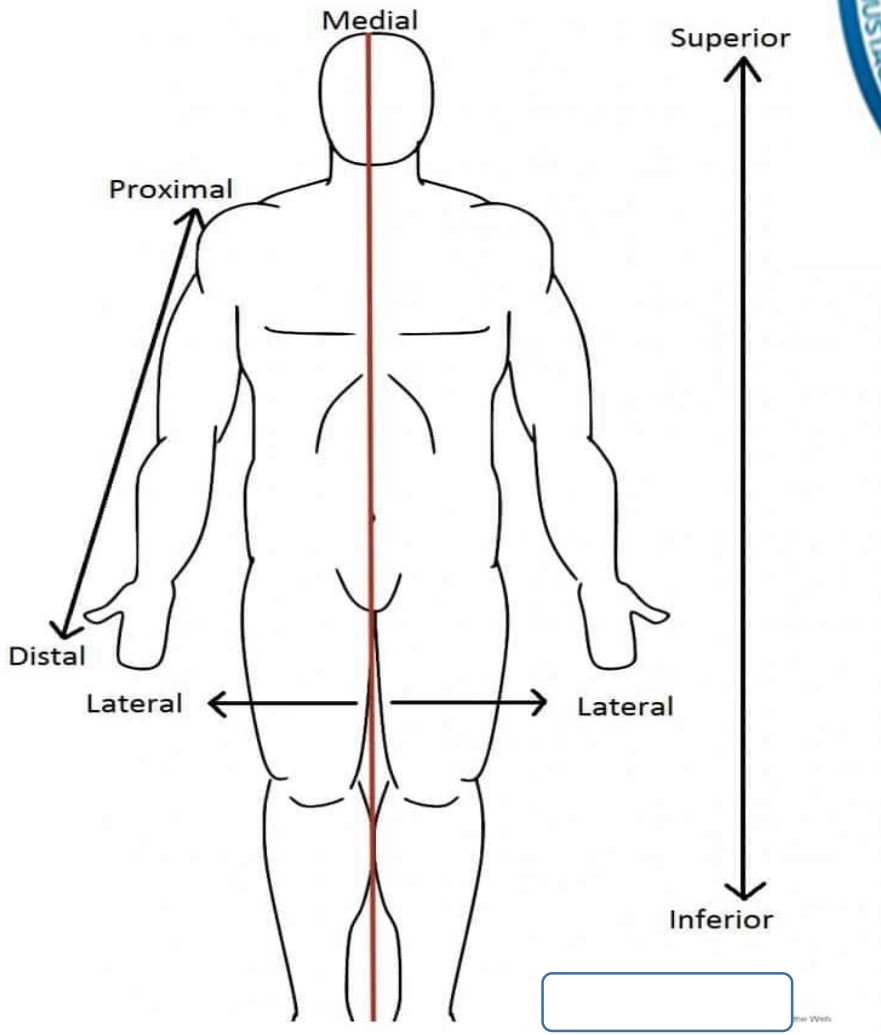
AL MUSTAQBAL UNIVERSITY

College of Pharmacy / First Stage



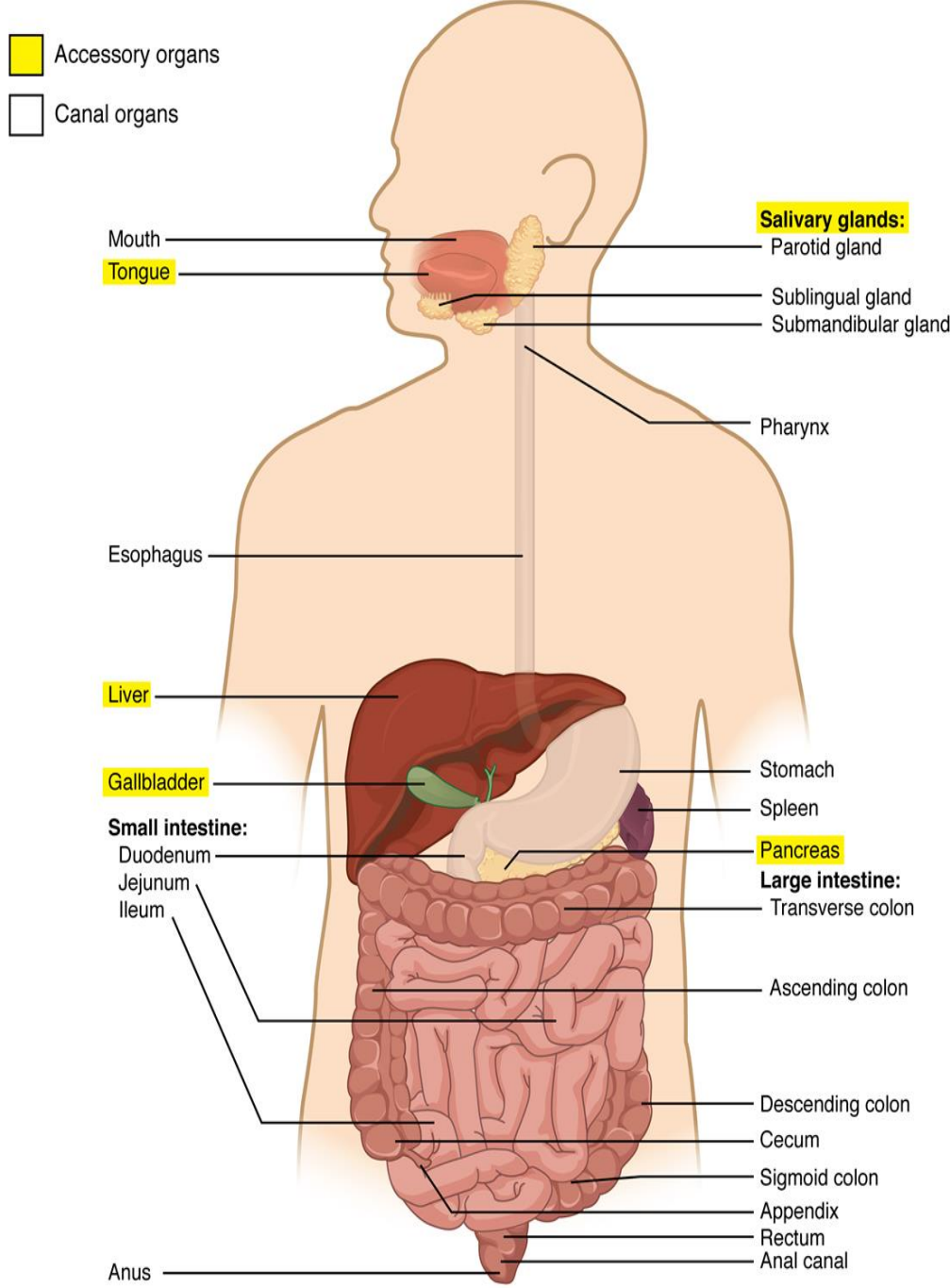
ANATOMY

(L3) Digestive System

Dr. Abdulhusein Mizhir Almaamuri

Introduction:

- 1. Digestive tract: also called **alimentary tract**
- **2. GI tract**: technically refers to stomach and intestines
- 3. Accessory organs
- 4. Regions
  - **Mouth** or **oral cavity** with **salivary glands** and tonsils
  - **Pharynx** (throat
  - **Esophagus**
  - **Stomach**
  - **Small intestine** (**duodenum**, **ileum**, **jejunum**)
  - **Large intestine** including **cecum**, **colon**, **rectum**
  - **anal canal** with mucous glands
  - **Anus**



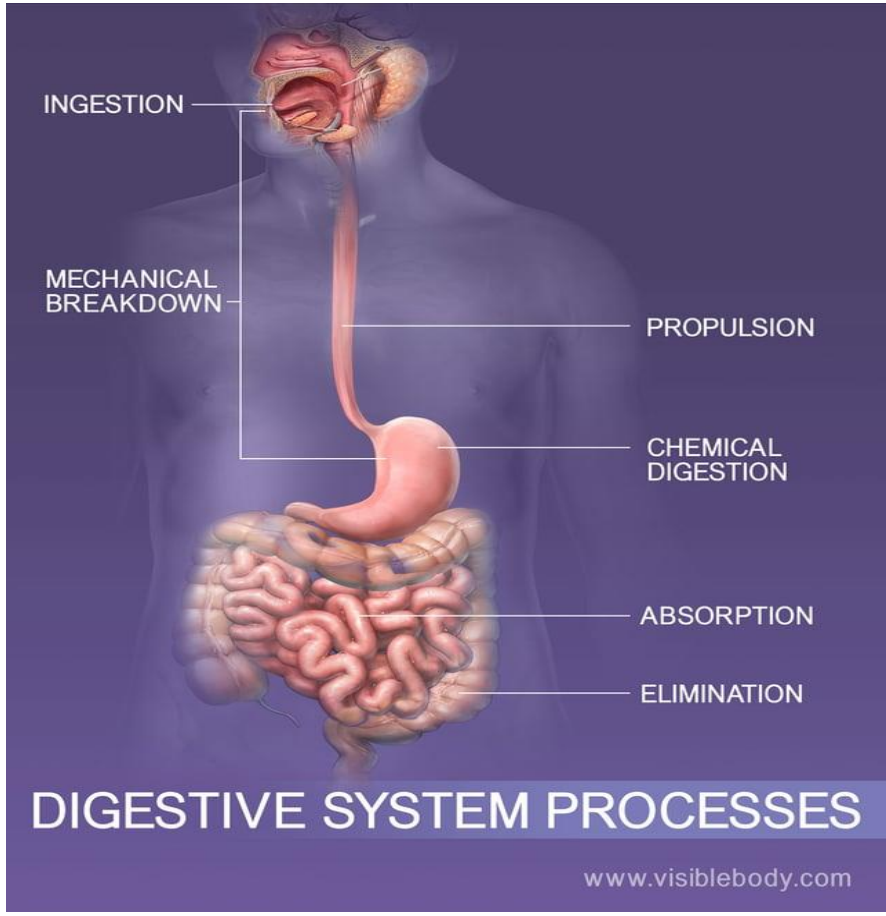
Functions of the Digestive System

The digestive system includes structures that form the **alimentary canal** and the **accessory organs** of digestion. Digestion breaks down large compounds in food and liquids into smaller molecules that can be absorbed into the bloodstream. The absorbed nutrients include carbohydrates, protein, fats, minerals, and vitamins. They are processed, then delivered throughout the body and used for energy, growth.

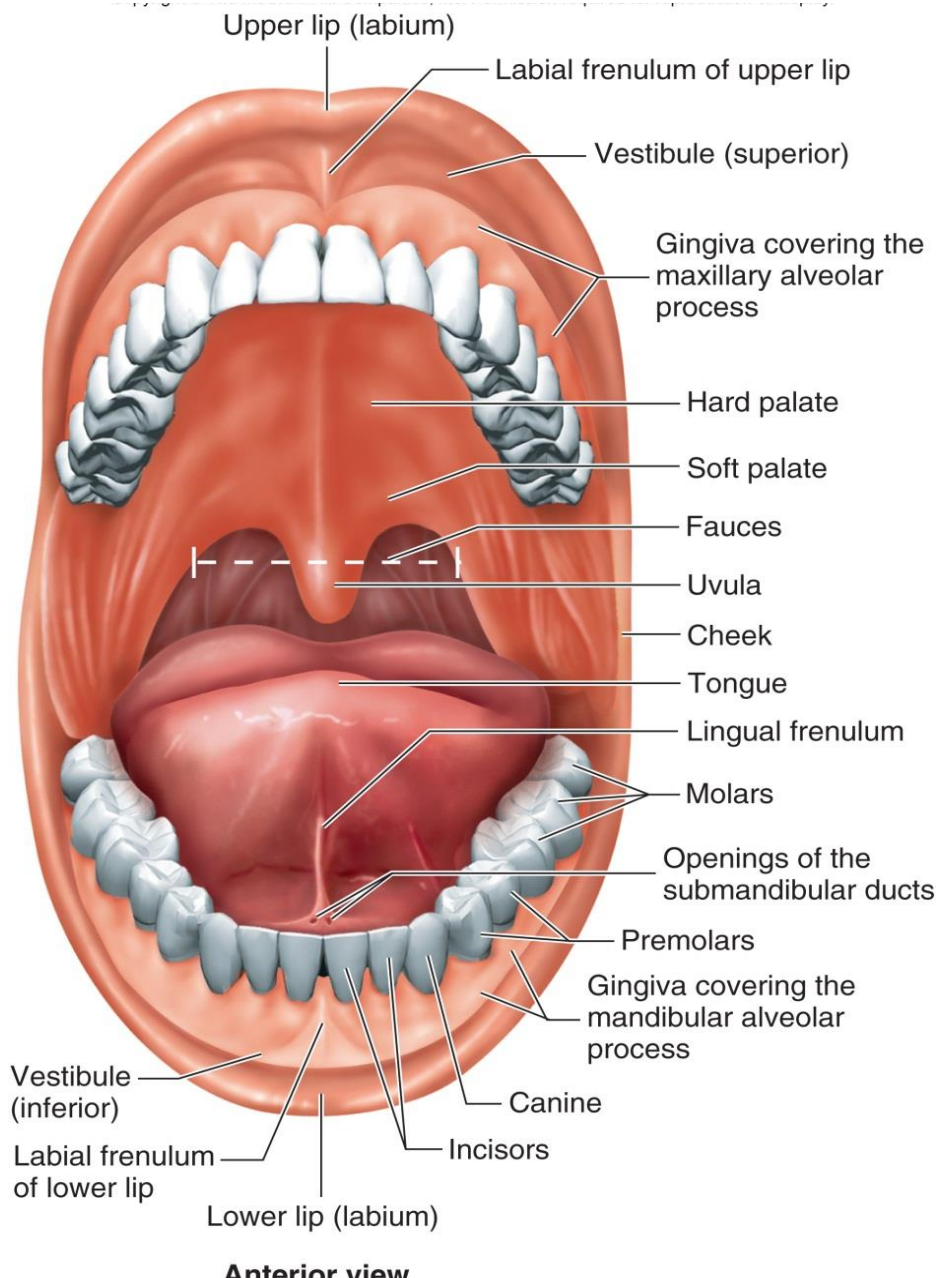
Digestion is a 6-Step Process:

The six major activities of the digestive system are:

ingestion, propulsion, mechanical breakdown, chemical digestion, absorption, and elimination. First, food is ingested, chewed, and swallowed. Next, muscular contractions propel it through the alimentary canal and physically break it down into tiny particles. Digestive fluids chemically break down the nutrients from food into molecules small enough for absorption. Finally, indigestible substances are eliminated as waste.



