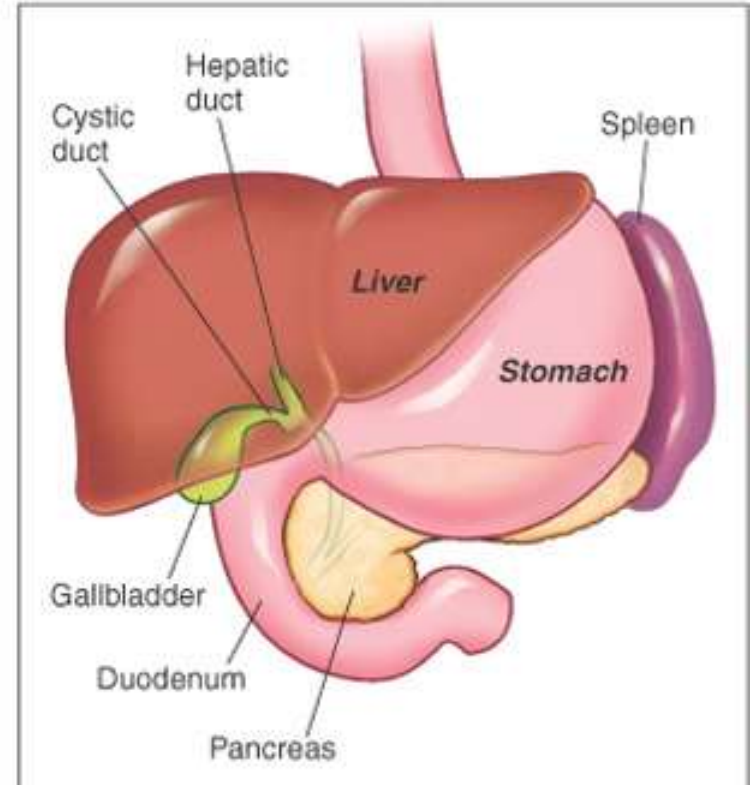


The Digestive System

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(2021)



Definitions

The Digestive System: ⇒ three function for digestive system?

Is the system of the body formed of all the organs responsible for the ingestion, digestion, and absorption of food. It includes the alimentary canal and the accessory glands.
↳ in the small intestine

→ food
↳ mechanical → break the food into small pieces
↳ chemical → break the food by acid

The Alimentary Canal: → digestive canal extend from mouth superiorly to anus (end anal canal)

Is a long continuous tube that extends from the mouth to the anus. It includes: the mouth, parts of the pharynx, the esophagus, the stomach, the small intestine, and the large intestine. The Gastrointestinal Tract (GIT) includes the stomach and intestines only.

↳ without mouth, pharynx and esophagus

→ three part :- ① nasopharynx posterior the nose (not part of digestive system), oropharynx and laryngopharynx part of GI system

The Accessory Glands } function?

These produce various secretions that help in the chemical breakdown of food. They include the salivary glands, the liver, and pancreas.

Food, however, does not pass through them. → these structure easier to digestion and absorption not the food pass through them.

Functions: of the digestive

1. Ingestion: taking food into mouth.
2. Secretion: release of enzymes and other substances. *↳ start from mouth such as : lipases and saliva*
3. Mixing and propulsion of food. *↳ secretion with food break* *↳ pushes the food toward pharynx*
4. Digestion: mechanical and chemical breakdown of food. *enzyme*
5. Absorption of nutrients
6. Elimination of waste.

