Digestive system

to
Second stage students
Al-Mustaqbal University College of Dentistry,
by

Lec 10+11

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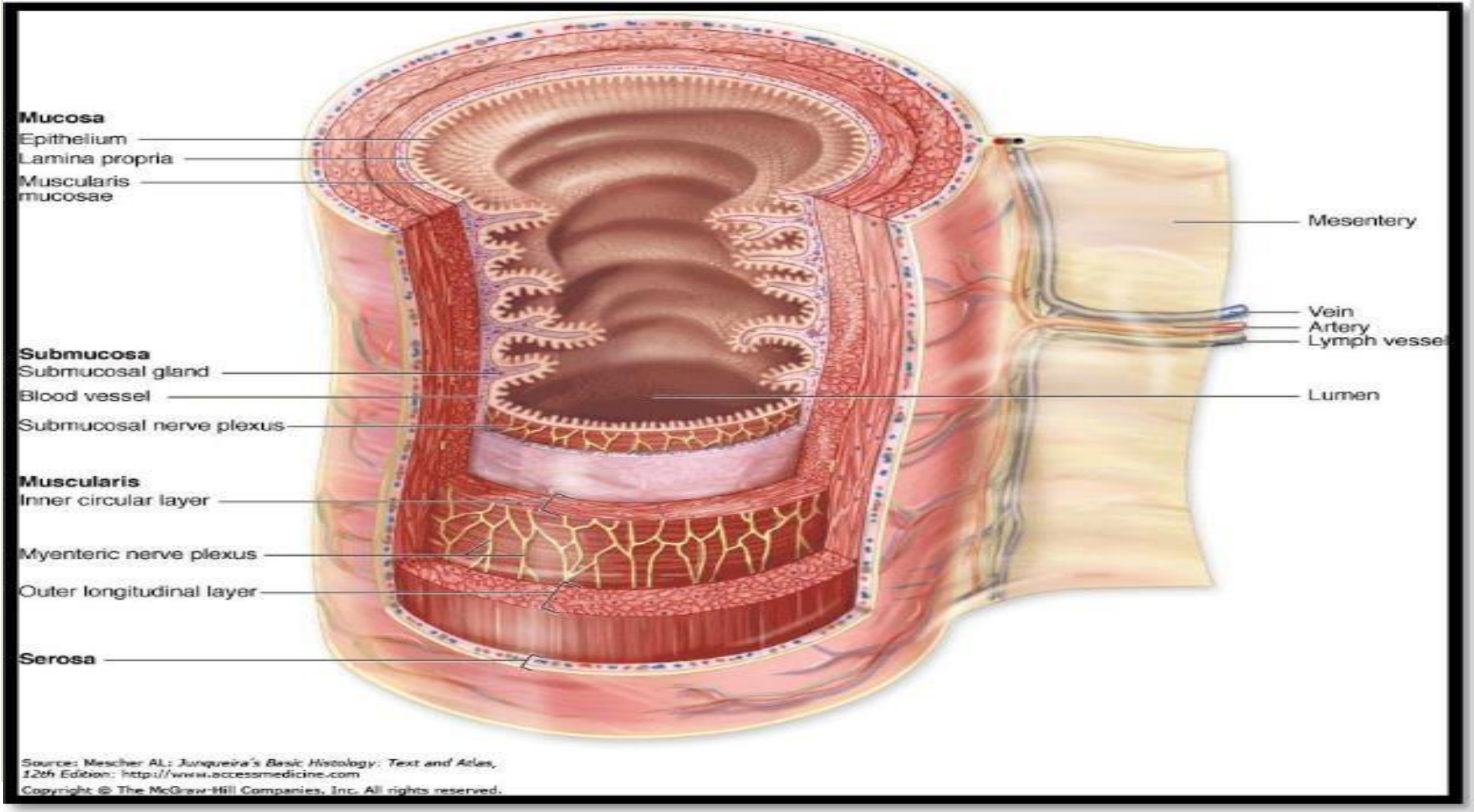
Digestive Tract

The digestive system consists of the digestive tract-oral cavity, esophagus, stomach, small and large intestines, and anus-and its associated glands-salivary glands, liver, and pancreas. Also called the gastrointestinal (Gl) tract (GIT) or alimentary canal its function is to obtain from ingested food the molecules necessary for the maintenance,
growth, and energy needs of the body.

