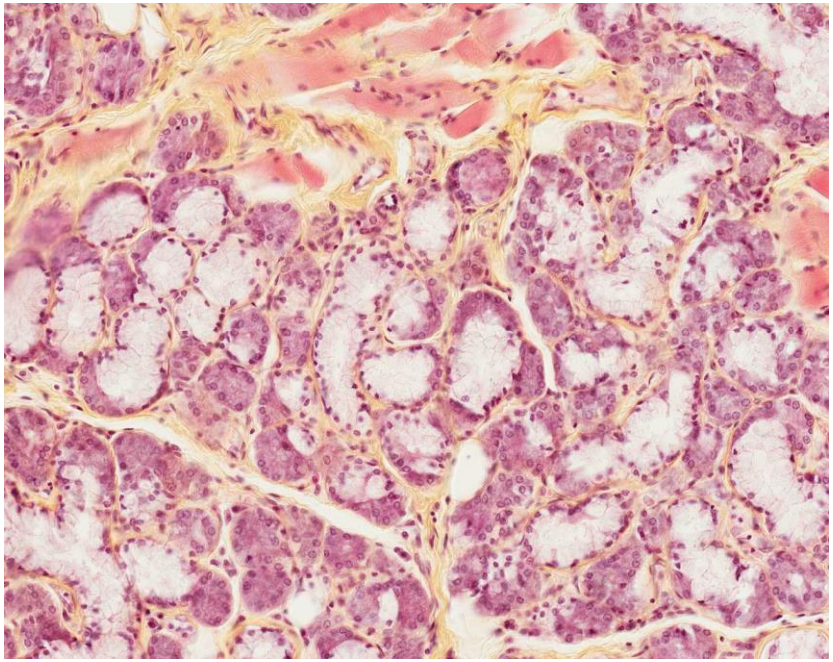
SOFT PALATE

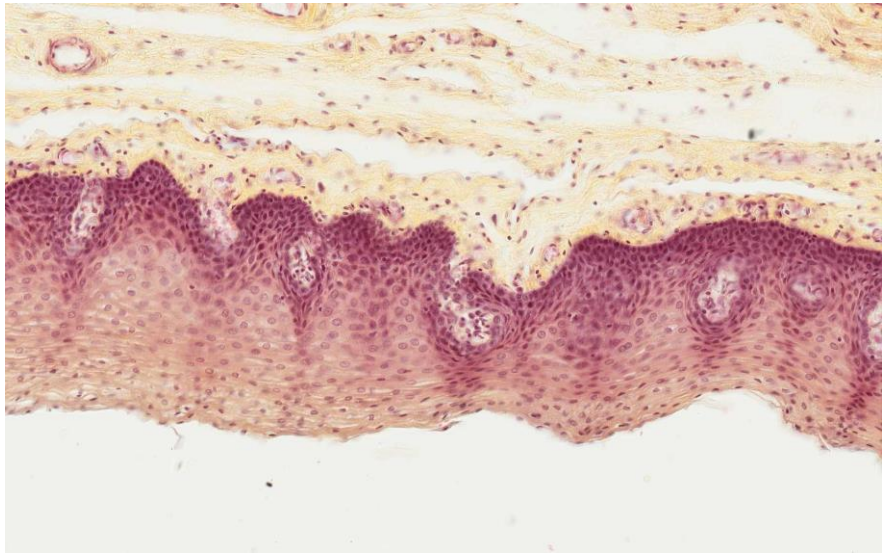


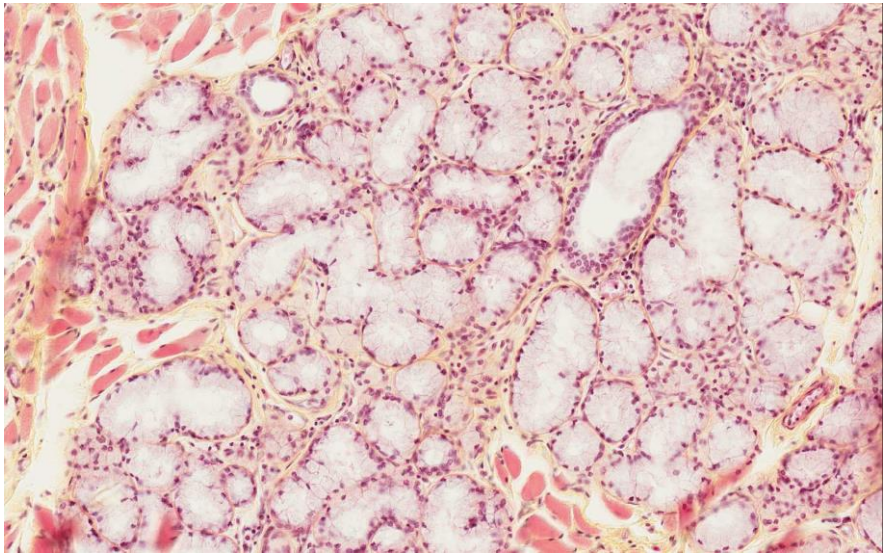


SOFT PALATE

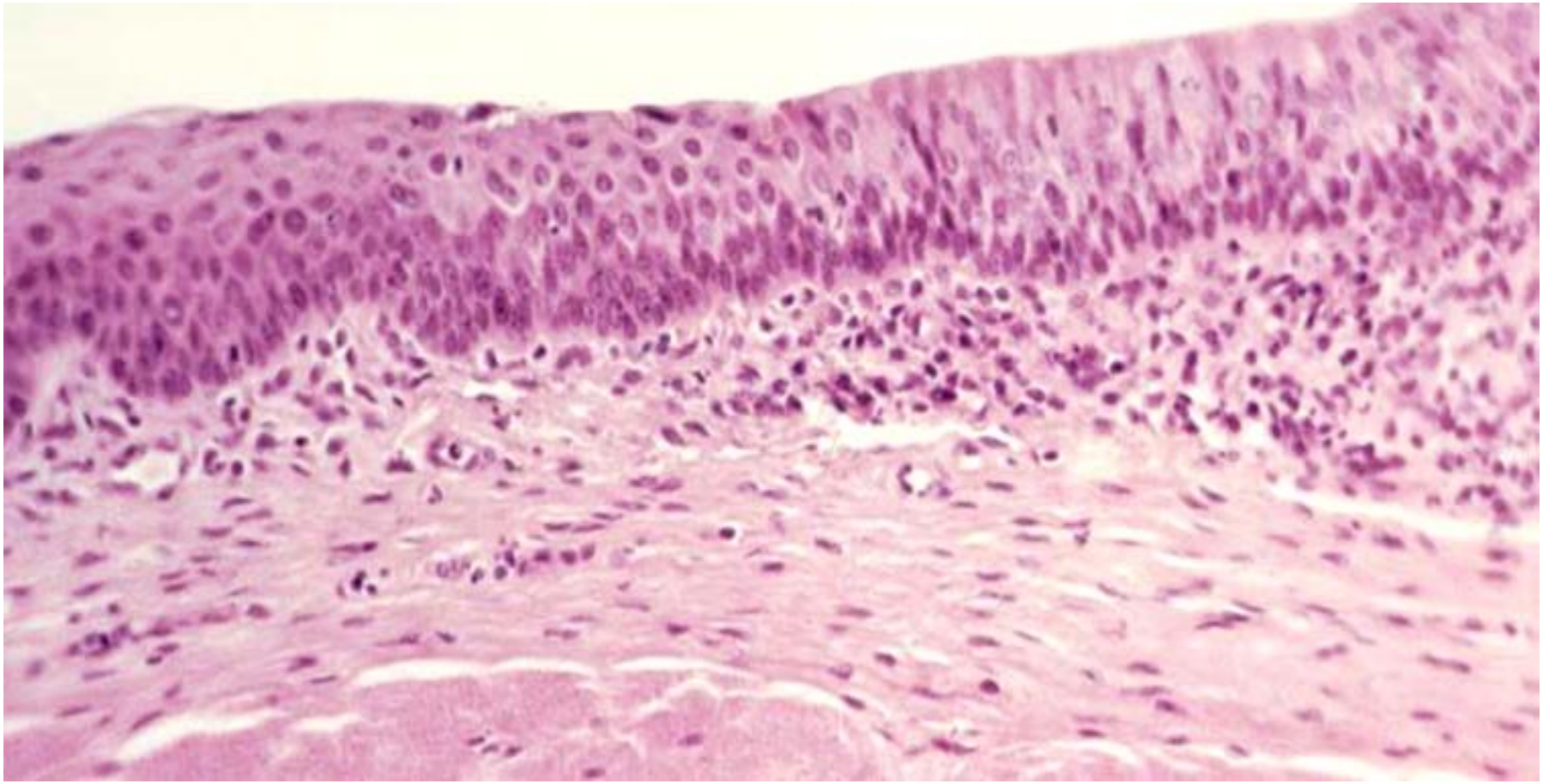




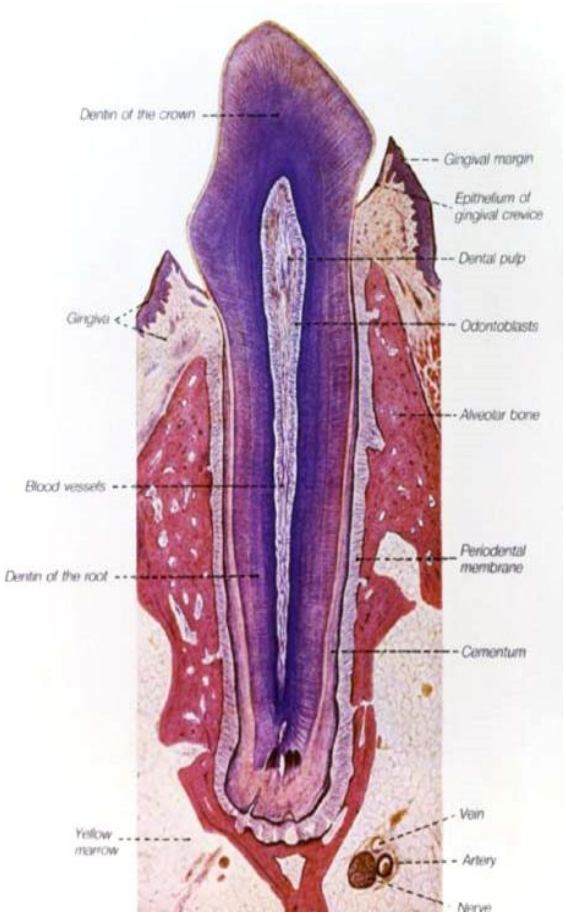




SOFT PALATE – EPITHELIAL CHANGE

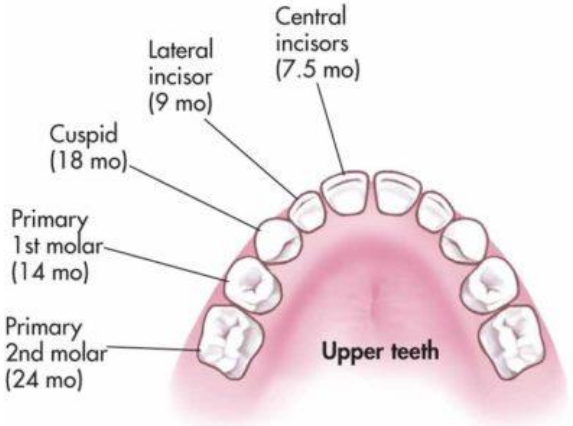


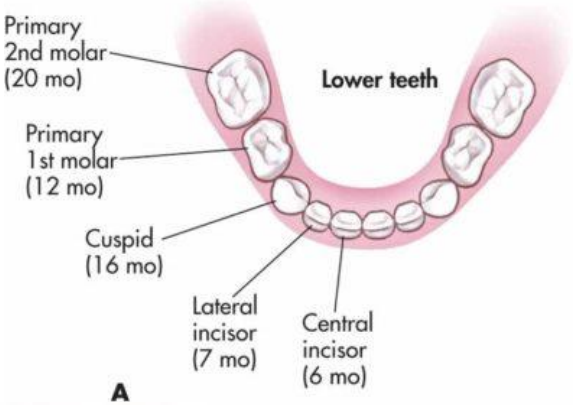
TOOTH



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

TOOTH





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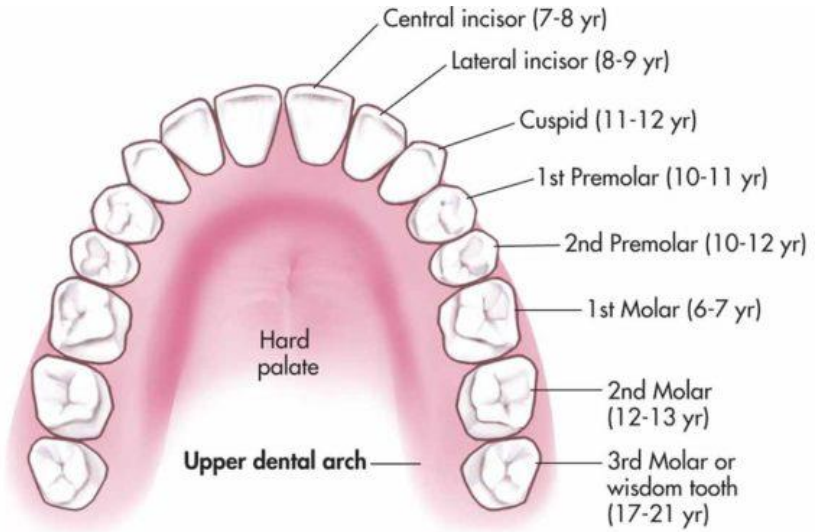
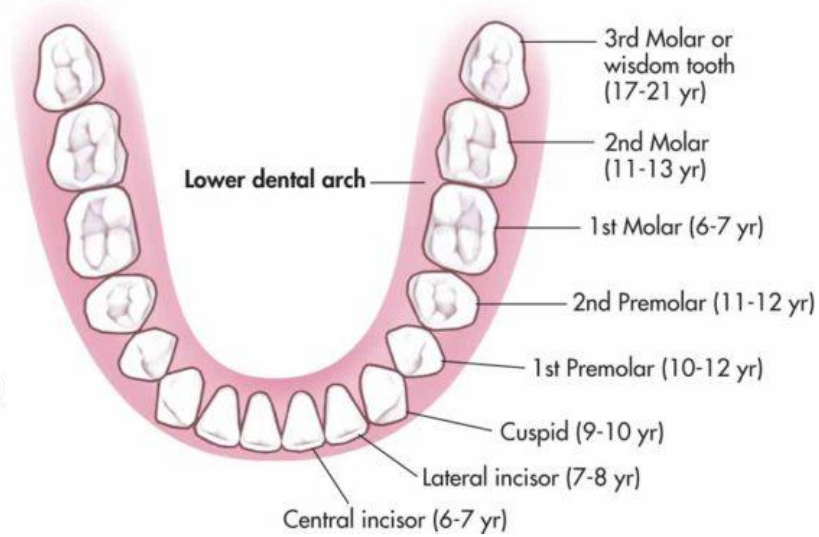




B

Vzorec mléčného chrupu:

$$\frac{m_2\ m_1\ c\ i_2\ i_1}{m_2\ m_1\ c\ i_2\ i_1} \quad \frac{i_1\ i_2\ c\ m_1\ m_2}{i_1\ i_2\ c\ m_1\ m_2}$$

Vzorec definitivního chrupu:

$$\frac{M_3\ M_2\ M_1\ P_2\ P_1\ C\ I_2\ I_1}{M_3\ M_2\ M_1\ P_2\ P_1\ C\ I_2\ I_1} \quad \frac{I_1\ I_2\ C\ P_1\ P_2\ M_1\ M_2\ M_3}{I_1\ I_2\ C\ P_1\ P_2\ M_1\ M_2\ M_3}$$

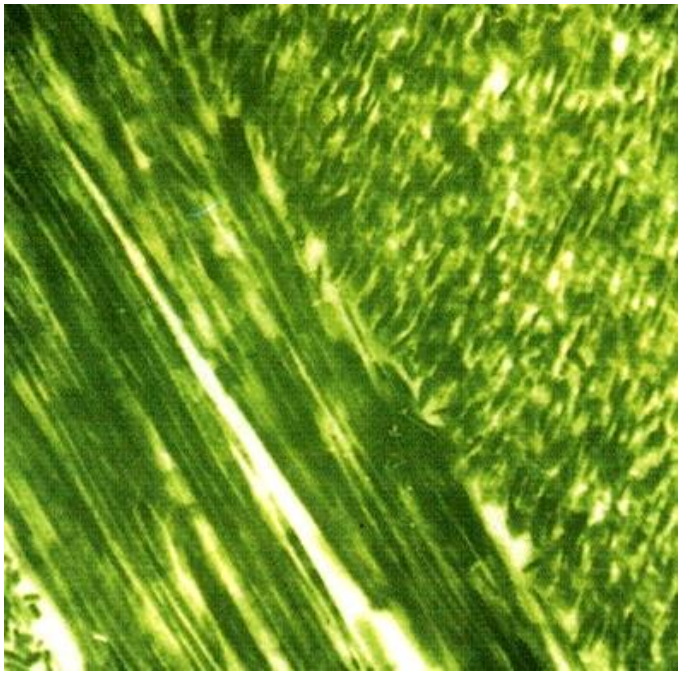
TOOTH - ENAMEL

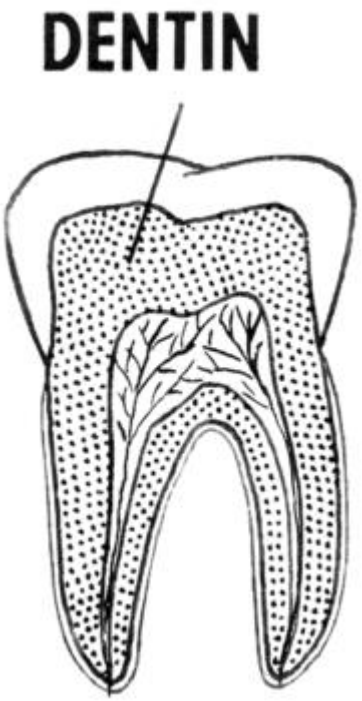
Enamel

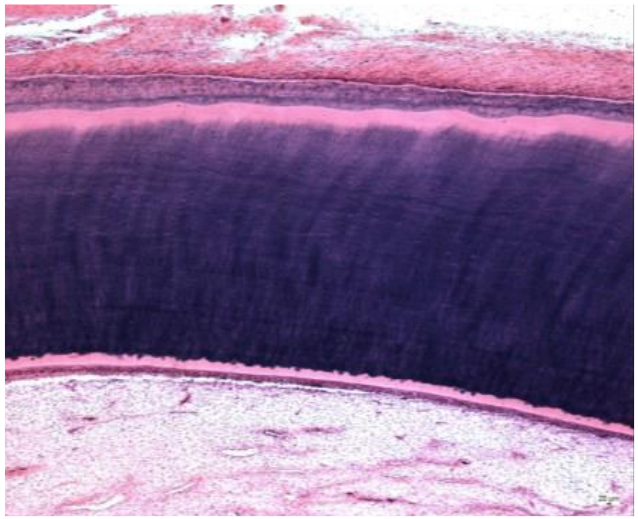
- Ameloblasts
- No regeneration
- 96% Ca-hydroxyapatite, prisms
- Enamelins, amelogenins, ameloblastins

Cementum

- Cementoblasts
- Regenerates
- 50% Ca-hydroxyapatite
- Collagen I, III, XII, GAGs, proteoglycans
- Sharpey's fibers - dental alveolus

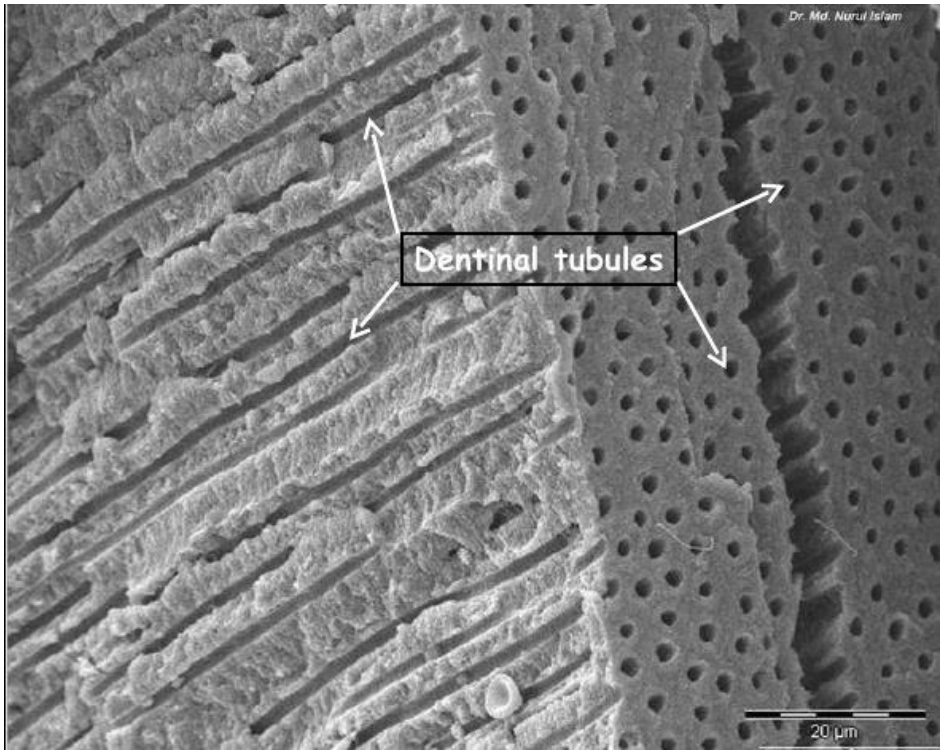






Dentin

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

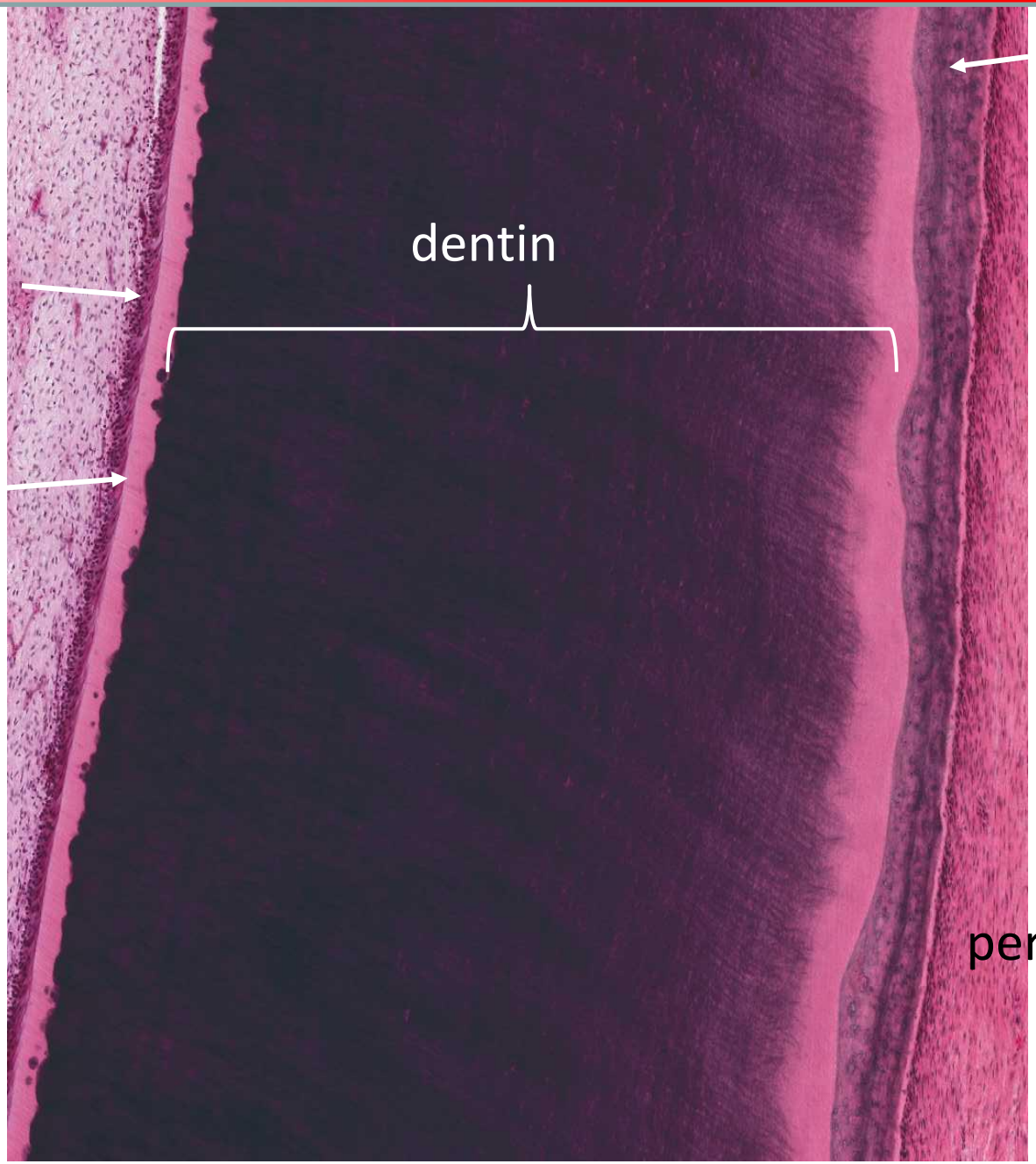


TOOTH - DENTIN

pulp

odontoblasts

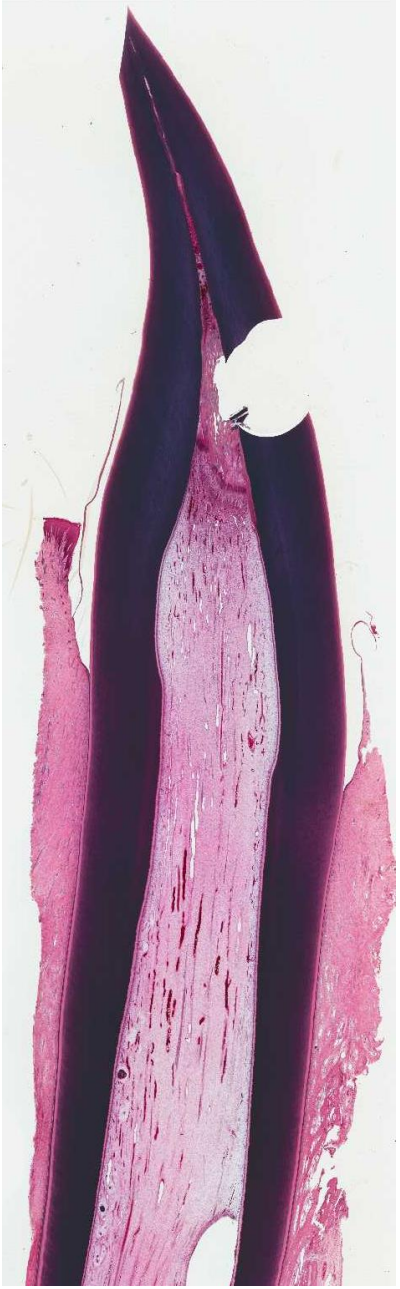
predentin

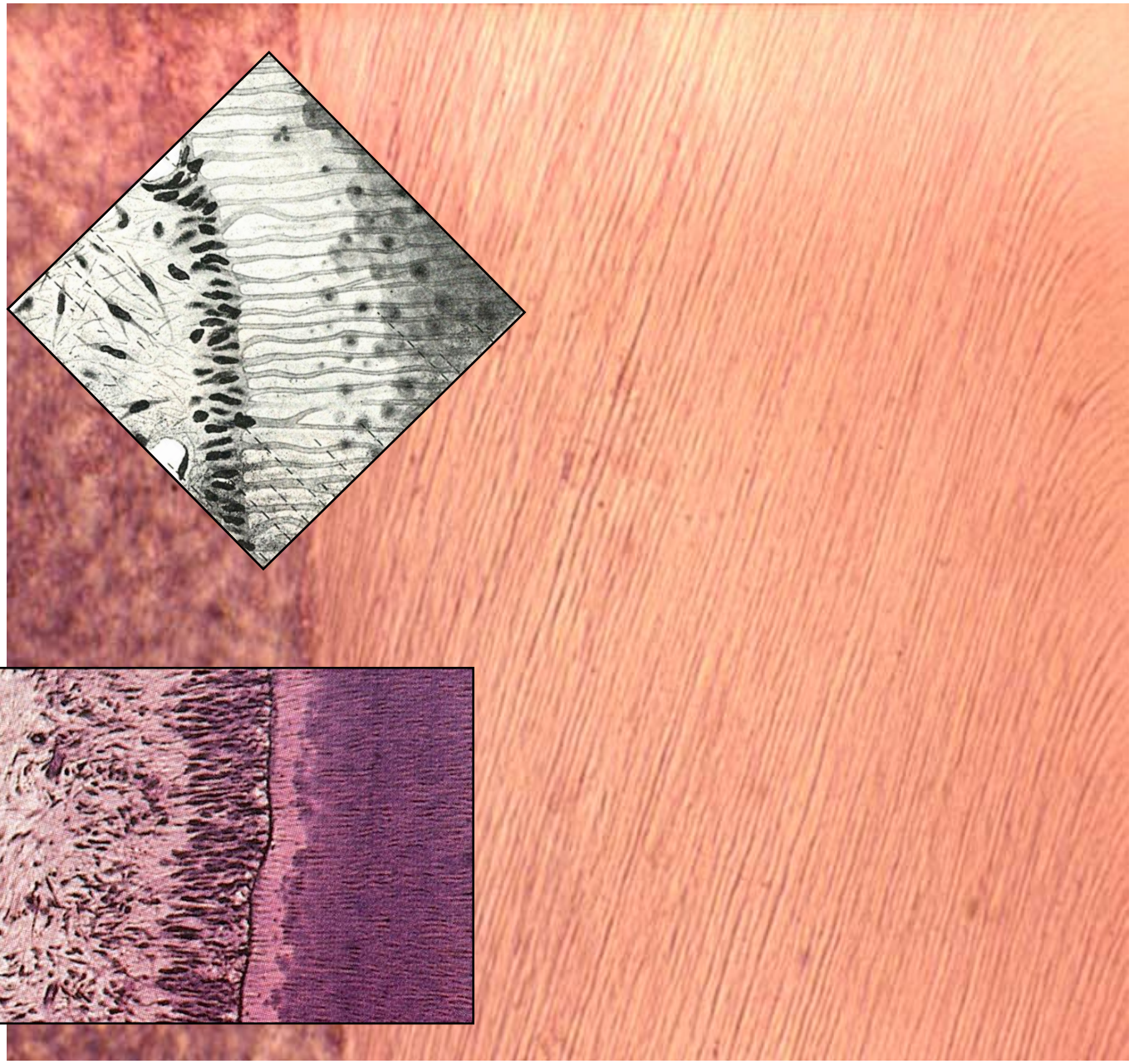


cementum

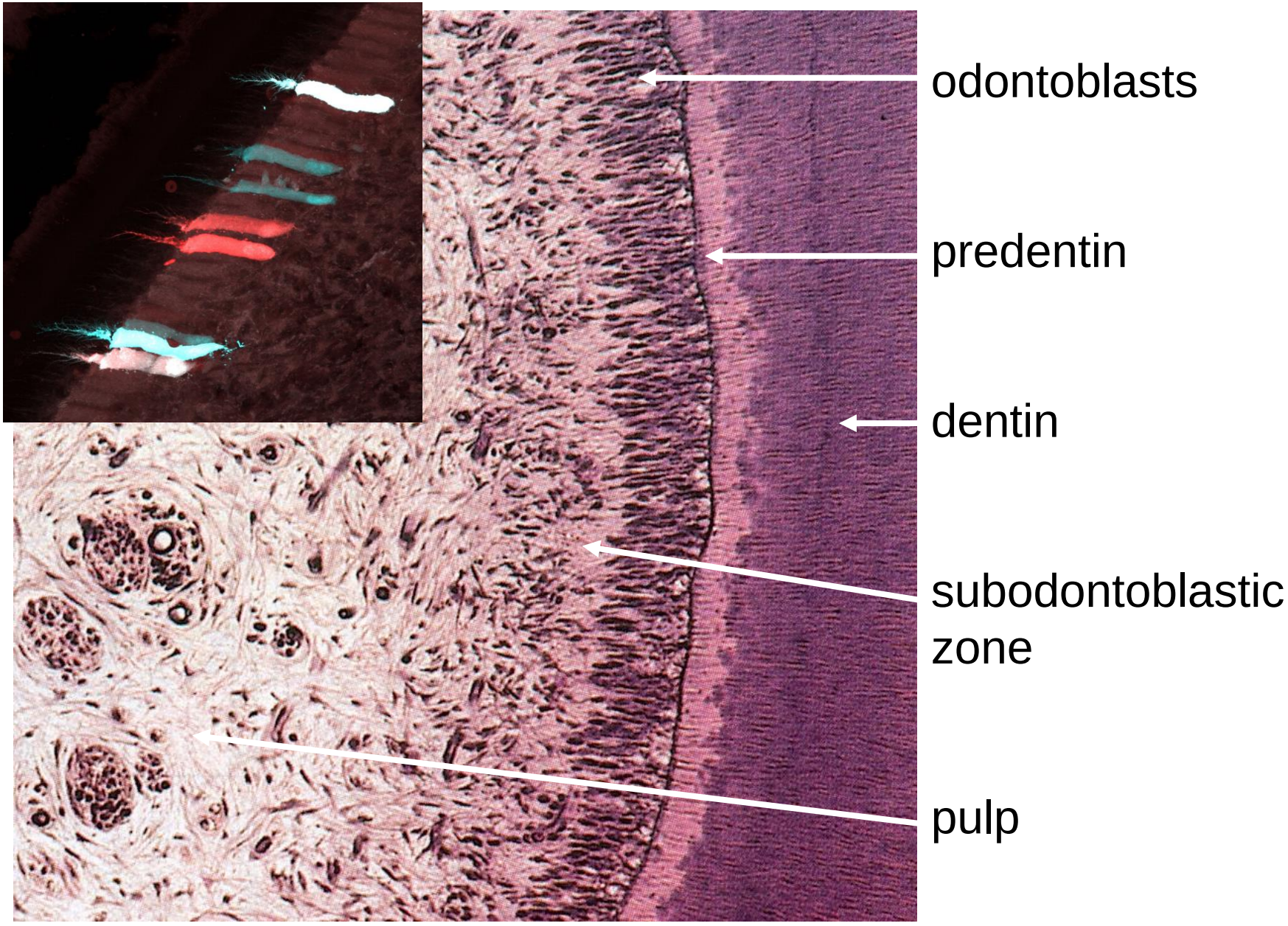
periodontium

TOOTH - ODONTOBLASTS

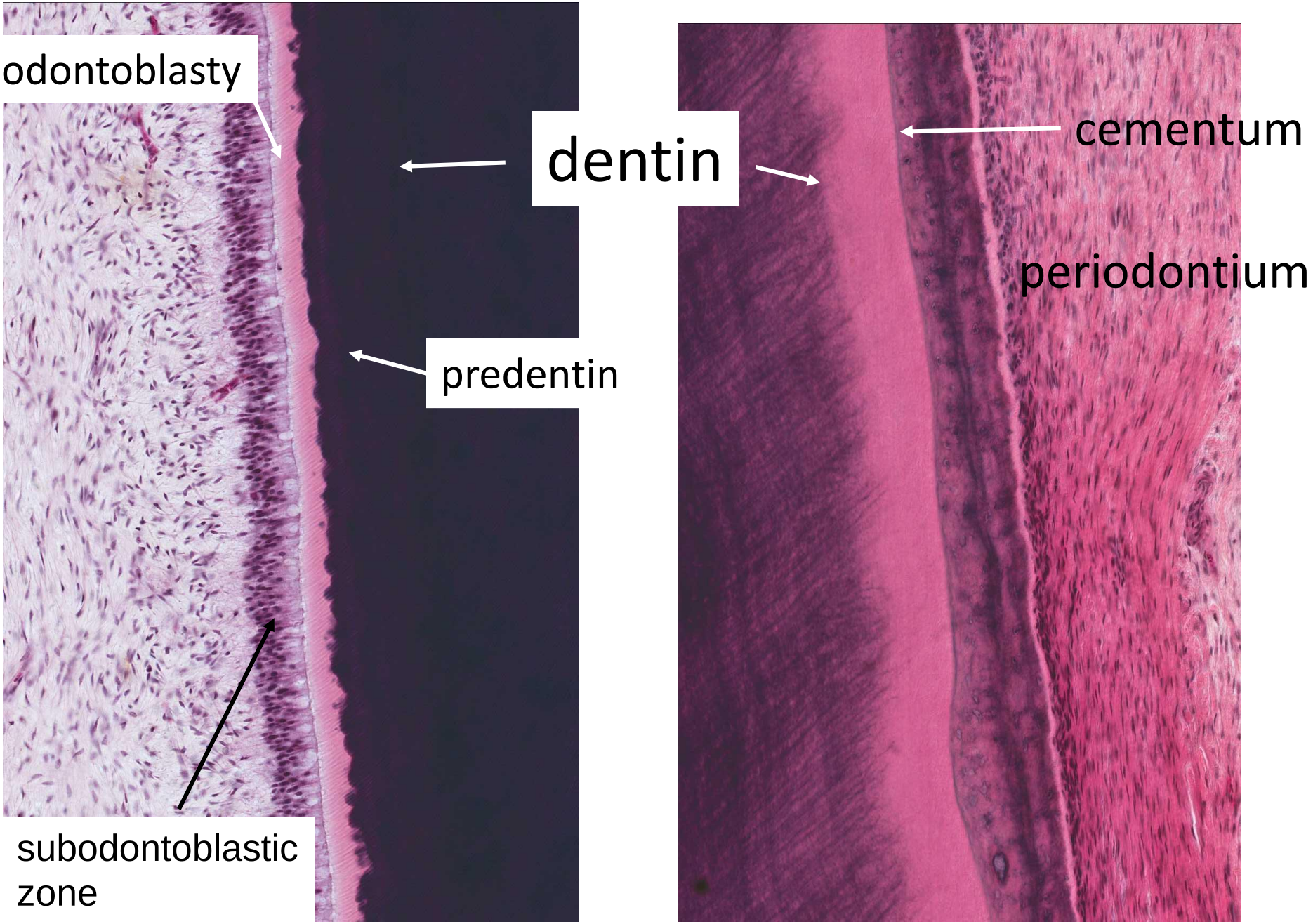




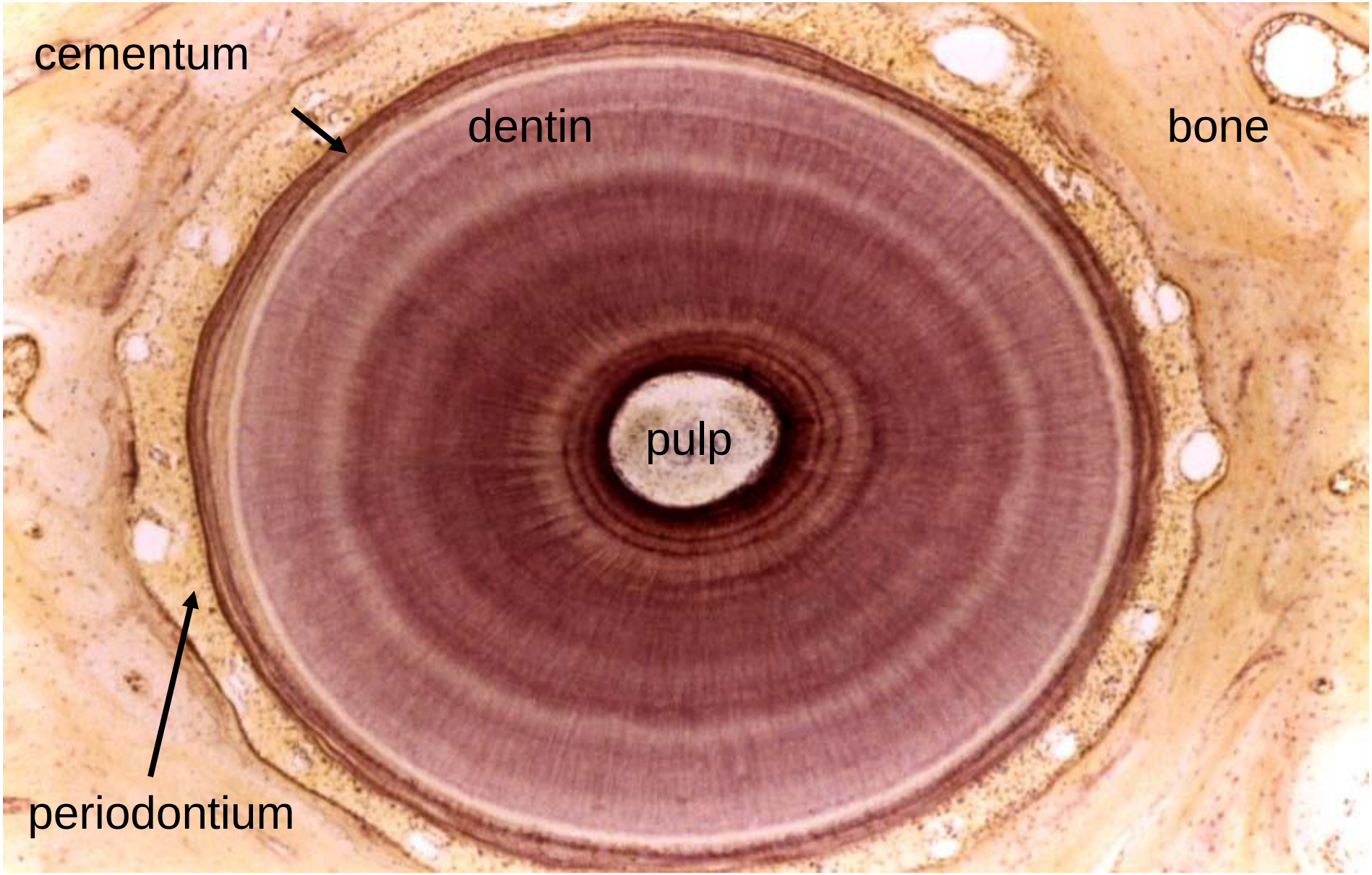
TOOTH - ODONTOBLASTS



TOOTH

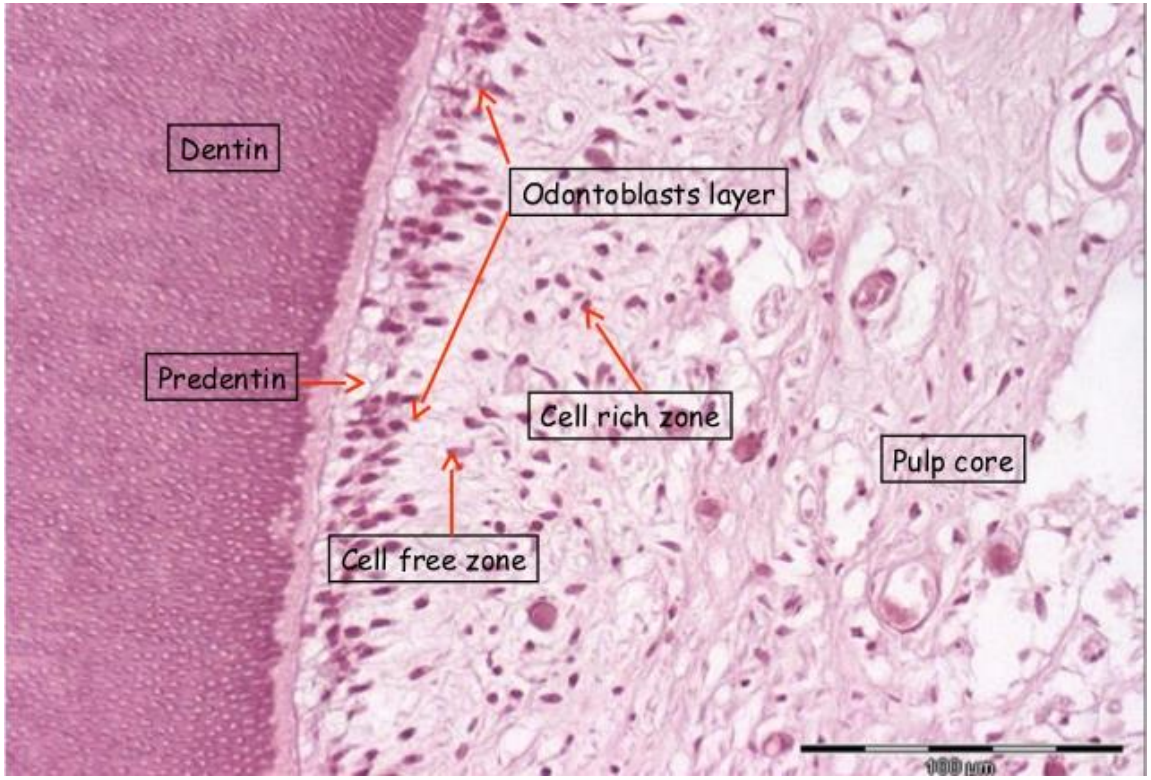

odontoblasty
dentin
predentin
subodontoblastic zone
cementum
periodontium

TOOTH



TOOTH - PULP

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

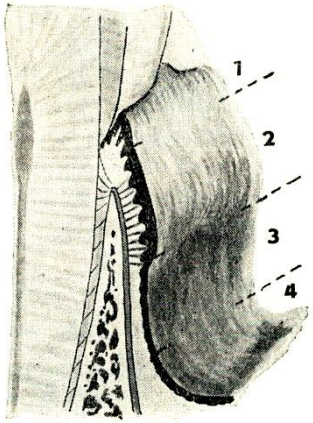


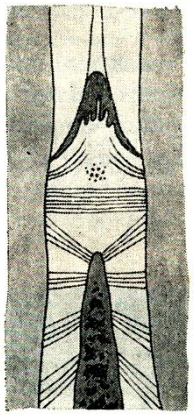
https://www.slideshare.net/hesham63/pulp-15597098