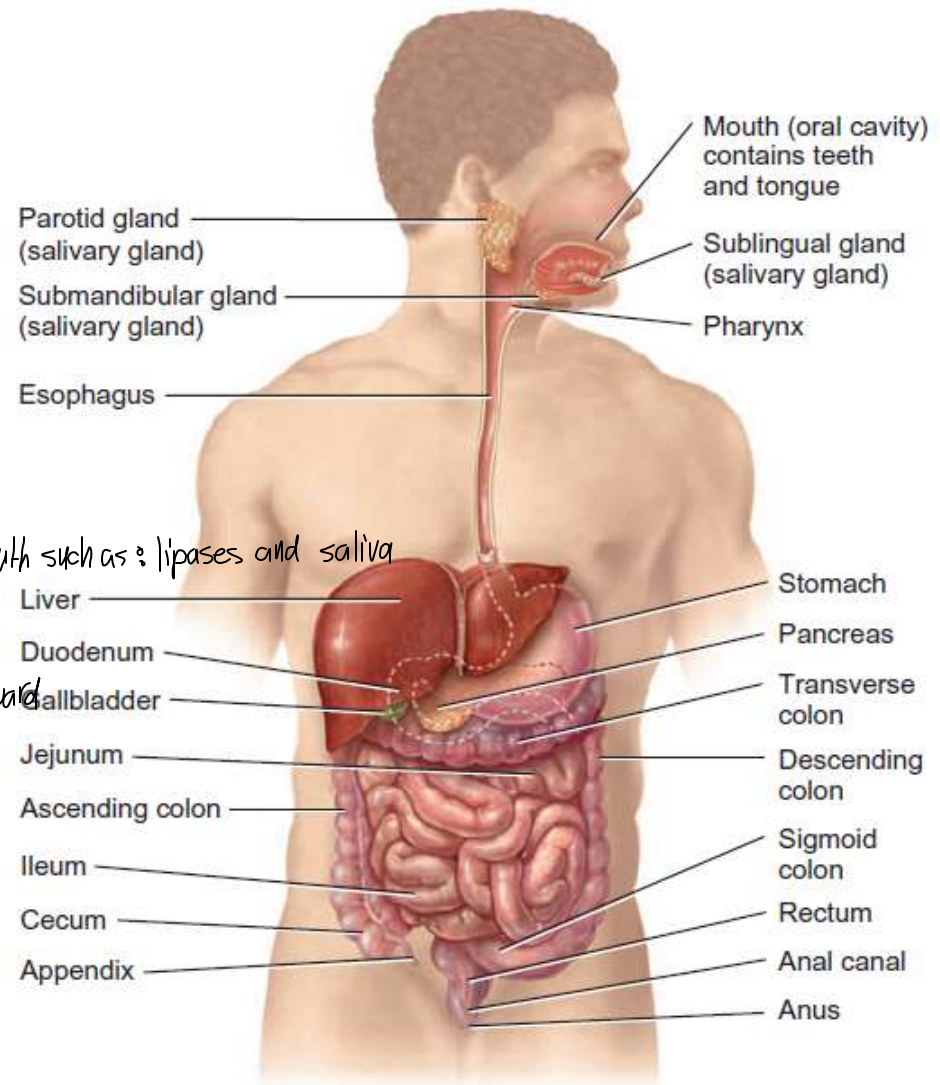


Fig.1: Organs of the digestive system.

Wall of the Gastrointestinal Tract

- Wall of the alimentary canal has a general layout. → four main layer?

1. **Mucosa** – inner lining formed of epithelium and connective tissue (lamina propria). Separated from the submucosa by a layer of smooth muscles (**muscularis mucosae**). → smooth muscle separate mucosa from submucosa

2. **Submucosa** – Connective tissue layer. Contains the submucosal plexus of nerves. → below mucosa layer

3. **Muscularis** – A muscular layer (voluntary or involuntary). Formed of an outer longitudinal and an inner circular layers between which we have the myenteric plexus of nerves. → two muscular layer

4. **Serosa/Adventitia** – Intraperitoneal organs are covered by serosa (visceral peritoneum). Retroperitoneal organs are covered by connective tissue adventitia.

