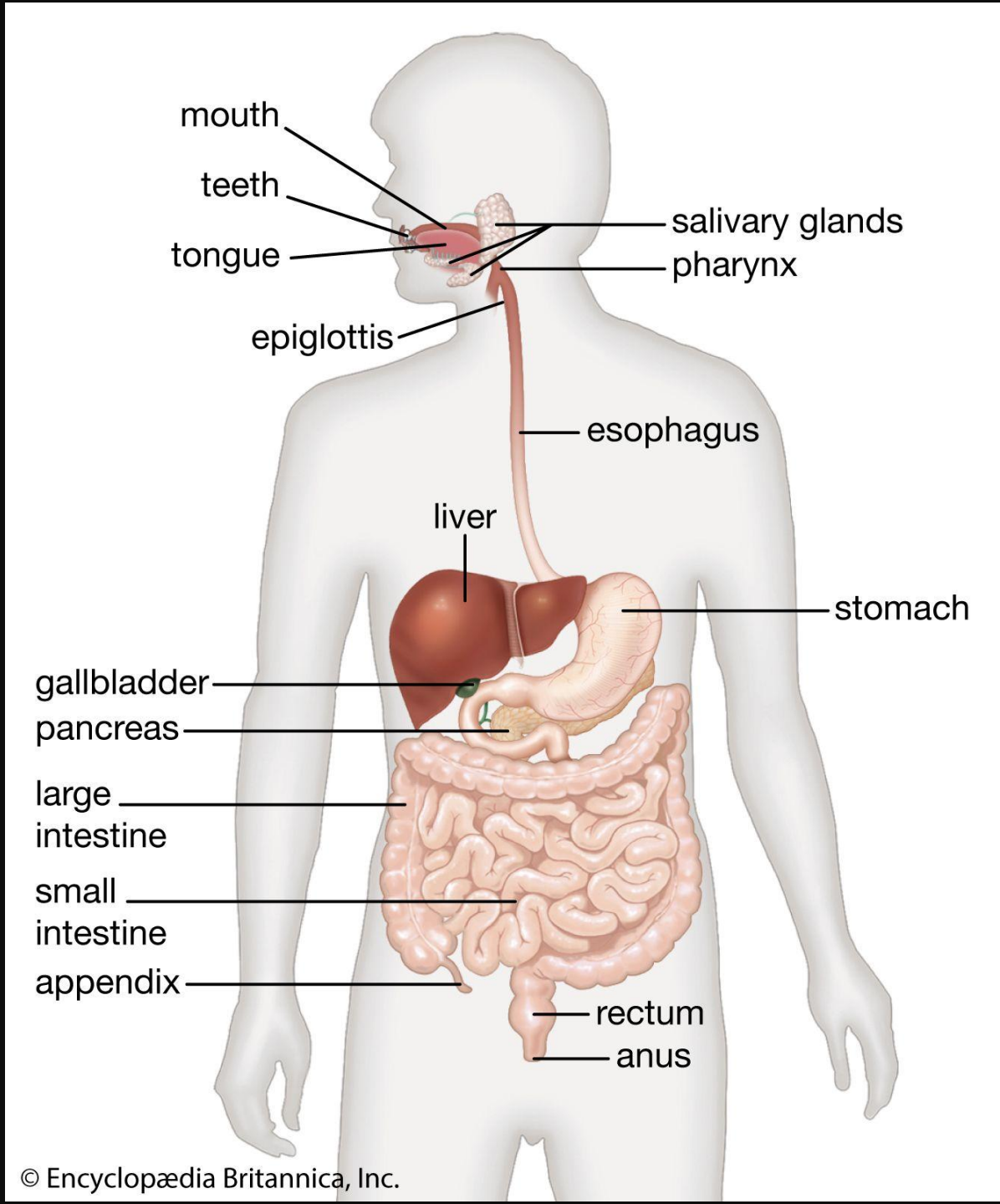
ANATOMY OF THE GASTROINTESTINAL SYSTEM

From an anatomical point of view, it is divided into:

- **DIGESTIVE TUBE:** oral cavity → pharynx → esophagus → stomach → small intestine → large intestine → rectum → anal canal.

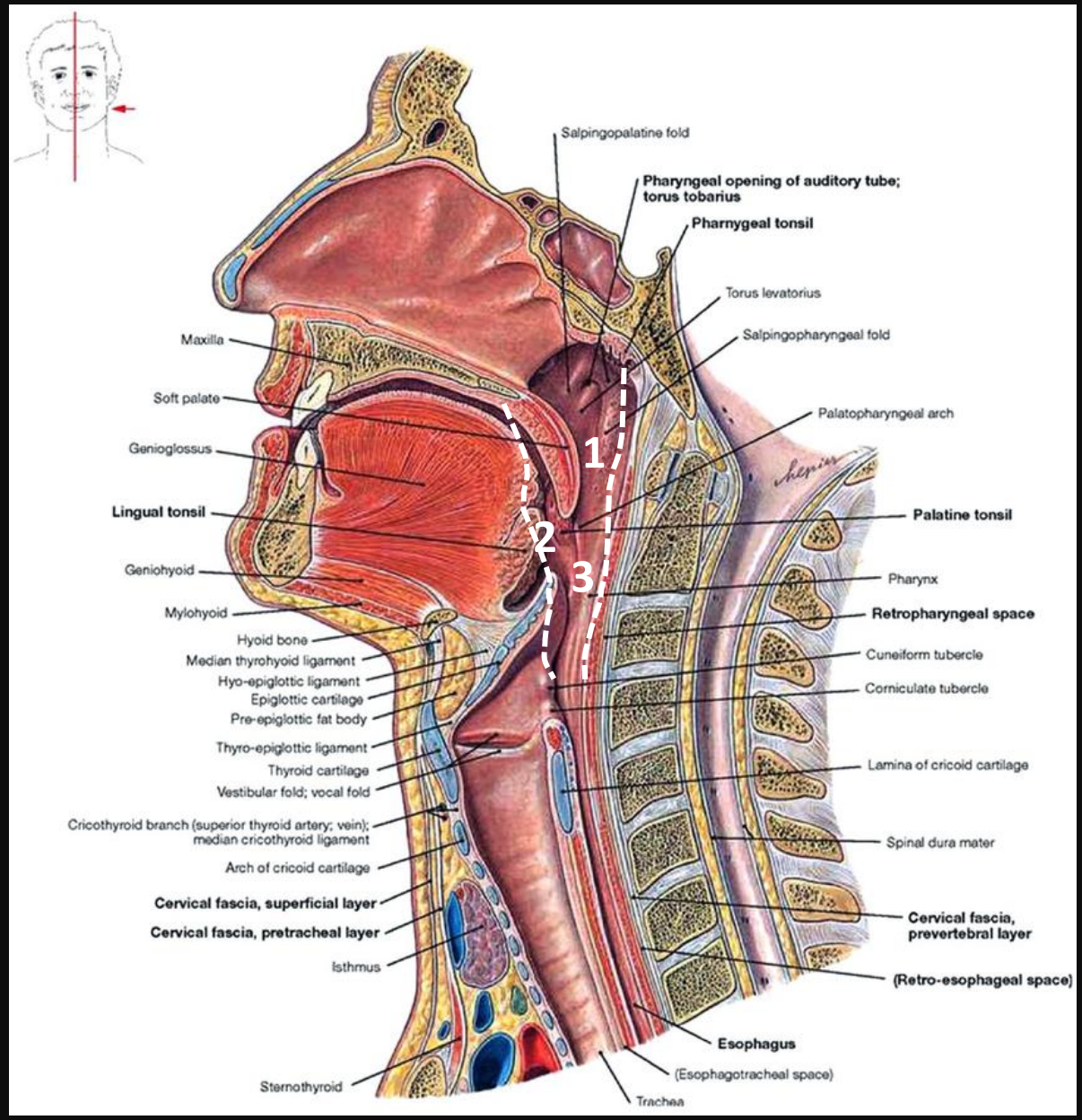
- **ACCESSORY GLANDS:** salivary glands, liver, bile ducts, pancreas.



ORAL CAVITY AND PHARYNX

The PHARYNX is a funnel-shaped structure common to the respiratory and digestive tracts and is divided into:

1) **NASOPHARYNX**
2) **OROPHARYNX**
3) **LARYNXOPHARYNX**



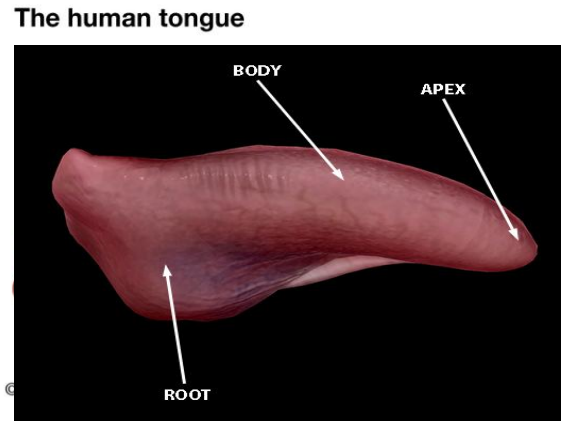
Digestive System I: Oral Cavity and Associated Structures

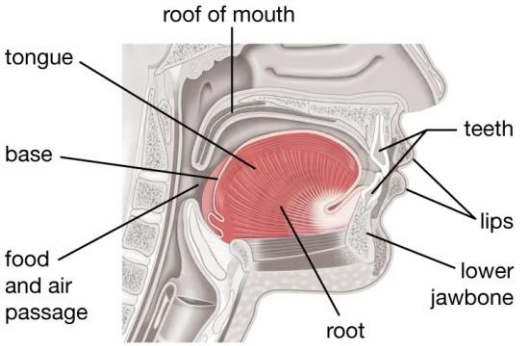
TONGUE

muscular organ that projects into the oral cavity from its inferior surface

composed of **extrinsic and intrinsic muscles** arranged in three perpendicular planes, a unique organization that provides great flexibility and precision of movement.

The **dorsal surface** of the tongue is divided into an **anterior two-thirds and a posterior one-third** by the **sulcus terminalis**, a V-shaped groove whose apex contains the **foramen cecum**, a remnant of thyroid gland development. The dorsal surface is covered by **lingual papillae**.





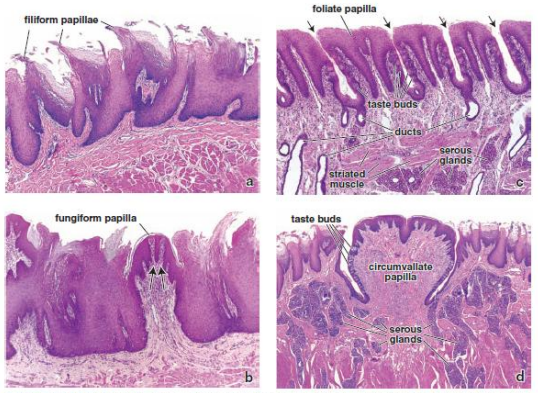


FIGURE 16.5 ▲ **Lingual papillae. a.** Structurally, the filiform papillae are posteriorly bent conical projections of the epithelium. These papillae do not possess taste buds and are composed of stratified squamous keratinized epithelium. ×45. **b.** Fungiform papillae are slightly rounded, elevated structures situated among the filiform papillae. A highly vascularized connective tissue core forms the center of the fungiform papilla and projects into the base of the surface epithelium. Because of the deep penetration of connective tissue into the epithelium (*arrows*), combined with a very thin keratinized surface, the fungiform papillae appear as small red dots when the dorsal surface of the tongue is examined by gross inspection. ×45. **c.** In a section, foliate papillae can be distinguished from fungiform papillae because they appear in rows separated by deep clefts (*arrows*). The foliate papillae are covered by stratified squamous nonkeratinized epithelium containing numerous taste buds on their lateral surfaces. The free surface epithelium of each papilla is thick and has a number of secondary connective tissue papillae projecting into its undersurface. The connective tissue within and under the foliate papillae contains serous glands (von Ebner's glands) that open via ducts into the cleft between neighboring papillae. ×45. **d.** Circumvallate papillae are covered by stratified squamous epithelium that may be slightly keratinized. Each circumvallate papilla is surrounded by a trench or cleft. Numerous taste buds are on the lateral walls of the papillae. The dorsal surface of the papilla is smooth. The deep trench surrounding the circumvallate papillae and the presence of taste buds on the sides rather than on the free surface are features that distinguish circumvallate from fungiform papillae. The connective tissue near the circumvallate papillae also contains many serous-type glands that open via ducts into the bottom of the trench. ×25.

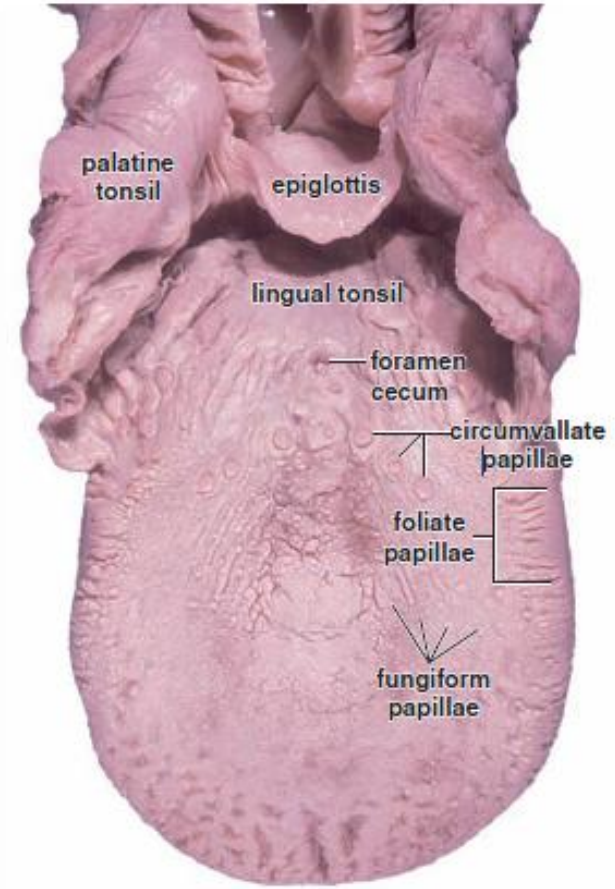


FIGURE 16.4 ▲ **Human tongue.** Circumvallate papillae are positioned in a V configuration, separating the anterior two-thirds of the tongue from the posterior third. Fungiform and filiform papillae are on the anterior portion of the dorsal tongue surface. The uneven contour of the posterior tongue surface is attributable to the lingual tonsils. The palatine tonsil is at the junction between the oral cavity and the pharynx.

TEETH AND SUPPORTING TISSUES

Humans have 32 permanent **teeth**; each tooth has a root embedded in the alveolar bone and a **clinical crown** that projects into the oral cavity.

The tooth has three specialized tissues:

-Visible **enamel** covering its anatomic crown;
-**cementum**, found on the root for the attachment of periodontal ligaments;
-and **dentin**, which lies deep to enamel and cementum.

