The Digestive System

1-Digestive (alimentary) tract:- oral cavity, oropharynx, oesophagus, stomach, small intestine, large intestine and the anus

2- large associated glands:- salivary glands, liver and pancreas

Functions of the digestive system:

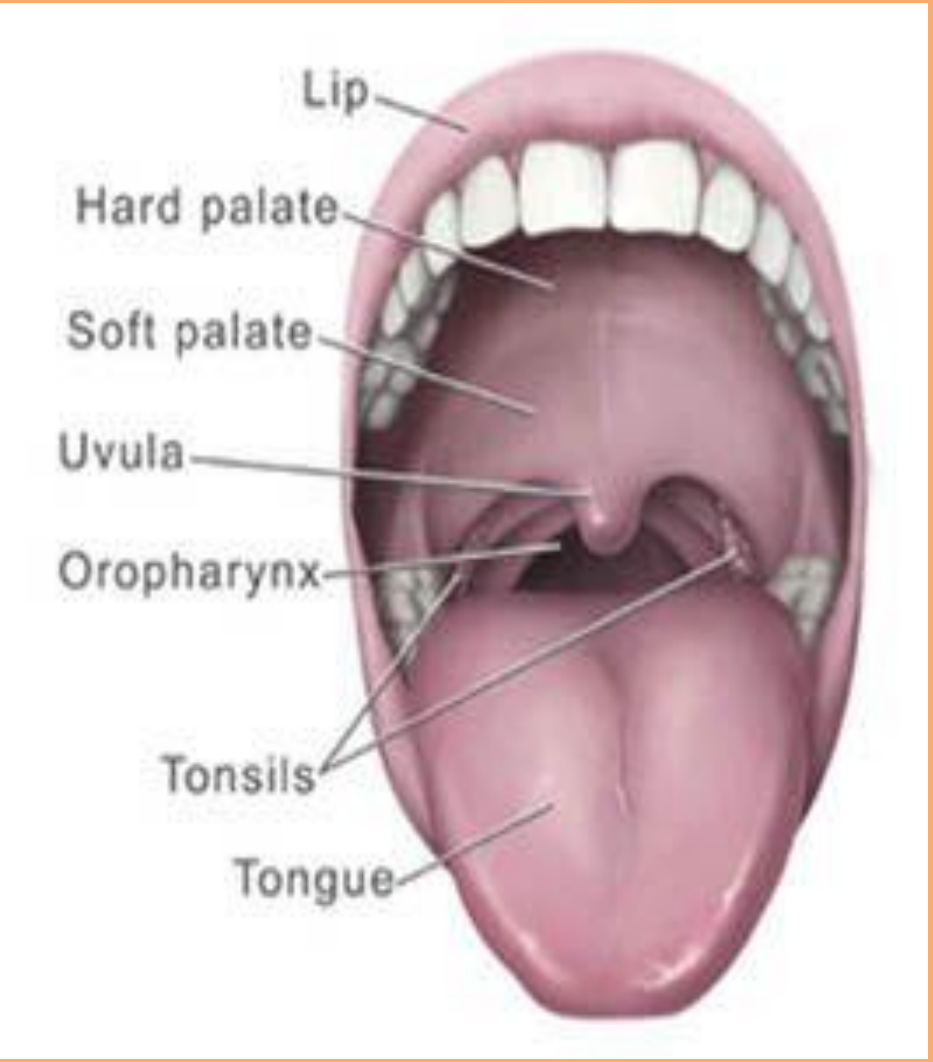
1. Mastication, tasting and swallowing of food
2. Digestion of food by digestive enzymes in stomach and small intestine
3. Absorption of digested food through the intestine
4. Elimination of the undigested food through the anous
5. Secretion of some hormones as gastrin, serotonin, panceozymin, cholecyctokinin and glucagon
6. Metabolism of the absorbed food by the liver

I. Oral cavity

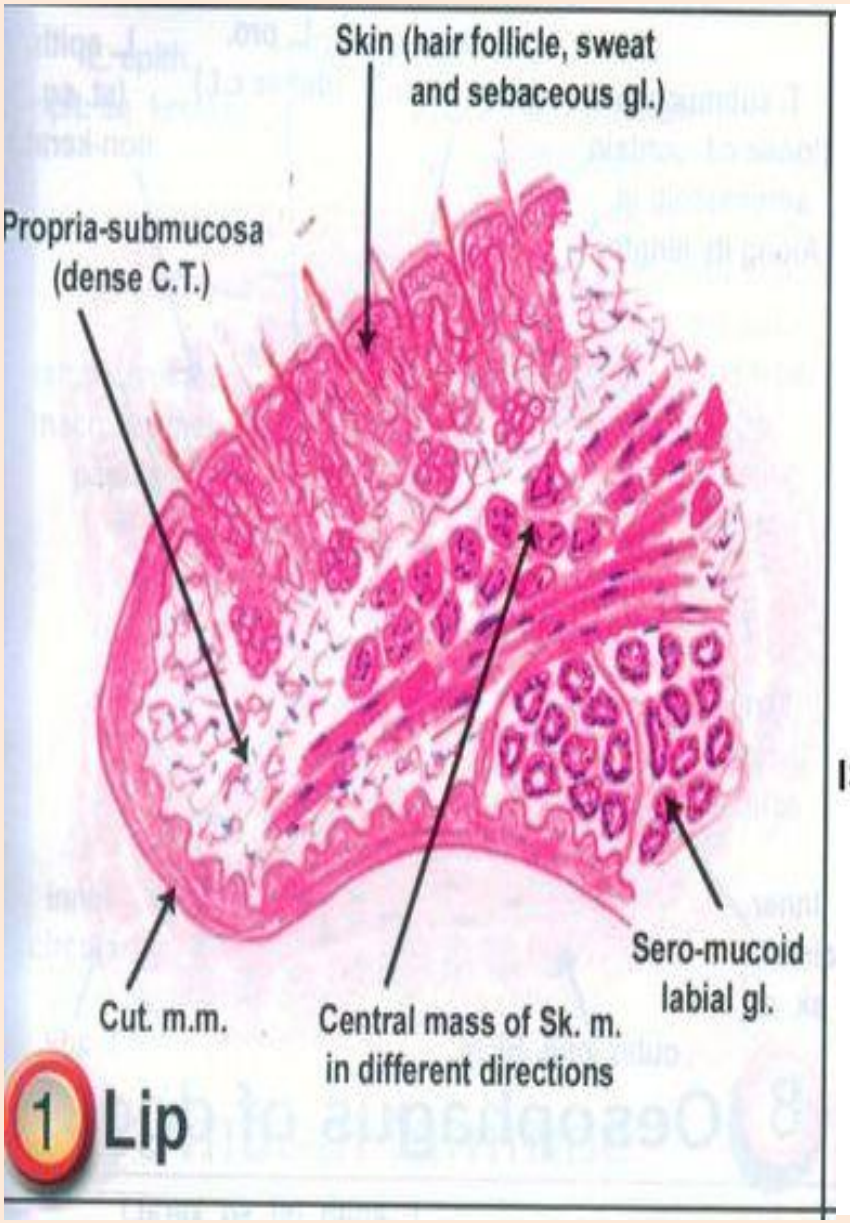
- The oral cavity is the entrance of the digestive tract housing the tongue.
- It is lined by stratified squamous epithelium, keratinized or nonkeratinized, depending on the animal species.
- The keratin layer protects the oral mucosa from damage during mastication

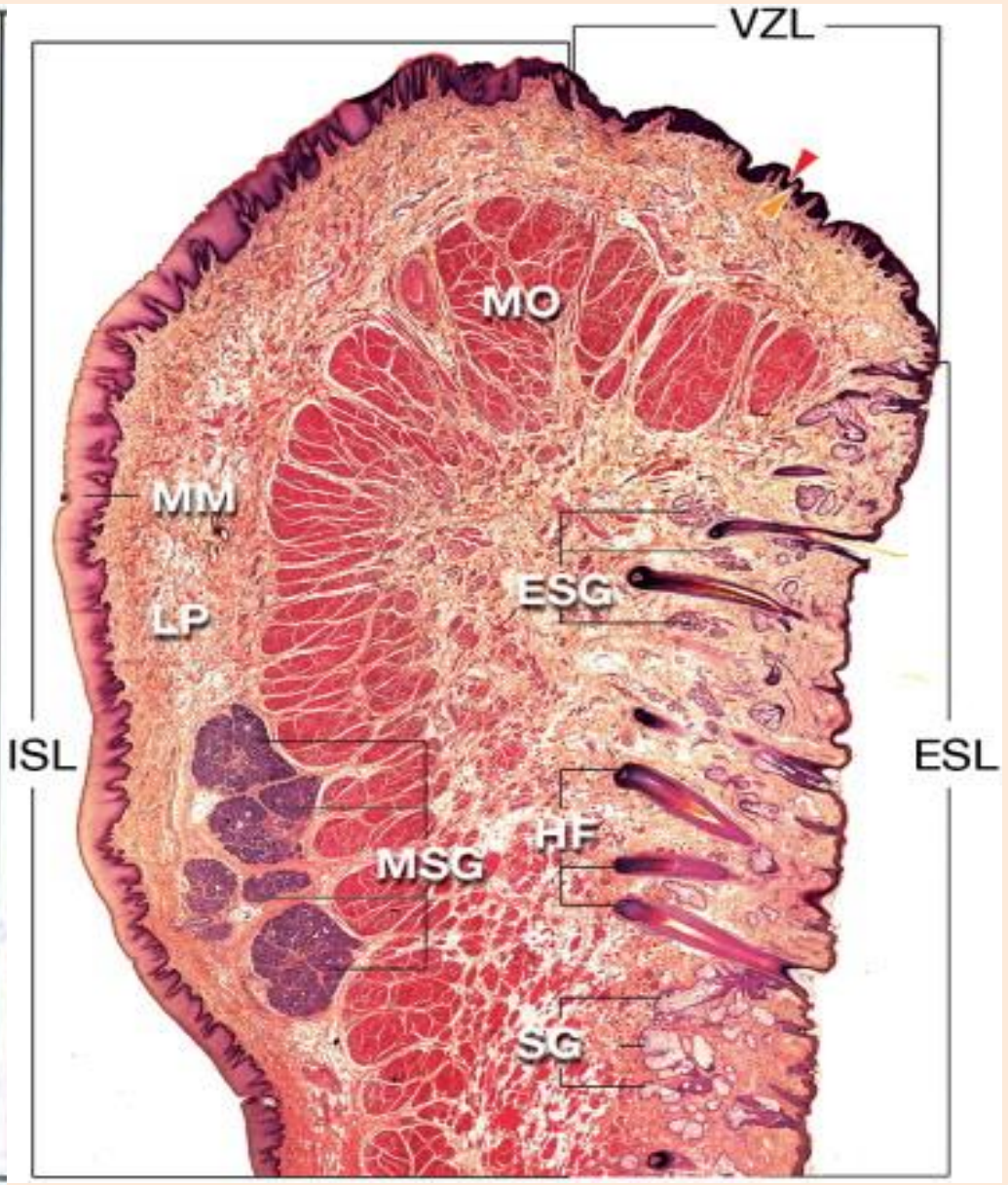
The main components:

- **The lips**
- **The cheeks**
- **The hard palate**
- **The soft palate**
- **The tongue**



The lips

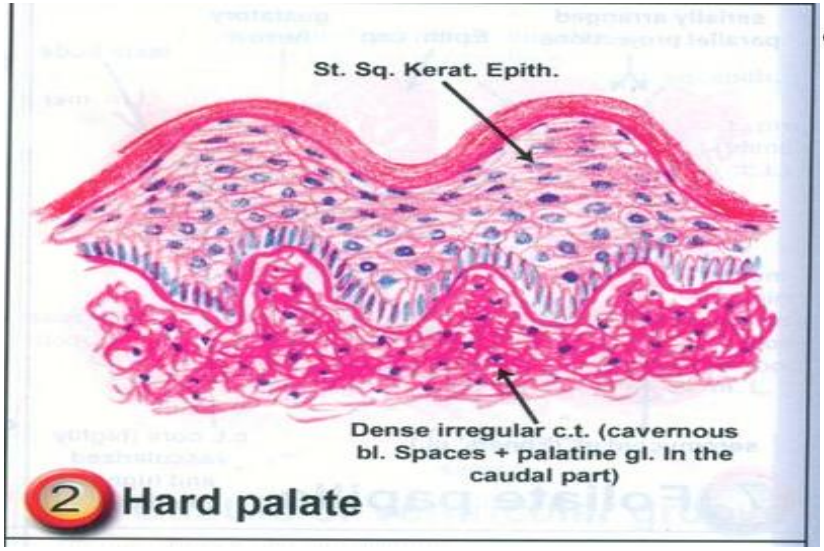

Skin (hair follicle, sweat and sebaceous gl.)
Propria-submucosa (dense C.T.)
Sero-mucoid labial gl.
Cut. m.m.
Central mass of Sk. m. in different directions
1 Lip


VZL
MO
MM
LP
ESG
ISL
ESL
HF
MSG
SG

The palate

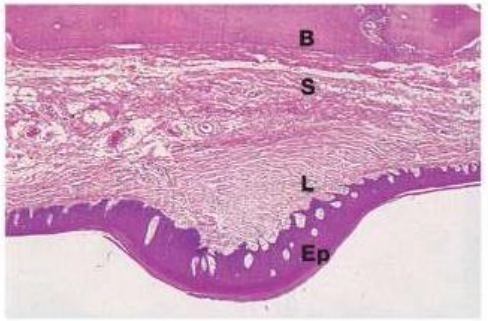
- It forms the roof of the oral cavity.
- It is composed of an anterior hard part (anterior 2/3) called the *hard palate* and posterior soft part (posterior 1/3) called *soft palate.*

(A) the Hard palate



Palatal mucosa

- the palate is covered by a thick stratified squamous epithelium Ep supported by densely collagenous lamina propria L.
- The mucosa of the hard palate is bound down to the underlying bone B by relatively dense submucosal tissue S containing a few accessory salivary glands.



