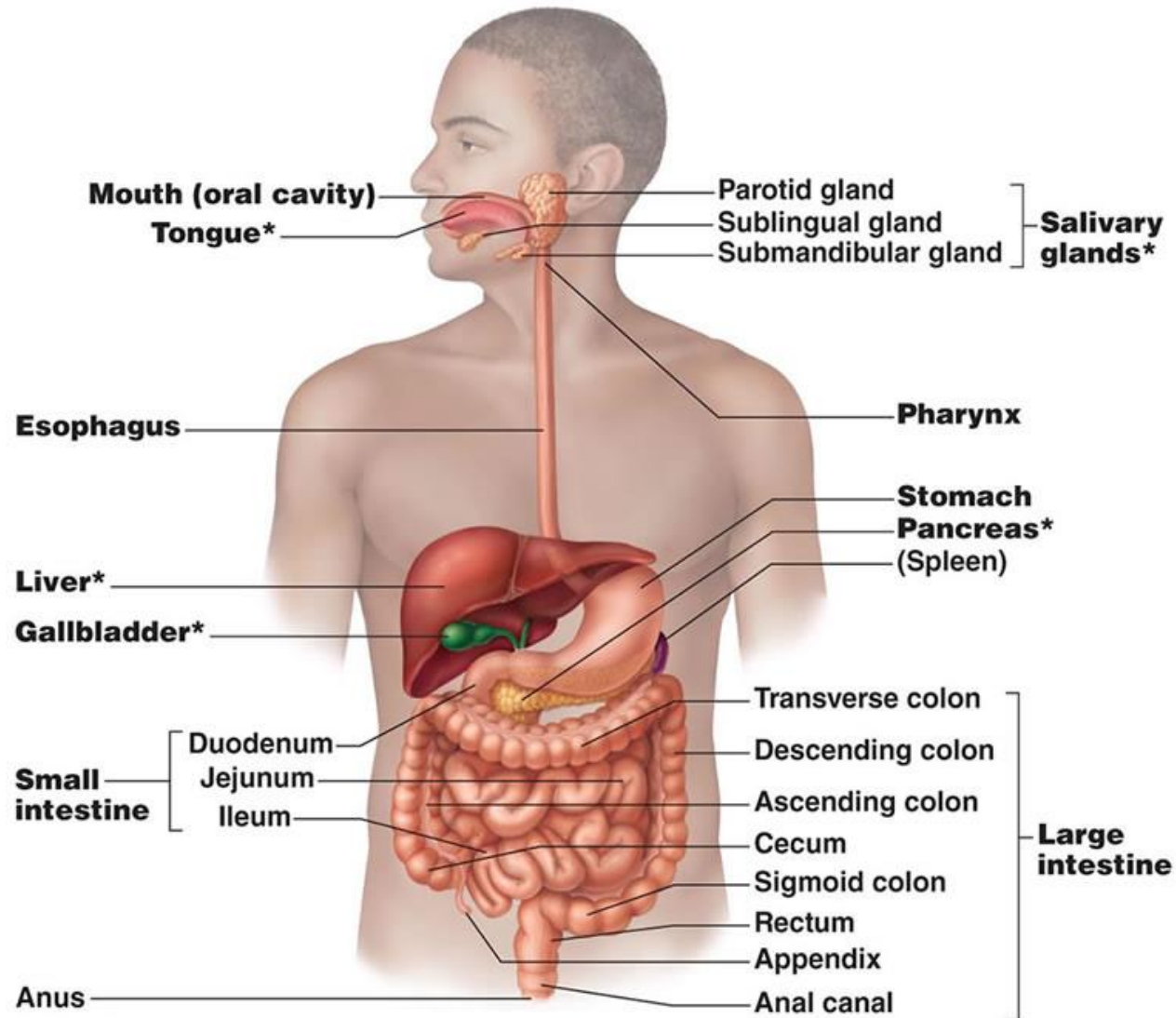


DIGESTIVE SYSTEM



Digestive System

Organs of GI Tract

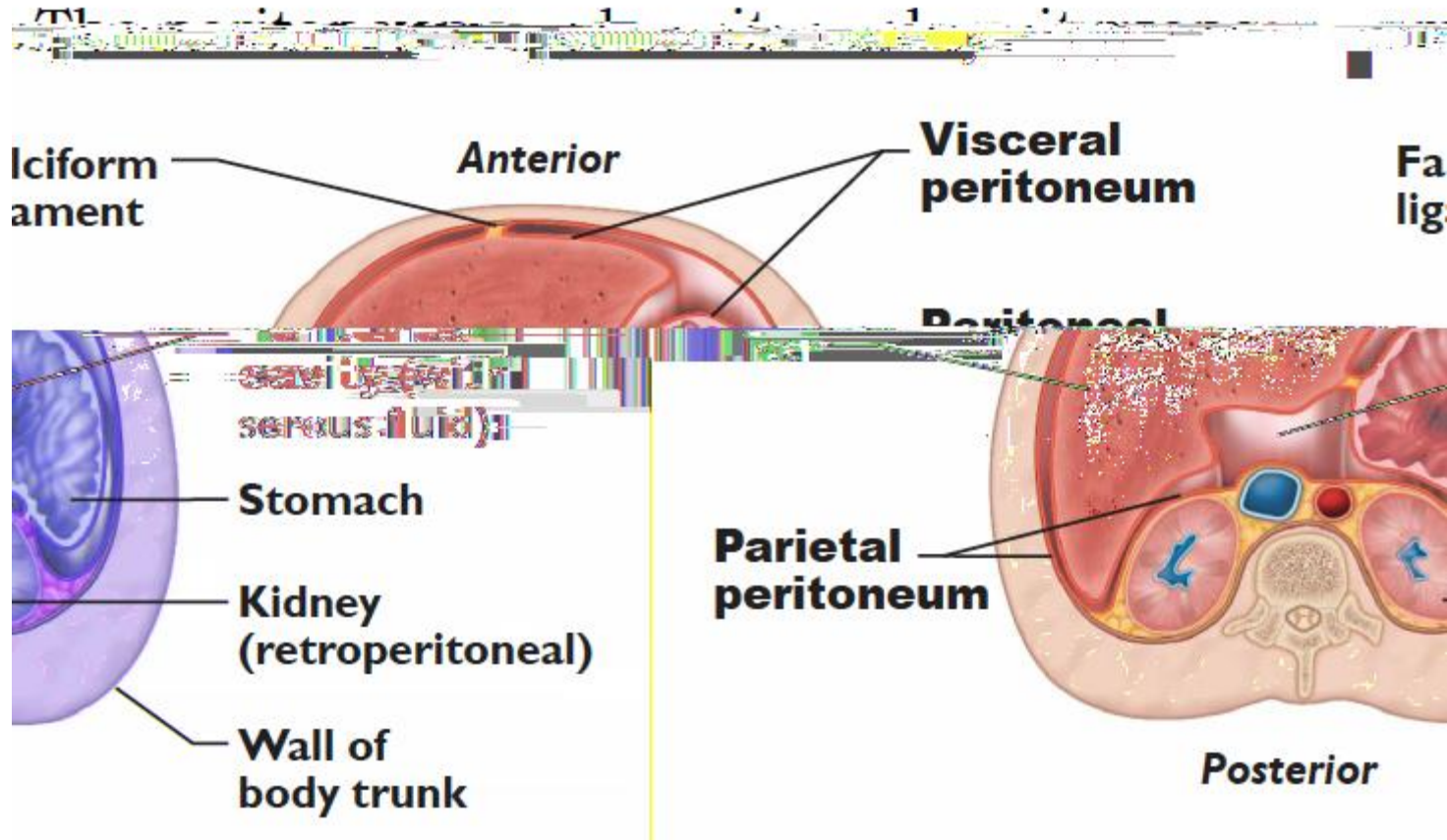
- Oral cavity
- Pharynx
- Esophagus
- Stomach
- Small intestine
- Large intestine

Accessory Organs of GI Tract

- Teeth
- Tongue
- Salivary glands
- Liver
- Gall bladder
- Pancreas

Functions of digestive system

- Ingestion
- Mastication
- Deglutition
- Digestion
- Absorption
- Peristalsis
- Defecation



LAYERS OF GASTROINTESTINAL TRACT

1. MUCOSA

2. SUB MUCOSA

3. TUNICA MUSCULARIS

4. SEROSA

LAYERS OF GASTROINTESTINAL TRACT



General Organization of the Gastrointestinal Tract

Mucosa

Epithelium

Lamina Propria

Muscularis Mucosa

Submucosa

Meissner's (Submucosa)

Muscularis Propria

Circular Muscle

Auerbach's (Myenteric)

Longitudinal Muscle

Serosa or Adventitia

Innervation of the Gastrointestinal Tract

- ☐ The GI tract is innervated by the sympathetic and parasympathetic divisions of the autonomic nervous system
- ☐ The vagus nerves are the source of parasympathetic activity in the esophagus, stomach, pancreas, gallbladder, small intestine, and upper portion of the large intestine.
- ☐ The lower portion of the large intestine receives parasympathetic innervation from spinal nerves in the sacral region.
- ☐ The submucosal plexus and myenteric plexus are the sites where preganglionic neurons synapse with postganglionic neurons that innervate the smooth muscle of the GI tract.
- ☐ Stimulation of the parasympathetic neurons increases peristalsis and the secretions of the GI tract.
- ☐ Postganglionic sympathetic fibers pass through the submucosal and myenteric plexuses and innervate the GI tract.
- ☐ The effects of sympathetic nerve stimulation are antagonistic to those of parasympathetic nerve stimulation.
- ☐ Sympathetic impulses inhibit peristalsis, reduce secretions, and constrict muscle sphincters along the GI tract.