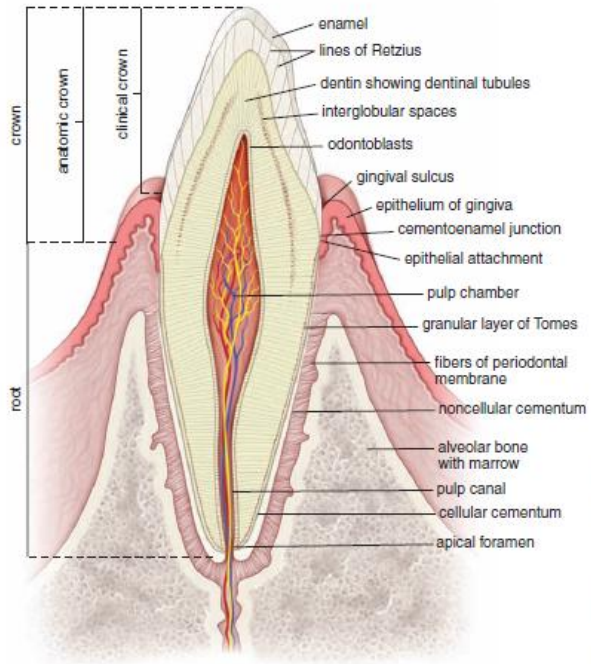
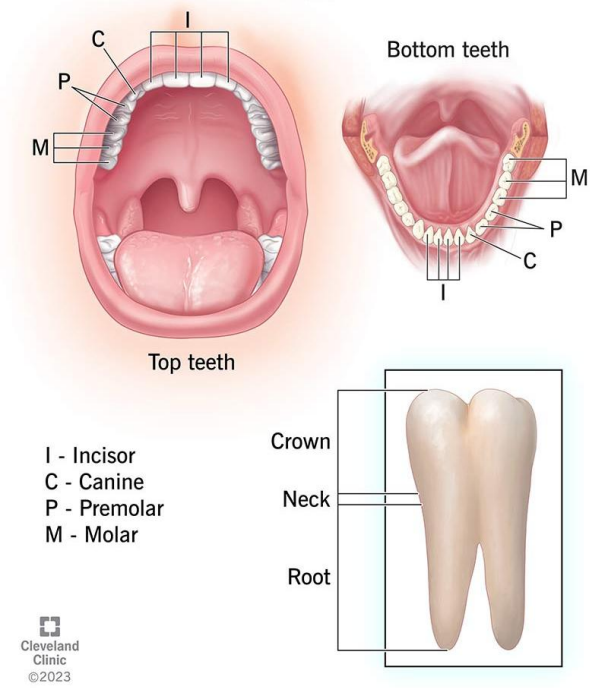


FIGURE 16.8 ▲ Diagram of a section of an incisor tooth and surrounding bony and mucosal structures. The three mineralized components of the tooth are dentin, enamel, and cementum. The central soft core of the tooth is the pulp. The periodontal ligament (membrane) contains bundles of collagenous fibers that bind the tooth to the surrounding alveolar bone. The clinical crown of the tooth is the portion that projects into the oral cavity. The anatomic crown is the entire portion of the tooth covered by enamel.



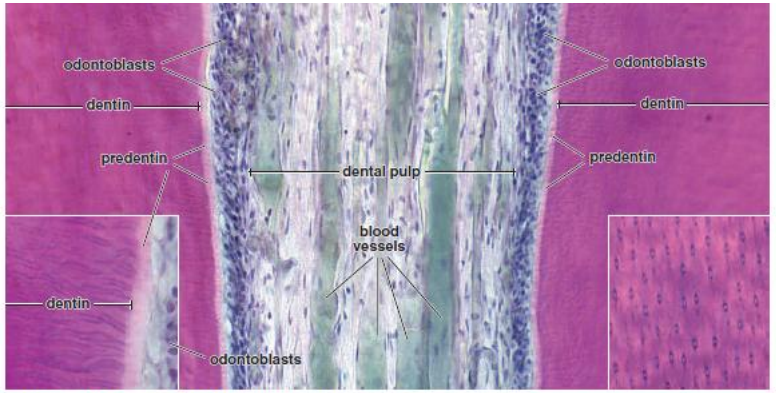


FIGURE 16.17 ▲ Dental pulp and structure of dentin. This photomicrograph of a decalcified tooth shows the centrally located dental pulp, surrounded by dentin on both sides. The dental pulp is a soft tissue core of the tooth that resembles embryonic connective tissue, even in the adult. It contains blood vessels and nerves. Dentin contains the cytoplasmic processes of the odontoblasts within dentinal tubules. They extend into the dentinoenamel junction. The cell bodies of the odontoblasts are adjacent to the unmineralized dentin called the predentin. ×120. **Left inset.** Longitudinal profiles of the dentinal tubules. ×240. **Right inset.** Cross-sectional profiles of dentinal tubules. The dark outline of the dentinal tubules, as seen in both insets, represents the peritubular dentin, which is the more mineralized part of the dentin. ×240.

ORAL CAVITY AND PHARYNX

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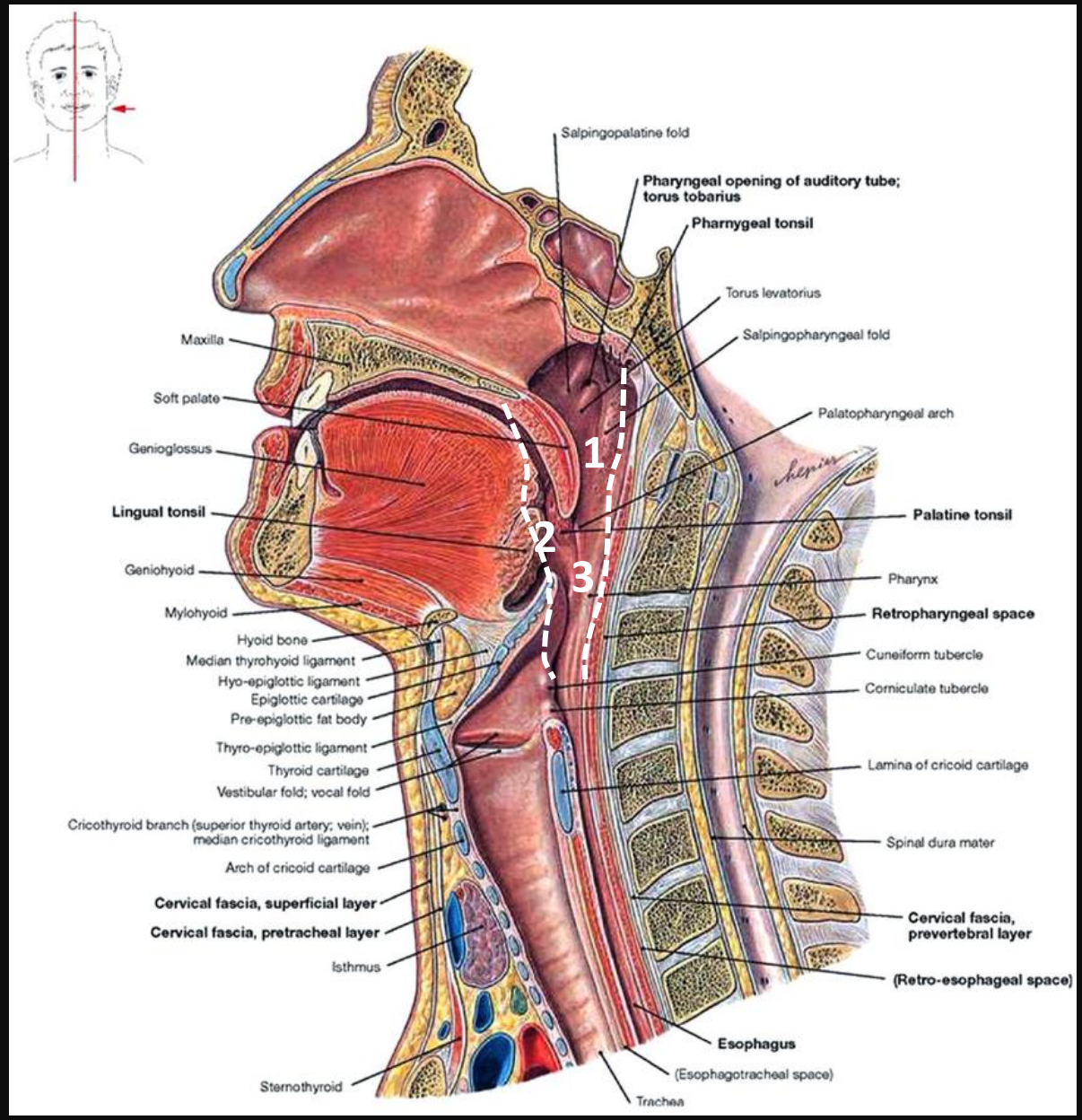
2) **OROPHARYNX**
3) **LARYNXOPHARYNX**



DIGESTIVE SYSTEM

ALIMENTARY CANAL STRUCTURE

The portion of the **alimentary canal,** that extends from the proximal part of the esophagus to the distal part of the anal canal is a hollow tube of varying diameter. This tube has the same basic structural organization throughout its length. Its wall is formed by four distinctive layers.

From the lumen outward they are as follows:

Mucosa,

Submucosa

Muscularis externa,

Serosa, **Adventitia**

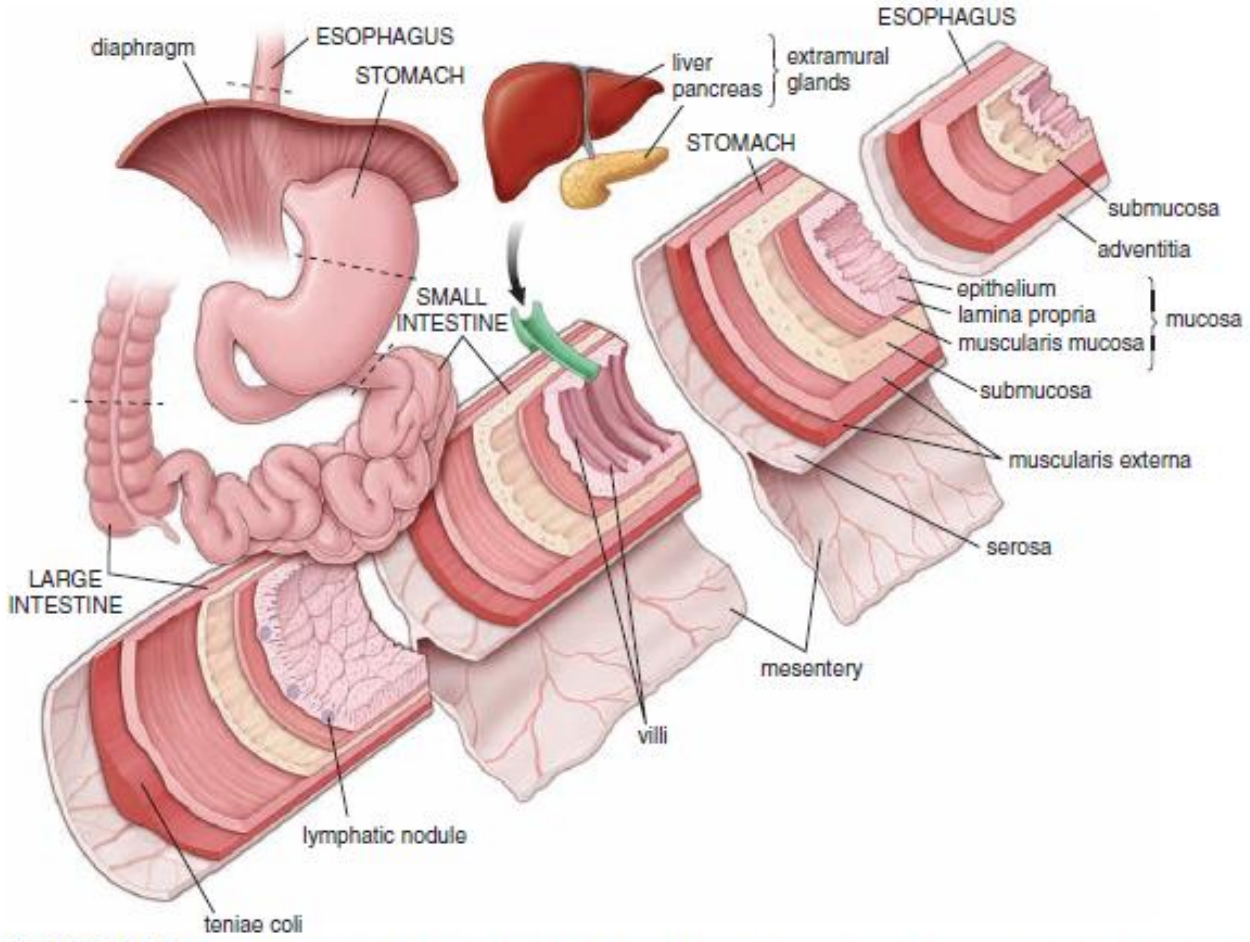


FIGURE 17.1 ▲ **Diagram of general organization of the alimentary canal.** This composite diagram shows the wall structure of the

DIGESTIVE SYSTEM

ESOPHAGUS

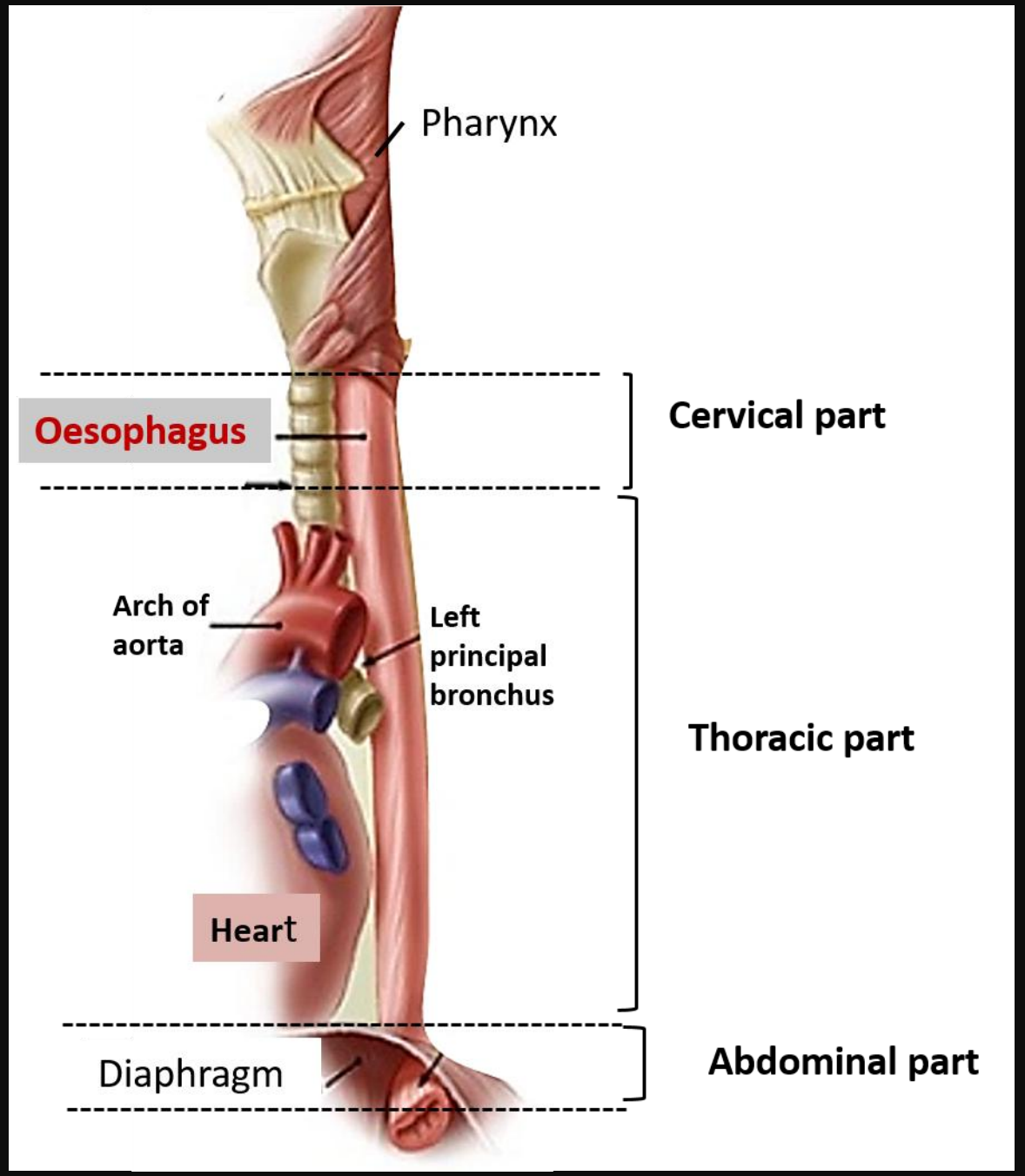
ESOPHAGUS

The esophagus can be divided into three sections:

1) CERVICAL

2) THORACIC

3) ABDOMINAL



DIGESTIVE SYSTEM

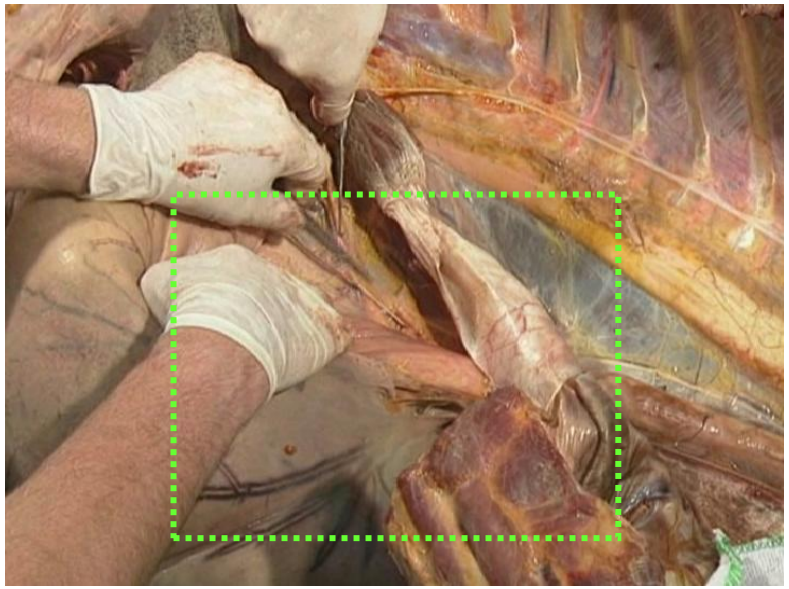
CERVICAL PORTION OF THE ESOPHAGUS

DIGESTIVE SYSTEM

THORACIC ESOPHAGUS

DIGESTIVE SYSTEM

ABDOMINAL PART OF THE ESOPHAGUS



ESOPHAGUS

Mucosal and submucosal glands of the esophagus secrete mucus to lubricate and protect the luminal wall.