(B) The soft palate

- - It is the posterior continuation of the hard palate.

- - It forms the posterior part of the roof of the oral cavity.

- **Function:**
- - It is strong and movable so that it can be drawn upward during swallowing.

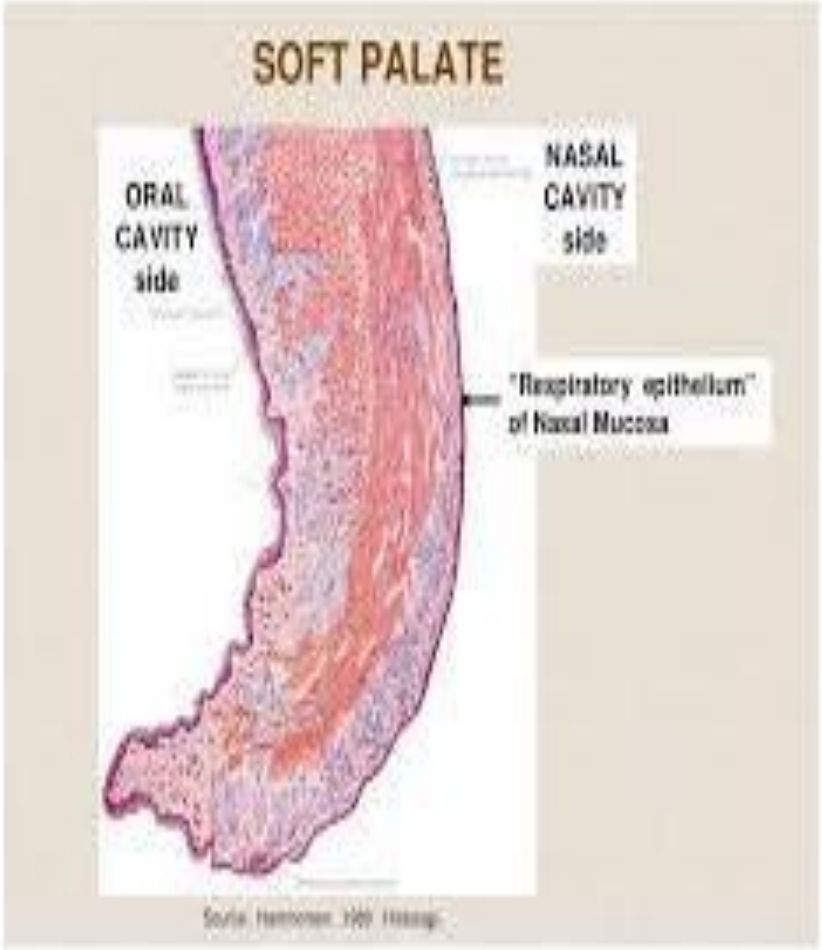
- This action closes off the nasopharynx and prevents food from being pushed up into the nasal cavity.

The superior surface (nasopharygeal) of the soft palate is covered with pseudo-stratified columnar ciliated epithelium with goblet cells.

- **The inferior surface (oropharyngeal) of the soft palate is covered with non-keratinized stratified squamous epithelium.**

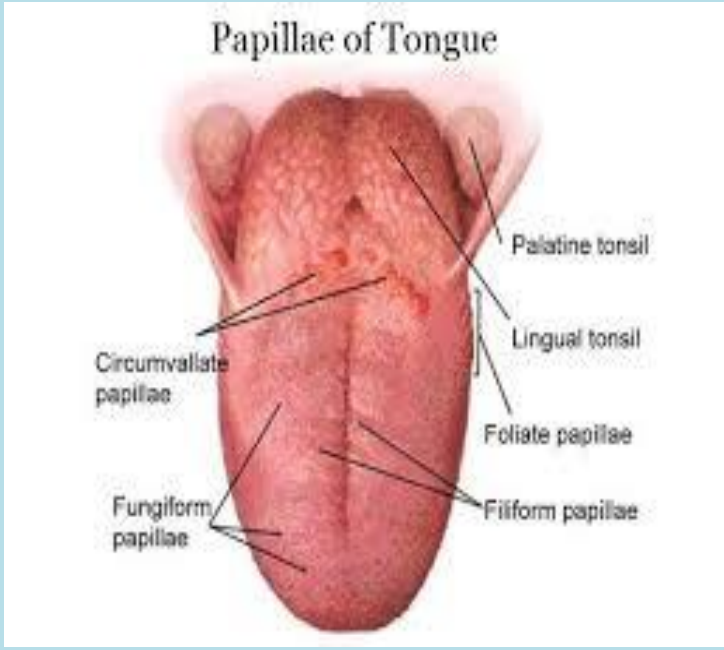
- The propria-submucosa consists of dense CT. containing seromucoid glands and lymphoid follicles

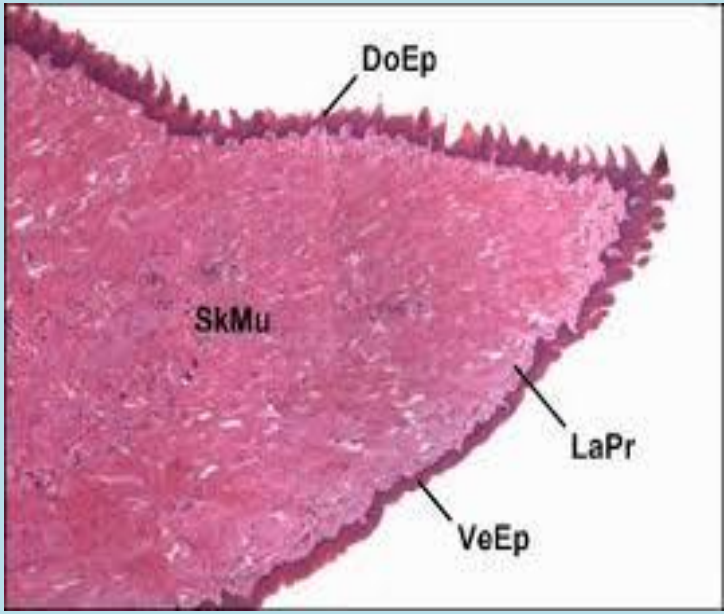
- It has central longitudinal muscular bands.



The tongue:

- The tongue is a mass of striated muscle covered by a mucous membrane present in the oral cavity.
- It consists of a thick striated central muscular mass arranged in different directions (longitudinal, transverse and vertical) to allow wide range of movement of the tongue.
- It covered on both surfaces by mucosa and submucosa





The lingual papillae:

- is a little projection of the mucous membrane. It is formed of a central core of C.T covered with stratified squamous epithelium.
- two types (according to function):