During digestion proteins, complex carbohydrates, nucleic acids, and fats are broken down into their small molecule subunits that are easily absorbed through the small intestine lining. Most water and electrolytes
are absorbed in the large intestine.



Source: Mescher AL: *Junqueira's Basic Histology: Text and Atlas, 12th Edition*: http://www.accessmedicine.com

Structures within the digestive tract allow the following:

- Ingestion of food and liquid into the oral cavity.
- Mastication which divides solid food into digestible pieces.
- Motility, muscular movements of materials through the tract.
- Secretion of lubricating and protective mucus, digestive enzymes, acidic and alkaline fluids, and bile.

- Hormone release for local control of motility and secretion.
- Chemical digestion or enzymatic degradation of large macromolecules in food to smaller molecules and their subunits.
- Absorption of the small molecules and water into the blood and lymph.
- Elimination of indigestible, unabsorbed components of food.

General structure of the digestive tract

All regions of the GI tract have certain structural features in common.

The GI tract is a hollow tube with a lumen of variable

diameter and a wail made up of four main layers:

The mucosa, submucosa, muscularis, and serosa,

1-The mucosa: consists of an epithelial lining; an underlying lamina propria of loose connective tissue rich in blood vessels, lymphatics, lymphocytes, smooth muscle cells, and often containing small glands; and a thin layer of smooth muscle called the muscularis mucosae separating mucosa from submucosa and allowing local movements of the mucosa. The mucosa is also frequently called a mucous membrane.

2-The submucosa: contains denser connective tissue with larger blood and lymph vessels and the submucosal (Meissner) plexus of autonomic nerves. It may also contain glands and significant lymphoid tissue.

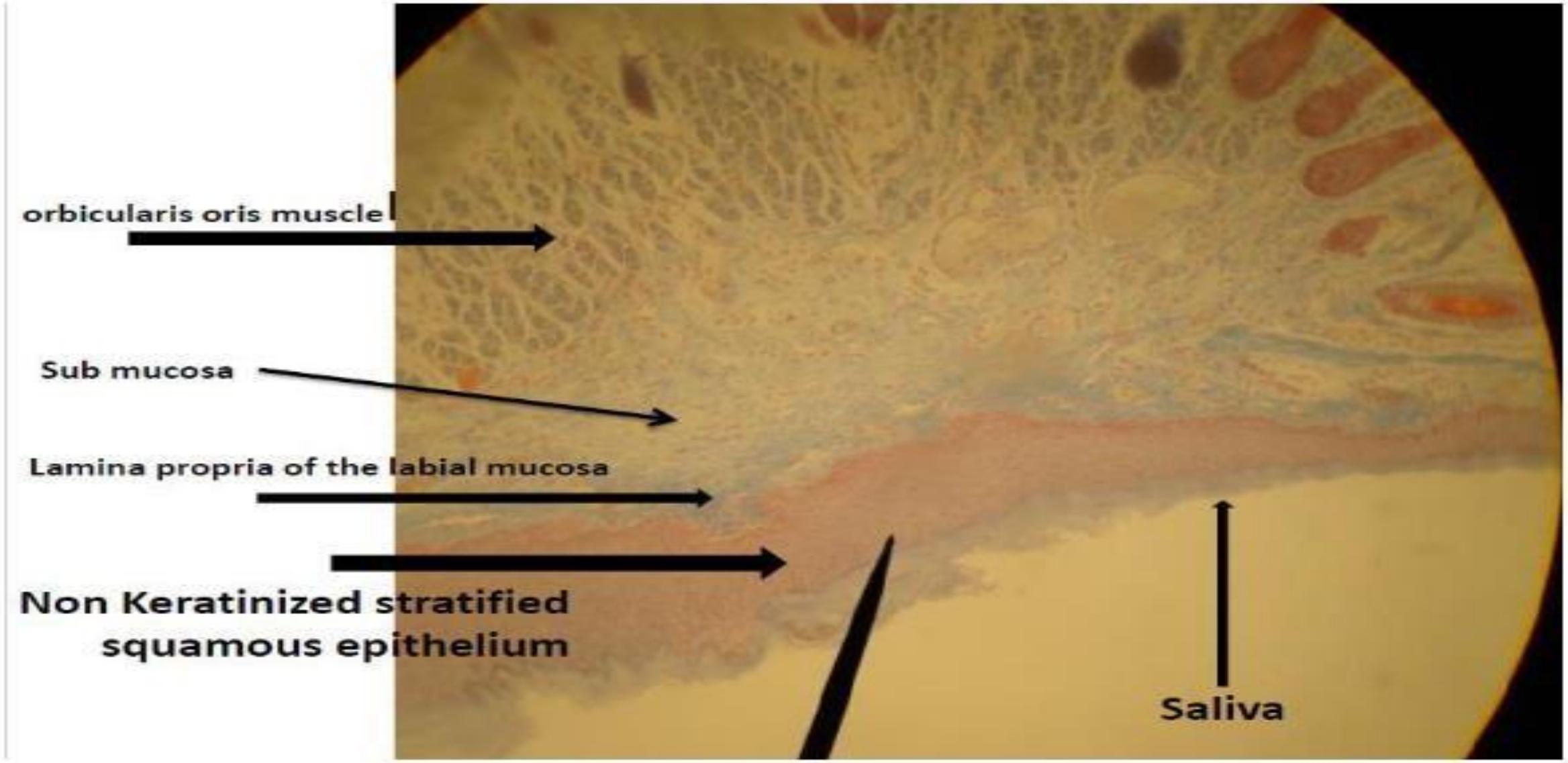
3-The thick muscularis (or muscularis externa): is composed of smooth muscle cells organized as two or more sublayers. In the internal sublayer (closer to the lumen), the fiber orientation is generally circular; in the external sublayer it is longitudinal. The connective tissue between the muscle sublayers contains blood and lymph vessels, as well as the myenteric (Auerbach) nerve plexus of many autonomic neurons aggregated into small ganglia and interconnected by pre-and postganglionic nerve fibers. This and the submucosal plexus together comprise the enteric nervous system of the digestive tract