The muscle of the esophageal wall is innervated by both autonomic and somatic nervous systems.

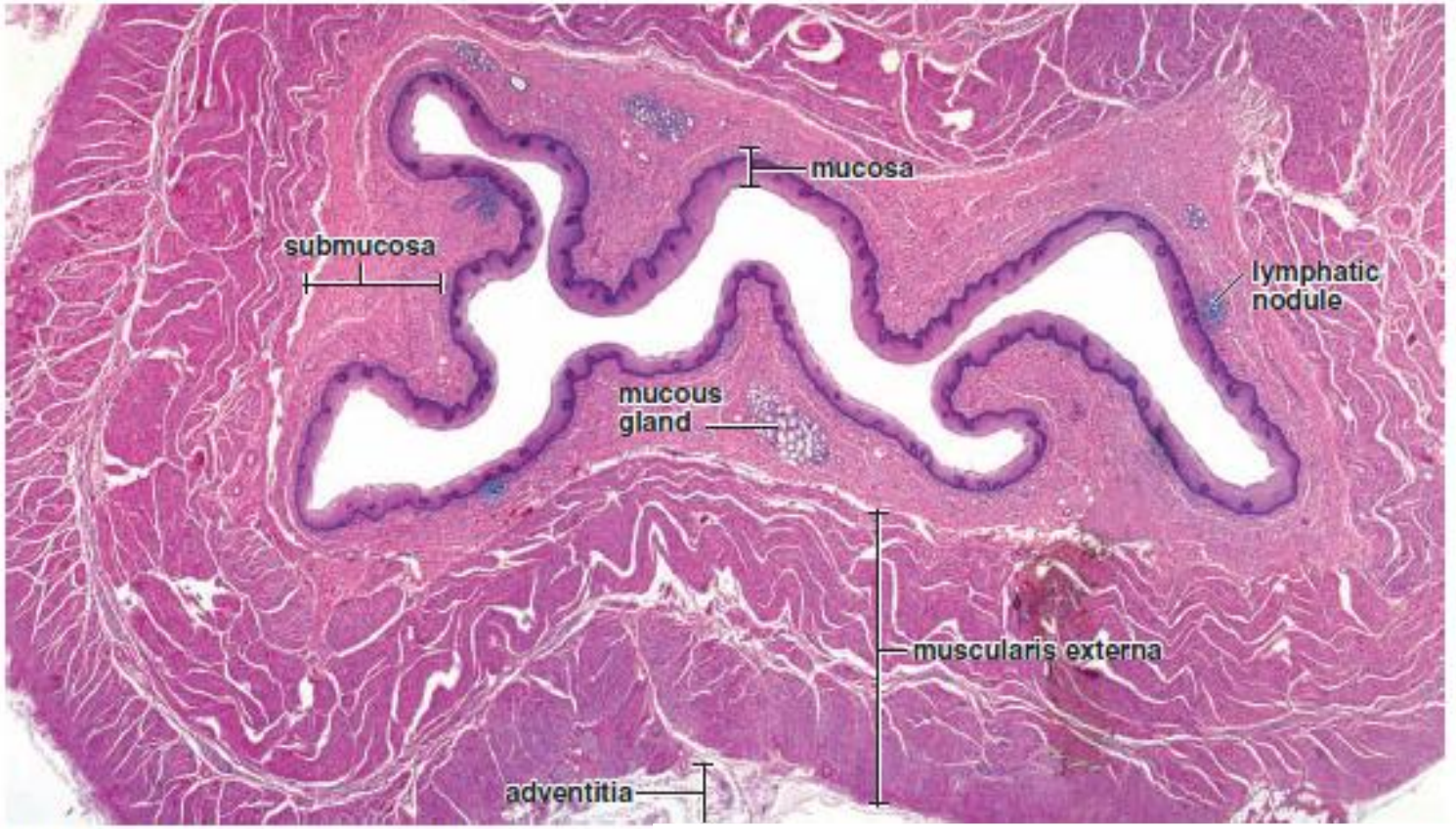
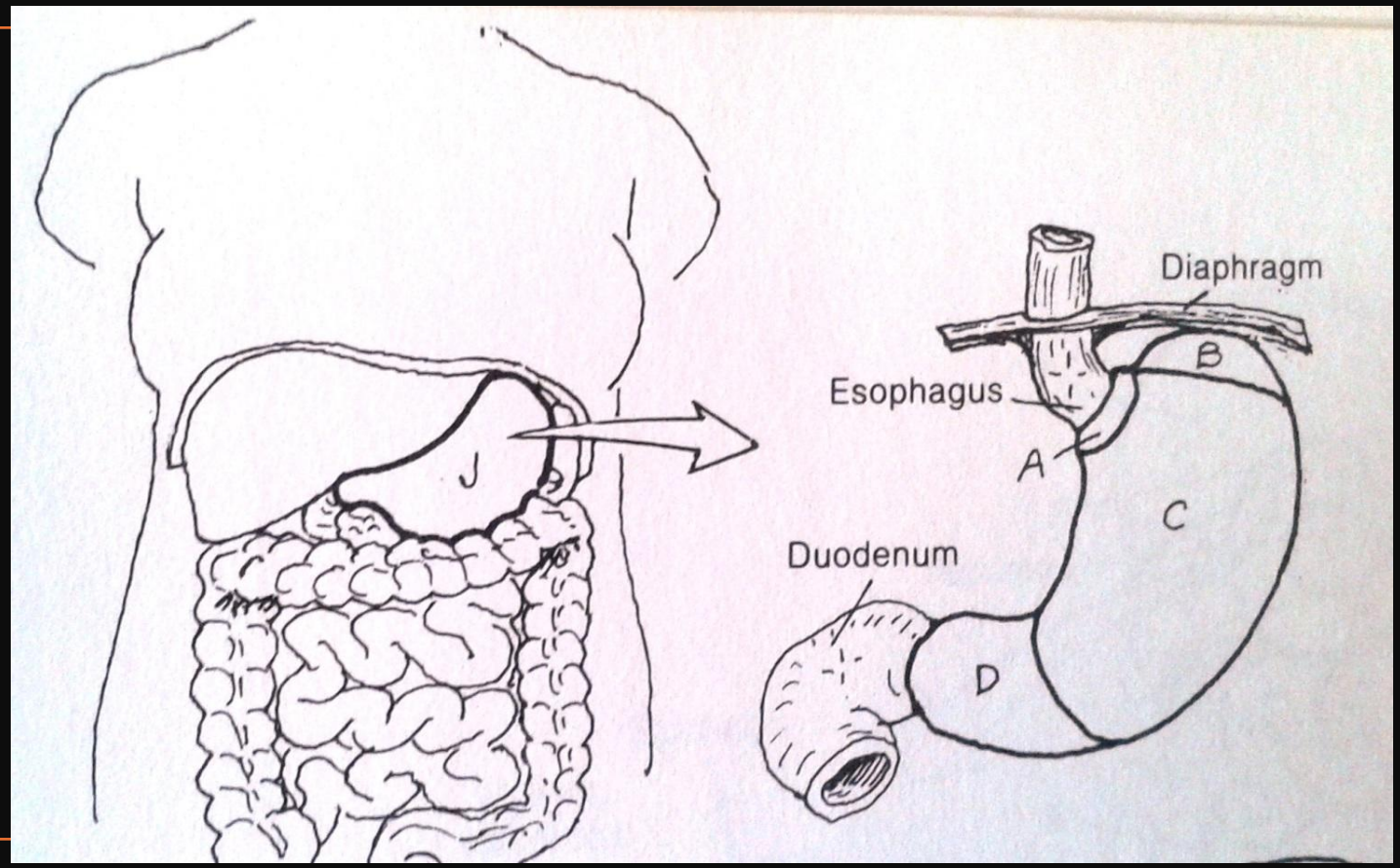


FIGURE 17.2 ▲ Photomicrograph of the esophagus.

STOMACH



STOMACH

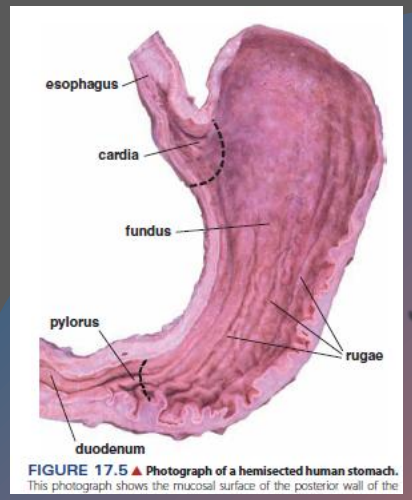
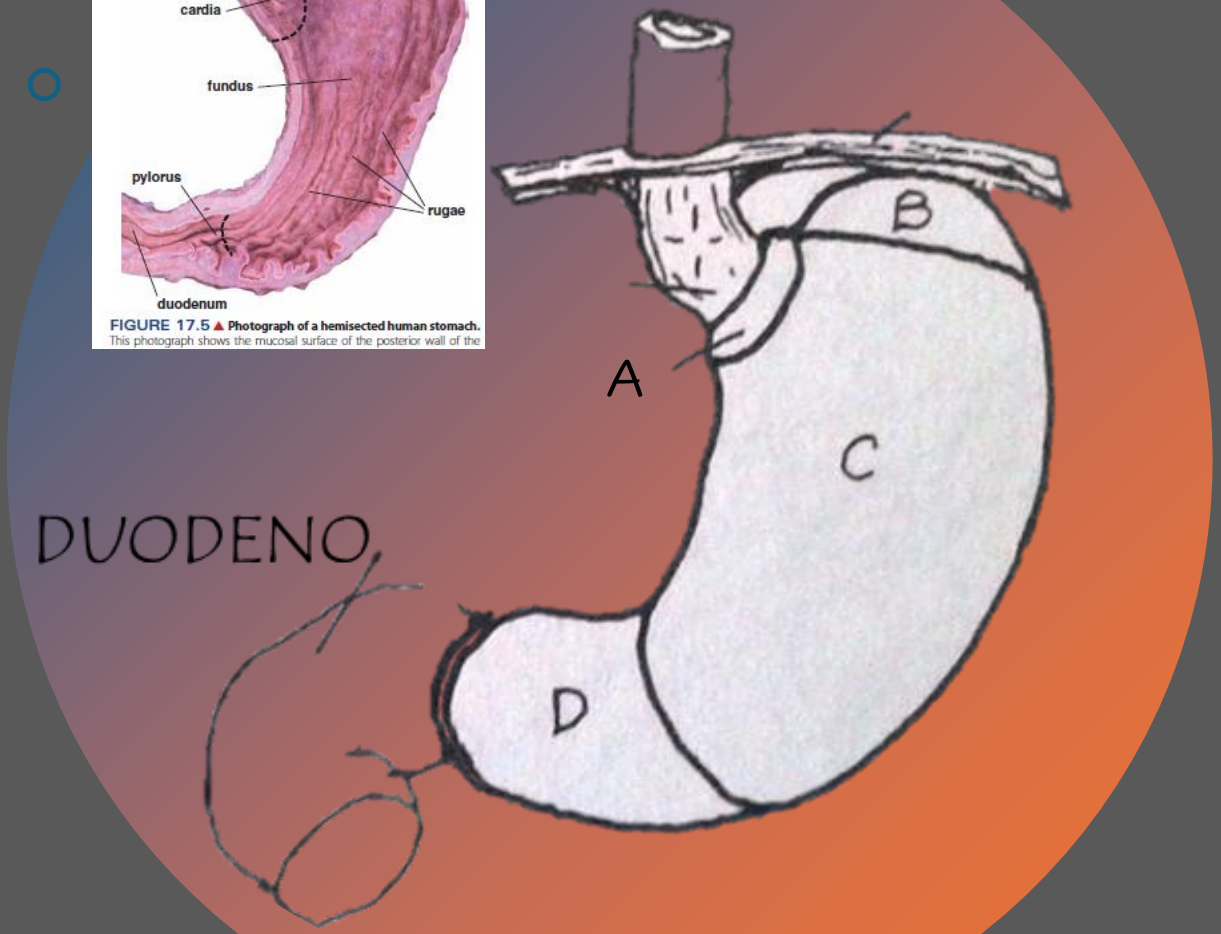


FIGURE 17.5 ▲ Photograph of a hemisected human stomach.
This photograph shows the mucosal surface of the posterior wall of the



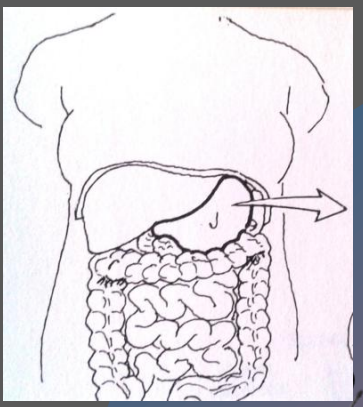
1. A **fundus (B)**, which lies above the **cardia (A)**.