Gingiva

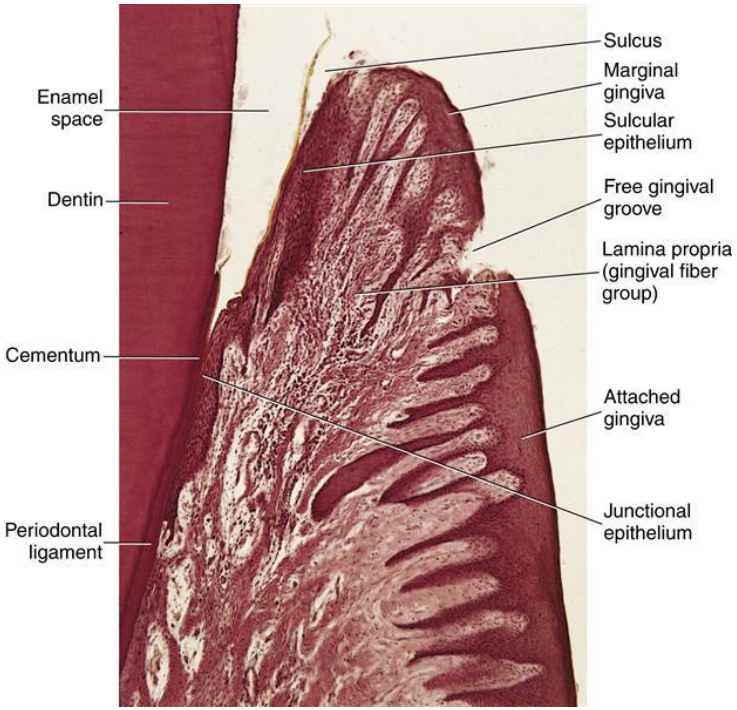
- free (marginal, g. libera)
- attached (g. affixa)
- paramarginal groove (outer gingival groove)
- sulcus gingivalis
- gingivodental junction of Gotlieb

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

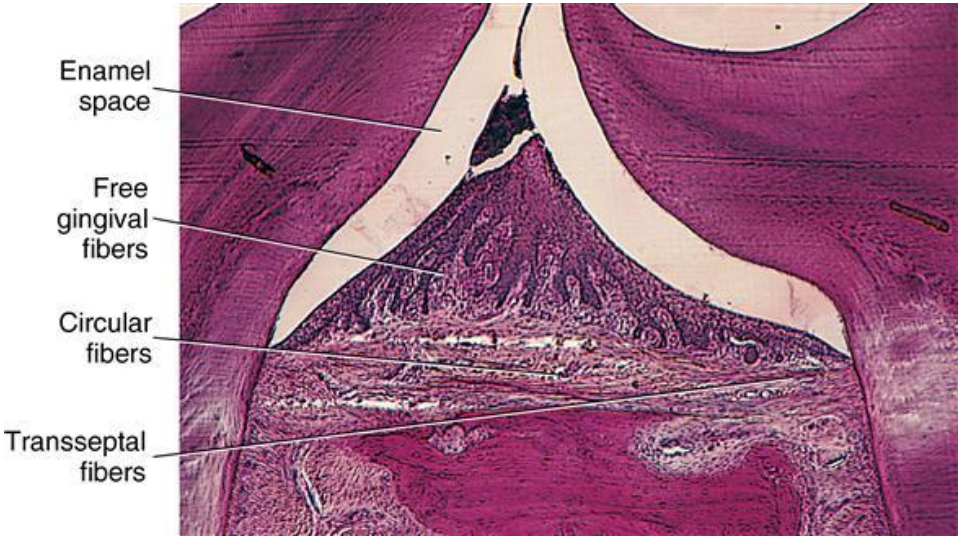


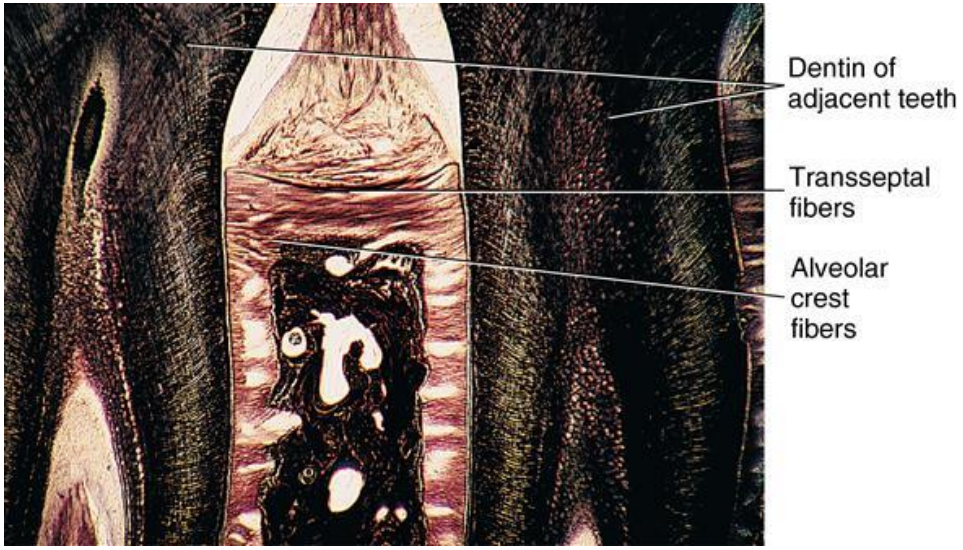


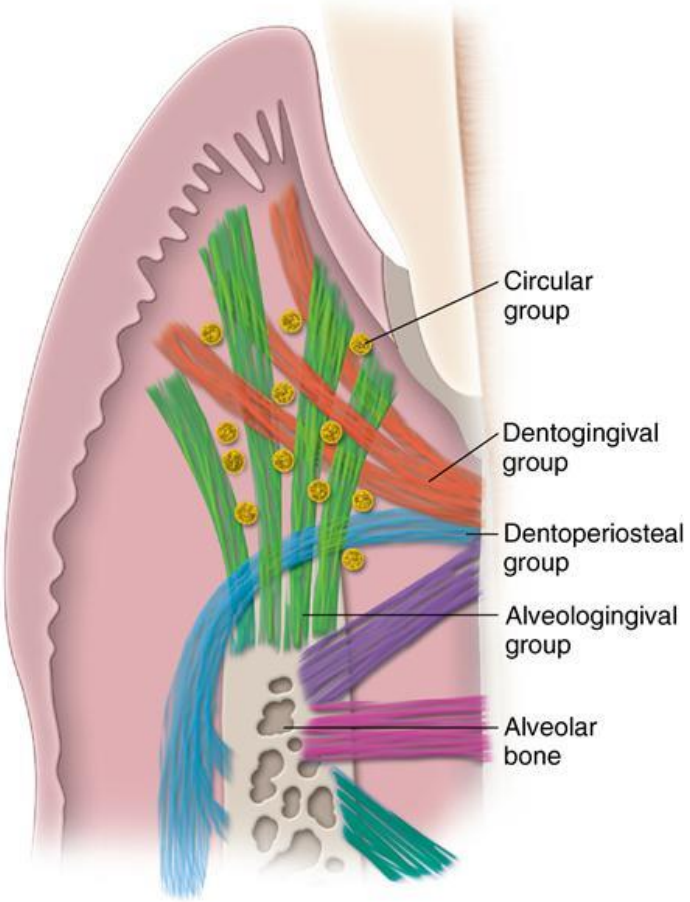
Obr. 8. Schéma gingivy. 1 — volná gingiva, 2 — připojená gingiva, 3 — alveolární sliznice, 4 — vestibulární sliznice



TOOTH – PERIODONTIUM AND GINGIVA

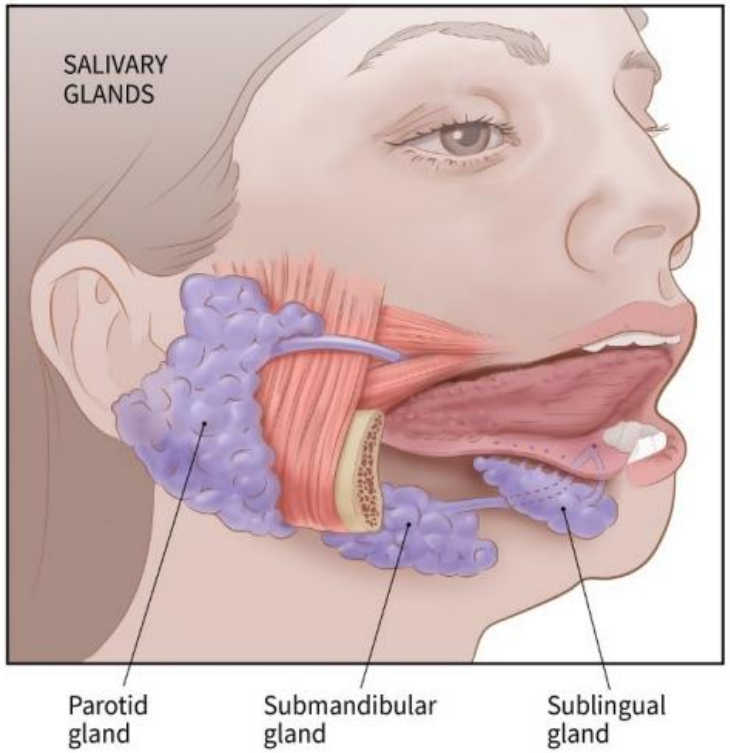






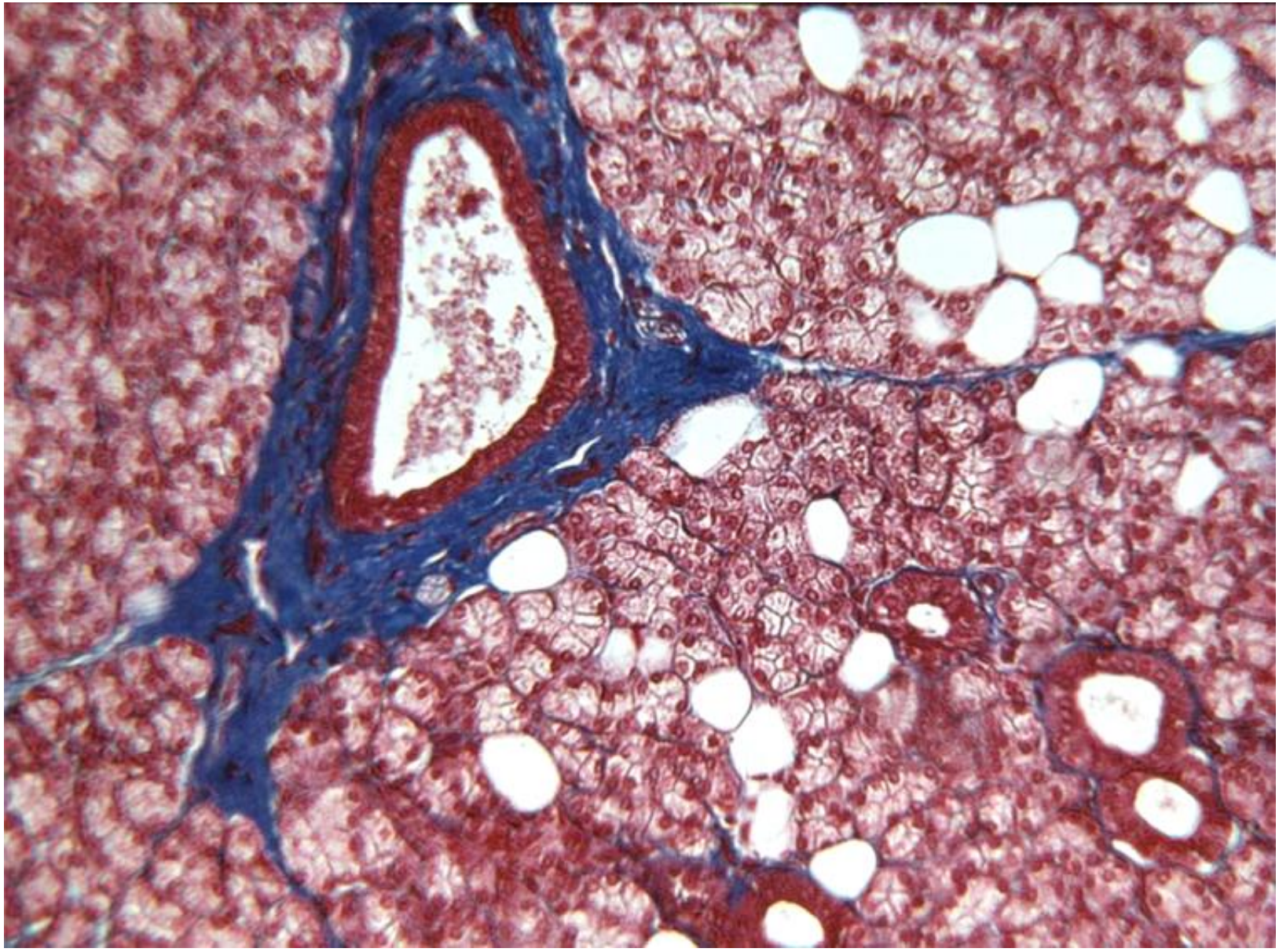
SALIVARY GLANDS

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

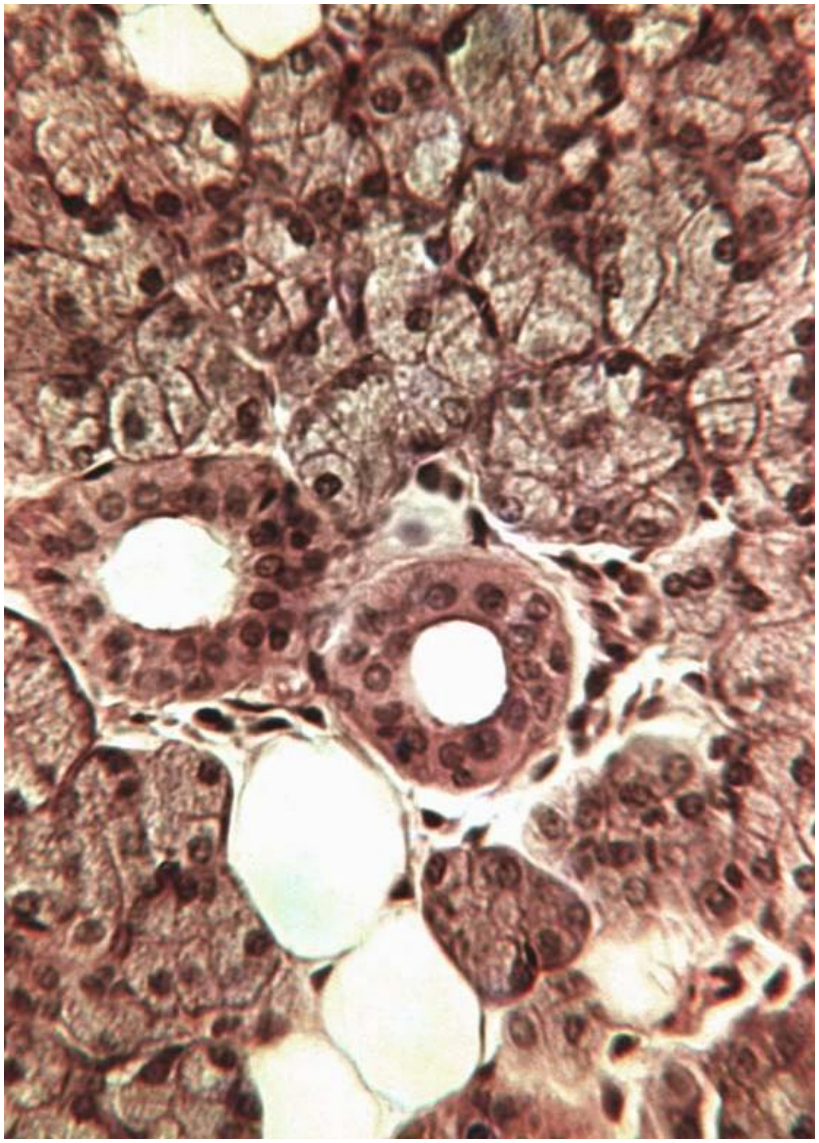


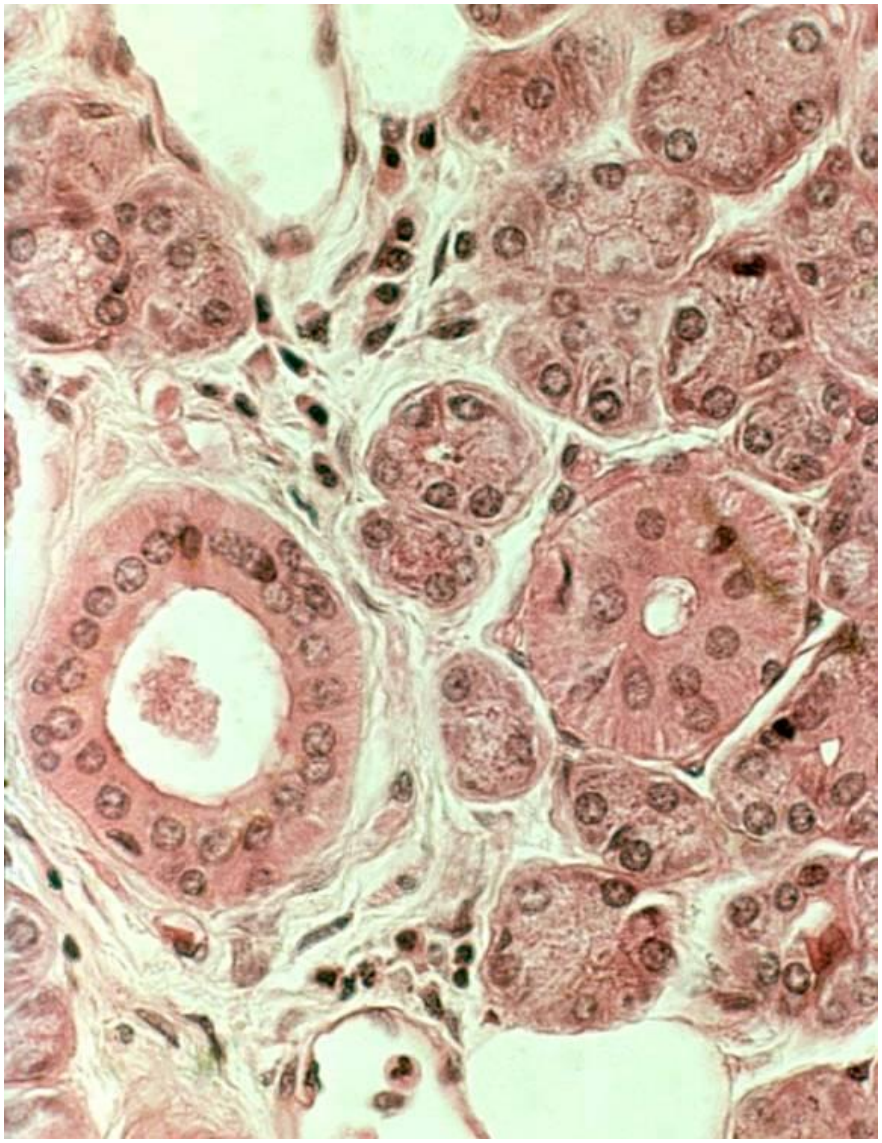
see GIT 3

SALIVARY GLANDS – GL. PAROTIS

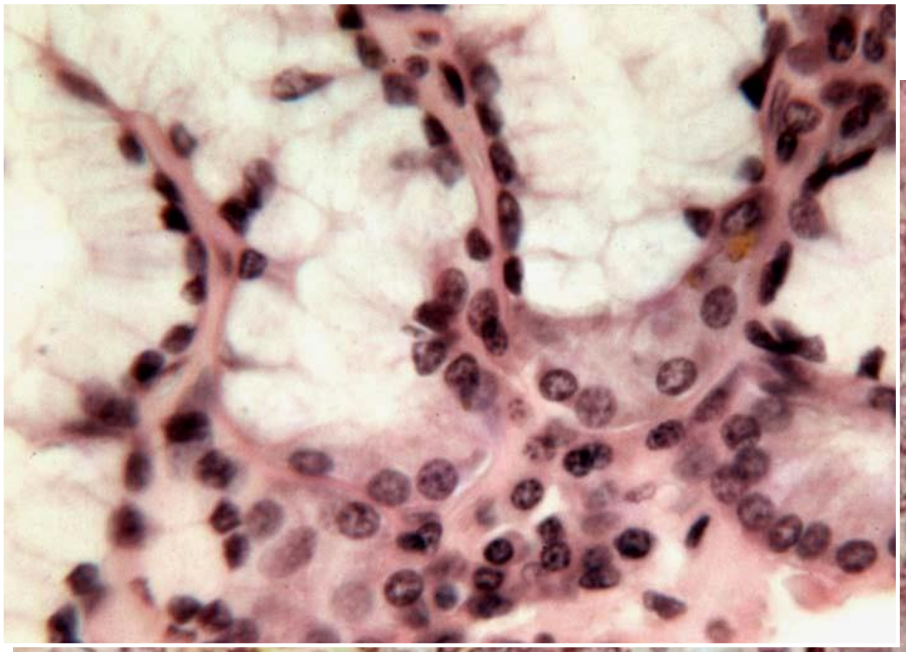


SALIVARY GLANDS – GL. PAROTIS

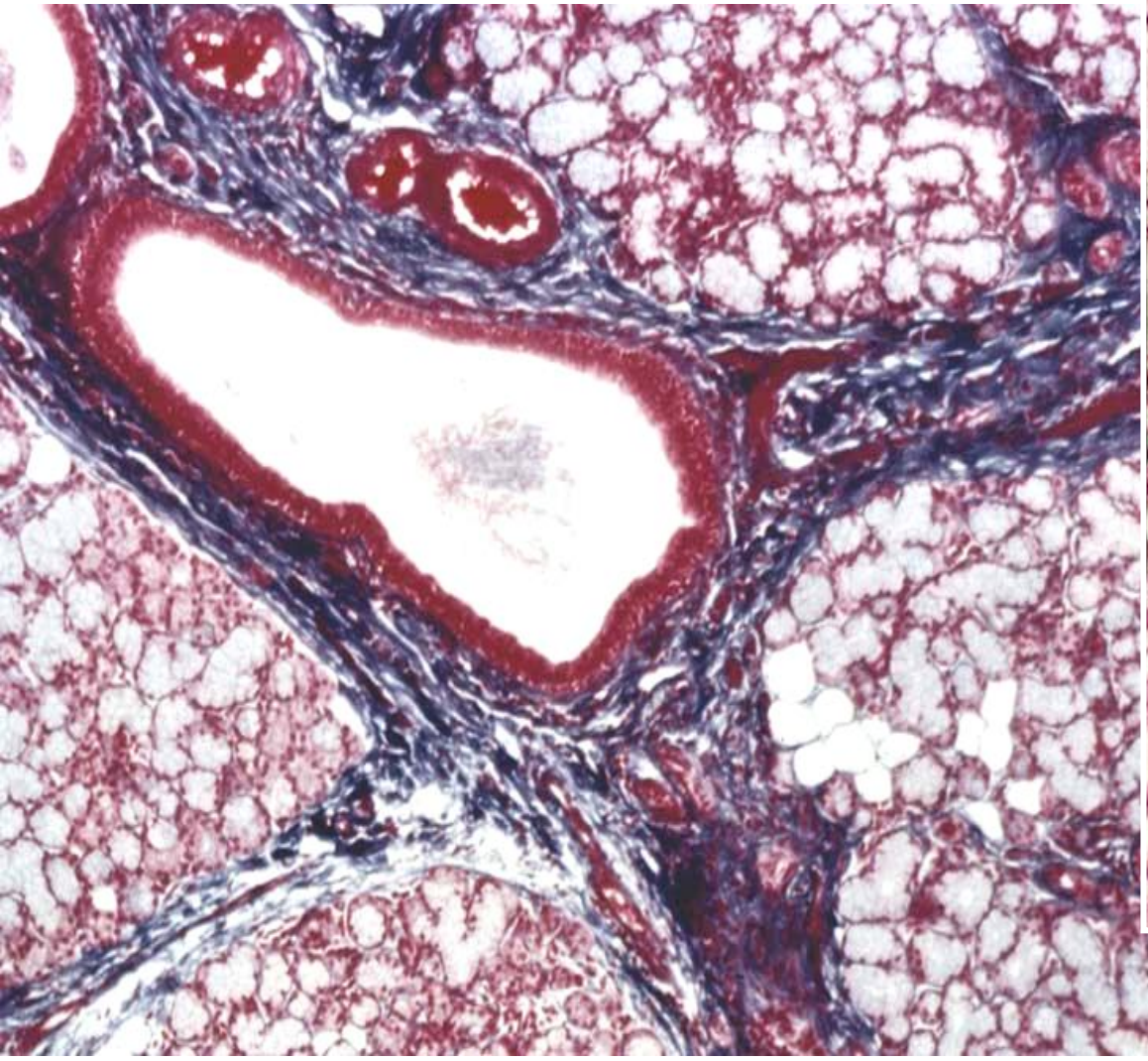


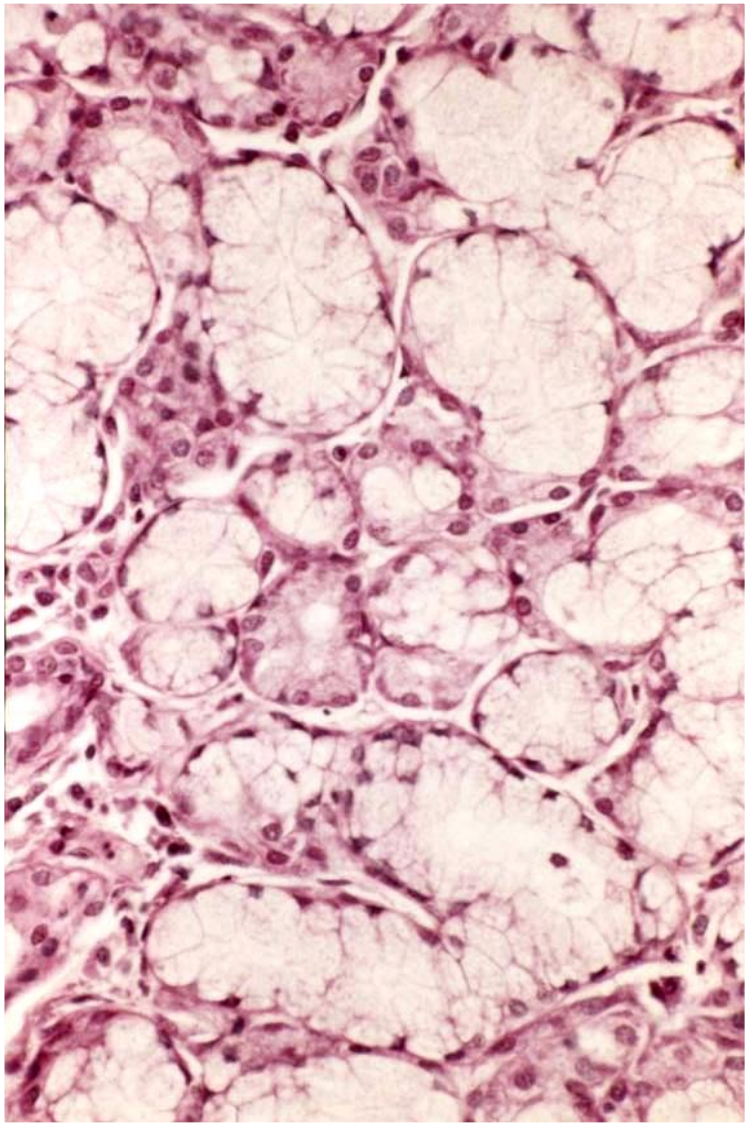


SALIVARY GLANDS – GL. SUBMANDIBULARIS

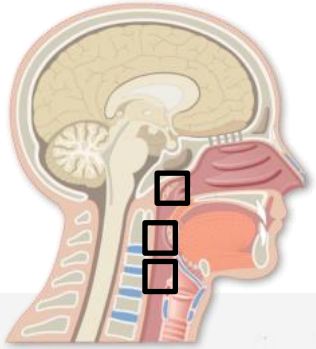


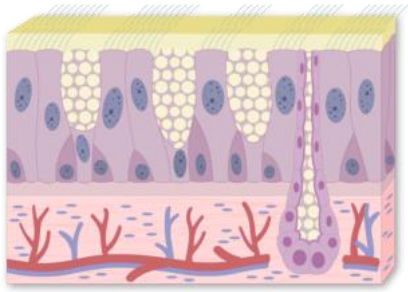
SALIVARY GLANDS – GL. SUBLINGUALIS





PHARYNX



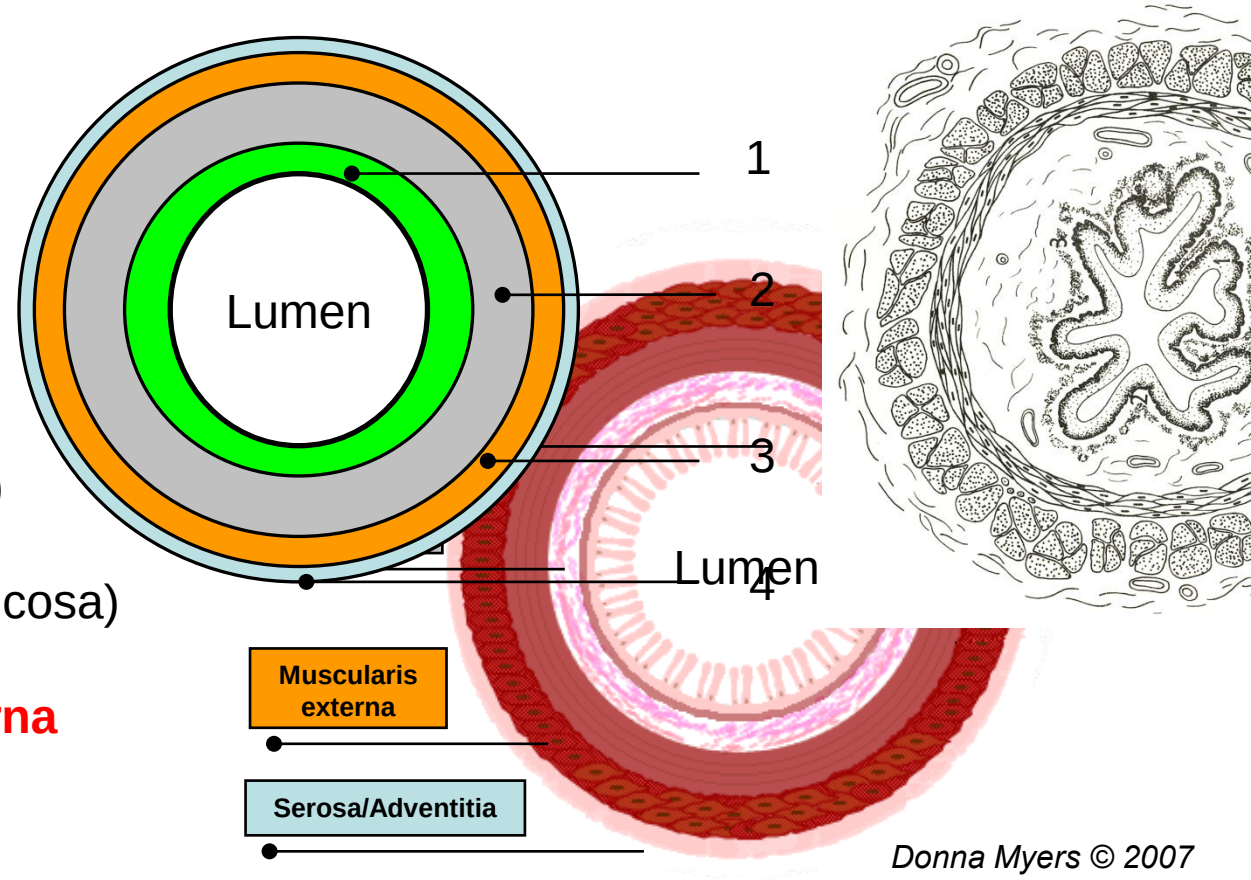


- nasopharynx
- oropharynx
- laryngopharynx

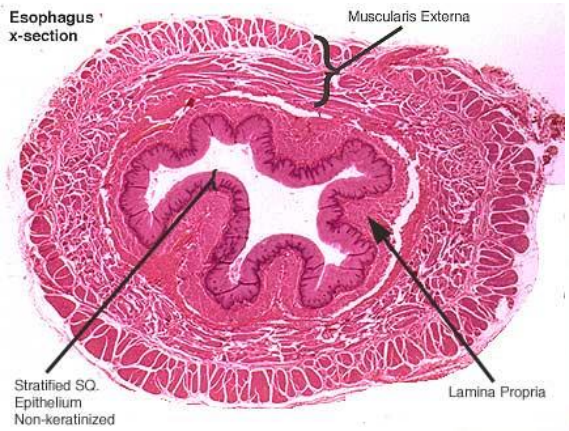
GENERAL ARCHITECTURE OF HOLLOW ORGANS

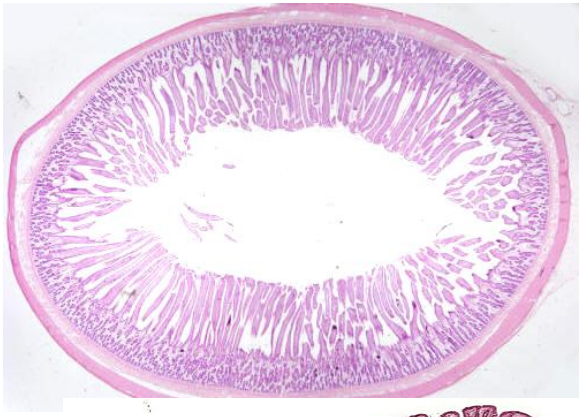
Four layers

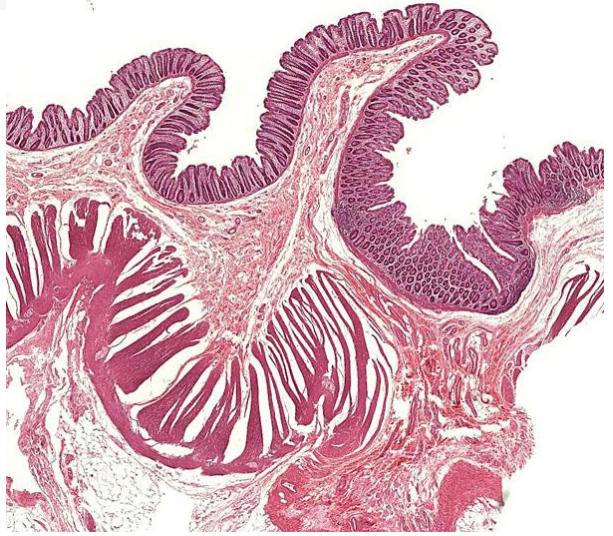
1. **Mucosa** (Tunica mucosa)
2. **Submucosa** (Tela submucosa)
3. **Tunica muscularis externa**
4. **Serosa/adventitia**