Terms of Oral Cavity



Anterior view

The mouth or oral cavity is where the process of digestion begins

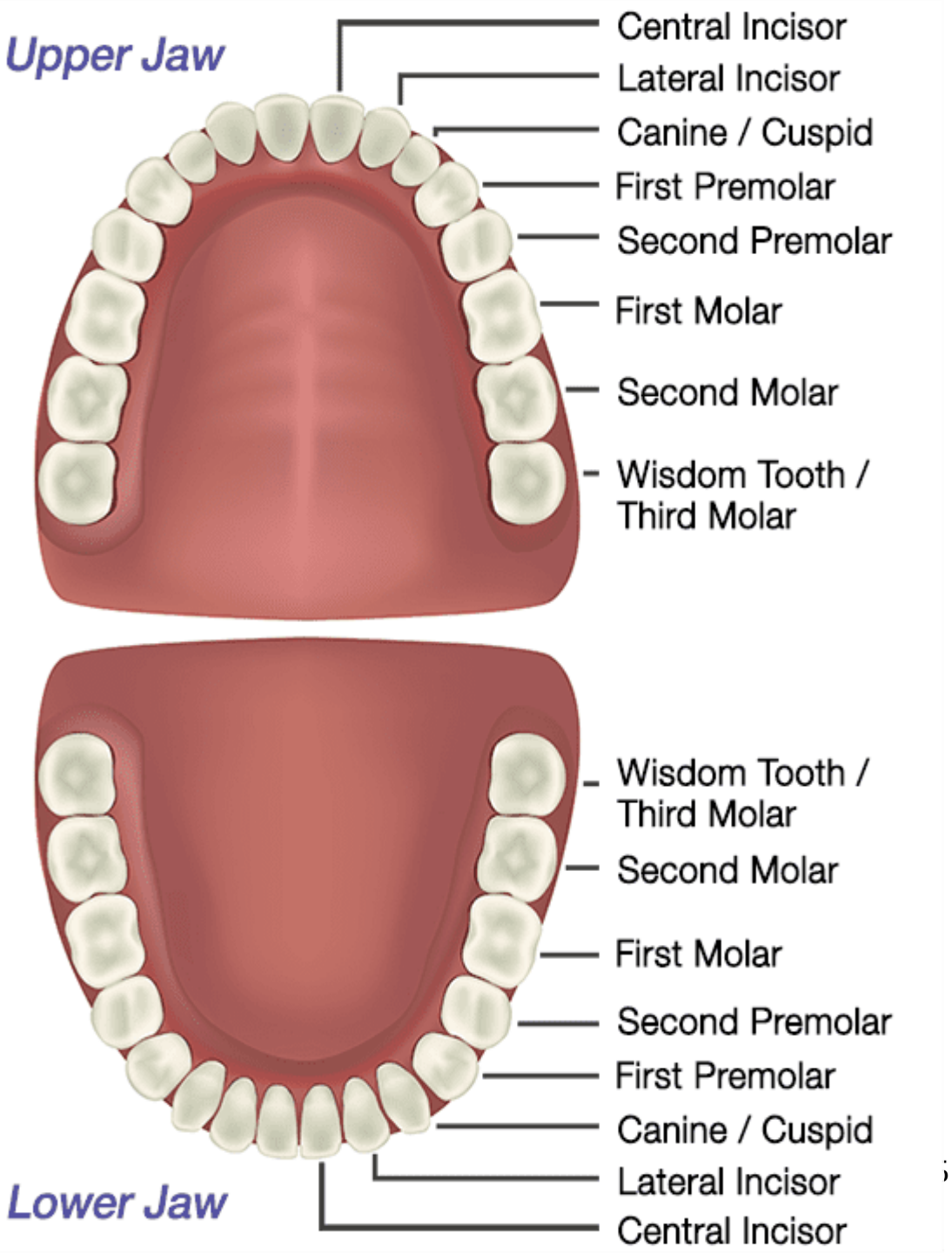
- **A. Vestibule**:
- **B. Oral cavity proper**:
- C. Frenulum:
- 1. labial
- 2. lingual
- D. Teeth
- 1. incisors
- 2. canines
- 3. premolars
- 4. molars
- E. Gingiva
- F. Hard palate
- G. Soft palate
- H. Uvula

- **Teeth**

(mechanical breakdown)

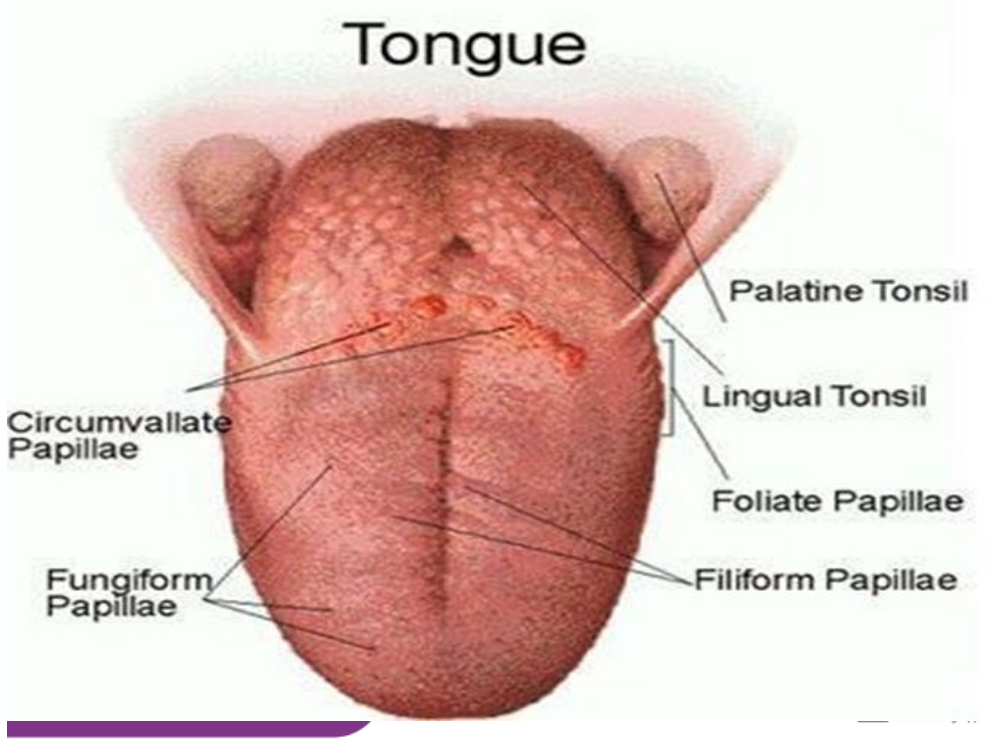
  - Incisors used for cutting
  - Canines used for stabbing and holding
  - Molars large surface area used for grinding
- Primary or deciduous teeth 20
- Secondary or permanent teeth 32

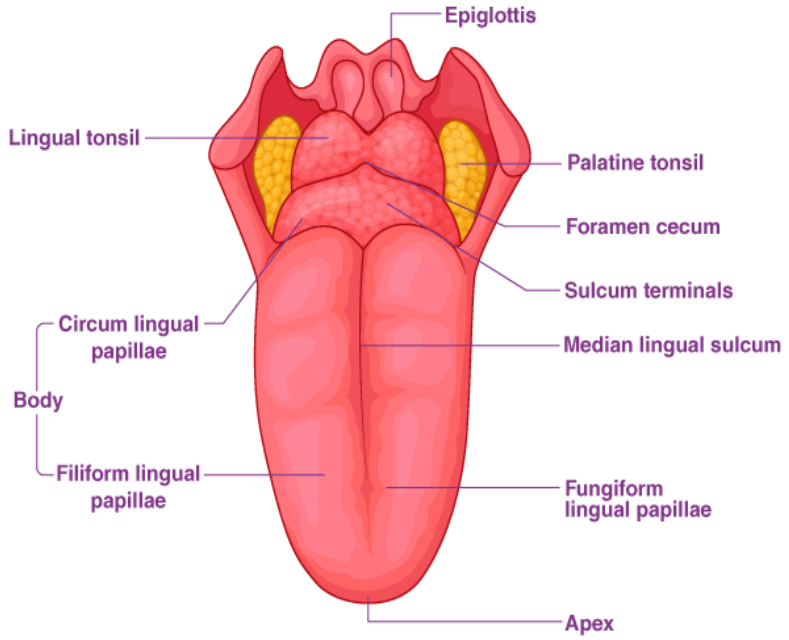
The permanent dentition consists of 32 teeth.
four incisors,
two canines,
four premolars (or bicuspids),
four molars
two wisdom teeth (third molars) in each jaw.



Tongue

- 1. Muscular
  - **Intrinsic muscles**: change shape
  - **Extrinsic muscles**: protrude or retract tongue, move side to side
- **2. Lingual frenulum**
- **3. Terminal sulcus**: groove divides tongue into anterior 2/3; posterior 1/3
- a. Anterior part: **papillae**, some of which have taste buds
- b. Posterior part: no papillae and a few scattered taste buds.
- c. Lymphoid tissue embedded in posterior surface: **lingual tonsil**
- 4. Moves food in mouth, participates in speech and swallowing