the outer layer → inside peritoneum (serosa)
→ outside peritoneum adventitia

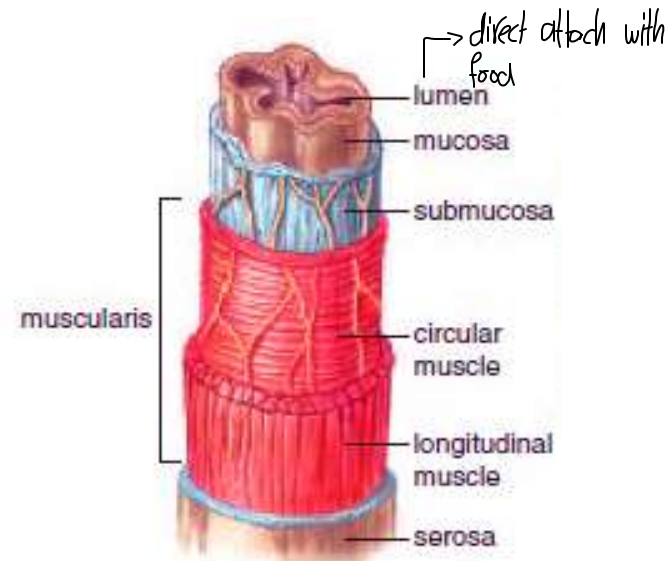


Fig.2: General layout of the wall of the alimentary canal.

The Abdominal Cavity

■ Borders:

1. **Anterior:** The anterior abdominal wall.

2. **Posterior:** Posterior abdominal wall.

3. **Superior:** The diaphragm.

4. **Inferior:** The pelvic brim. → separate between pelvic cavity and abdominal cavity

■ Below the pelvic brim the cavity is called the **pelvic cavity**. The abdominal and pelvic cavities are continuous with each and together form the **abdominopelvic cavity**.
→ pelvic cavity + abdominal cavity
→ inside the pelvic cavity bladder and gonadal organ

Body cavities:

