



Gastrointestinal Tract (GIT)

The gastrointestinal tract (GIT), also known as the digestive tract or alimentary canal, is a continuous muscular tube approximately **30 feet (9 meters)** long that extends from the **M**outh to the **A**nus. It is the primary pathway for the **I**ngestion of food, **N**utrient **A**bsorption, and the **E**xcretion(**E**limination) of waste.

It consists of **two main parts**:

1. Major Organs of the GIT

The tract is clinically divided into the upper and lower GIT at the **suspensory muscle of the duodenum**.

☞ Upper GIT:

- ✓ **Mouth:** Where mechanical digestion (chewing) and initial chemical breakdown of starches begin.
- ✓ **Pharynx & Esophagus:** Passageways that transport food to the stomach via peristalsis (rhythmic muscle contractions).
- ✓ **Stomach:** A J-shaped organ that churns food with gastric juices (hydrochloric acid and enzymes like pepsin) to create a semi-liquid called **chyme**.

☞ Lower GIT:

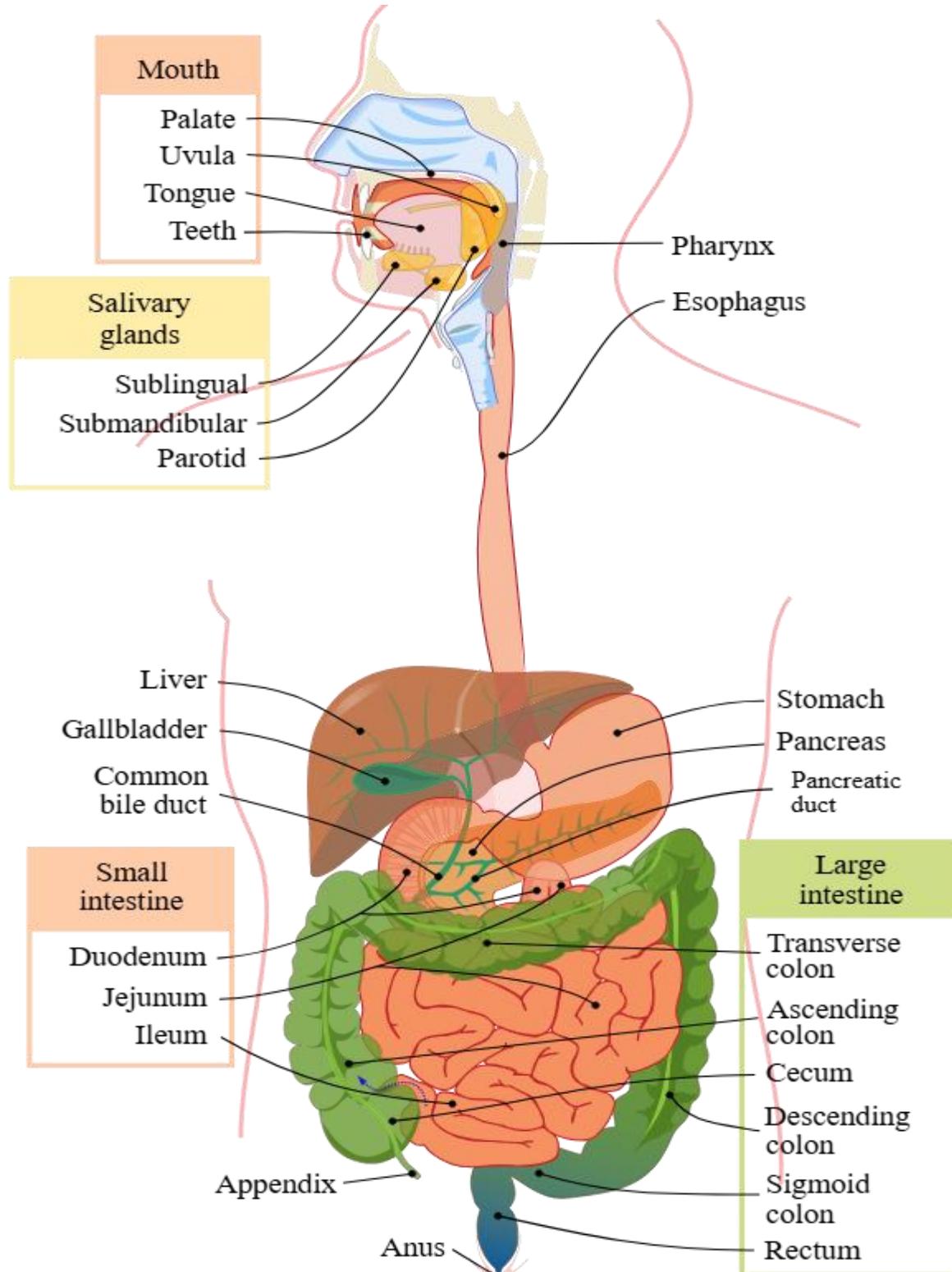
- ✓ **Small Intestine:** Composed of the **duodenum, jejunum, and ileum**. It is the primary site for chemical digestion and nutrient absorption.



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- ✓ **Large Intestine (Colon):** Includes the cecum, appendix, colon (ascending, transverse, descending, sigmoid), and rectum. It primarily absorbs water and electrolytes to solidify waste into feces.
- ✓ **Anus:** The final opening where waste is expelled.