The serosa:

is a thin layer of loose connective tissue, rich in blood vessels, lymphatics, and adipose tissue, with a simple squamous covering epithelium or mesothelium. In the abdominal cavity, the serosa is continuous with mesenteries, thin membranes covered by mesothelium on both sides that support the intestines. Mesenteries are continuous with the peritoneum, a serous membrane that lines that cavity. In places where the digestive tract is not suspended in a cavity but bound directly to adjacent structures, such as in the esophagus

thousands of microbial species, including both useful inhabitants of the gut as well as potential pathogens ingested with food and drink. The mucosa-associated immune defense system provides an essential backup to the thin physical barrier of the epithelial lining. Located just below the epithelium, the lamina propria is rich with macrophages and lymphocytes, many for production of IgA antibodies. Such antibodies undergo transcytosis into the intestinal lumen bound to the secretory protein produced by the epithelial cells. This IgA complex resists proteolysis by digestive enzymes and provides important protection against specific viral and bacterial pathogens.

Oral cavity


orbicularis oris muscle
Sub mucosa
Lamina propria of the labial mucosa
Non Keratinized stratified squamous epithelium
Saliva

The oral cavity is lined with stratified squamous epithelium, which may be keratinized, partially keratinized, or nonkeratinized depending on the location.

Like the keratinized surface cells of epidermis, the flattened superficial cell of the oral epithelium undergoes continuous desquamation. or loss at the surface unlike those of the epidermis, the shed cells of the nonkeratinized or Para keratinized oral epithelium retain their nuclei.

The keratinized cell layers resist damage from abrasion and are best developed in the masticatory mucosa on the gingiva (gum) and hard palate.

The lamina propria in these regions' rests directly on the periosteum of underlying bone. Nonkeratinized squamous epithelium predominates in the lining mucosa over the soft palate, cheeks, the floor of the mouth, and the pharynx, the posterior region of the oral cavity leading to the esophagus.

Lining mucosa overlies a thick submucosa. containing many minor salivary glands, which secrete continuously to keep the mucosal surface wet, and diffuse lymphoid tissue. Throughout the oral cavity, the epithelium contains transient antigen-presenting cells and rich sensory
innervation.