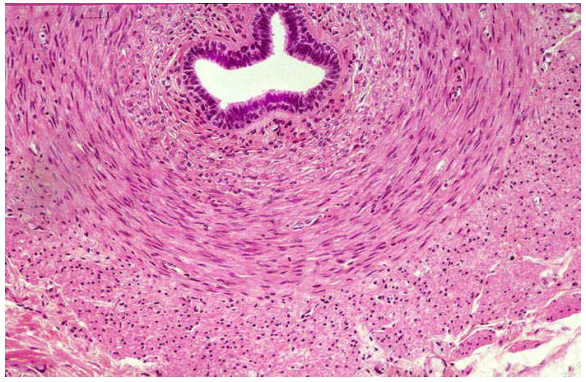


GENERAL ARCHITECTURE OF HOLLOW ORGANS

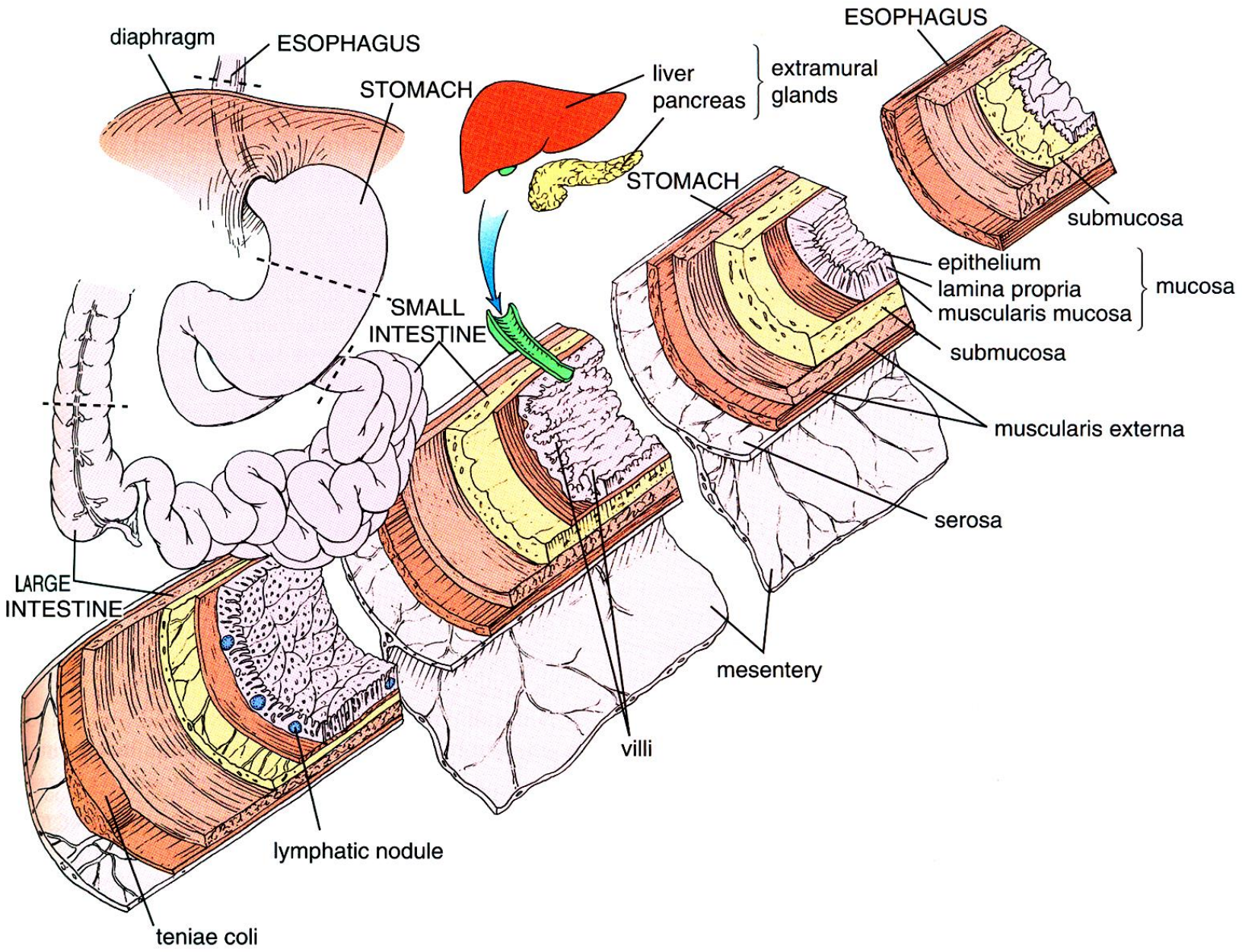








GENERAL ARCHITECTURE OF HOLLOW ORGANS

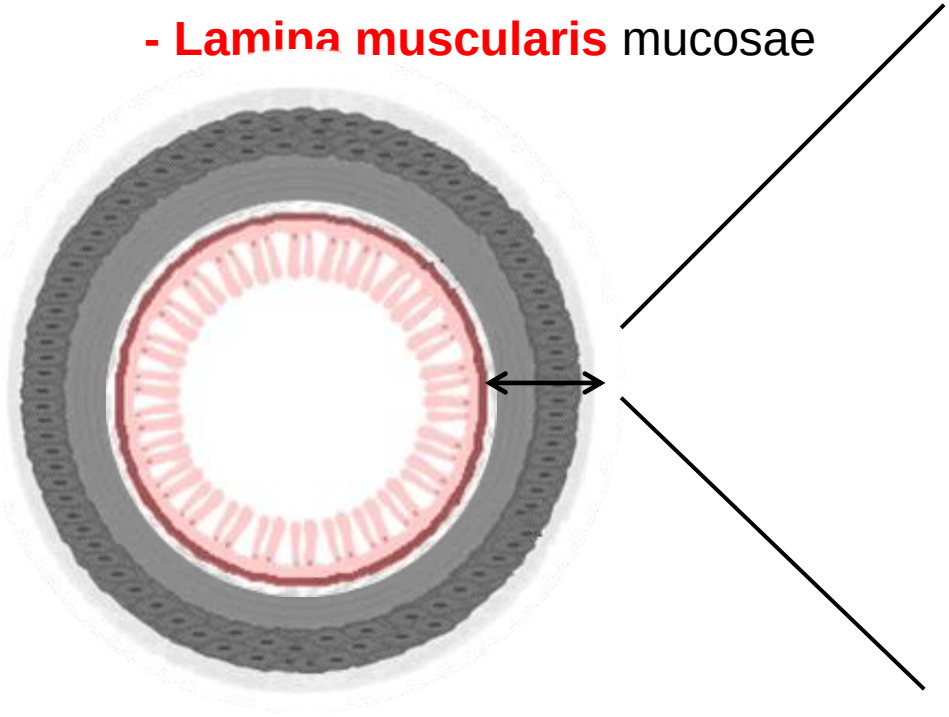


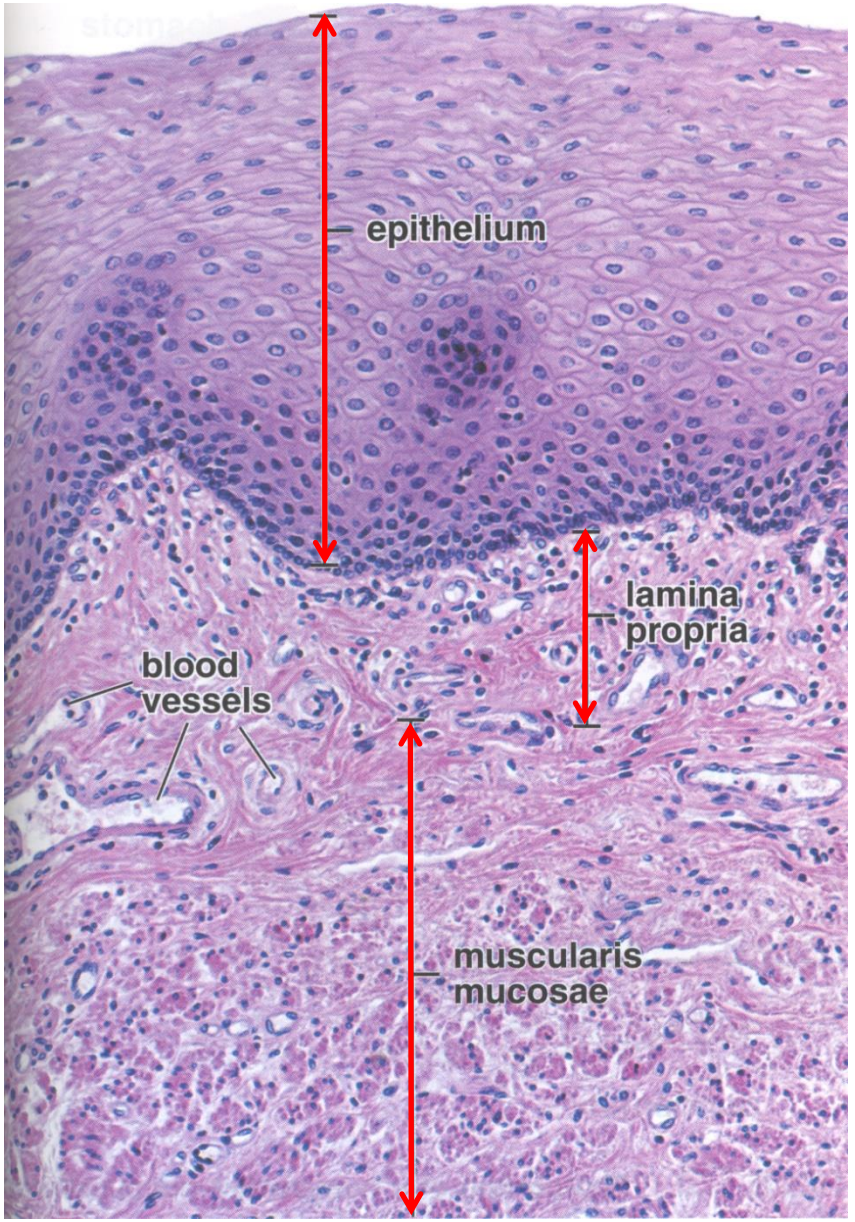
GENERAL ARCHITECTURE OF HOLLOW ORGANS

Mucosa (Tunica mucosa)

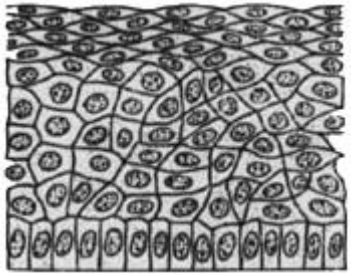
- inner layer of gut tube
- protective, absorption and resorption
- microscopic structure depends on localization

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



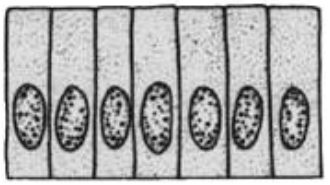


Mucosa (Tunica mucosa)



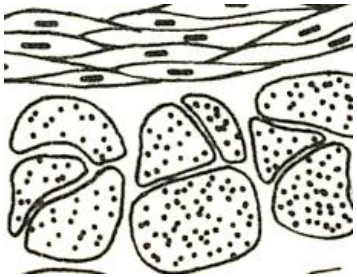
- **Lamina epithelialis** mucosae

- 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

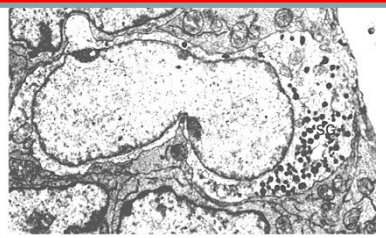
- Layer of mucosal connective tissue – loose collagen
- Fenestrated blood capillaries – transport of metabolite (intestine)
- mucosal glands in some regions /esophagus)
- innervations, immune system



- **Lamina muscularis** mucosae

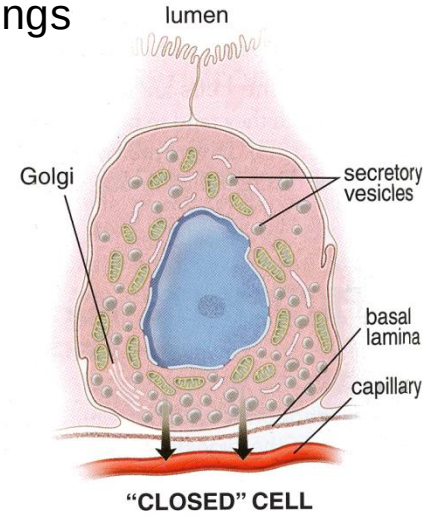
- smooth muscles in two layers (inner circular, outer longitudinal)
- small mechanical movements of mucosa facilitating secretion and absorption independently on peristaltic movements.

MICROSCOPIC ANATOMY OF GIT



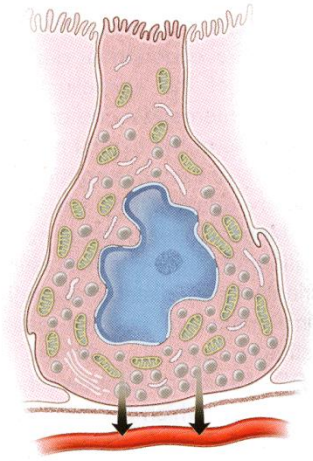
(entero)endocrine

- minor, secretion
- granules
- different cell types with different sensitivity to various histological stainings
- secretion of various biologically active compounds
- DNES/APUD
- GIT chemosensing
- see spring semester lesson - Epithelial tissue



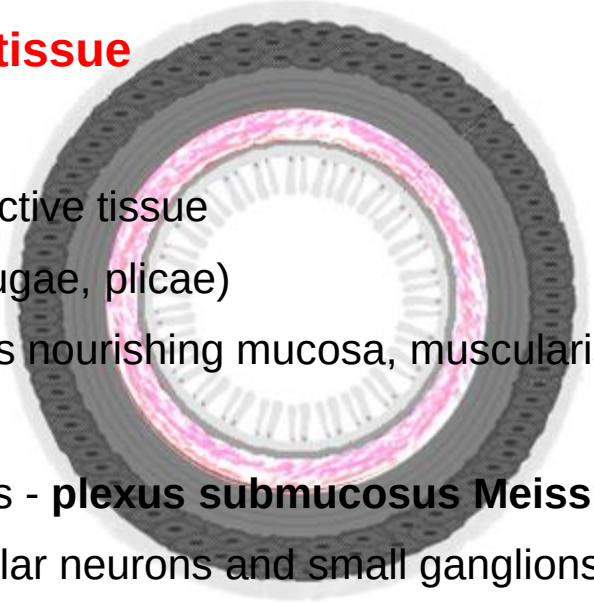
"CLOSED" CELL

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



"OPEN" CELL

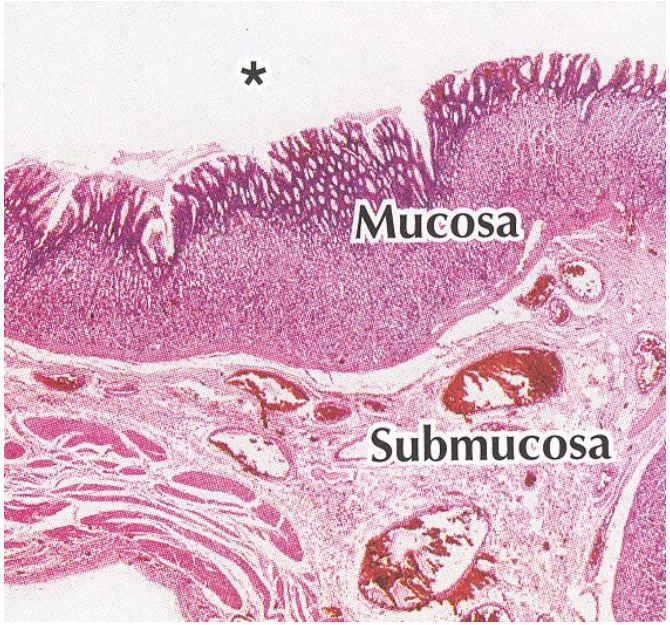
Submucosa (Tela submucosa)



Submucose connective tissue

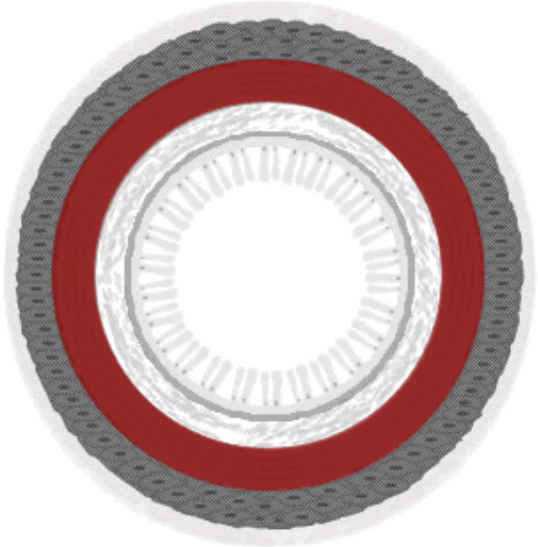
- distinct layer of loose connective tissue
- defines shape of mucosa (rugae, plicae)
- larger blood and lymph veins nourishing mucosa, muscularis externa and serosa
- **innervations** – nerve plexus - **plexus submucosus Meissn**
  = groups of multipolar neurons and small ganglions, visceral sensory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

- glands – different in different regions
  - protective function

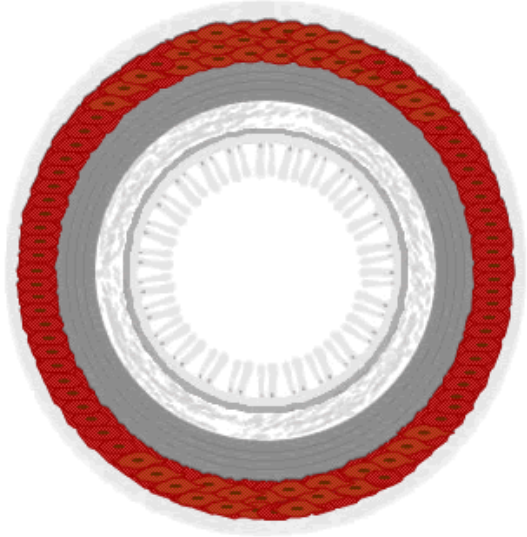


Outer muscular layers (Tunica muscularis externa)

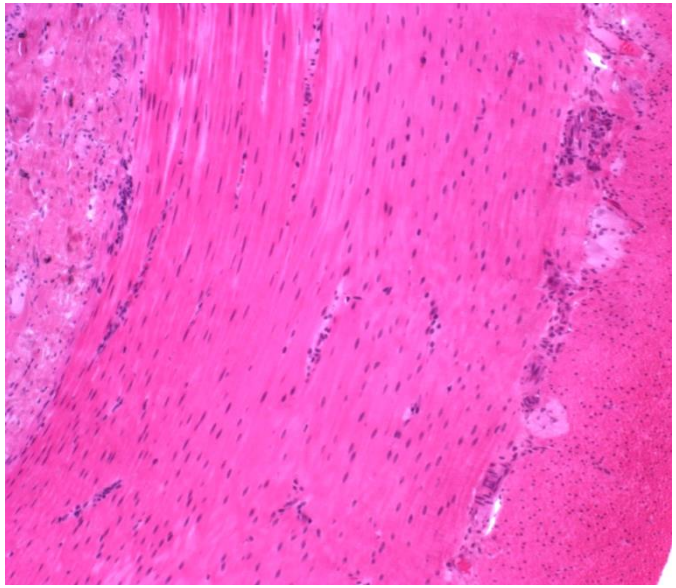
- Two concentric, thick layers of smooth muscle, separated by thin layer of connective tissue
- Inner – **circular**, outer – **longitudinal** (spiral)
- Myenteric (Auerbach) plexus
- Peristaltic – passage through the gut tube
- **Local modifications of m.e**.
    - internal anal sphincter
    - stomach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



Circular



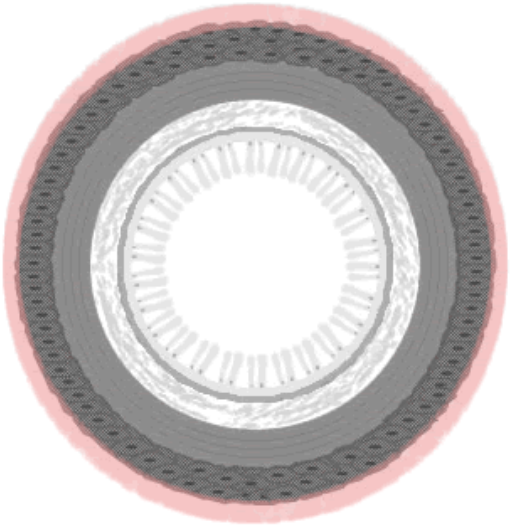
Longitudinal



Serosa/Adventitia (Tunica serosa/adventitia)

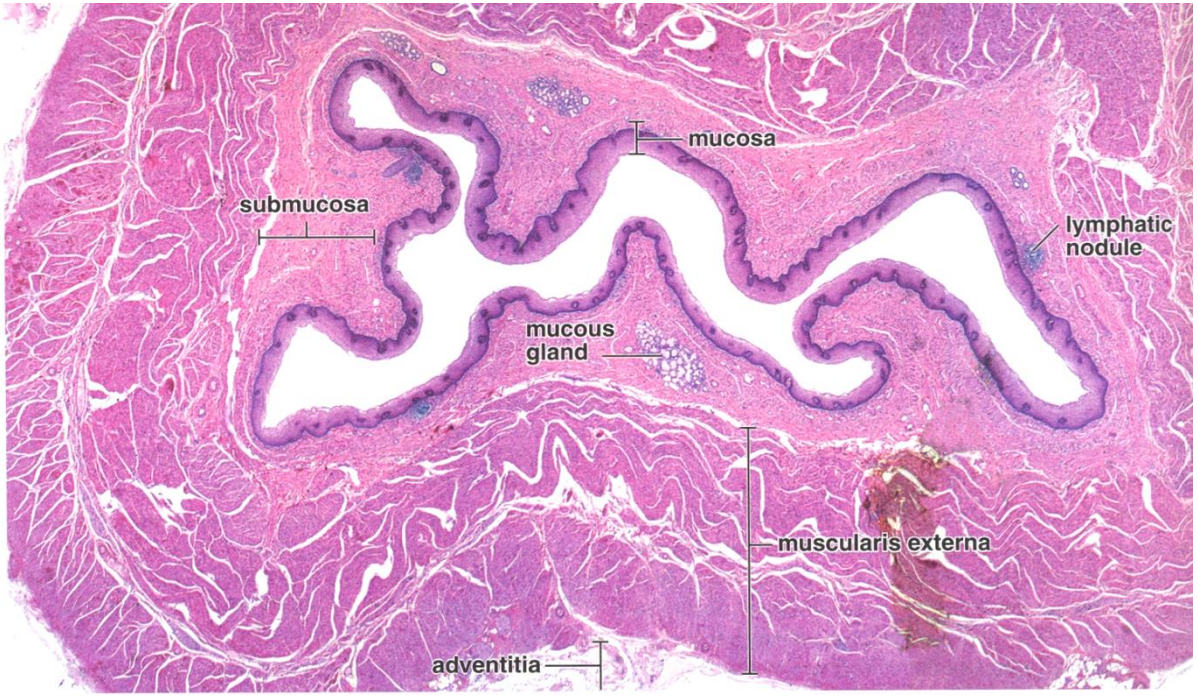
- outermost layer of gut tube
- **Serosa**
  - serous membrane of loose connective tissue (Lamina propria serosae) and single layer squamous epithelium (L. epithelialis serosae)
  - syn. mesothelium, visceral peritoneum
  - continuous with mesenterium
  - barrier against various pathogens , antiadhesive 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 ir walls (duodenum, part of colon, rectum, anal canal)
  - connective tissue only continuous with connective tissue of the walls



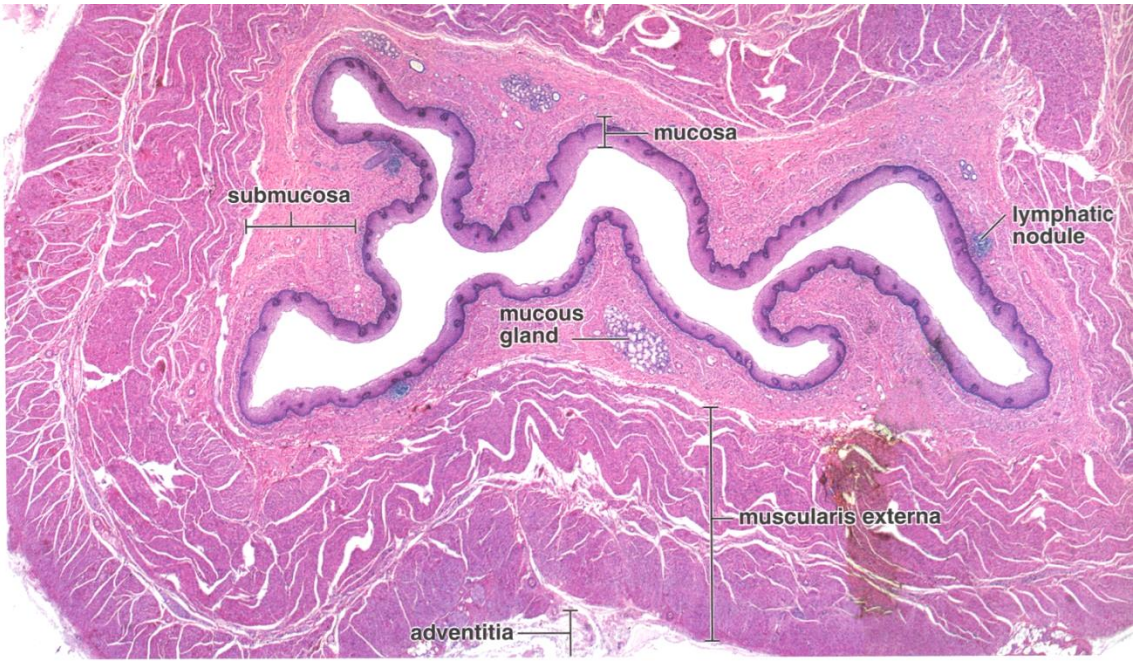
Esophagus (Oesophagus)

- **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
  - diffuse lymphatic tissue



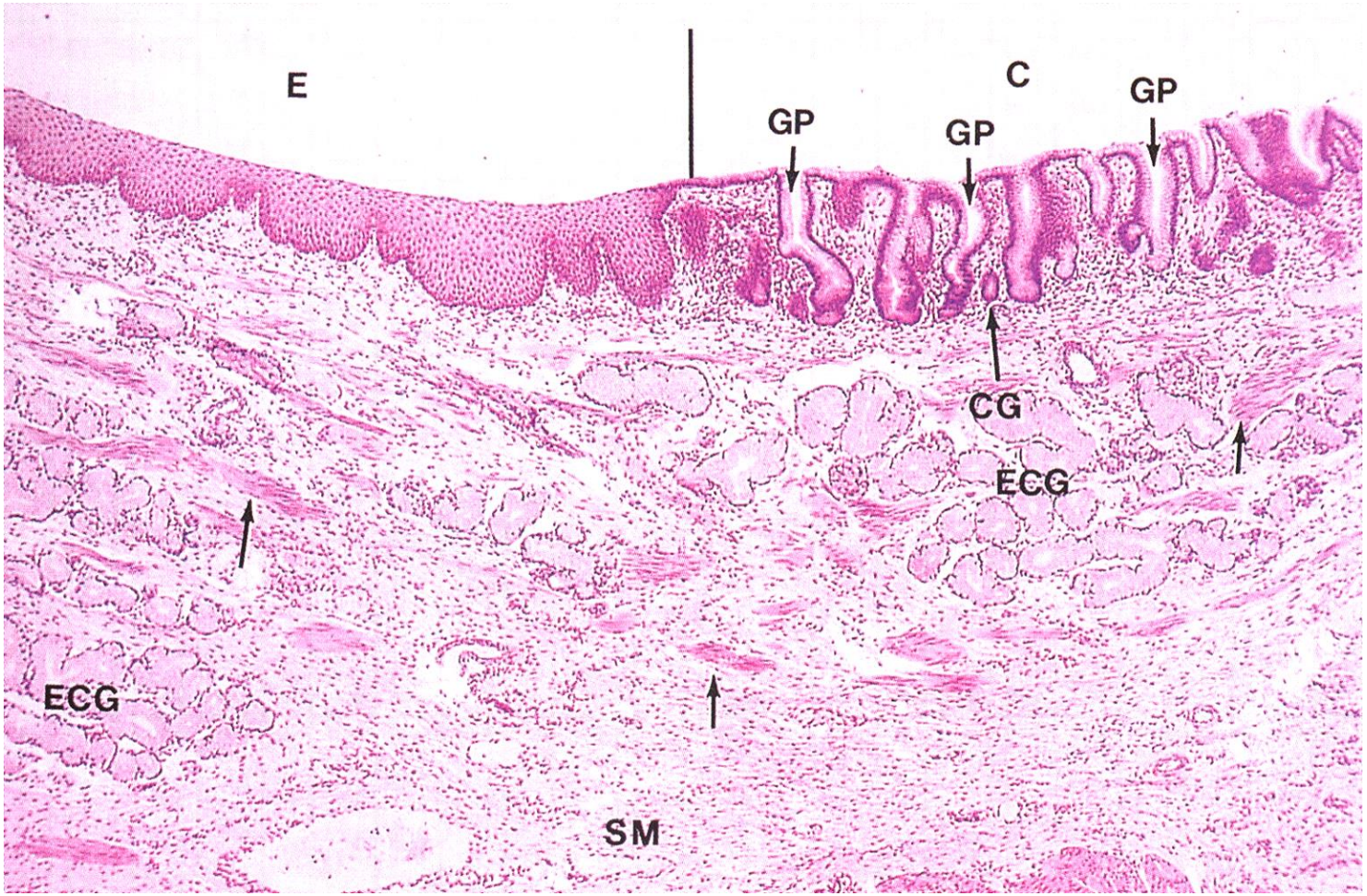
Esophagus (Oesophagus)

- **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



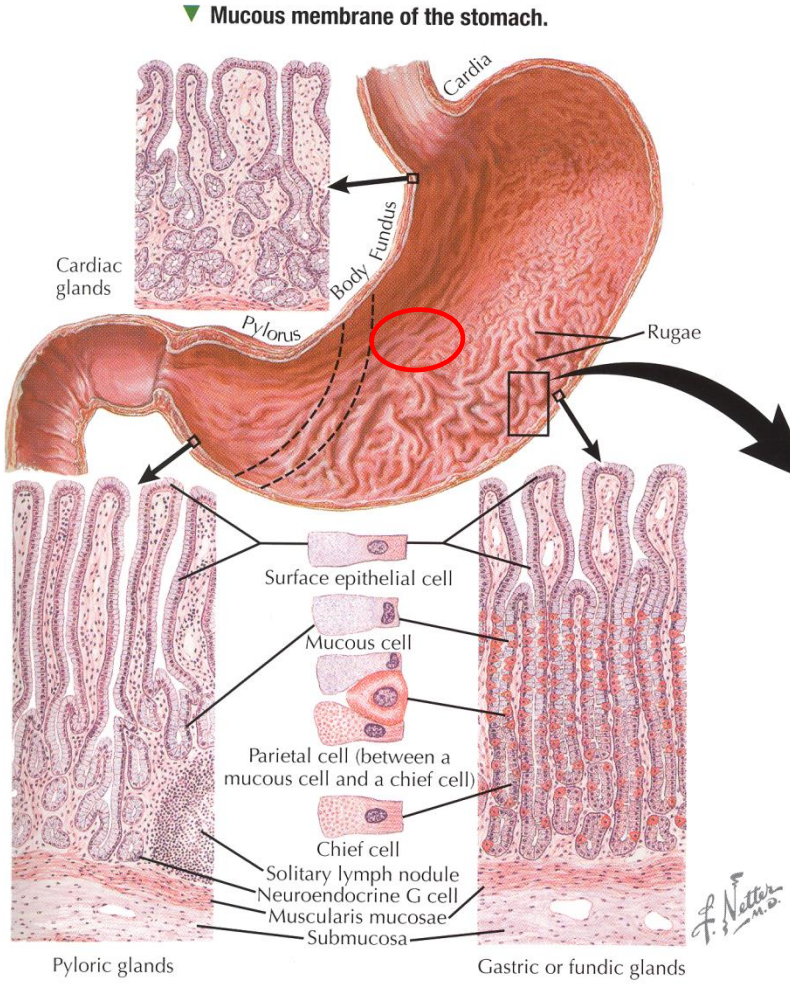
Cardia of stomach – connection with esophagus

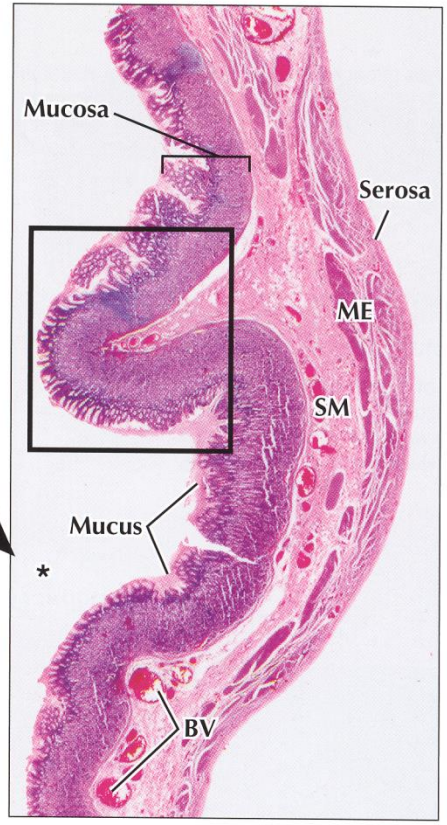
Nonkeratinized stratified squamous epithelium → simple columnar epithelium



Stomach (Ventriculus, Gaster)

- general anatomy of hollow tube
- anatomical regions differ also in their histologic structure
- rugae gastricae (submucosa)
- areae gastricae
- foveolae gastricae





▲ **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.*

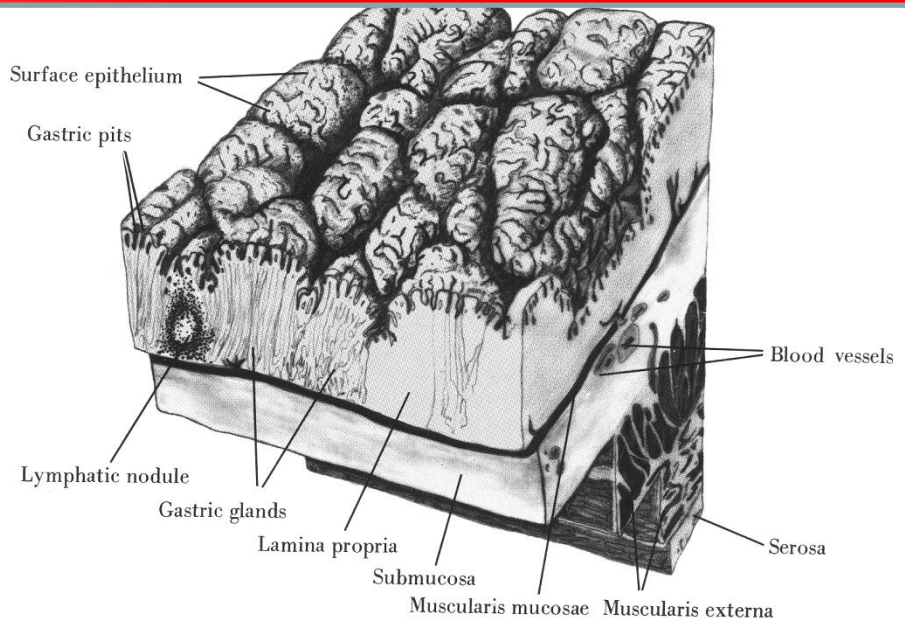
MICROSCOPIC ANATOMY OF GIT

- **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)

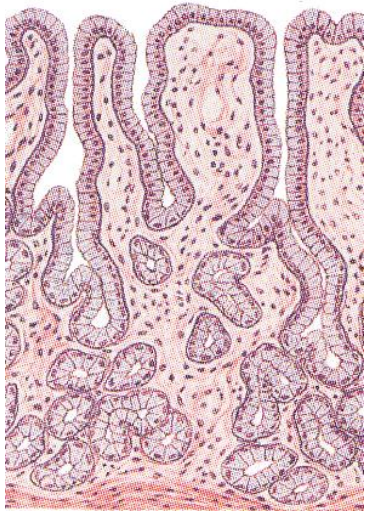
- **Gastric mucosa**

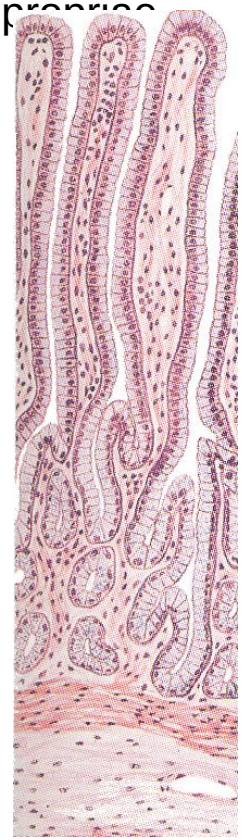
- L. propria contains large amount of g

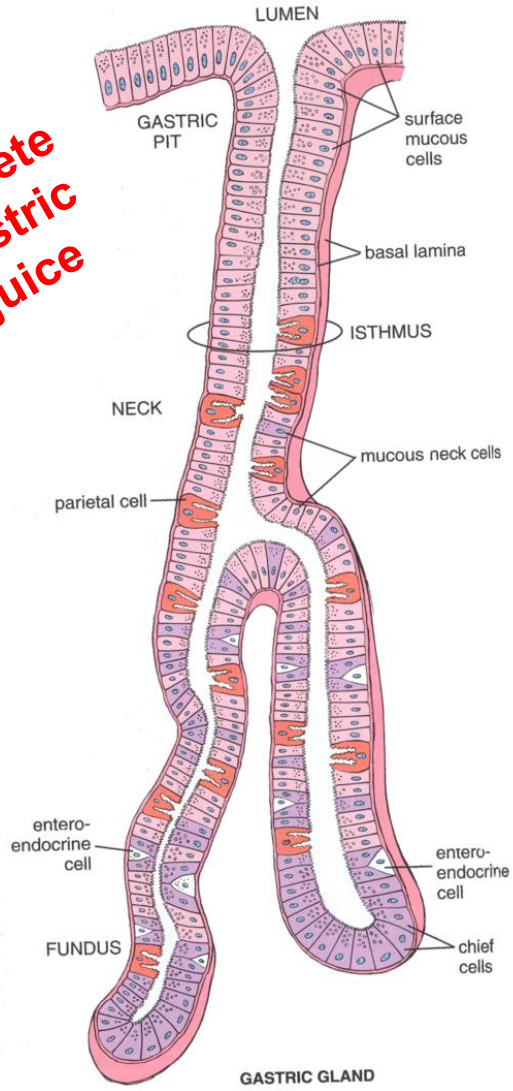
  - Gl. cardiacae
  - Gl. pyloricae
  - Gl. gastricae proprie