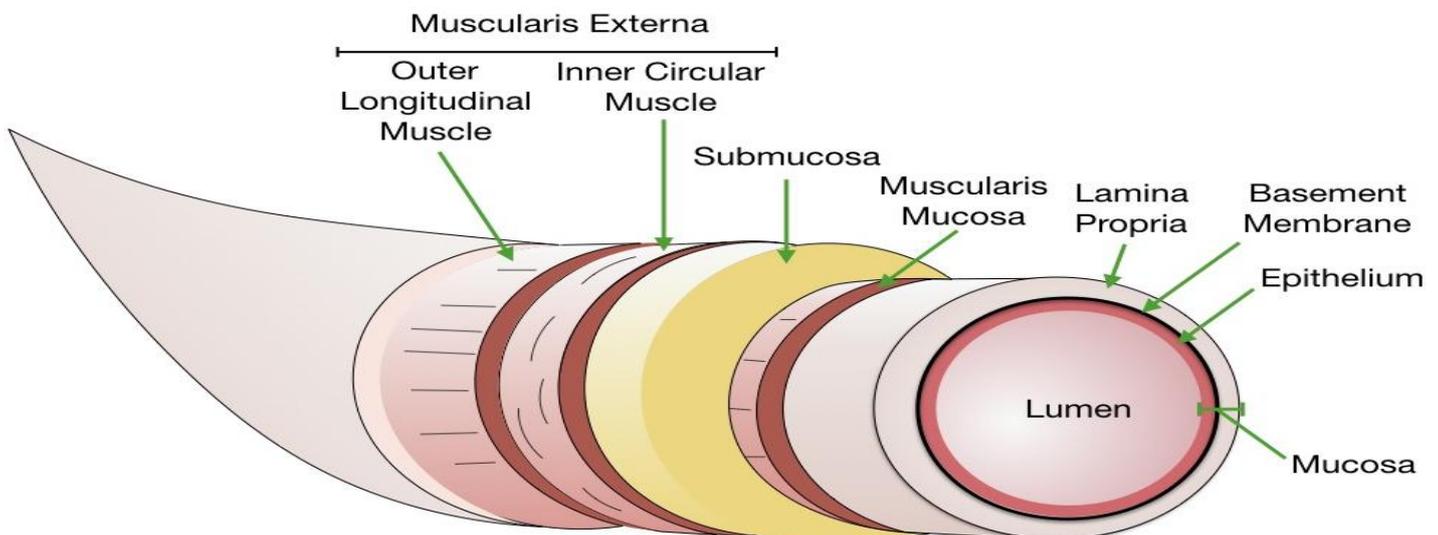
2. Regulation and Accessory Organs

- ✓ **Accessory Organs:** The liver, **gallbladder**, and **pancreas** are not part of the hollow tube but provide essential enzymes and bile for digestion.
- ✓ **Enteric Nervous System (ENS):** Often called the "second brain," the ENS allows the GIT to function independently of the central nervous system to coordinate local reflexes.
- ✓ **Hormonal Control:** Key hormones like **gastrin**, **secretin**, and **cholecystokinin (CCK)** regulate the release of digestive juices and stomach emptying.

3. Histological Layers (Wall Structure)

The GIT wall is composed of four concentric layers that are consistent throughout the tract:

1. **Mucosa:** The innermost lining specialized for secretion and absorption.
2. **Submucosa:** Contains blood vessels, lymphatics, and the **submucosal (Meissner) plexus**.
3. **Muscularis Externa:** Two layers of smooth muscle (inner circular and outer longitudinal) that control motility. The **myenteric (Auerbach) plexus** lies between these layers to regulate peristalsis.
4. **Serosa/Adventitia:** The outermost protective layer.





1- Anatomy of the Oral Cavity

The oral cavity, also known as the mouth, is the first part of the gastrointestinal tract. It is the place where food enters the body. The oral cavity plays an important role in **ingestion of food, chewing (mastication), tasting, and starting the process of digestion.**

Parts of the Oral Cavity: The oral cavity is divided into **two main parts:**

1. Vestibule

The vestibule is the **space between the lips and cheeks on the outside and the teeth and gums on the inside.** This space allows food to be held in the mouth during chewing. The **parotid salivary gland duct** opens into the vestibule and releases saliva, which helps in moistening food and starting digestion.

2. Oral Cavity Proper

The oral cavity proper is the **space inside the teeth and gums.** It is the main area where food is chewed and mixed with saliva. Posteriorly, it opens into the **oropharynx**, which leads food toward the pharynx during swallowing.

Boundaries of the Oral Cavity

The oral cavity has clear anatomical boundaries:

- ☞ **The roof** of the oral cavity is formed by the **hard palate in the front** and the **soft palate at the back.** The hard palate is made of the maxilla and palatine bones and separates the mouth from the nasal cavity. The soft palate is muscular and ends in the **uvula.** During swallowing, the soft palate moves upward to prevent food from entering the nasopharynx.
- ☞ **The floor** of the oral cavity is muscular and is mainly formed by the **mylohyoid muscle.** It supports the **tongue** and contains the openings of the **submandibular and sublingual salivary glands**, which secrete saliva into the mouth.
- ☞ **The anterior boundary** is formed by the **lips**, which allow food to enter the mouth and help in speech.



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- ☞ **The lateral walls** are formed by the **cheeks**, which contain the **buccinator muscle**. This muscle helps keep food between the teeth during chewing.
- ☞ **The posterior boundary** is the **oropharynx**, and the opening between the oral cavity and oropharynx is called the **oropharyngeal isthmus**.

Important Structures in the Oral Cavity

A- The teeth are used for **chewing and breaking down food**. There are four types of teeth:

- ✓ **I**ncisors for cutting,
- ✓ **C**anines for tearing,
- ✓ **P**remolars and **M**olars for grinding food.

B- The tongue is a strong muscular organ. It helps in **taste, mixing food with saliva, swallowing, and speech**. The surface of the tongue is covered with **papillae**, which contain taste buds.

C- The salivary glands: Parotid, **S**ubmandibular, and **S**ublingual—open into the oral cavity. They produce **saliva**, which moistens food, helps in swallowing, begins chemical digestion, and cleans the mouth.