• Lips or labia

The well-developed core of striated muscle in the lips, or labia, makes these structures highly mobile for ingestion, speech, and other forms of communication. Both lips have three differently covered surfaces:

1-The internal mucous surface has lining mucosa with a thick, nonkeratinized epithelium and many minor labial salivary glands.

2-The red vermilion zone of each lip is covered by very thin keratinized stratified squamous epithelium and is transitional between the oral mucosa and skin. This region lacks salivary or sweat glands and is kept moist with saliva from the tongue. The underlying connective tissue is very rich in both sensory innervation and capillaries, which impart the pink color to this region.

3-The outer surface has thin skin, consisting of epidermal and dermal layers, sweat glands, and many hair follicles with sebaceous glands.

. Tongue

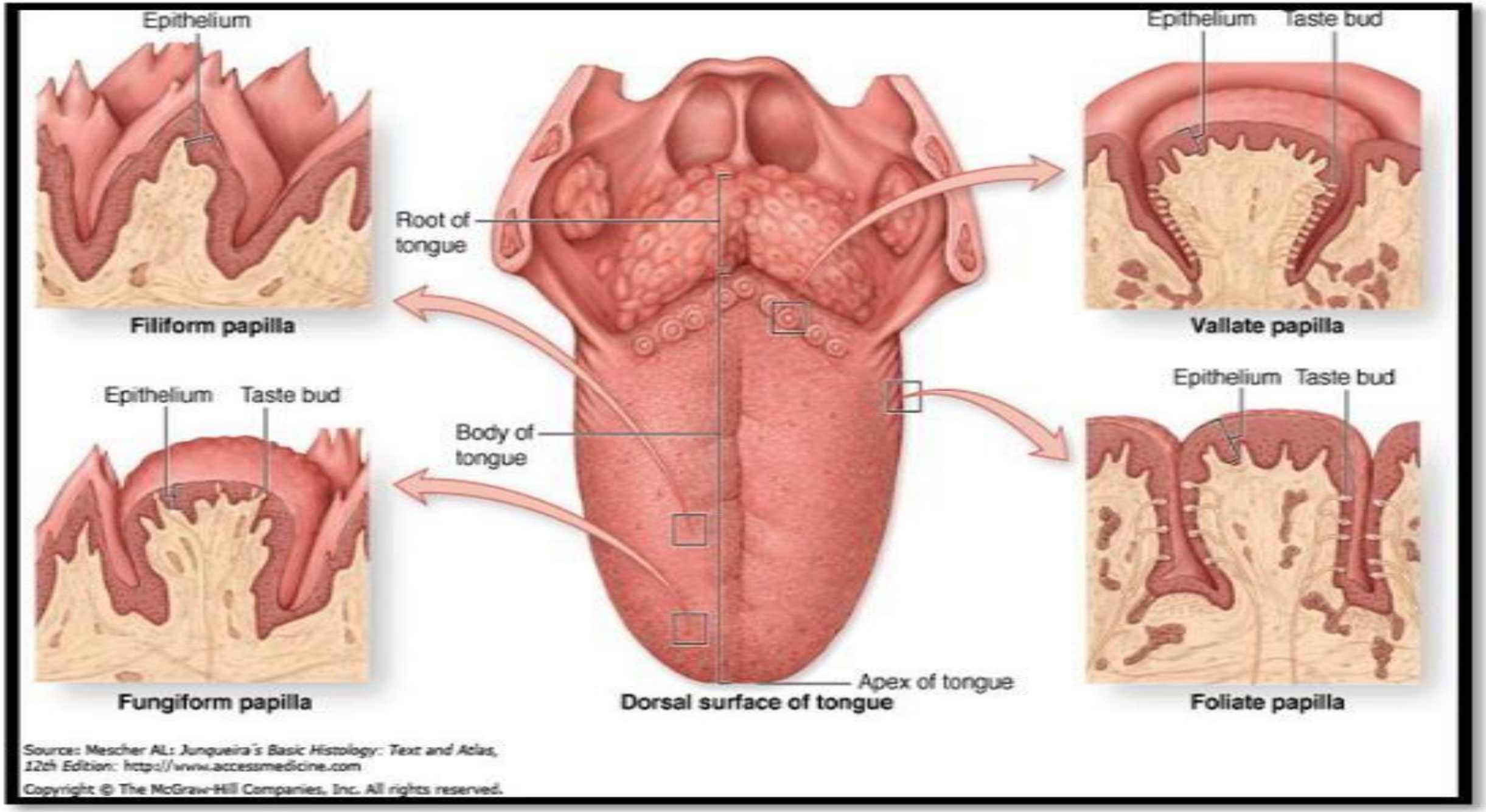
The tongue is a mass of striated muscle covered by mucosa, which manipulates ingested material during mastication and swallowing. The muscle fibers are oriented in all directions, allowing a high level of mobility.