Mechanical papillae

Gustatory papillae

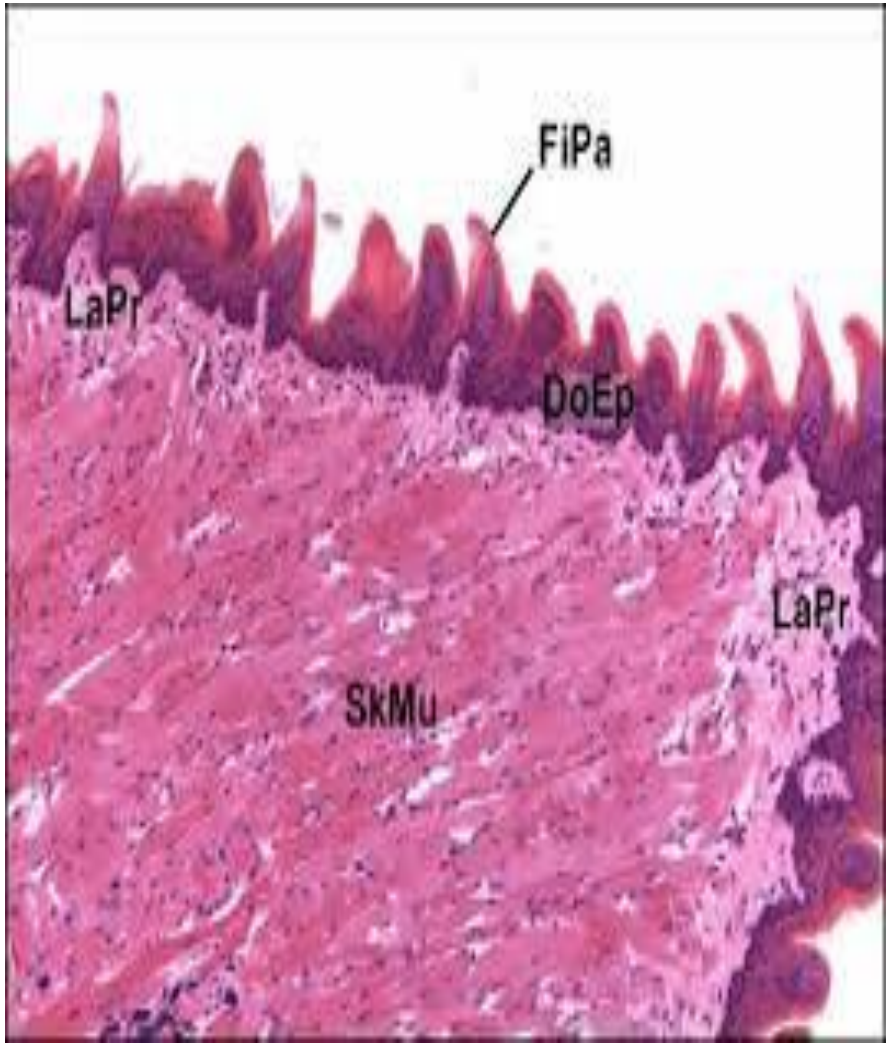
Mechanical papillae

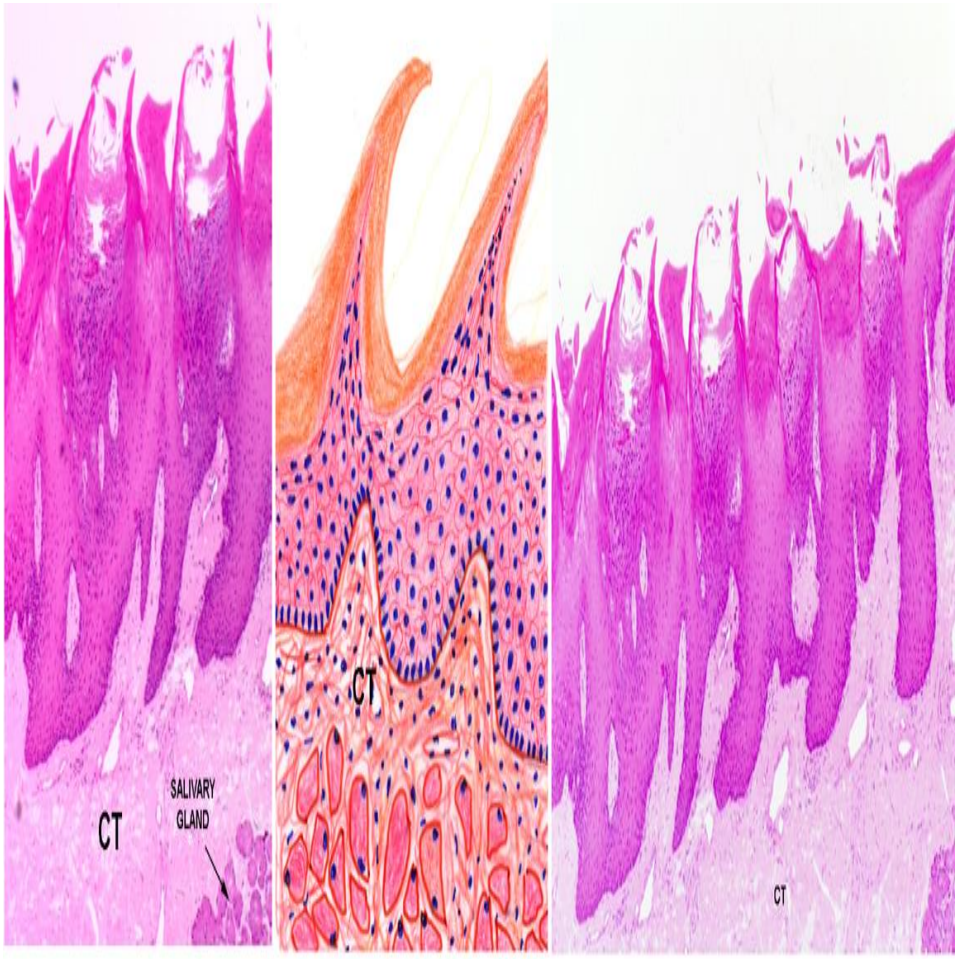
Filiform papilla

Coniform papilla

Lentiform papilla

Filiform papilla





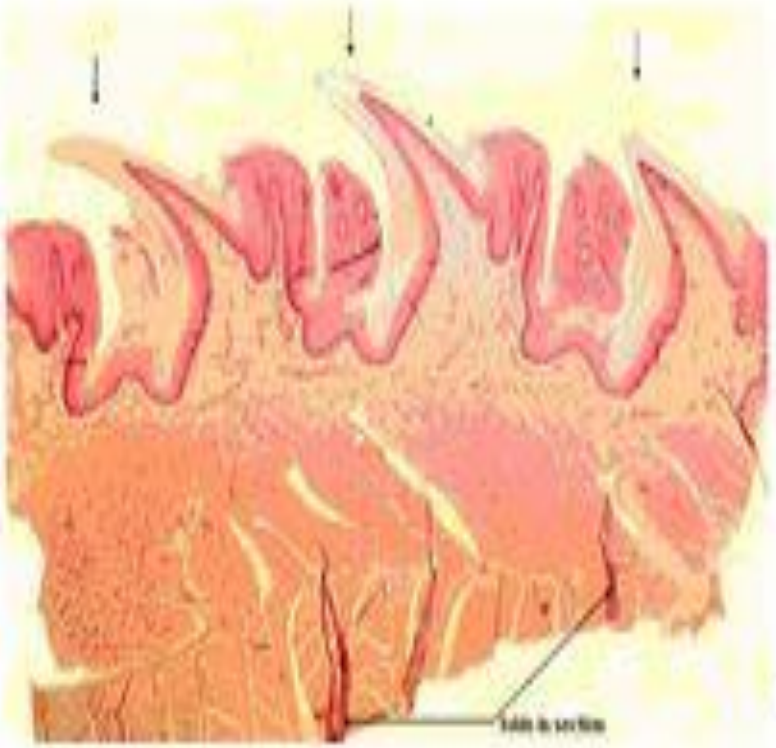
FILIFORM PAPILLAE IN SCHEMATIC VIEW (CENTER) AND AT HIGH AND LOW MAGNIFICATION. Note that the papilla is made solely of the keratinized epithelium: there is no CT core in this type.

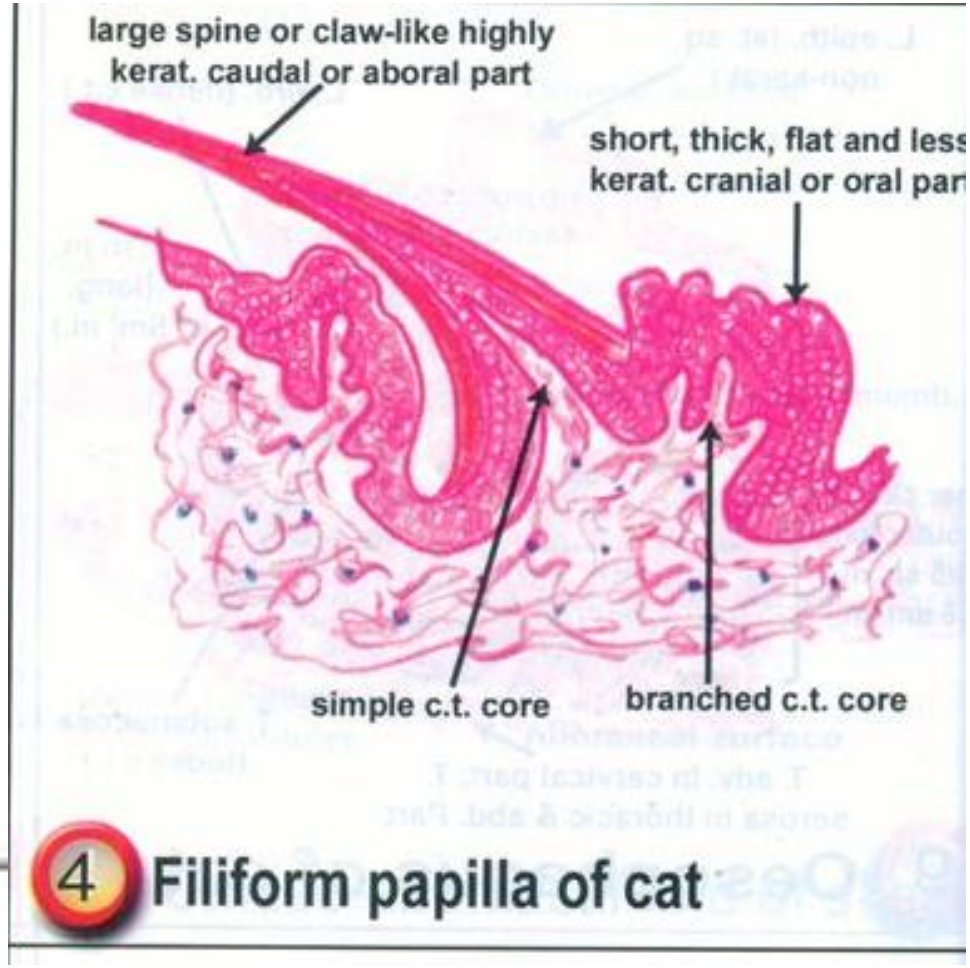
Filiform papilla of cat

SLIDE 5 Filiform papillae (cat)

Identify the main papillae in this section.

Filiform papillae (arrowed).





Gustatory papillae

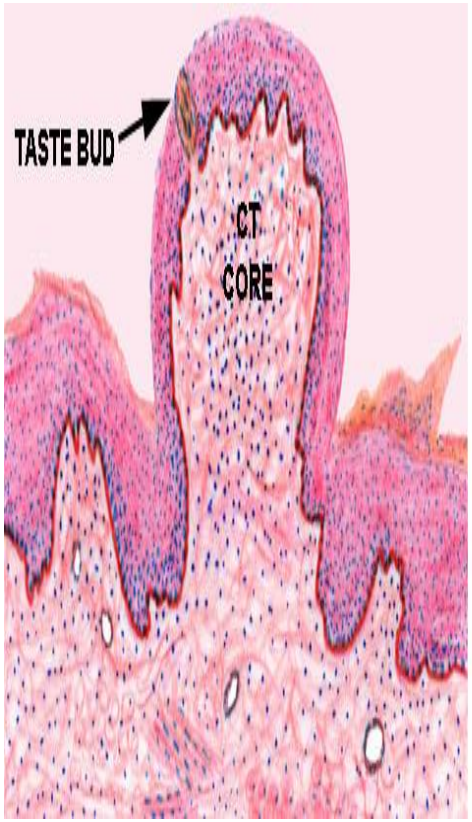
Fungiform

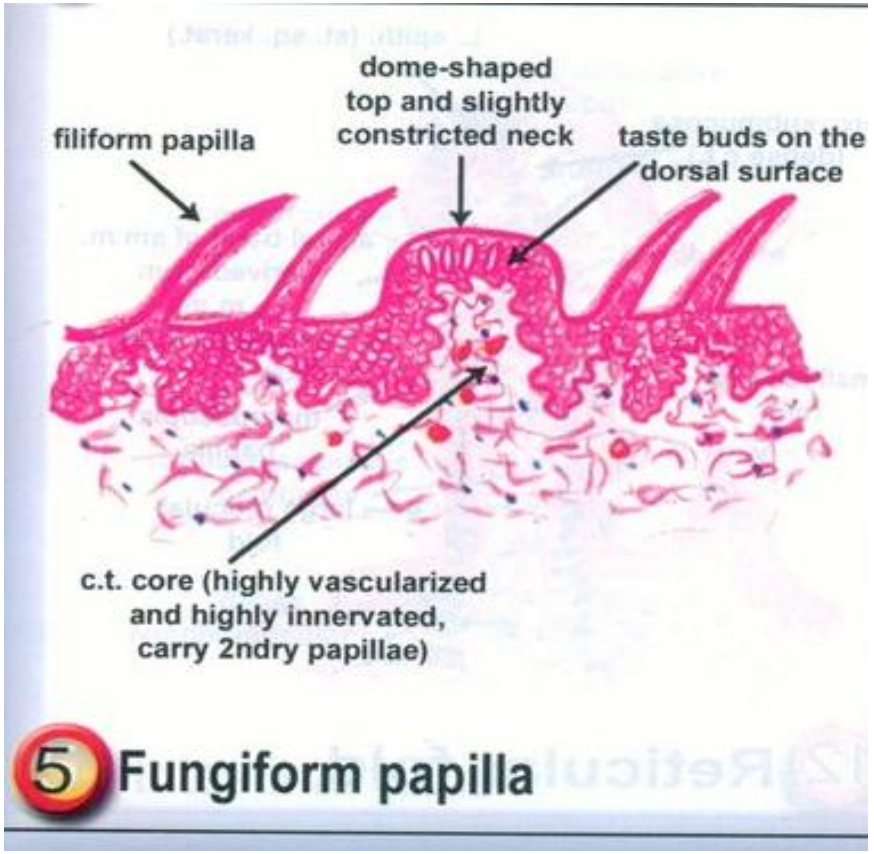
Circumvallate

Foliate

Fungiform papilla

They are present over the anterior 2/3 of the tongue among the rows of filiform papillae. They are Mushroom (fungus)-like short and broad.

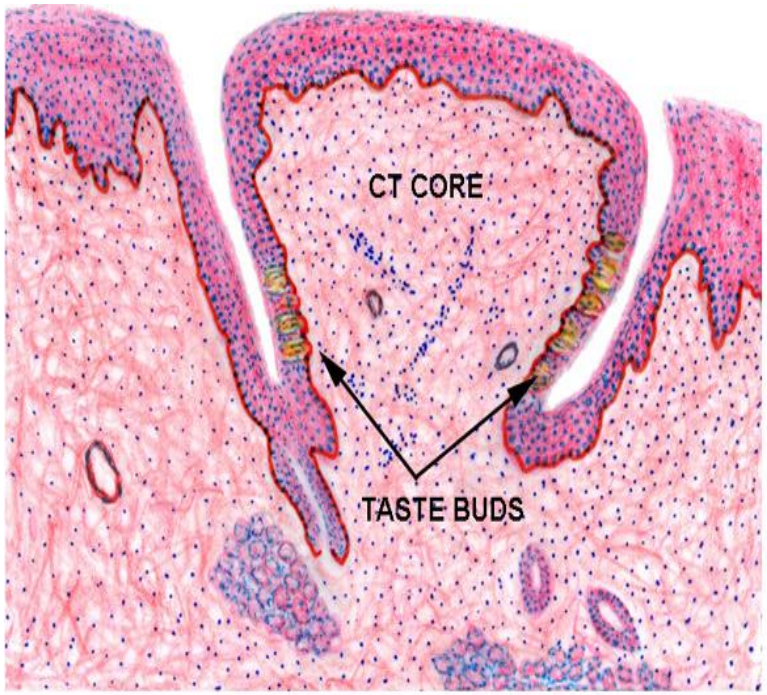


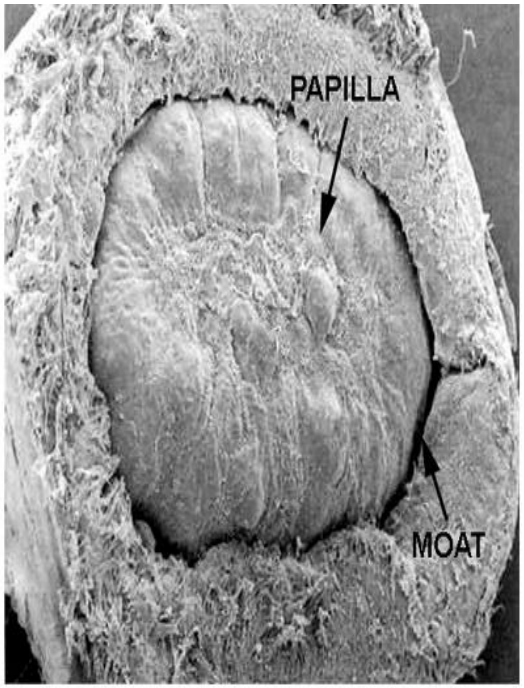


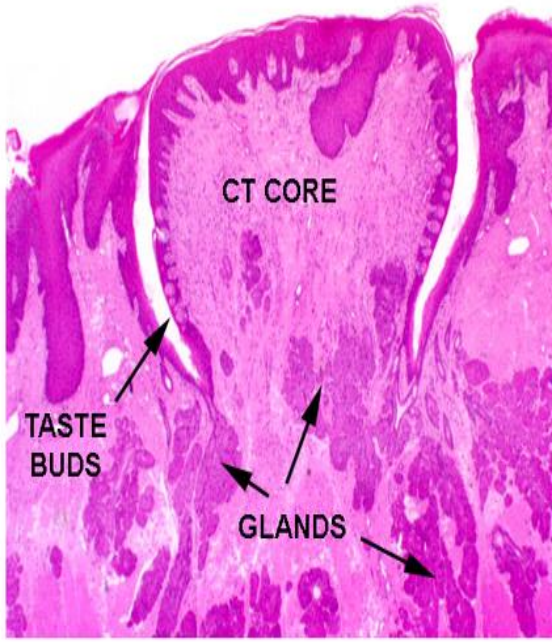
Circumvallate papilla

They are present in the caudal part of the tongue along and deeply to the v-shaped sulcus terminalis.