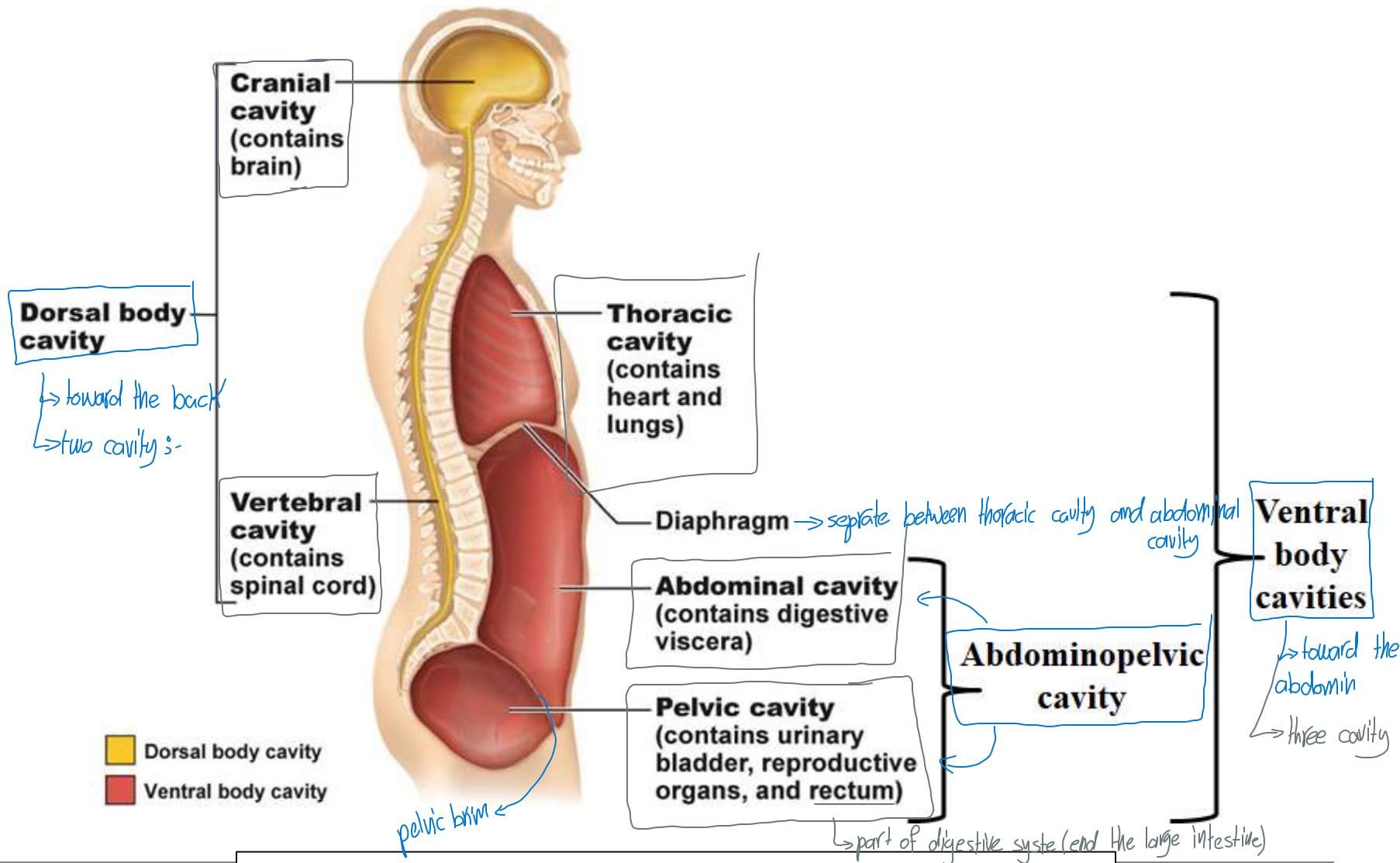


Fig.3: Lateral view of the body showing body cavities.

Peritoneum

- Largest serous membrane of the body.

- Divided into:

- Parietal peritoneum — lines wall of cavity.

- Visceral peritoneum — covers some organs (= Serosa).

- Space between is called the peritoneal cavity and contains the peritoneal fluid.

- ~~Peritoneal folds:~~

- Two layers of peritoneum connecting organs to each other and to the anterior and posterior abdominal walls.

- Examples: greater omentum, lesser omentum, and mesentery.

- The space between the two walls of the greater omentum is called the lesser sac (located behind the stomach). The rest of the peritoneal cavity is called the greater sac.

→ the outer layer covered the abdominal cavity

→ the inner layer surrounded the organ

→ the same visceral

↳ space fill with peritoneal fluid between visceral and parietal peritoneum
↳ prevent friction