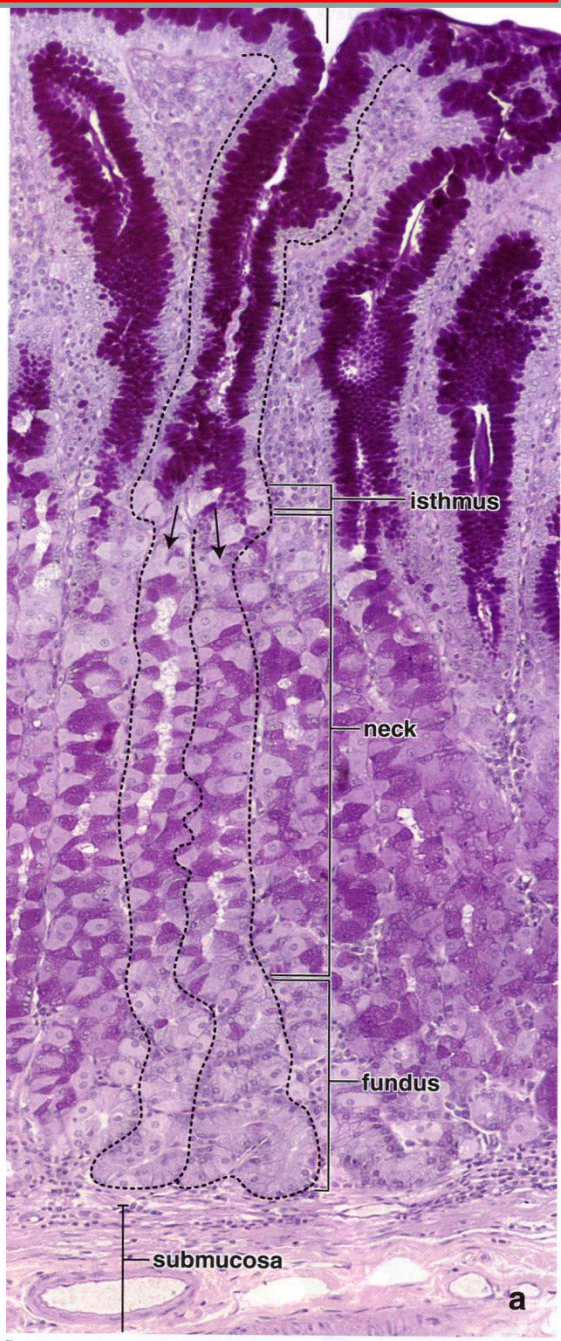
Mucous

Secrete gastric juice







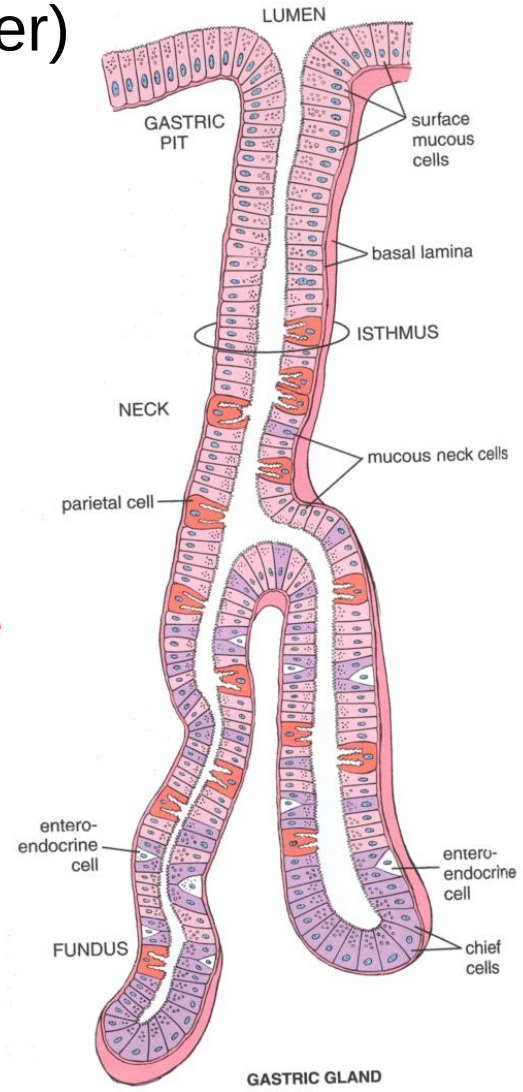


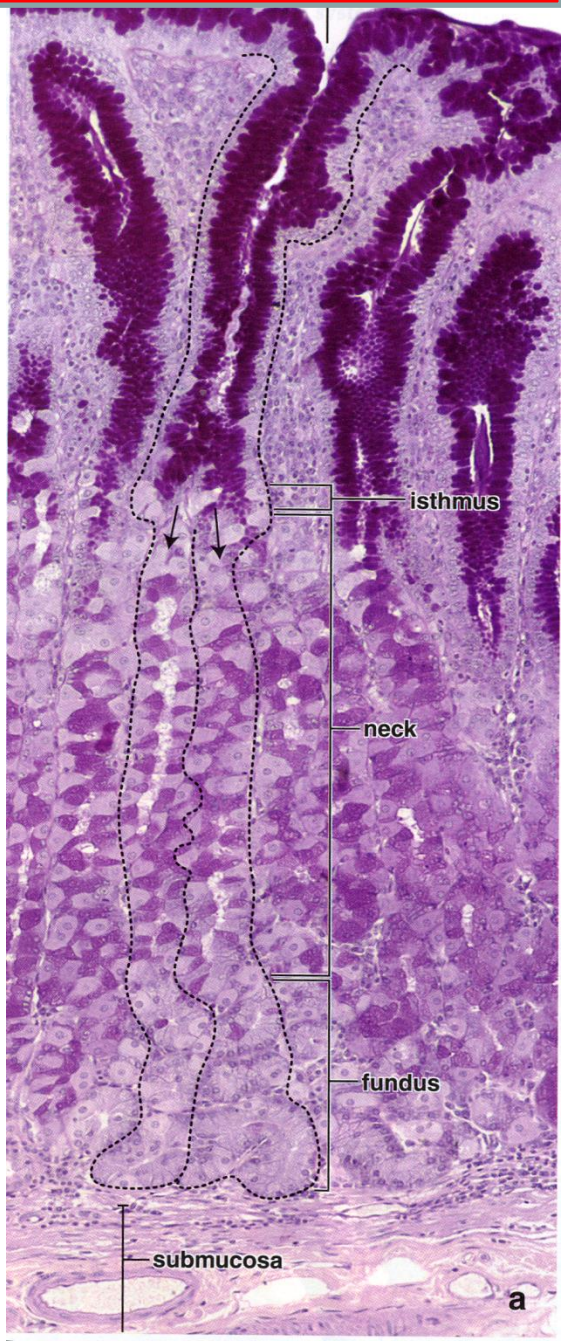
MICROSCOPIC ANATOMY OF GIT

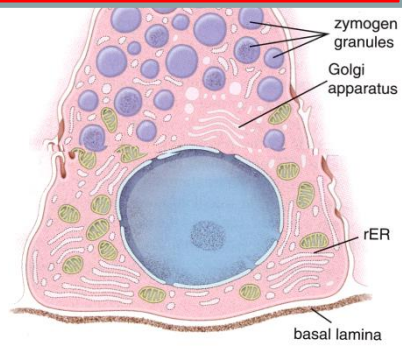
Stomach (Ventriculus, Gaster)

- **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**





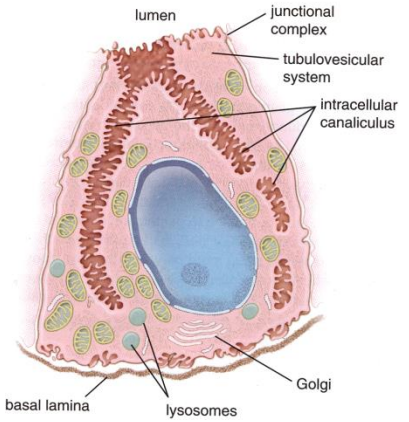


Stomach(Ventriculus, Gaster)

Gl. gastricae propriae

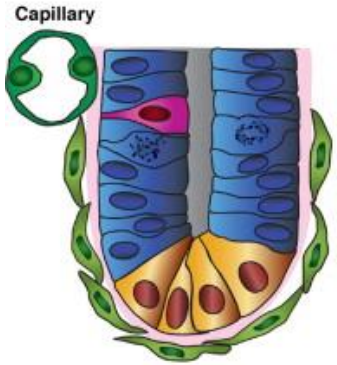
chief

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



parietal

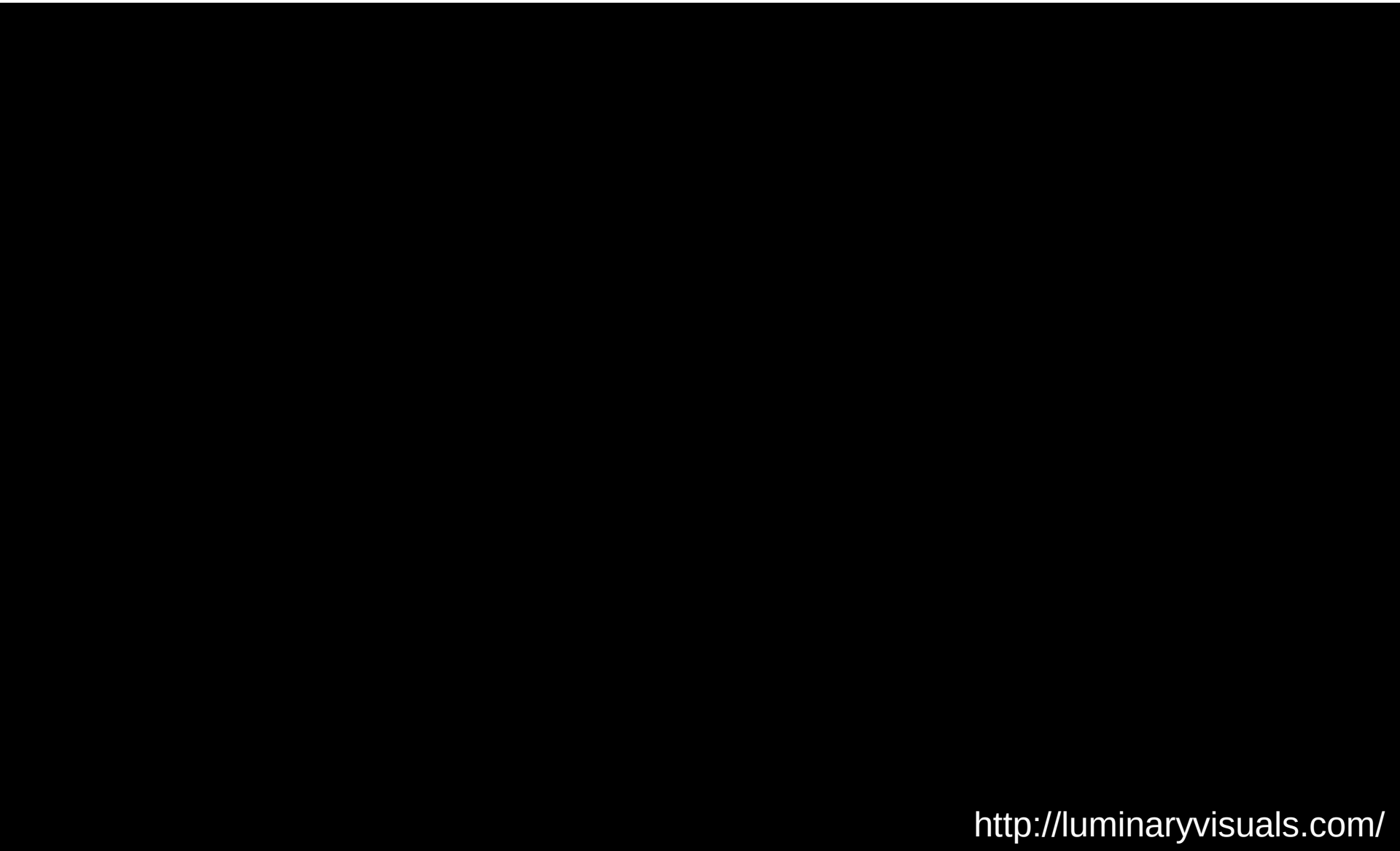
- neck-body junction
- eosinophilic cytoplasm, high numbers of mtch., SER
- complex and dynamic ultrastructure
- intracellular canals in apical part with microvilli – membrane bound enzyme complexes producing H^+ a Cl^- (<u>HCl originates extracelullarly</u>)



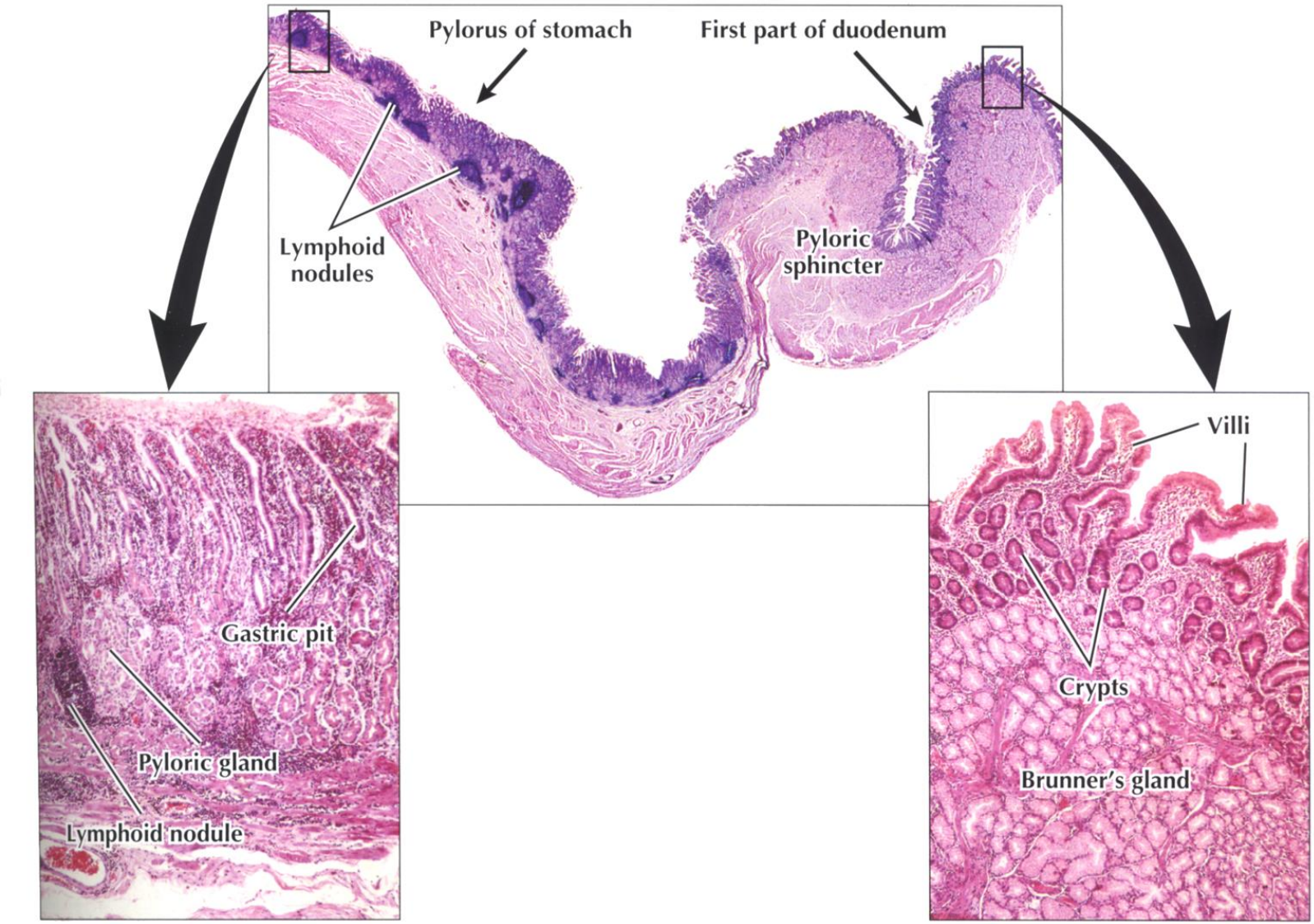
neck cells

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

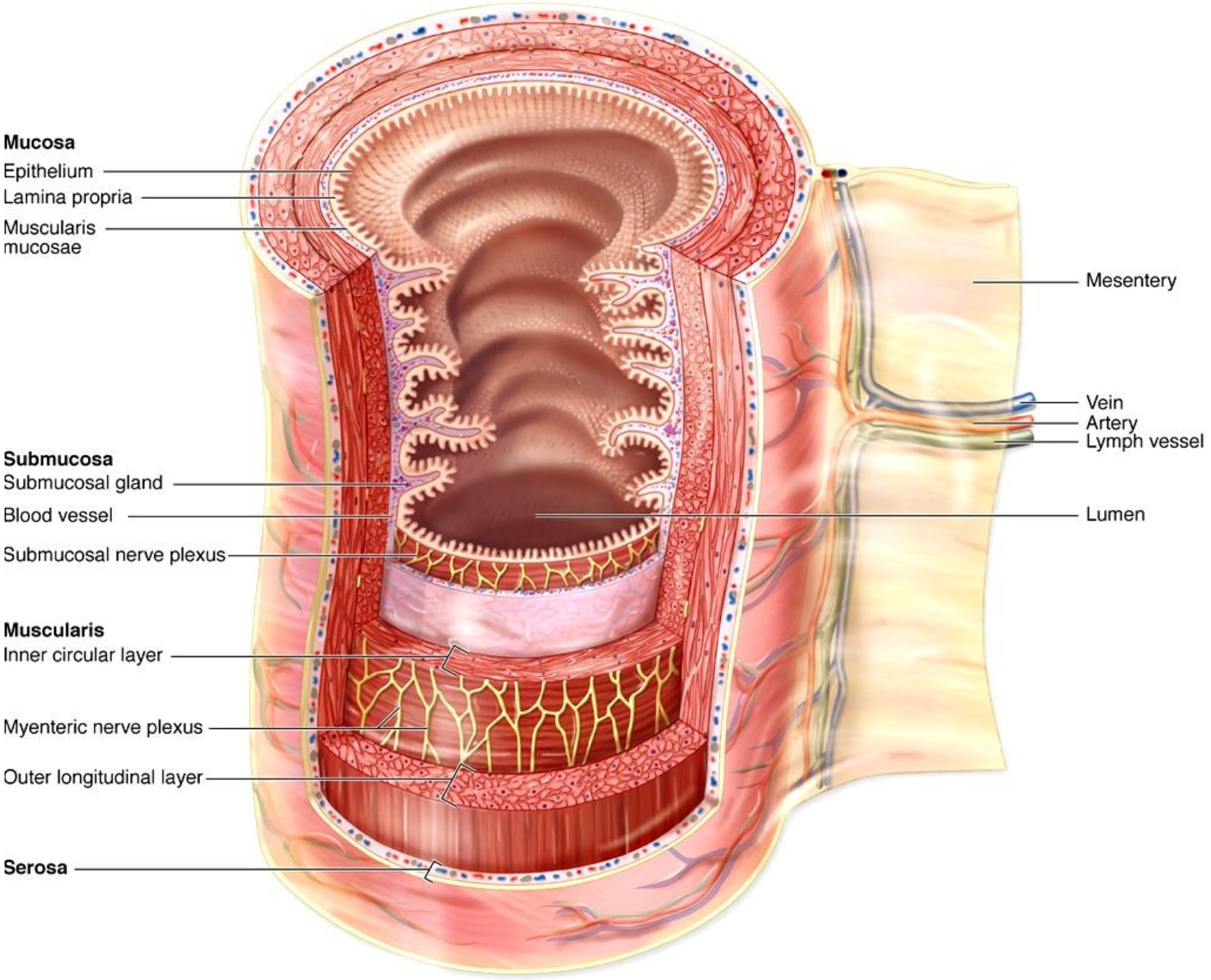
GASTRIC ACID PRODUCTION AND REGULATION



Gastroduodenal junction



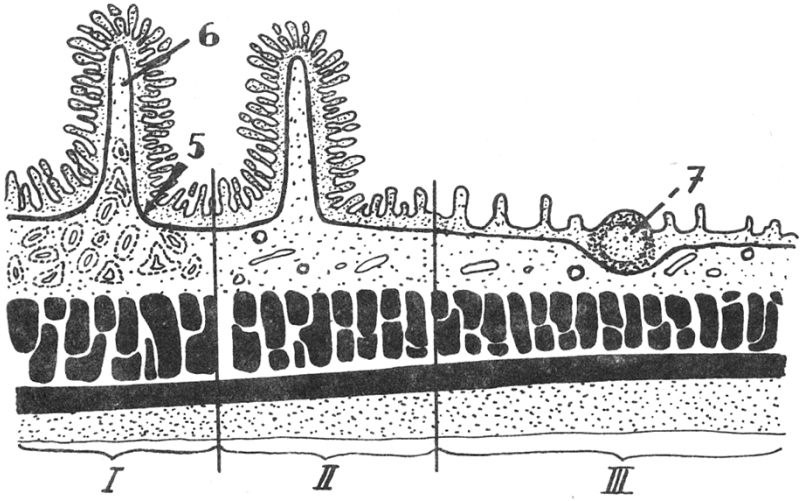
MICROSCOPIC ANATOMY OF GIT



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



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

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

Intestinal mucosa

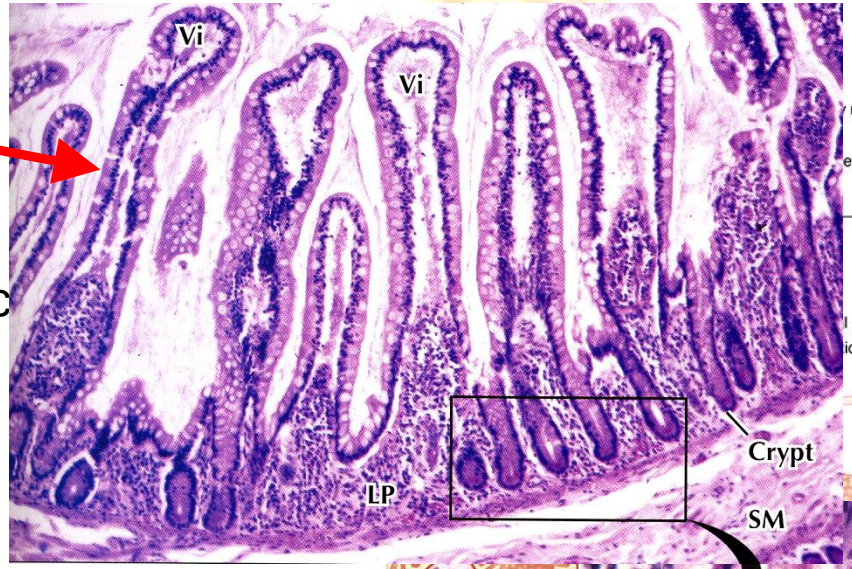
plicae circulares (Kerc
– **2-3x**

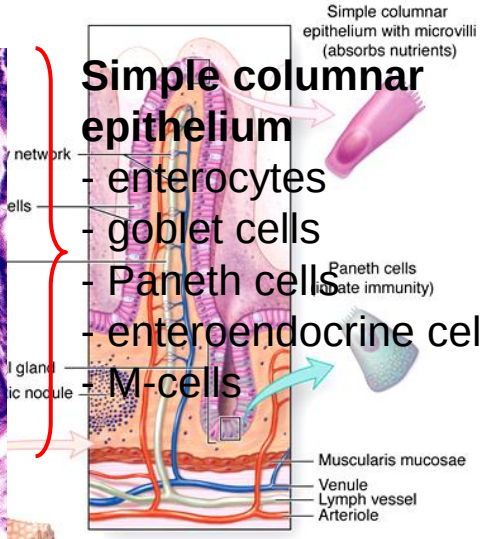
villi (villi intestinales)
– **5-10x**

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

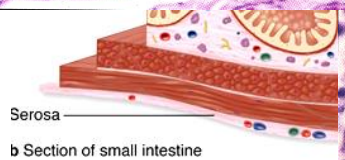
Crypts of Lieberkühn

200-600x



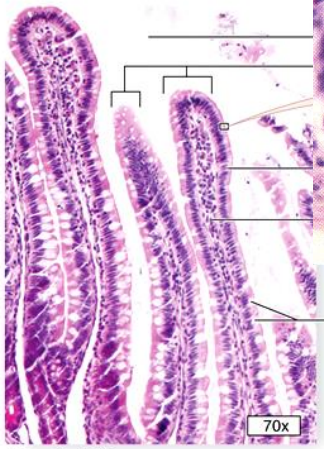


Simple columnar epithelium
- enterocytes
- goblet cells
- Paneth cells
- enteroendocrine cells
- M-cells



b Section of small intestine

e Microvilli

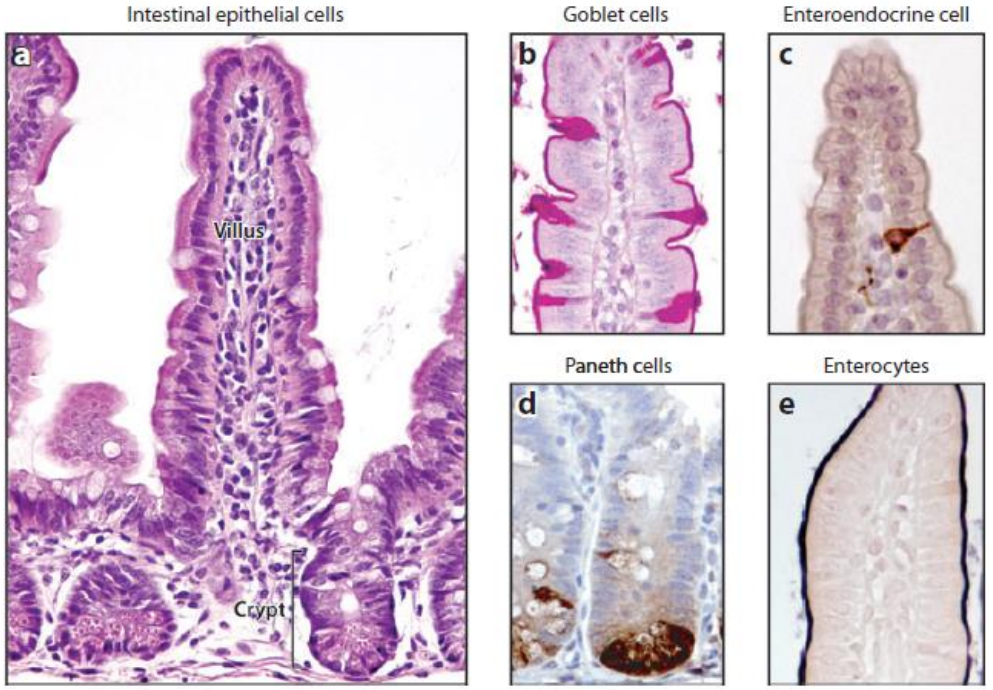


d Intestinal villi

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



MICROSCOPIC ANATOMY OF GIT

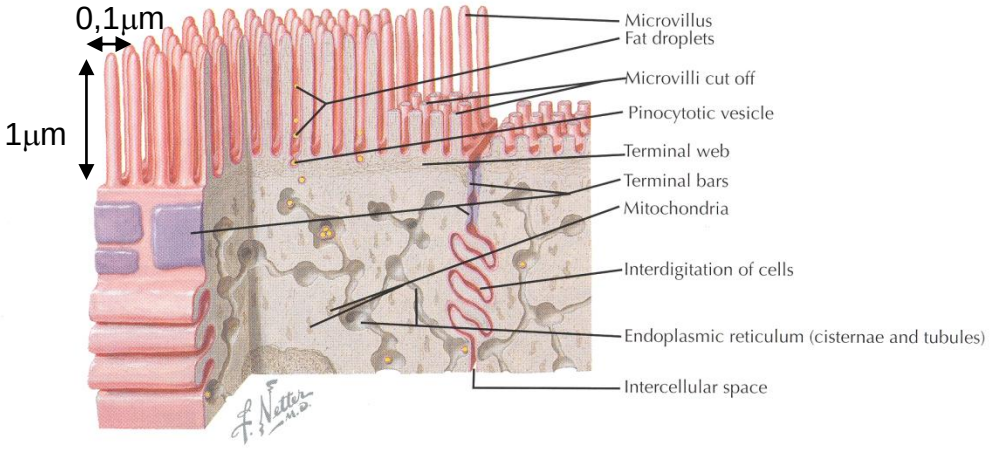
Enterocytes

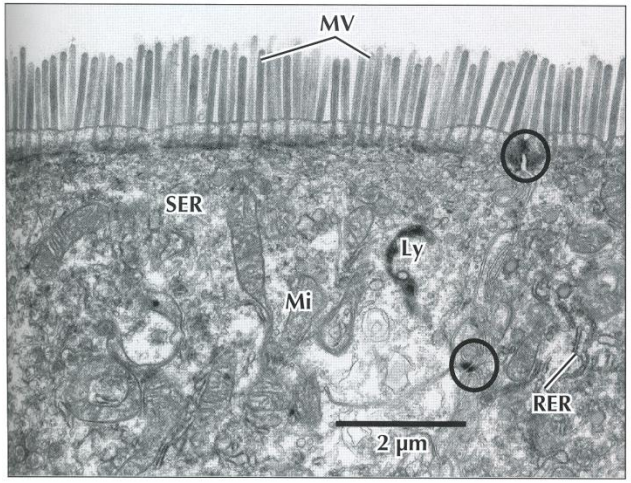
- tall, columnar cells
- nucleus located in basis of the cell
- apical surface modified- microvilli (3000) + glycocalyx (0,5μm) = *striated border (cuticle)*
- tight intercellular connections, interdigitations

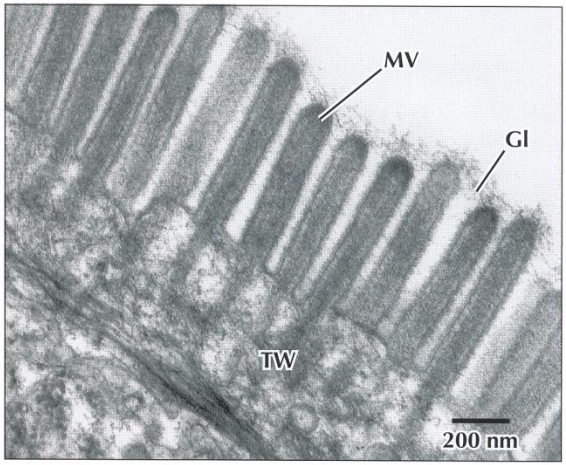
Function:

- 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.**



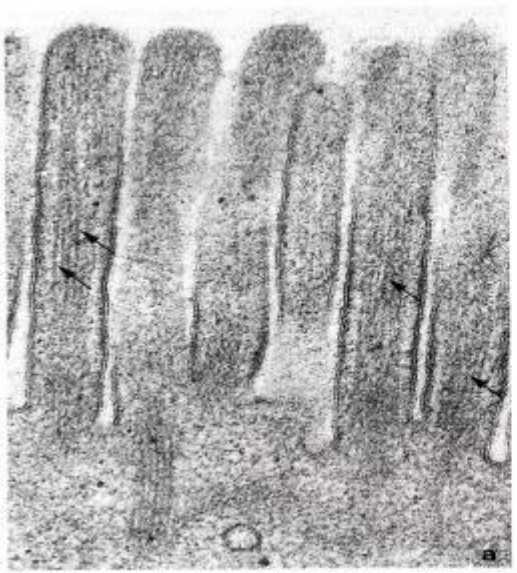


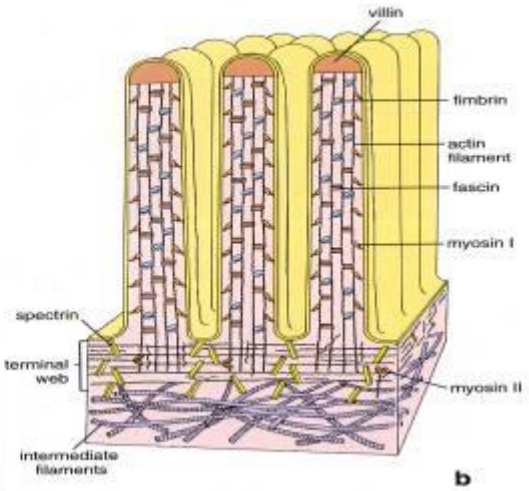


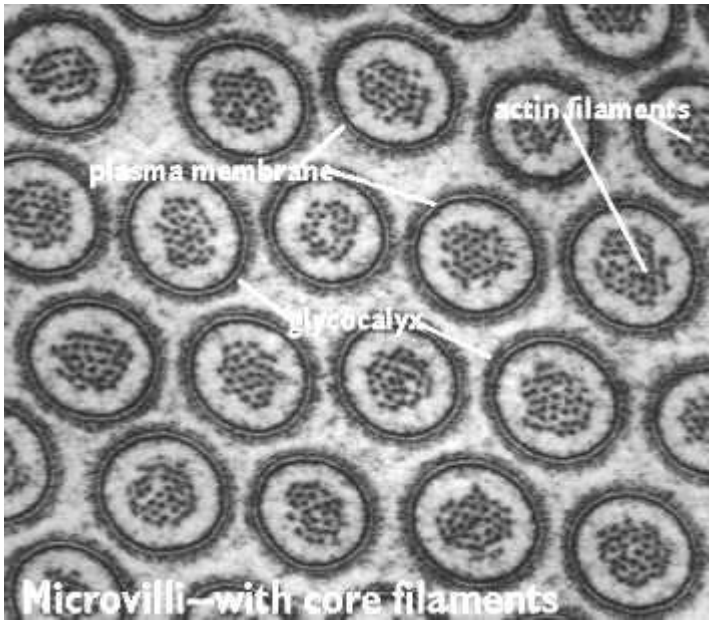
▲ **EMs of enterocytes at low (Left) and high (Right) magnification.** Apical microvilli (**MV**) make up a striated border and extend from free surfaces of the cells. A fuzzy glycocalyx (**Gl**) covers them. A terminal web (**TW**) of actin filaments in the apical cytoplasm reaches into microvilli. 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×.

MICROSCOPIC ANATOMY OF GIT

Microvilli



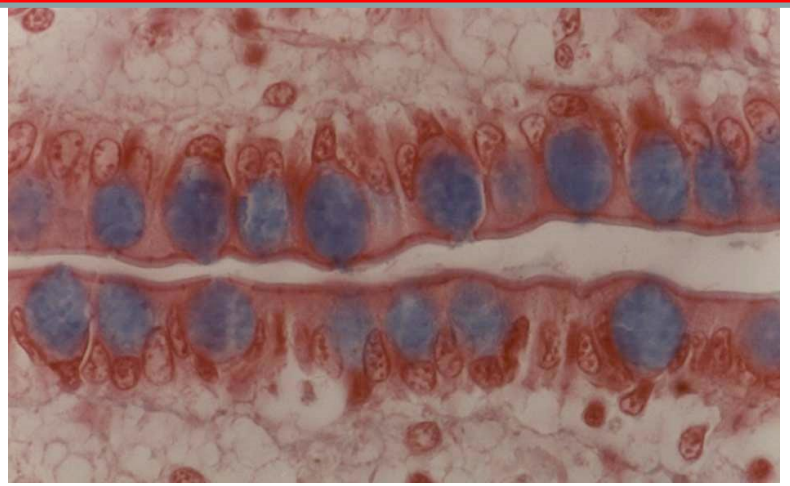


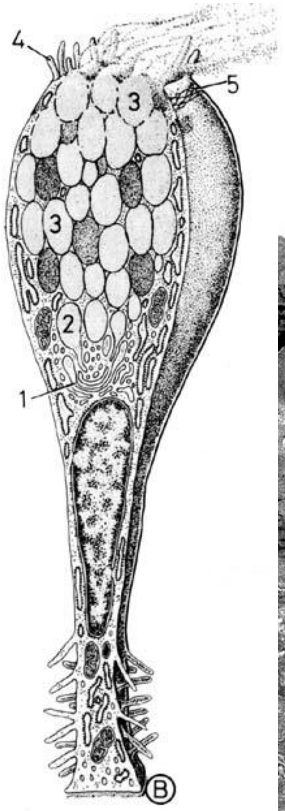


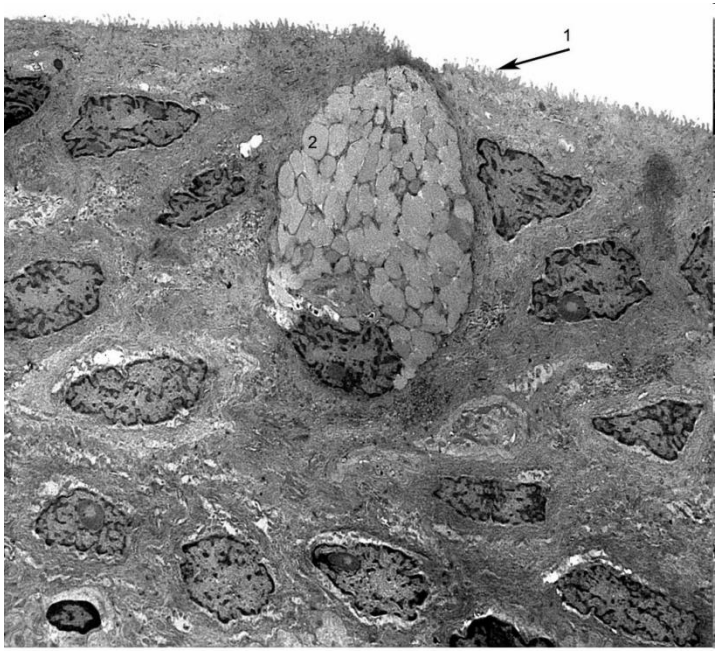
MICROSCOPIC ANATOMY OF GIT

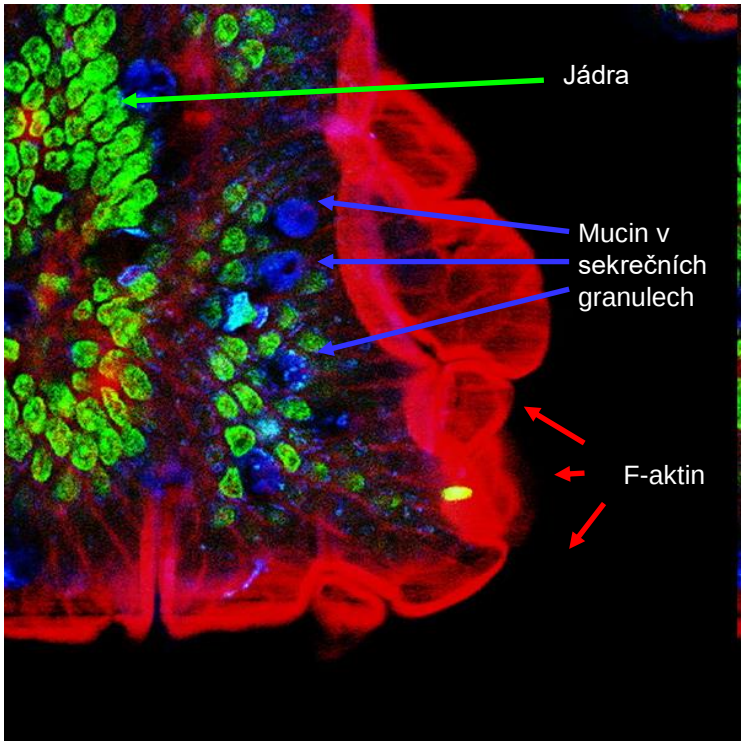
Goblet cells

- Cylindrical glandular epithelial cells
- Apical surface – apocrine/merocrine secretion of mucin
- Basal part – RER, GA, nucleus, mitochondria
- Mucinogenic granules
- see lesson spring semester 2015 - Epithelial tissue