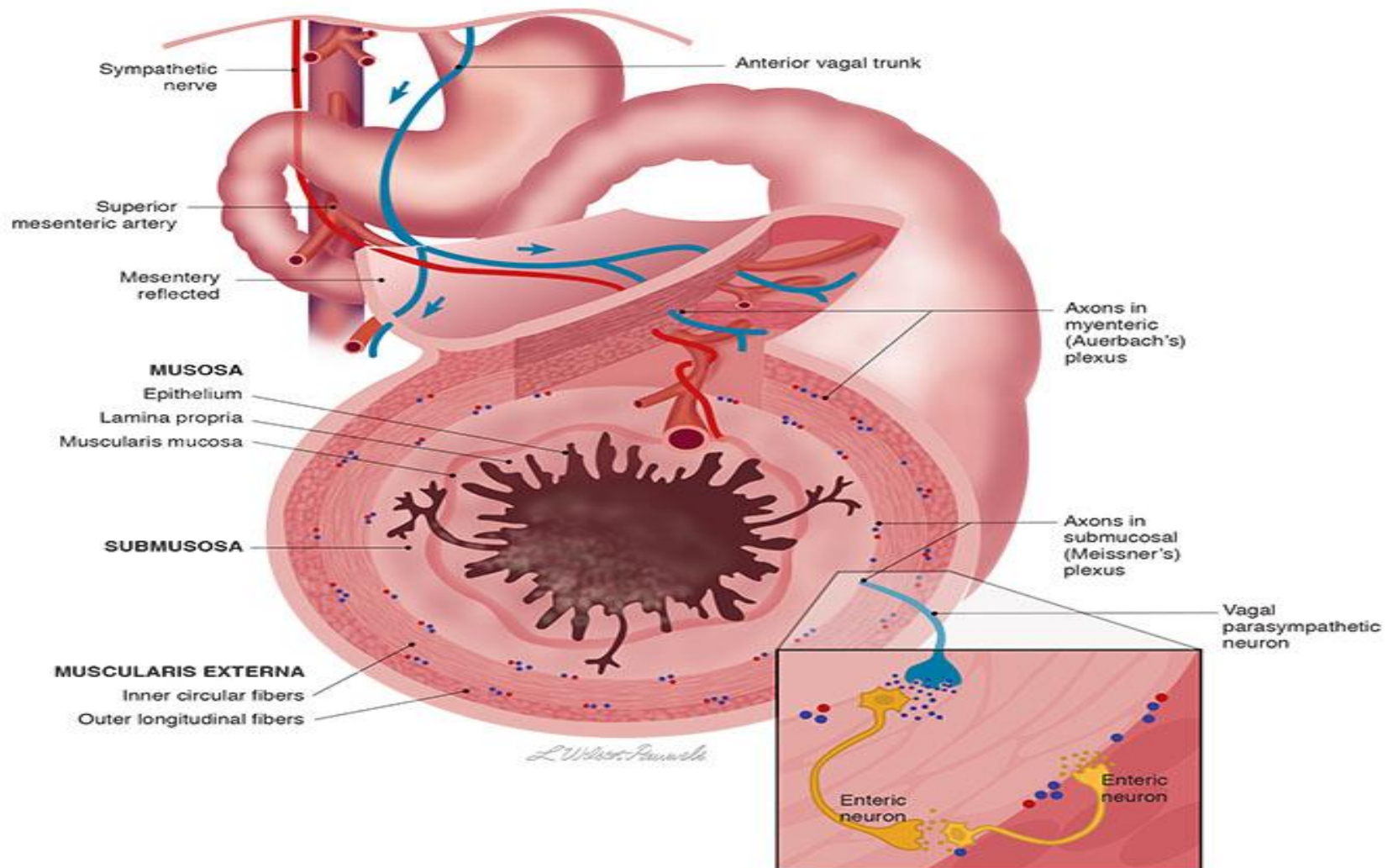
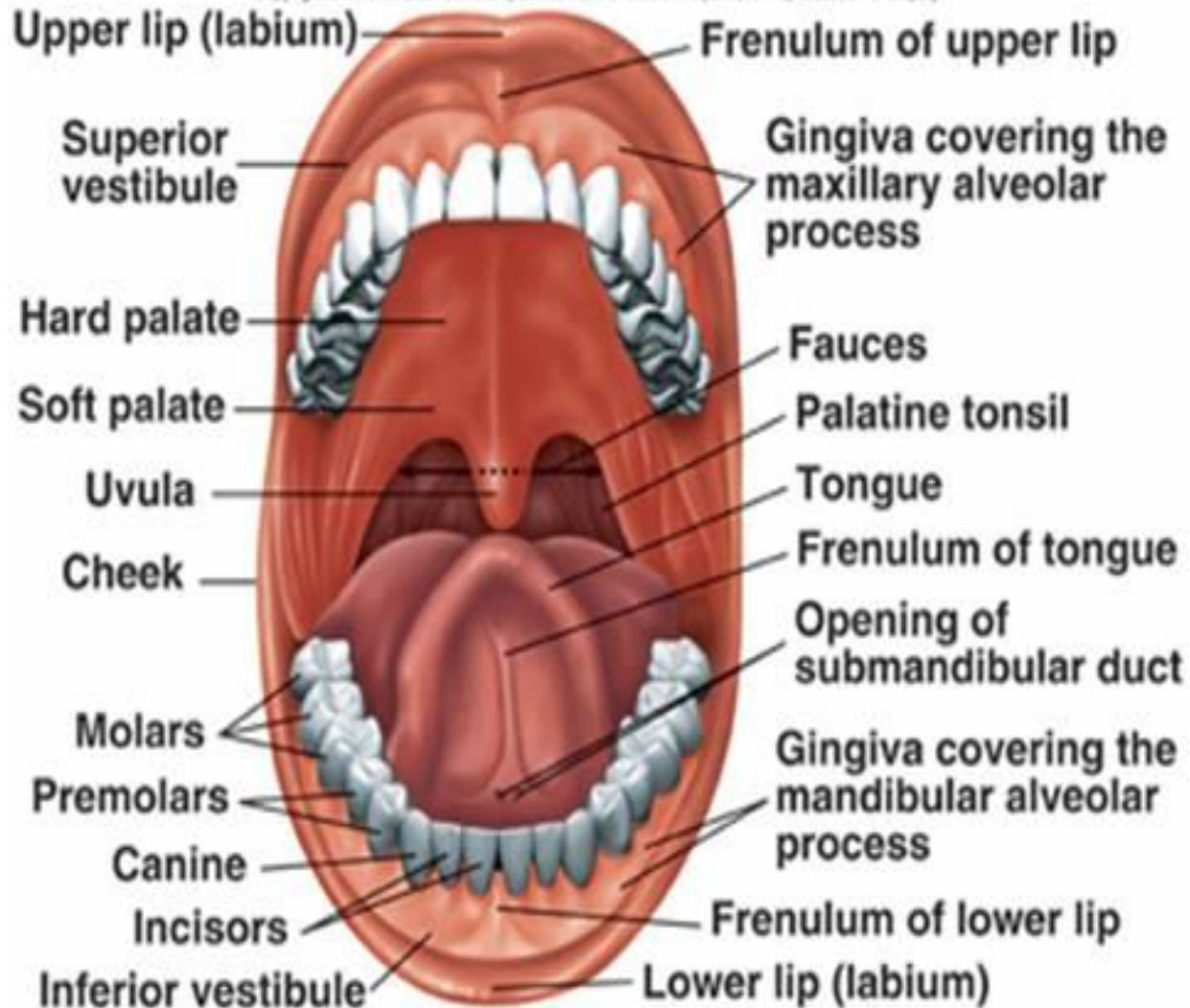


Figure X-11 The effect of the parasympathetic innervation of the vagus nerve on the enteric nervous system of the gut. The myenteric plexus (of Auerbach) between the inner circular and outer longitudinal muscle layers and the submucosal plexus (of Meissner) in the submucosal space are highlighted. The insert shows a simplified version of a parasympathetic nerve affecting an enteric neuron.

MOUTH

- Mouth also known as oral cavity is formed by cheeks, lips, hard palate & soft palate.
- Vestibule is the of oral cavity is the depression between the cheeks & lips externally and gums & teeth internally.
- Opening of oral cavity is referred to as oral orifice.
- Opening between oral cavity & pharynx is called fauces.