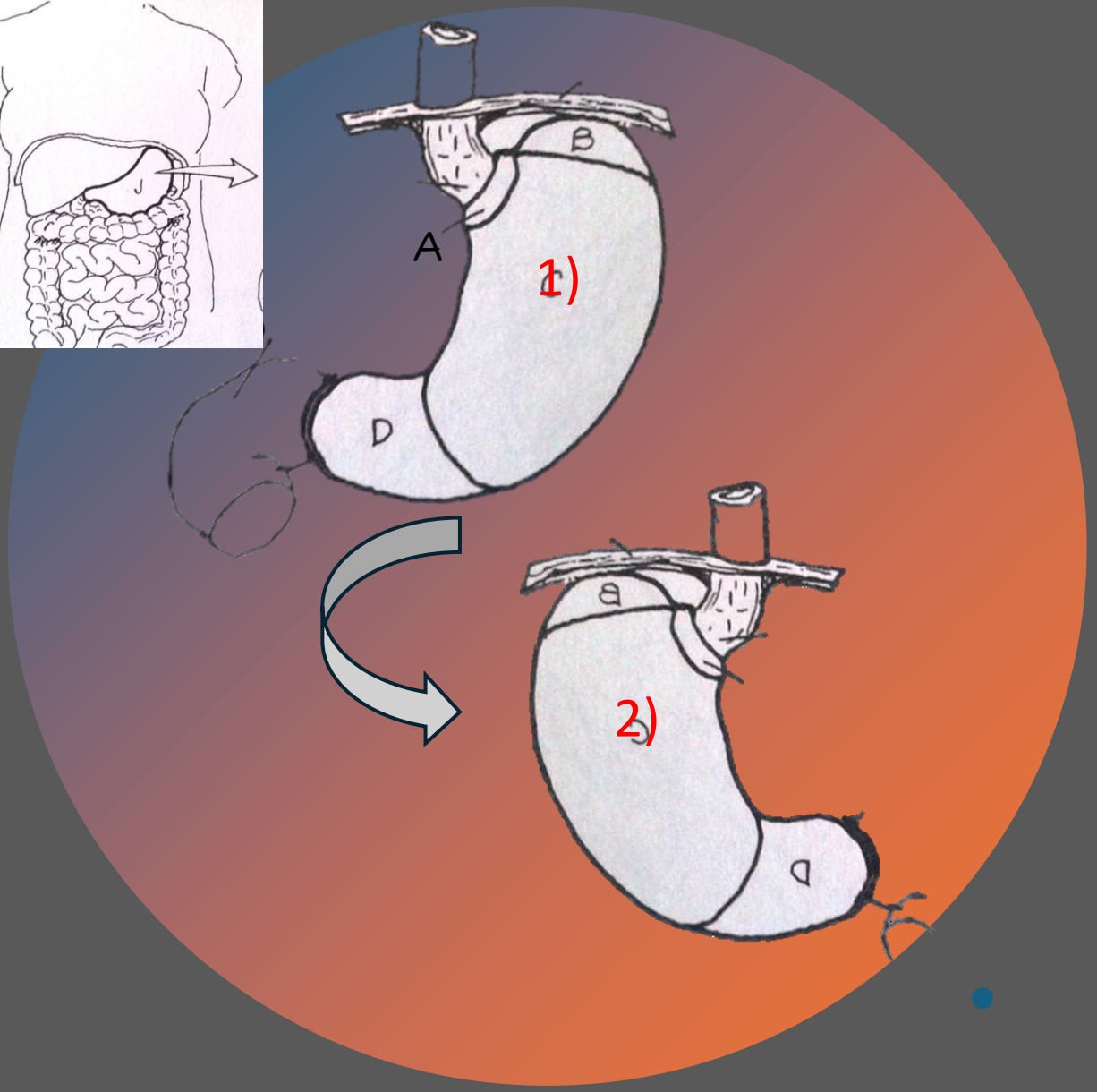
2. A **body (C)**, located ventrally to the fundus (B).

3. A **pyloric part (D)**, which corresponds to the lower folded portion of the stomach.

In turn, the **pyloric** part is divided into:
a) a **pyloric antrum**
b) a **pyloric canal**, which is followed by
c) the **pylorus**.

STOMACH

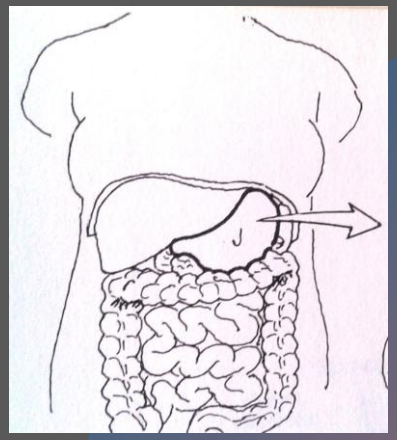


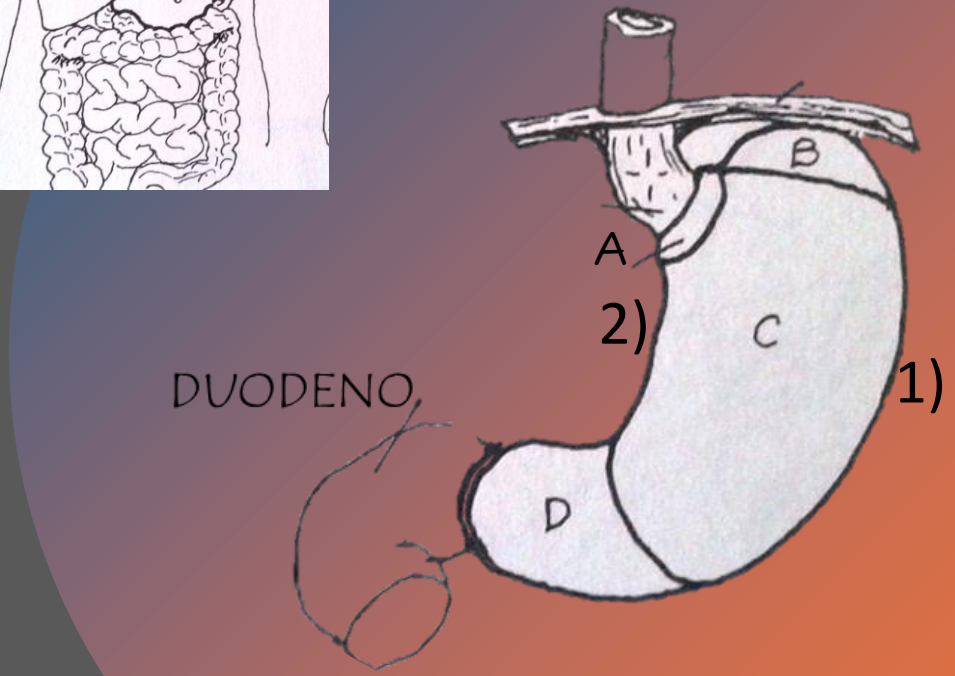


1) ANTERIOR DIAPHRAGMATIC SURFACE or PARIETAL SURFACE
in relation to the diaphragm and a

2) POSTERIOR VISCERAL SURFACE or SPLENIC SURFACE
in relation to the abdominal cavity viscera

STOMACH





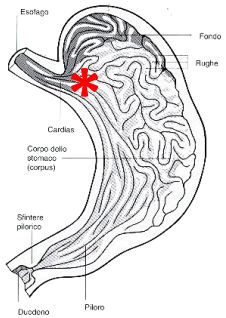
1) GREATER CURVATURE

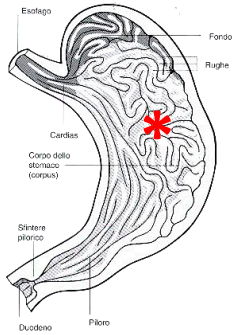
2) LESSER CURVATURE

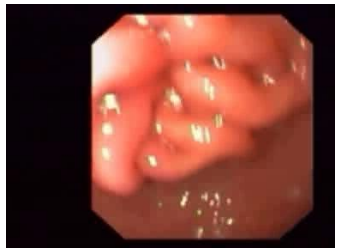
STOMACH

CARDIA

BODY

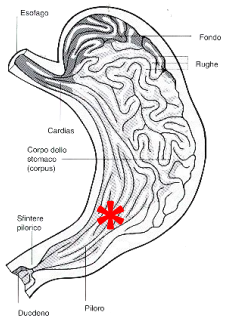


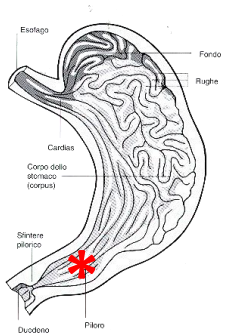




PYLORIC ANTRUM

PYLORUS





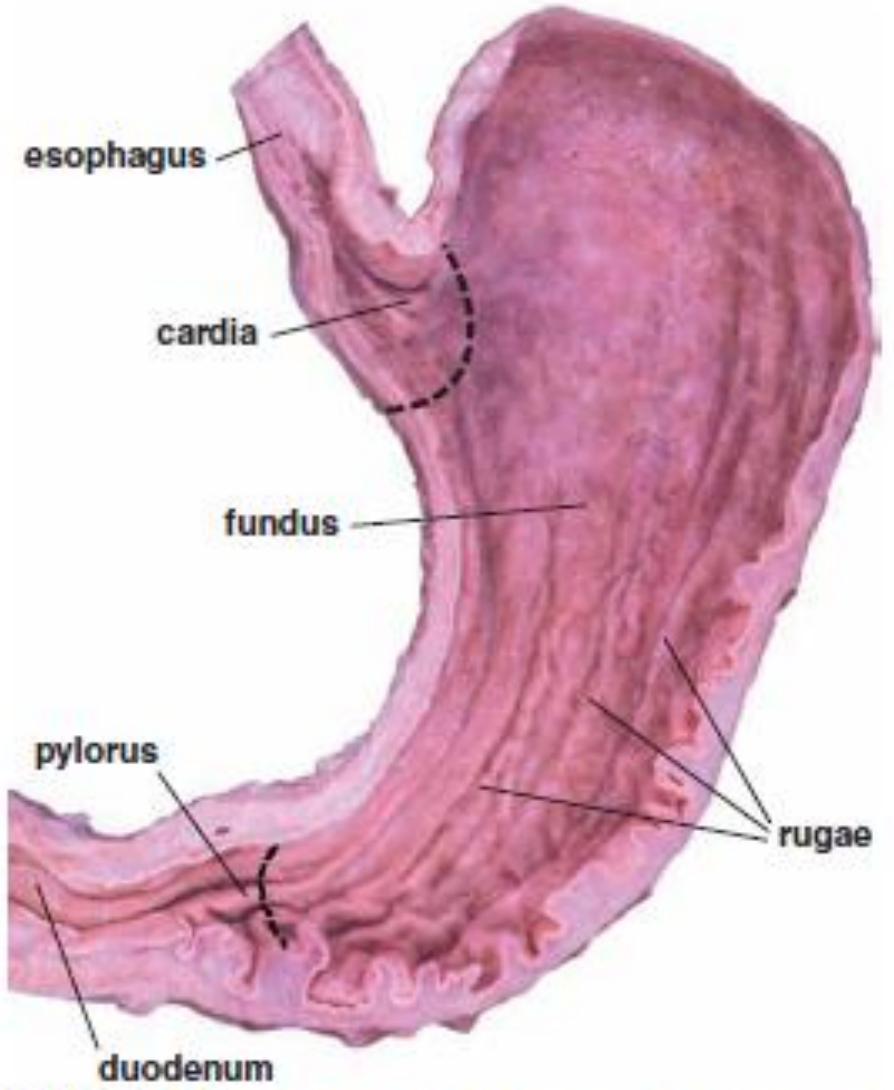
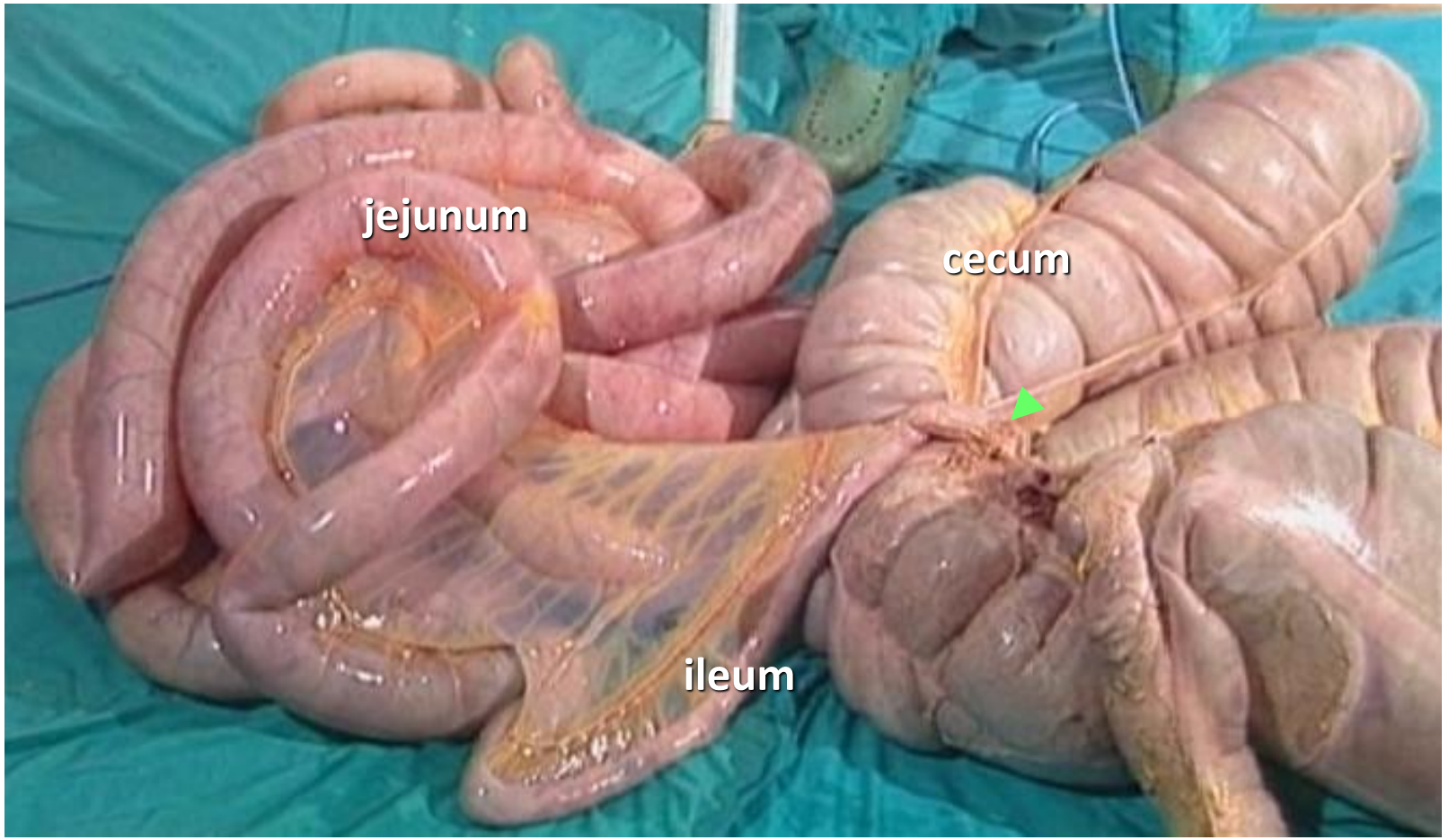


FIGURE 17.5 ▲ Photograph of a hemisected human stomach.

DIGESTIVE SYSTEM

SMALL INTESTINE

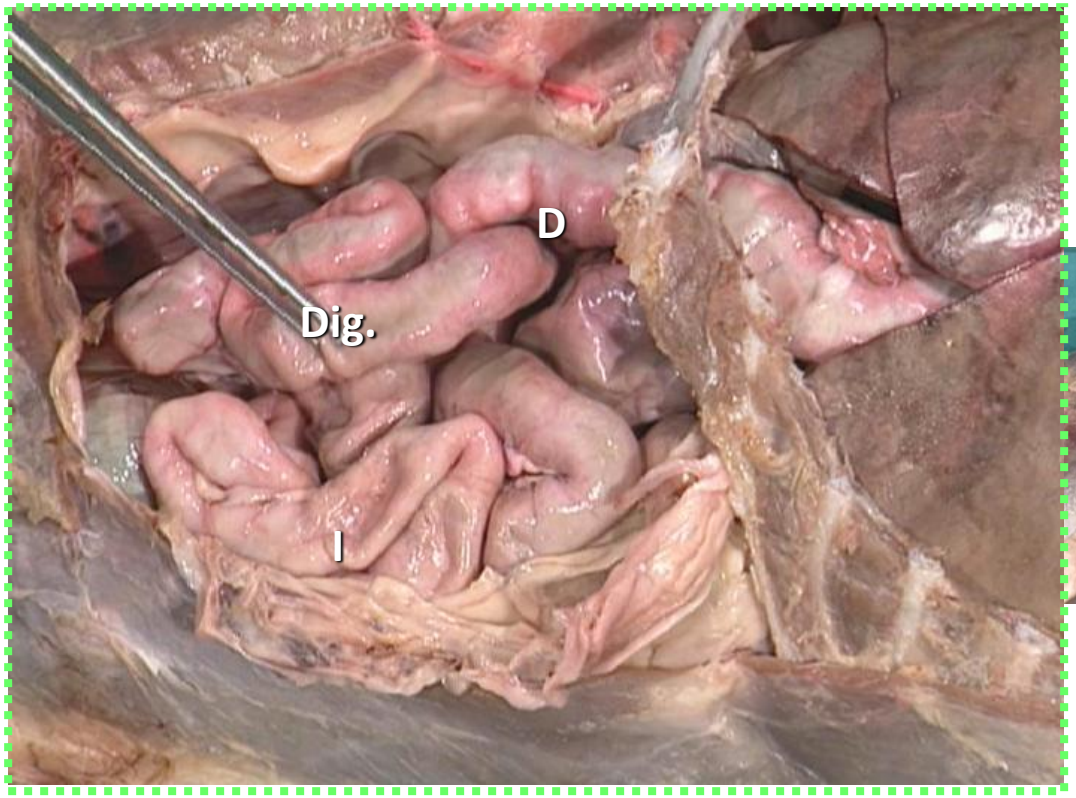
The **small intestine** follows the stomach in **monogastric animals**, or the **abomasum** in **ruminants**, at the level of the pylorus. It ends at the **ileocecal junction**, where it continues into the **large intestine**.