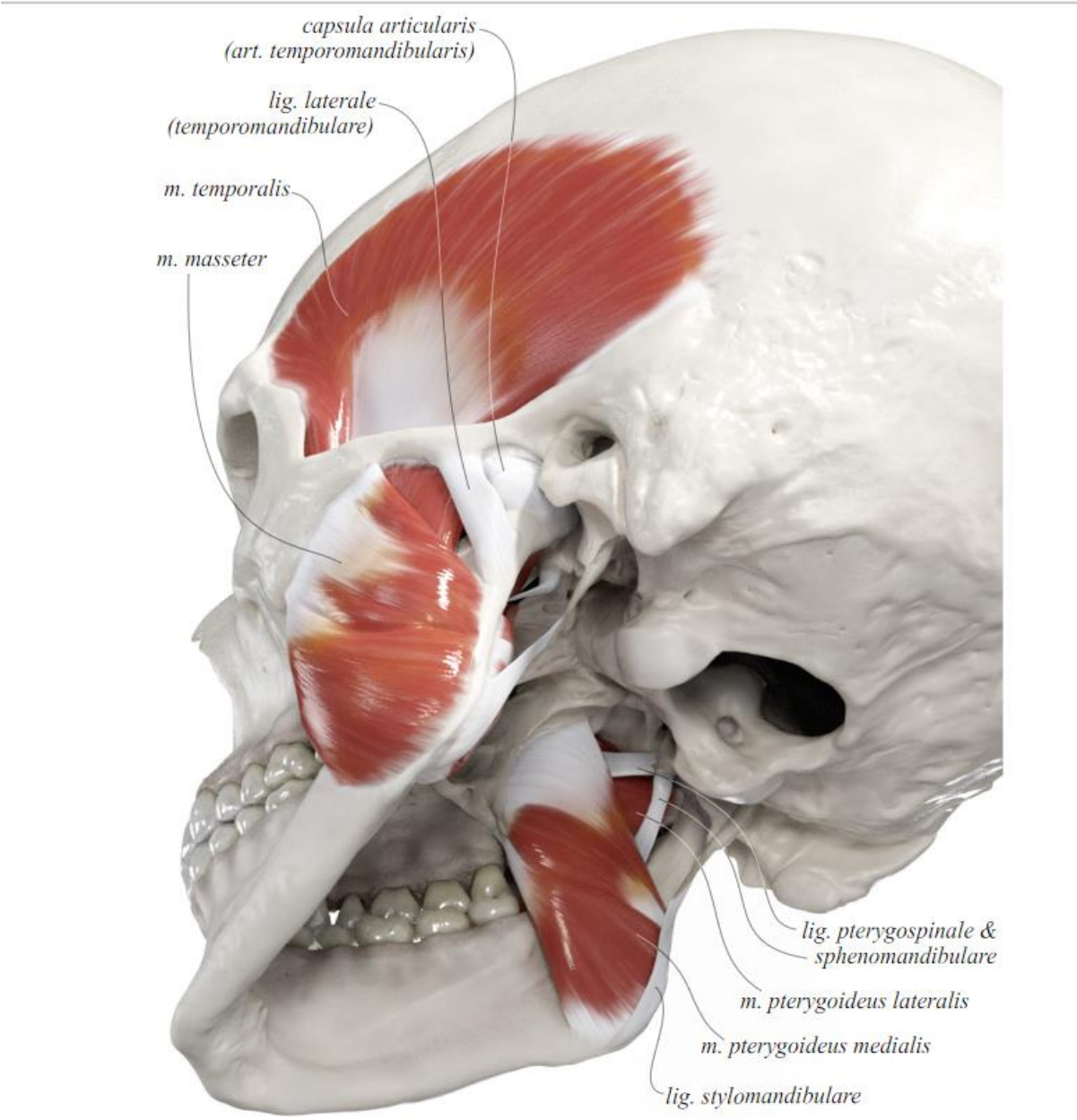


Muscles of Mastication

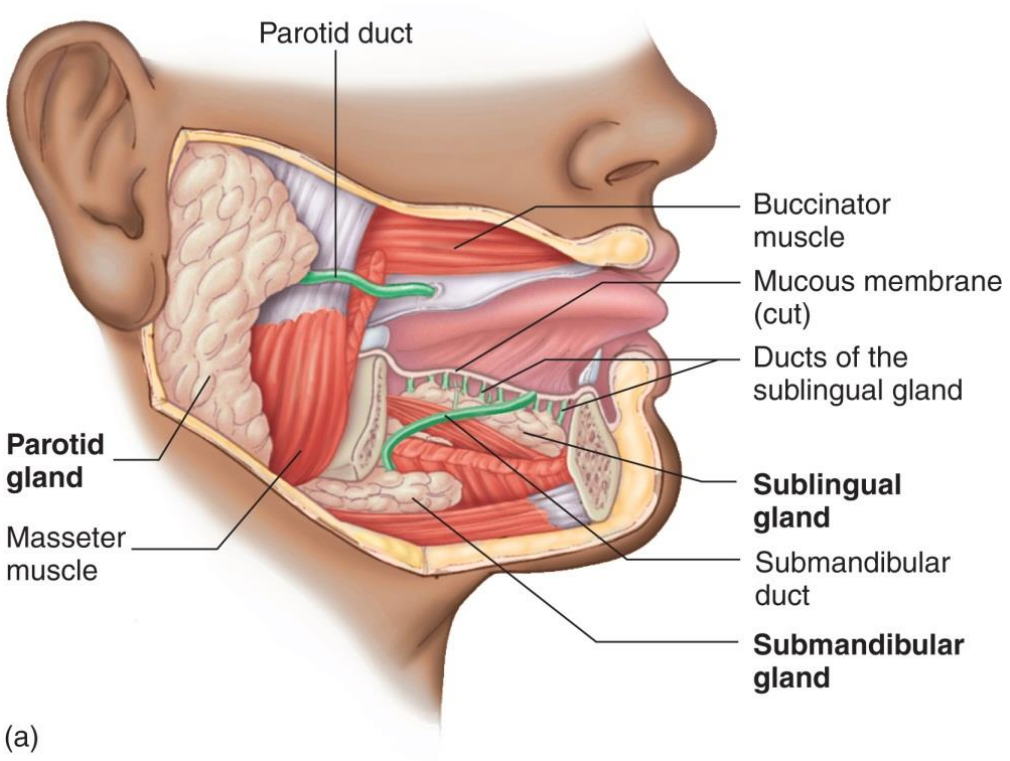
- 1. masseter
- 2. temporalis
- 3. medial and lateral pterygoids.

Nerve supply: Mandibular nerve (CN V3)

The muscles of mastication are muscles that attach to the mandible and thereby produce movements of the lower jaw(temporomandibular joint).



Salivary Glands-three pairs



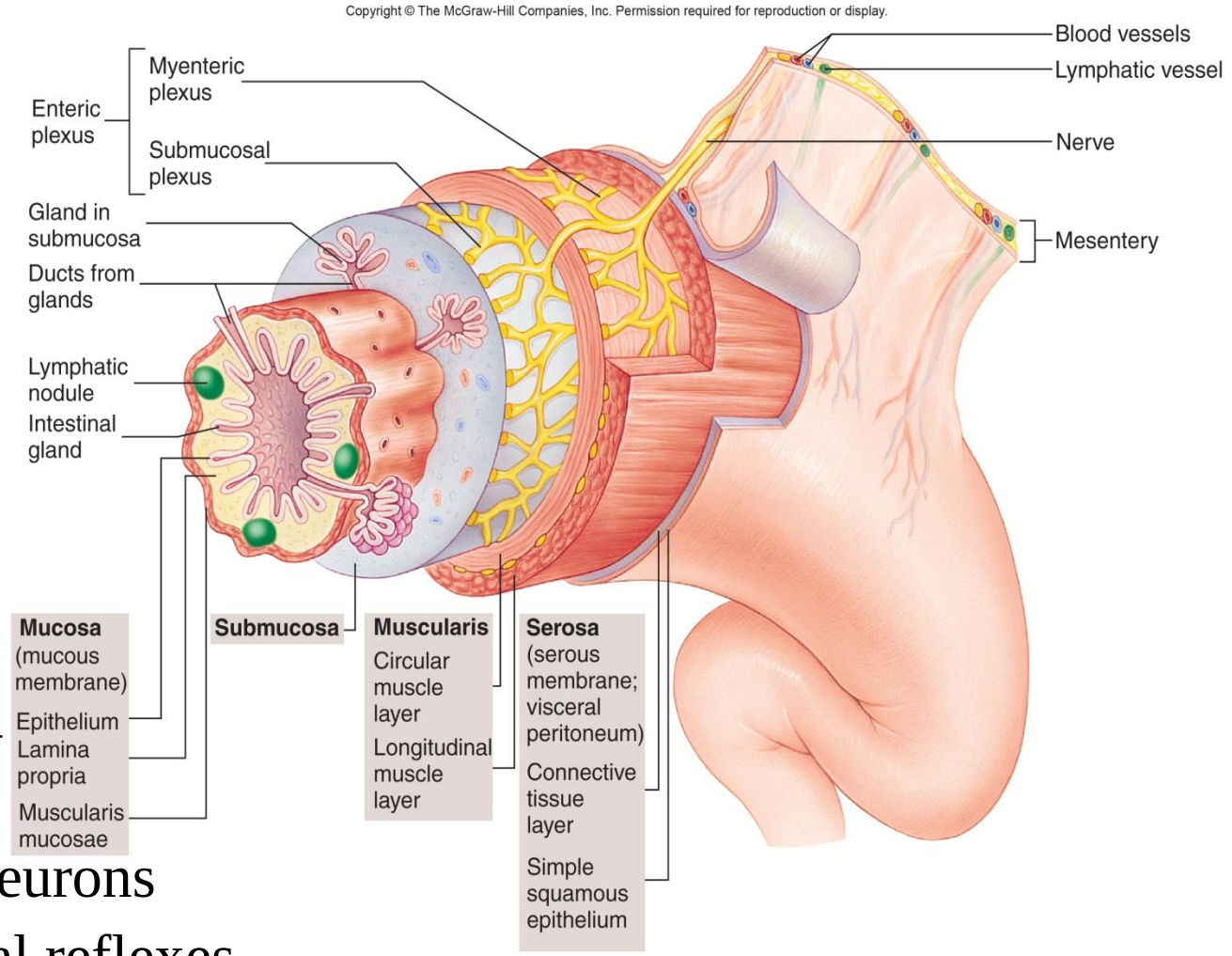
- **1. Parotid**: largest.
- **2. Sublingual**: smallest.
- **3. Submandibular**:
- Posterior half of inferior border of mandible.

Functions of Saliva:

1. Prevents bacterial infection
2. Lubrication
3. Contains salivary amylase that breaks down starch into disaccharides.
4. Helps to form bolus for deglutition

Histology of the Digestive Tract

1. **Mucosa**
2. **Submucosa**
3. **Muscularis**:
   1. circular and longitudinal
   2. smooth except for upper esophagus
4. **Serosa** or **adventitia**:
   1. visceral peritoneum in abdominal cavity
   2. tunica adventitia outside of the abdominal cavity



Nervous regulation of the Digestive System

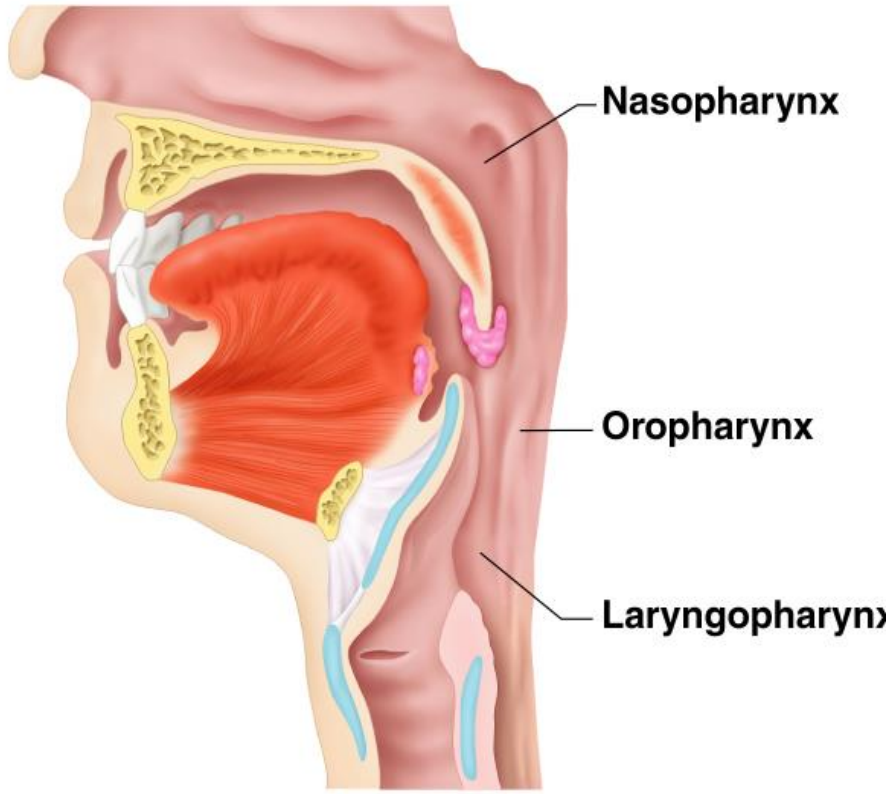
- **1. Local**: **enteric nervous system**
  - Types of neurons: sensory, motor, interneurons
  - Coordinates peristalsis and regulates local reflexes
  - As stomach empties into small intestine, local reflex regulates rate of emptying
- **2. General**: coordination with the CNS. May initiate reflexes because of sight, smell, or taste of food. Parasympathetic primarily. Sympathetic input inhibits muscle contraction, secretion, and decrease of blood flow to the digestive tract.

Pharynx

A. Common chamber of respiratory and digestive system

B. Structures ensuring that food gets to the right place

1. hard palate
2. soft palate and uvula
3. epiglottis: The function of the epiglottis is to close the laryngeal inlet during swallowing and so to prevent the passage of food and liquid into the lungs (aspiration). This is why we can't (and shouldn't try to) talk and breathe while swallowing



- Nasopharynx – not part of the digestive system
- Oropharynx – posterior to oral cavity
- Laryngopharynx – below the oropharynx and connected to the esophagus

Esophagus

- The **esophagus** is posterior to the larynx and trachea in the neck region and upper thorax. It passes through the diaphragm, and connects with the stomach. It's about 25 cm in length.