Connective tissue between the small fascicles of muscle is penetrated by the lamina propria, which makes the mucous membrane strongly adherent to the muscular core. The lower surface of the tongue is smooth, with typical lining mucosa.

The dorsal surface is irregular, having hundreds of small protruding papillae of various types on its anterior two-thirds and the massed lingual
tonsils on the posterior third, or root of the tongue.

The papillary and tonsillar areas of the lingual surface are separated by a V-shaped groove called the sulcus terminalis.

The lingual papillae are elevations of the mucous membrane that assume various forms and functions. There are four types:



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1-Filiform papillae are very numerous, have an elongated conical shape, and are heavily keratinized, which gives their surface a gray or whitish appearance. They provide a rough surface that facilitates
movement of food during chewing.

2-Fungiform papillae: are much less numerous, lightly keratinized, and interspersed among the filiform papillae. They are mushroom-shaped with well-vascularized and innervated cores of lamina propria.

3-Foliate papillae consist of several parallel ridges on each side of the tongue, anterior to the sulcus terminalis, but are rudimentary in humans, especially older individuals. Z

4-Vallate (or circumvallate) papillae: are the largest papillae, with diameters of 1 to 3 mm. Eight to twelve vallate papillae are normally aligned just in front of the terminal sulcus. Ducts of several small, serous salivary (von Ebner) glands empty into the deep, moat like groove surrounding each vallate papilla. This provides a continuous f low of fluid over the taste buds that are abundant on the sides of these papillae, washing away food particles so that the taste buds can receive and
process new gustatory stimuli.

. *Taste buds*

Taste buds are ovoid structures within the stratified epithelium on the tongue's surface, which sample the general chemical composition of ingested material. Approximately 250 taste buds are present on the lateral surface of each vallate papilla, with many others present on fungiform and foliate (but not the keratinized filiform) papillae. They are not restricted to papillae and are also widely scattered elsewhere on the dorsal and lateral surfaces of the tongue where they are also continuously
flushed by numerous minor salivary glands.

Types of the cells in the taste buds:

A taste bud has 50-100 cells, about half of which are elongated gustatory (taste) cells which turn over with a 7- to 10-day life span. Other cells present are slender supportive cells, immature cells, and slowly dividing basal stem cells that give rise to the other cell types. The base of each bud rests on the basal lamina and is entered by afferent sensory axons that form synapses with the gustatory cells. At the apical ends of the gustatory cells, microvilli project toward a 2-µm-wide opening in the structure called the taste pore. Molecules (tastants) dissolved in saliva contact the microvilli through the pore and interact with cell surface taste receptors.

Esophagus

The esophagus is a muscular tube, about 25 cm long in adults, which transports swallowed material from the pharynx to the stomach. The four layers of the GI tract first become well established and clearly seen in the esophagus.

The esophageal mucosa has nonkeratinized stratified squamous epithelium, and the submucosa contains small mucus-secreting glands, the esophageal glands, which lubricate and protect the mucosa.

Near the stomach the mucosa also contains groups of glands, the esophageal cardiac glands, which secrete additional mucus.

In approximately the upper one-third of the esophagus, the muscularis is exclusively skeletal muscle like that of the tongue. The middle portion of the esophagus has a combination of skeletal and smooth muscle fibers, and in the lower third the muscularis is exclusively smooth muscle.

Only the distal 1 to 2 cm of the esophagus, in the peritoneal cavity, is covered by serosa; the rest is enclosed by the loose connective tissue of the adventitia, which blends into the surrounding tissue.

Stomach

The stomach is a greatly dilated segment of the digestive tract whose main functions are:

1-To continue the digestion of carbohydrates initiated by the **amylase** of saliva.