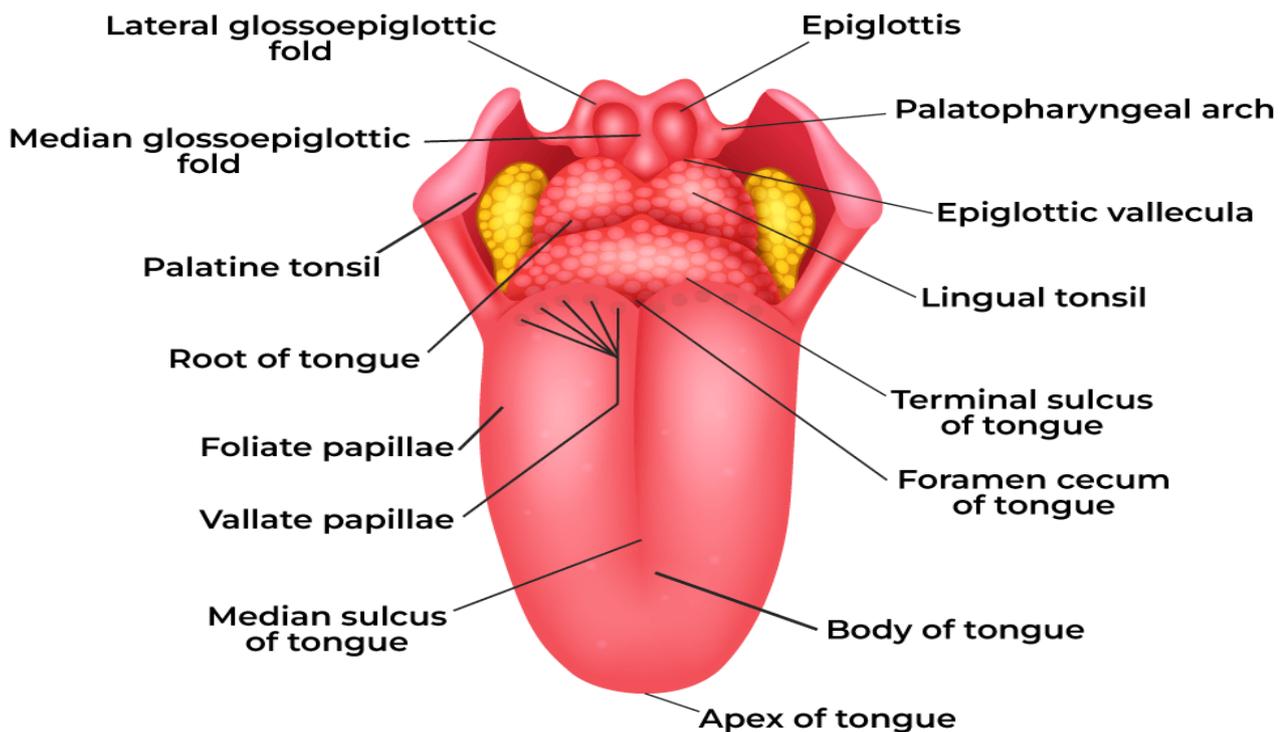
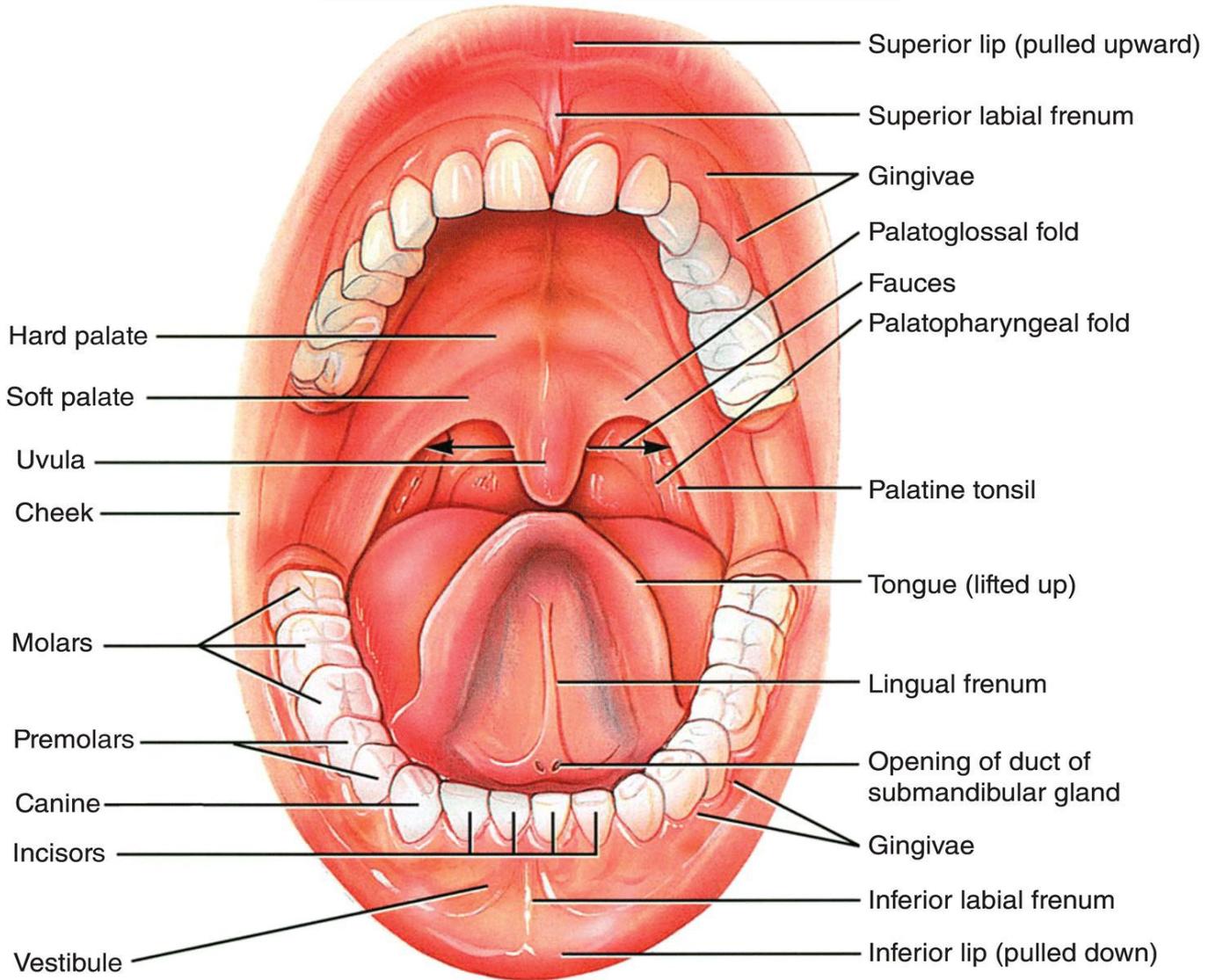
D- The oral mucosa lines the inside of the oral cavity. It is made of **stratified squamous epithelium**, which protects the mouth from mechanical injury during chewing.