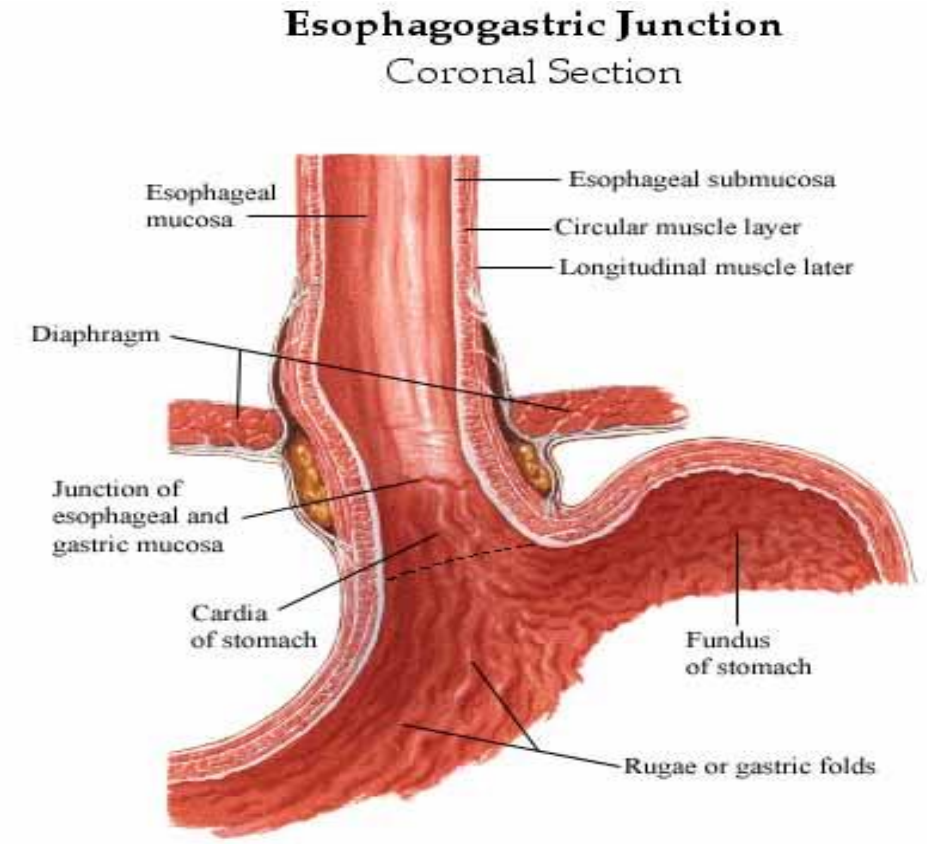
-There are inner circular and outer longitudinal muscle layers.

- The upper third is skeletal muscle (voluntary), middle third is mixed, and lower third is smooth muscle (involuntary).

-Conducts food by peristalsis (slow rhythmic squeezing):

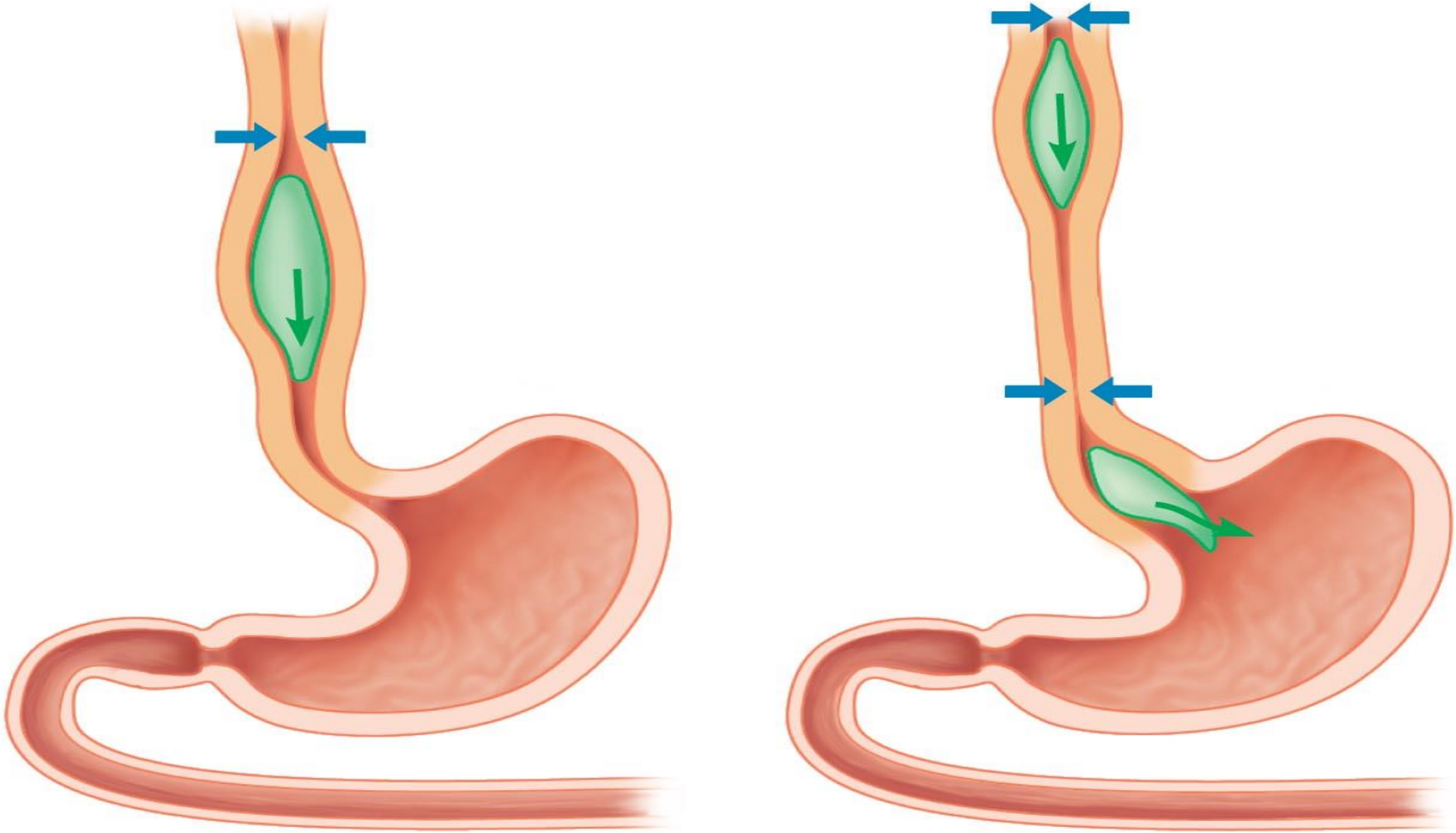
contraction of circular layer above thefood and contraction

of longitudinal below the food



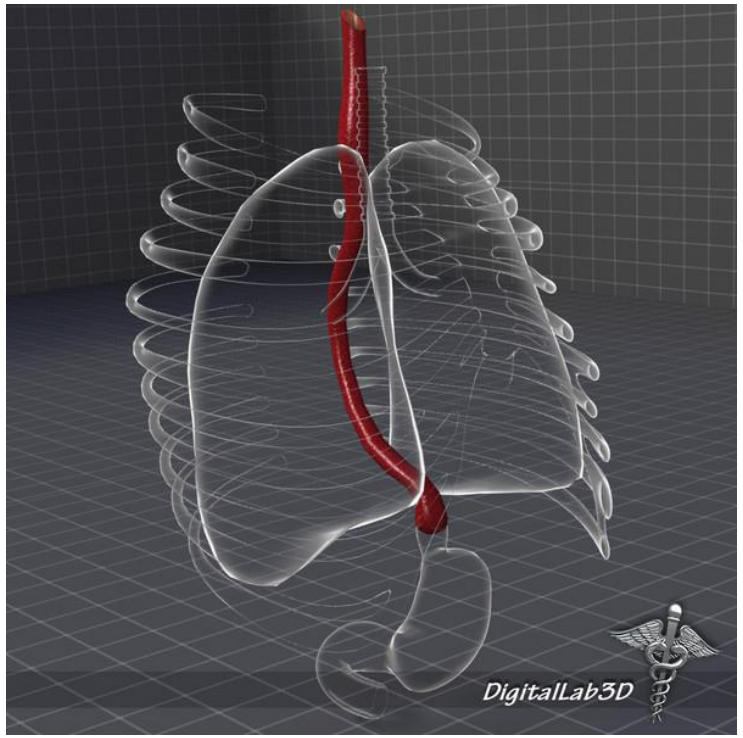
-**Esophagogastric junction** is located approximately at the level of the diaphragm. Contractions of the diaphragm create sphincter-like effects, preventing reflux of stomach acids and content. The esophagogastric junction is a functional, not anatomical, sphincter.

Peristalsis in Esophagus



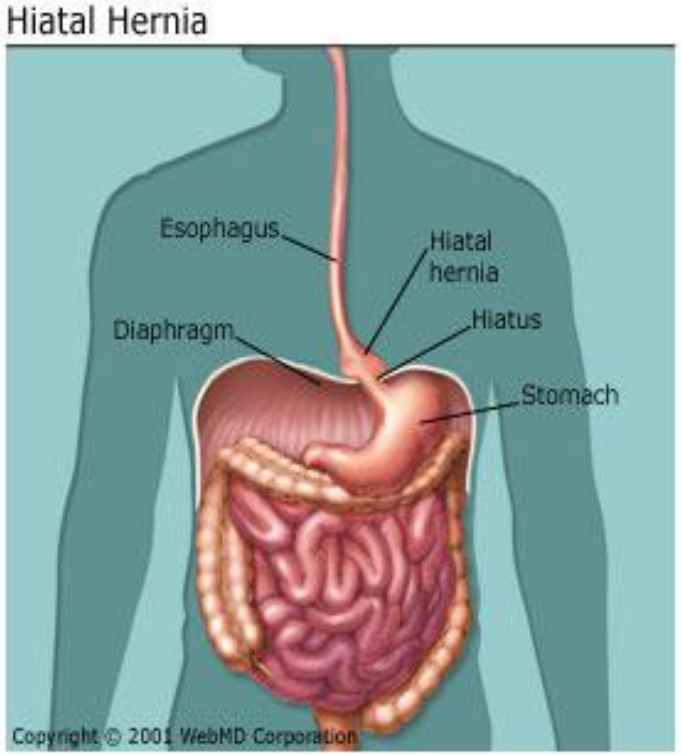
The upper oesophageal sphincter regulates the movement of substances into the oesophagus and the lower oesophageal sphincter (also known as the cardiac sphincter) regulates the movement of substances from the oesophagus to the stomach.

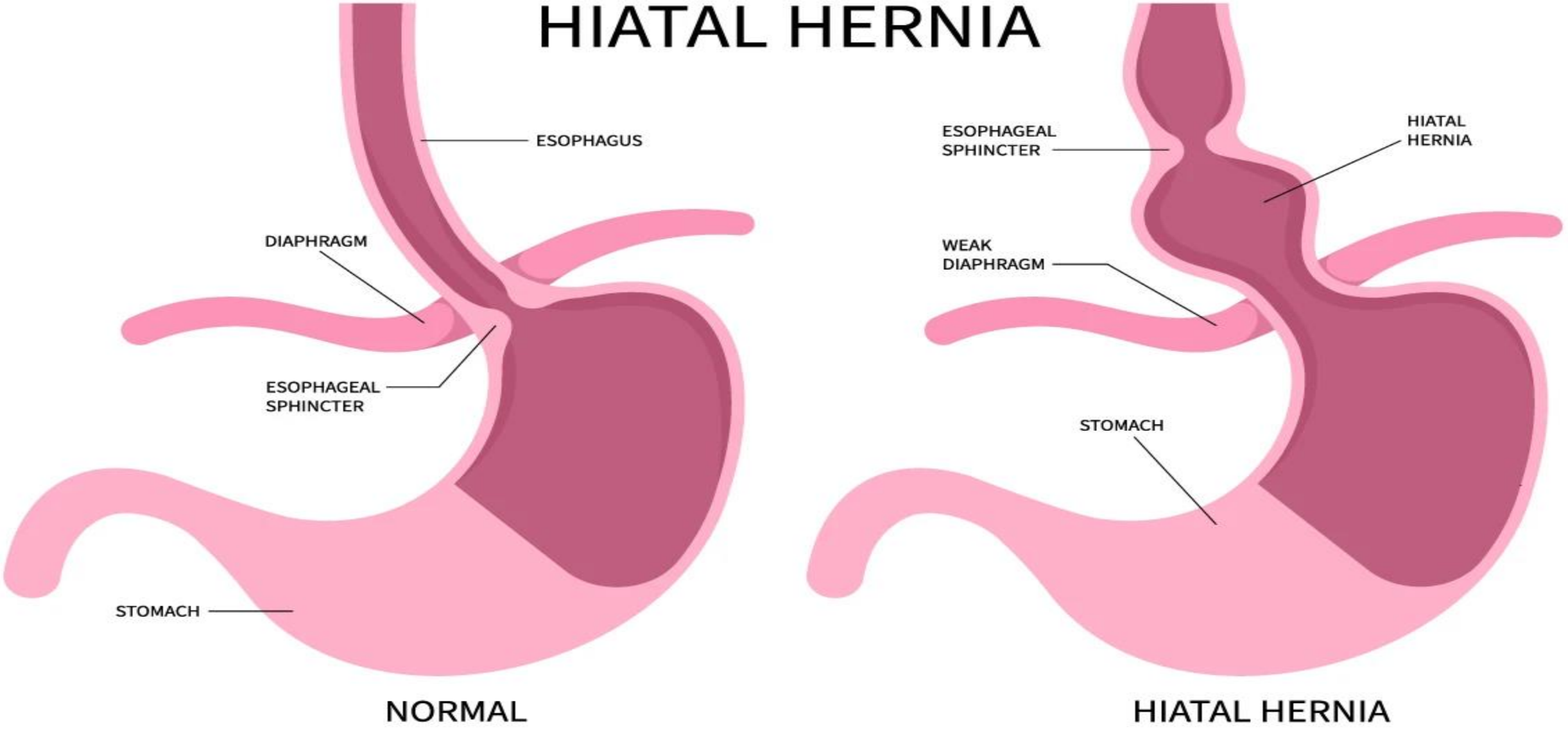
The muscle layer of the oesophagus differs from the rest of the digestive tract as the superior portion consists of skeletal (voluntary) muscle and the inferior portion consists of smooth (involuntary) muscle. Breathing and swallowing cannot occur at the same time.