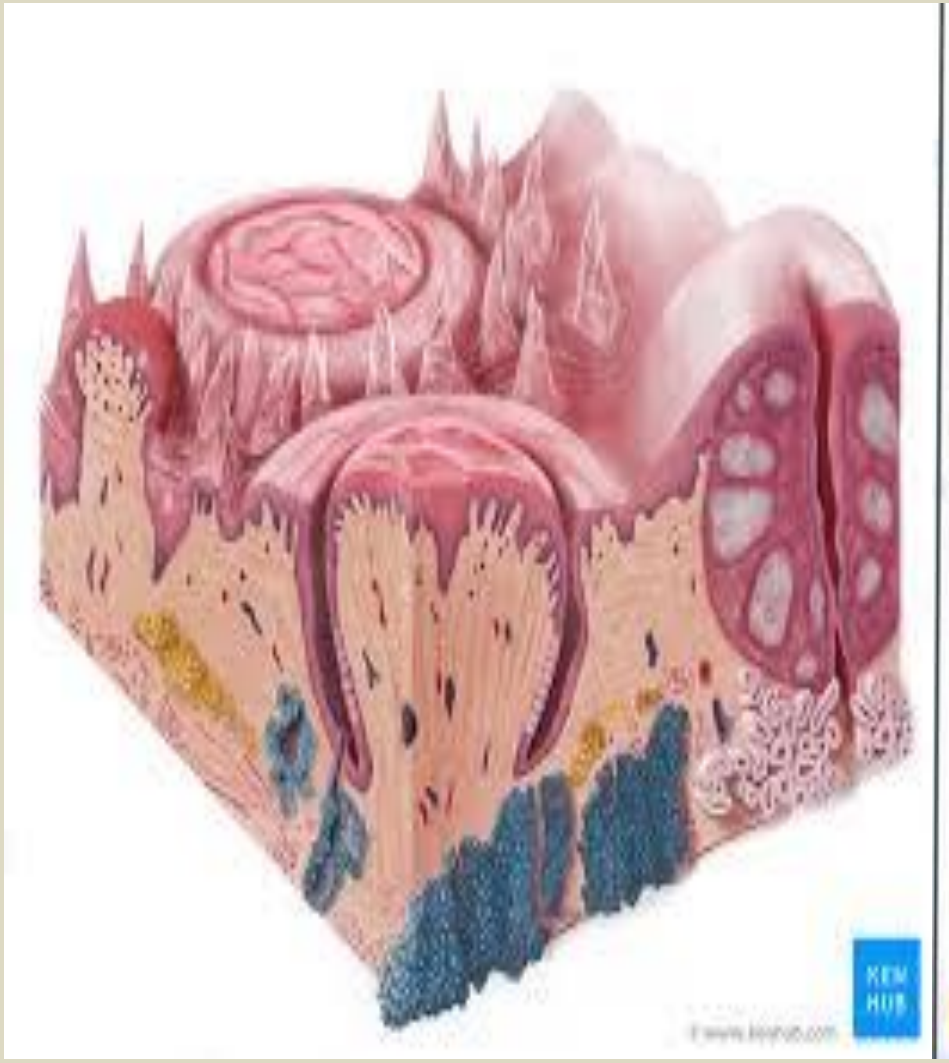
<u>Shape</u>: They are large papillae with broad tops and completely surrounded by deep furrow or moat.

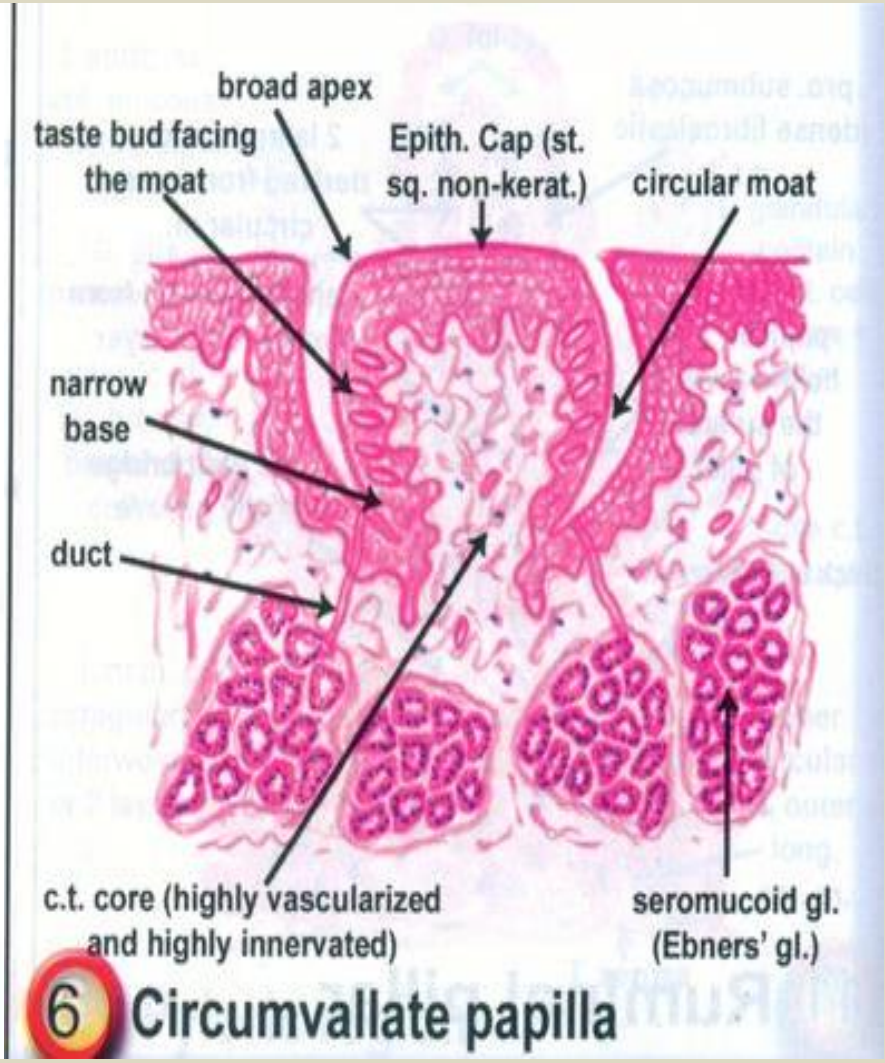






THREE VIEWS OF A CIRCUMVALLATE PAPILLA: SCHEMATIC, SCANNING E.M., AND LOW-POWER LIGHT MICROSCOPE
(SEM Image courtesy of Dr Suraj Kumar)