E- Lymphoid Tissues: Tonsils

Lymphoid tissues are part of the immune system and play an important role in protecting the body against infections. Tonsils help trap and destroy microorganisms that enter the body through the mouth and nose.



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2-Pharynx and Esophagus

After food is chewed and mixed with saliva in the mouth, it must pass to the stomach. This movement happens through two important structures: the **pharynx** and the **esophagus**.

Pharynx

Is a **muscular tube** located behind the nose, mouth, and larynx. It acts as a **common passage for both air and food**. The pharynx connects the nasal and oral cavities to the larynx and esophagus. It also helps in **swallowing** and contains lymphoid tissue that protects the body from infection. The pharynx is divided into **Three parts**, each with a specific location and function.

☞ Nasopharynx

Is the **upper part of the pharynx**, located behind the nasal cavity. It is used **only for breathing** and does not normally allow food to pass through. The nasopharynx contains the **pharyngeal tonsils (adenoids)**, which help protect against infections. It also has openings of the **auditory (Eustachian) tubes**, which connect the pharynx to the middle ear and help equalize pressure.

☞ Oropharynx

Is the **middle part of the pharynx**, located behind the oral cavity. It extends from the **soft palate to the epiglottis**. This part allows the passage of **both air and food**. The oropharynx contains the **palatine tonsils on both sides** and the **lingual tonsils at the base of the tongue**, which play an important role in immune defense.

☞ Laryngopharynx

Is the **lower part of the pharynx**, located behind the larynx. It extends from the **epiglottis to the esophagus**. During swallowing, this part directs **food and liquids into the esophagus** while air passes into the larynx.

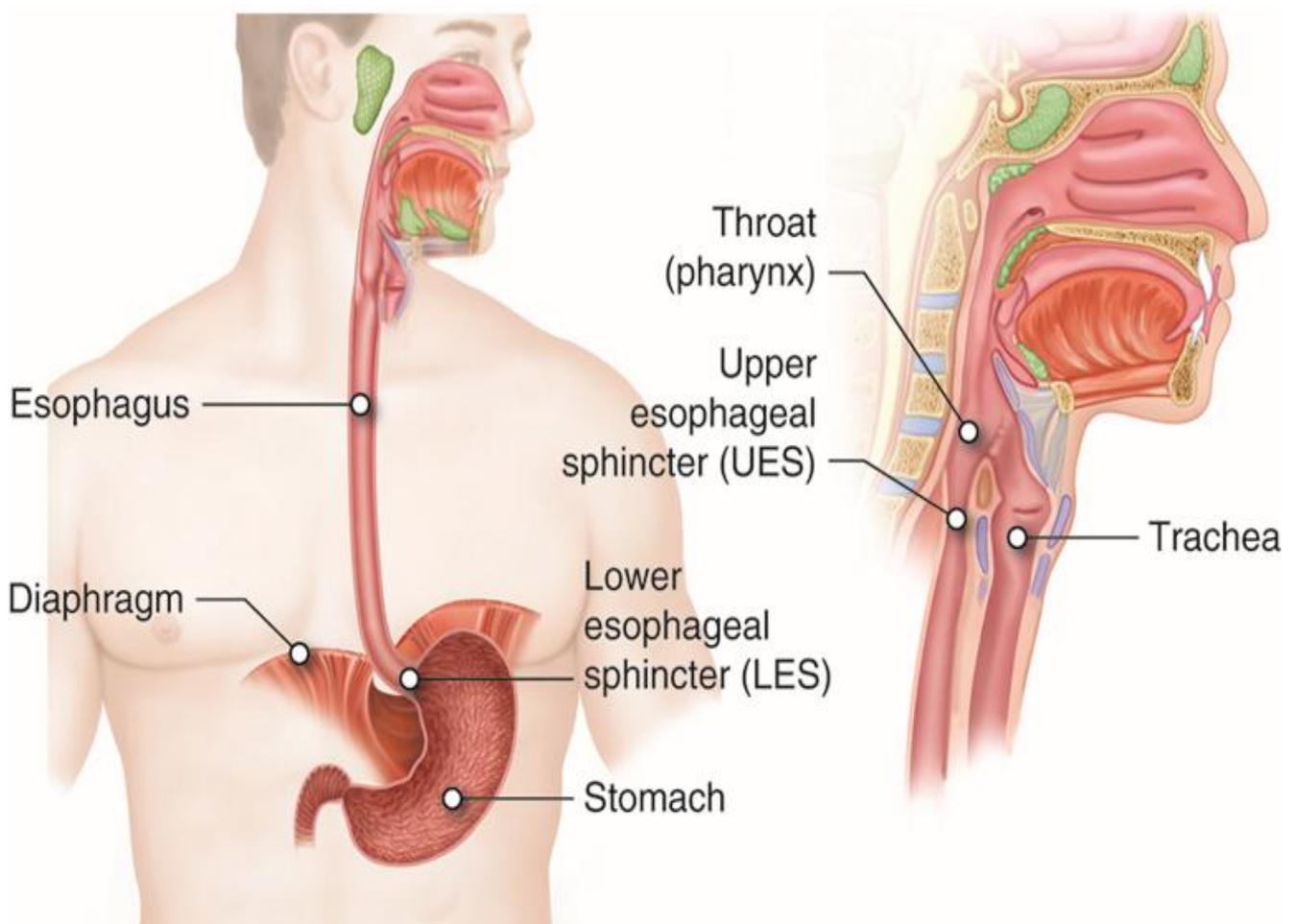


Esophagus:

The **esophagus** is a **muscular tube** (**25–30** cm long in adults) that connects the **laryngopharynx** to the **stomach**. Its main function is to **transport food and liquids** from the mouth to the stomach. *Unlike the stomach or intestines, the esophagus does not participate in digestion; it only moves food along.*