Esophagus passes through diaphragm at **esophageal hiatus.**

Hiatal hernia is caused when part of your stomach bulges up through the diaphragm





When you have hiatal hernia symptoms over a long time, stomach acids may back up (reflux) and cause **gastroesophageal reflux disease (GERD)** or damage the lining of the esophagus. If this continues, it may increase your risk of developing a kind of cancer of the esophagus.

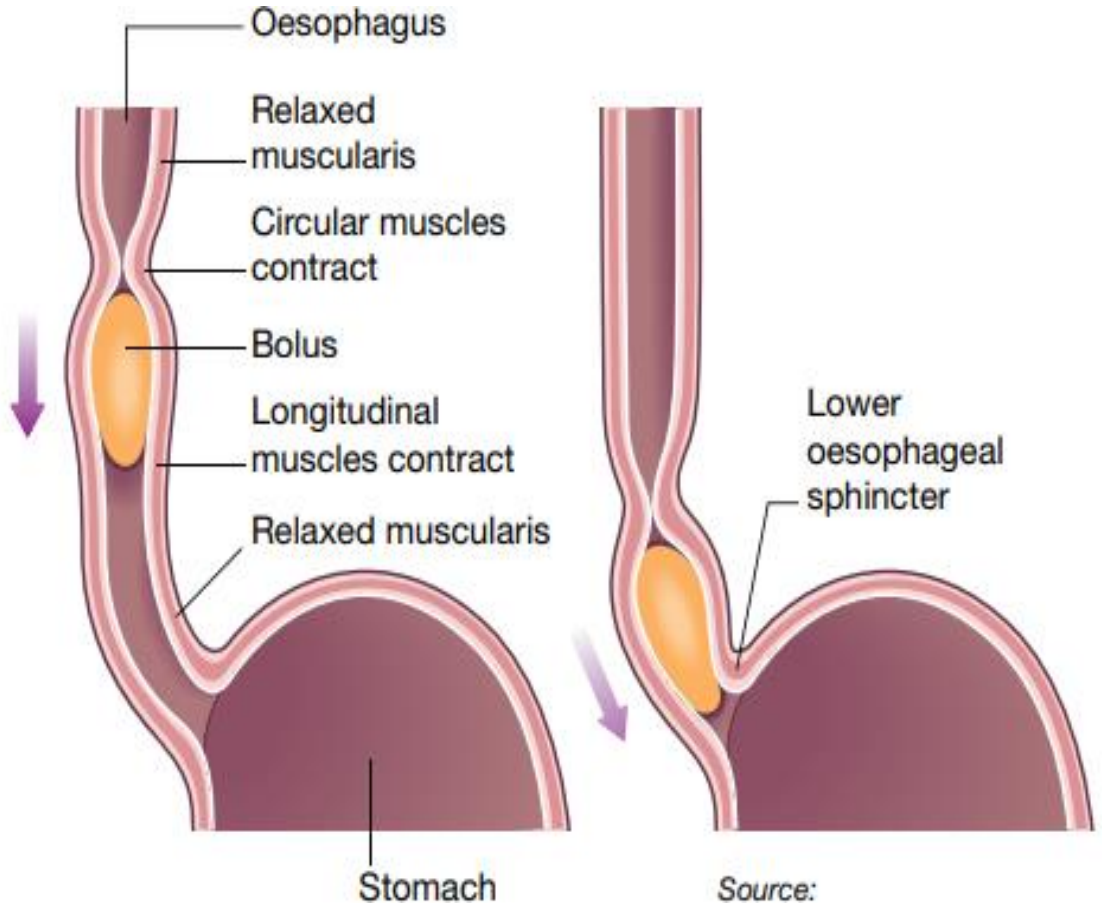
Swallowing (Deglutition): three phases

1.The voluntary phase is where food is moved to the oropharynx by the voluntary muscle.

2.The pharyngeal phase which is under the involuntary neuromuscular control. Once the food **bolus** encroaches on the palatoglossal folds, or anterior tonsilar pillars, the pharyngeal phase of swallowing reflexively begins.

3. The oesophageal phase. Like the pharyngeal phase of swallowing, the oesophageal phase of swallowing is under involuntary neuromuscular control.

The outer fibres of the upper zone are arranged longitudinally while the inner fibres have a circular configuration



Stomach

The stomach is a muscular organ located on the left side of the upper abdomen. The stomach receives food from the oesophagus. As food reaches the end of the oesophagus, it enters the stomach through a muscular valve called the lower oesophageal sphincter.

The stomach is supplied with arterial blood from a branch of the celiac artery and venous blood leaves the stomach via the hepatic vein. The vagus nerve innervates the stomach with parasympathetic fibres that stimulate gastric motility and the secretion of gastric juice. Sympathetic fibres from the celiac plexus reduce gastric activity.

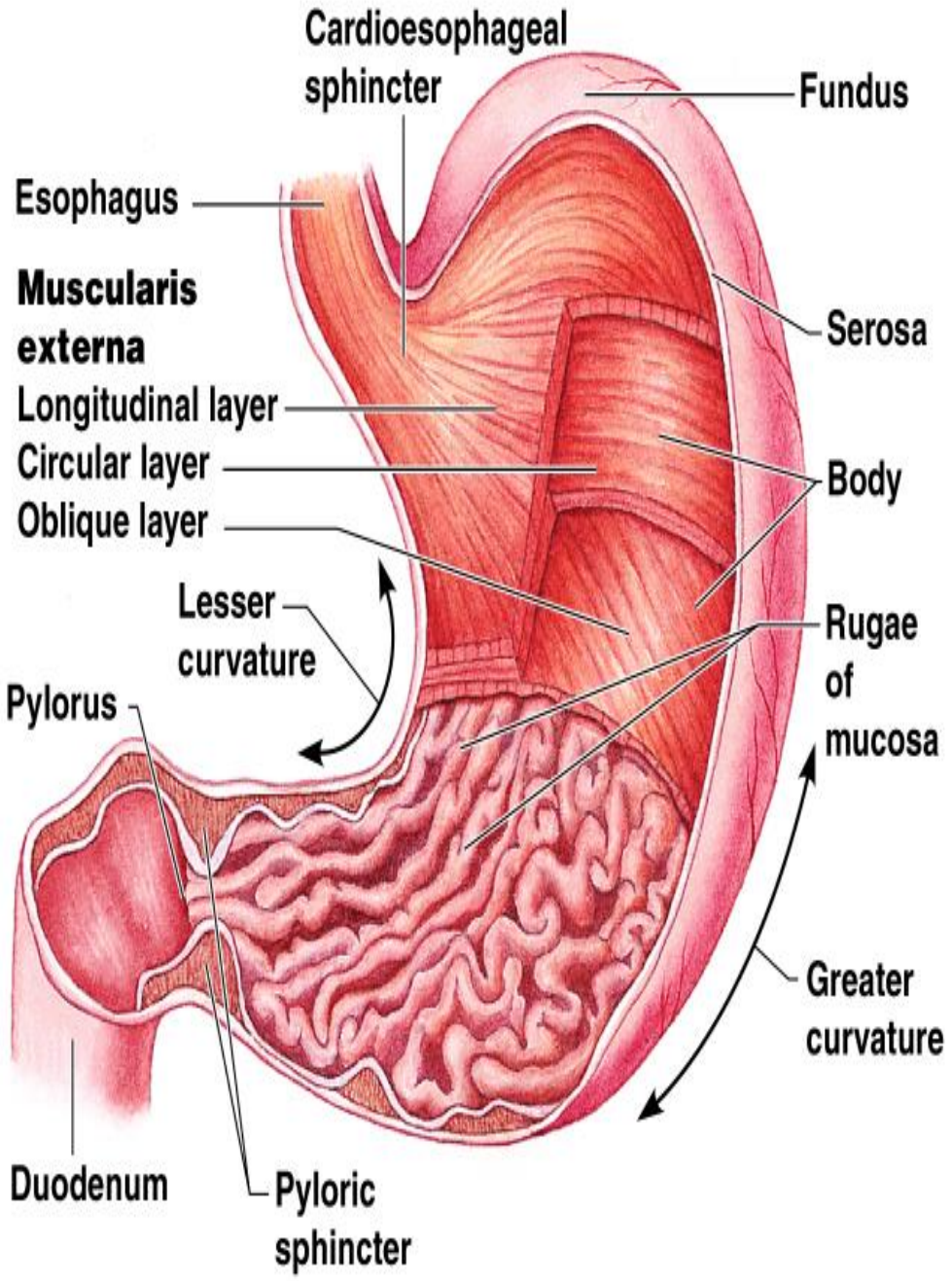
The stomach has the same four layers of tissue as the digestive tract but with some differences. The muscularis contains three layers of smooth muscle instead of two. It has longitudinal, circular and oblique muscle fibres. The extra muscle layer facilitates the churning, mixing and mechanical breakdown of food. The stomach secretes acid and enzymes that digest food. Ridges of muscle tissue called rugae line the stomach.

The pyloric sphincter is a muscular valve that opens to allow food to pass from the stomach to the duodenum.

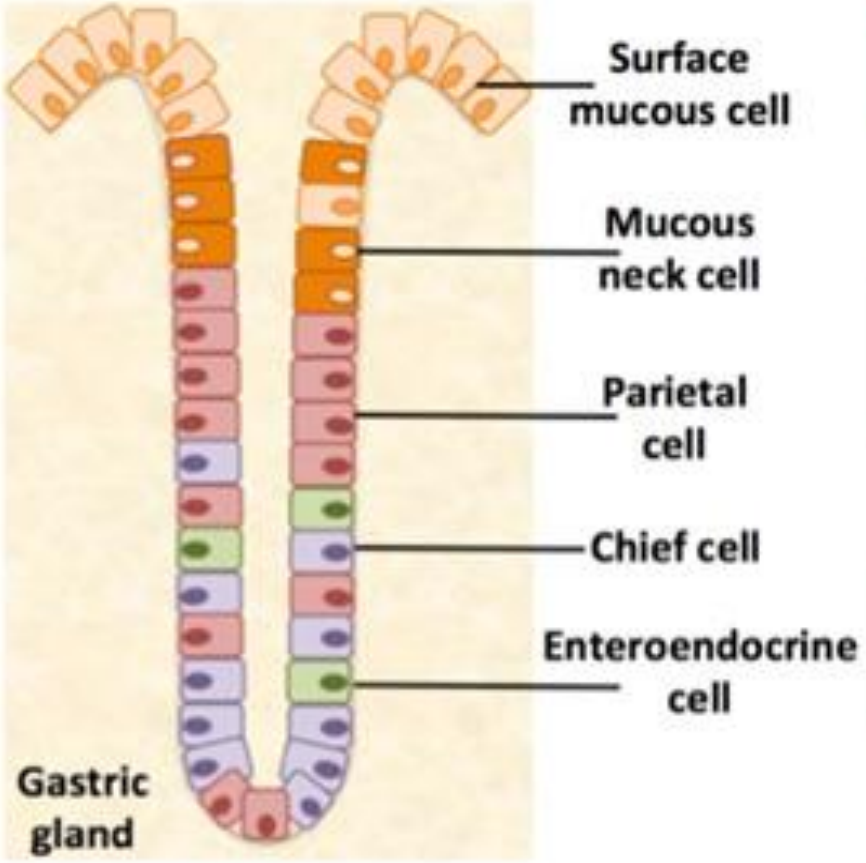
Stomach

1. Openings
   - **Gastroesophageal** (**cardiac**): to esophagus
   - **Pyloric**: to duodenum
2. Parts
   - **Cardiac**
   - **Fundus**
   - **Body**
   - **Pyloric**: **antrum** and **canal**
   - **Greater and lesser curvatures**: attachment sites for omenta

1. Layers (from outside)
   - a. Serosa or visceral peritoneum
   - b. Muscularis: three layers
     - Outer longitudinal
     - Middle circular
     - Inner oblique
   - c. Submucosa
   - d. Mucosa
   - **e. Rugae**: folds in mucosa



The **stomach** is the site where food is converted to a thick fluid called **chyme** that allows for efficient enzymatic digestion of macromolecules. The wall of the stomach contains gastric folds or rugae that expand when the stomach is full.