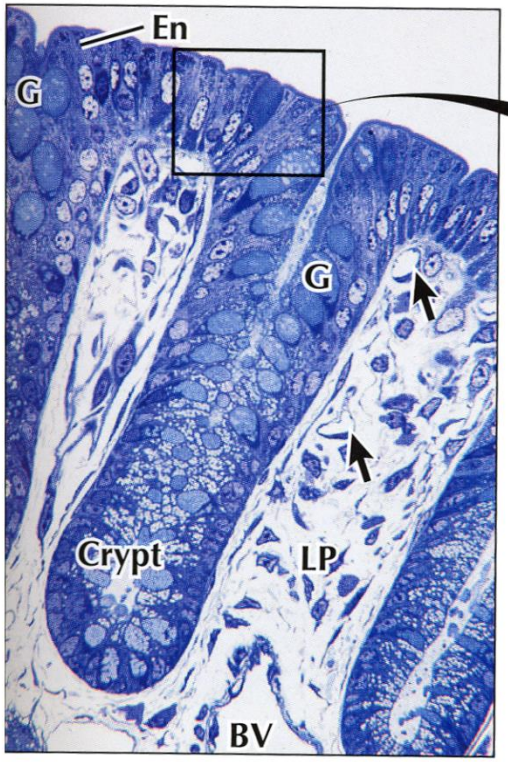




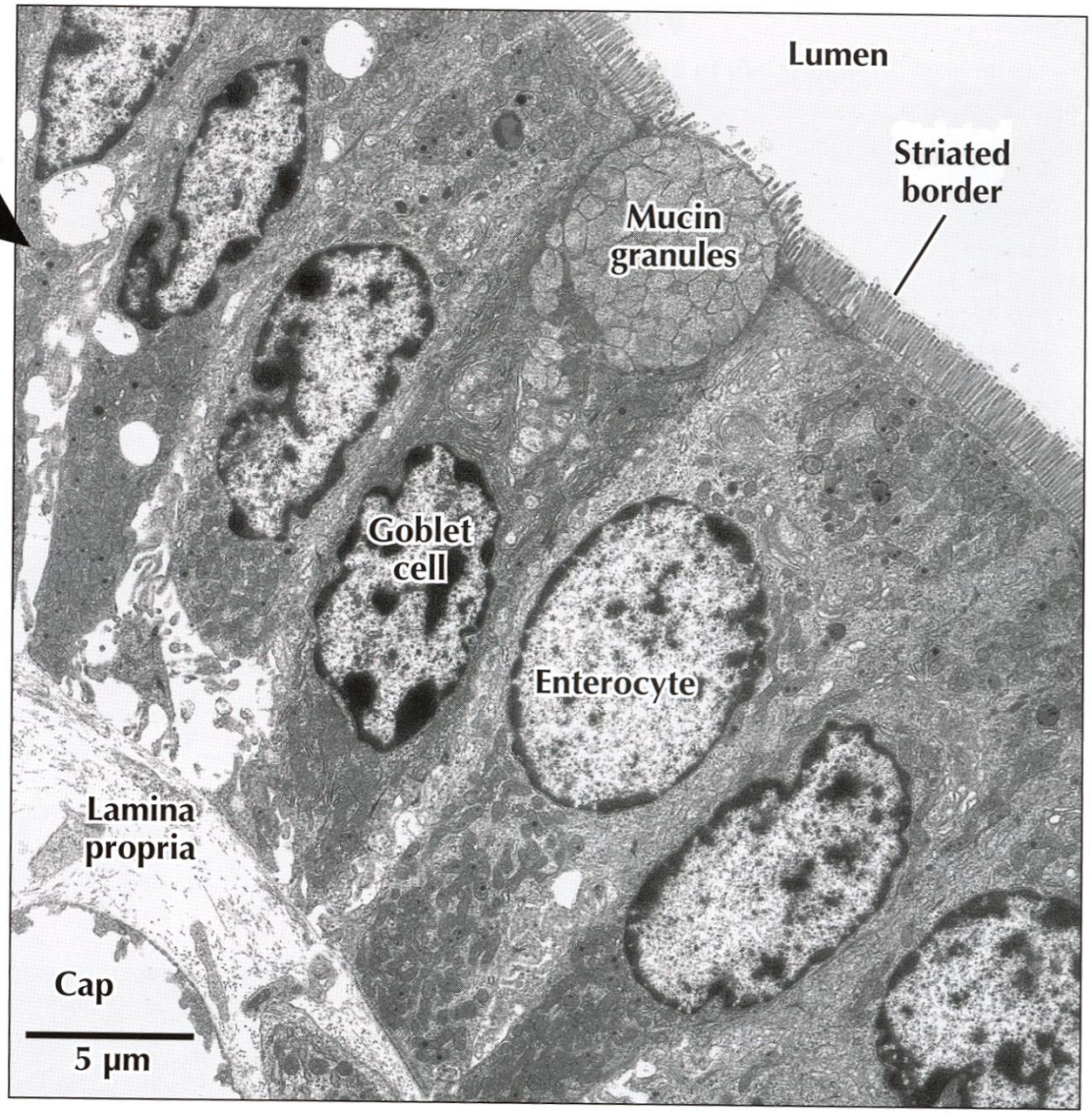




Goblet cells

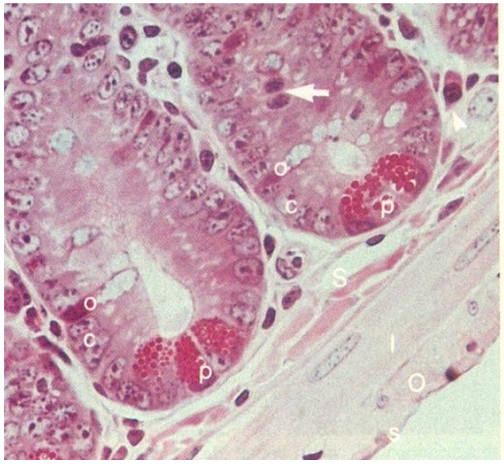


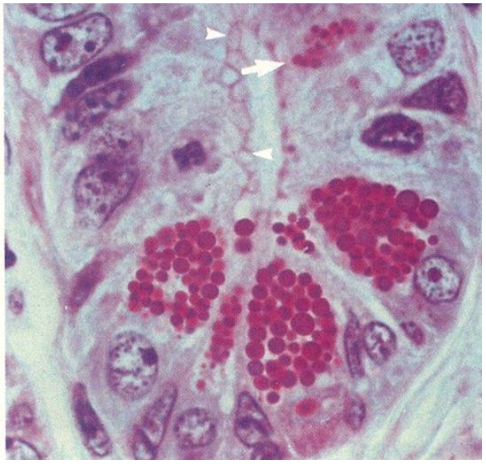
▲ **LM of the colonic mucosa.** Surface epithelium containing goblet cells (**G**) and enterocytes (**En**) invaginates to form an intestinal crypt. The lamina propria (**LP**), with capillaries (**arrows**) and larger blood vessels (**BV**), is richly cellular. 600×. *Toluidine blue.*



MICROSCOPIC ANATOMY OF GIT

Paneth cells

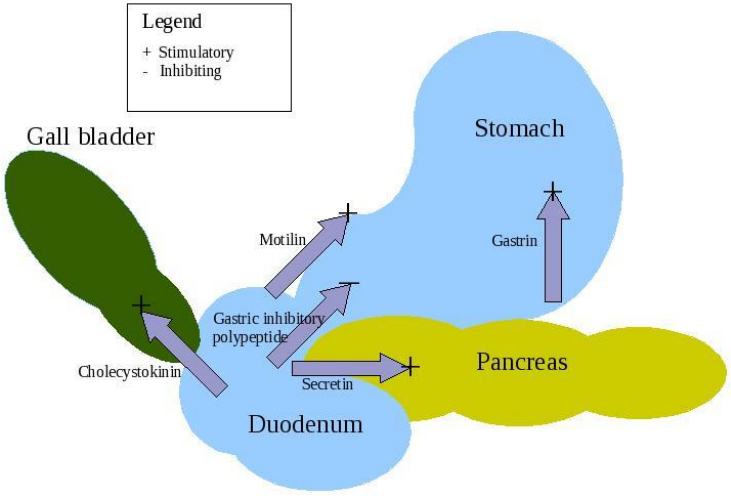




- basal part of crypts of Lieberkühn
- basophilic cytoplasm
- GA located above nucleus
- acidophilic (red) granules
- immune system
- secretion granules contain biologically active substances e.g. lysozym)
- influence intestinal microflora

Enteroendocrine cells

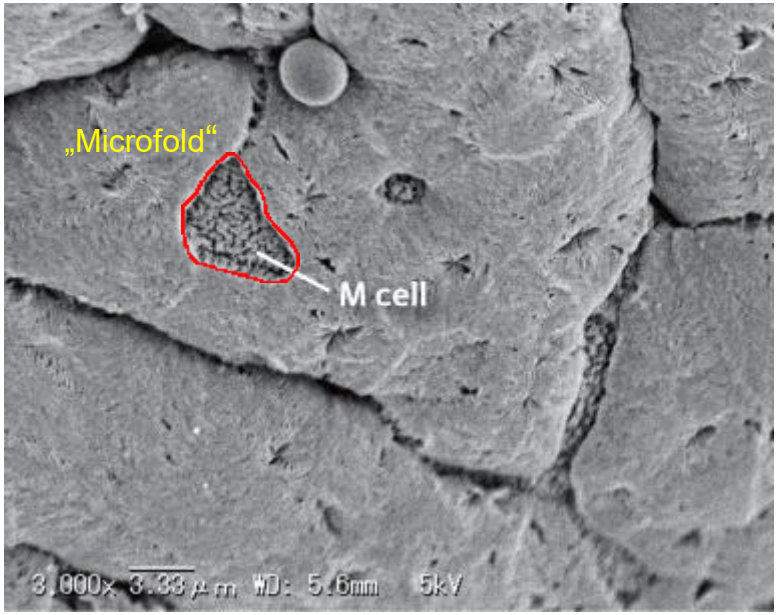
- similar to gastric enteroendocrine cells
- regulate pancreatic secretions
- homeostatic axis (brain-intestine-adipose tissue)
- cholecystokinin, secretin, GIP, motilin, neurocrine peptides etc.

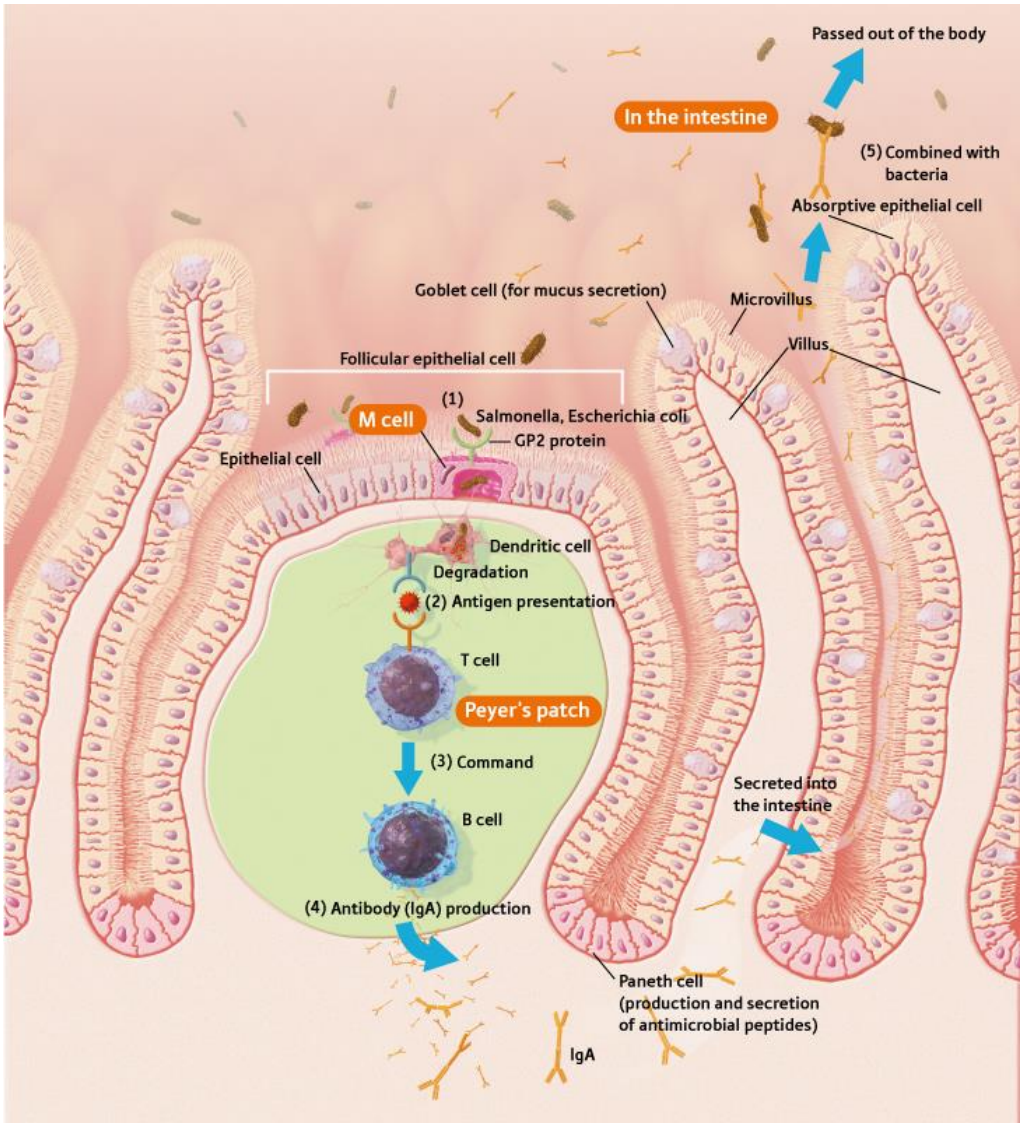


MICROSCOPIC ANATOMY OF GIT

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

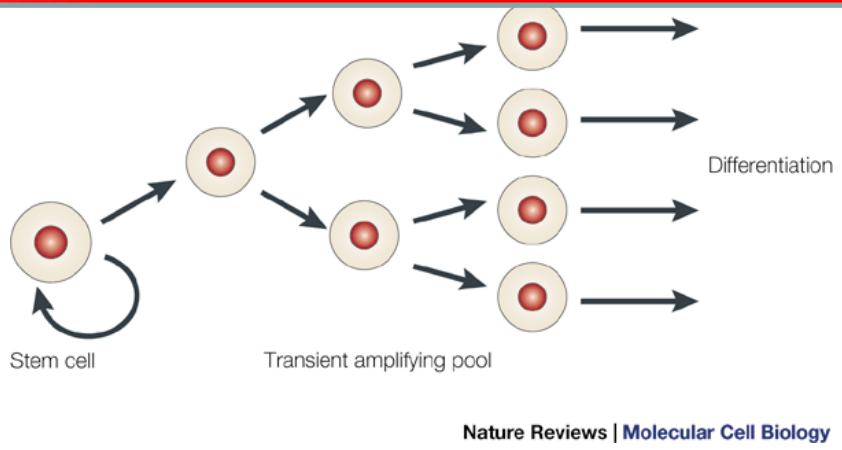


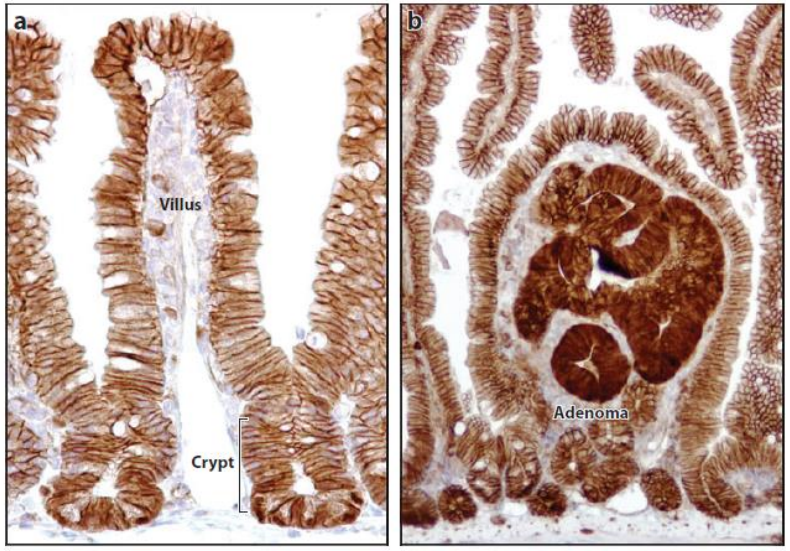


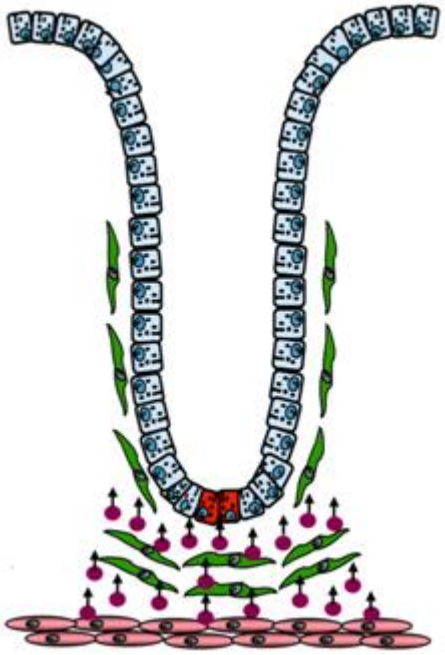
MICROSCOPIC ANATOMY OF GIT

Intestinal stem cells

- bottom of crypts of Lieberkühn
- epithelial renewal (4-5 days)
- stem cell niche
- tumour transformation

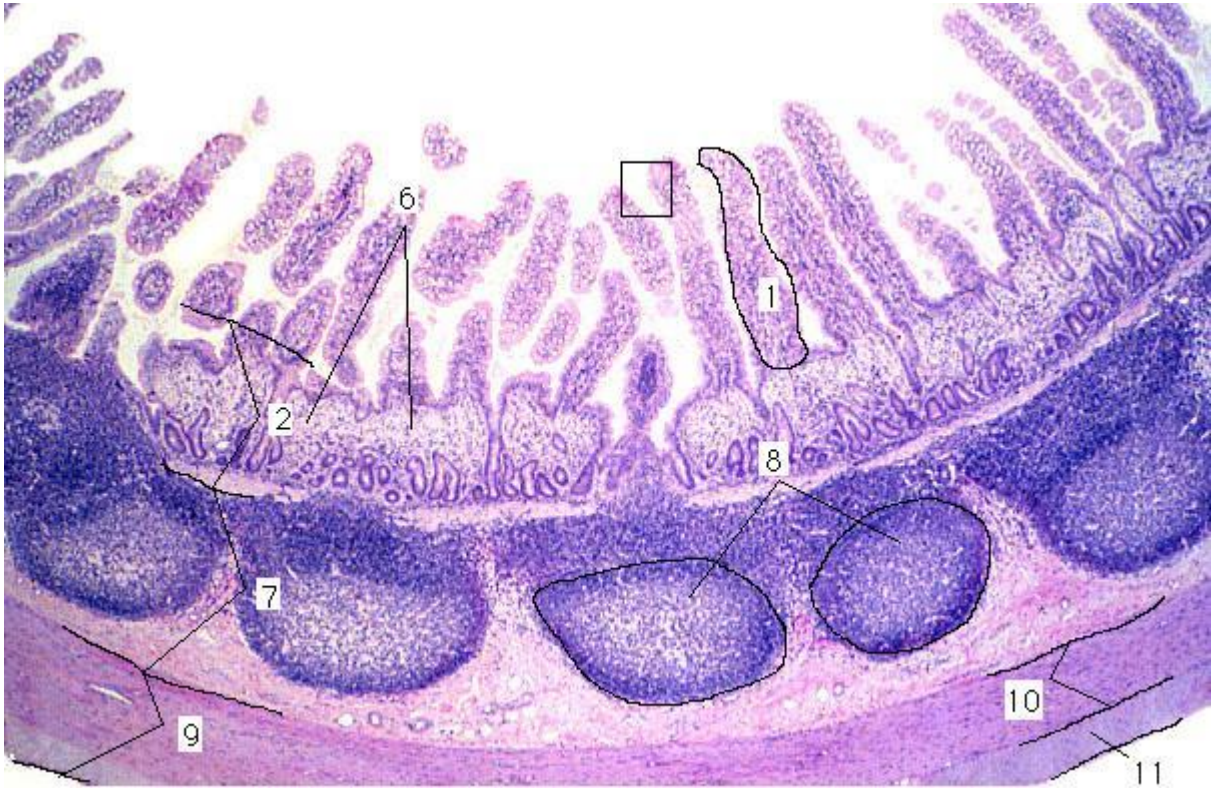






L. propria

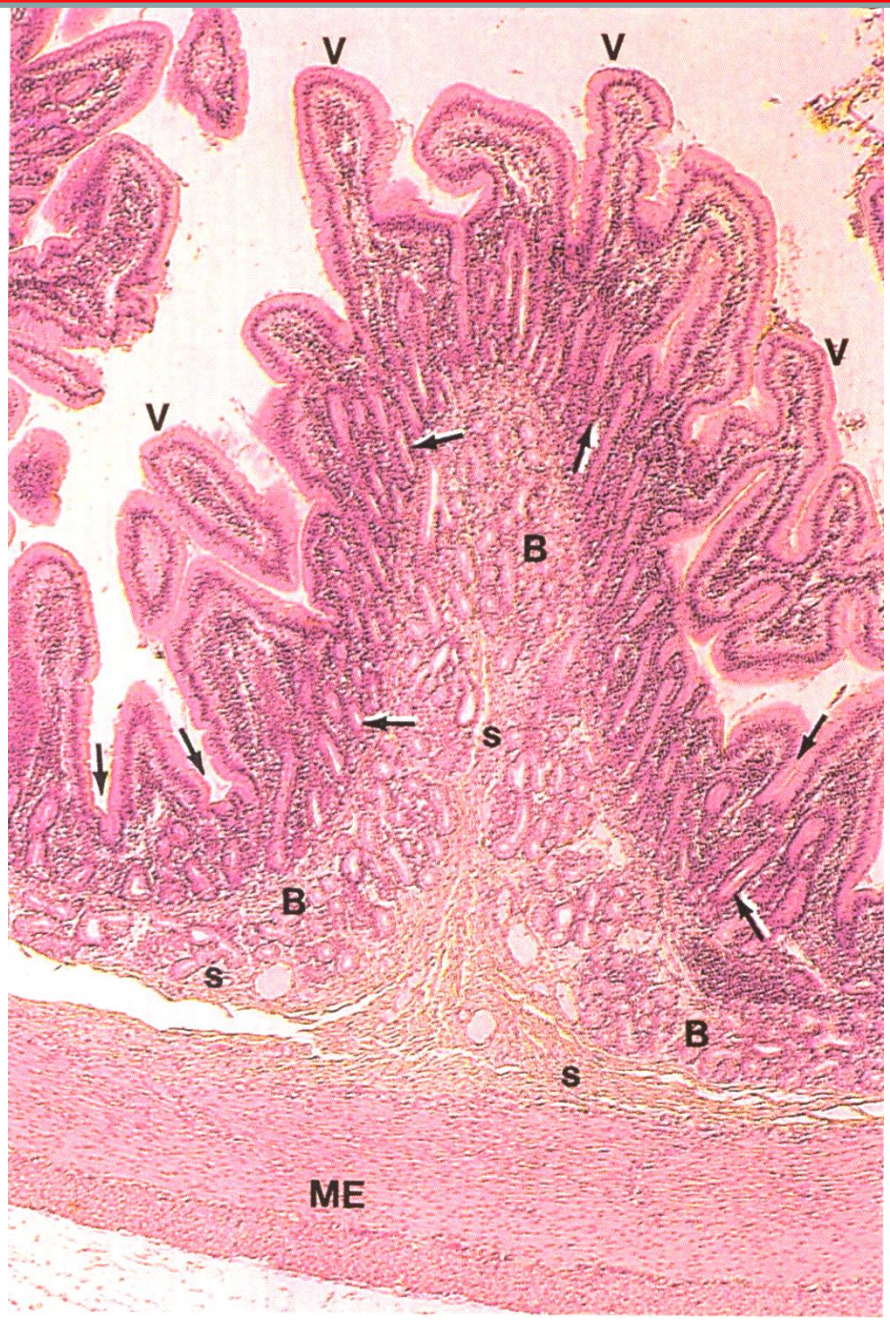
- immune system – GALT
- immunologic barrier
- Peyer's patches



Submucose

Brunner's glands

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

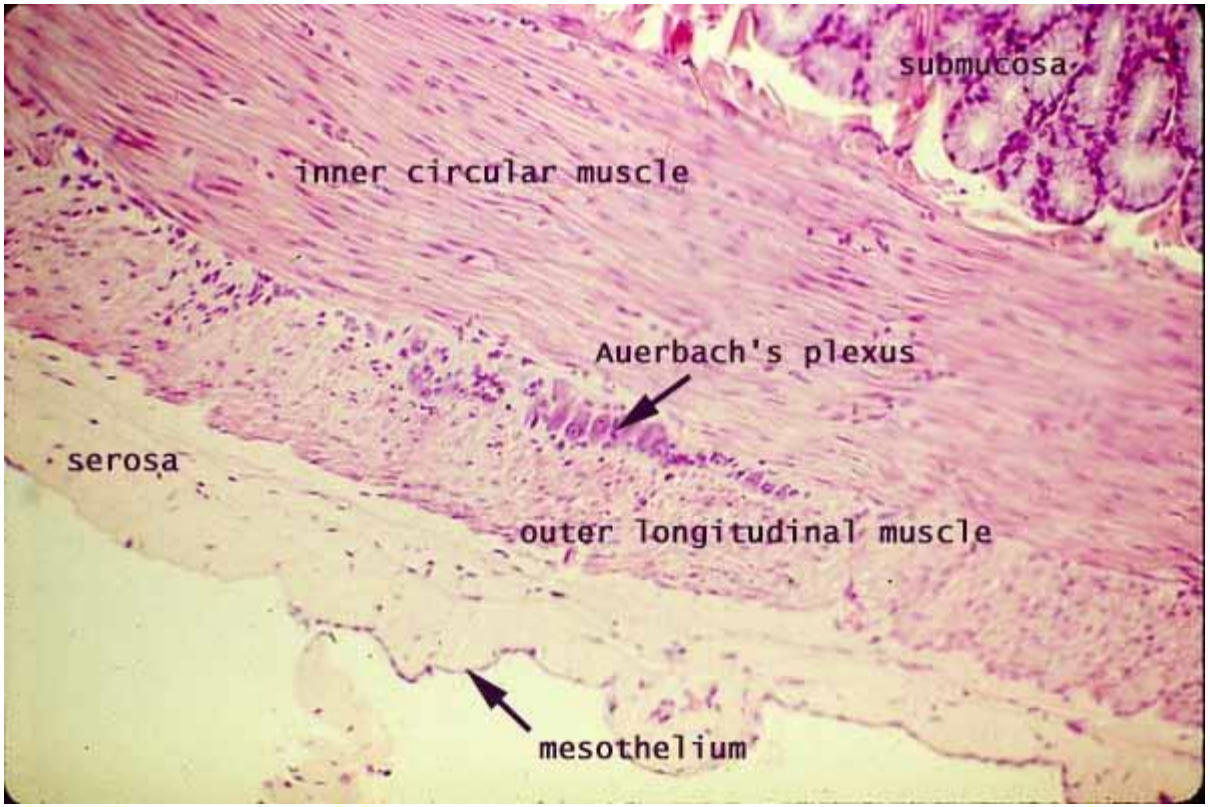


Muscularis externa

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

Serosa

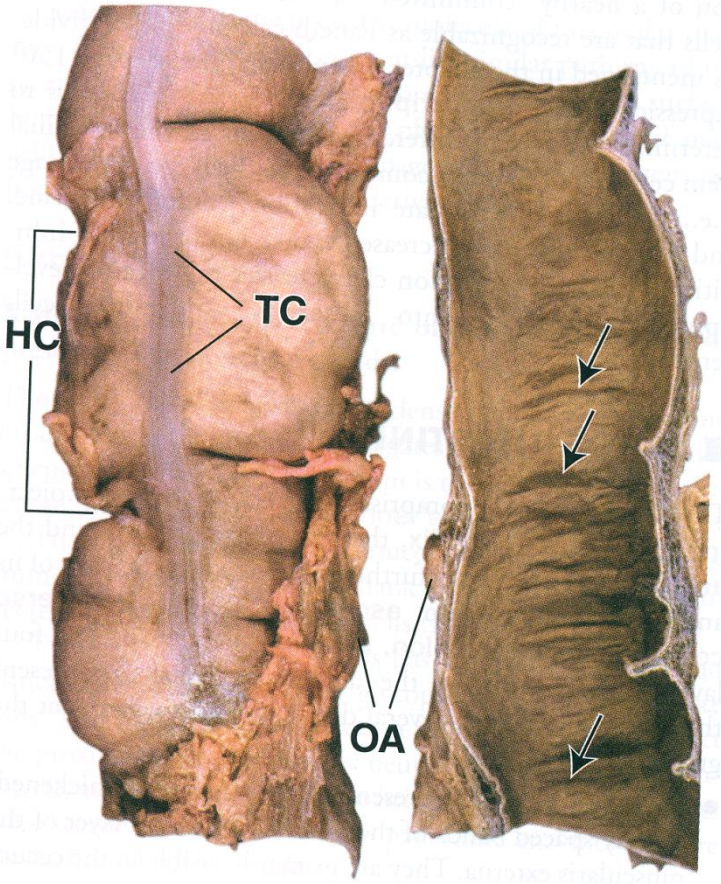
- loose collagen connective tissue + simple squamous epithelium (mesothelium)



Colon

- no plicae of Kerckring, villi
- muscularis externa – longitudinal layer forms taenie coli
- surface serosa forms appendices epiploicae (adipose)

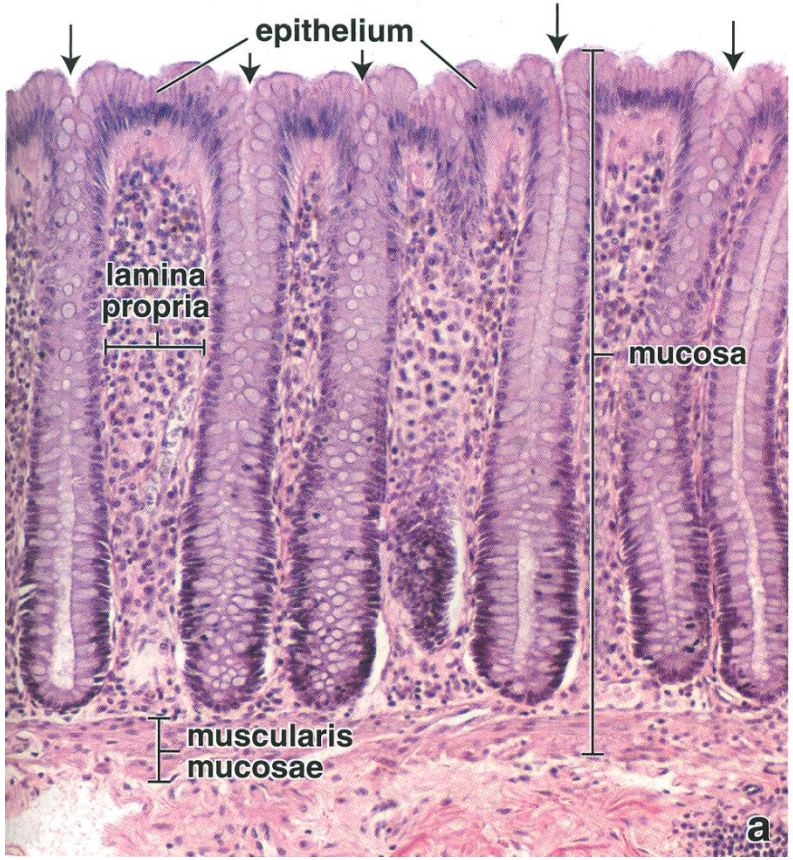
Small intestine

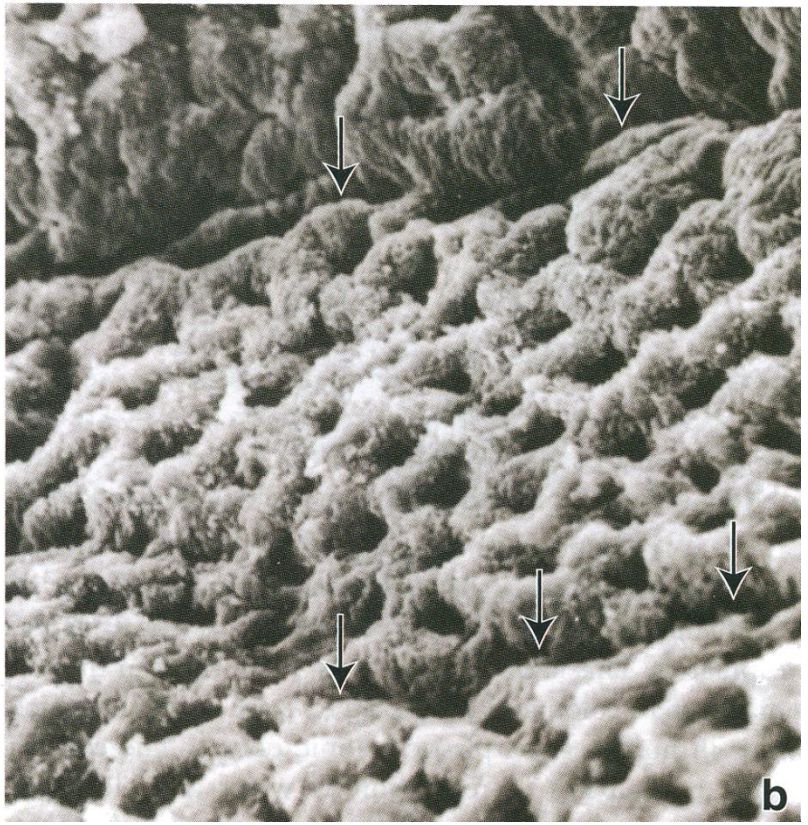


Colon

MICROSCOPIC ANATOMY OF GIT

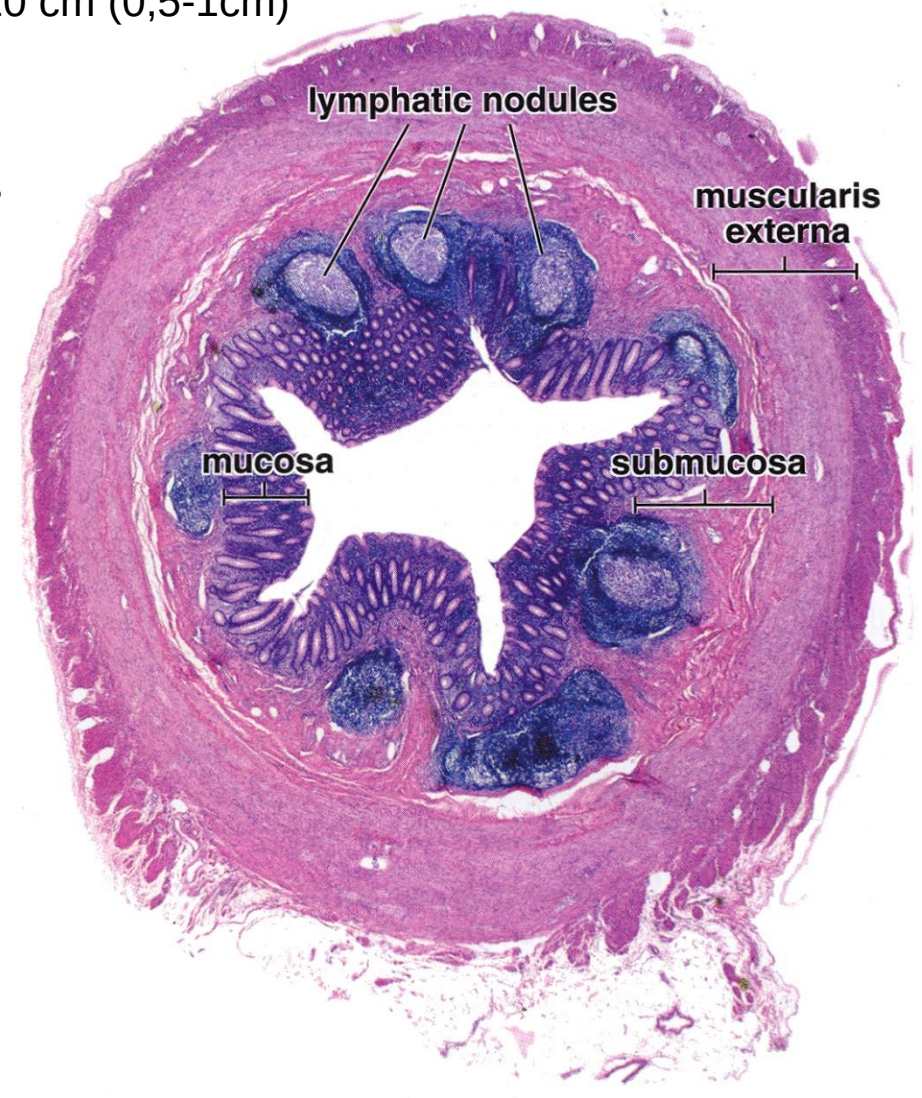
- absorption of water, electrolytes
- deeper crypts of Lieberkühn, no Paneth cells
- abundant goblet cells
- abundant lymphatic follicles in l. propria (GALT)





Apendix

- 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

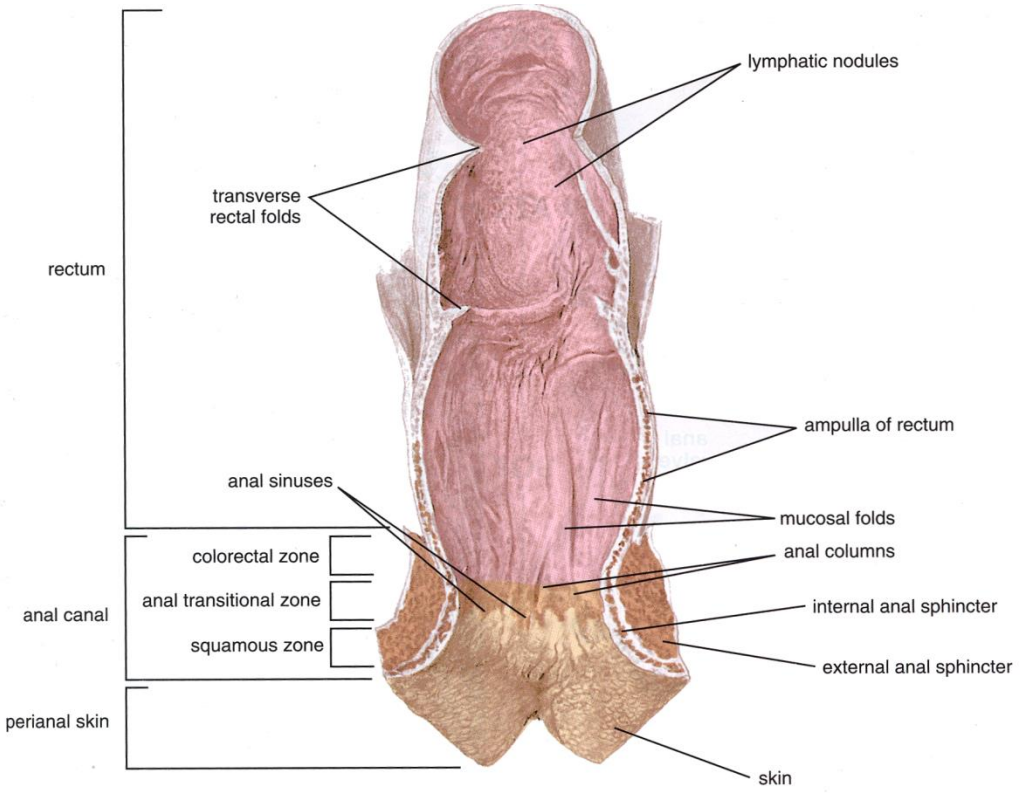


Rectum and anal canal

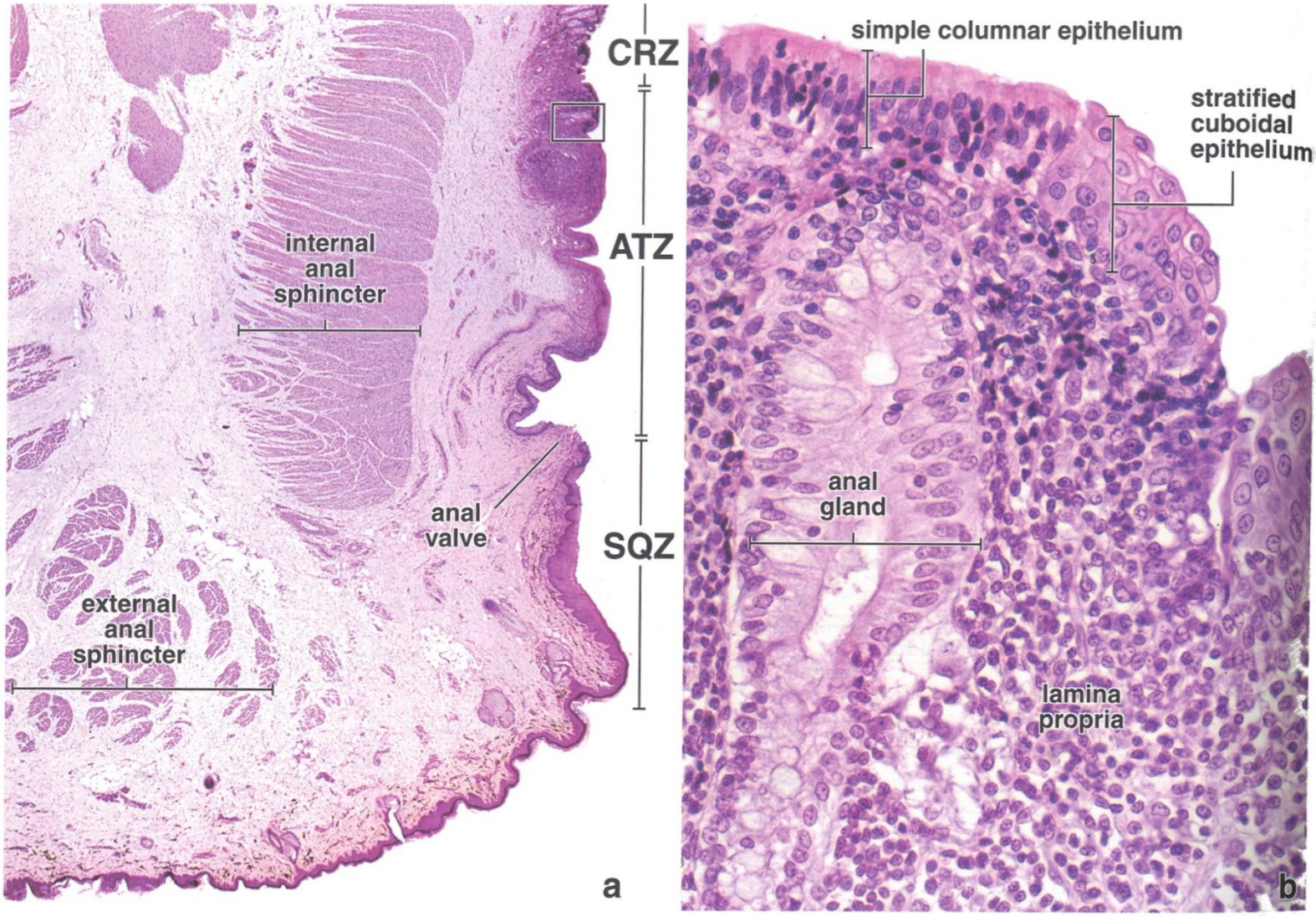
- Pars pelvina
  - *plicae transversae recti*
  - histological architecture identical to colon