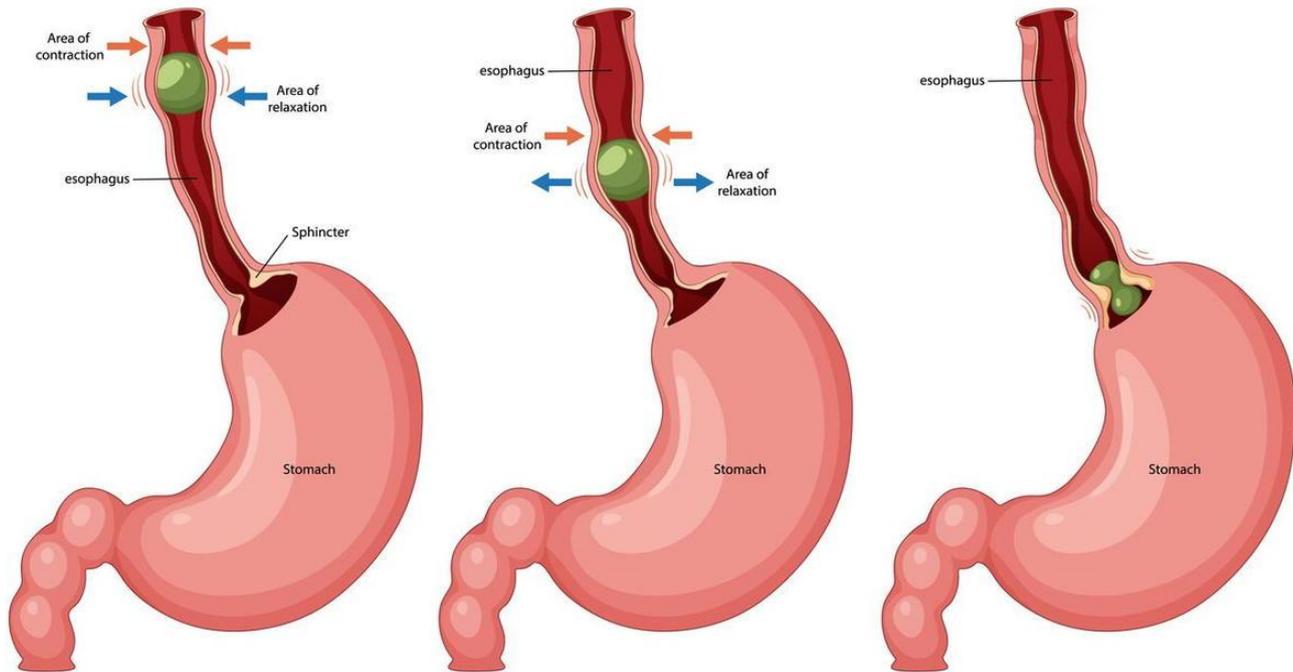
Characteristics of the Esophagus

- ✓ **Muscular Tube:** Composed of **striated and smooth muscles**, which allow **swallowing and peristaltic movement**.
- ✓ **Passageway Only:** It does not secrete digestive enzymes or absorb nutrients.
- ✓ **Peristalsis:** Food is pushed down by **rhythmic muscular contractions**, called **peristalsis**.
- ✓ **Lower Esophageal Sphincter (LES):** The muscular valve at the lower end prevents **stomach acid and food from refluxing** back into the esophagus.
- ✓ **Location:** Lies behind the trachea in the neck and thorax and passes through the **diaphragm** to reach the stomach.





PERISTALSIS



3- Stomach

The stomach is a muscular, J-shaped sac located in the left upper quadrant of the abdomen, just below the diaphragm. It is an important organ of the gastrointestinal tract because it can digest food both mechanically and chemically, transforming it into a semi-liquid mixture called chyme.

Functions of the Stomach

- ✓ **Mechanical digestion:** The muscular walls of the stomach **churn and mix food**, breaking it into smaller particles.
- ✓ **Chemical digestion:** Gastric juices containing **enzymes and hydrochloric acid** help digest proteins and kill bacteria.
- ✓ **Storage:** The stomach temporarily **stores food** and releases it gradually into the small intestine.

Major Regions of the Stomach

The stomach is divided into **four main regions:**

1. **Cardia** – the area surrounding the **opening of the esophagus** into the stomach