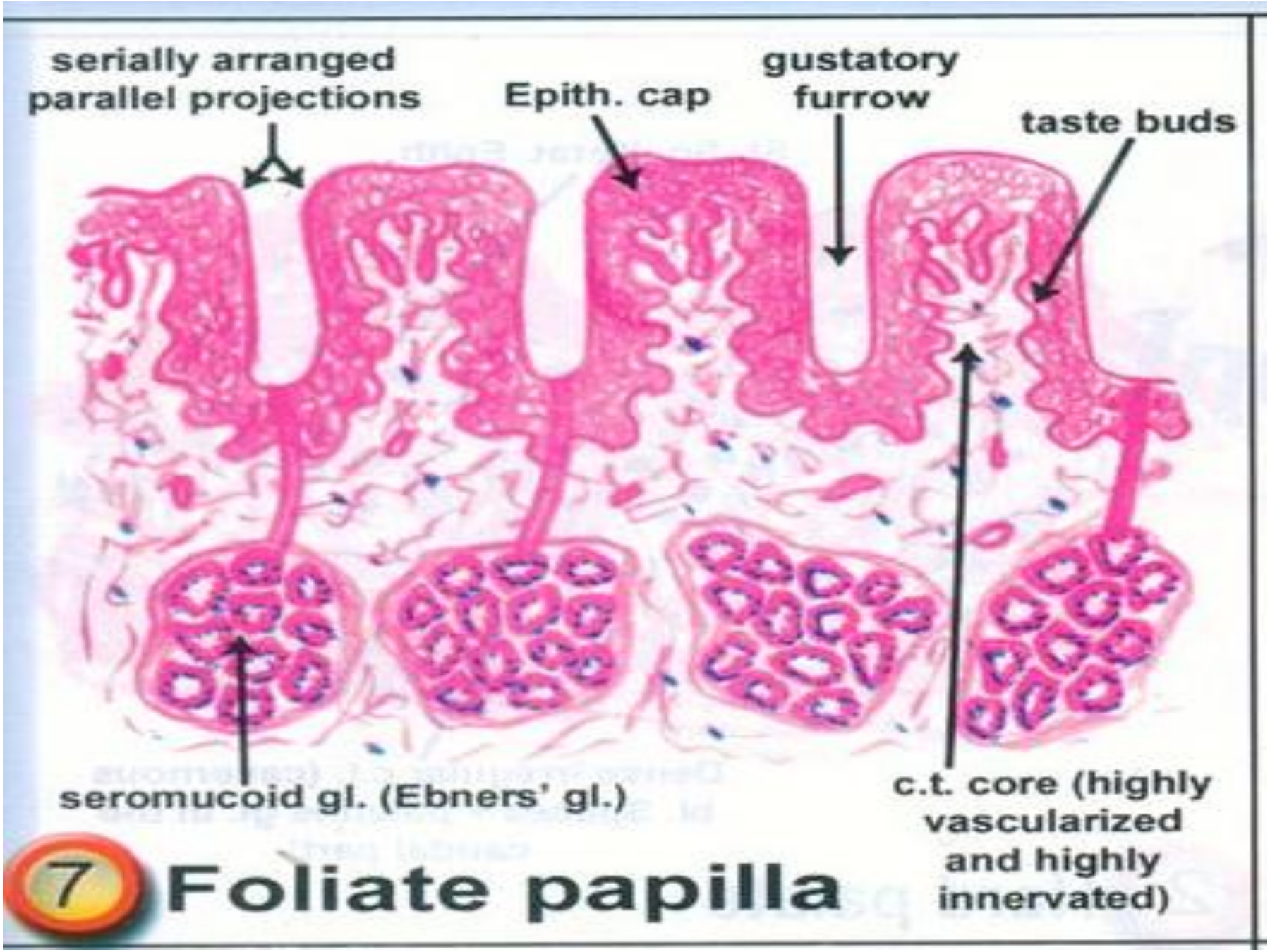


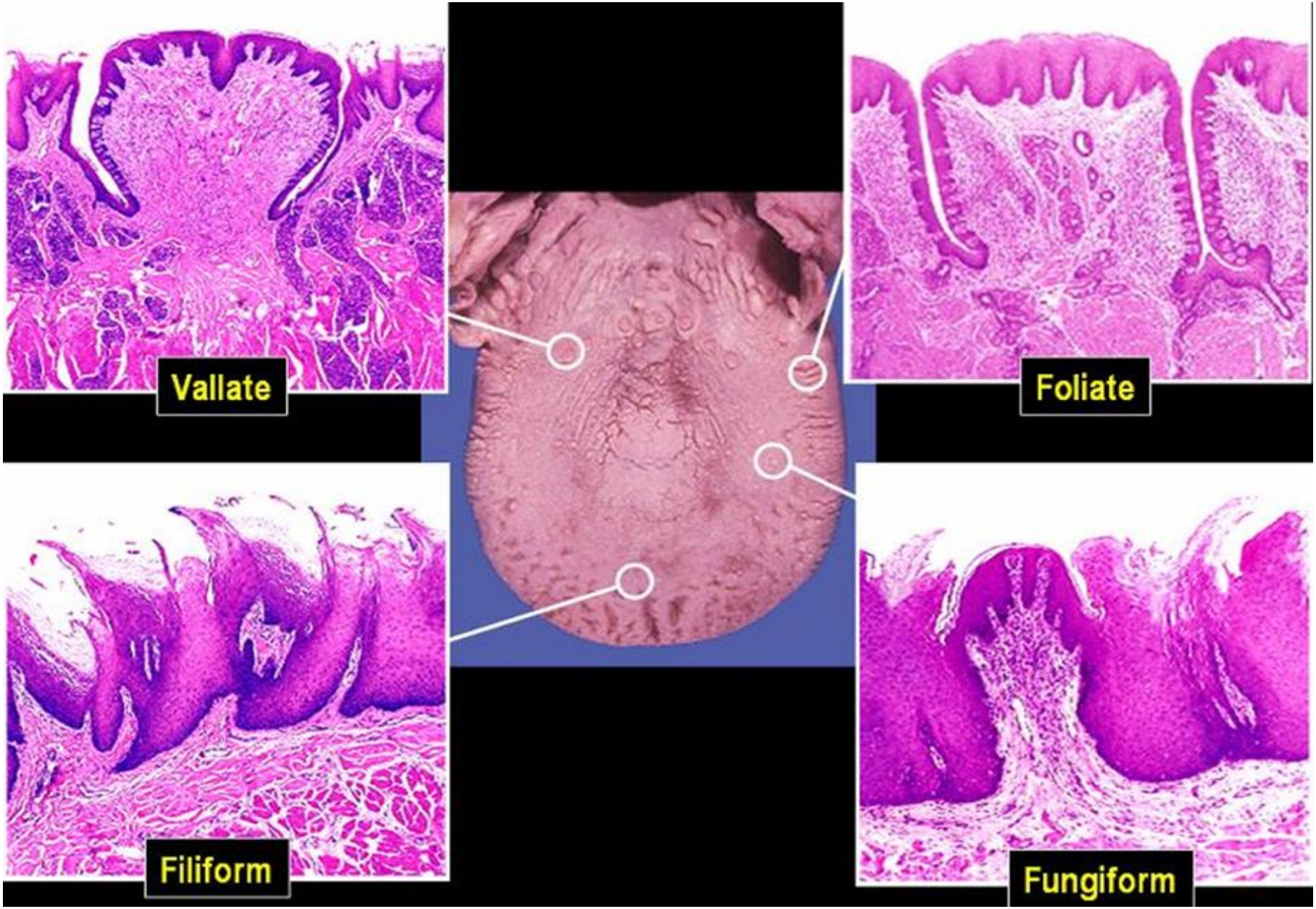

broad apex
taste bud facing the moat
Epith. Cap (st. sq. non-kerat.)
circular moat
narrow base
duct
c.t. core (highly vascularized and highly innervated)
seromucoid gl. (Ebners' gl.)
6 Circumvallate papilla

Foliate papilla

Site: They are found on each side at the root of the tongue. They are well developed in the posterior part of the tongue of rabbit. They are 2 in horses (one on each side) and absent in ruminants.

Shape: They are consisted of leaf-like projections separated by gustatory furrows.


serially arranged parallel projections
Epith. cap
gustatory furrow
taste buds
seromucoid gl. (Ebners' gl.)
c.t. core (highly vascularized and highly innervated)
7 Foliate papilla


Vallate
Foliate
Filiform
Fungiform

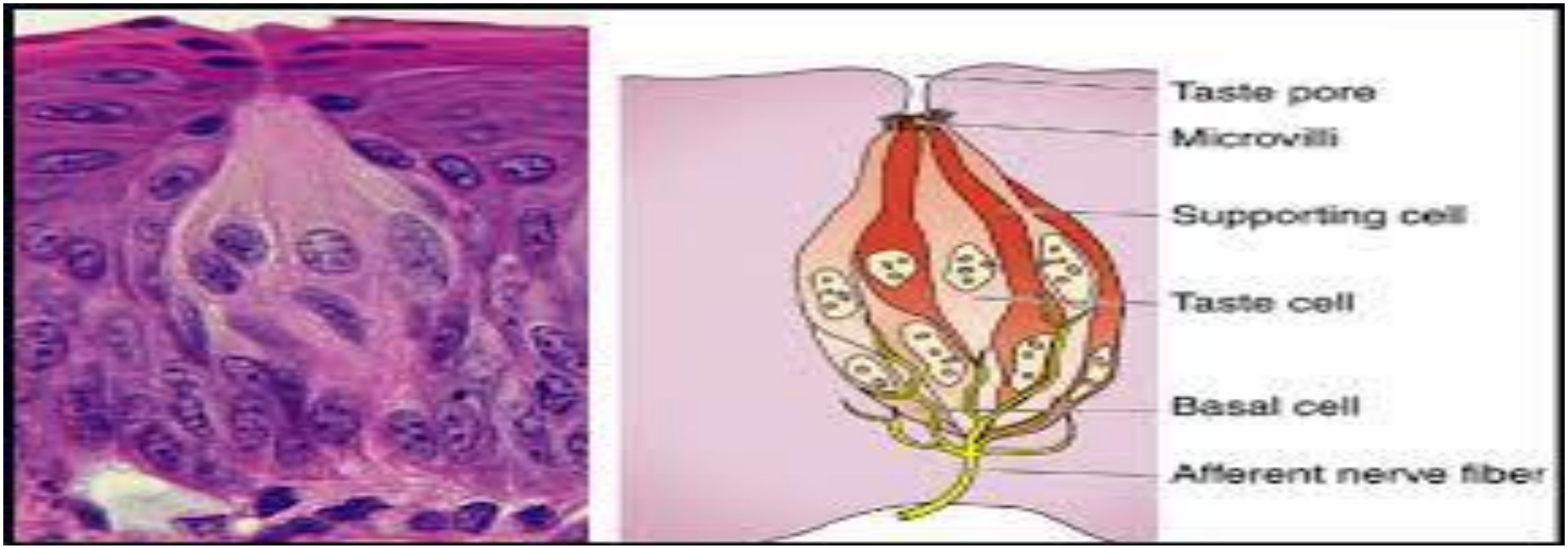
Taste buds

Neuro-epithelial small sensory organs in the form of **onion-like structure** responsible for perception of taste.

1) Neuro-epithelial taste cells or gustatory cells or receptor cells: banana-shape modified columnar cells which are about six centrally arranged cells

2) Supporting or sustentacular cells: peripheral in position forming the outer wall of the taste bud.

3) Basal cells: short cells basally located. They act as stem cells for renewal of taste cells and supporting cells

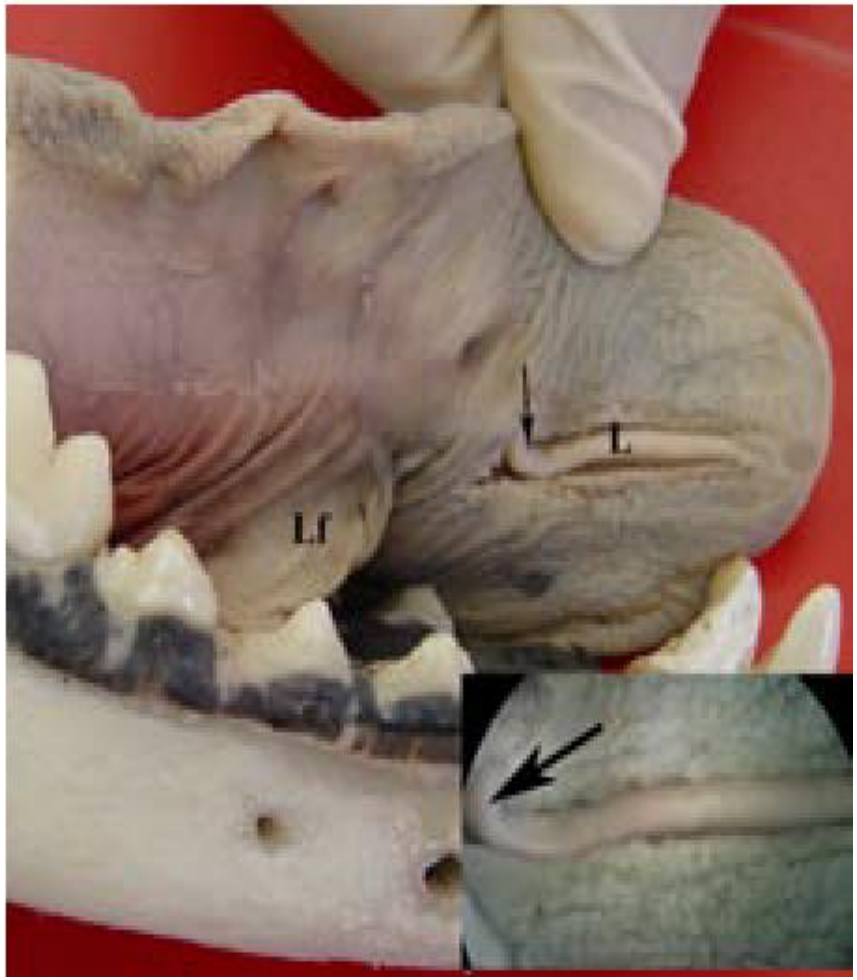


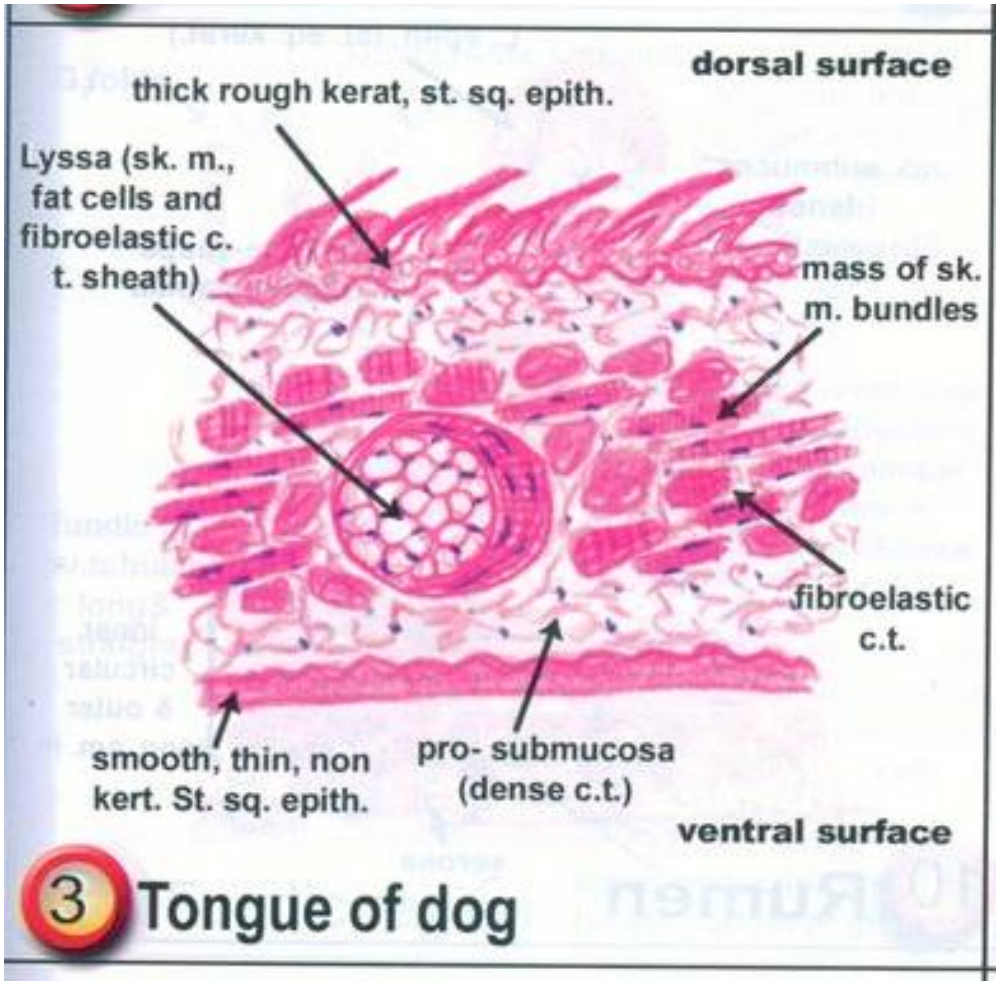
Special structures of tongue

- **1) <u>Lingual fibrous cord:</u>**
- - It is present in equines.
- - It is composed of fibro-elastic tissue, hyaline cartilage, fat cells and skeletal muscles.
- **<u>2) Dorsal prominence (Torus linguae):</u>**
- - It is present in ruminants.
- - It consists of a thick area of mucous membrane with a spongy center.