2-To add an acidic fluid to the ingested food and mixing its contents into a viscous mass called **chyme** by the churning activity of the muscularis.

3-To begin digestion of triglycerides by a secreted **lipase.**

4-To promote the initial digestion of proteins with the enzyme **pepsin**.

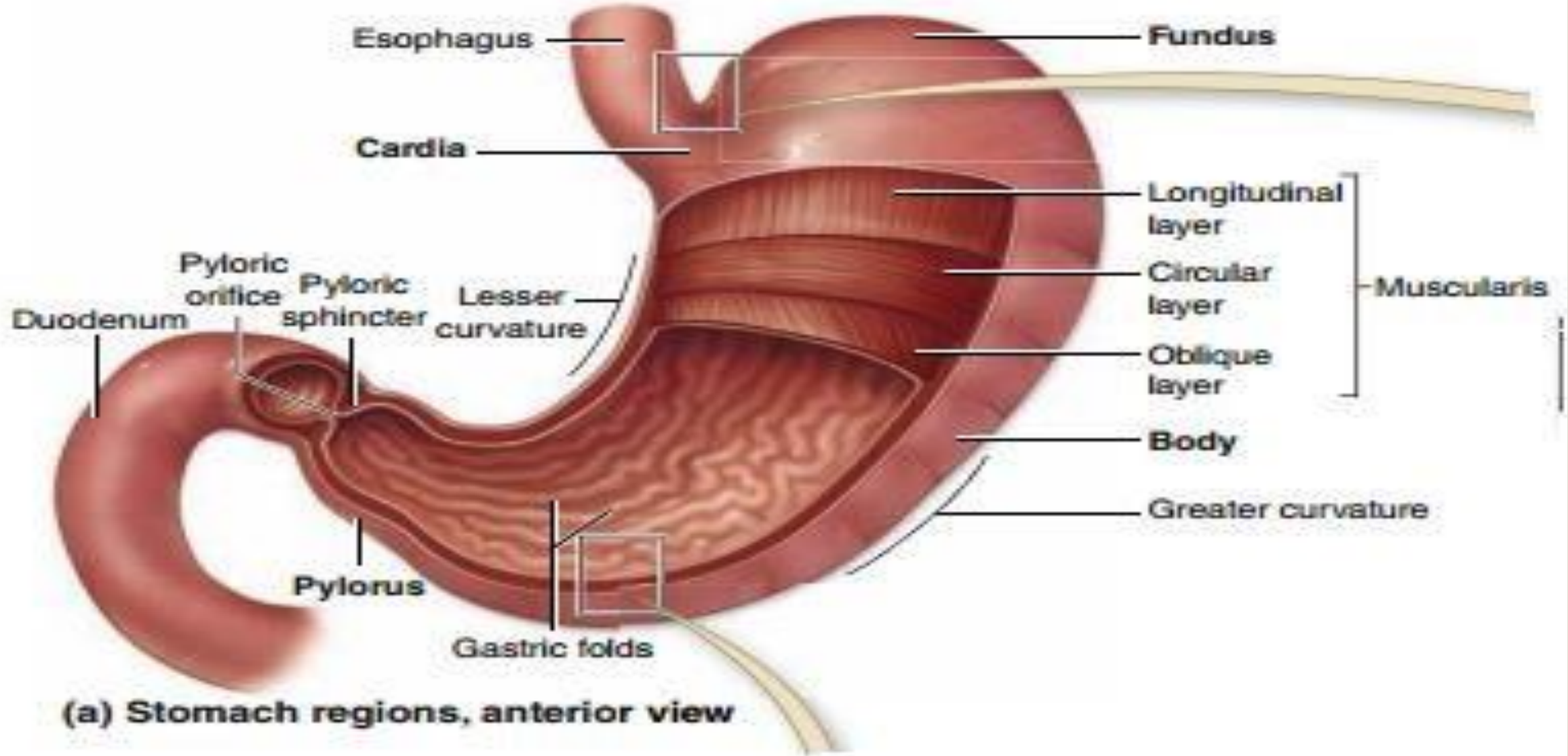
Four major regions make up the stomach: the **cardia, fundus, body and pylorus**.