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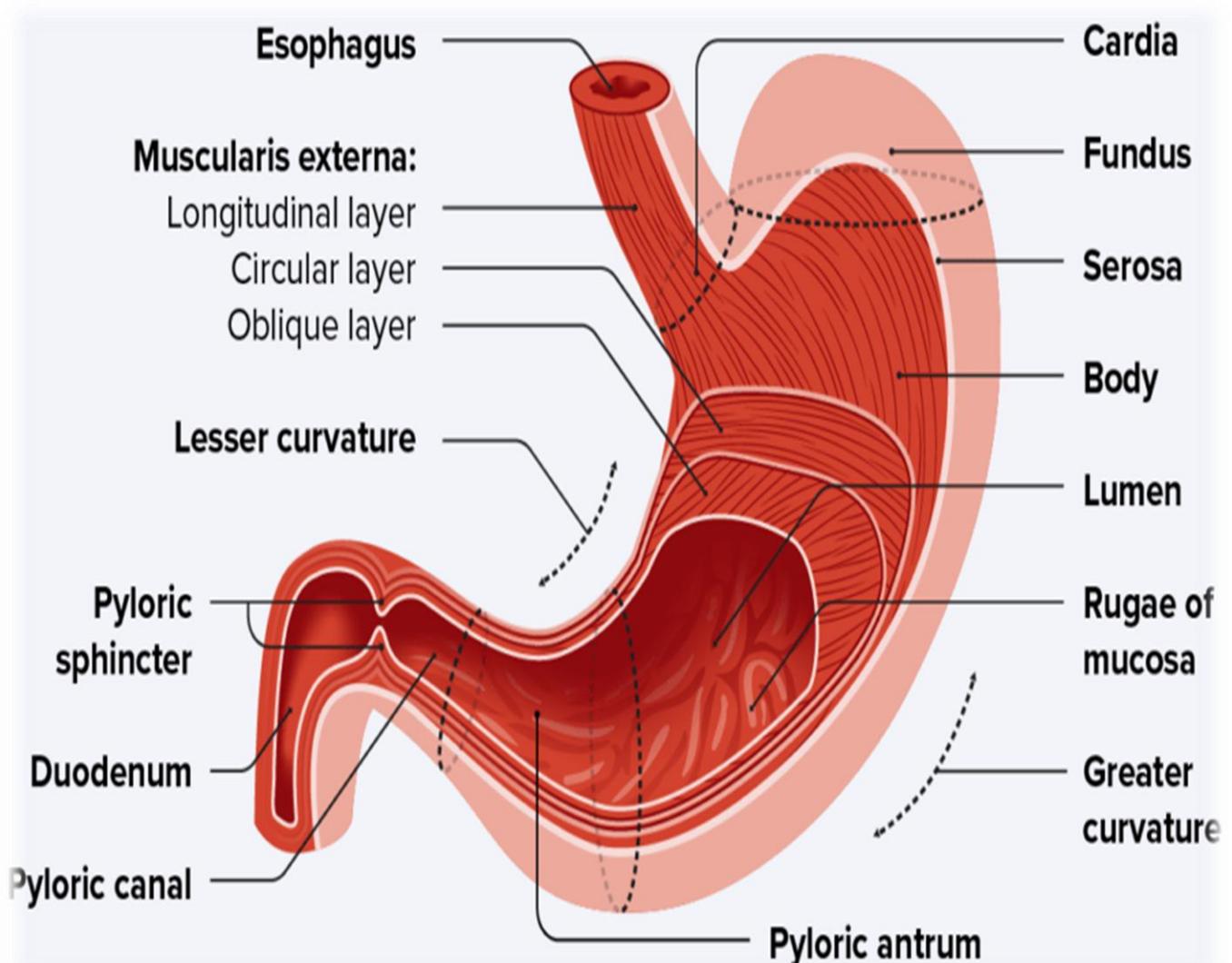
2. **Fundus** – the **upper dome-shaped portion** above the cardia
3. **Body (Corpus)** – the **largest central portion** of the stomach
4. **Pylorus** – the **lower portion** that connects the stomach to the **duodenum**; contains the **pyloric sphincter**, which controls the passage of chyme

Curvatures of the Stomach : The stomach has **two curvatures**:

1. **Greater curvature** – the **lateral, longer border** of the stomach
2. **Lesser curvature** – the **medial, shorter border** of the stomach

From these curvatures extend **Omentum folds**:

- ✓ **Greater Omentum**: hangs from the greater curvature; connects the stomach to other abdominal organs and contains fat, blood vessels, and lymph nodes
- ✓ **Lesser Omentum**: extends from the lesser curvature; connects the stomach to the liver





4- Small Intestine

The small intestine is a long, coiled tube extending from the stomach to the large intestine. It is the main site for final digestion, nutrient absorption, and hormone secretion. Its structure is highly specialized to maximize surface area for absorption.

Segments of the Small Intestine

1. Duodenum (first 25–30 cm)

- ✓ C-shaped, located near the stomach
- ✓ Receives **chyme from the stomach**
- ✓ Receives **bile from the liver** and **digestive enzymes from the pancreas** through the **hepatopancreatic ampulla**
- ✓ Functions in **chemical digestion** of carbohydrates, proteins, and fats

2. Jejunum (middle 2.5 meters approx.)

- ✓ Located mostly in the **upper-left abdomen**
- ✓ **Primary site for absorption of nutrients** (amino acids, sugars, fats, vitamins, minerals)
- ✓ Has **many folds, villi, and microvilli** to increase surface area

3. Ileum (last 3–4 meters approx.)

- ✓ Located mostly in the **lower-right abdomen**
- ✓ Absorbs **bile salts, vitamin B12, and remaining nutrients**
- ✓ Contains **Peyer's patches** (lymphoid nodules) for immune defense

Histological Features of the Small Intestine

The wall of the small intestine is specialized to **maximize digestion and absorption**.

A. Villi

- ✓ Finger-like projections of the **mucosa** into the lumen
- ✓ Greatly **increase surface area** for absorption
- ✓ Each villus contains:
 - **Blood capillaries** → absorb amino acids and sugars
 - **Lacteals (lymph vessels)** → absorb fats

B. Plicae Circulares (Circular Folds)

- ✓ Permanent folds of **mucosa and submucosa**



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- ✓ Slow down the movement of chyme
- ✓ Further **increase surface area** for absorption

C. Crypts of Lieberkühn (Intestinal Glands)

- ✓ Tubular glands that extend from the mucosal surface down into the **lamina propria**
- ✓ Open at the **base of the villi**
- ✓ Contain several cell types:
 1. **Stem Cells** → regenerate the epithelium every 3–5 days
 2. **Goblet Cells** → secrete mucus to lubricate intestinal contents
 3. **Enterocytes (absorptive cells)** → absorb nutrients
 4. **Paneth Cells** → secrete antibacterial enzymes (lysozyme) to protect against infection
 5. **Enteroendocrine Cells** → secrete hormones like **secretin, cholecystokinin (CCK), and GIP** to regulate digestion

D. Microvilli

- ✓ Tiny finger-like projections on the **apical surface of absorptive cells**
- ✓ Form the **brush border**
- ✓ Contain enzymes for **final digestion of carbohydrates and proteins**

Function Summary

Structure	Function
Duodenum	Receives chyme, bile, pancreatic juices; chemical digestion
Jejunum	Absorption of most nutrients
Ileum	Absorption of bile salts, vitamin B12, water, and electrolytes; immune defense (Peyer's patches)
Villi	Increase surface area for absorption; contain capillaries and lacteals
Plicae circulares	Slow down chyme; increase surface area
Crypts of Lieberkühn	Produce mucus, enzymes, antimicrobial substances; epithelial regeneration
Microvilli	Brush border enzymes; nutrient absorption



Secretions and Hormones

- ✓ **Digestive enzymes:** brush border enzymes (maltase, lactase, peptidases)
- ✓ **Mucus:** secreted by goblet cells
- ✓ **Hormones:**
 - **Secretin** → stimulates bicarbonate secretion by pancreas
 - **CCK (cholecystokinin)** → stimulates bile release from gallbladder, enzyme secretion from pancreas
 - **GIP (glucose-dependent insulinotropic peptide)** → stimulates insulin secretion

5- Large Intestine and anus

Is the final part of the gastrointestinal tract. Unlike the small intestine, its main roles are to absorb water and electrolytes, store and transport undigested food, and help in microbial digestion.