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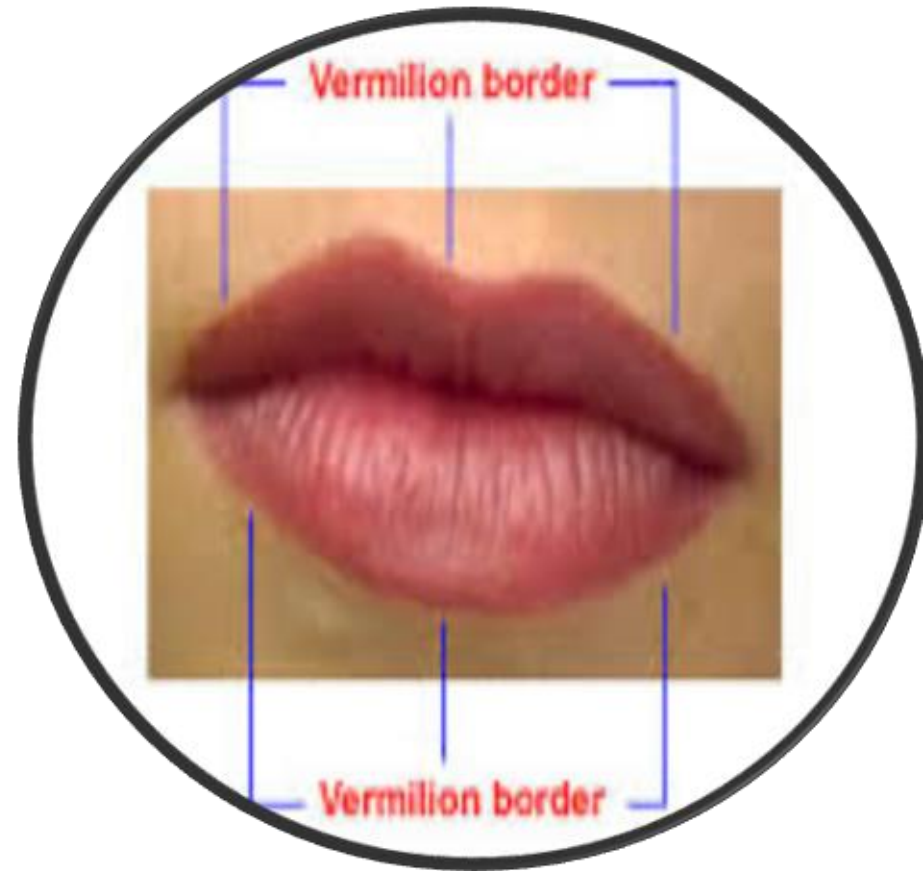
CHEEKS

- Cheeks form the lateral walls of the oral cavity
- They consist of outer layer of skin, subcutaneous fats, facial muscles that assist in manipulating food in oral cavity & inner lining of stratified squamous epithelium.
- Anterior portion of lips terminate in superior & inferior lips that surrounds oral orifice.

LIPS

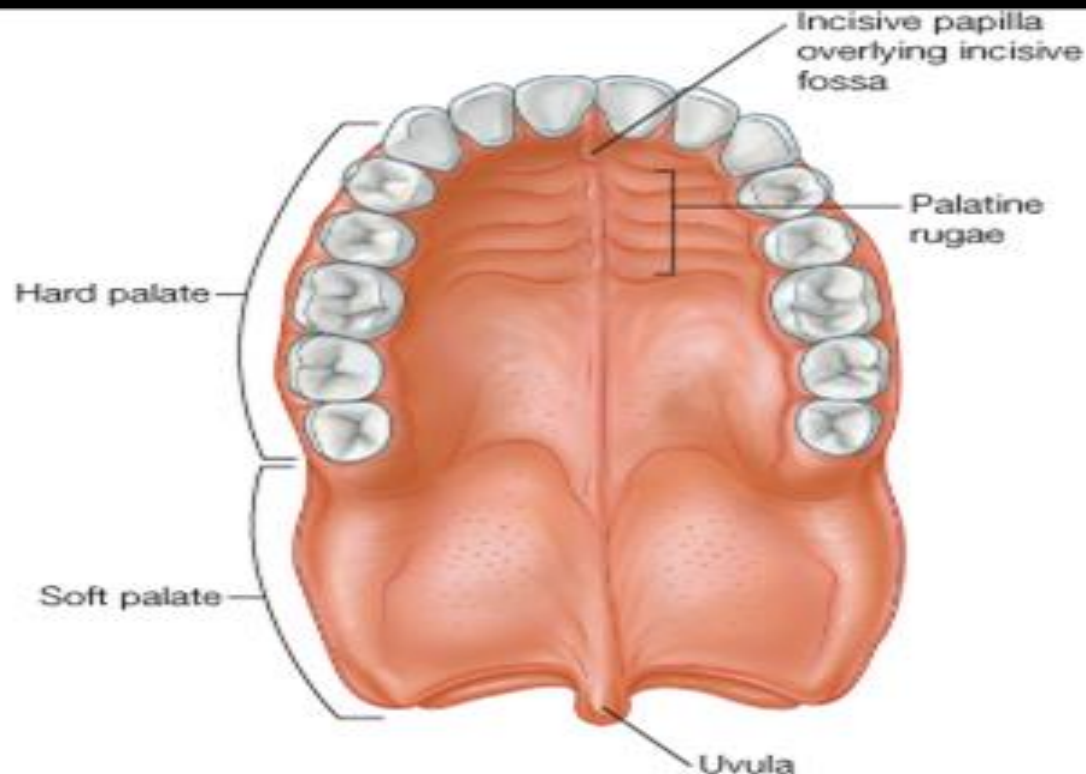
- Lips are fleshy highly mobile organs whose principle function in human is associated with speech.
- Lips also serve for suckling, manipulating food & keeping food between upper & lower teeth.
- Each lip is attached from its inner surface to the gum by a midline fold of mucus membrane called labial frenulum.

Between outer skin & mucous membrane of oral cavity is a transition zone called the **Vermilion**



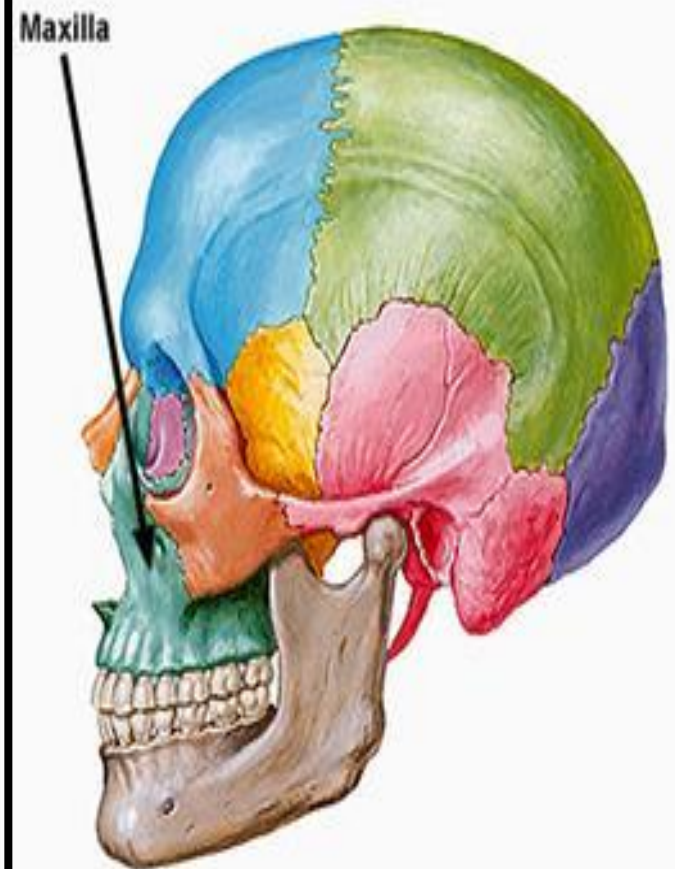
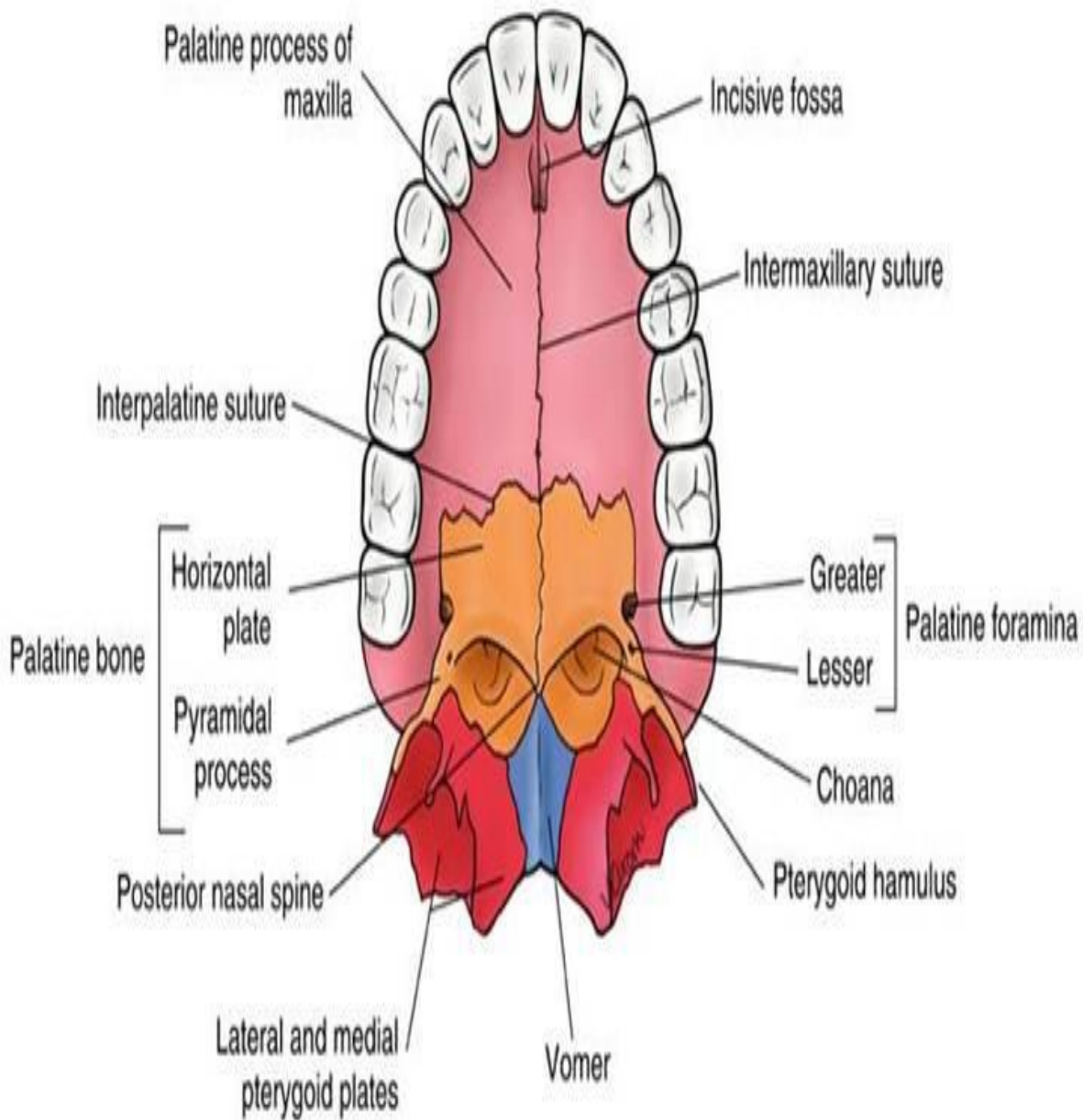
PALATE

- Palate which forms the roof of oral cavity consists of bony hard palate anteriorly & soft palate posteriorly.