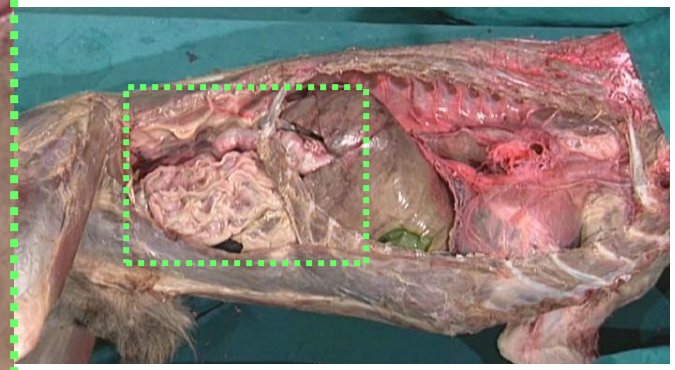


DIGESTIVE SYSTEM
SMALL INTESTINE

*The **small intestine** is conventionally divided into three sections:*

- ***Duodenum***
- ***Jejunum***
- ***Ileum***



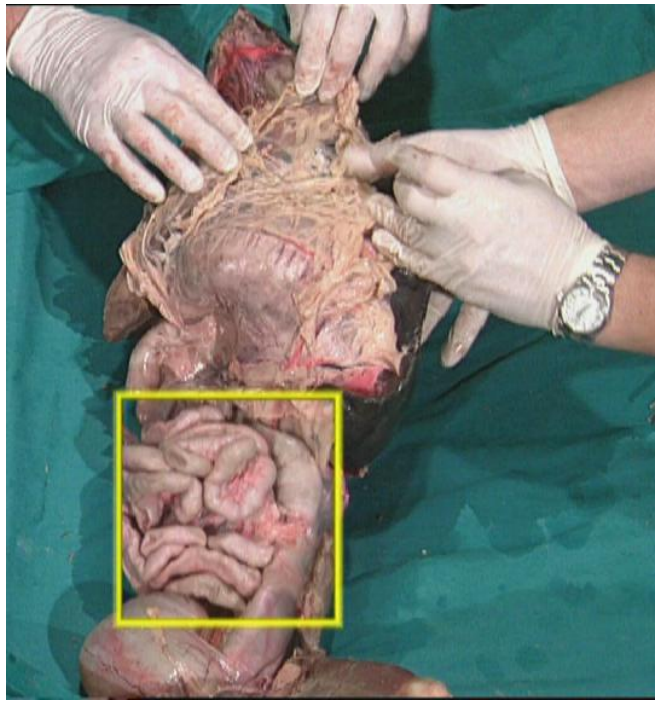


***Digiuno** ed **ileo,** poiché provvisti di un lungo meso, sono assai mobili.*

DIGESTIVE SYSTEM

JEJUNUM AND ILEUM

Jejunum *is very long and its bends do not have a constant topography, being very mobile.*

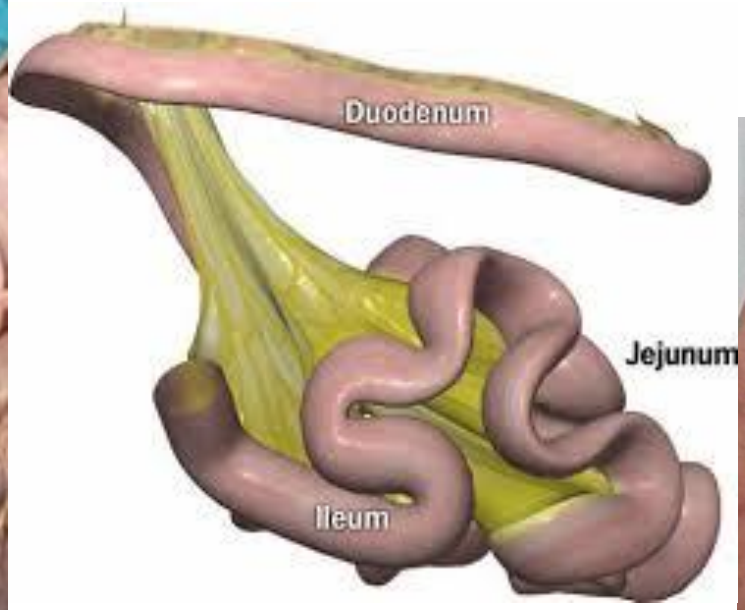


The ***ileum*** *is short and opens into the* ***cecum*** *at the level of* ***the ileal papilla****.*

DIGESTIVE SYSTEM

JEJUNUM AND ILEUM IN HORSE

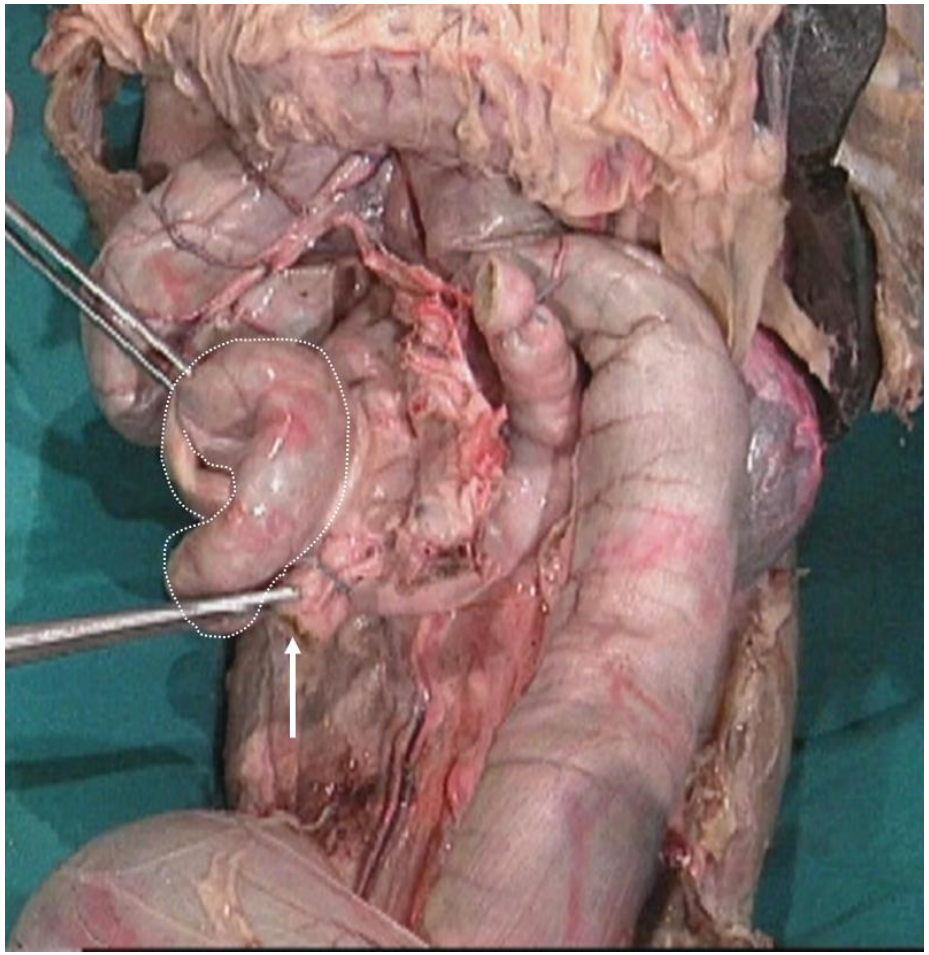
Ansae digiunales and mesentery.



*The **ileum**, the **cecum**, and the **ileocecal junction**.*

DIGESTIVE SYSTEM

ILEOCECAL JUNCTION IN DOGS



*The **ileum**, the **cecum**, and the **ileocecal junction**.*

DIGESTIVE SYSTEM

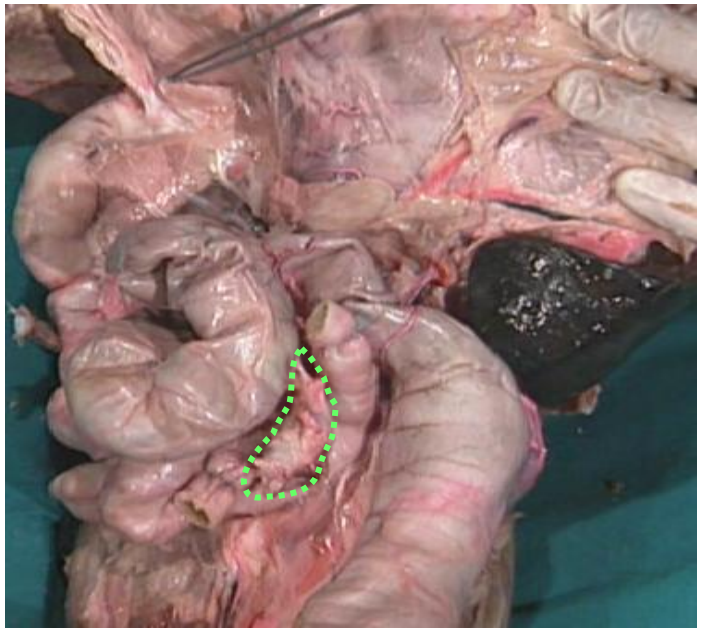
JEJUNUM, ILEUM, AND MESENTERY

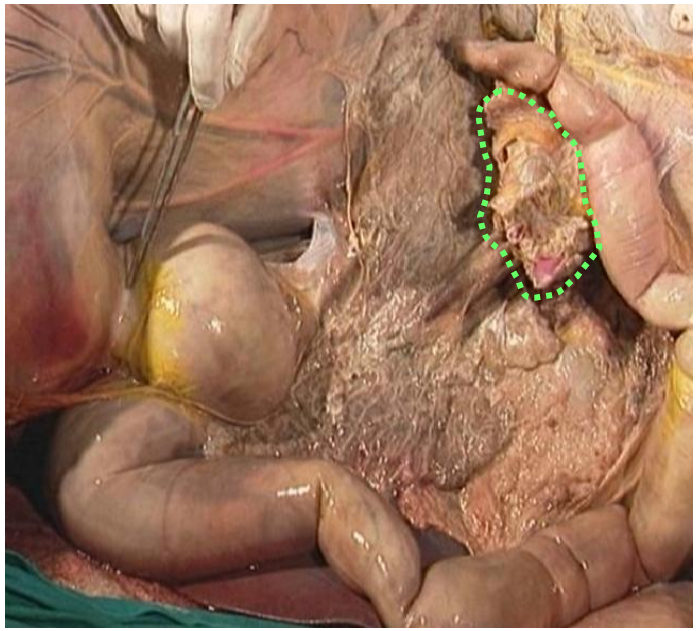
The **mesentery** (a fold of the peritoneum that extends from the viscera to the sublumbar region) suspends the **jejunum** and the **ileum** from the sublumbar region.

From the intestinal margin of the viscera, it converges in a fan-like manner into a single root: the **mesenteric root**.

DIGESTIVE SYSTEM
MESENTERIC ROOT

The mesenteric root, where the mesentery converges in a fan-shaped manner, extends from the left kidney to the right iliac region.

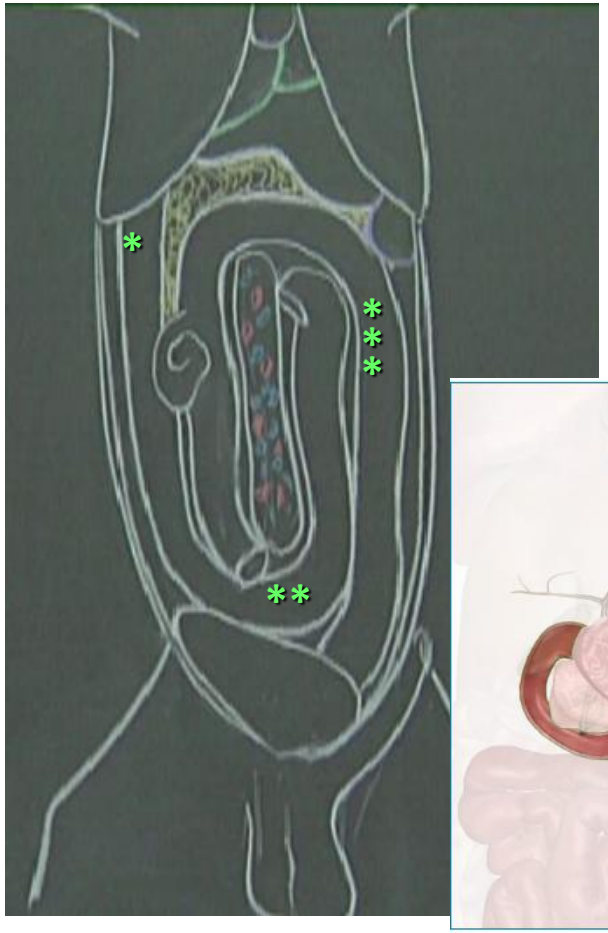




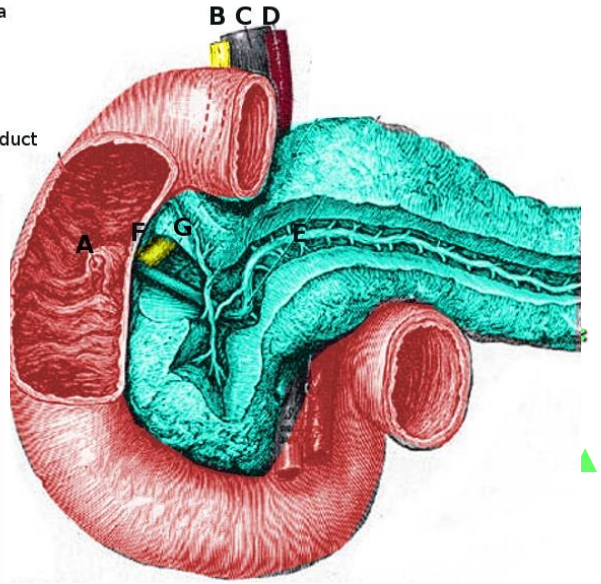
It contains the **cranial mesenteric artery**, its collateral branches, **venous vessels**, **lymphatic vessels**, **nerves**, and **lymph nodes**.

DIGESTIVE SYSTEM
DUODENUM AND MESENTERIC ROOT

The **DUODENUM** is a fixed portion due to the limited development of the mesentery, which anchors it to the **right lumbar wall**..