- Canalis analis
  - simple columnar epithelium replaced by stratified squamous epithelium
  - rich venous plexus
  - *columnae rectales, sinus rectales* a
  - *zona cutanea* – typical skin

- Rectal submucosa – high and loose (prolapse of mucose)



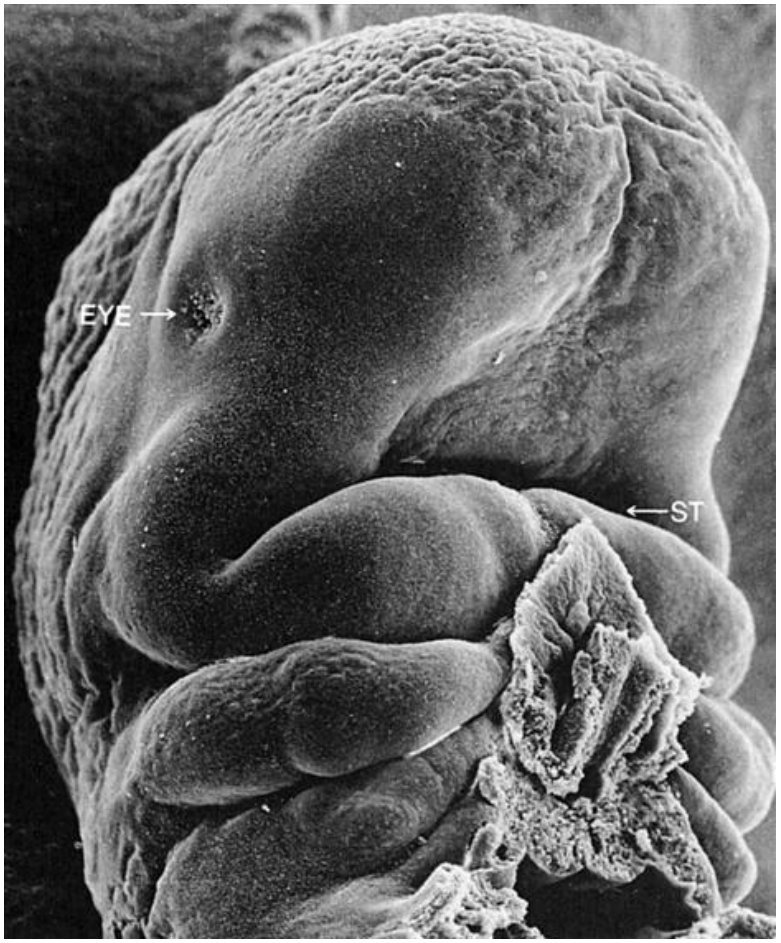
Rectum and anal canal



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				

BRIEF OVERVIEW OF FACE AND GIT DEVELOPMENT

DEVELOPMENT OF FACE AND ASSOCIATED STRUCTURES

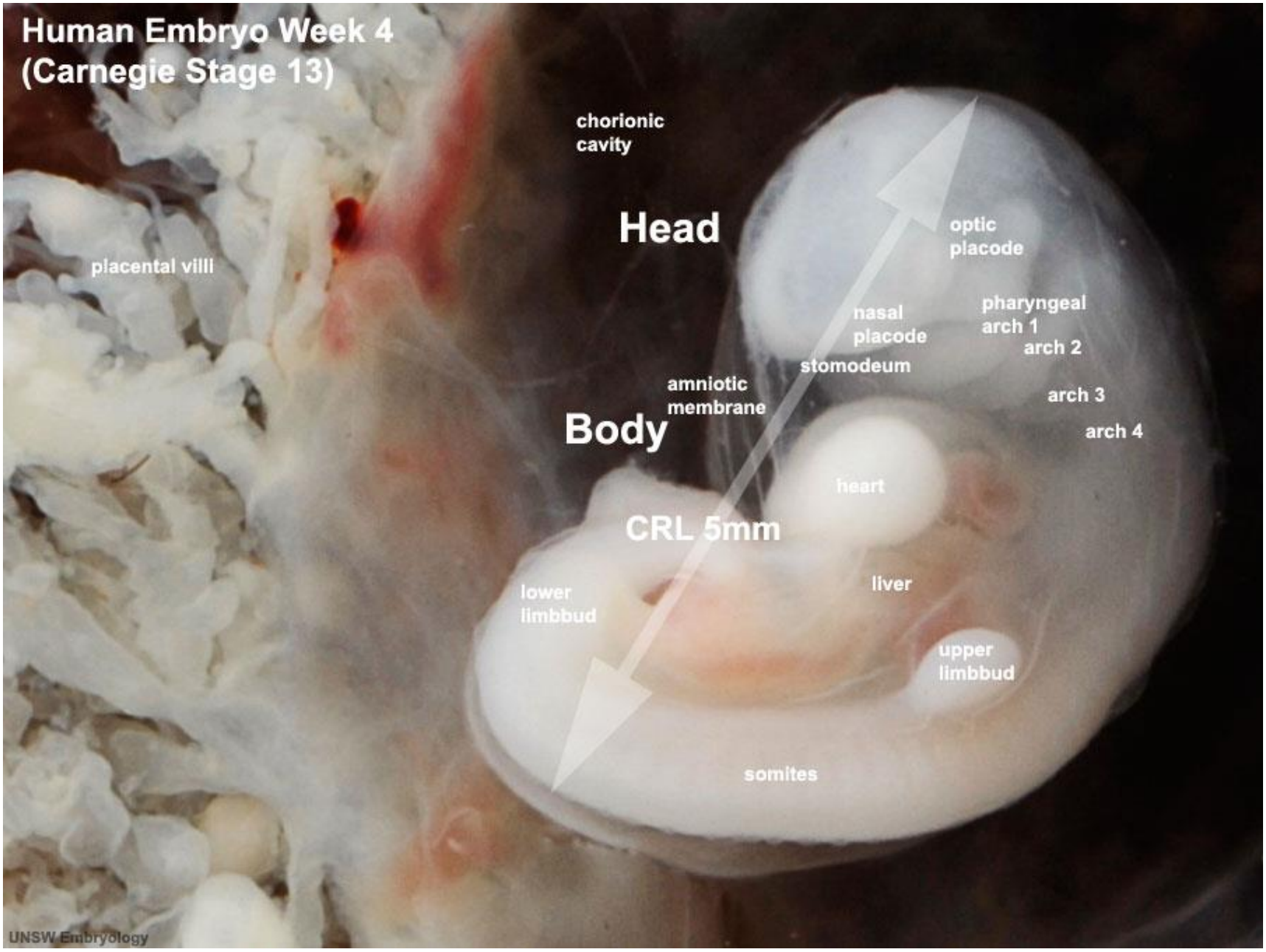


Key developmental structure:

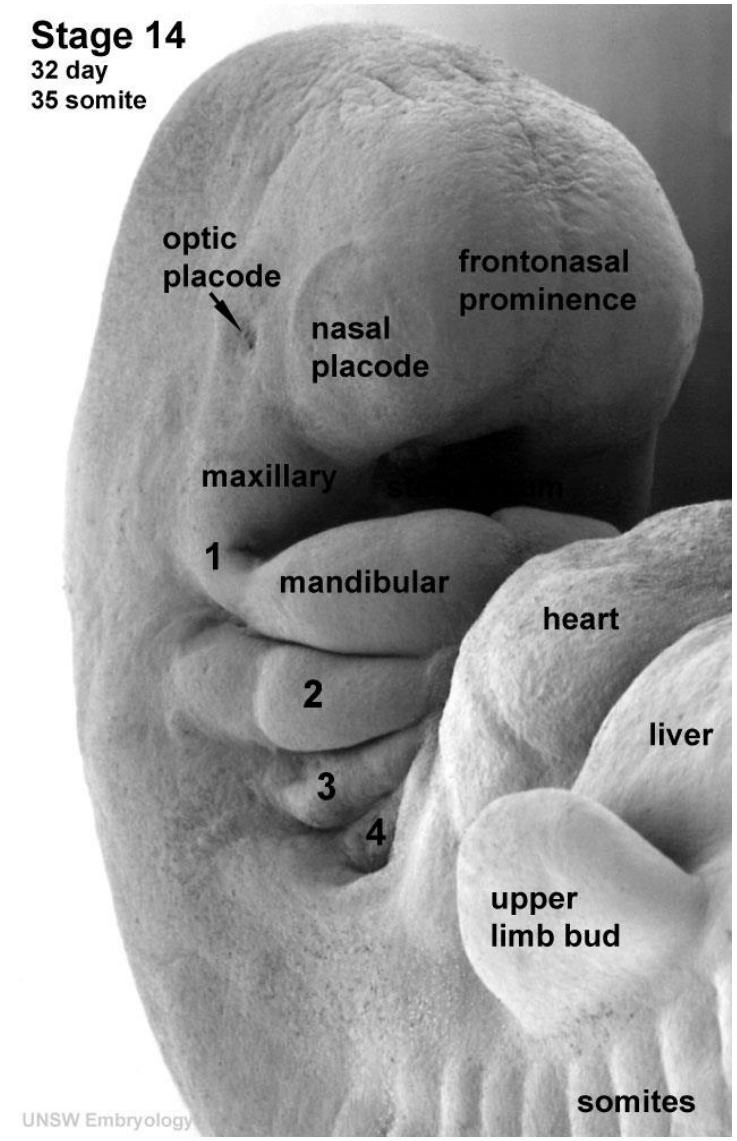
PHARYNGEAL (BRANCHIAL)

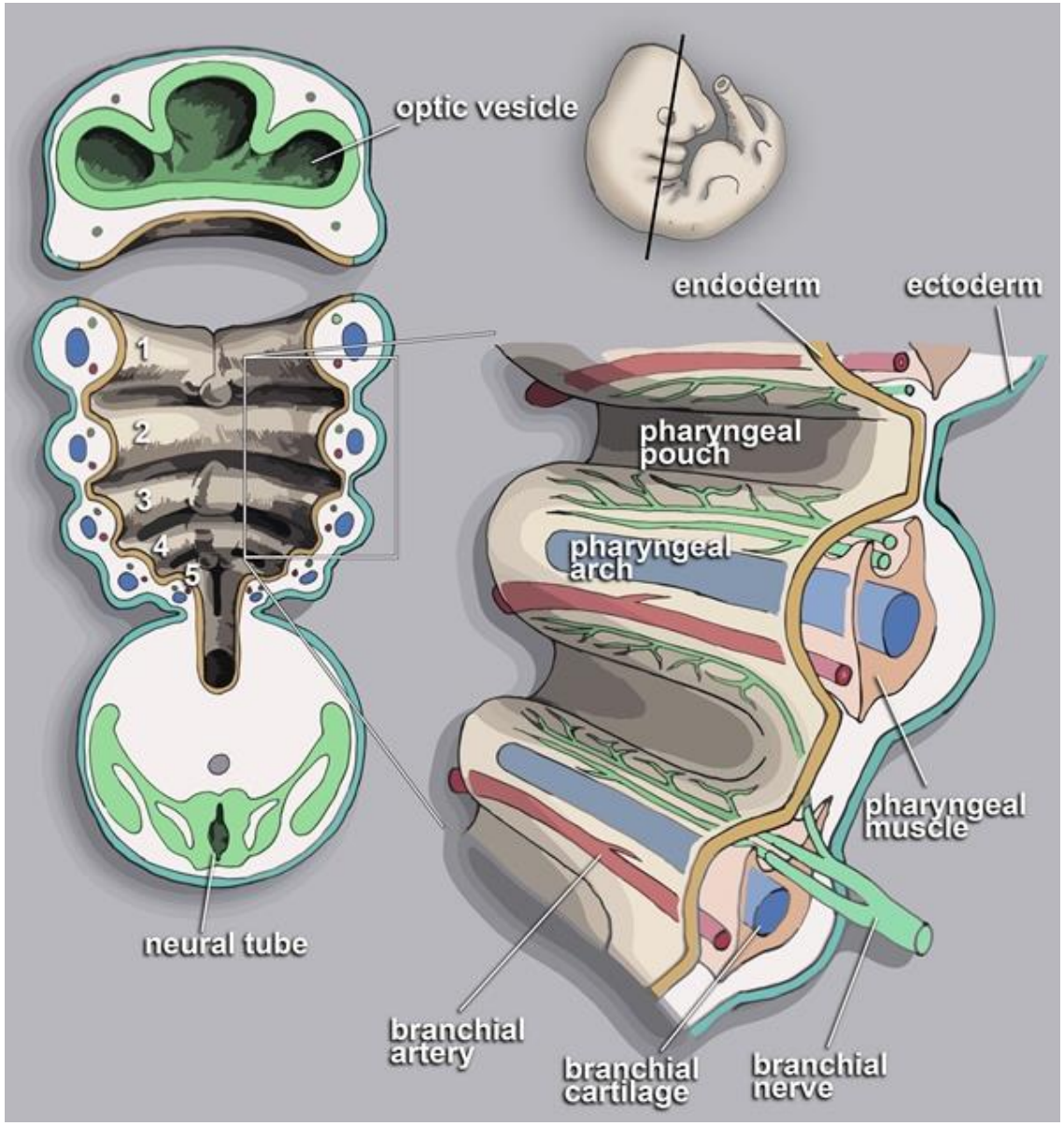
APPARATUS

PHARYNGEAL APPARATUS

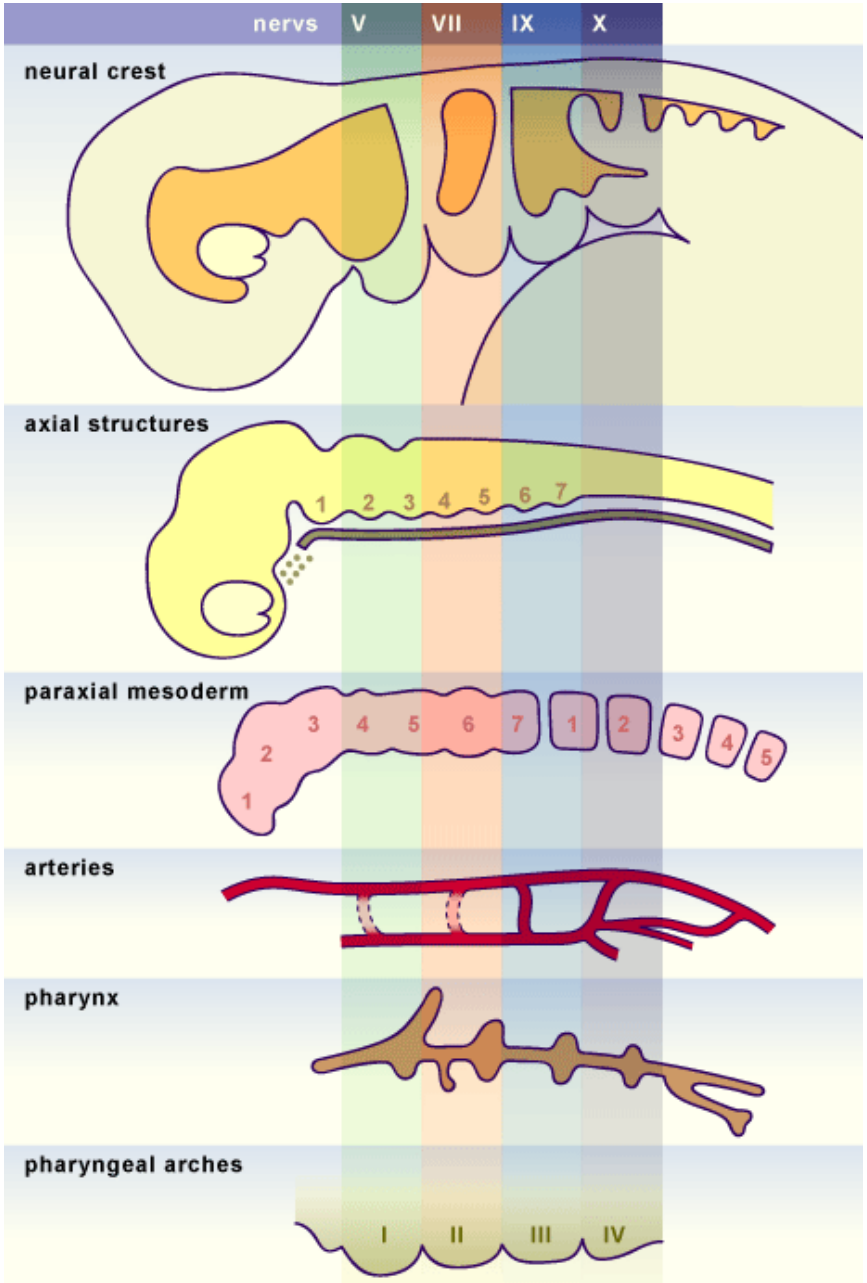


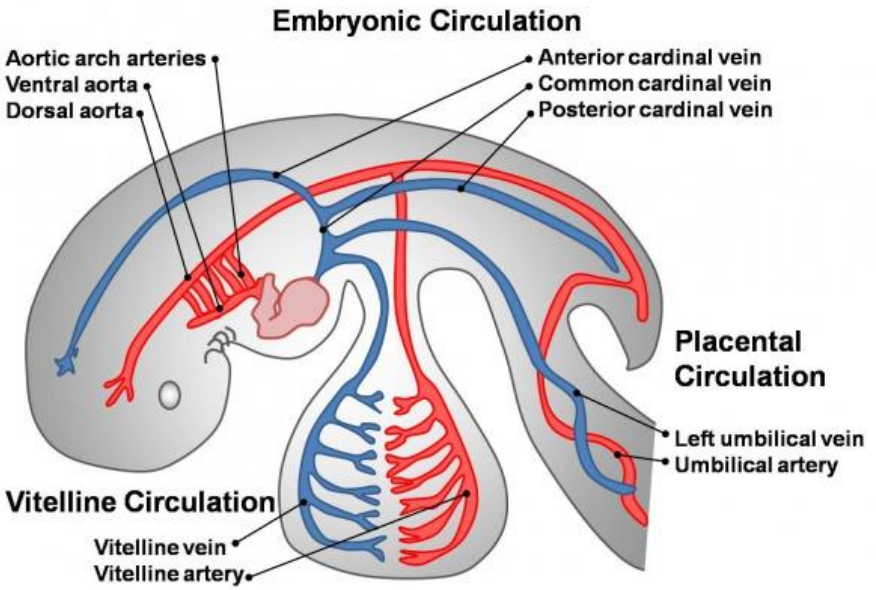
PHARYNGEAL APPARATUS



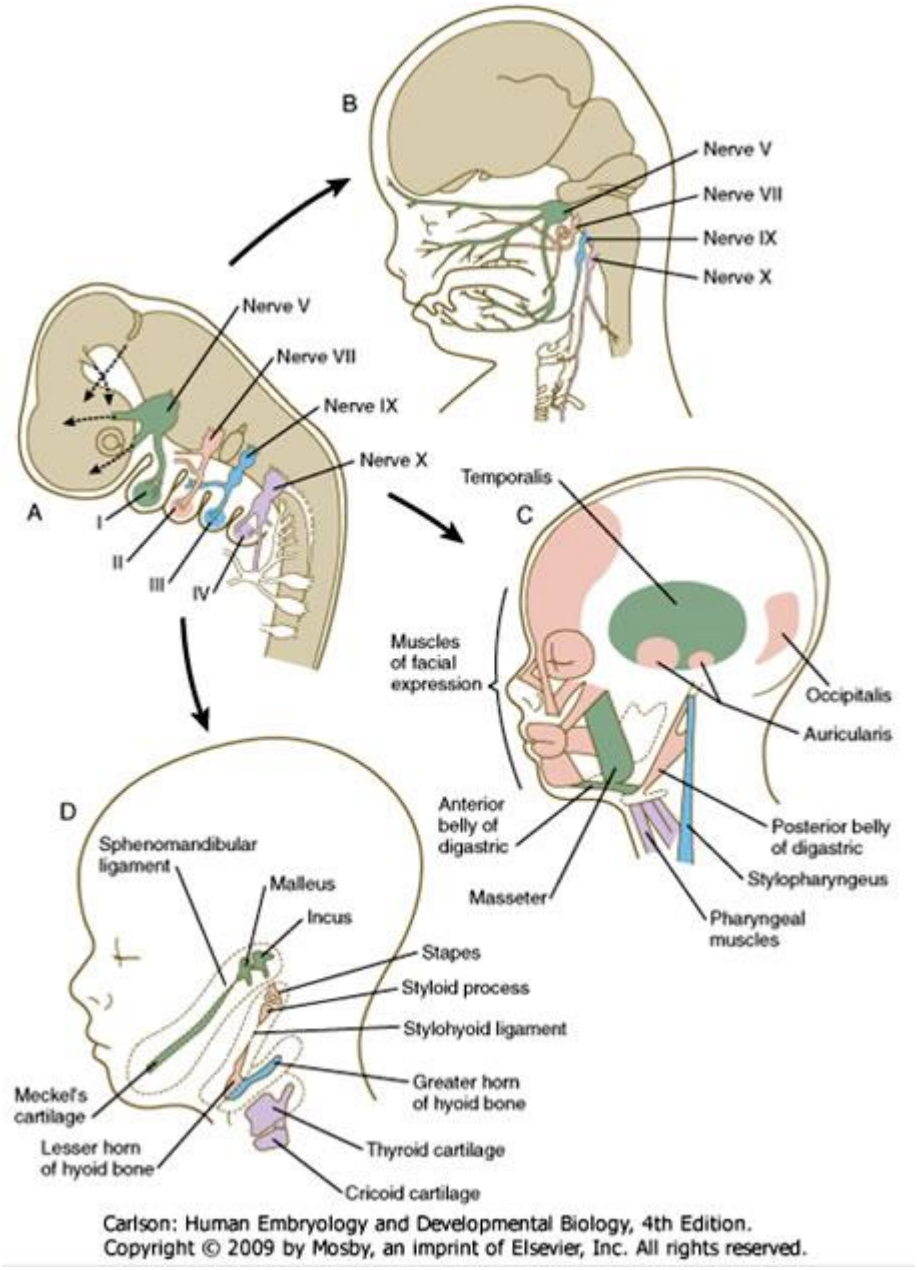


PHARYNGEAL APPARATUS





PHARYNGEAL APPARATUS



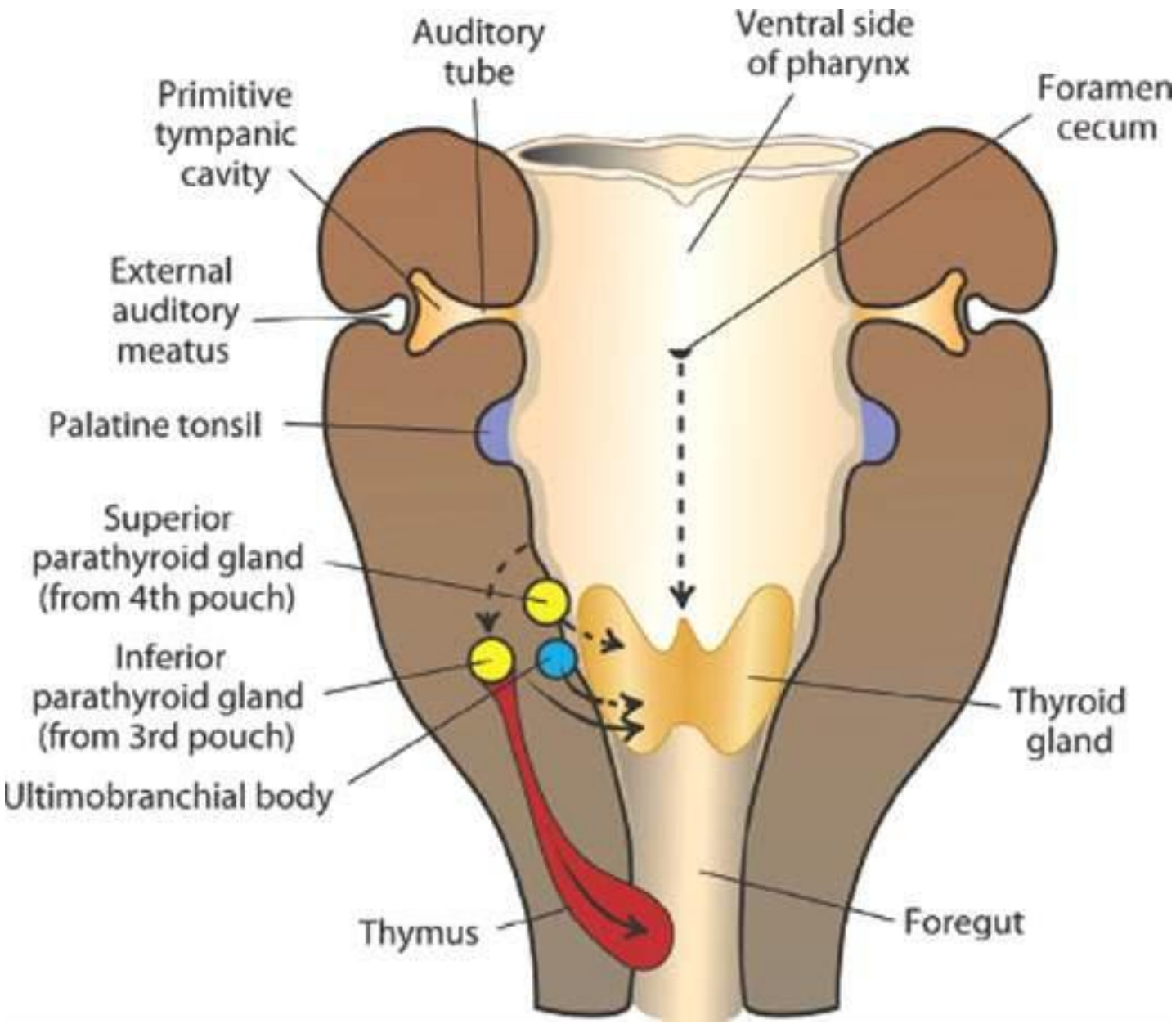
Derivatives of pharyngeal apparatus

- Face including soft tissues
- Mimic and masticatory muscles
- Outer and middle ear
- Hyoid bone
- Laryngeal cartilages
- Thymus
- Parathyroid bodies
- Fossa tonsillaris (t. palatina)
- Large arteries (aortic arches)

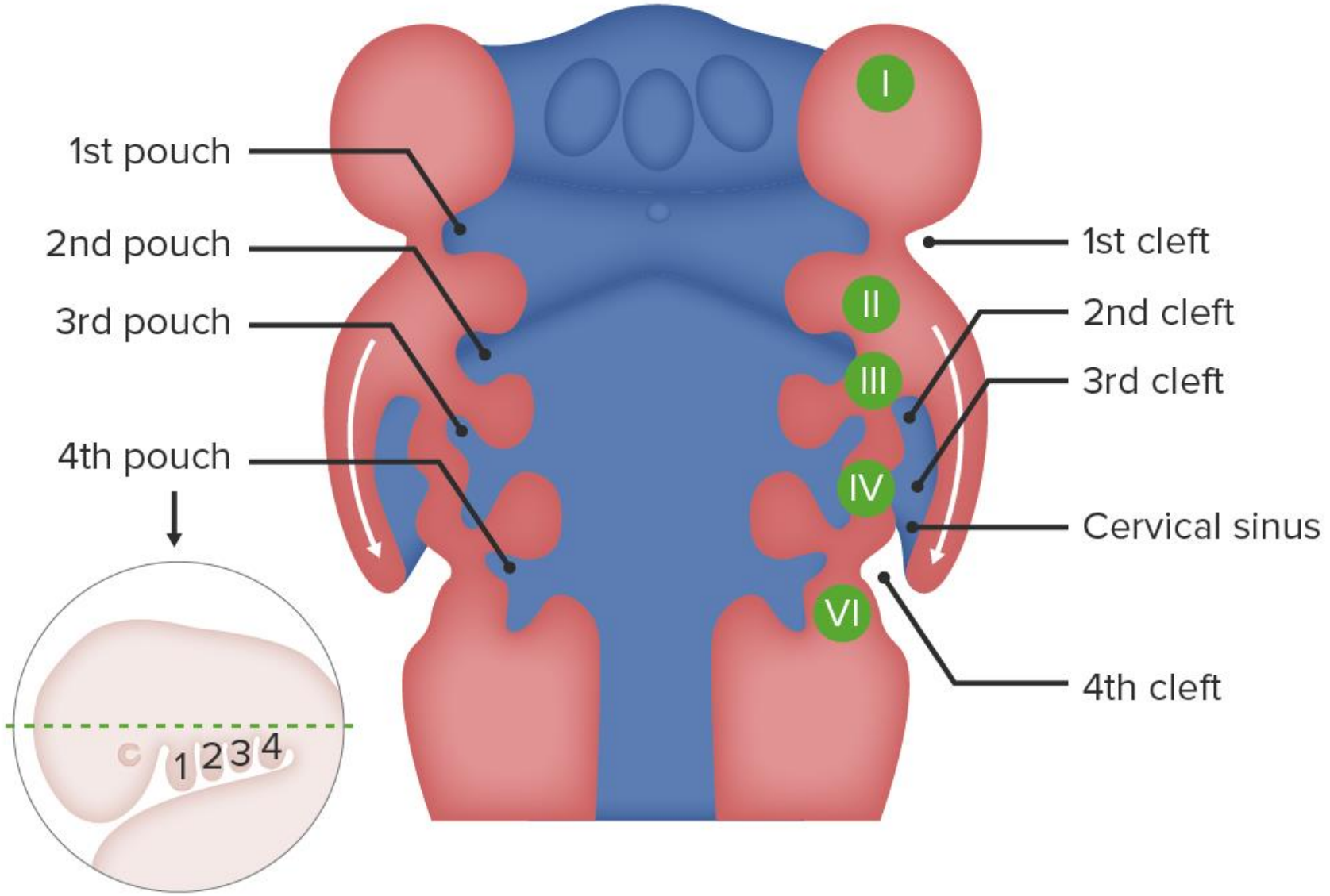
Derivatives of primitive pharyngs

- Thyroid gland
- Tongue

PHARYNGEAL APPARATUS



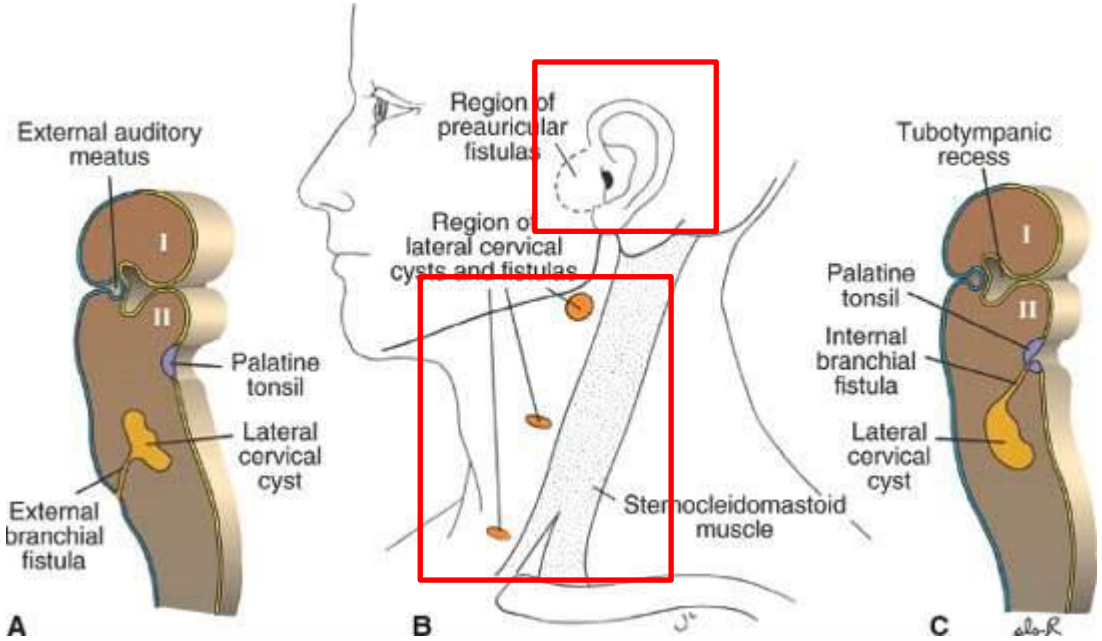
PHARYNGEAL APPARATUS – SINUS CERVICALIS

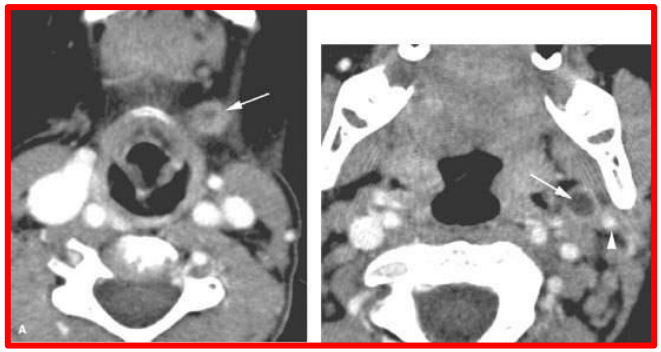


PHARYNGEAL APPARATUS

Derivative of ectodermal ridge	Pharyngeal arch	Aortal arch	Cranial nerve	Example of branchiomeric muscles	Skeletal derivatives	Derivative of endodermal pouch
external acoustic meatus	1 mandibular	a. maxillaris	V trigeminus	masticatory	incus, maleus lig. sphenomandib. Meckel cartilage	middle ear cavity, tuba auditiva
disappear	2 hyoid	a. stapedia a. hyoidea	VII facialis	mimic	stapes proc. styloideus, hyoid cartilage.	fossa tonsillaris
	3	a. carotis interna	IX glossopharyngeus	m. stylopharyngeus	hyoid cartilage	thymus, parathyroid bodies (inf)
	4	a. subclavia dx. a. arcus aortae	X vagus	svaly faryngu a laryngu	laryngeal cartilages	parathyroid bodies (sup)