Cells of the gastric glands	Secretory products
Surface mucous cells	Mucin in an alkaline fluid
Mucous neck cells	Mucin in an acidic fluid
Parietal cells	HCl & intrinsic factor
Chief cells	Pepsinogen & lipase
G cells/enteroendocrine cells	Gastrin

Peritoneum:

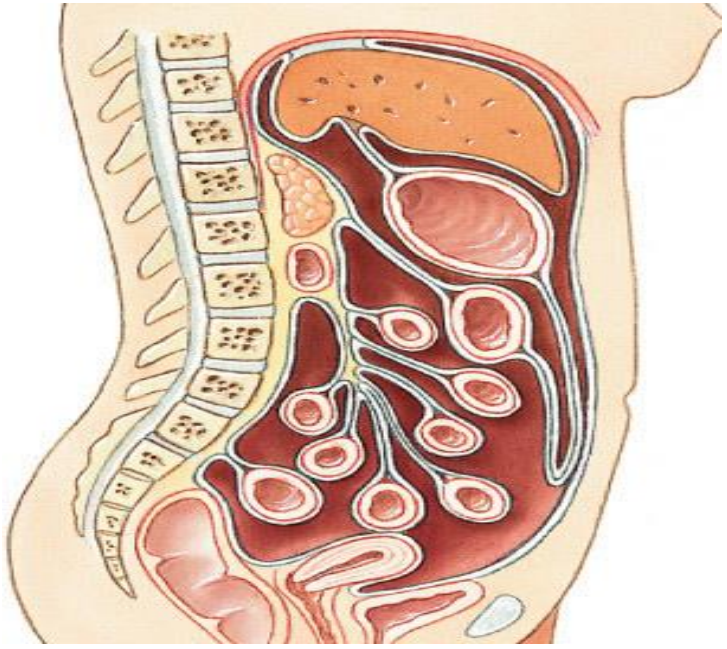
is the largest serous membrane of the body. Divide into:

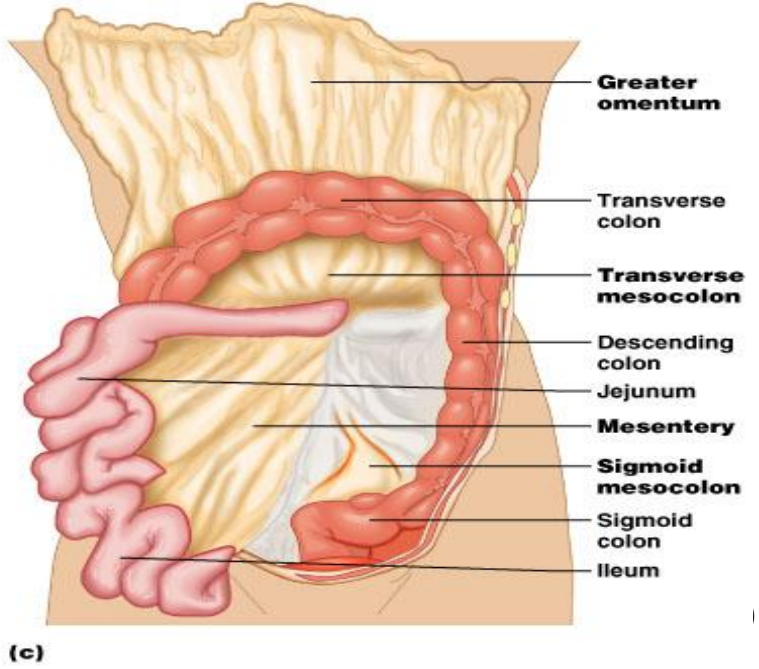
1. **Parietal peritoneum**: lines the wall of abdominopelvic cavity internally
2. **Visceral peritoneum**: cover some oh the organs in the cavity

The space between them contain fluid and called **peritoneal cavity** this cavity may be accumulated by several liters of fluid state called **ascites.**

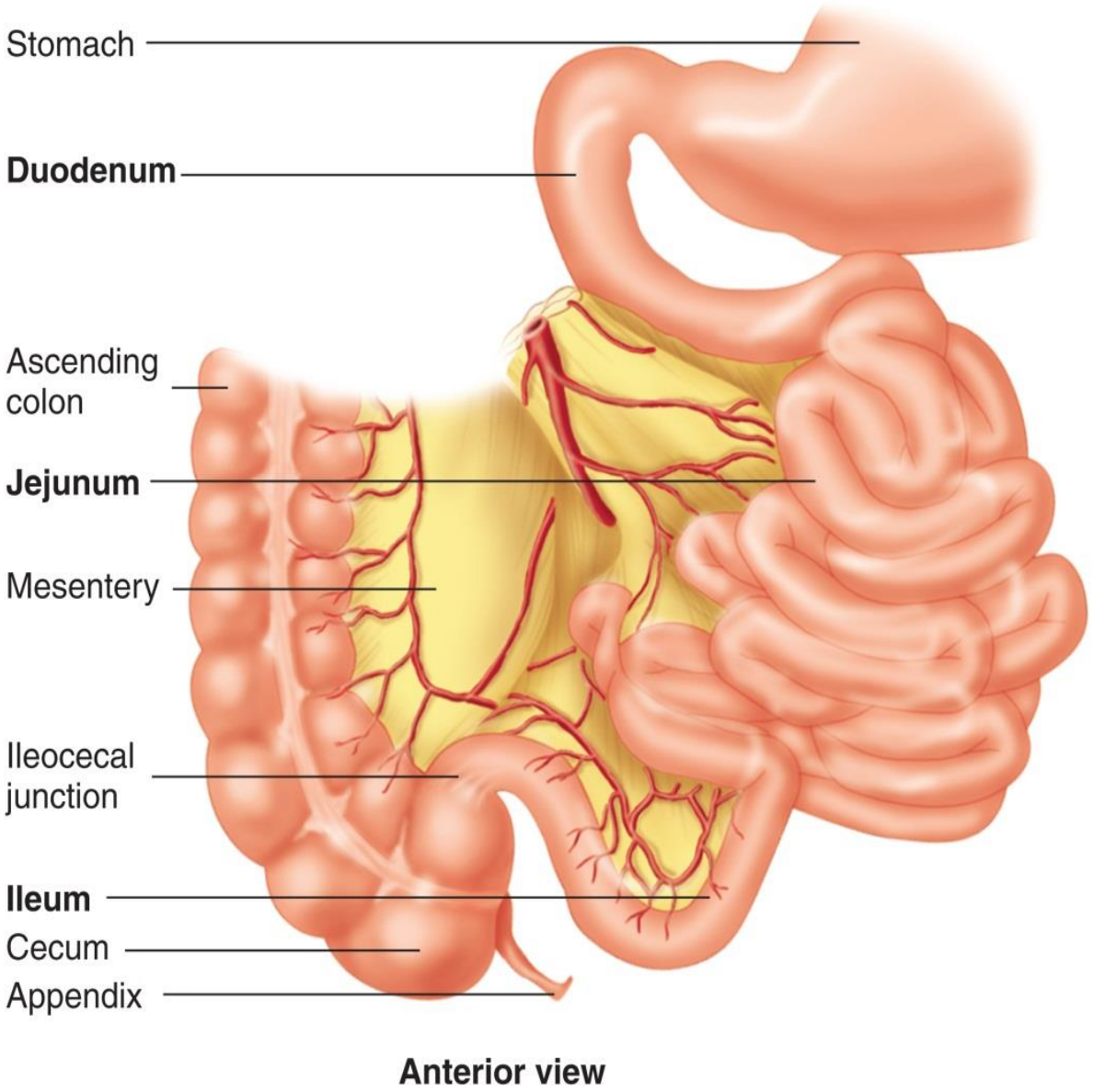
Retroperitoneal organs: e.g., kidneys, pancreas, duodenum

Mesenteries: double sheets of peritoneum, surrounding and suspending portions of the digestive organs





Small Intestine

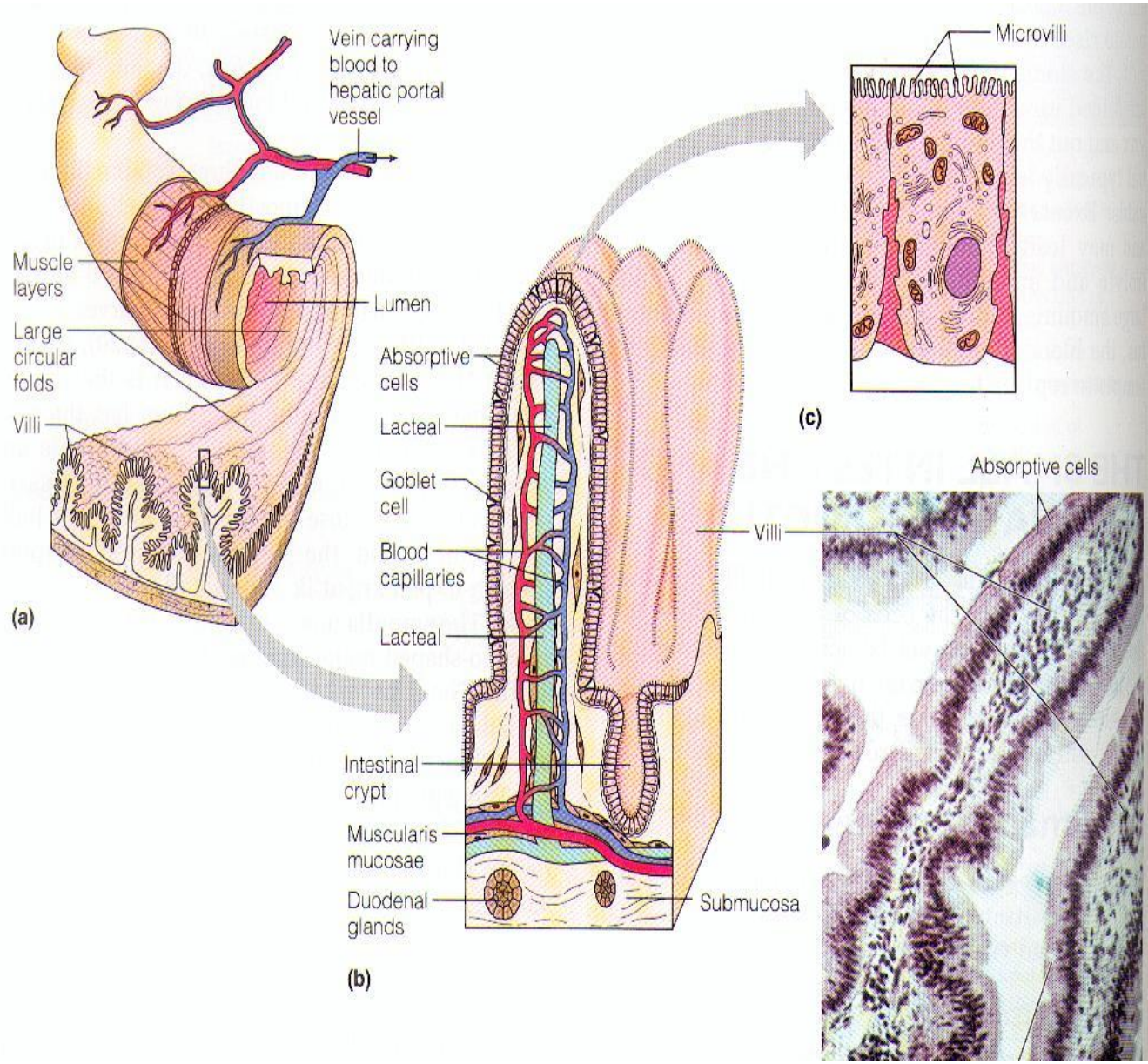


- Site of greatest amount of digestion and absorption of nutrients and water
- Divisions
  - **Duodenum**- first 25 cm beyond the pyloric sphincter.
  - **Jejunum**- 2.5 m
  - **Ileum**- 3.5 m. Peyer's patches or lymph nodules