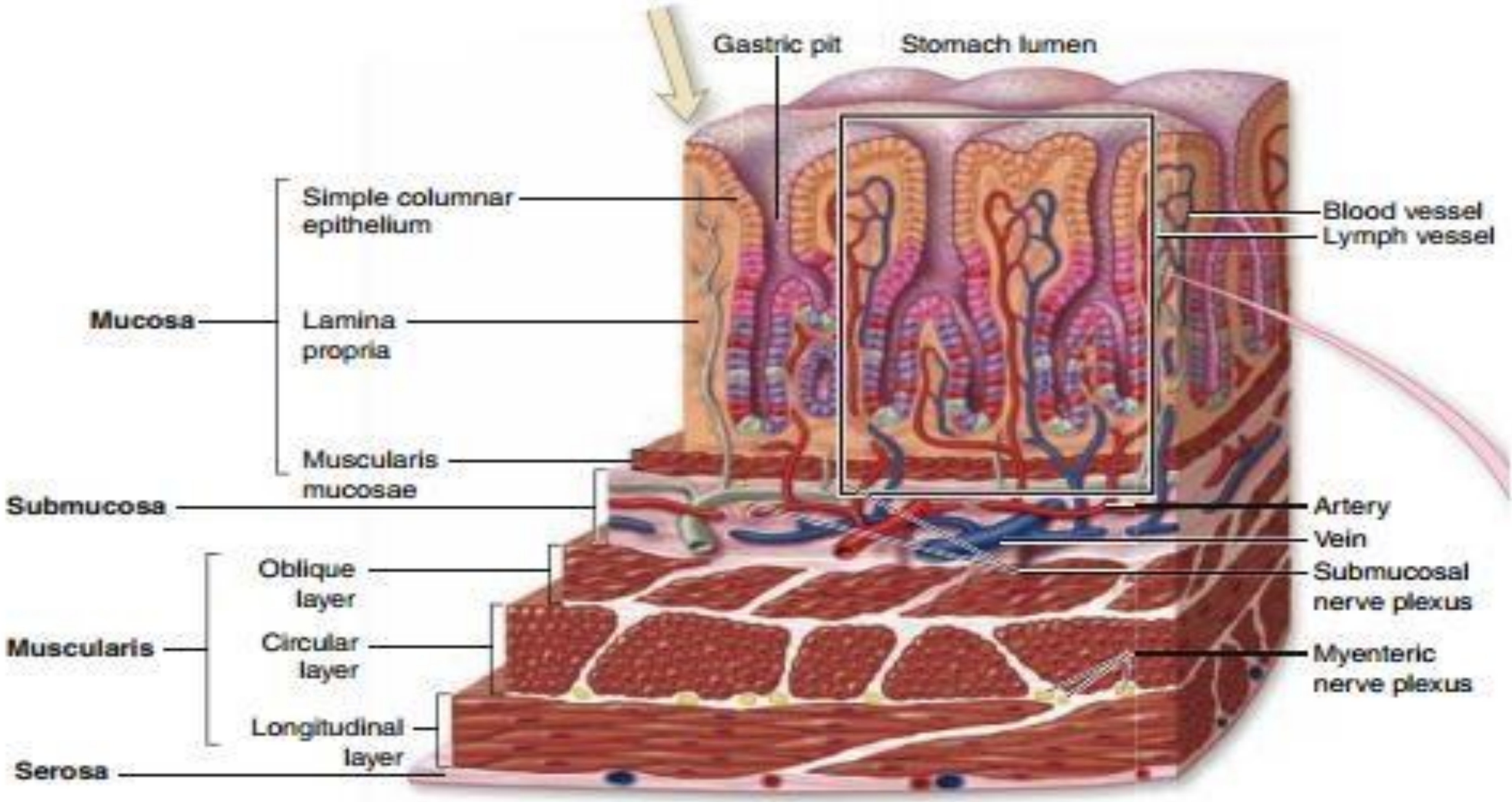
The **cardia** is a narrow transitional zone, 1.5-3 cm wide, between the esophagus and the stomach.

The **pylorus** is the funnel-shaped region that opens into the small intestine. Both these regions are primarily involved with mucus production and are similar histologically.

The much larger **fundus** and **body** regions are identical in microscopic structure and are the sites of gastric glands releasing acidic gastric juice.

FIGURE 15–14 Stomach.





(c) Stomach wall, sectional view

Thank you for listening