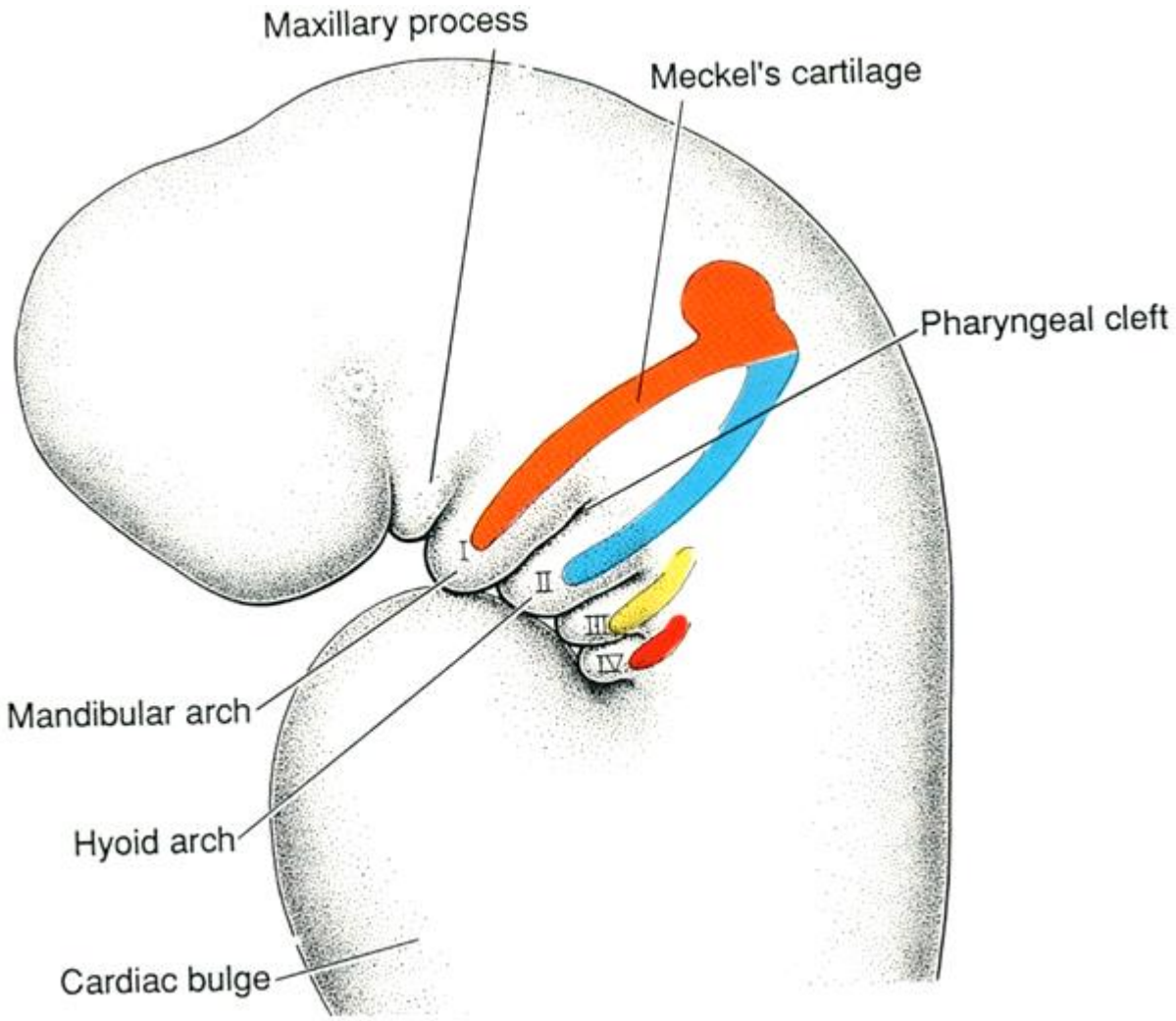
ABNORMALITIES OF PHARYNGEAL APPARATUS



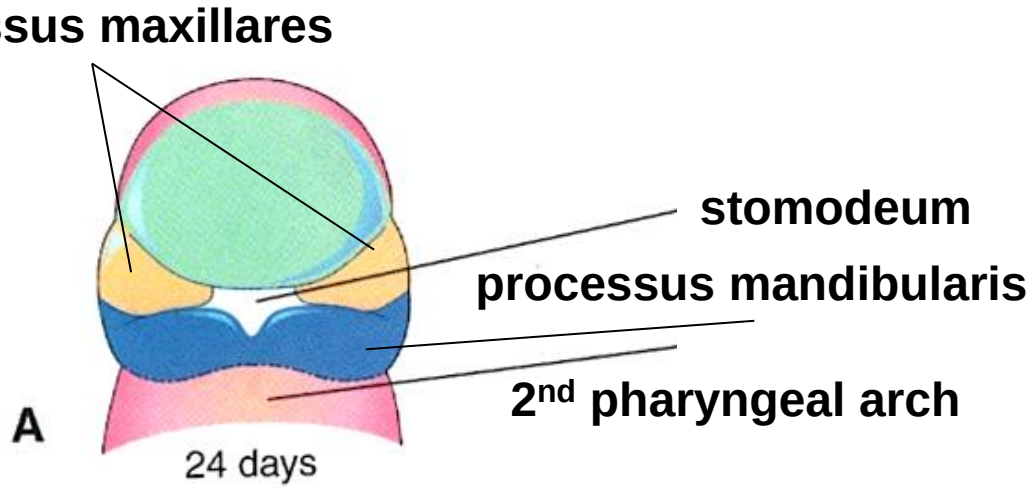


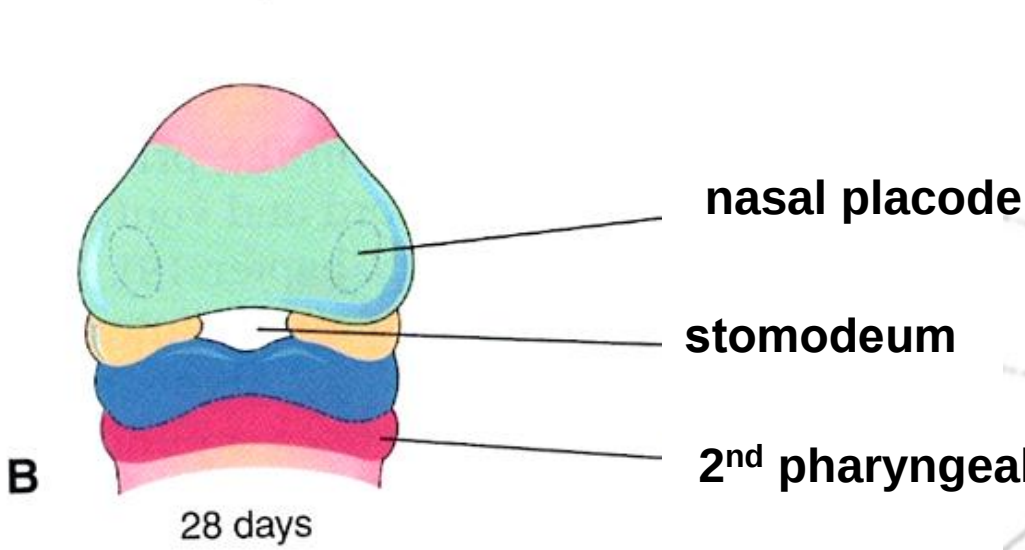
Radiology Key

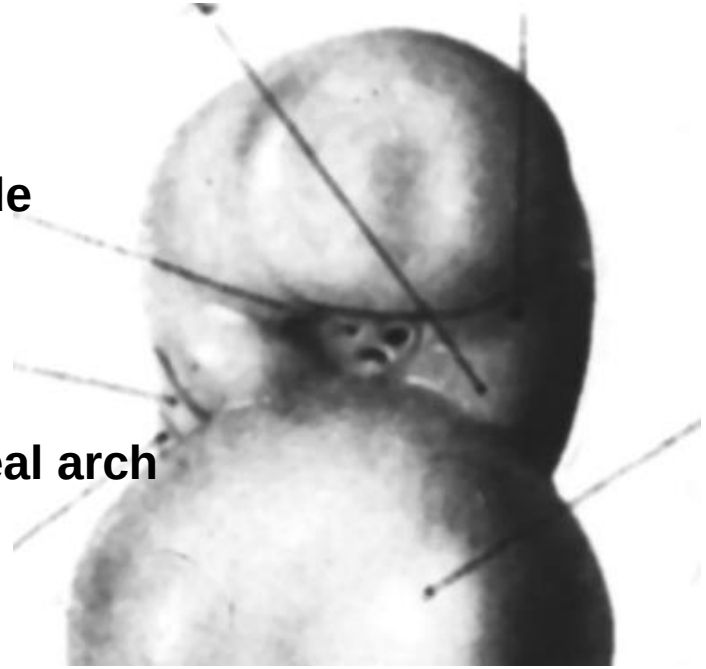
DEVELOPMENT OF FACE



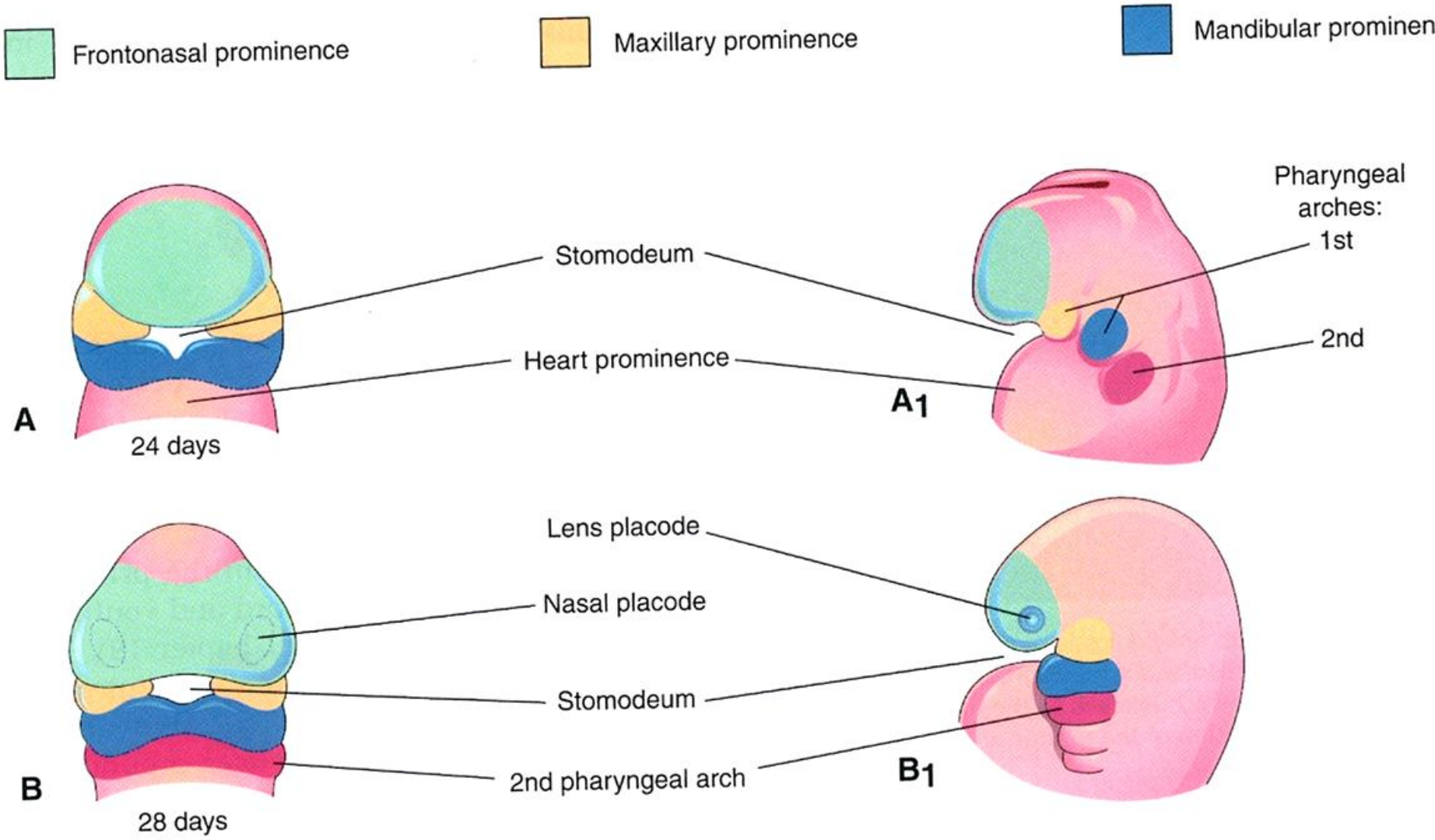
DEVELOPMENT OF FACE





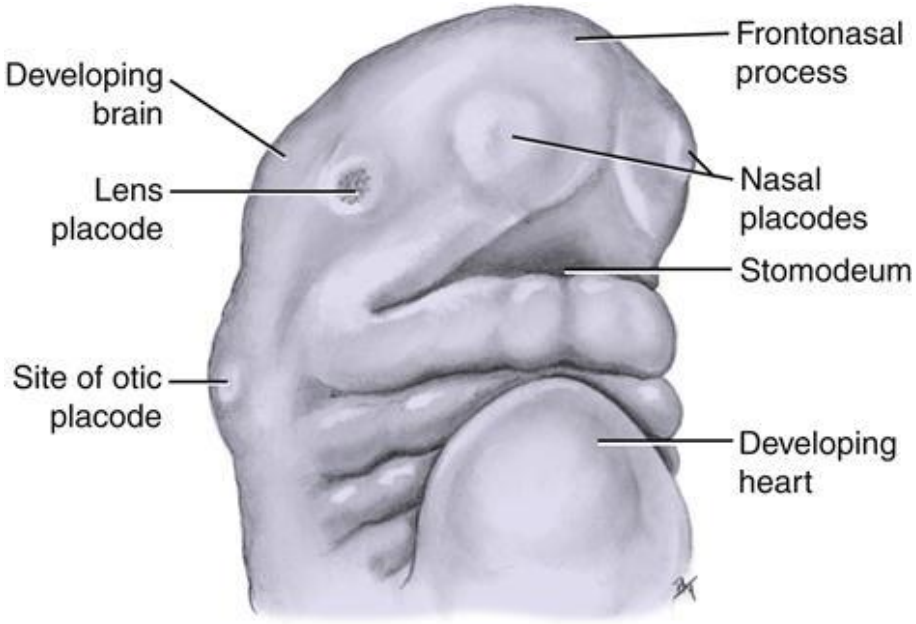


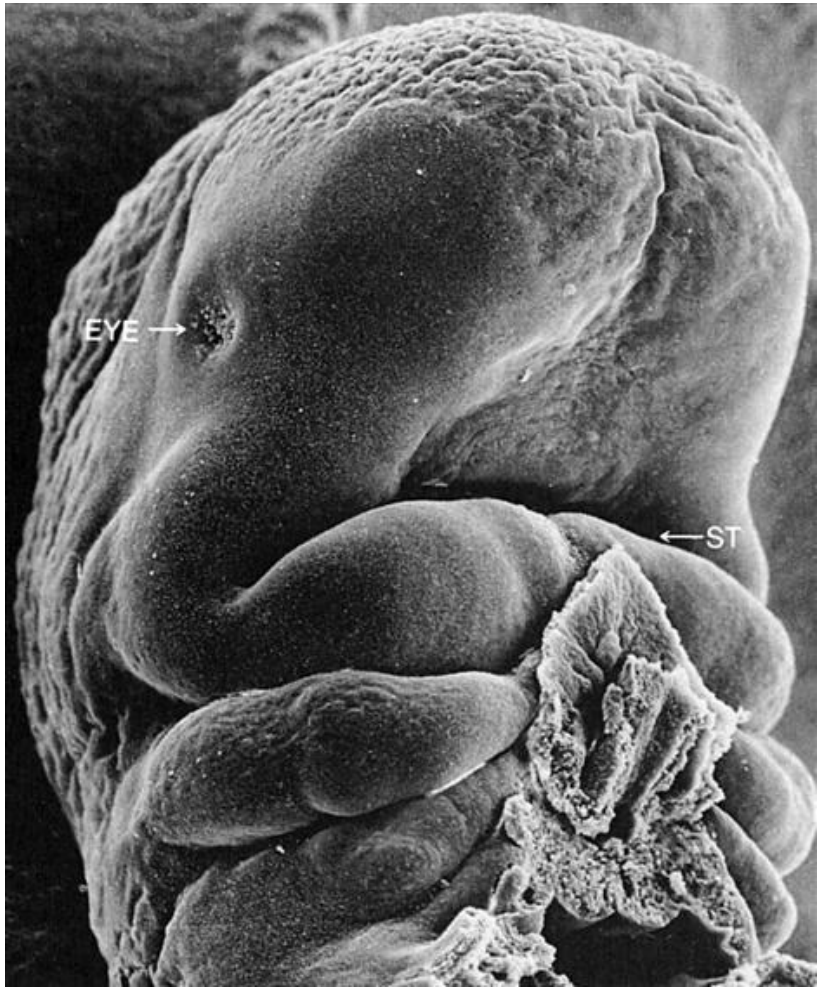
DEVELOPMENT OF FACE



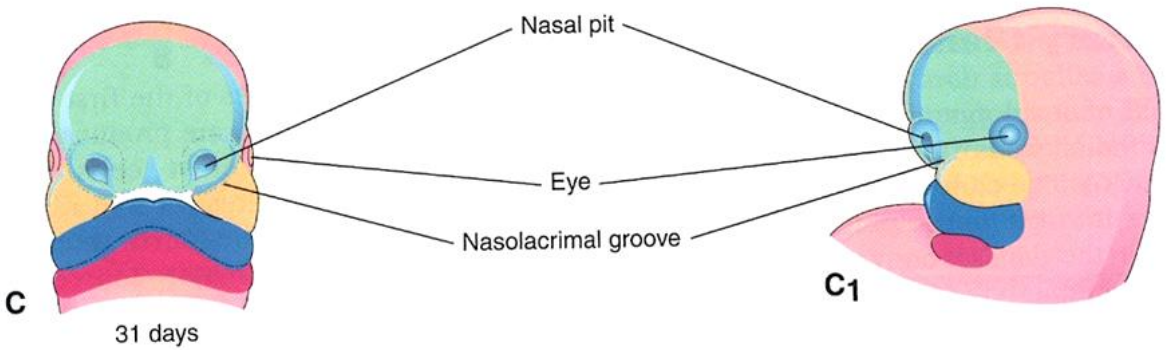
DEVELOPMENT OF FACE

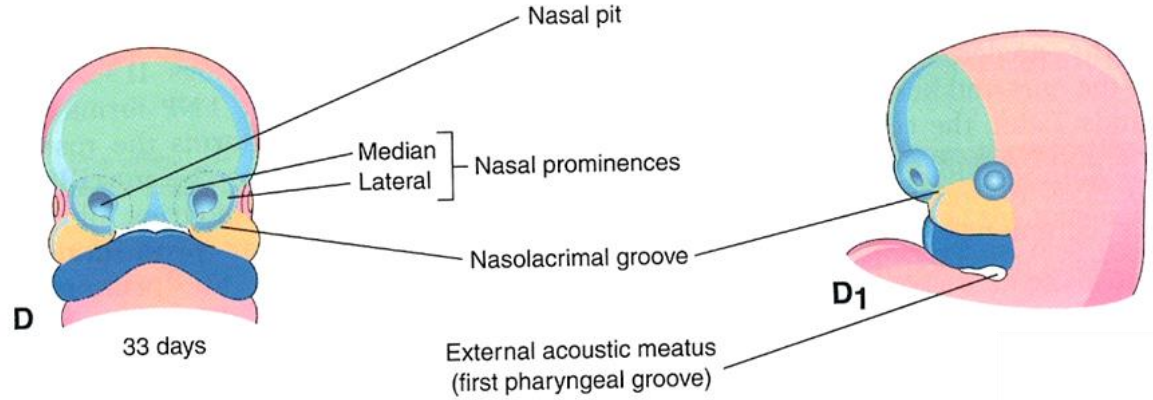
4th week

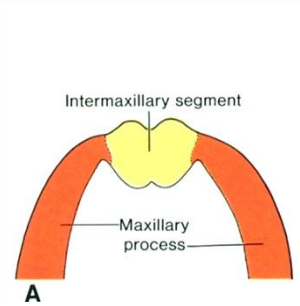


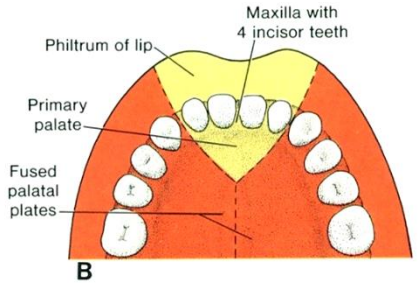


DEVELOPMENT OF FACE



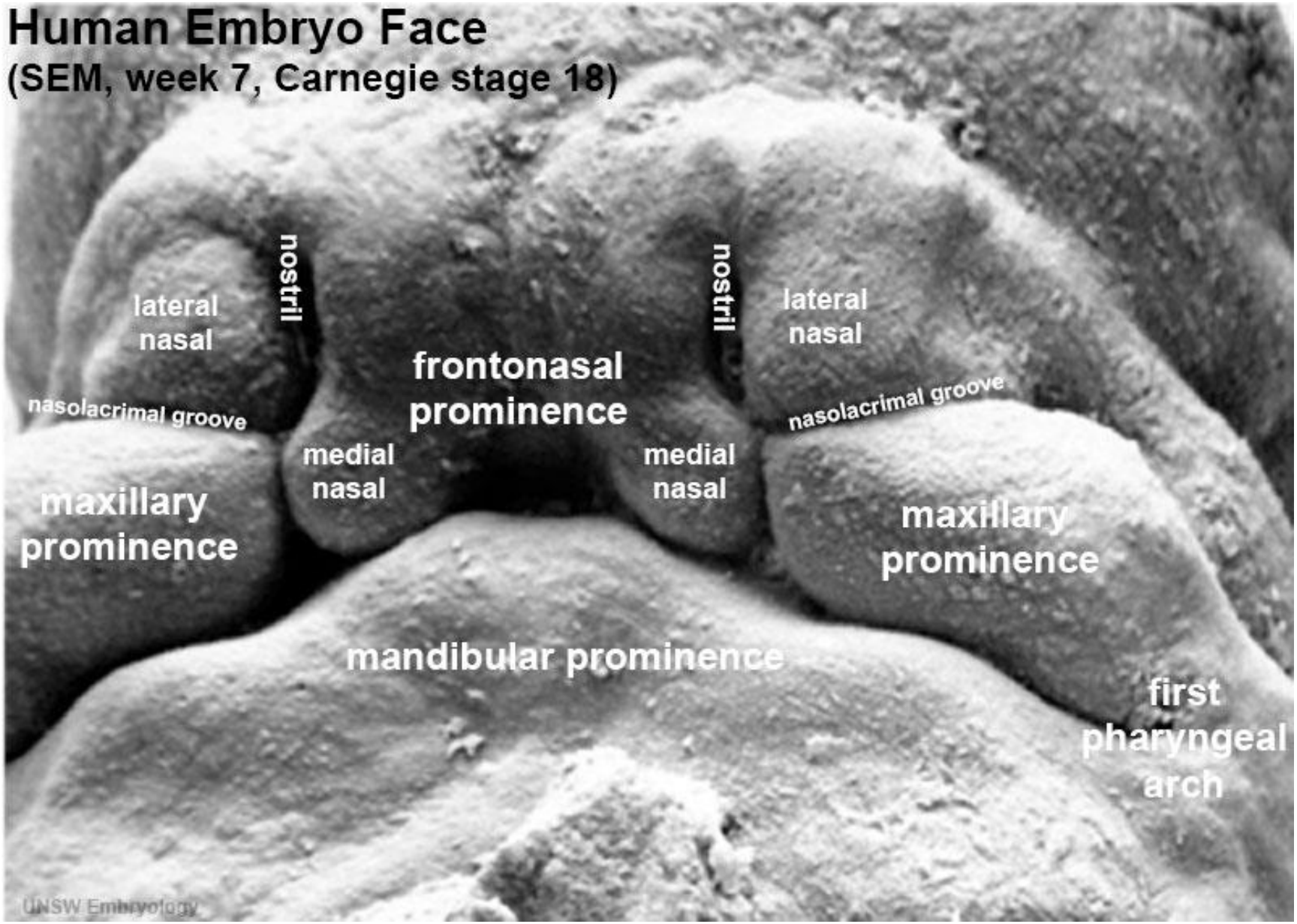




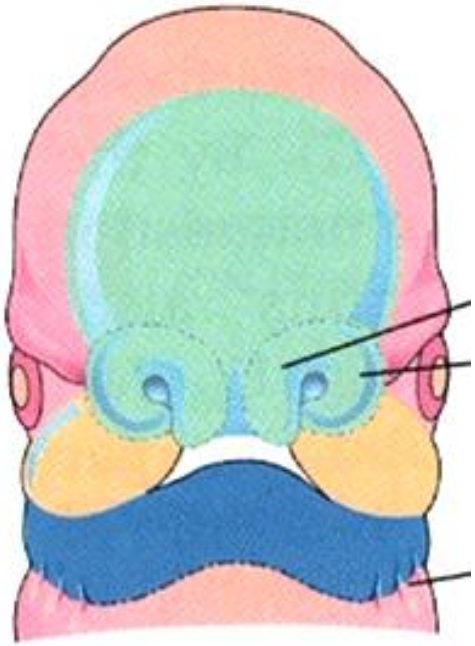


- nasal pits surrrounded by paired prominences – **medial and lateral nasal prominence**
- **area triangularis** (nose)
- **intermaxilary segment** (medial part of upper lip, part of upper jaw, primary palate)

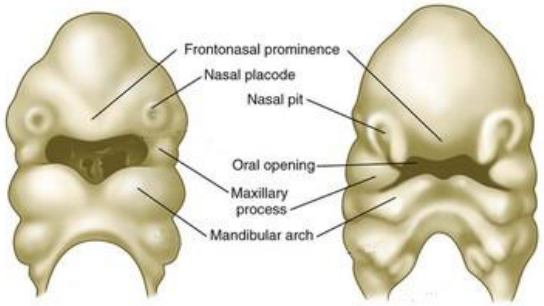
DEVELOPMENT OF FACE

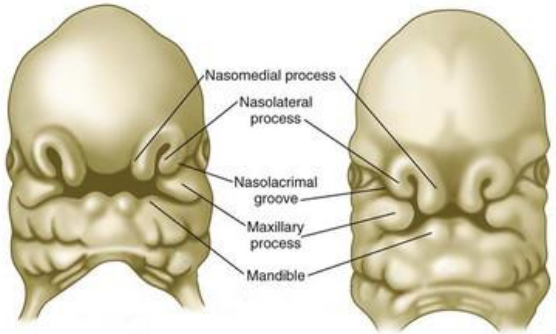


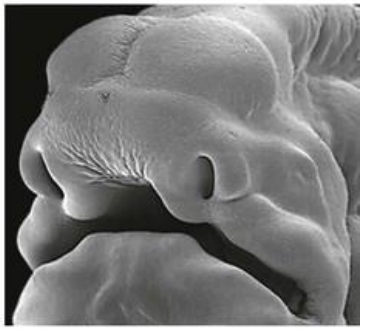
DEVELOPMENT OF FACE

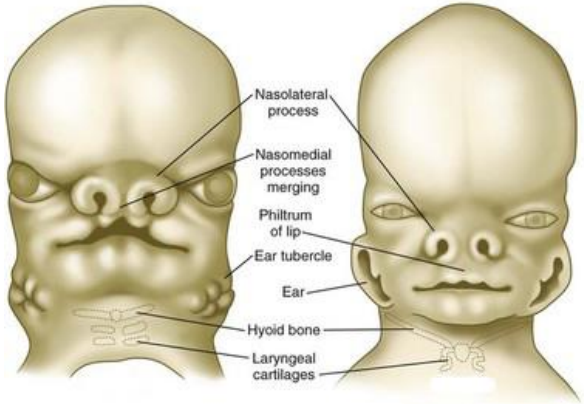


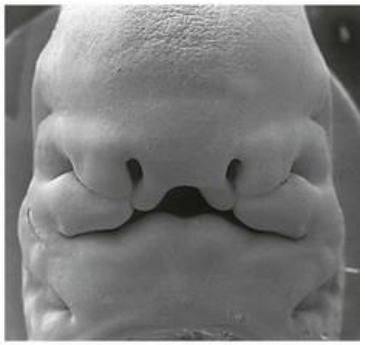
35 days











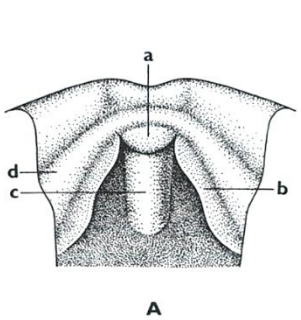
- maxillary prominences fuse with
1. intermaxillary segment
2. lateral nasal prominences
- sulcus nasolacrimalis

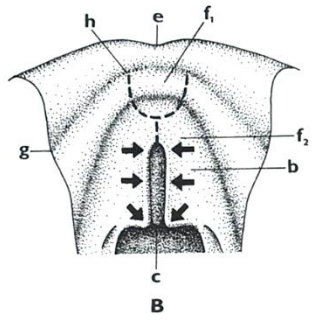
DEVELOPMENT OF FACE

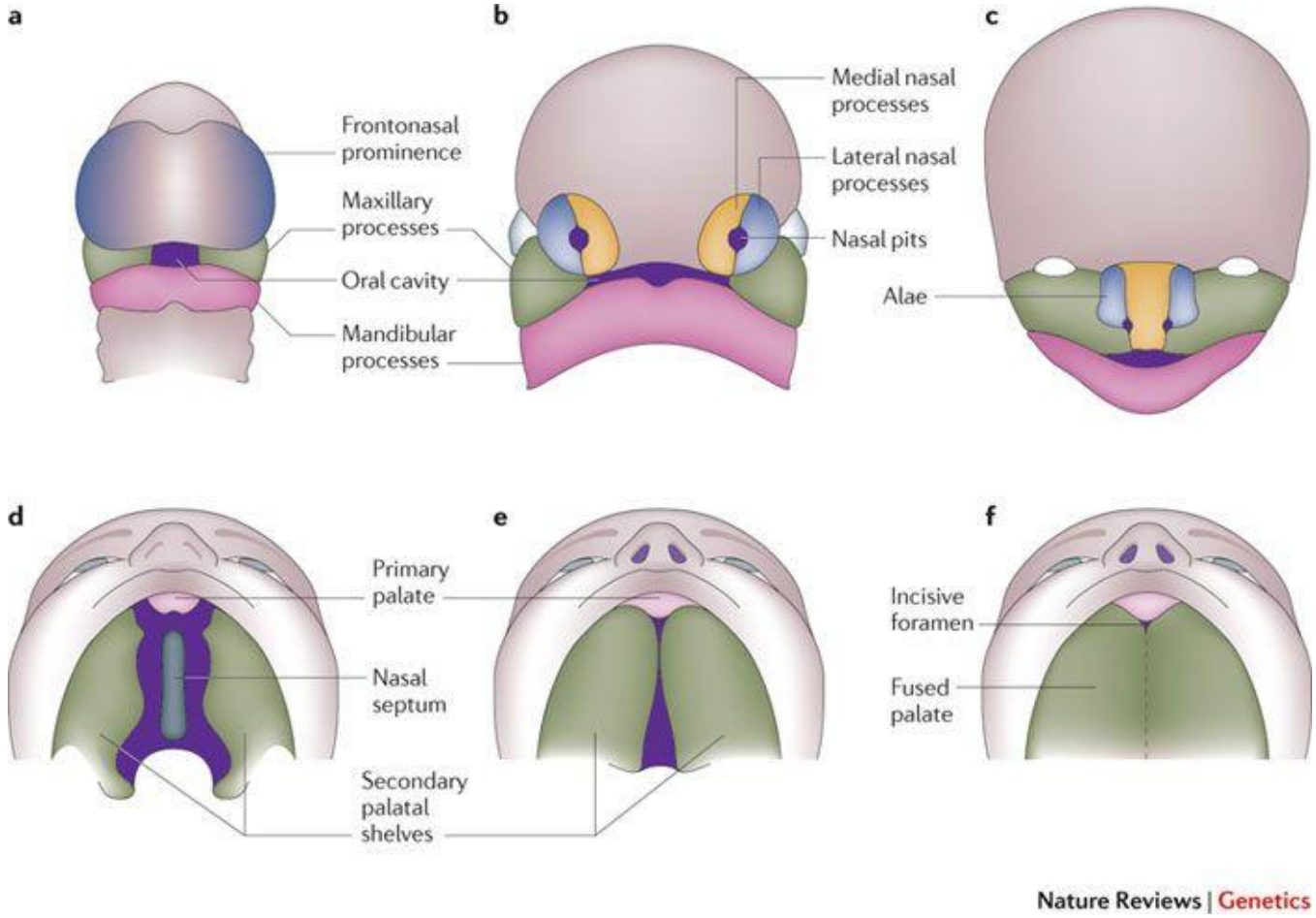
http://www.youtube.com/watch?v=4LQJIf0XLP0

DEVELOPMENT OF FACE - PALATE

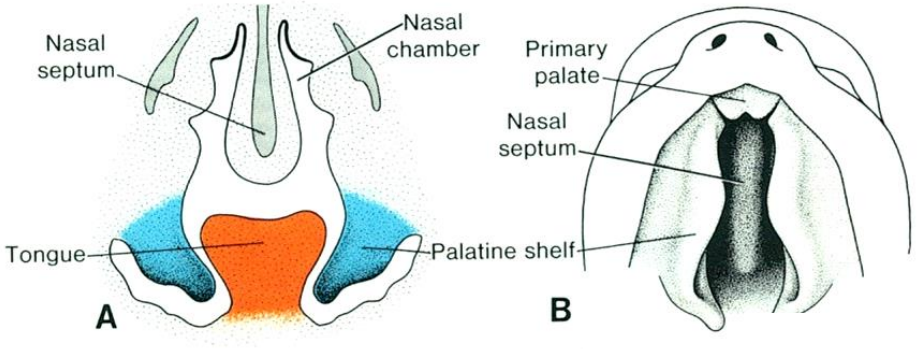
- **primary palate** (intermaxillary segment)
- **secondary palate** (lateral palate shelves

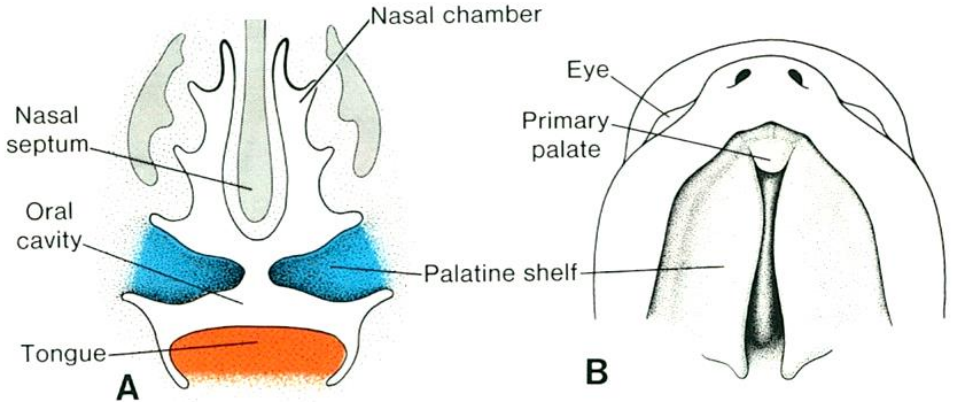


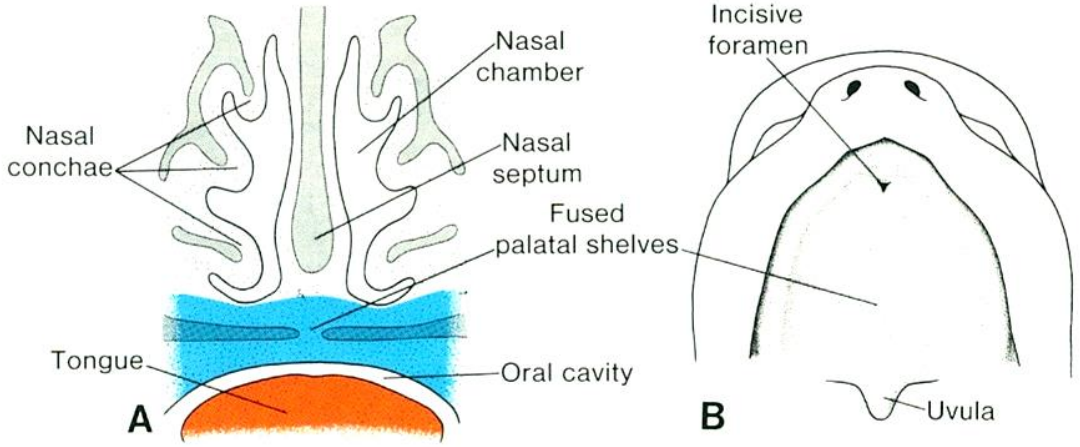




DEVELOPMENT OF FACE - PALATE



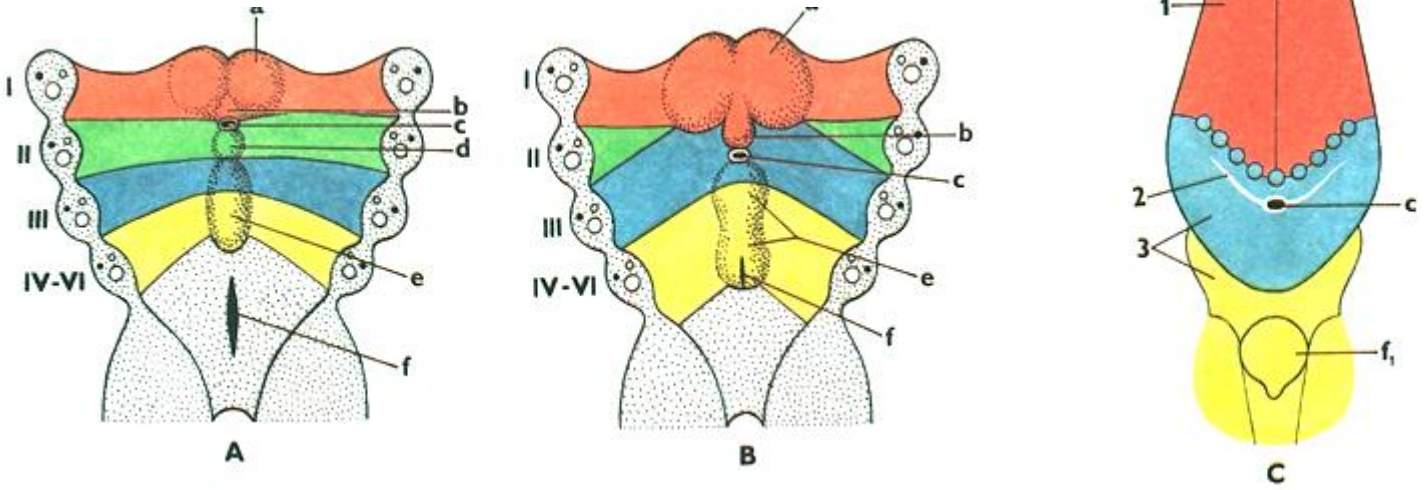




DEVELOPMENT OF TONGUE

Pharynx floor nearby pharyngeal arches:

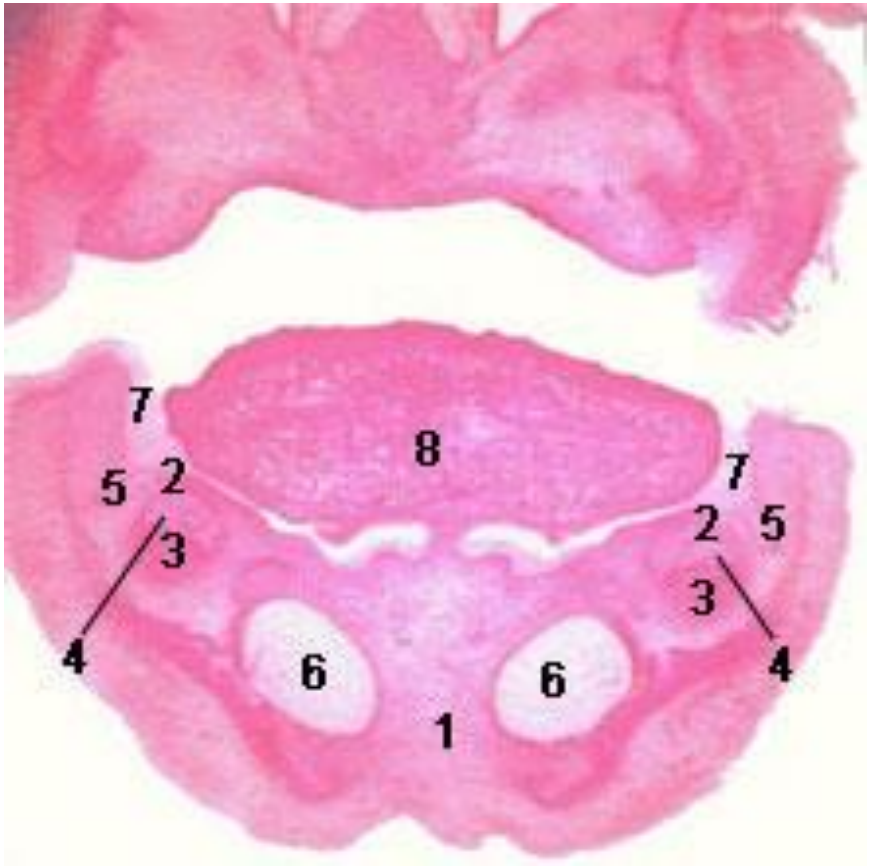
- I. tuberculum linguale laterale (dx. wt sin.) (paired) and tuberculum impar → **apex and corpus**
- III and IV. copula and eminentia hypobranchialis → **radix**



DEVELOPMENT OF VESTIBULUM ORIS

Vestibular lamina

- Dental lamina
- Labiogingival lamina

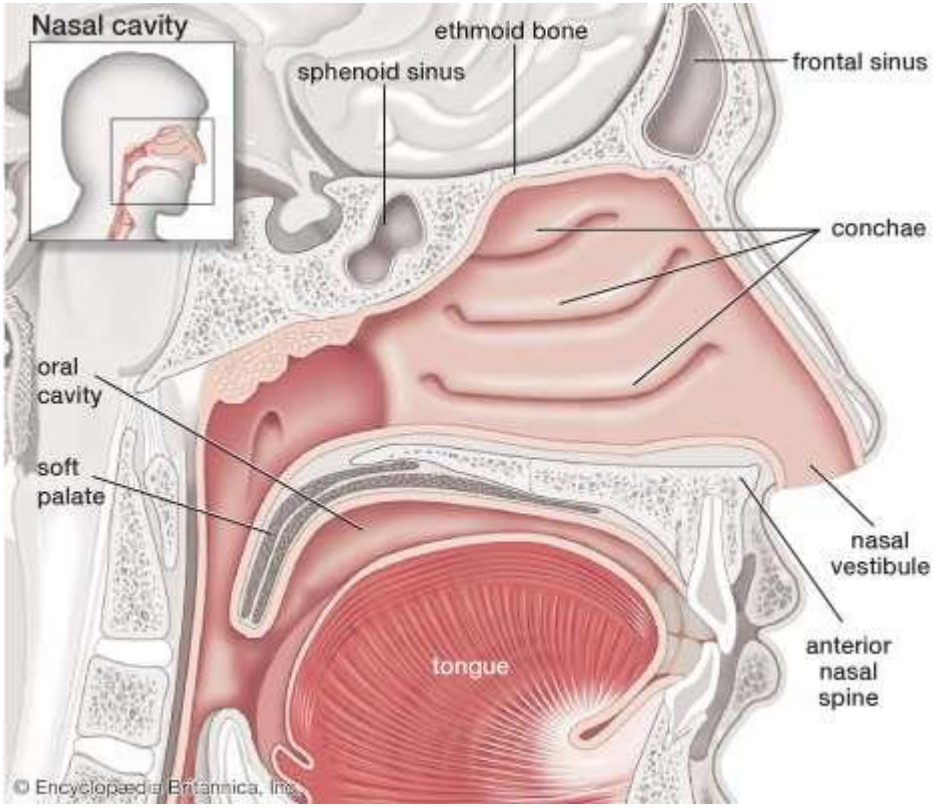


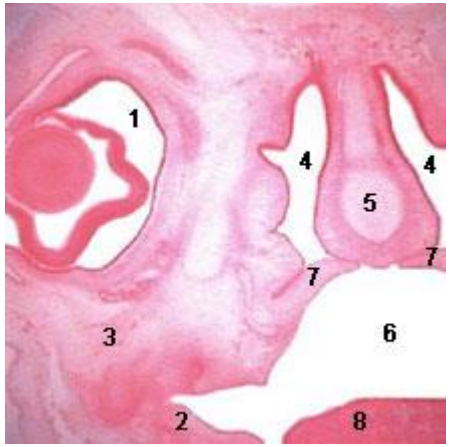
1. Mandible
2. Dental lamina
3. Dental papilla
4. Enamel organ
5. Labiogingival lamina
6. Meckel's cartilage
7. Oral epithelium
8. Tongue

http://www.chronolab.com/atlas/embryo/histo_head.htm

DEVELOPMENT OF VESTIBULUM NASI

- **Nasal canals** – primitive choans
- **Nasal septum** – from area triangularis – fusing with secondary palate