Modifications to Increase Surface Area

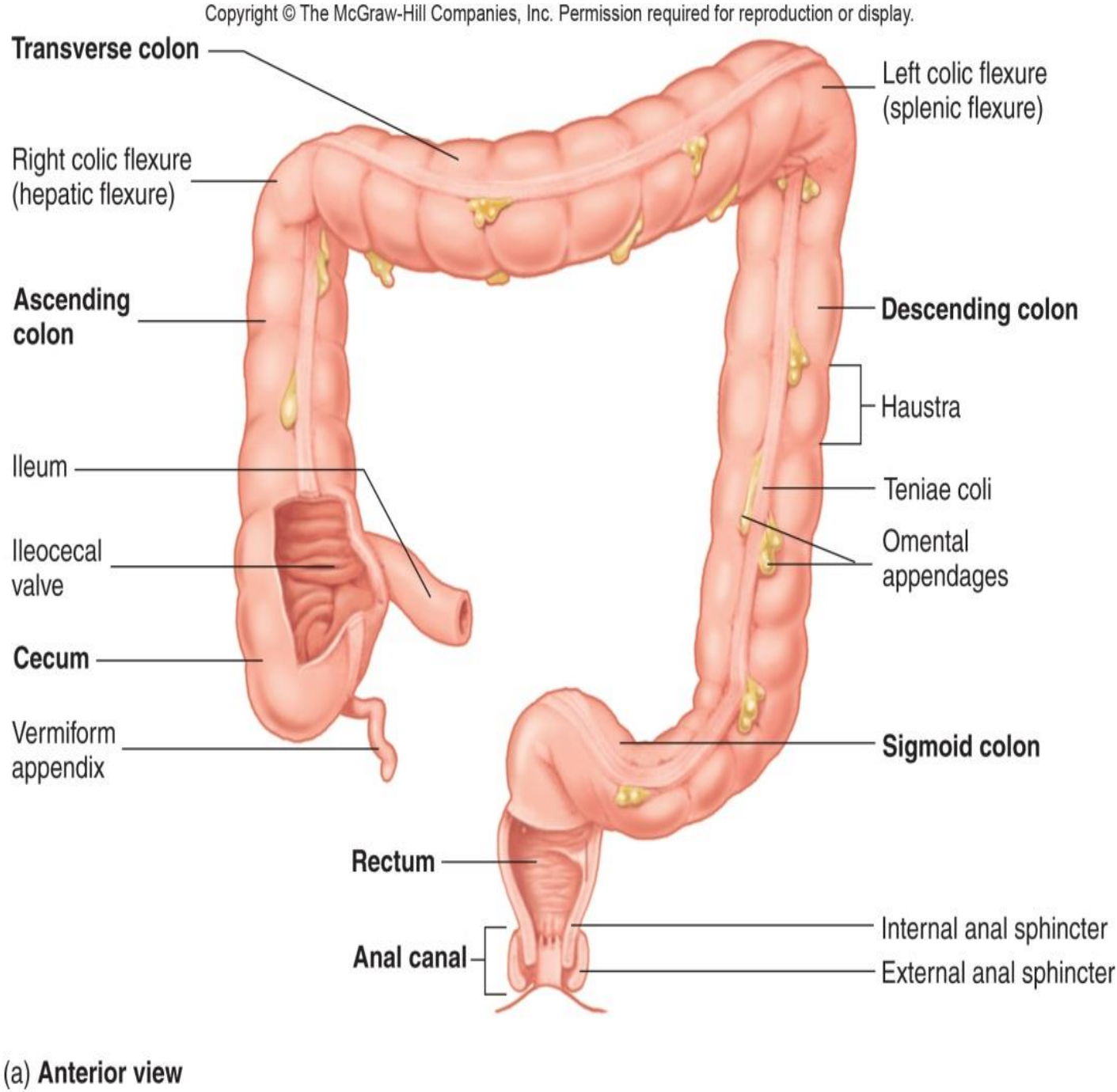
- **1. Plicae circulares** (circular folds)
- **2. Villi** that contain capillaries and lacteals. Folds of the mucosa
- **3. Microvilli**: folds of cell membranes of absorptive cells
- 4. total surface area about that of a tennis court.

Ileocecal junction: where ilium meets large intestine. **Ileocecal sphincter** and **ileocecal valve**



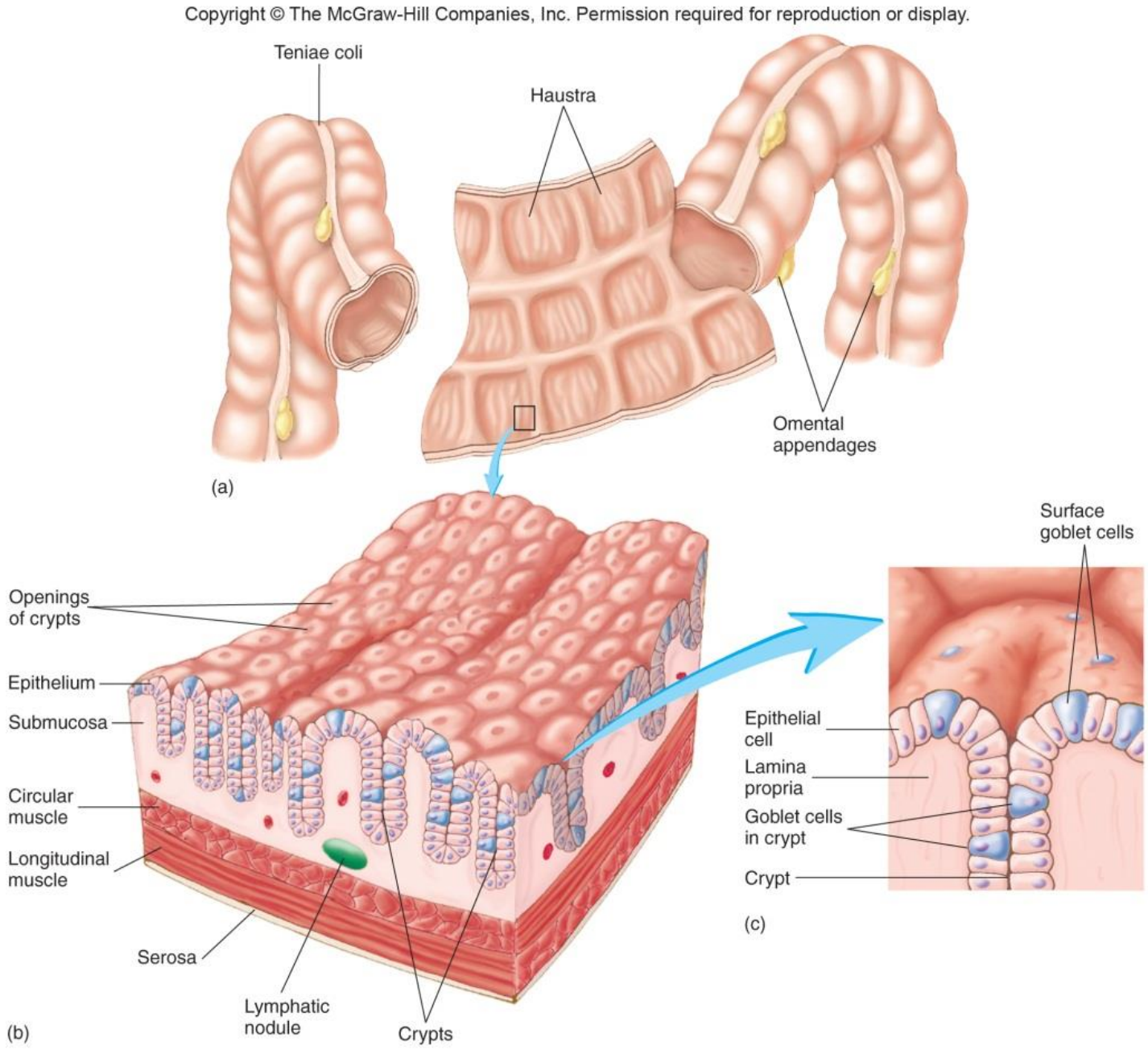
Large Intestine

- A. Extends from ileocecal junction to **anus**
- B. Consists of **cecum**, **colon**, **rectum**, **anal canal**
- C. Movements sluggish (18-24 hours); chyme converted to feces.
- D. Absorption of water and salts, secretion of mucus, extensive action of microorganisms.
- E. 1500 mL chyme enter the cecum, 90% of volume reabsorbed yielding 80-150 mL of feces



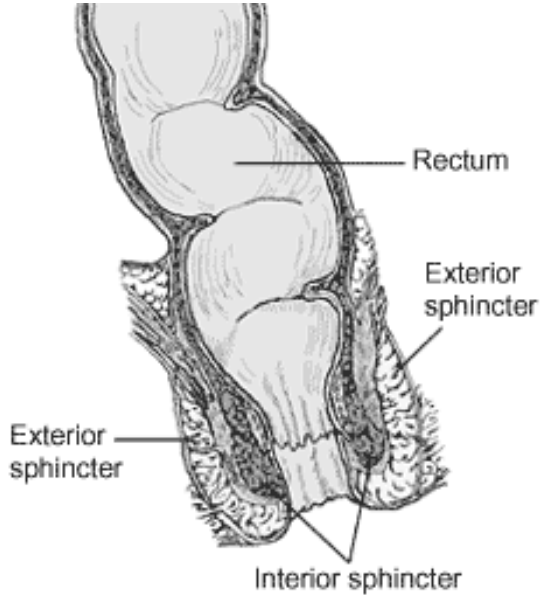
Anatomy of the Large Intestine

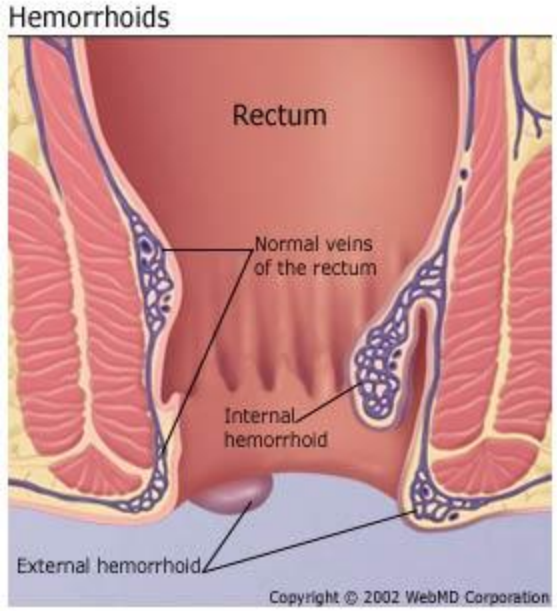
- 1. Cecum
  - Blind sac, **vermiform appendix** attached.
- 2. Colon
  - **Ascending**, **transverse**, **descending**, **sigmoid**
  - Circular muscle layer complete; longitudinal incomplete (three **teniae coli**). Contractions of teniae form pouches called **haustra**.
  - Mucosa has numerous straight tubular glands called **crypts**. Goblet cells predominate, but there are also absorptive and granular cells as in the small intestine



- 3. Rectum
  - Straight muscular tube, thick muscular tunic

- 4. Anal canal:
  - **Internal anal sphincter** (smooth muscle)
  - **External anal sphincter** (skeletal muscle)
  - Hemorrhoids: Vein enlargement or inflammation