Hard Palate

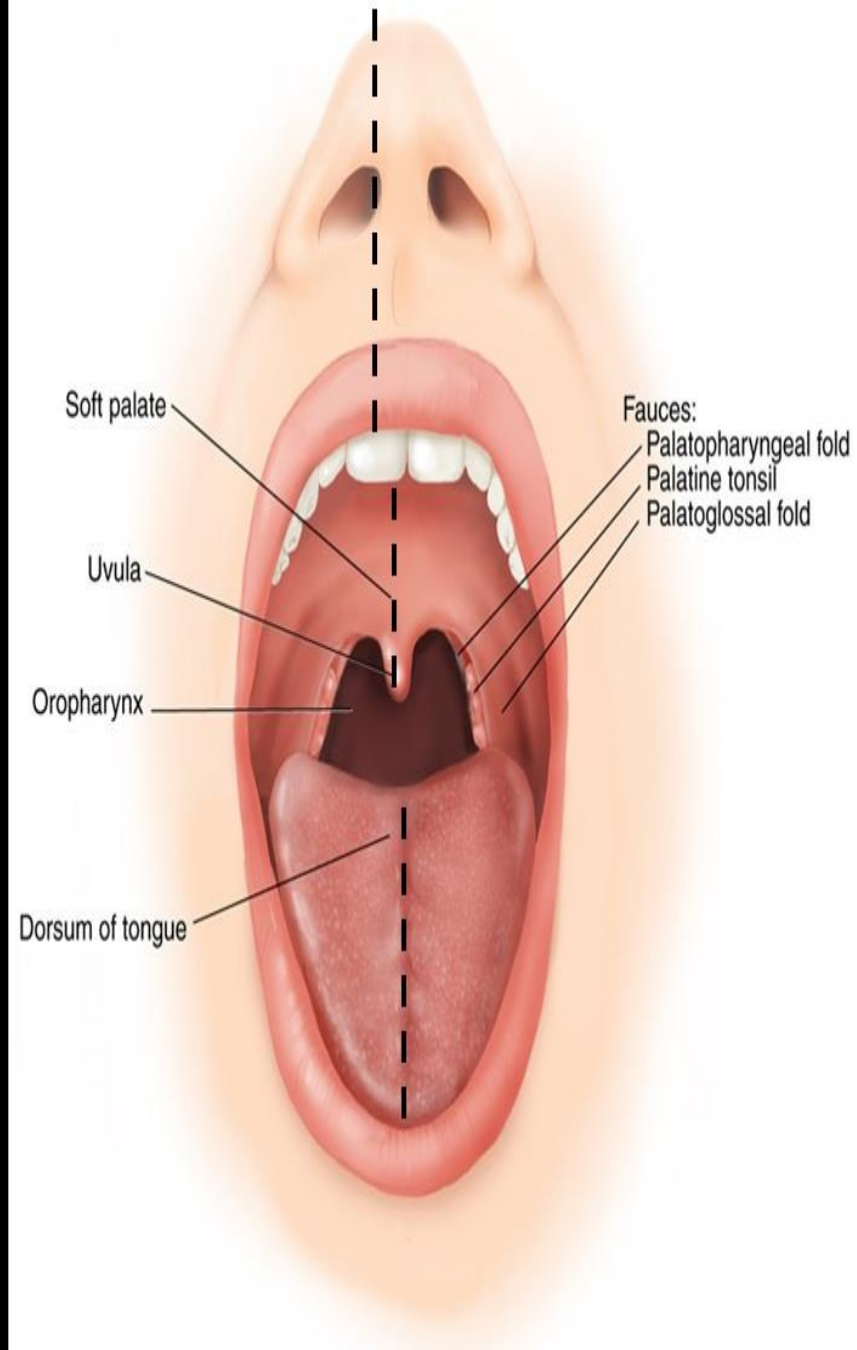
- Hard palate formed palatine process of maxillae & horizontal plates of palatine bones & is covered with mucous membrane.
- Transverse palatine folds or Palatal Rugae are located along the mucous membrane of the hard palate.



Soft Palate

- Soft Palate is a muscular arch covered mucous membrane & is continuous with the hard palate anteriorly.
- Suspended from the middle lower border of the soft palate is a cone shaped projection called Palatine Uvula.

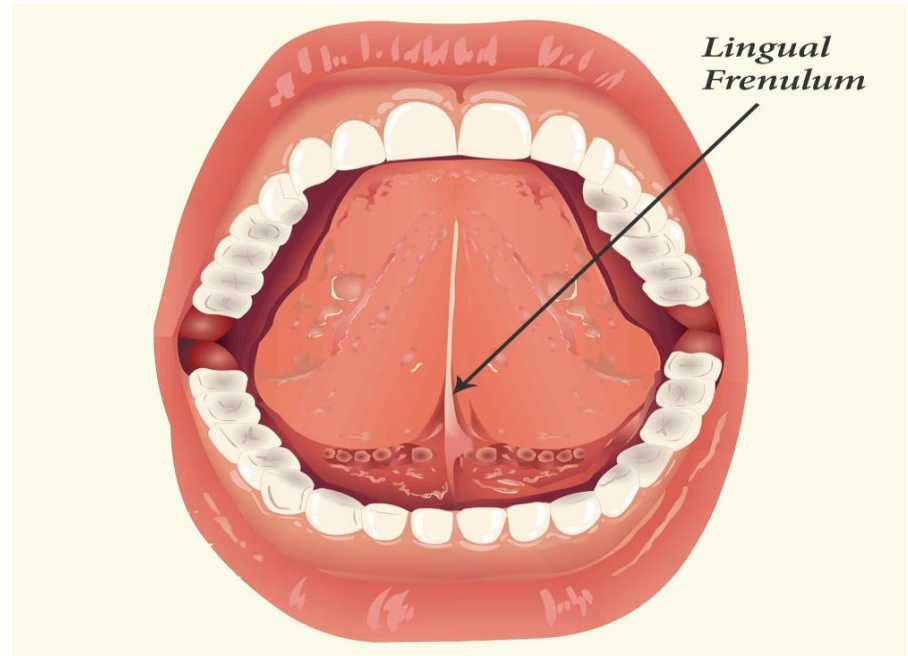
- Two muscular folds extend downward from both sides of the base of palatine uvula.
- The anterior fold is called **glossopalatine arch** & posterior fold is called **pharyngopalatine arch**.
- Between these two arches is the **palatine tonsil**.