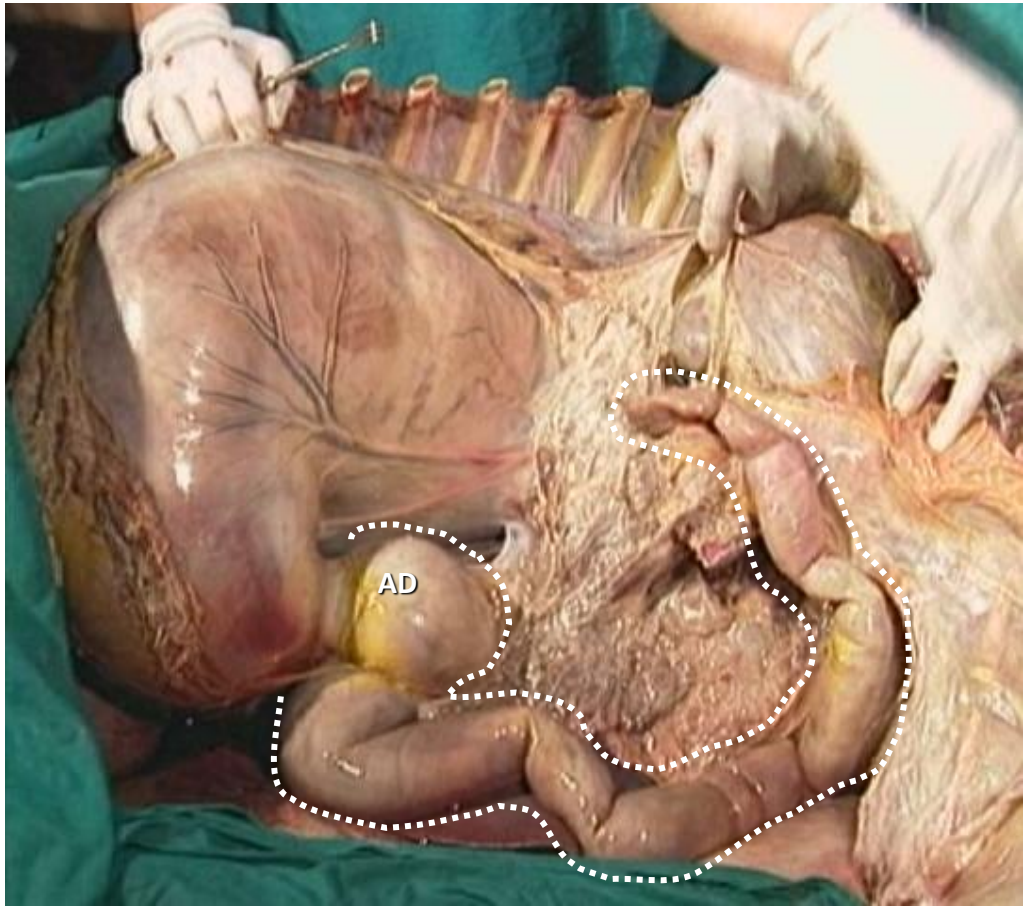
A- Major duodenal papilla
B- CBD
C- Portal vein
D- Hepatic artery
E- Pancreatic duct
F: CBD
G- Accessory pancreatic duct



It maintains a **constant topographic relationship** with the **mesenteric root**.

DIGESTIVE SYSTEM

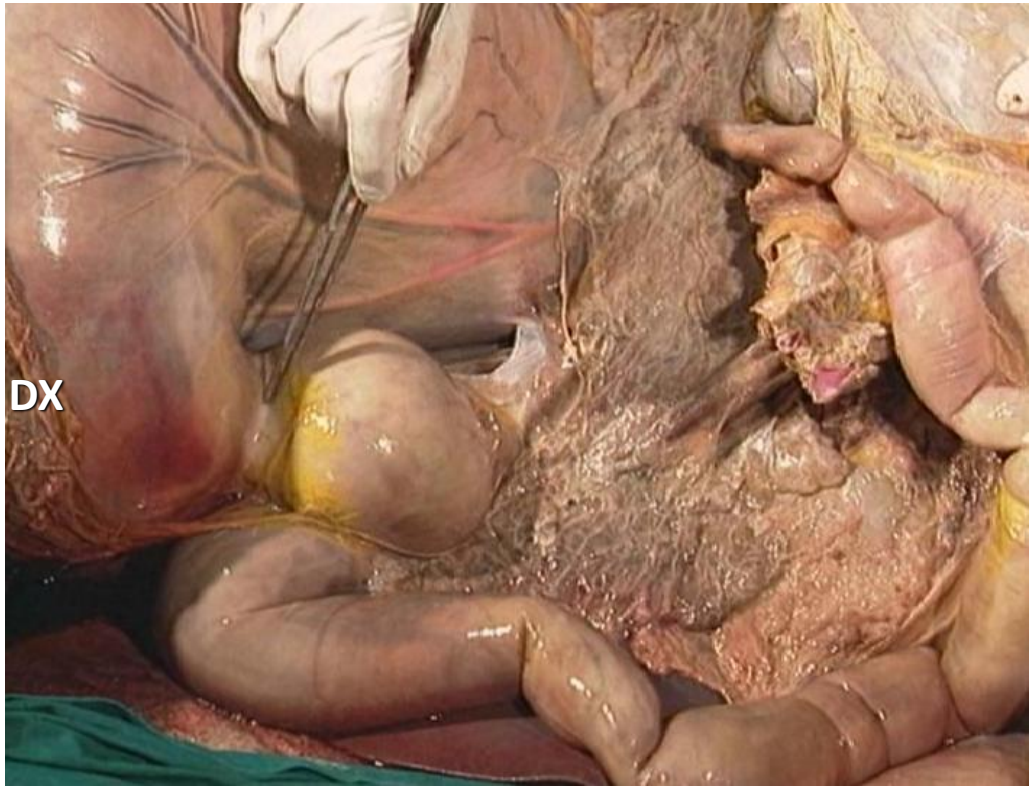
SMALL INTESTINE: DUODENUM



The **duodenum** originates slightly to the right of the sagittal plane, continuing from the **pylorus** with the **duodenal ampulla (AD)**.

DIGESTIVE SYSTEM
DESCENDING DUODENUM

Following the **duodenal ampulla**, the **descending duodenum** proceeds toward the right and caudally**..**



It reaches the lateral abdominal wall and, at the level of the **3rd lumbar vertebra**, bends into the **caudal curvature**.

DIGESTIVE SYSTEM
TRANSVERSE DUODENUM

From the **caudal curvature** begins the third portion of the duodenum: the **transverse duodenum**, which runs contralaterally, skirting caudally along the **mesenteric root**.

.

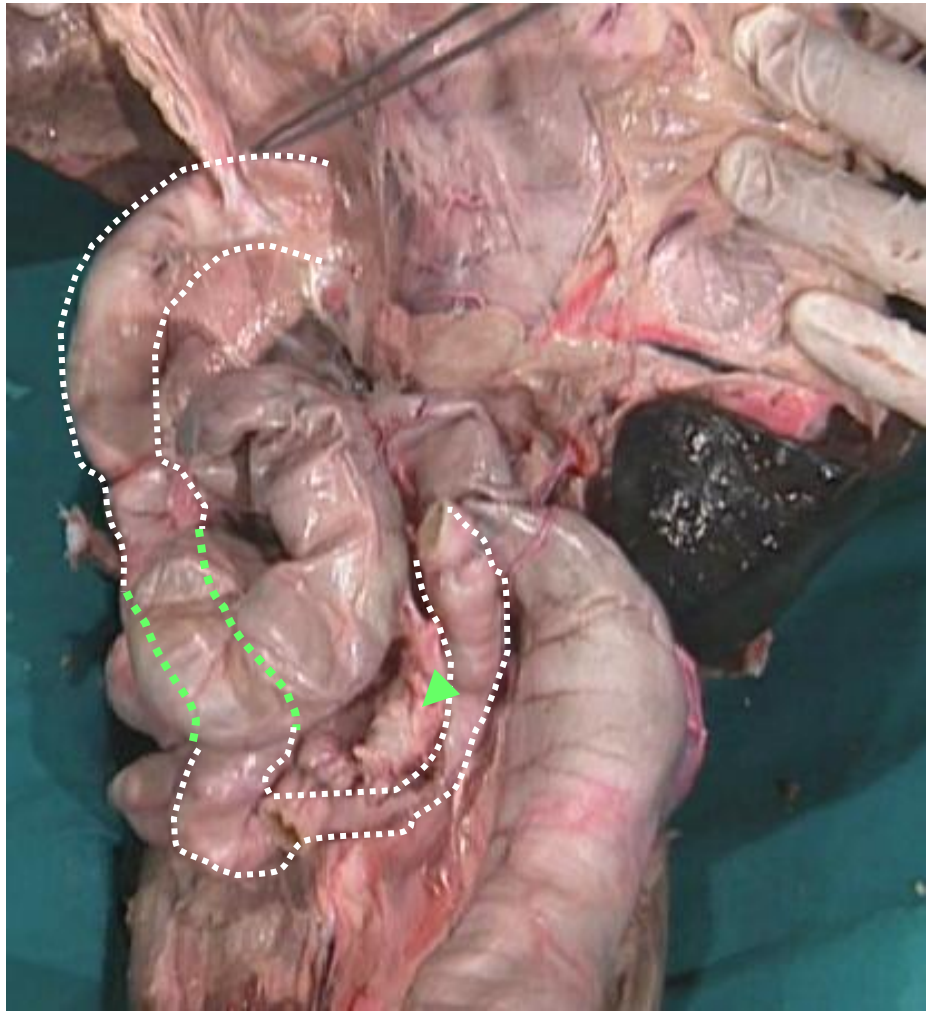
DIGESTIVE SYSTEM
ASCENDING DUODENUM

On the sagittal plane, the **transverse duodenum** bends sharply and, ascending upward, forms the **fourth part of the duodenum**: the **ascending duodenum**.

DIGESTIVE SYSTEM

ASCENDING DUODENUM

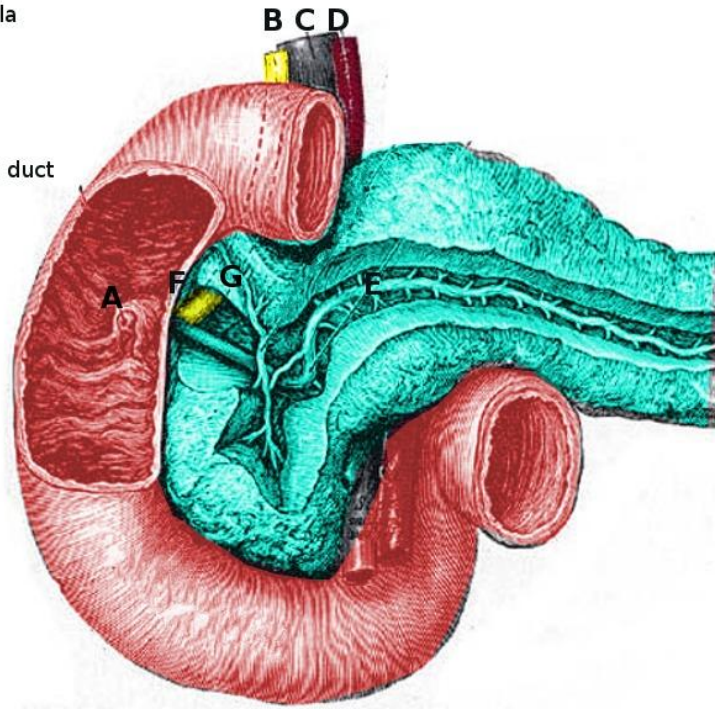
The **ascending duodenum** adheres to the lateral surface of the **mesenteric root** ▲ and continues into the **duodenojejunal flexure.**

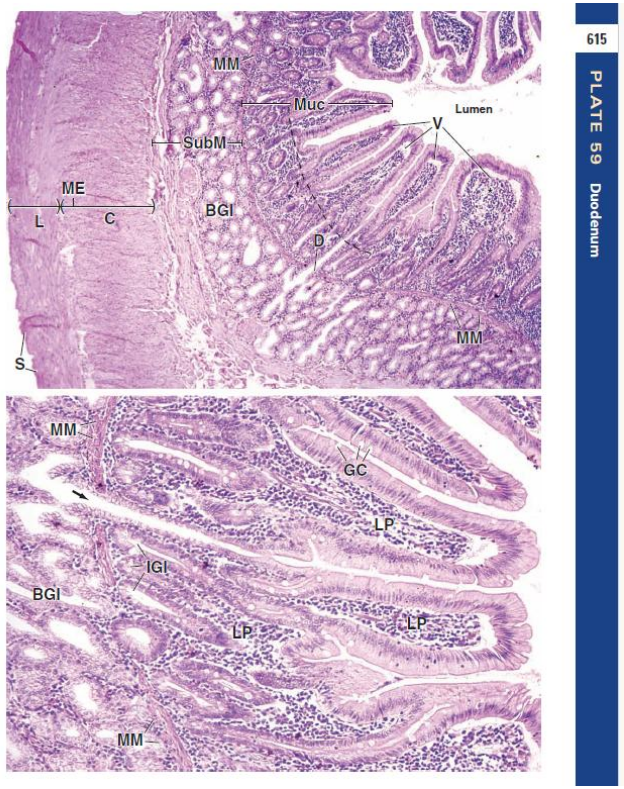


DIGESTIVE SYSTEM
DUODENUM

From: Anatomy, Abdomen and Pelvis: Duodenum

A- Major duodenal papilla
B- CBD
C- Portal vein
D- Hepatic artery
E- Pancreatic duct
F: CBD
G- Accessory pancreatic duct



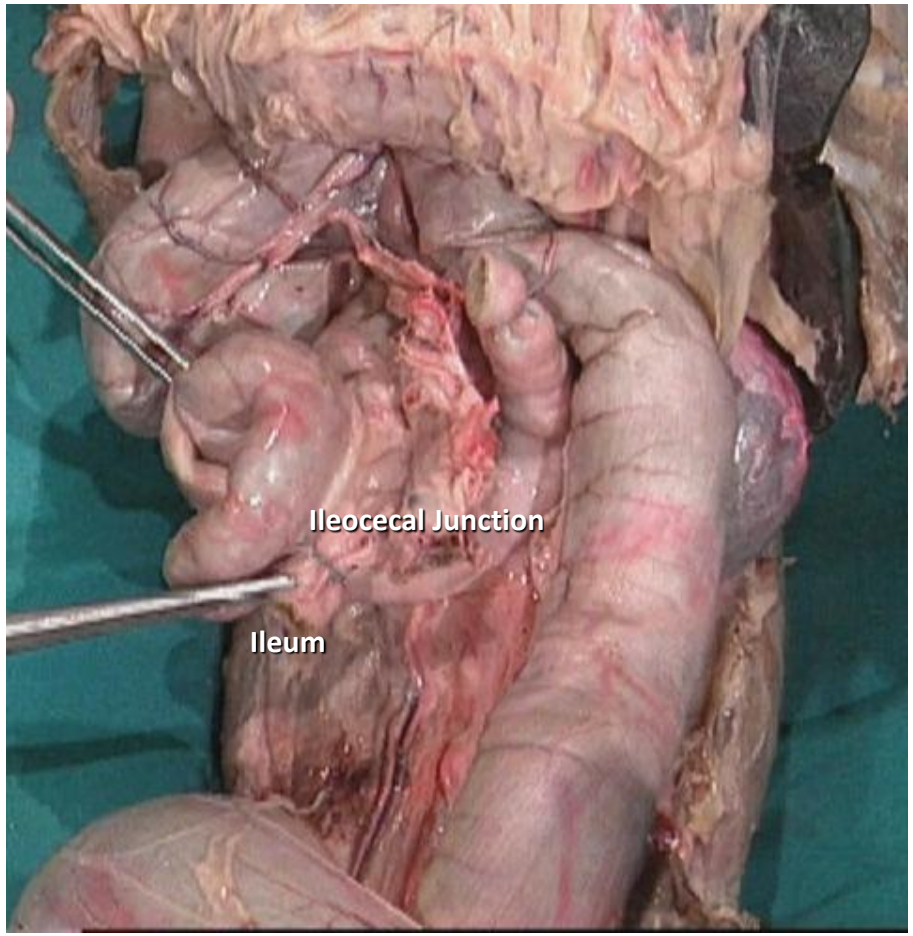


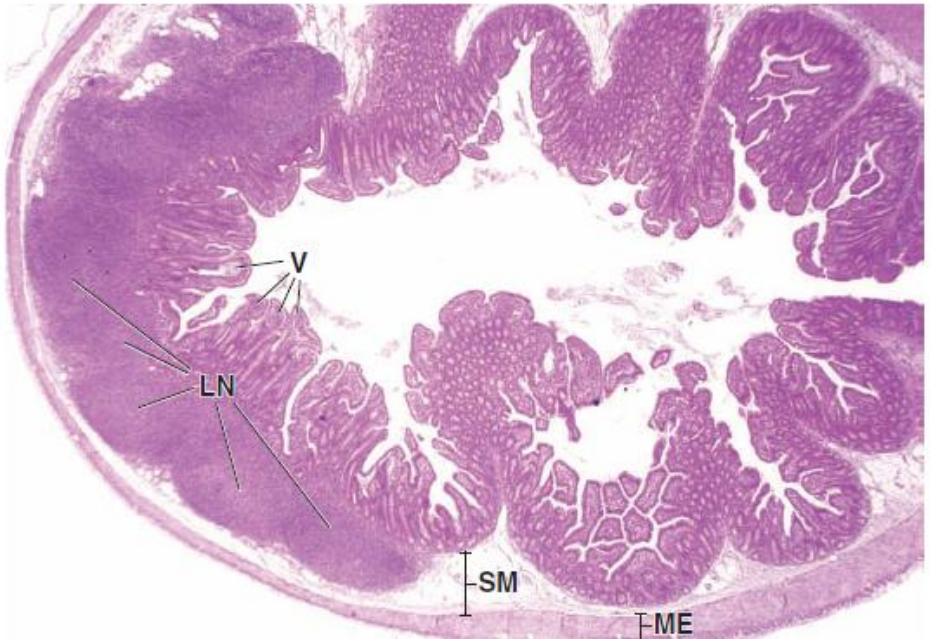
The small intestine is characterized by **plicae circulares**, permanent transverse folds that contain a core of submucosa, and **villi**, finger-like and leaf-like projections of the mucosa that extend into the lumen.