☞ Size & Shape:

- ✓ Shorter but wider than the small intestine
- ✓ About **1.5 meters long** and **6–8 cm in diameter**
- ✓ Inner wall has **sacculations called haustra**, which **store and move contents slowly**, helping with absorption

Ileocaecal Junction

- ✓ The **ileum (end of small intestine)** joins the large intestine at the **cecum**
- ✓ **Ileocaecal sphincter** controls this junction
- ✓ **Function:** Prevents **backflow of colonic contents** into the small intestine and allows gradual entry of digested material

Divisions of the Large Intestine

A. Cecum and Appendix

- ☞ **Cecum:** Pouch-like structure at the beginning of the large intestine
 - ✓ Receives **digested material from the ileum**
 - ✓ Has a **smooth internal mucosa**
- ☞ **Appendix:** Small, finger-like projection from the cecum
 - ✓ Contains **lymphoid tissue**



- ✓ Plays a **minor role in immune defense**

B. Colon: Main portion of the large intestine, divided into four sections:

1. **Ascending colon** – travels **upward on the right side**, absorbs water and electrolytes
2. **Transverse colon** – travels **across the abdomen**, longest part, continues absorption and microbial fermentation
3. **Descending colon** – travels **down the left side**, stores contents until sigmoid colon
4. **Sigmoid colon** – S-shaped, leads to the rectum, prepares stool for storage

C. Rectum

- ✓ Terminal storage for feces before elimination
- ✓ About **12–15 cm long**
- ✓ Expands to hold stool, triggering the **defecation reflex**

D. Anus

- ✓ The **final opening** of the digestive tract
- ✓ Controlled by **two sphincters**:
 - **Internal sphincter:** involuntary control
 - **External sphincter:** voluntary control
- ✓ **Function:** Regulates passage of stool during defecation

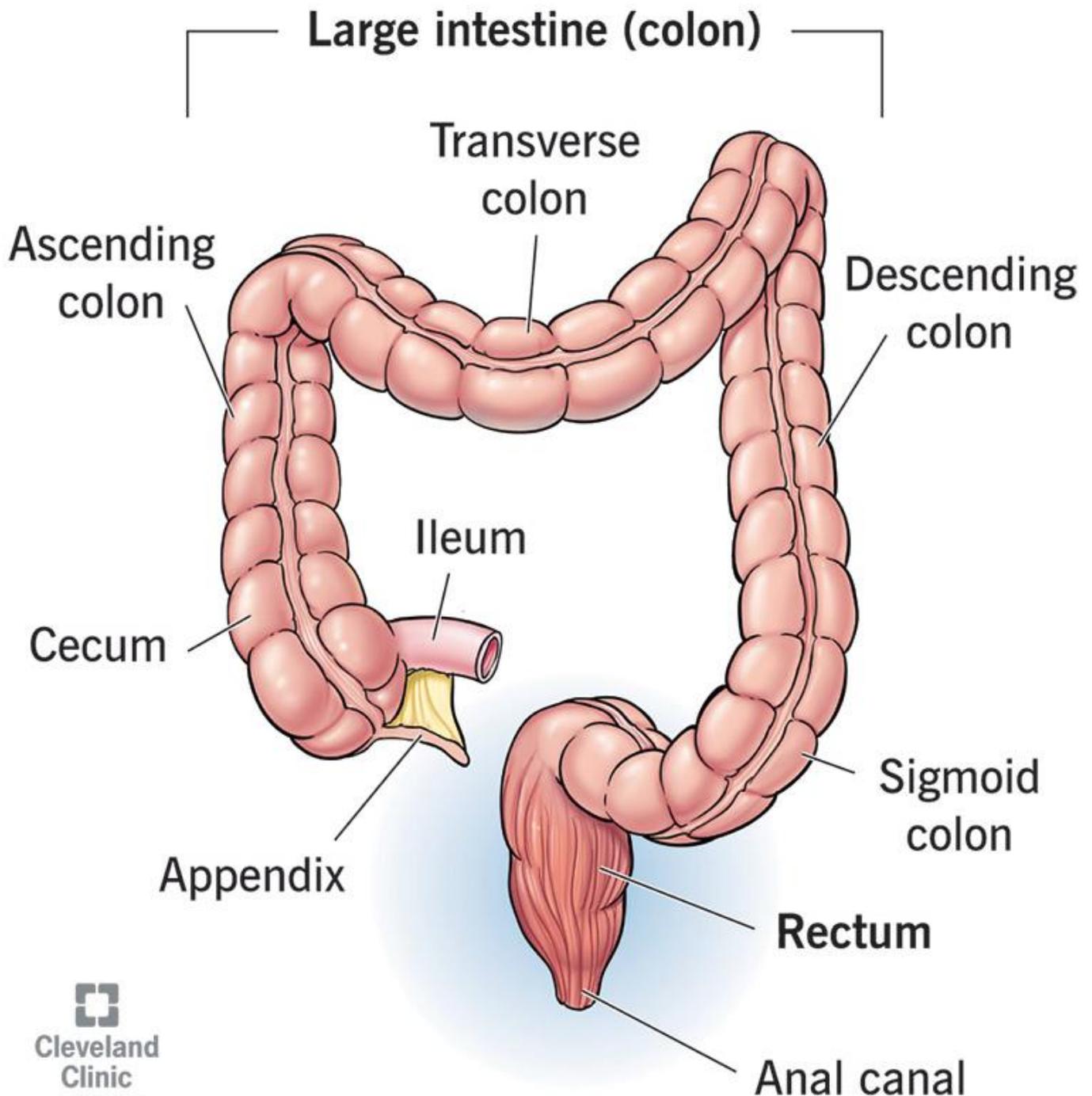
Histology of the Large Intestine

- ✓ **Mucosa:** simple columnar epithelium with many **goblet cells** to secrete mucus
- ✓ **No villi** (unlike small intestine)
- ✓ **Haustra:** sac-like pouches formed by **taenia coli (longitudinal muscle bands)**
- ✓ **Lymphoid tissue (GALT):** gut-associated lymphoid tissue protects against pathogens
- ✓ **Muscular layer:** outer longitudinal layer forms **taenia coli**, inner circular layer helps move feces