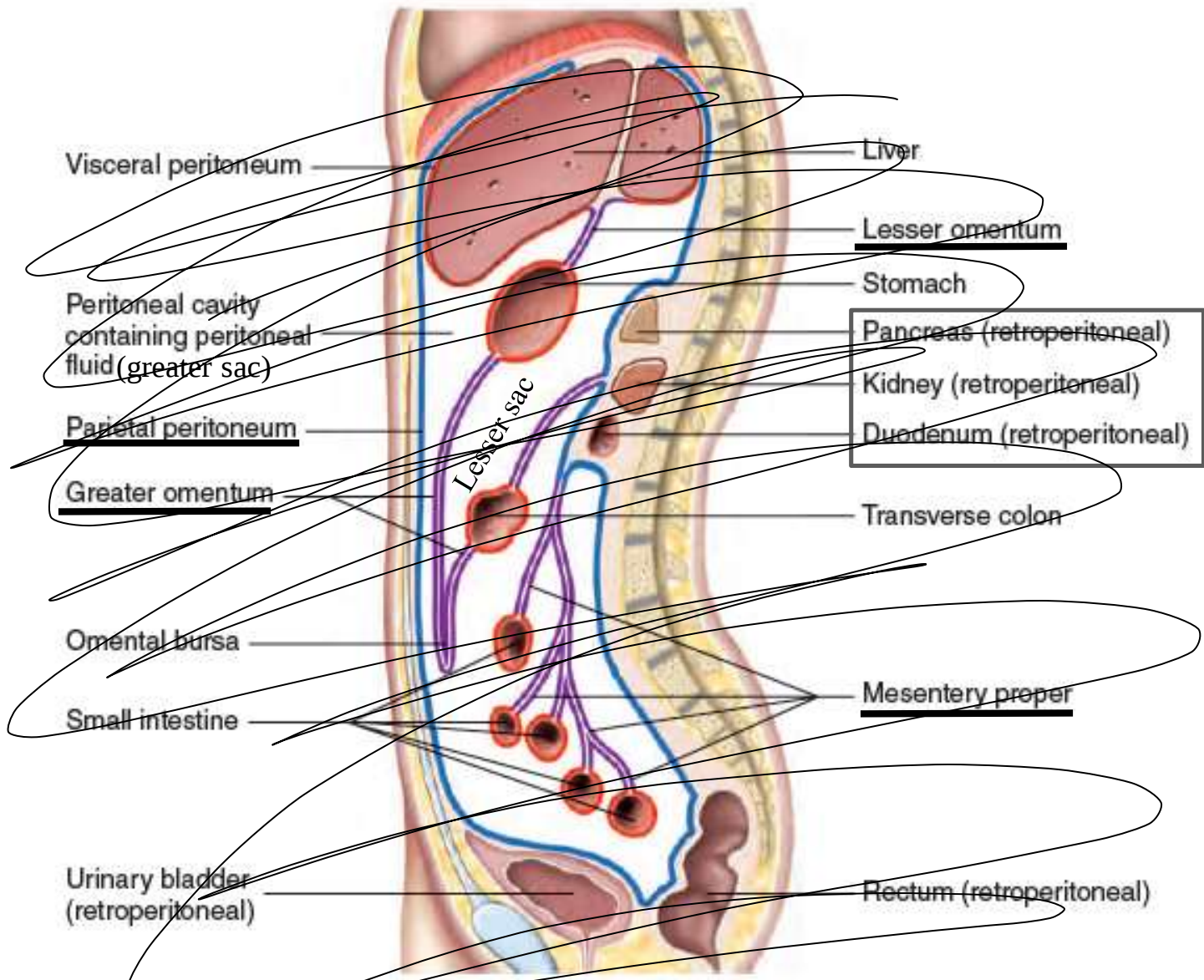


Fig.4: The peritoneum and its folds.

The Mouth (Oral/Buccal Cavity)

↳ digestive beginning mechanically and chemically from the mouth

- **Bordered** by the cheeks, lips, hard and soft palates, and the tongue.

- **Vestibule of the mouth** is the space between the cheeks and lips externally and the gum and teeth internally.

- **Oral cavity proper** is the space that extends from the gums and teeth to the fauces.

- **The cheeks and lips help keep the food in the mouth.**

- The mouth contains the tongue, the teeth and gums and into it open the ducts of salivary glands.