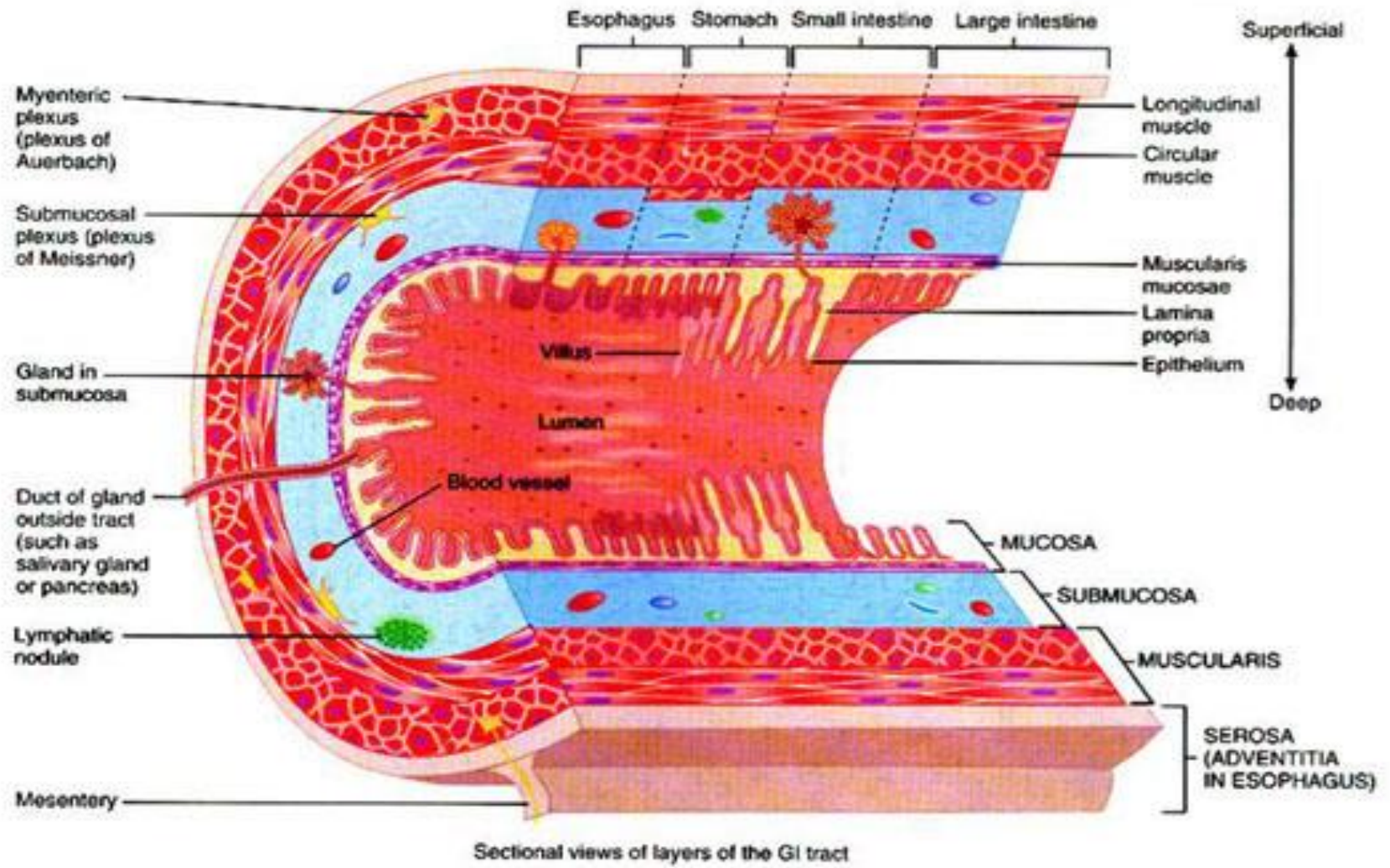
3) Lingual lyssa

- It is present in carnivores in the med-ventral part of the tongue





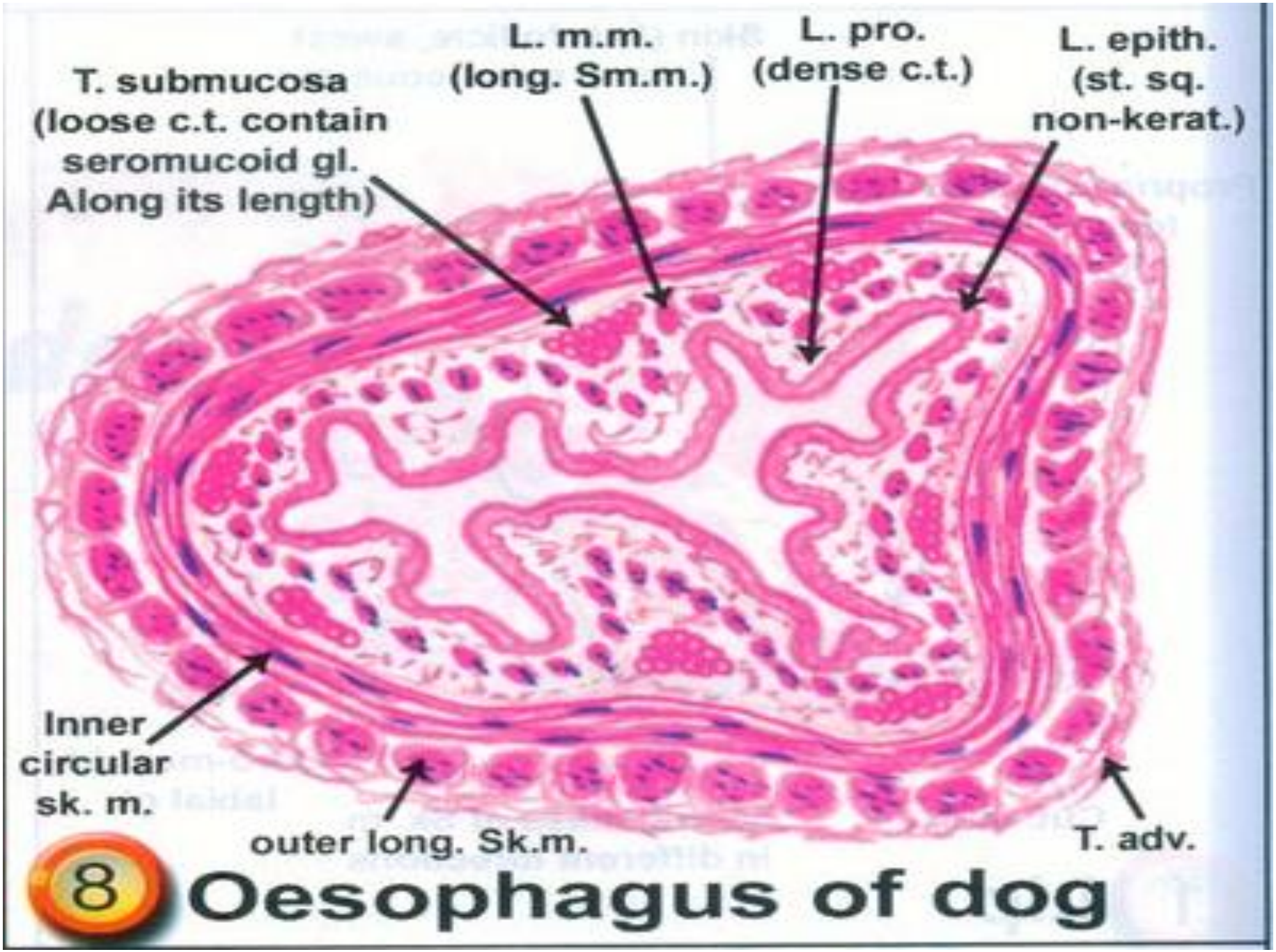
General structure of the digestive tract



Sectional views of layers of the GI tract

The oesophagus

	Horses	Pigs	Cattle	Goats	Sheep	Dogs	Cats
Stratified squamous epithelium[a]	Keratinized	Keratinized	Keratinized	Keratinized	Keratinized	Nonkeratinized	Nonkeratinized
Lamina muscularis	[b]	Absent in cranial part Highly developed in caudal part	[b]	[b]	[b]	Absent in cranial part Interrupted in middle part	[b]
Submucosal glands	[c]	Present only in cranial half	[c]	[c]	[c]	Present throughout and extend into stomach	[c]
Tunica muscularis[d]	Cranial two thirds striated Caudal one third smooth	Cranial part striated Middle part mixed Caudal part smooth	Striated throughout and extends into the reticular sulcus			Striated throughout	Cranial part striated Caudal one third to one fifth smooth
Tunica adventitia	Loose connective tissue cells and fibers with blood and lymph vessels and nerves surround the esophagus. A tunica serosa may be present in the thoracic cavity (mediastinal pleura) or near the stomach (visceral peritoneum).						



8 Oesophagus of dog

The stomach

- Types of stomach:
- 1) Monolocular simple stomach in dogs and cats.
- 2) Monolocular compound stomach in horses and pigs.
- 3) Multilocular compound stomach in ruminants.

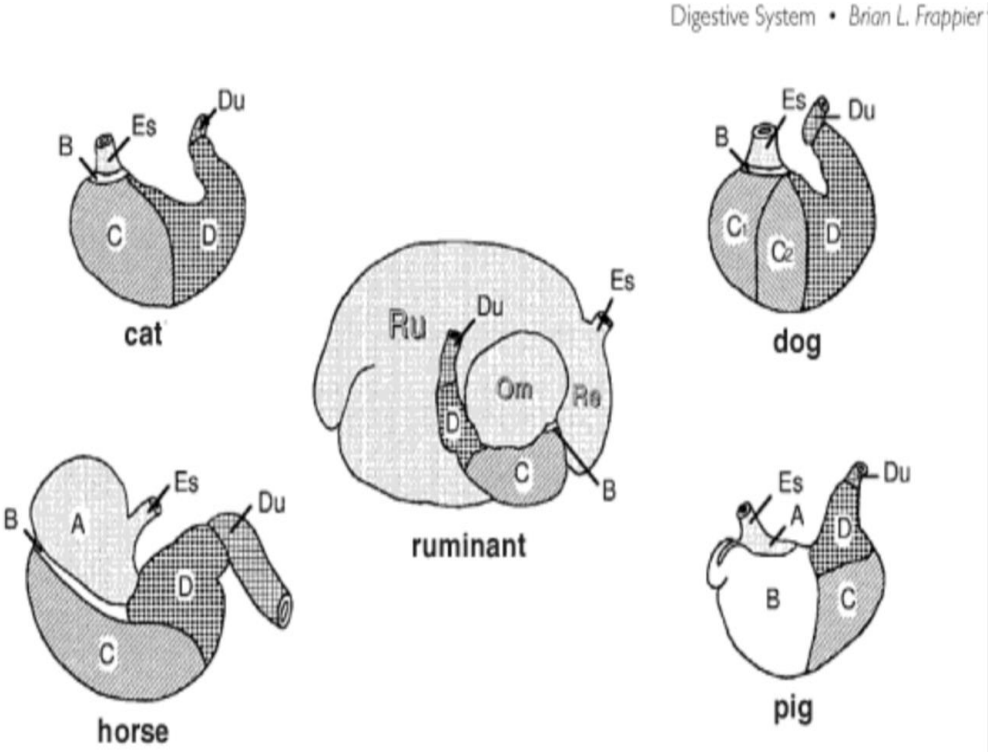


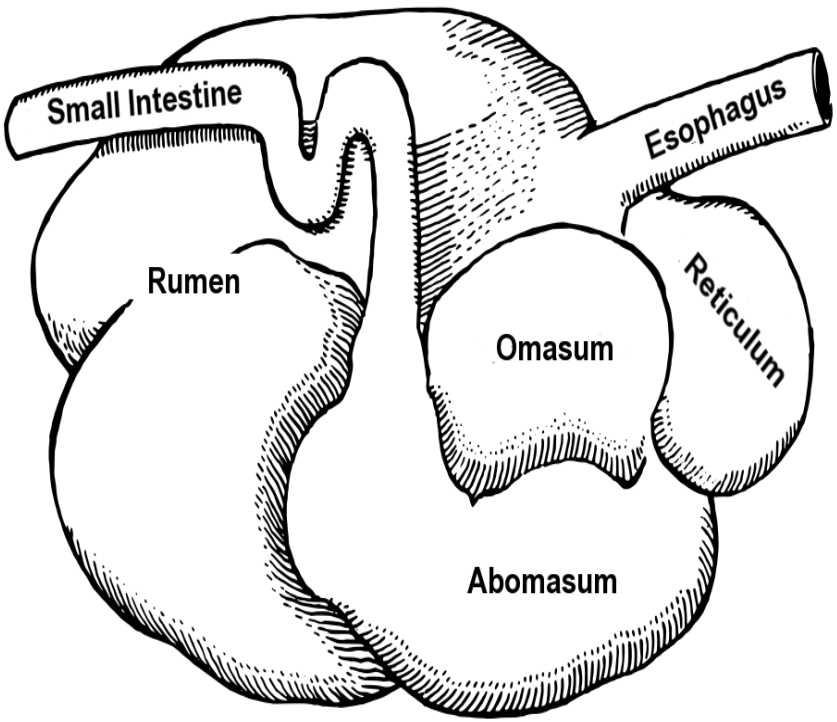
FIGURE 10-32 Schematic drawing illustrating the regions of the gastric tunica mucosa. Nonglandular region of the mucosa lined by stratified squamous epithelium (A), including the rumen (Ru), reticulum (Re), and omasum (Om); cardiac gland region (B); fundic gland region (C), with light (C1) and dark (C2) zones in the dog; pyloric gland region (D); esophagus (Es); duodenum (Du).