DIGESTIVE SYSTEM

ILEUM

The **ileum**, the terminal portion of the small intestine, ends by merging into the **large intestine** at the base of the **cecum**, through an **ileal orifice**, which appears internally as an **ileal papilla**.





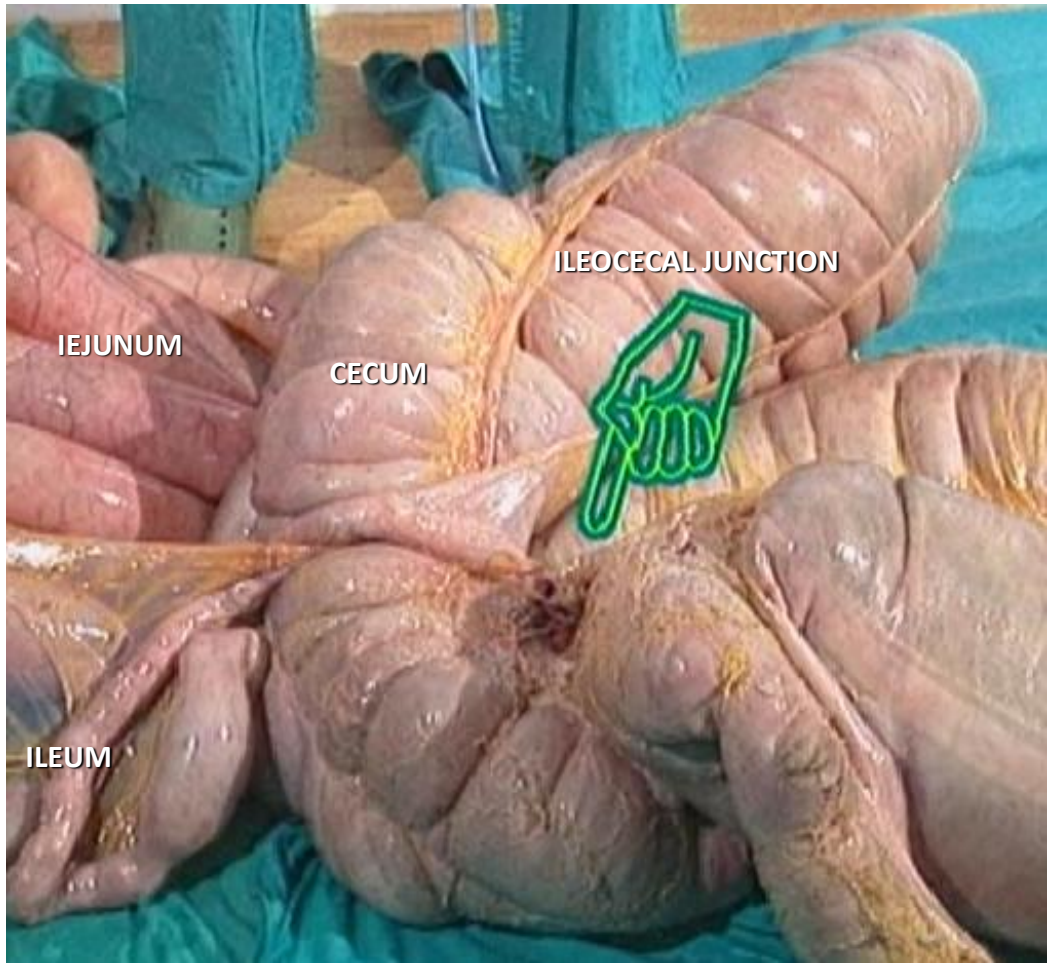
619

PLATE 61 Ileum

Ileum, monkey, H&E 20.

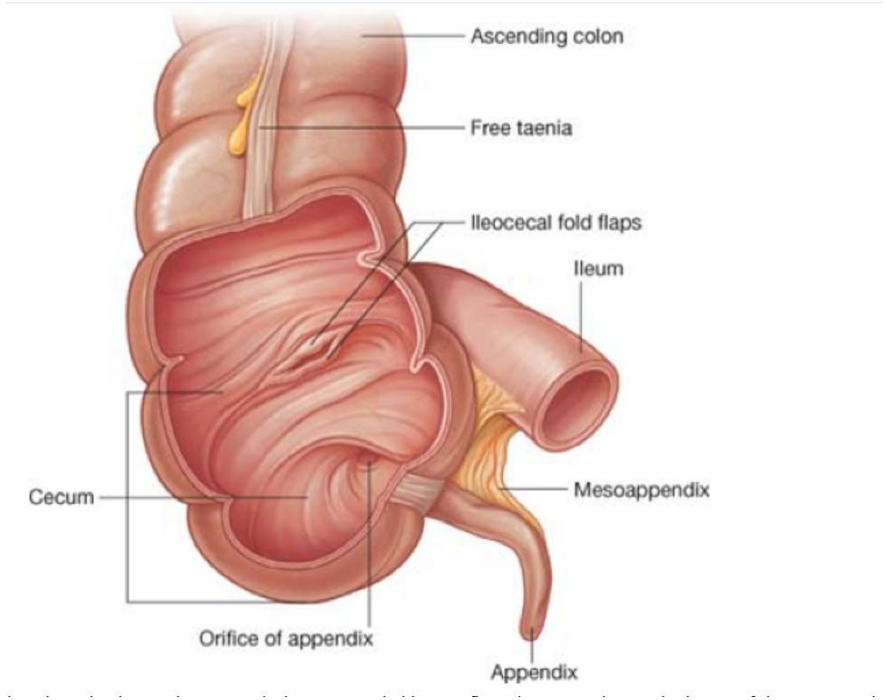
DIGESTIVE SYSTEM

ILEOCECAL JUNCTION



HORSE

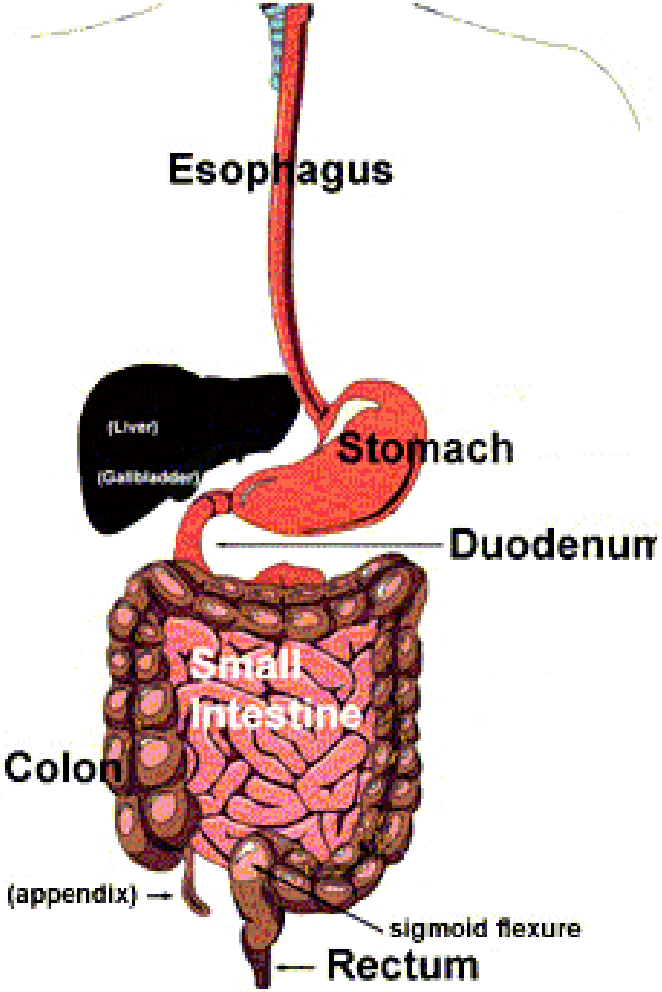
The ileocecal junction is the site where the terminal ileum opens into the cecum in the right iliac fossa. It is characterized by the ileocecal valve, which controls intestinal transit and prevents backflow from the colon.

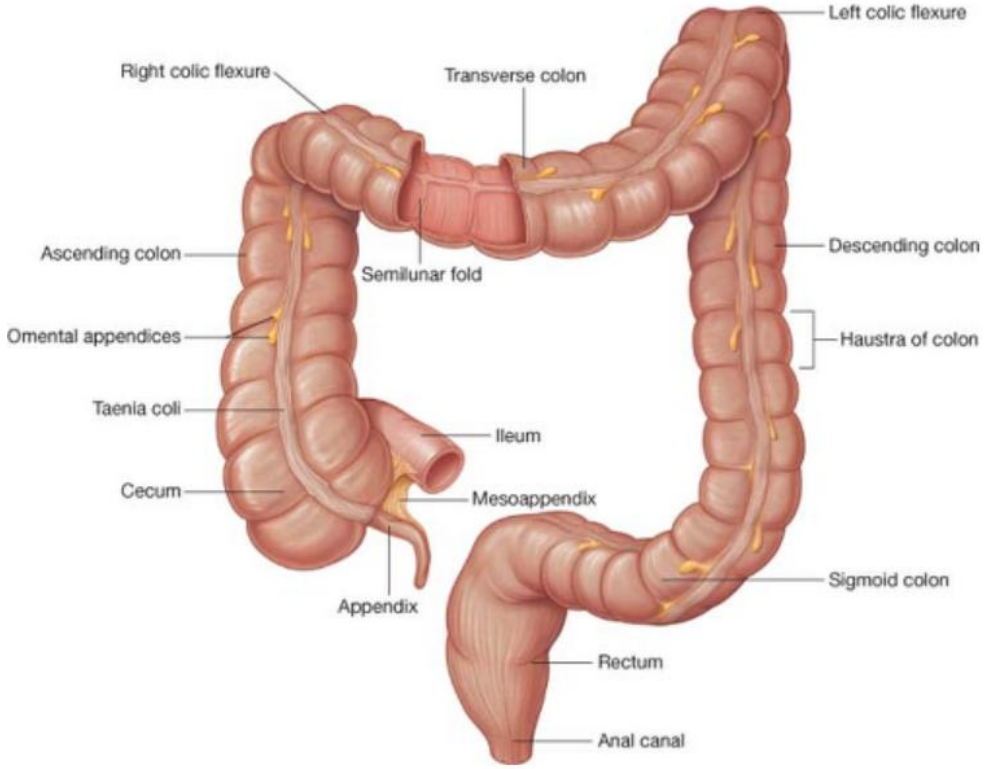


(From Drake RL, Vogl W, Mitchell AWM, et al. *Gray's Atlas of Anatomy*. Philadelphia: Churchill Livingstone (Elsevier); 2008.)

DIGESTIVE SYSTEM
LARGE INTESTINE

The segment of the digestive tract that follows the small intestine has a larger diameter and is therefore called the **large intestine** or **colon**..





It is composed **of three parts**, developed to varying degrees depending on the species:

the **cecum**, the **colon**, and the **rectum**, which is followed by the **anal canal**, opening to the exterior through the **anus**.

Fig. 1. The components of the large intestine, which consists of the cecum, the appendix, and the ascending, transverse, descending, and sigmoid colons, the rectum and the anal canal. (From Drake RL, Vogl W, Mitchell AWM, et al. *Gray's Atlas of Anatomy*. Philadelphia: Churchill Livingstone (Elsevier); 2008.)

DIGESTIVE SYSTEM

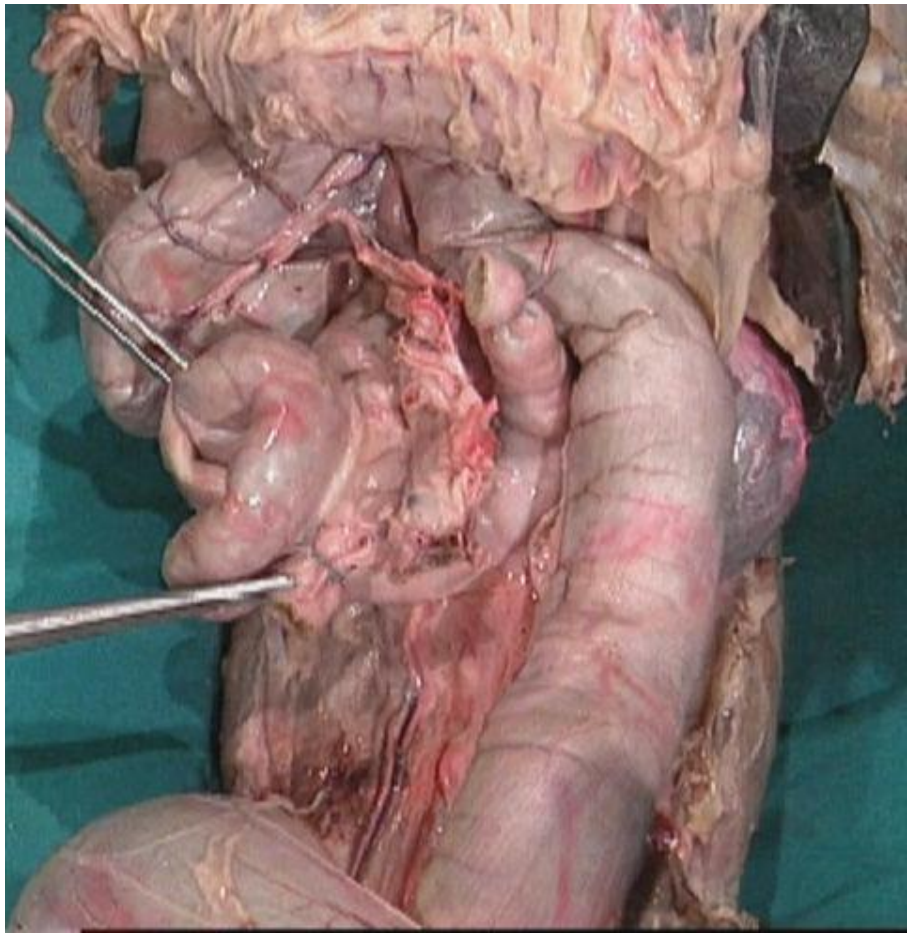
LARGE INTESTINE: CECUM OF THE HORSE

In the horse, the **cecum** is an elongated, comma-shaped sac composed of a **base**, a **body**, and an **apex**.

It has **three taeniae** that contribute to the formation of the characteristic **haustra (sacculations)**..