TONGUE

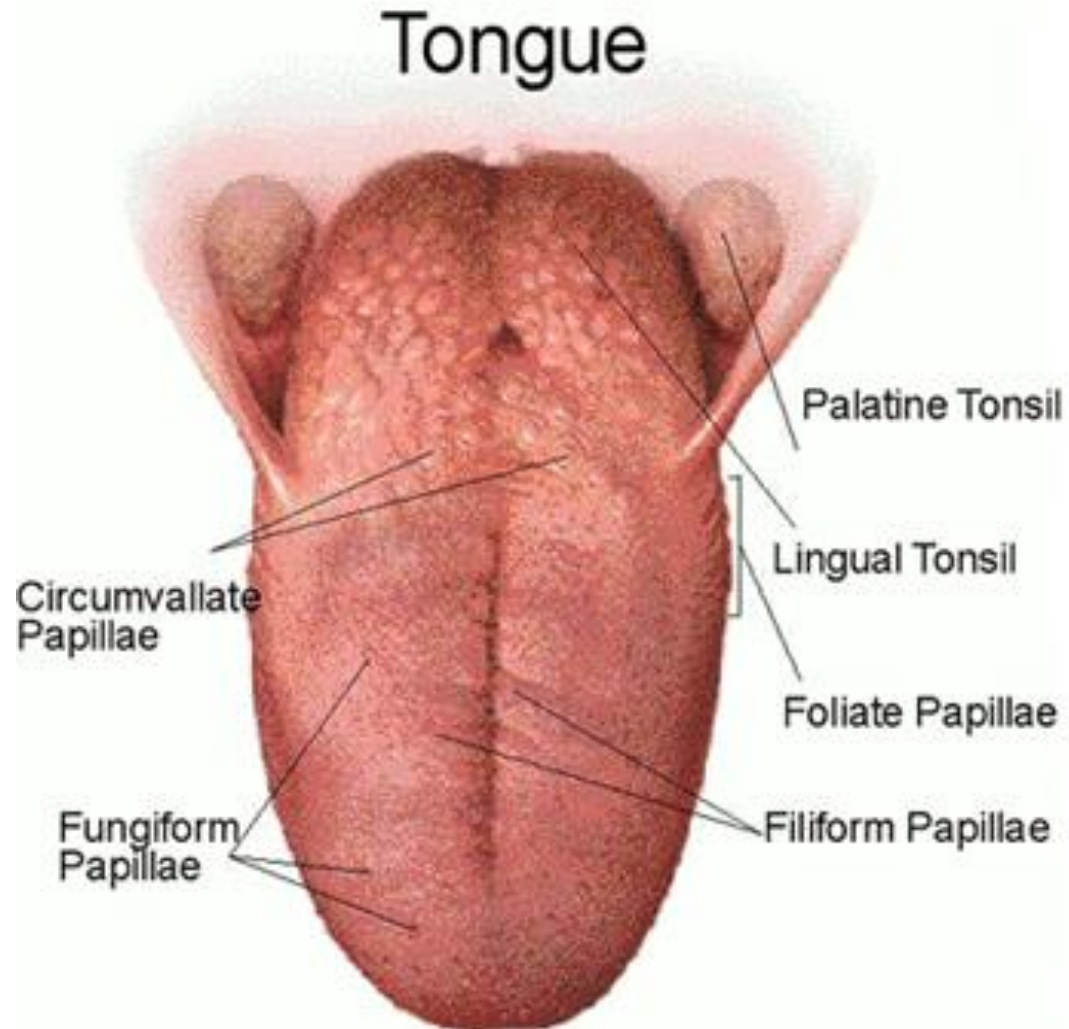
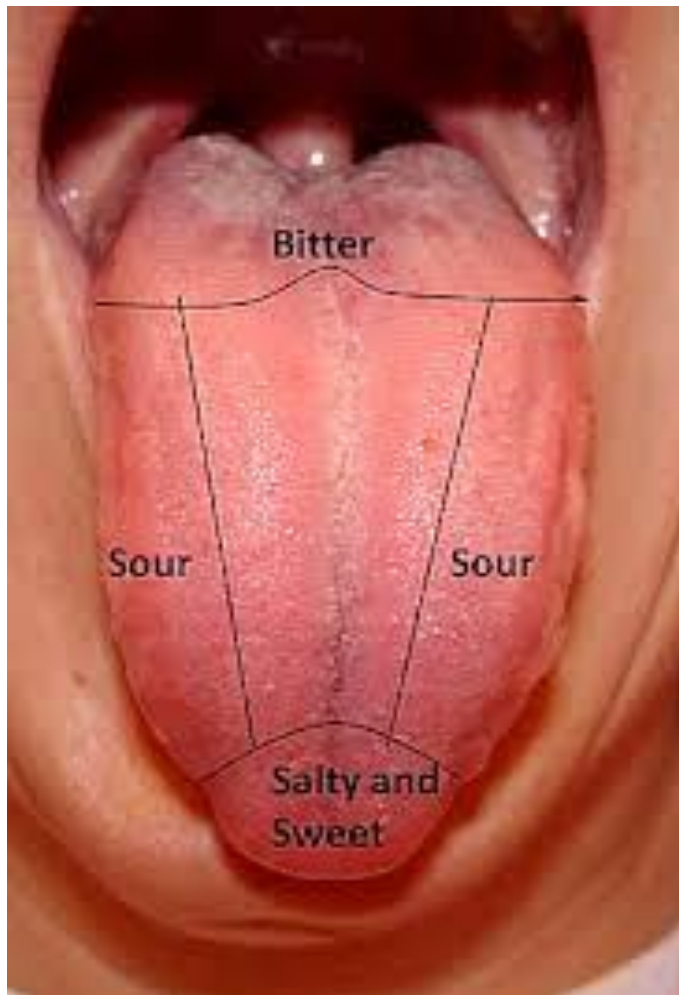
- Tongue is a mass of skeletal muscle covered with mucous membrane.
- Tongue function to move food around the mouth during mastication & to assist in swallowing food
- Essential in producing speech.
- Extrinsic tongue muscles move tongue from side to side & in and out.
- Only anterior 2/3 of tongue lies in oral cavity & remaining 1/3 lies in pharynx and is attached to hyoid bone.

- Rounded masses of lingual tonsils are located on the superior surface of the base of the tongue.
- The inferior surface of the tongue is connected along midline anteriorly to the floor of mouth by vertically positioned Lingual frenulum .



- **Papillae** are numerous small elevations on the surface of tongue.
- They give tongue a distinct roughened surface that aids in handling of food.
- They also contain taste buds that respond to sweet, salty, sour & bitter chemical stimuli.
- 4 types of papillae are present on surface of tongue
 1. Filiform
 2. Fungiform
 3. Foliate
 4. Circumvallate

Surface of tongue

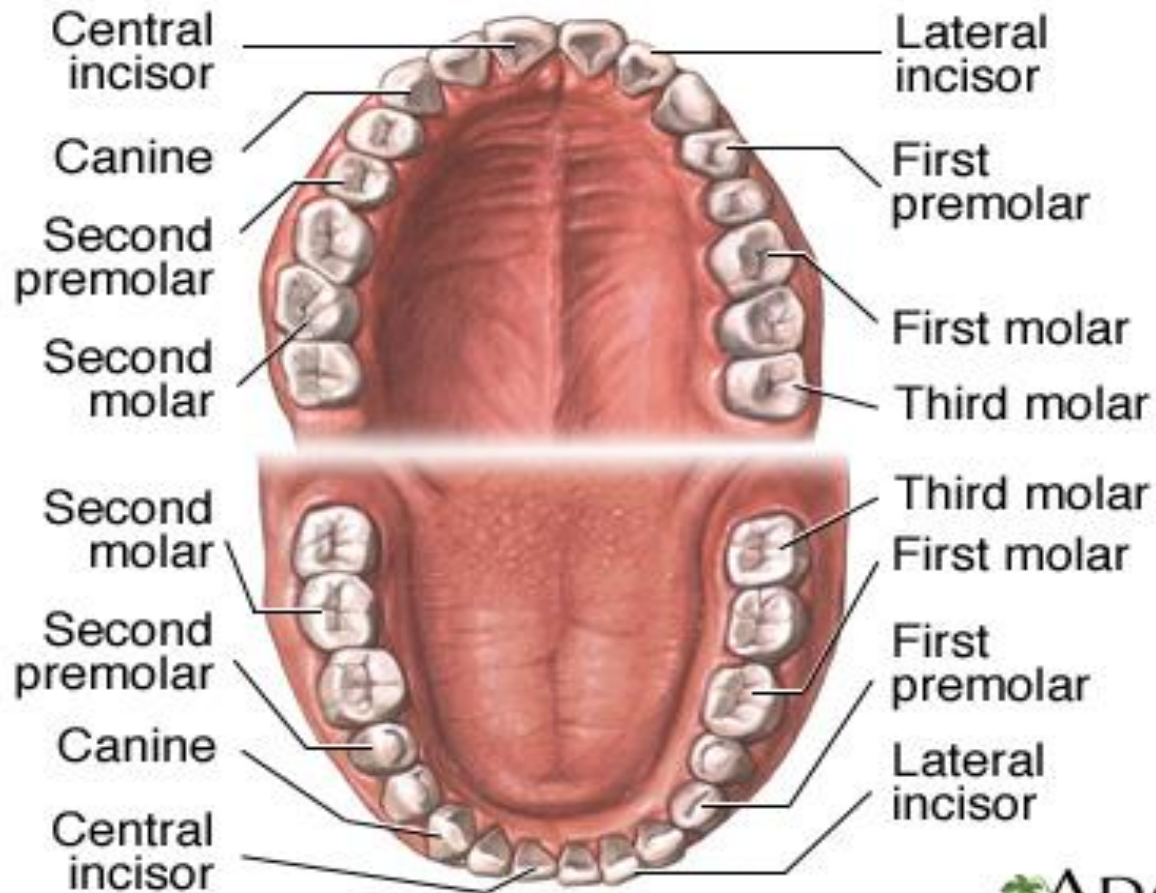


- [Filiform papillae](#) Filiform papillae are sensitive to touch, have tapered tips, and are by far the most numerous. These papillae lack taste buds and are not involved in the perception of taste.
- [Fungiform papillae](#) -The fungiform papillae are involved in the sensations of taste and have [taste buds](#) on their upper surface which can distinguish the tastes: [sweet](#), [sour](#), [bitter](#), [salty](#)
- [Circumvallate papillae](#) - there are only about 10 to 14 of these papillae on most people, and are arranged in a V-shaped formation directed toward the throat. The taste buds of the vallate papillae are sensitive to bitter flavors.
- [Foliate papillae](#) - these are ridges and grooves towards the posterior part of the tongue found at the lateral borders