Functions of the Large Intestine

- 1. Absorption:** water, electrolytes, and some vitamins (like vitamin K and B)
- 2. Fermentation & Microbial Digestion:** bacteria break down remaining carbohydrates, producing gases and short-chain fatty acids
- 3. Formation and Storage of Feces:** converts liquid waste into solid stool
- 4. Immune Defense:** lymphoid tissue (GALT) in the mucosa protects against infections
- 5. Excretion:** controlled elimination of feces via rectum and anus





6- Liver

The liver is the largest internal organ in the body and plays a key role in digestion, metabolism, and detoxification. It acts as a bridge between the digestive system and the blood.

Functions of the Liver

1. Processing Nutrients

- ✓ Nutrients absorbed from the digestive tract are delivered to the liver via the **portal vein**.
- ✓ The liver **metabolizes, stores, or modifies these nutrients** for use by other organs.

2. Detoxification

- ✓ Harmful substances absorbed from food or medications are **detoxified** in the liver.

3. Storage

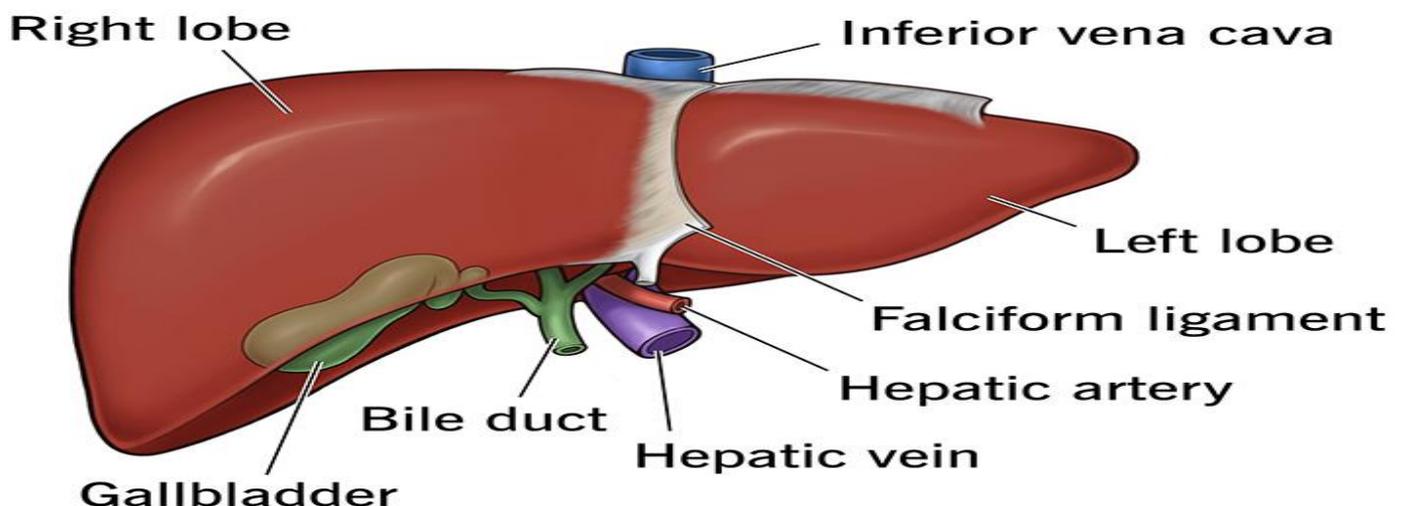
- ✓ Stores important substances such as **glycogen, vitamins, and minerals**.

4. Lipid Transport

- ✓ Most nutrients enter the liver via blood, but **complex lipids (fats)** are transported mainly via **lymph vessels**.

Anatomy of the Liver : The liver is divided into **four lobes**:

1. **Right Lobe** – the largest lobe, mainly on the right side of the body
2. **Left Lobe** – smaller lobe on the left side
3. **Quadrate Lobe** – located near the gallbladder
4. **Caudate Lobe** – located near the inferior vena cava





7- Pancreas

The pancreas is a long, soft gland located behind the stomach. It is an accessory organ of the digestive system and also has important endocrine functions (hormone secretion).

Anatomy of the Pancreas : The pancreas is divided into **three main parts**:

1. **Head** – the widest part, lies in the curve of the **duodenum**
2. **Body** – the central portion, extends across the midline of the abdomen
3. **Tail** – the narrow end, reaches toward the **spleen**

Pancreatic Ducts and Connection to Bile Duct

- ✓ The **main pancreatic duct** carries pancreatic secretions (enzymes and bicarbonate) to the **duodenum**.
- ✓ This duct **joins the common bile duct** to form the **ampulla of Vater (hepatopancreatic ampulla)**, which opens into the duodenum.
- ✓ This allows **bile from the liver and gallbladder** and **pancreatic juice** to enter the small intestine together for digestion.

Functions of the Pancreas

1. Exocrine Function (Digestive)

☞ Secretes **pancreatic juice**, which contains:

- **Enzymes** for digestion: amylase (carbohydrates), lipase (fats), proteases (proteins)
- **Bicarbonate** to neutralize stomach acid

2. Endocrine Function (Hormonal)

☞ The **islets of Langerhans** secrete hormones:

- **Insulin** → lowers blood sugar
- **Glucagon** → raises blood sugar
- **Somatostatin** → regulates other pancreatic hormones