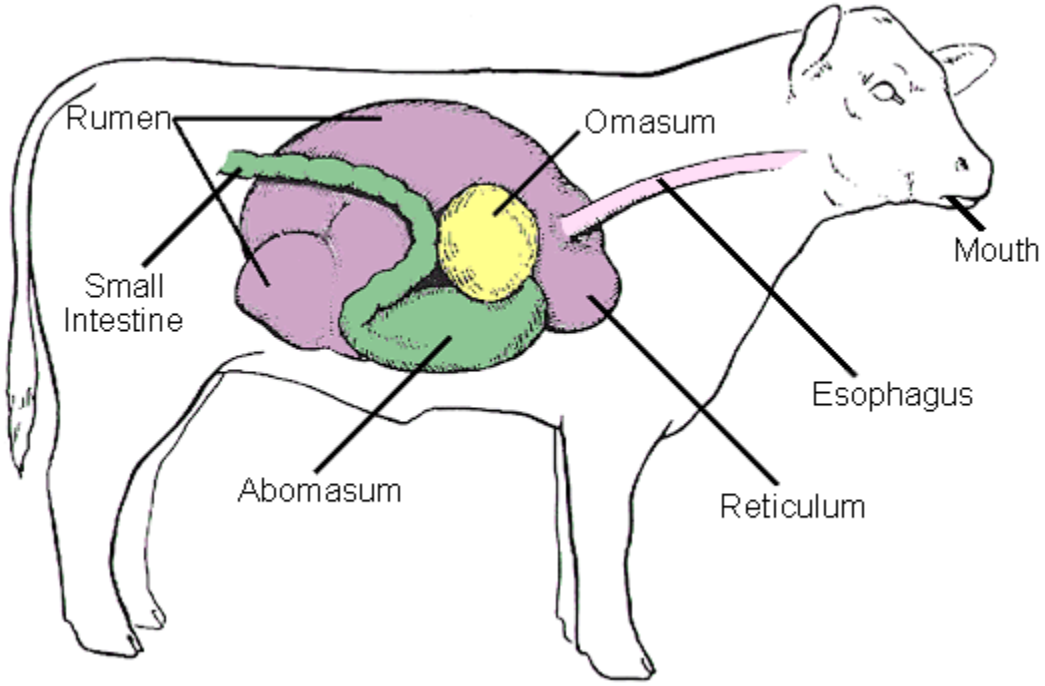
I. Non-glandular stomach of ruminants

1) Rumen

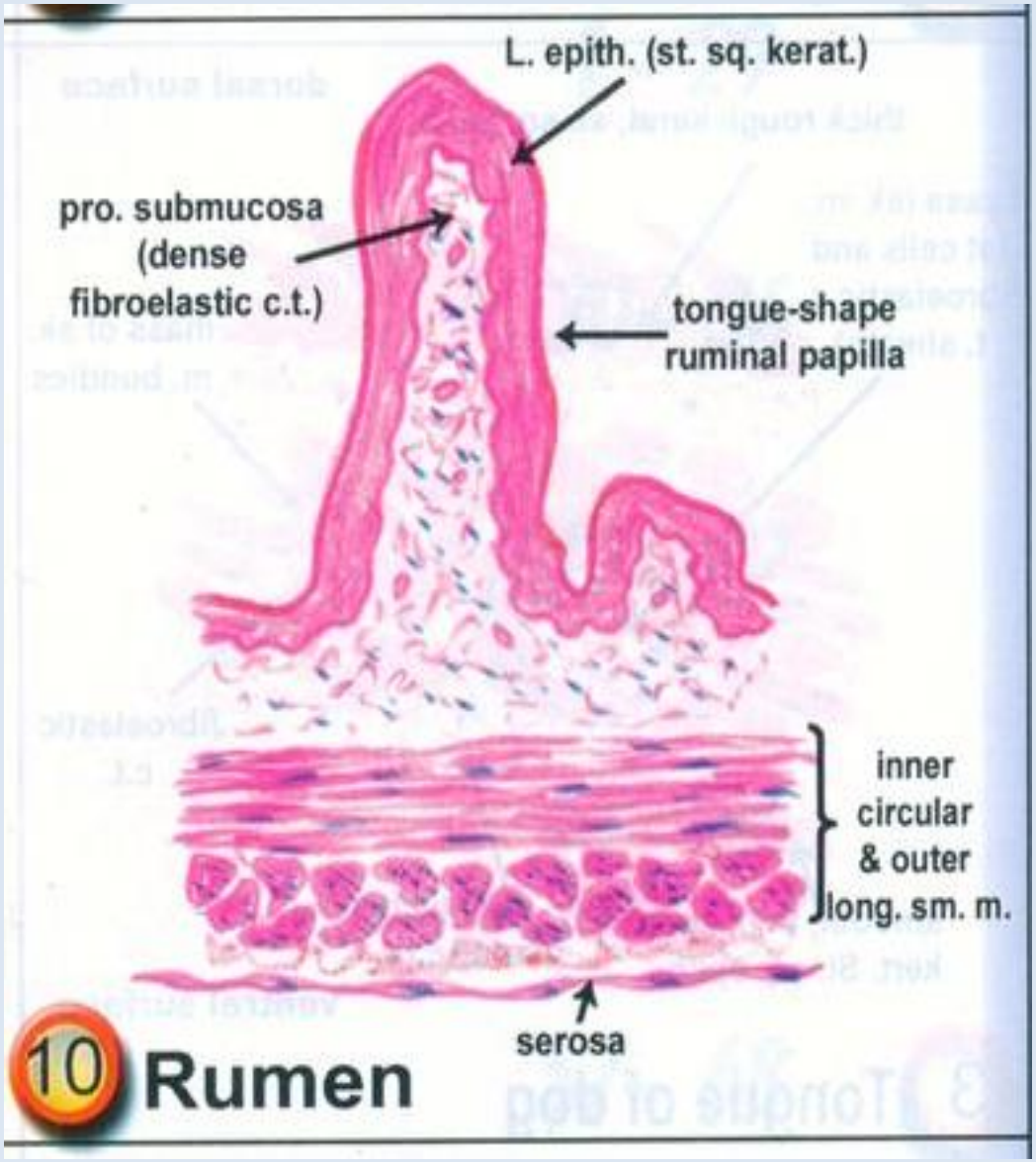
2) Reticulum

3) Omasum

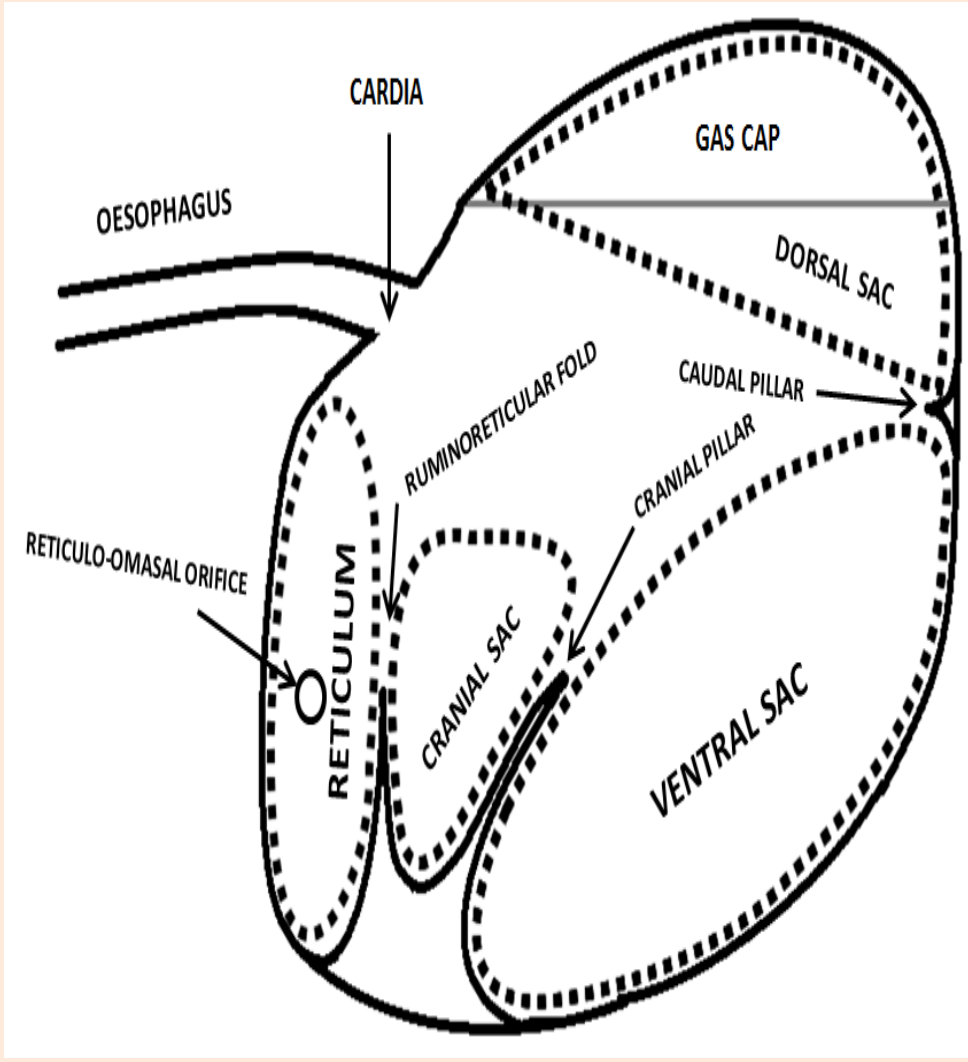

Small Intestine
Esophagus
Rumen
Omasum
Reticulum
Abomasum

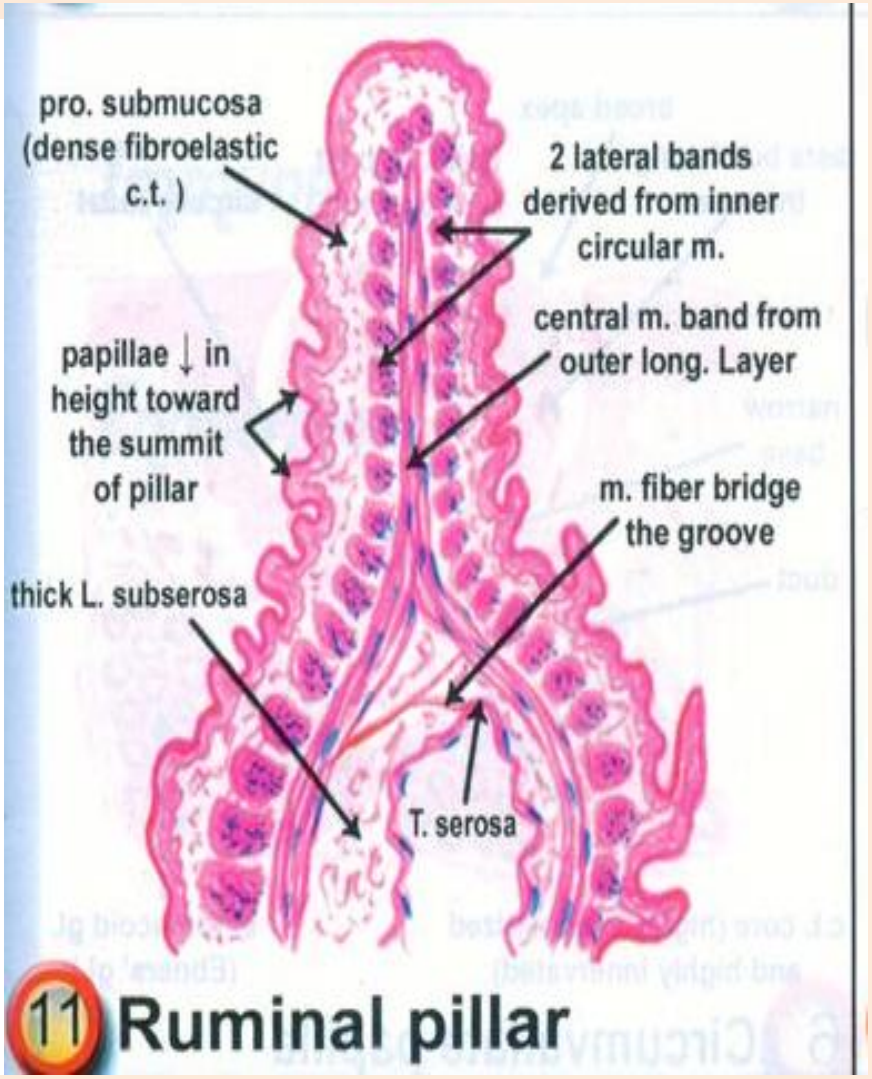

Rumen
Omasum
Mouth
Small Intestine
Esophagus
Abomasum
Reticulum

1) The rumen

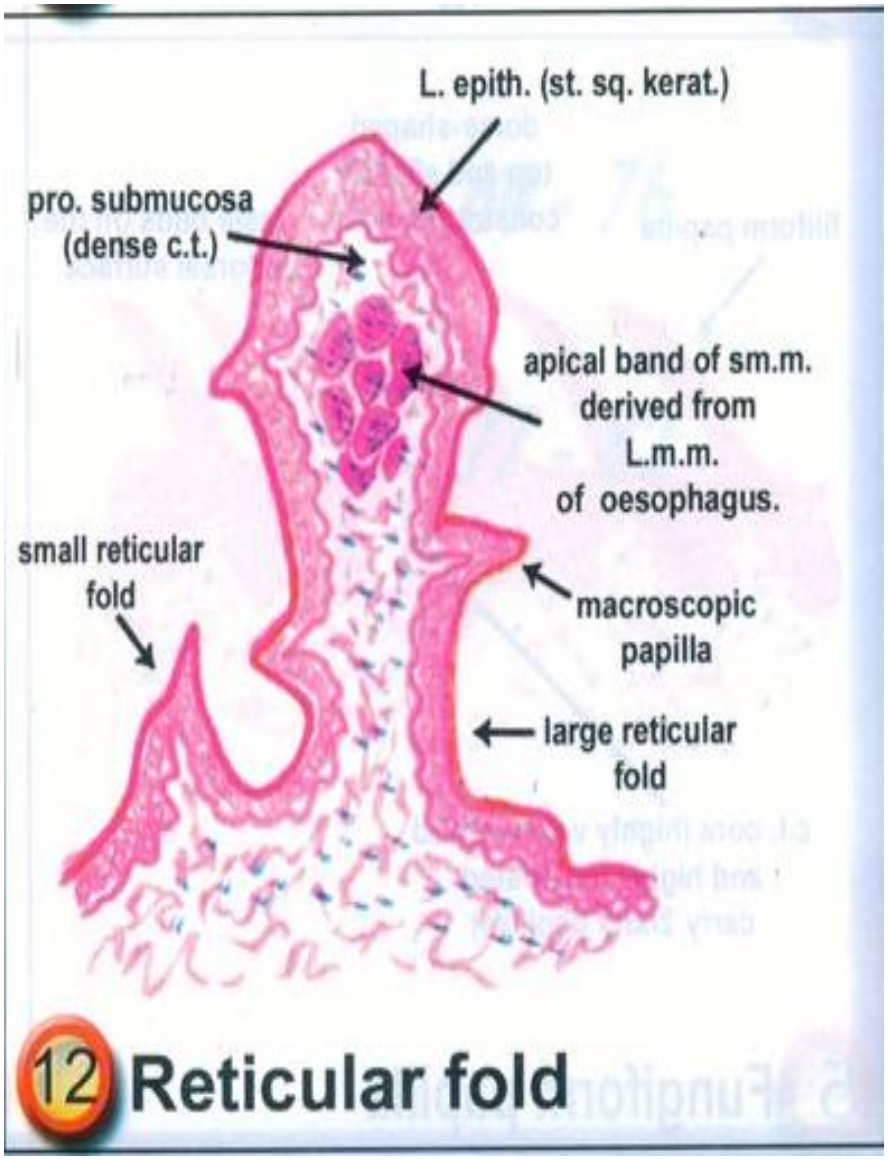

L. epith. (st. sq. kerat.)
pro. submucosa (dense fibroelastic c.t.)
tongue-shape ruminal papilla
inner circular & outer long. sm. m.
serosa
10 Rumen

Ruminal pillar

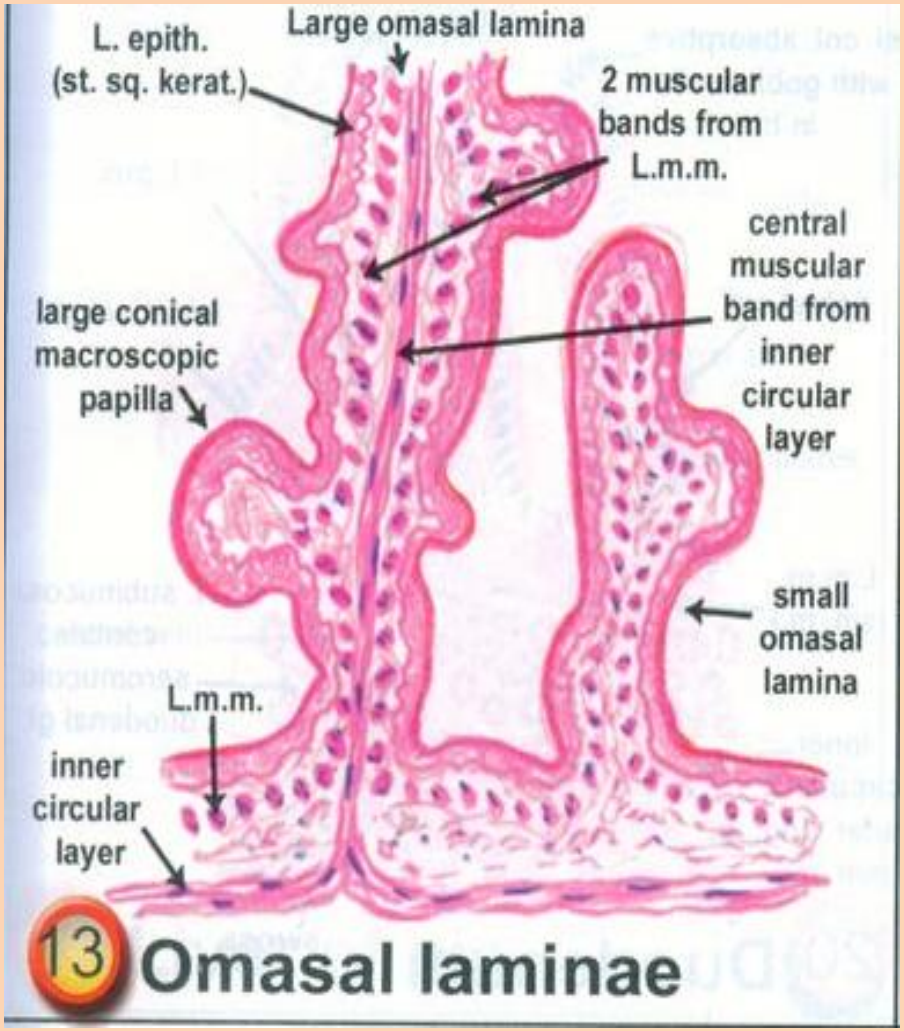




Reticulum

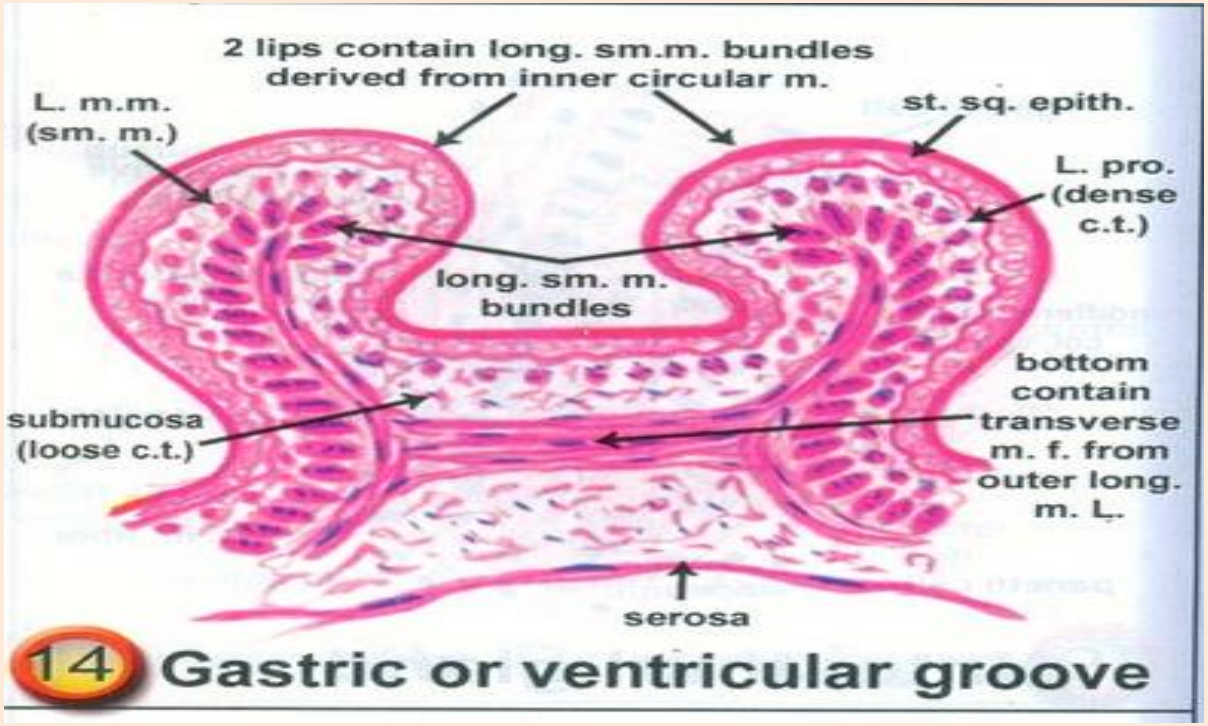

L. epith. (st. sq. kerat.)
pro. submucosa
(dense c.t.)