↳ exocrine pour secretion inside the mouth by duct

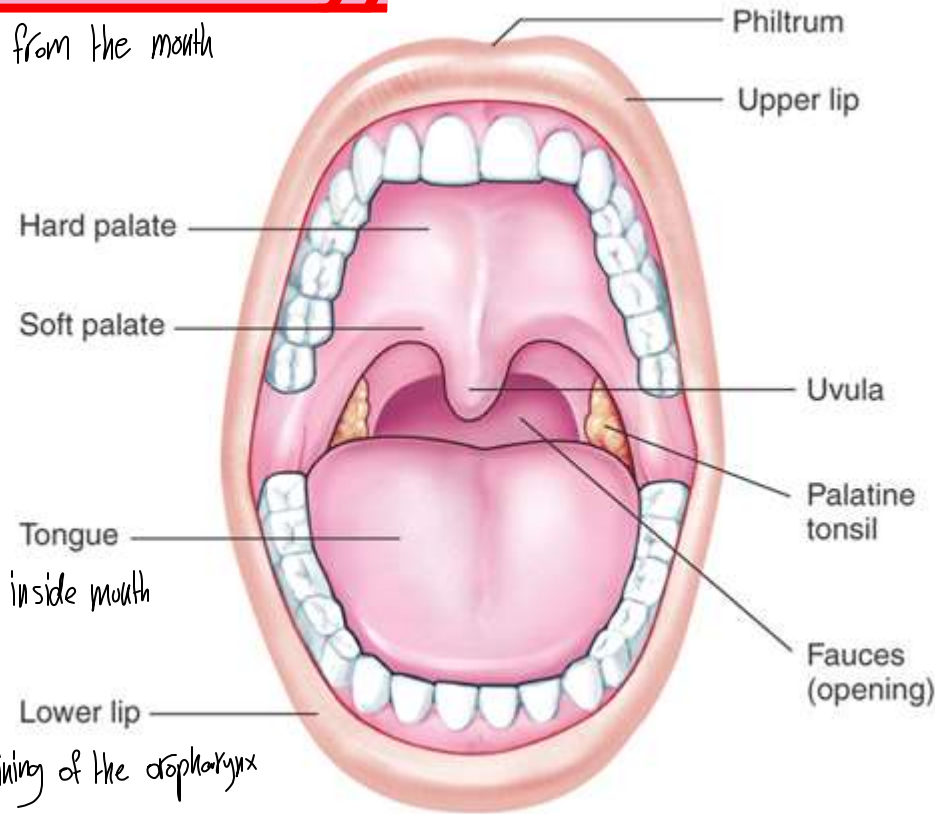


Fig.5: The mouth and its borders.

The Tongue

- ~~Skeletal muscles covered by mucous membrane.~~

Function of the tongue?

- **Maneuvers food for chewing and forces food back for swallowing.** → into oesophagus

- Contains **Lingual glands** which **secrete lipase.** → break the lipid → monolipids

- Dorsal surface has 3 types of projections called **lingual papillae**: **Filiform**, **Fungiform**,

and **Vallate**. The vallate type is the least numerous but it's the largest and contains most of the taste buds (for the **sense of taste**). Fungiform papillae also has taste buds. Filiform papillae has no taste buds but assist in moving food around the mouth.