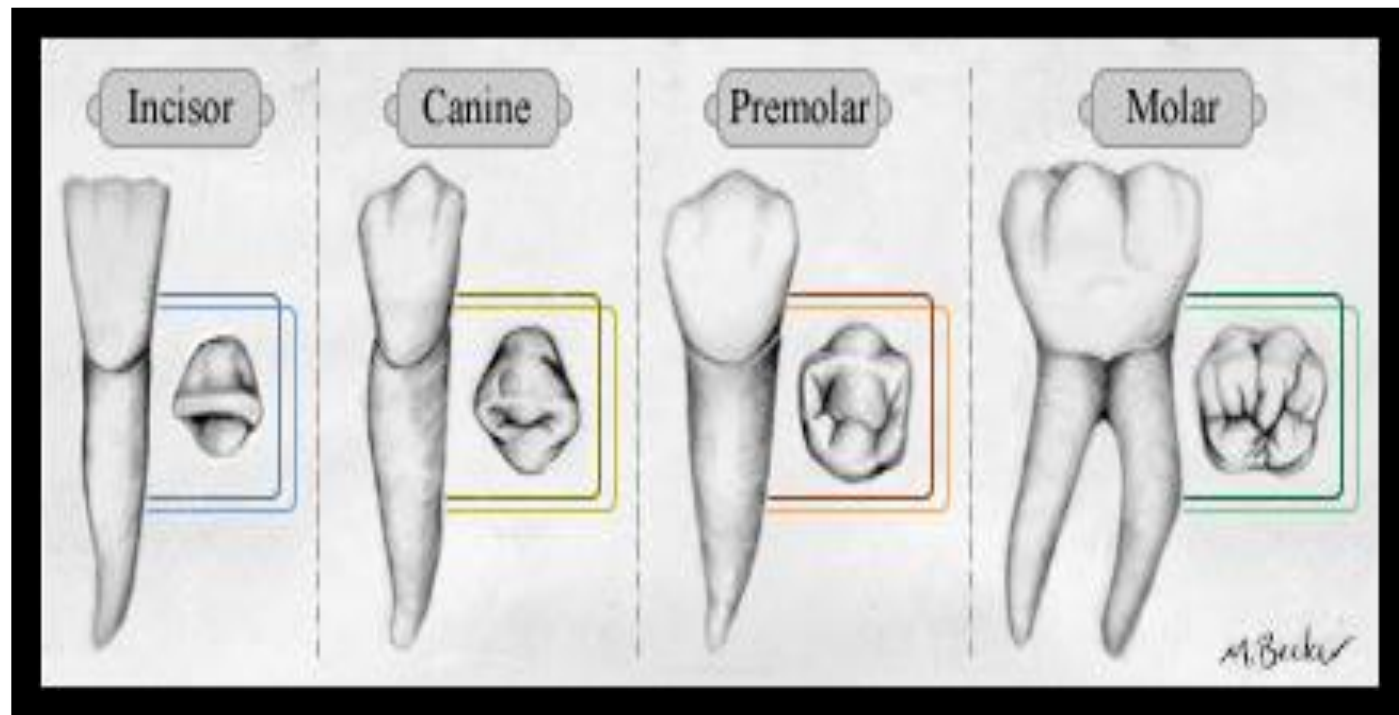
TEETH

- Humans & other mammals have heterodont dentition means they have various types of teeth.
- The four pairs (upper & lower jaws) of anterior most teeth are the incisors adapted for cutting & shearing food.
- Two pairs of cone shaped canines (cuspids) are located at the anterior corners of the mouth they are adapted for holding & tearing.
- Incisors & canines are characterized by singly root on each tooth

TEETH



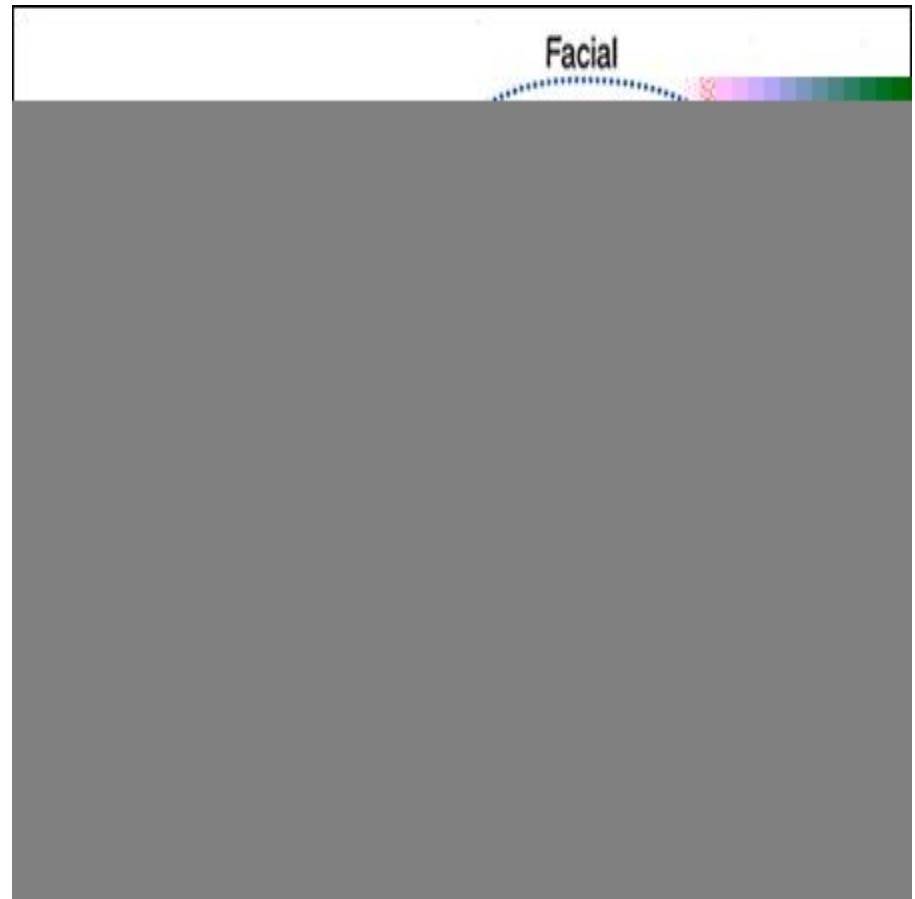
- Located behind the canines are the **premolars** & **molars**
- They have 2 or 3 roots & somewhat rounded, irregular surfaces called dental cusps for crushing & grinding food.



The **buccal surface** of the premolars & molars is adjacent to cheek.

The **labial surface** of the incisors & canines is adjacent to the lip.

The **lingual surface** of all teeth is adjacent to tongue.



TEETH

- Humans are diphyodont that is normally 2 sets of teeth develop in person's lifetime.
- Twenty deciduous (milk) teeth begin to erupt at about 6 months of age, beginning with the incisors.
- All erupt at the age of 2.5 yrs
- 32 permanent teeth replace the deciduous teeth in predictable sequence.
- Process begins at age of 6 and continues until about age of 17yrs.
- Third molars (wisdom teeth) are the last to erupt at age 17-25

- A dental formula is a graphic representation of the types, number & position of teeth in the oral cavity
- Formula for deciduous dentition
I 2/2, **C** 1/1 , **DM** 2/2 = $10 \times 2 = 20$ teeth
- Formula for permanent dentition
I 2/2, **C** 1/1, **P** 2/2, **M** 3/3 = $16 \times 2 = 32$ teeth

Where I = incisor

C = canine

P = premolar

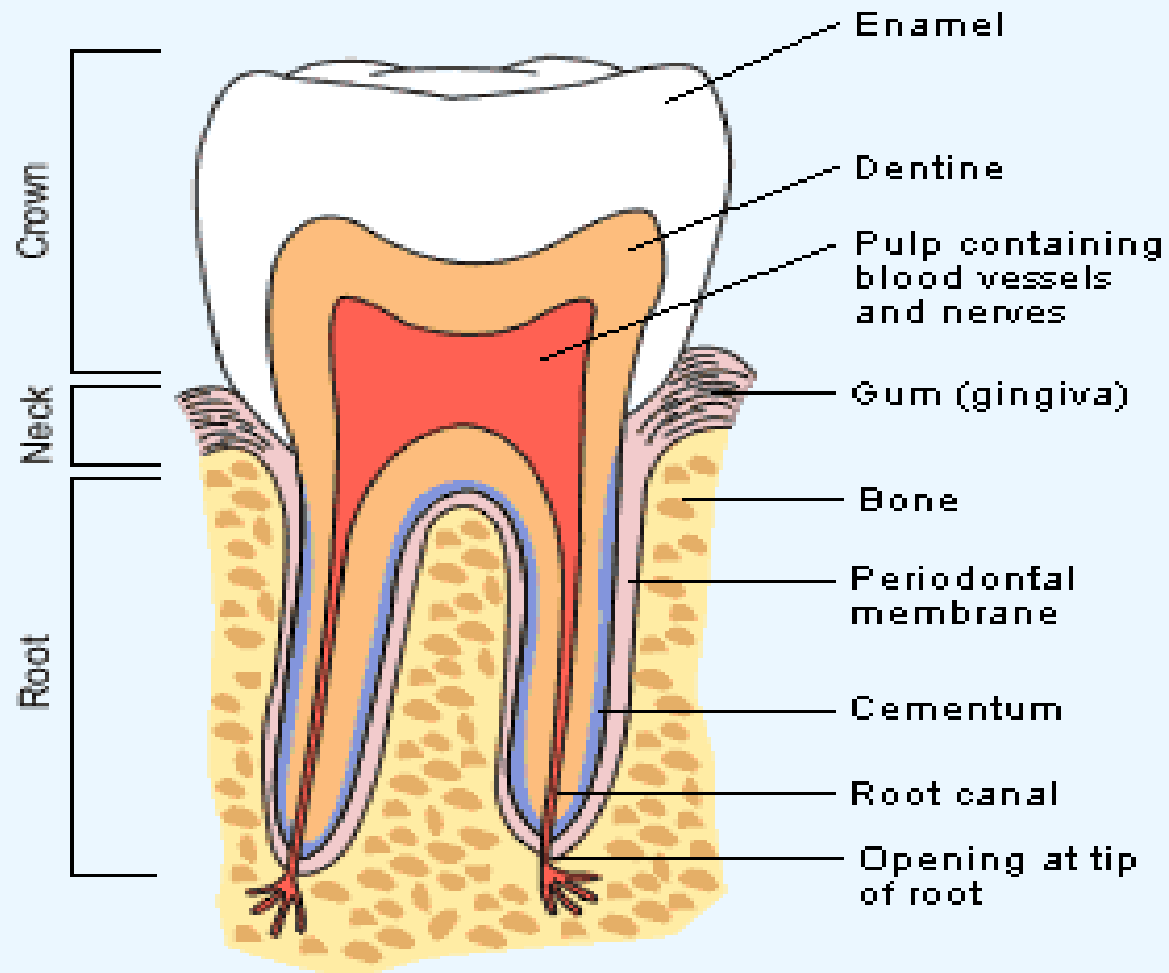
DM = deciduous molar

M = molar

Structure of tooth

- A tooth consists of exposed crown, which is supported by neck that is anchored firmly into the jaw by one or more roots.
- Root of teeth fits into sockets called **dental alveoli**, in the alveolar processes of mandible & maxillae.
- Each socket is lined by connective tissue periosteum, specifically called **periodontal membrane**.
- Root of tooth is covered with a bone like material called **cementum**.