apical band of sm.m.
derived from
L.m.m.
of oesophagus.
small reticular
fold
macroscopic
papilla
large reticular
fold
12 Reticular fold

The omasum

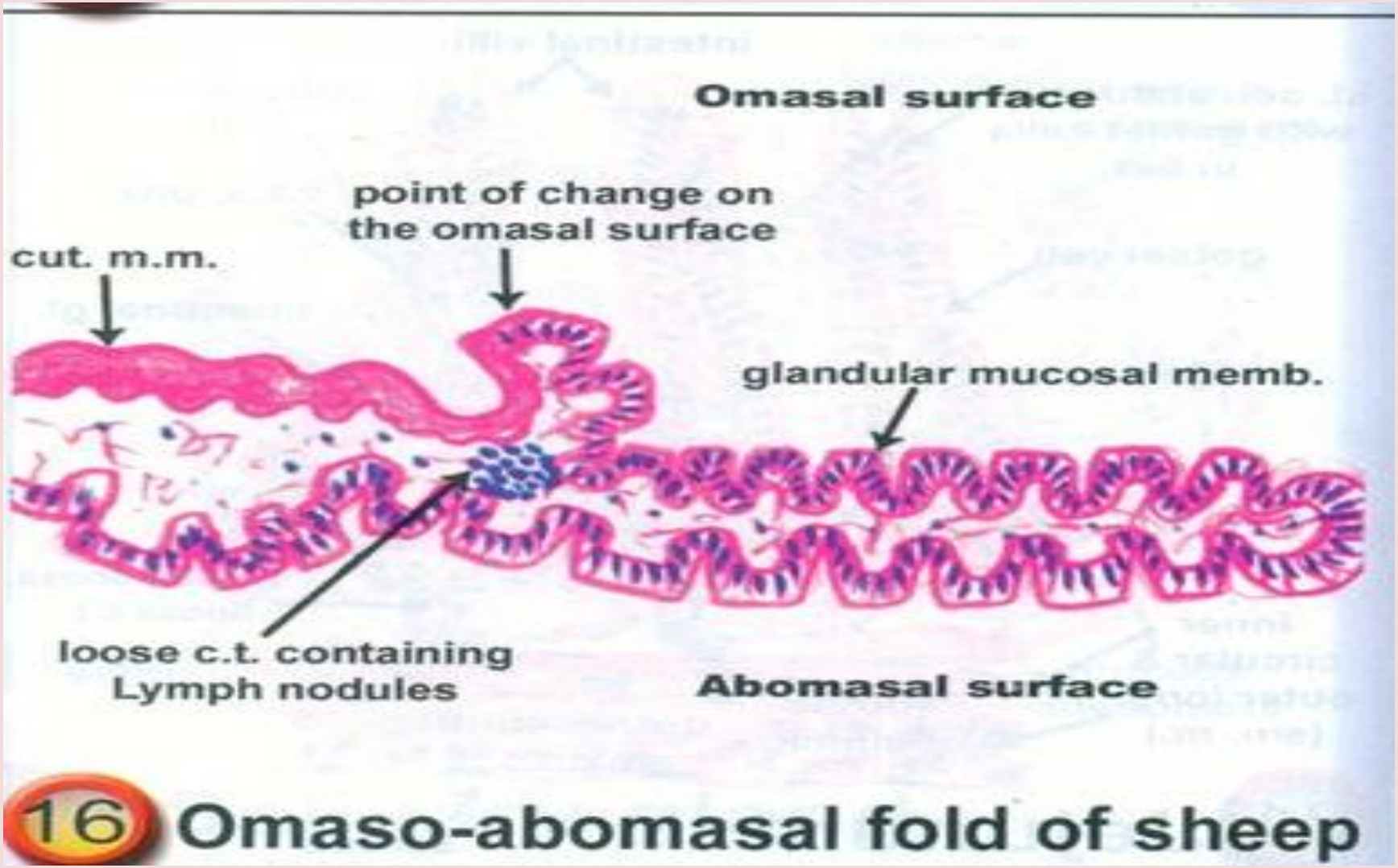

L. epith.
(st. sq. kerat.)
Large omasal lamina
2 muscular
bands from
L.m.m.
central
muscular
band from
inner
circular
layer
large conical
macroscopic
papilla
small
omasal
lamina
L.m.m.
inner
circular
layer
13 Omasal laminae

The gastric groove

- - In the young, especially the suckling animals, the ventricular groove contacts reflexly to form a tube, which conducts the milk to the abomasum by the shortest route
- The ventricular groove subdivided into ruminal, reticular and omasal parts



The omaso abomasal fold



16 Omaso-abomasal fold of sheep