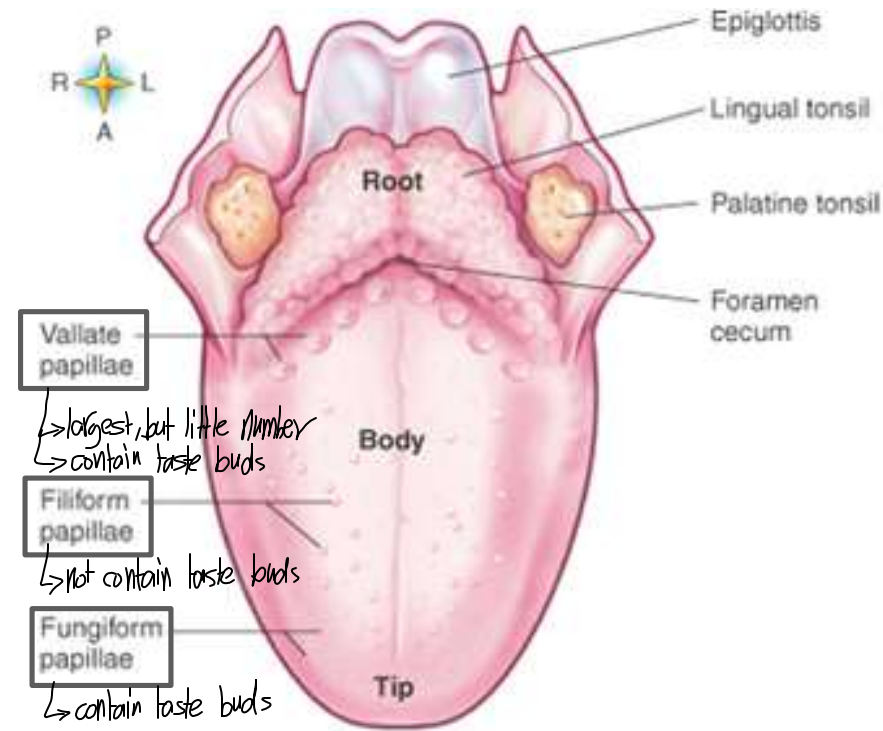
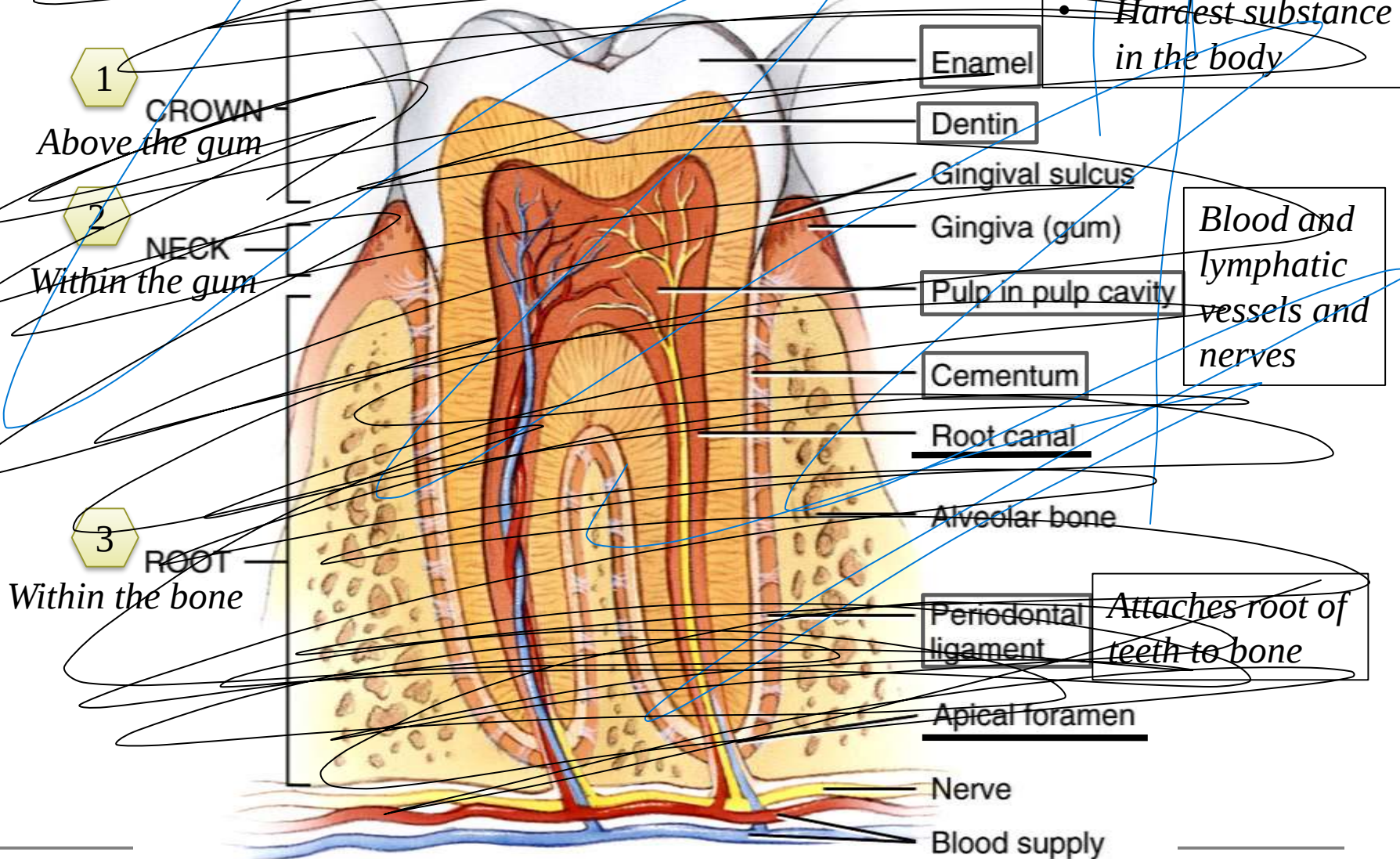


Fig.6: The tongue.