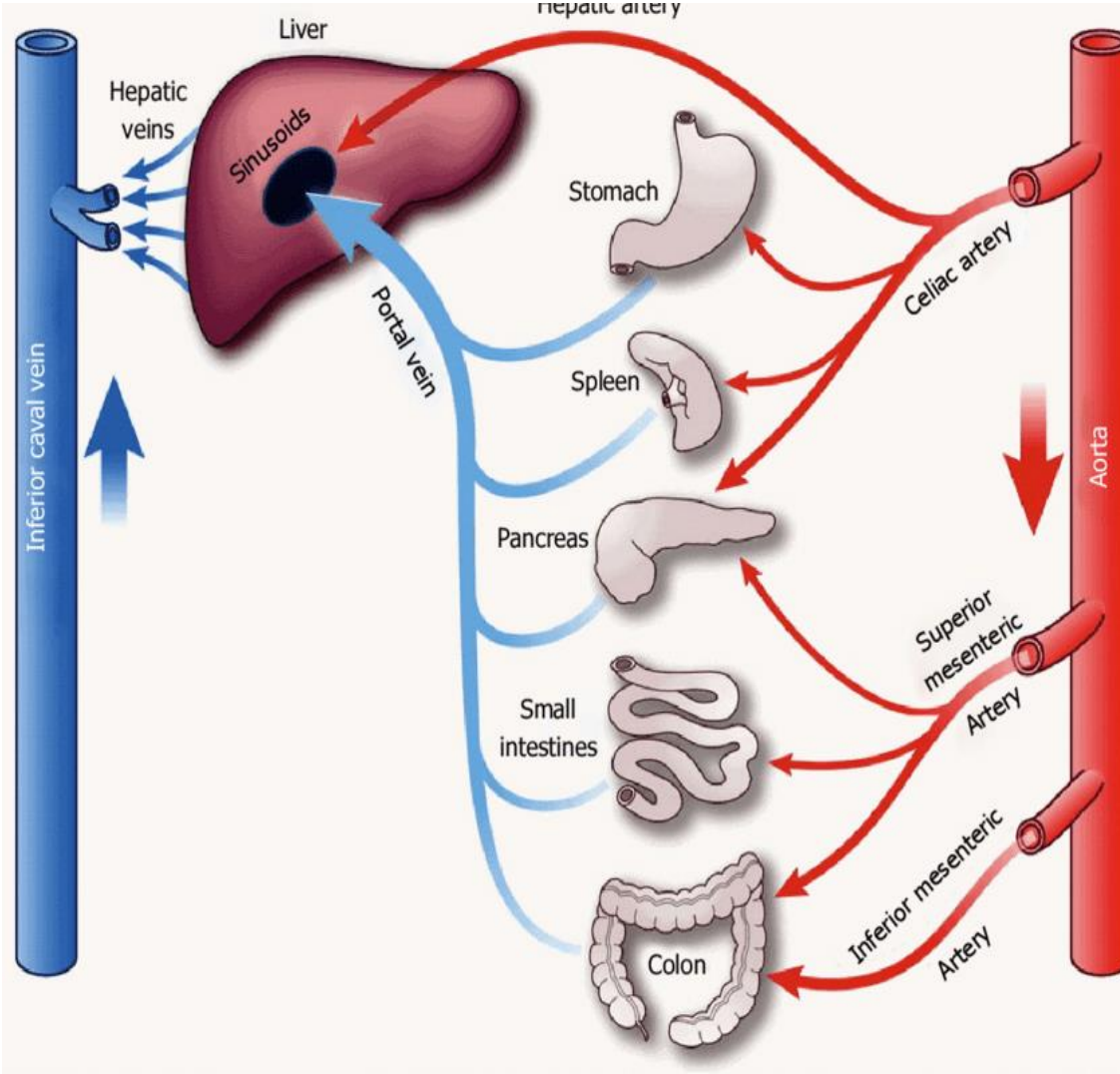
Liver

The liver is the largest solid organ in the body. In adults, the liver can weigh up to 1.5 kilograms (kg). It is in the upper-right abdomen, just under the rib cage and below the diaphragm.

Hepatic Portal Circulation

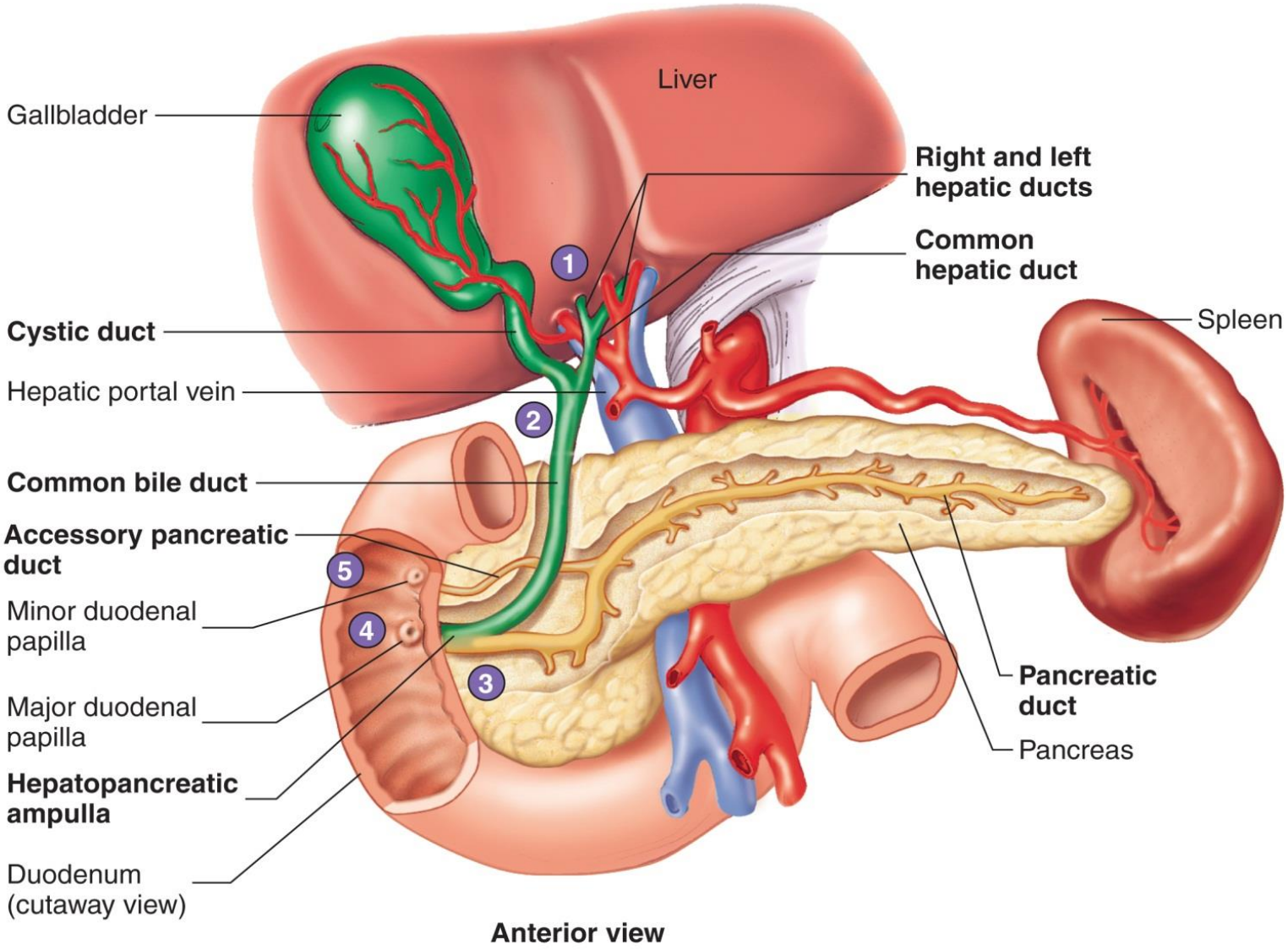
The **hepatic artery** comes off the celiac trunk which in turn comes from the aorta. The venous blood from the digestive tract is collected by the **portal vein**, which then supplies blood to liver.

The **hepatic veins** drain blood from liver into the **inferior vena cava**. Branches of the hepatic **artery** and **vein** and the **bile duct** flow into the liver. Collectively, these three vessels are termed the **portal triad**.



Liver, Gallbladder, Pancreas and Ducts

1. The hepatic ducts, which carry bile from the liver lobes, combine to form the common hepatic duct.
2. The common hepatic duct combines with the cystic duct from the gallbladder to form the common bile duct.
3. The common bile duct and the pancreatic duct combine to form the hepatopancreatic ampulla.
4. The hepatopancreatic ampulla empties bile and pancreatic secretions into the duodenum at the major duodenal papilla.
5. The accessory pancreatic duct empties pancreatic secretions into the duodenum at the minor duodenal papilla.



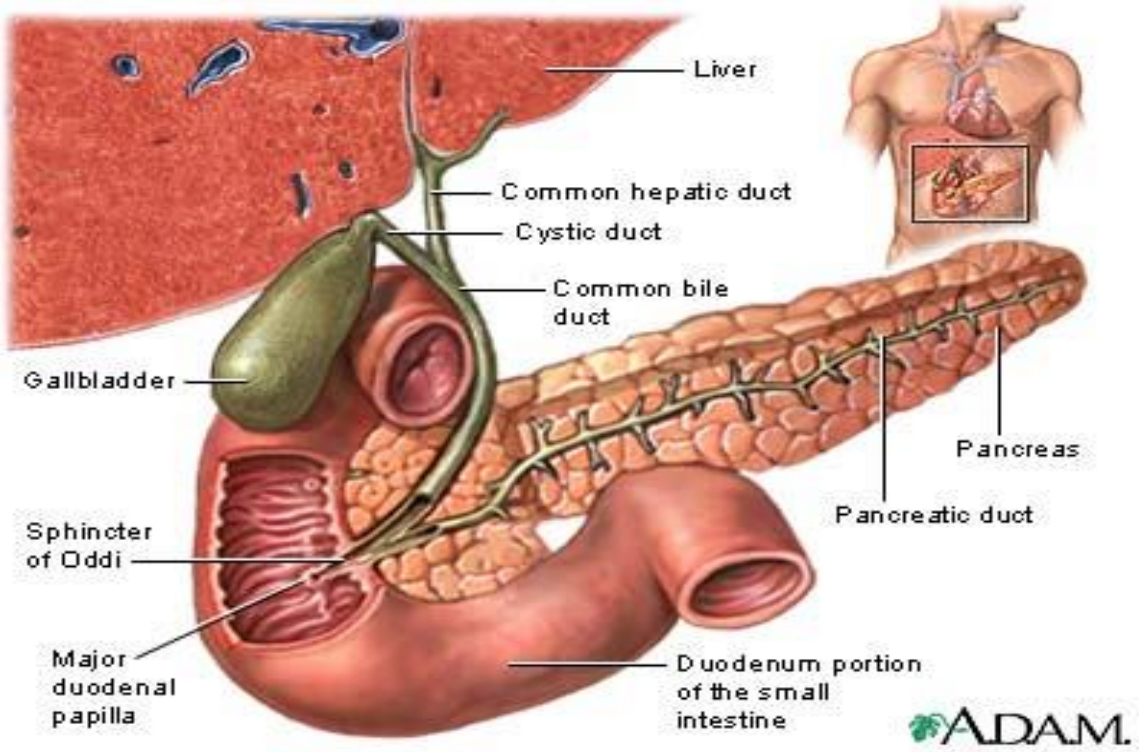
Anterior view

Pancreas:

Retroperitoneal :compose of head, body and tail

Endocrine and exocrine gland

Endocrine: pancreatic islets or Islets of Langerhans.



Gall Bladder :

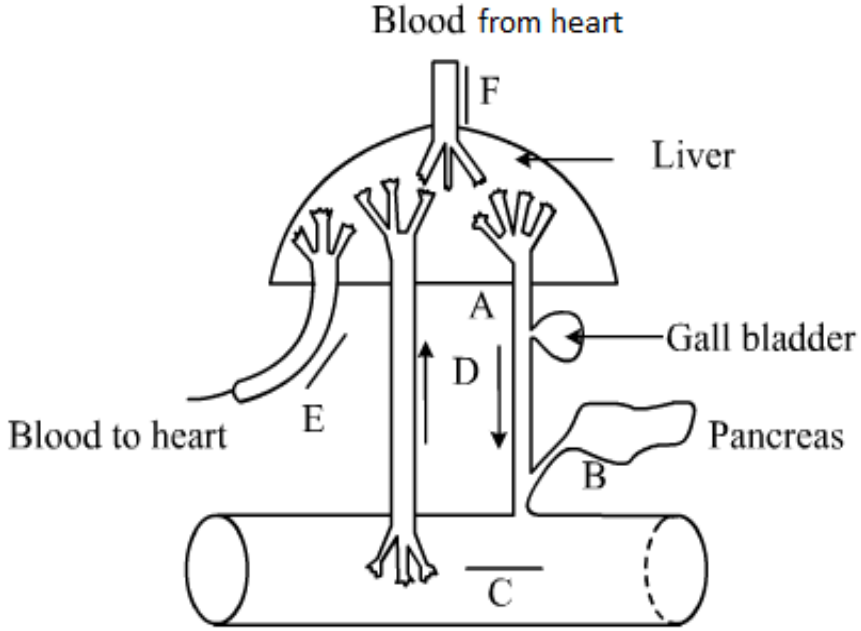
Sac where bile arrives constantly from liver, stored and concentrated.

Bile exits through cystic duct then into common bile duct

Gallstones:

Can block cystic duct

THANK YOU!


Blood from heart
F
Liver
A
Gall bladder
D
Blood to heart
E
Pancreas
B
C