DIGESTIVE SYSTEM

LARGE INTESTINE: CECUM OF CARNIVORES



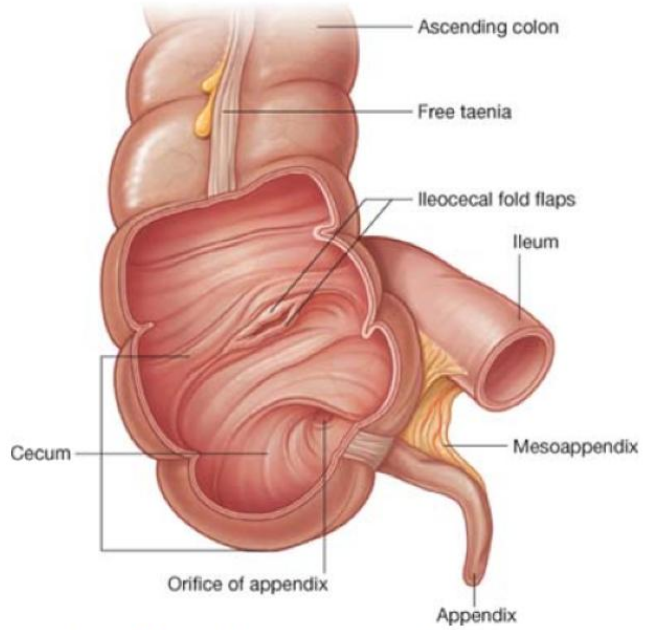
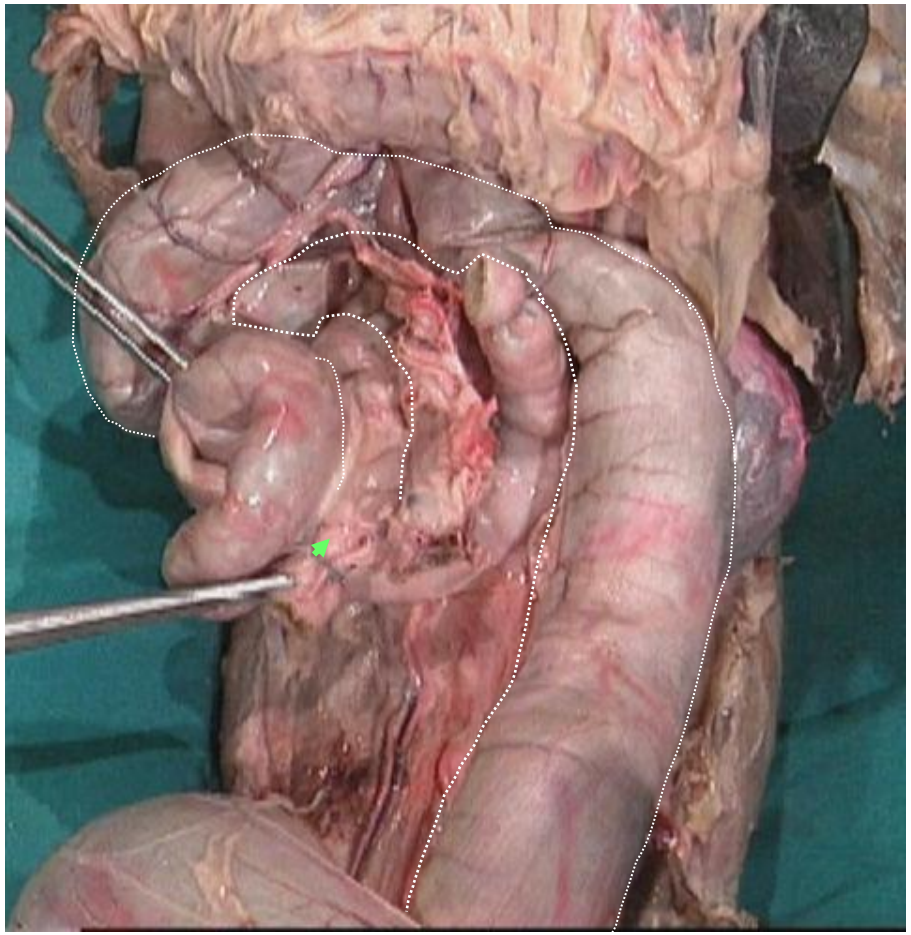


Fig. 2. The cecum is opened to show the ileocecal ostium, which is surrounded by two flaps that protrude into the lumen of the cecum and form the ileocecal valve. (From Drake RL, Vogl W, Mitchell AWM, et al. *Gray's Atlas of Anatomy*. Philadelphia: Churchill Livingstone (Elsevier); 2008.)

In **carnivores**, the **cecum** is reduced to a comma-shaped structure that makes **one and a half turns on itself**.

DIGESTIVE SYSTEM
LARGE INTESTINE: COLON

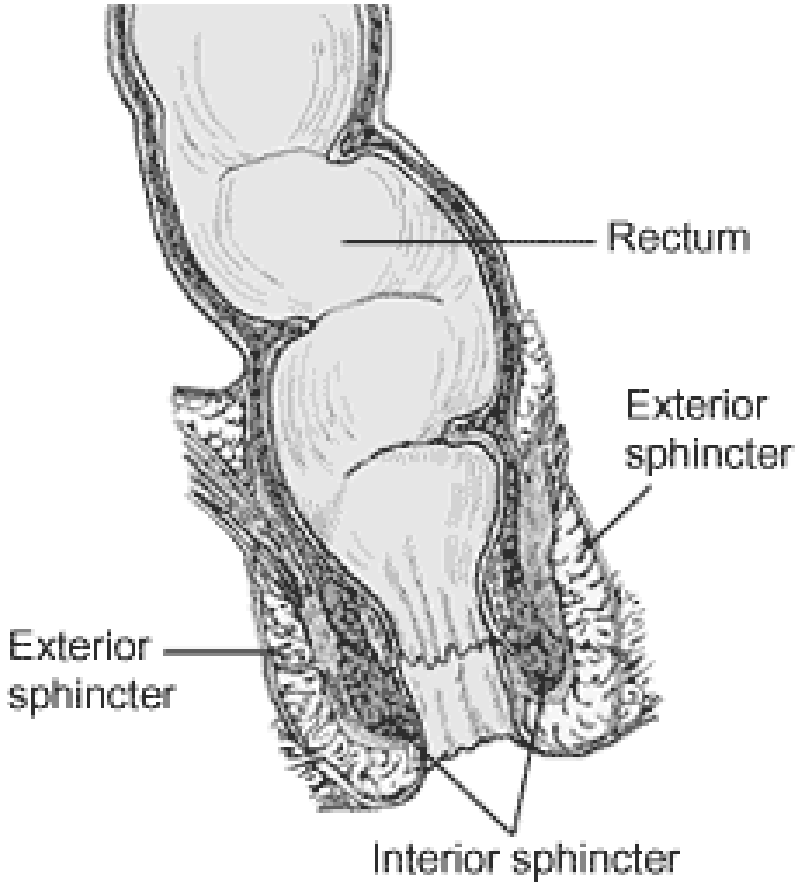
The **colon** begins at the level of the **ceco-colic orifice** and continues into the **rectum**.



DIGESTIVE SYSTEM

LARGE INTESTINE: RECTUM AND RECTAL AMPULLA

The **rectum** increases in diameter and, at the level of the **second–third coccygeal vertebra**, forms a dilation known as the **rectal ampulla**..



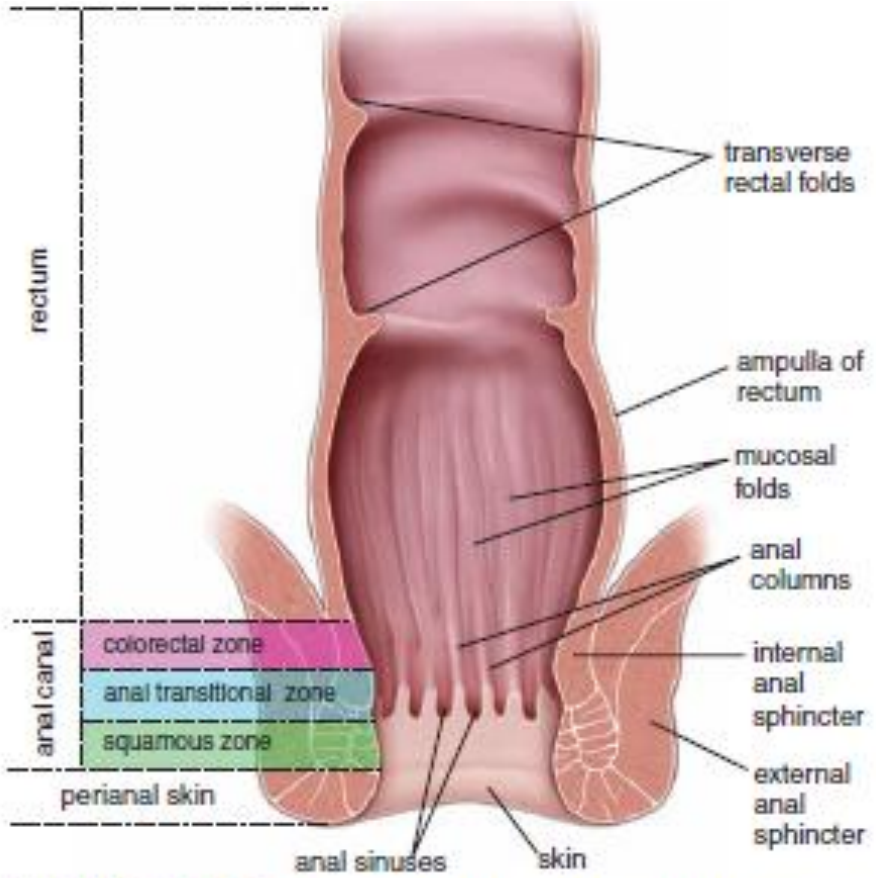
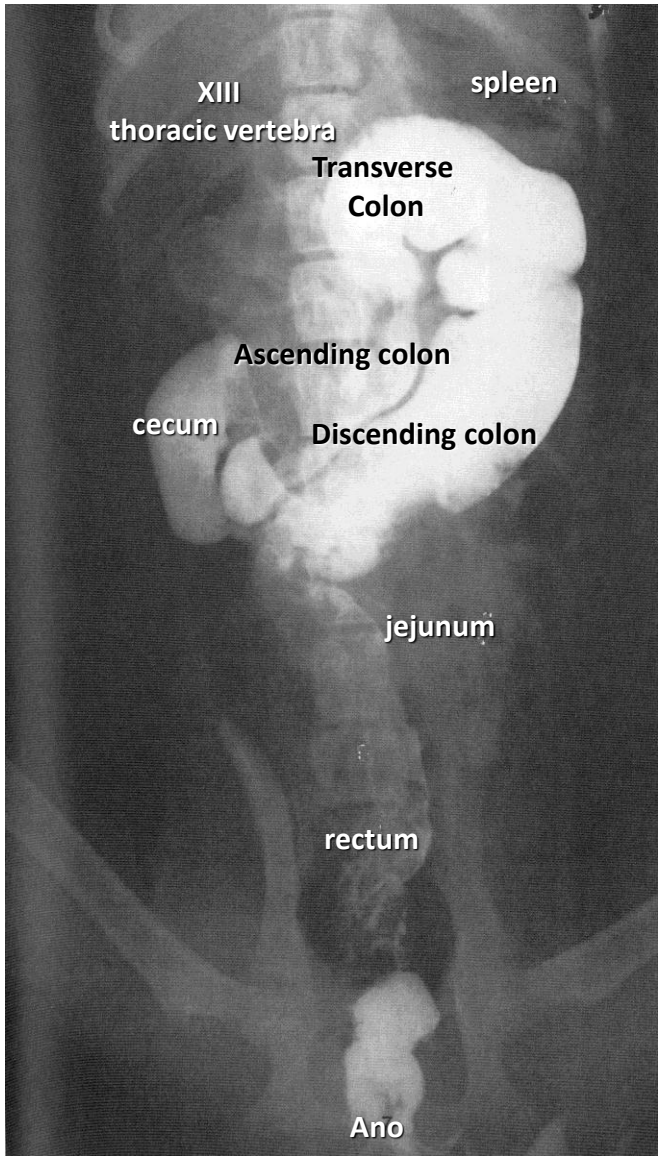


FIGURE 17.31 ▲ **Drawing of the rectum and anal canal.** The

DIGESTIVE SYSTEM

ANUS

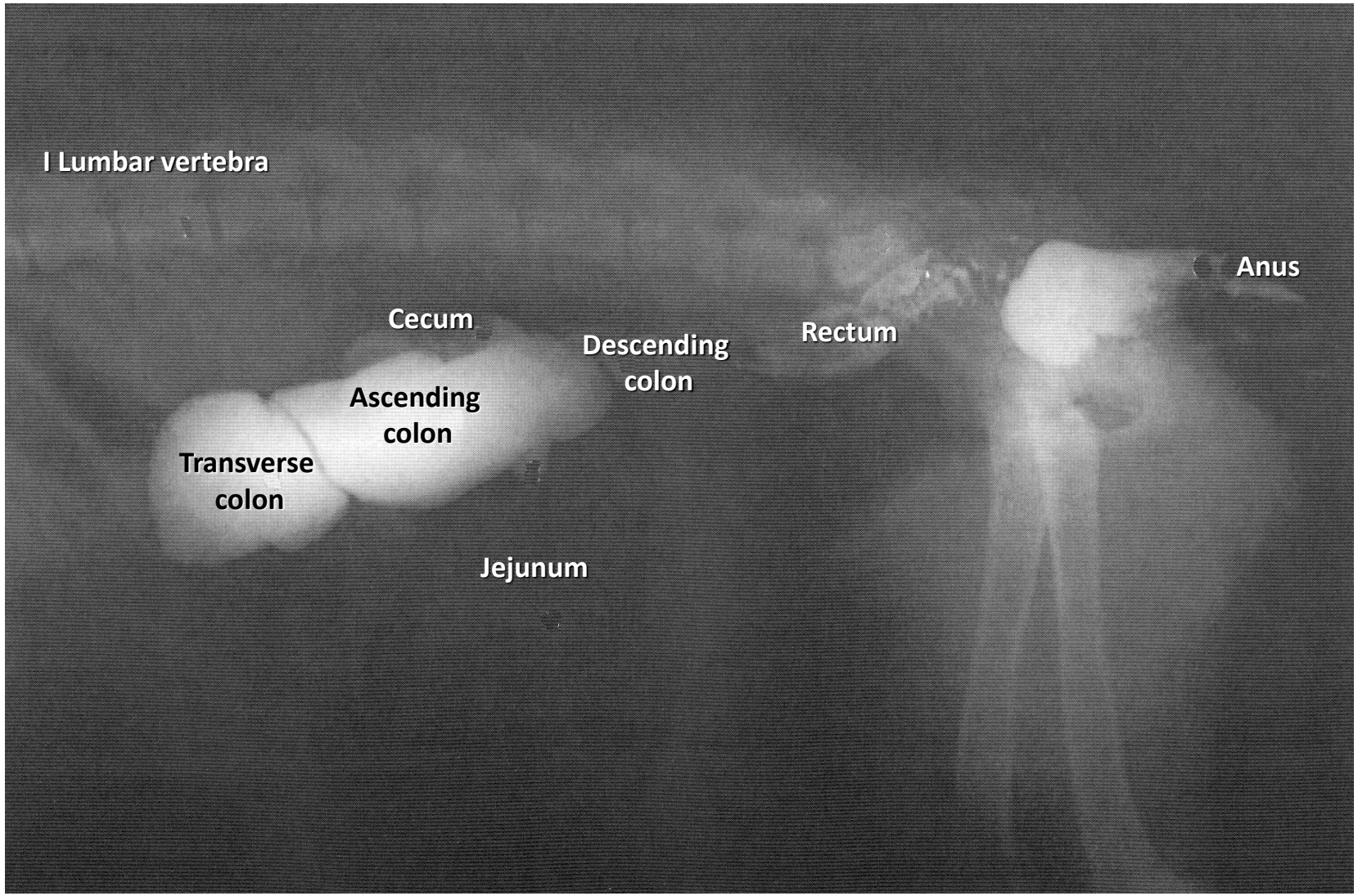
It appears as a **rounded protrusion** located **ventral to the tail** and is **covered by pigmented skin**.



Abdominal X-ray of a dog: ventral-dorsal projection

DIGESTIVE SYSTEM

LARGE INTESTINE: RECTUM AND RECTAL AMPULLA



Abdominal X-ray of a dog: lateral-lateral projection

https://www.innerbody.com/image/digeov.html