NORMAL TOOTH



- The **gingiva**(gum) is the mucous membrane surrounding the alveolar processes in oral cavity.
- Bulk of tooth consists of **dentin** a substance similar to bone but harder.
- Covering the dentin on the outside & forming the crown is a tough, durable layer of **enamel** .
- Enamel is composed of calcium phosphate & is the hardest substance in body.
- Central region of tooth contains the **pulp cavity**

- It contains pulp which is composed of connective tissue with blood vessels, lymph vessels & nerves.
- A root canal continuous with the pulp cavity opens to the connective tissue surrounding the root through an **apical foramen**.

SALIVARY GLANDS

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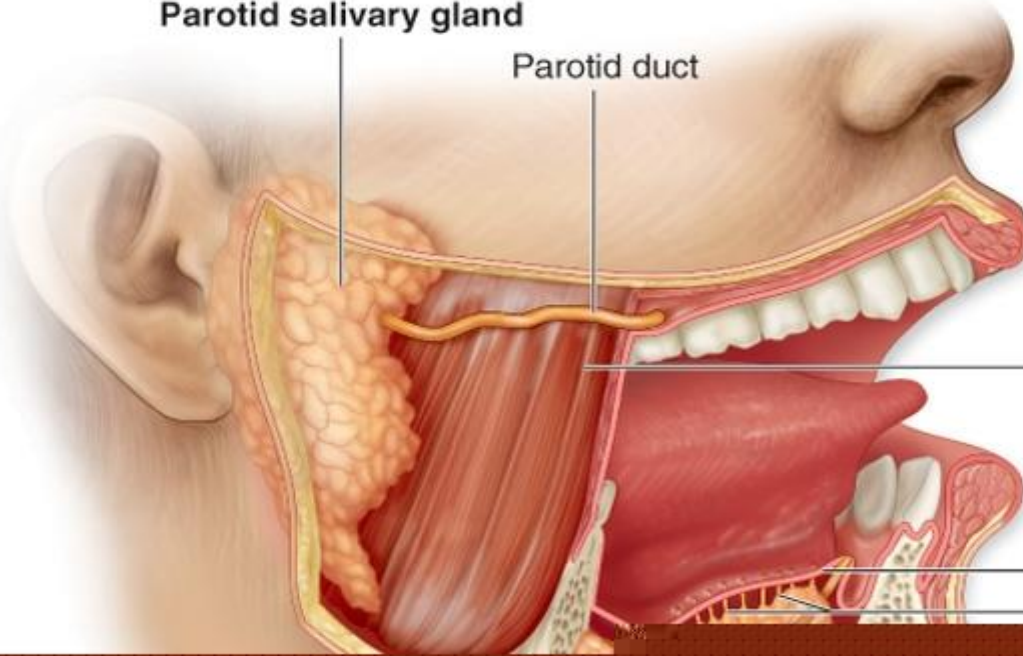
Parotid salivary gland

Parotid duct

Masseter muscle

Mucosa (cut)

Sublingual ducts



SALIVARY GLANDS

- The salivary glands are accessory digestive glands that produce a fluid secretion called ***saliva***.
- The amount of saliva secreted daily ranges from **1.0 to 1.5 L**.
- Saliva also contains starch-digesting enzymes and lubricating mucus, which aids swallowing.
- **PAROTID GLANDS**
- **SUBMANDIBULAR GLANDS**
- **SUBLINGUAL GLANDS**

Two types of secretory cells, **serous and mucous cells**, are found in all salivary glands in various proportions . Serous cells produce a watery fluid containing digestive enzymes; mucous cells secrete a thick, stringy mucus. Cuboidal epithelial cells line the lumina of the salivary ducts.

The salivary glands are innervated by both divisions of the autonomic nervous system. Sympathetic impulses stimulate the secretion of small amounts of viscous saliva. Parasympathetic stimulation causes the secretion of large volumes of watery saliva. Physiological responses of this type occur whenever a person sees, smells, tastes, or even thinks about desirable food

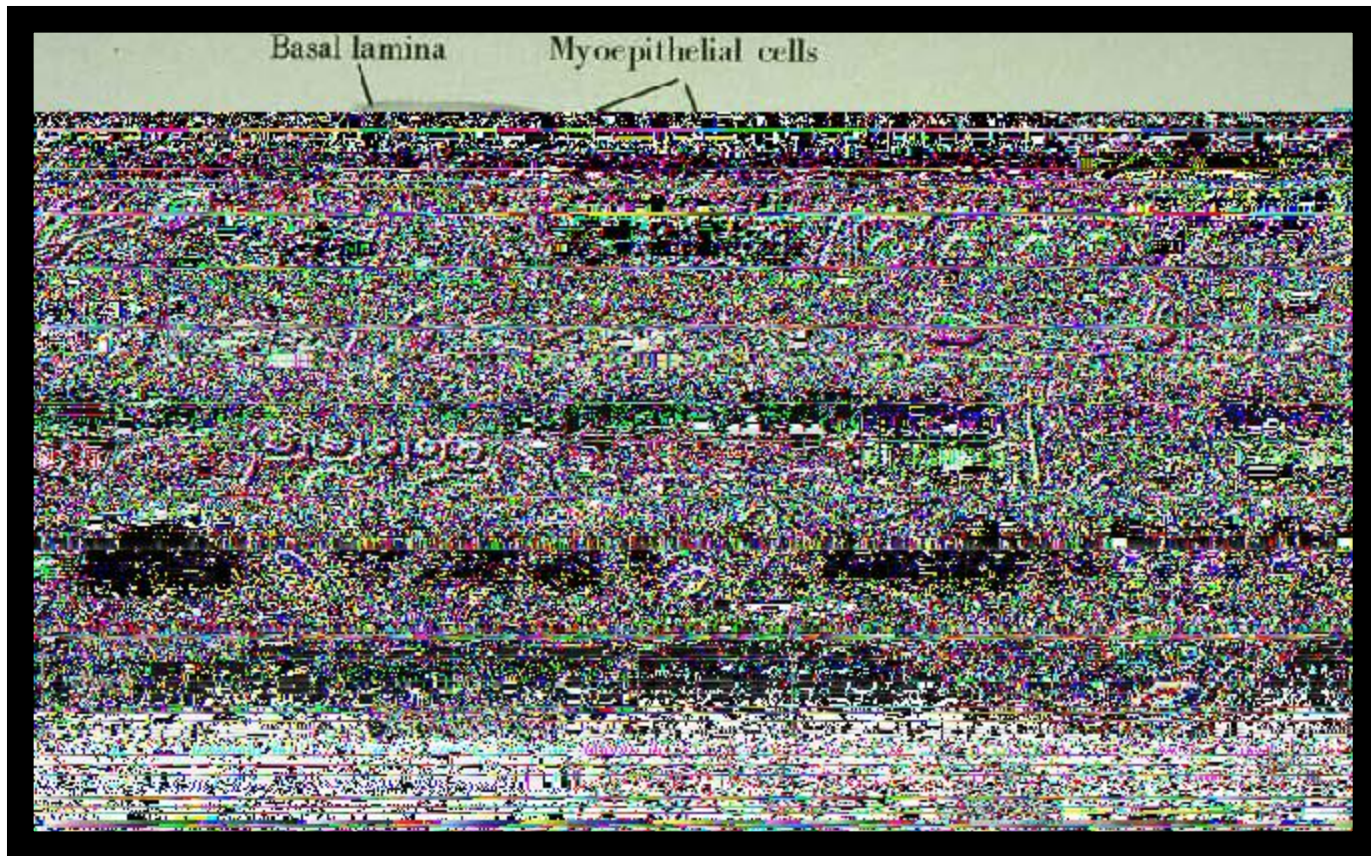
HISTOLOGY OF SALIVARY GLANDS

Acini:

- Secretory cells are found in a group, or acinus (plural, acini).
- Each acinus is located at the terminal part of the gland connected to the ductal system, with many acini within each lobule of the gland.
- Each acinus consists of a single layer of cuboidal epithelial cells surrounding a lumen, a central opening where the saliva is deposited after being produced by the secretory cells.
- The three forms of acini are classified in terms of the type of epithelial cell present and the secretory product being produced: [serous](#), [mucoserous](#) and [mucous](#).
- Two types of secretory cells, **serous and mucous cells**, are found in all salivary glands in various proportions. Serous cells produce a watery fluid containing digestive enzymes; mucous cells secrete a thick, stringy mucus.