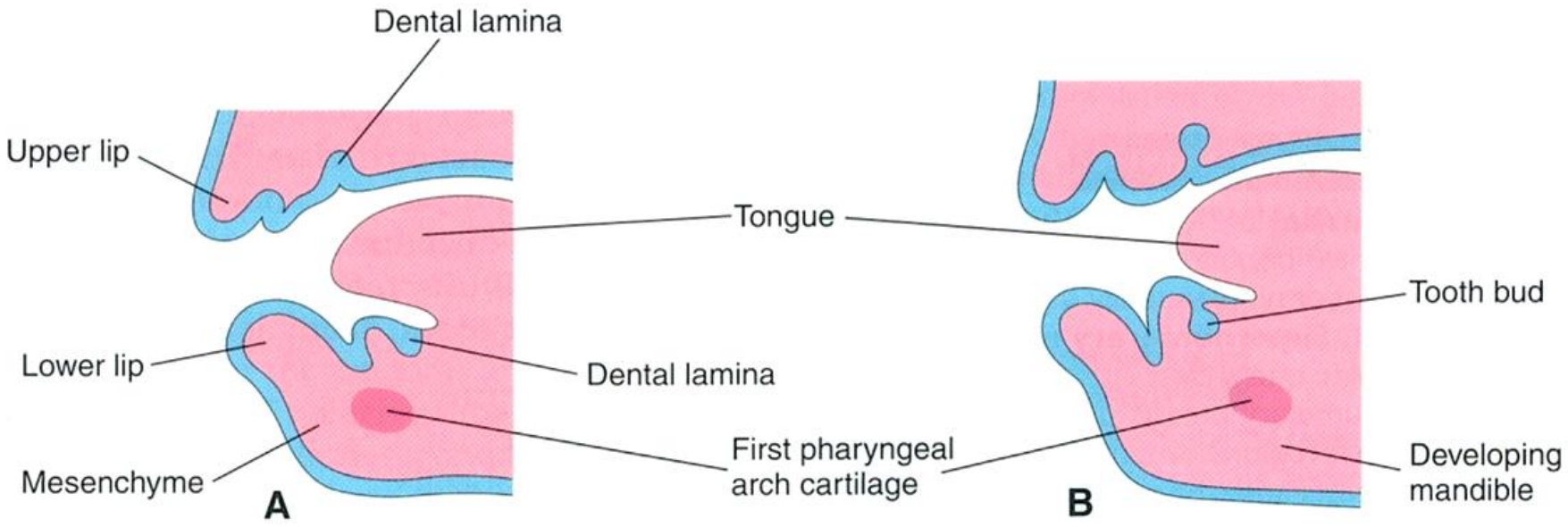




1. Eye
2. Mandibular bone
3. Maxillary bone
4. Nasal cavity
5. Nasal septum
6. Oral cavity
7. Palatine process
8. Tongue

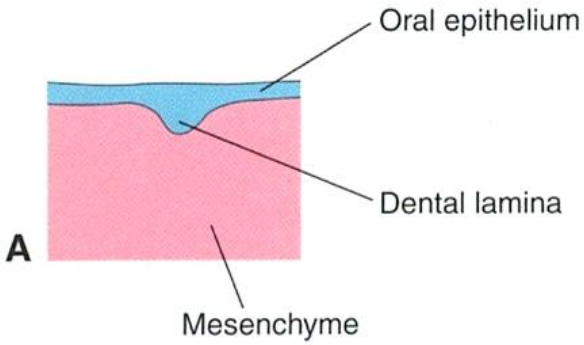
Interactions of ectoderm and mesenchyme

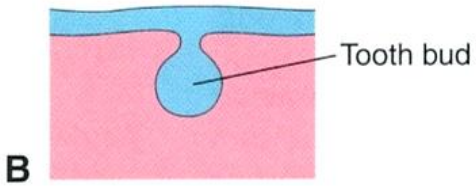
- primary dental lamina – teeth primordia

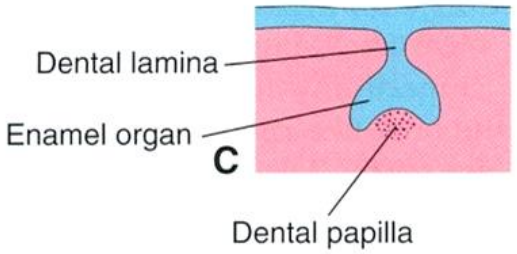


DEVELOPMENT OF TOOTH

- inititation stage
- tooth bud (primordium)
- cap stage
- bell stage (enamel organ, ectoderm), dental pulp (mesenchyme)

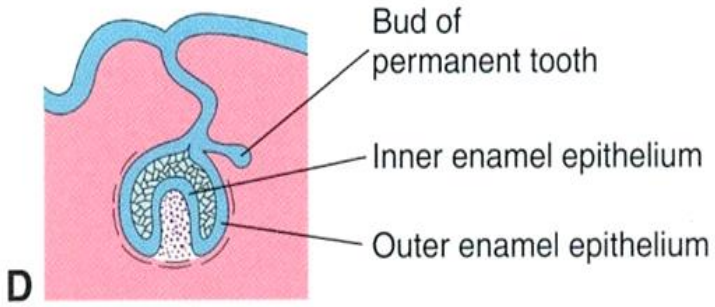


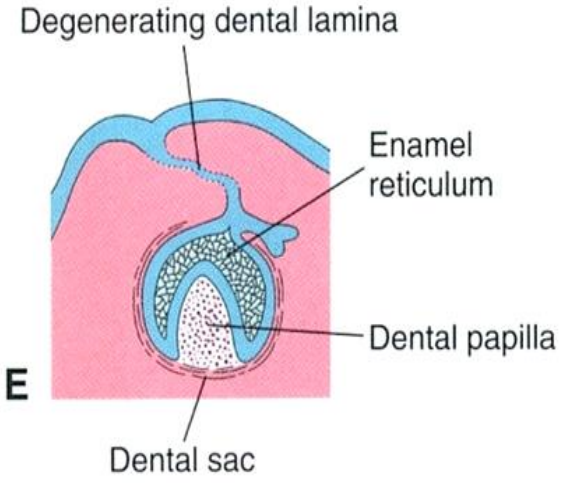


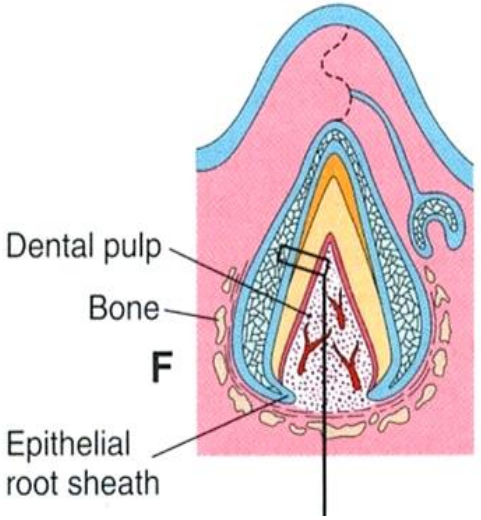


DEVELOPMENT OF TOOTH

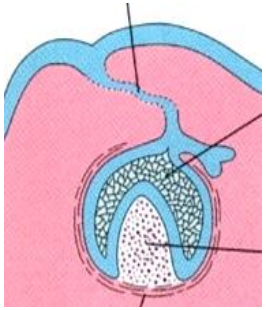
- bell stage – enamel, differentiation of odontoblasts from cells of dental pulp
- enamel prisms and dentin matrix
- dental sac

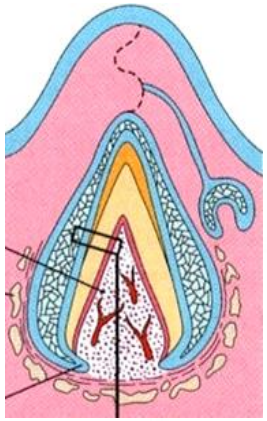




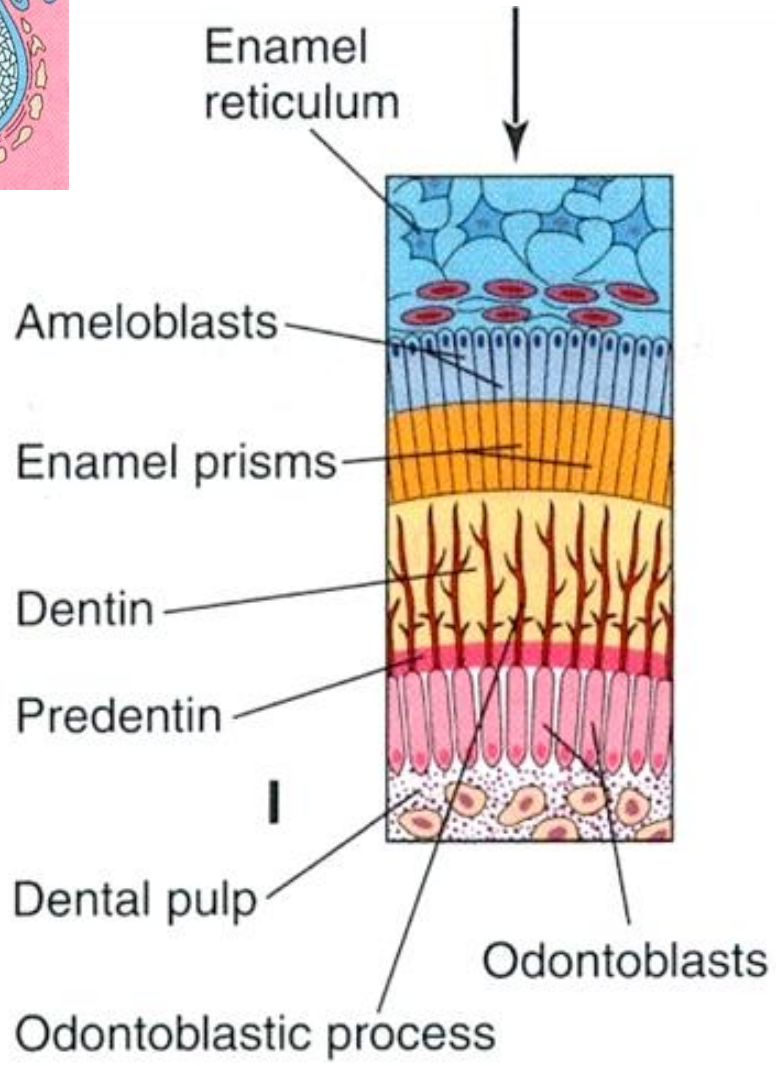


DEVELOPMENT OF TOOTH





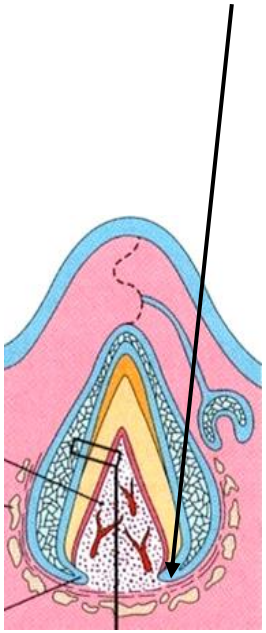
- enamel organ (inner and outer ameloblasts, stratum intermedium stellate reticulum - pulp) – prisms
- odontoblast differentiation - dentin matrix, (processes of odontoblasts = Tomes fibers)

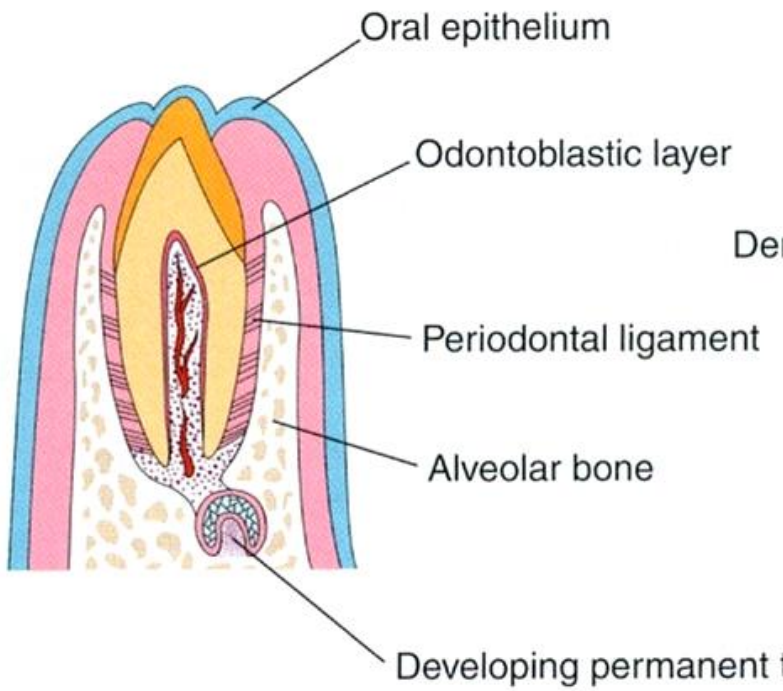


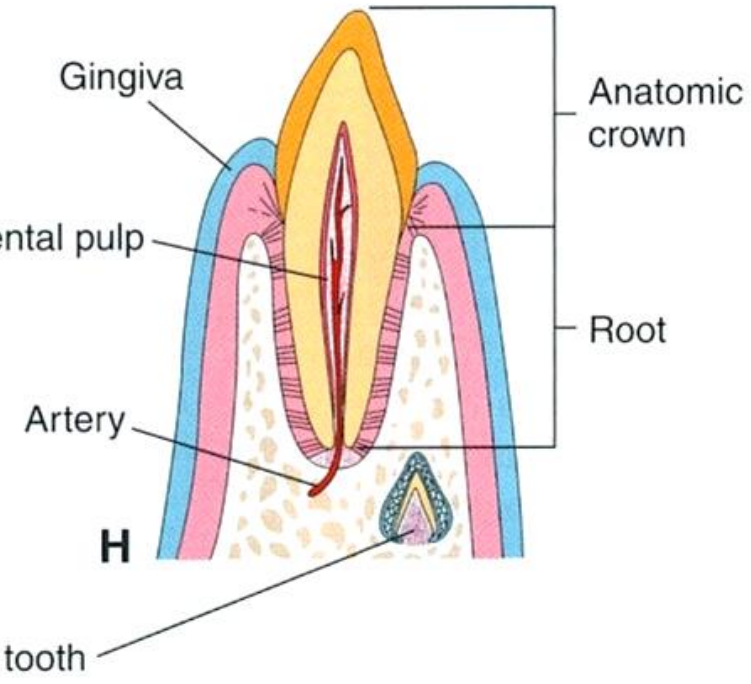
DEVELOPMENT OF TOOTH

root development – tooth eruption

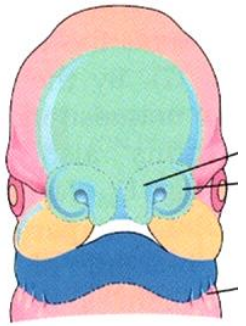
cervical loop → Hertwig epithelial root sheath



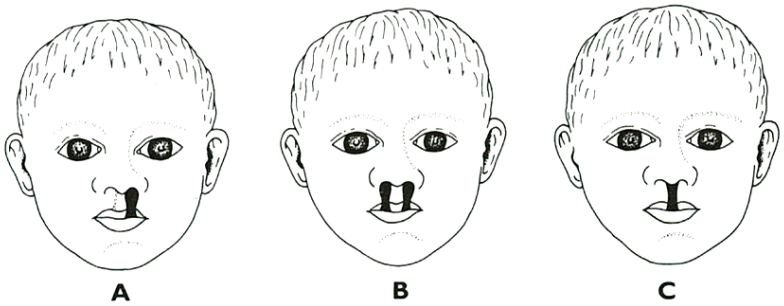




Soft tissue clefts


35 days

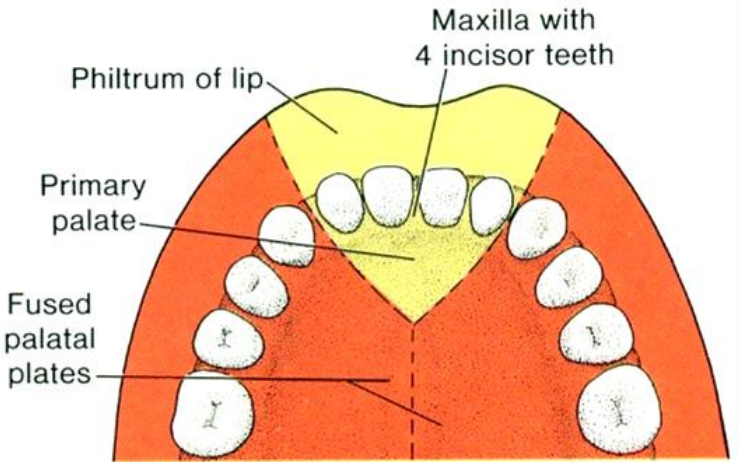
- upper lip (*cheiloschisis*) – lateral (uni, bi), medial
- lower lip – medial, always combined (jaw, tongue) – *gnathoschisis et cheiloschisis inf*.
- oblique cleft (*fissura orbitofacialis*)
- transferse cleft (*fissura transversa*)



ABNORMALITIES OF FACE DEVELOPMENT - CLEFTS

Hard tissue clefts

- upper jaw
- between 2nd incisor and canine
- unilateral or bilateral
- always combined with palate cleft (cheilognathoschisis)
- palate (palatoschisis)
- primary (before foramen incisivum)
- secondary (behind foramen incisivum)
- combined: cheilognathopalatoschisis



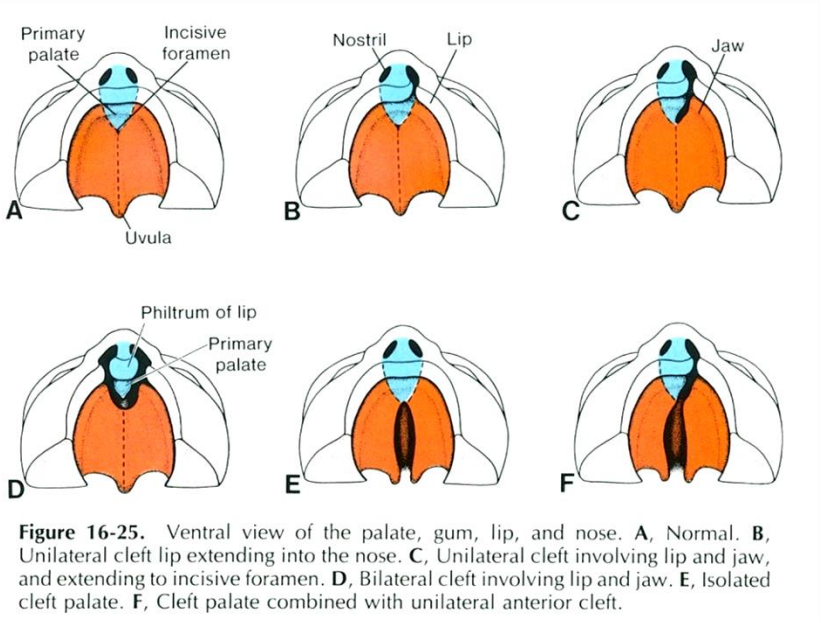


Figure 16-25. Ventral view of the palate, gum, lip, and nose. **A**, Normal. **B**, Unilateral cleft lip extending into the nose. **C**, Unilateral cleft involving lip and jaw, and extending to incisive foramen. **D**, Bilateral cleft involving lip and jaw. **E**, Isolated cleft palate. **F**, Cleft palate combined with unilateral anterior cleft.

ABNORMALITIES OF FACE DEVELOPMENT - CLEFTS

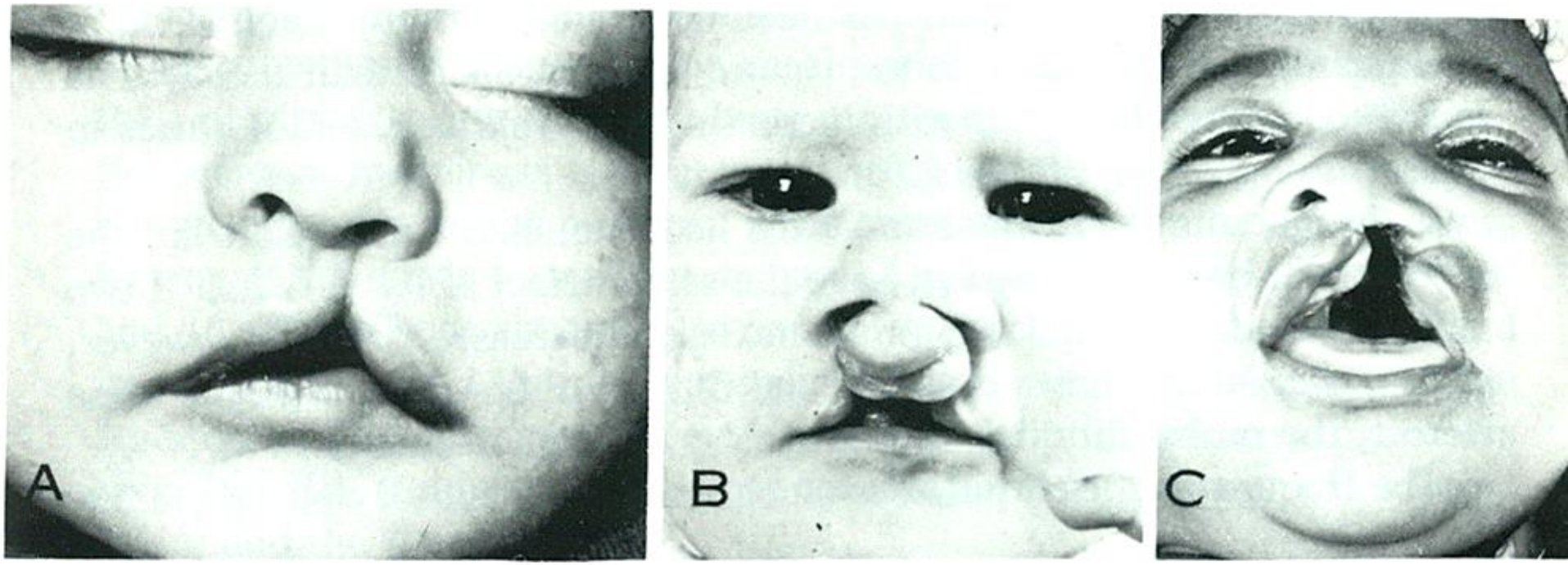
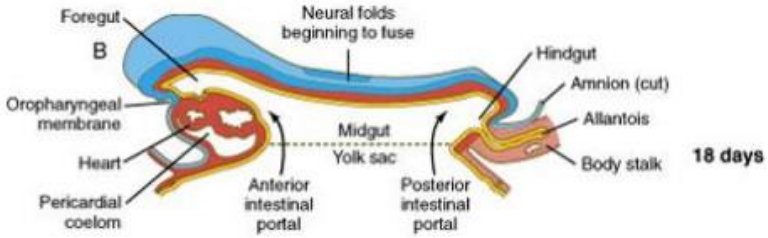
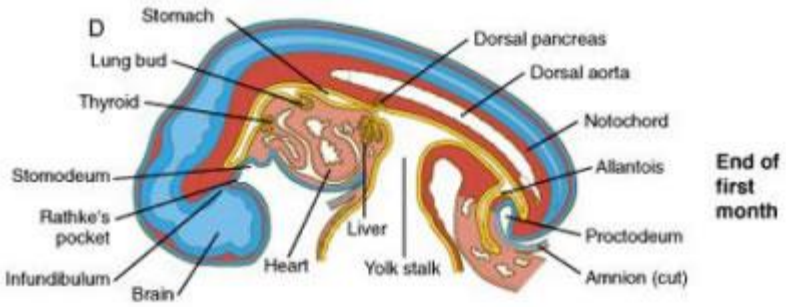


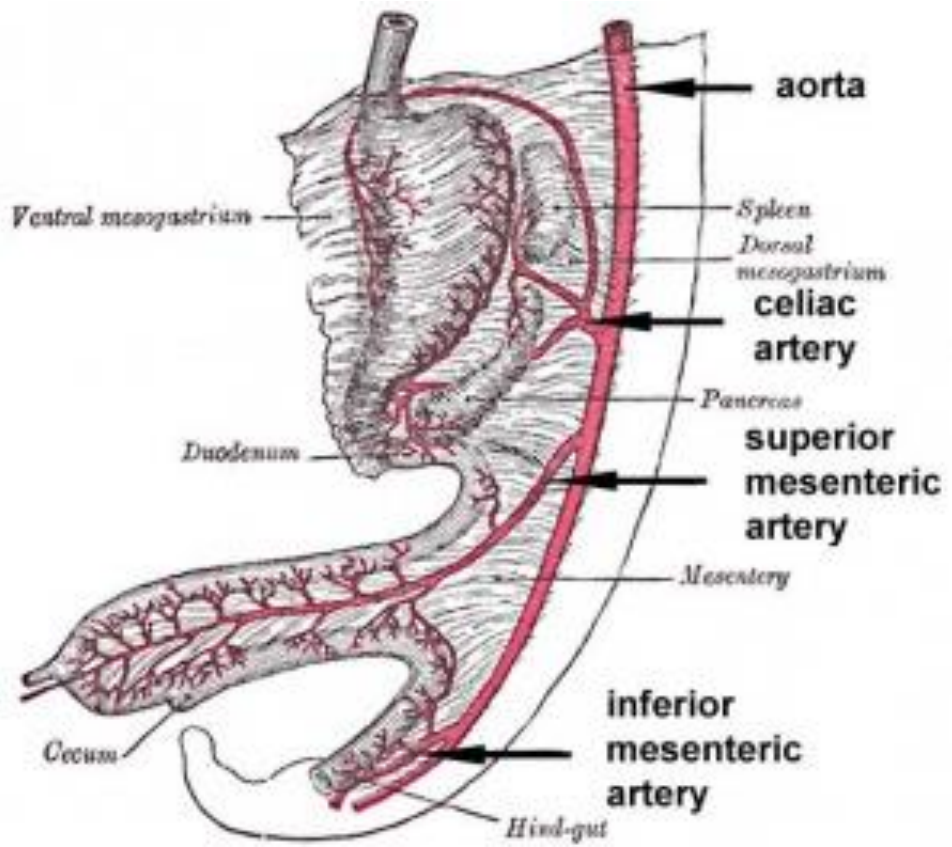
Figure 16-26. Photographs of incomplete cleft lip (**A**), bilateral cleft lip (**B**), and cleft lip, cleft jaw, and cleft palate (**C**). (Courtesy Dr. M. Edgerton, Department of Plastic Surgery, University of Virginia.)

http://www.youtube.com/watch?v=agmSH8_mLz0

Primitive gut

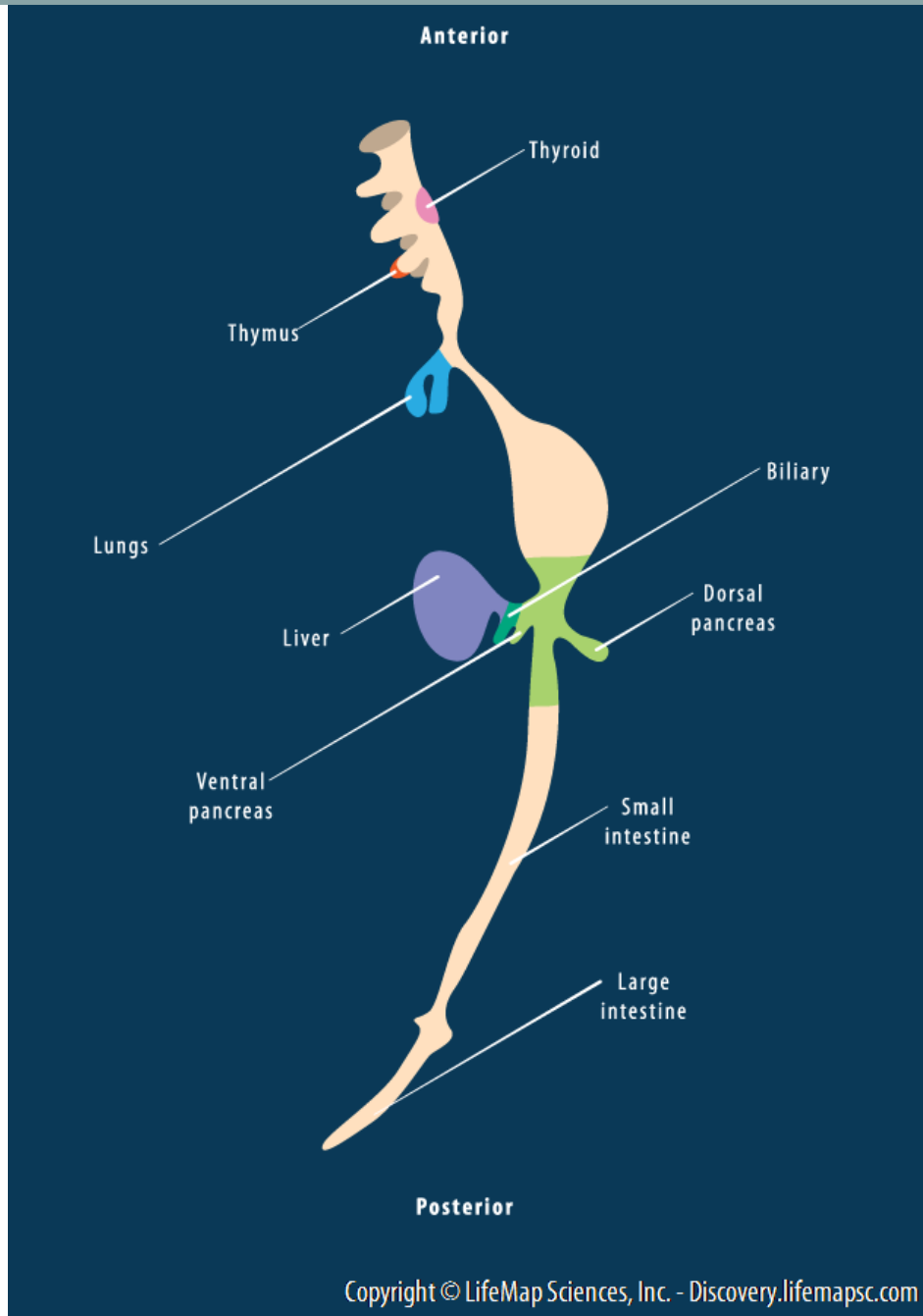






PRIMITIVE GUT

Derivatives of primitive gut



PRIMITIVE GUT VASCULARISATION

Four regions according to structural and molecular patterns

pharynx

– buccopharyngeal membrane – tracheobronchial diverticle

foregut

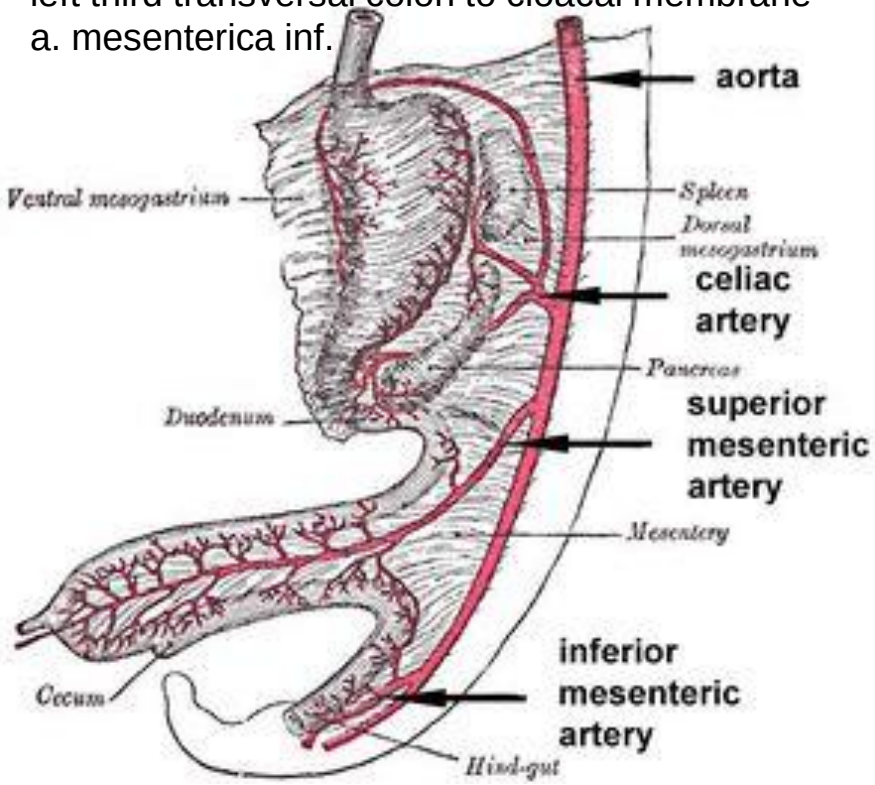
- caudally to liver diverticle
- t. coeliacus

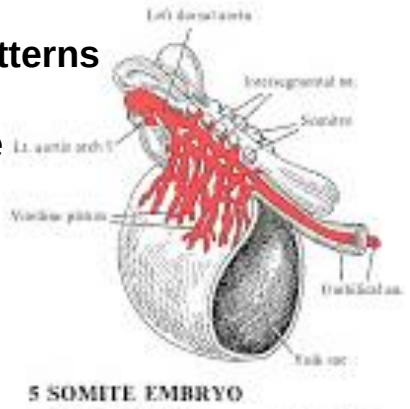
midgut

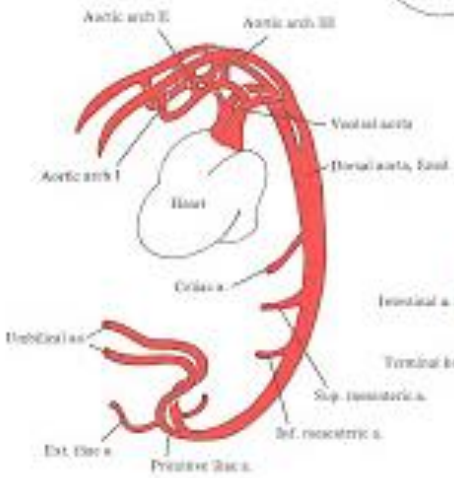
- a. mesenterica sup.

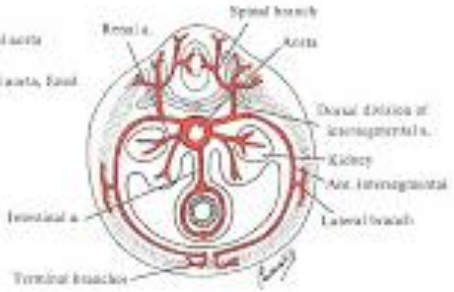
hindgut

- left third transversal colon to cloacal membrane
- a. mesenterica inf.



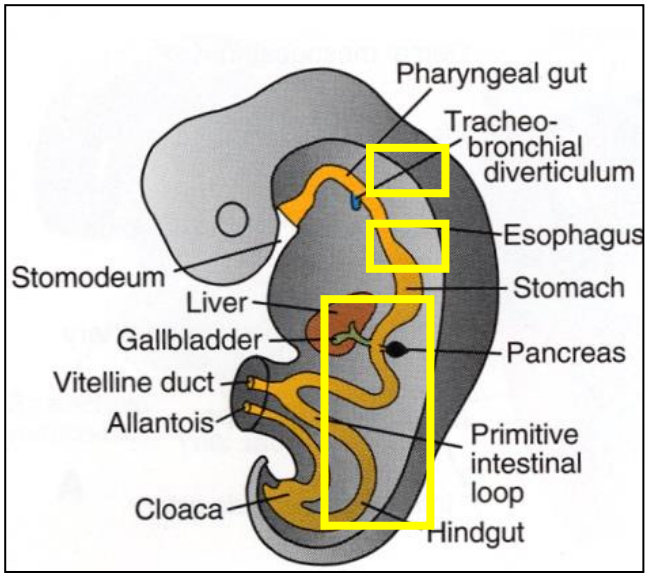






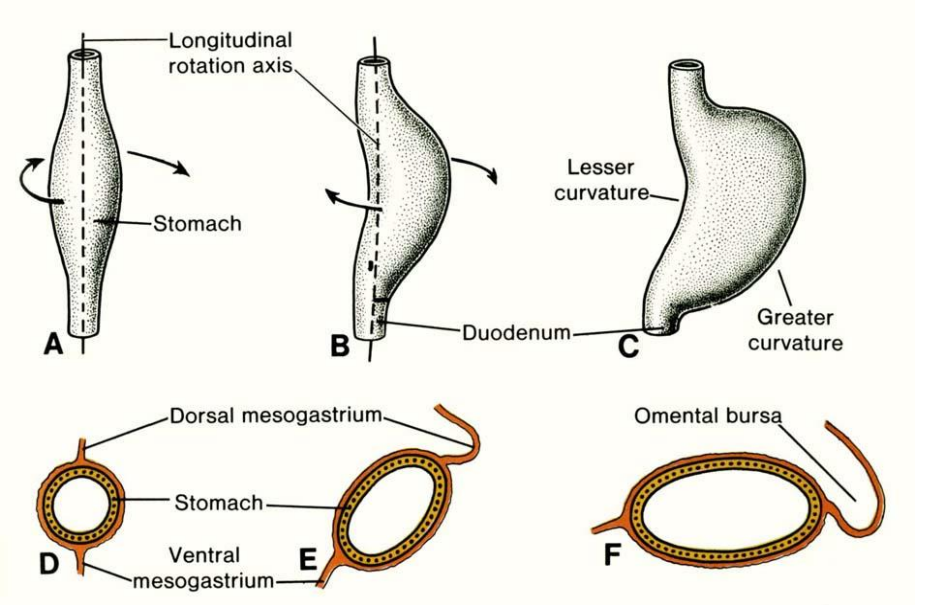
EARLY EVENTS IN GIT DEVELOPMENT

- **Esophagus**
  - caudal part of foregut from laryngotracheal diverticle
  - endoderm (epithelium and glands), c.t. - mesoderm

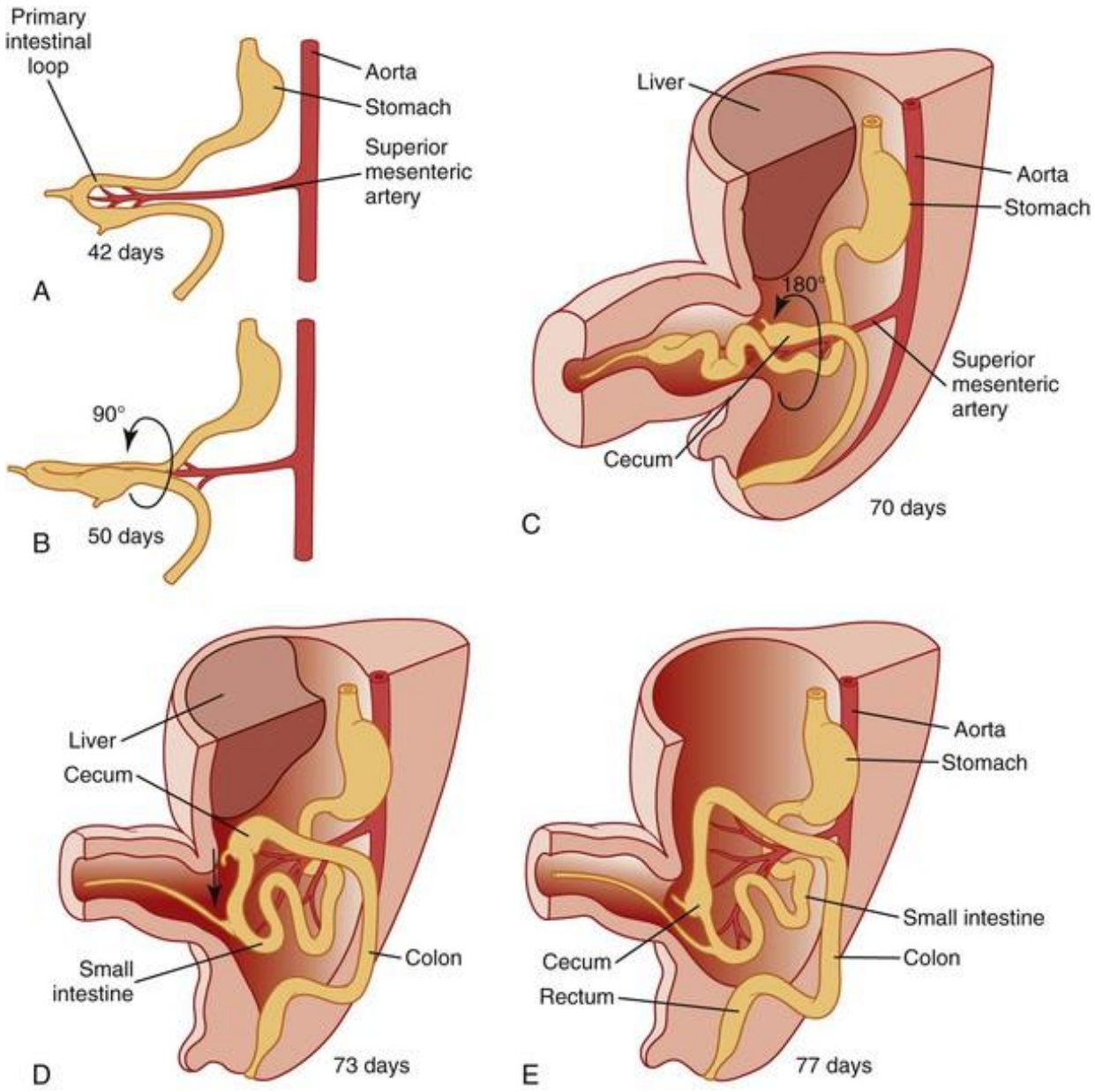


- **Stomach**
  - -4th week – fusiform dilatation of foregut
  - symmetric - asymmetric
  - major and minor curvature
  - rotation - longitudinal and sagittal axis
  - definitive localization and morphology about week 8 i.u.

- **Gut**
  - midgut – duodenal and umbilical loop
  - rotation
  - physilogical umbilical hernia



DEVELOPMENT OF GIT



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