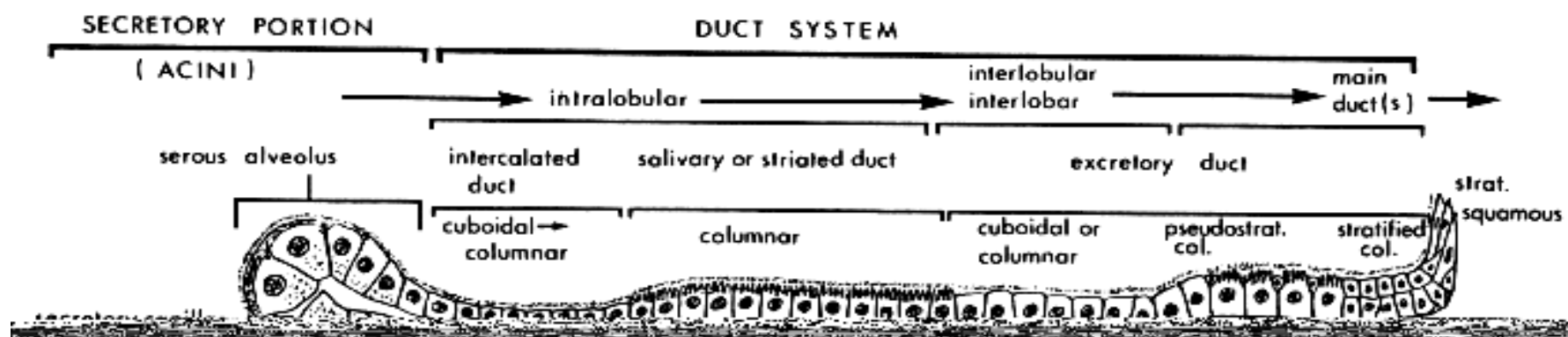
Ducts:

- In the duct system, the lumina are formed by [intercalated ducts](#), which in turn join to form [striated ducts](#). These drain into ducts situated between the lobes of the gland (called [interlobar ducts](#) or secretory ducts). These are found on most major and minor glands (exception may be the sublingual gland).



Acinus Intercalated Duct Striated Duct (Intralobular)
..... Excretory Duct (Interlobular)

A Schematic Exocrine Gland



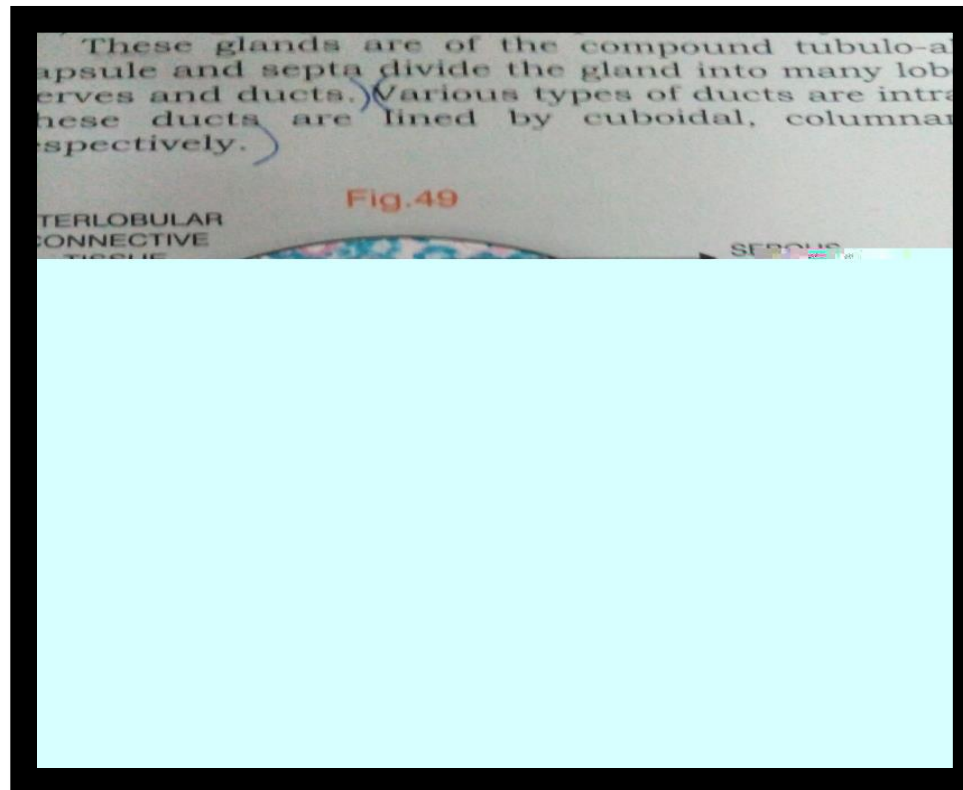


PAROTID GLANDS

- Largest of salivary glands
- Positioned below & in front of the auricle of ear, between skin & masseter muscle.
- Saliva produced drain through parotid (Stensen's) duct.
- Secrete watery serous fluids, salts & enzymes.
- It become infected & swollen with the mumps.

HISTOLOGY OF PAROTID GLANDS

- The acini of glands secrete enzymes
- The acinus is rounded & is lined by pyramidal cells surrounding a very small lumen
- Nuclei are rounded & basal in position.



SUBMANDIBULAR GLAND

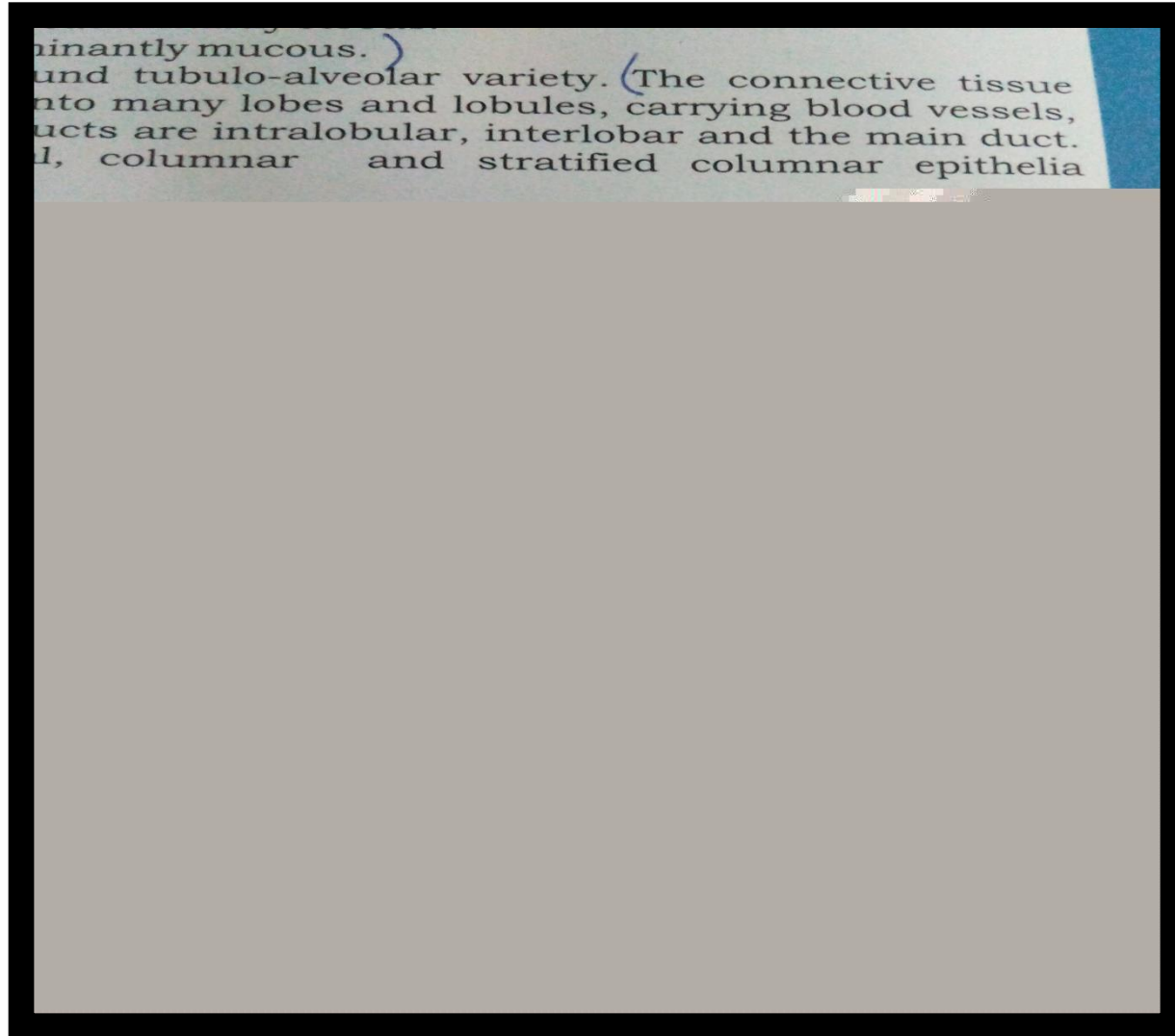
- Lies inferior to the body of the mandible, about midway along the inner side of jaw.
- Saliva produced in the submandibular gland drains through the submandibular (Wharton's duct) & empties into the floor of the mouth on lateral side of lingual frenulum.

HISTOLOGY OF SUBMANDIBULAR

GLANDS

- Consists of both serous & mucous acini.
- Mucous acini is lined by columnar cells.
- Size of mucous acini is larger than the serous one & shows bigger lumen.
- Between the mucous cells & the basement membrane are half moon shaped polyhedral granular serous cells.
- These cells are known as demilunes of Gianuzzi.

SUBMANDIBULAR GLAND



SUBLINGUAL GLANDS

- Lies under the mucous membrane of the floor of the mouth.
- Contains small sublingual ducts (Rivinus ducts) that empty into the floor of the mouth in an area posterior to the papilla of submandibular duct

HISTOLOGY OF SUBLINGUAL GLANDS

- Sublingual gland is predominantly mucous.
- The acinus is lined by truncated columnar cells.
- Size of acinus is bigger than serous acinus with wider lumen
- Nucleus is flattened and rest against basement membrane.

SUBLINGUAL GLAND