The Teeth: (Fig.7*)



Function: break down food into smaller particles (mastication)

The Salivary Glands

→ Function of these glands?

- Salivary glands **release saliva into the mouth:**

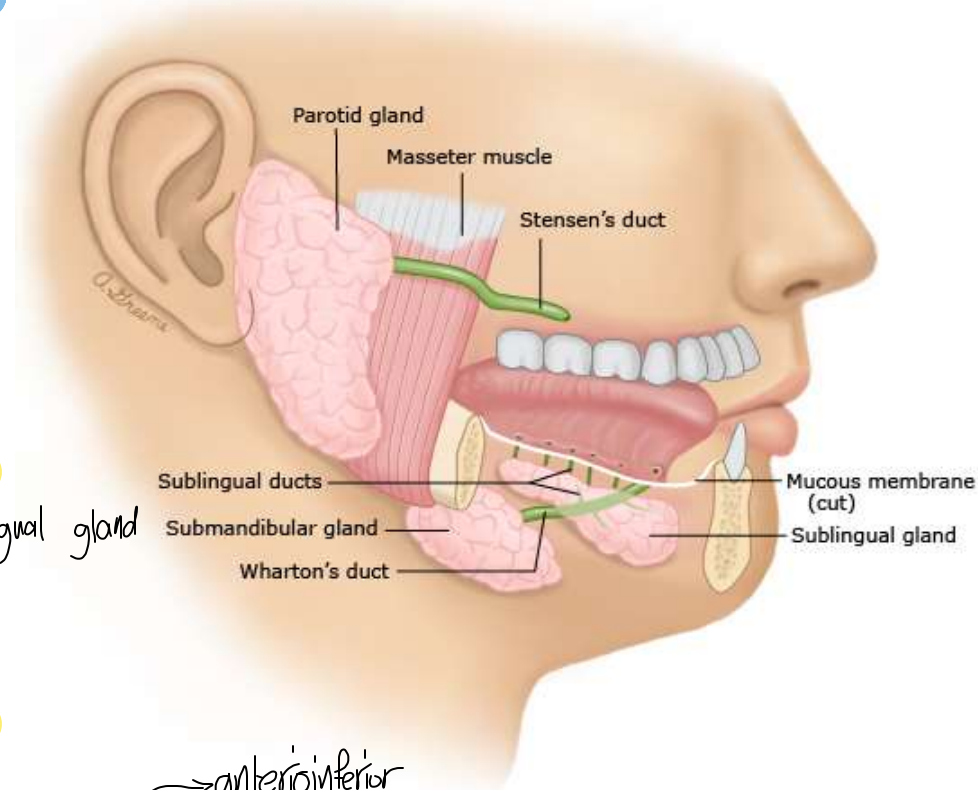
- Ordinarily, just **enough** is secreted to **keep mouth and pharynx moist and clean.**
- When food enters mouth, secretion increases to **lubricate mouth, dissolve food, and begin chemical digestion.** → in addition lipase secreted by lingual gland

→ as number 6

- There are **3 pairs** of major salivary glands. The **ducts** of these glands **into the mouth.**

1. **Parotid:** The **largest**. Located **anterior and inferior to the ear.**
2. **Submandibular:** Located **near the angle of the mandible.**
3. **Sublingual:** Located **under the tongue.**

Fig.8: The major salivary glands.



→ anterior/inferior

The Esophagus عريء

■ A long muscular tube

■ Course:

□ **Begins in the neck at the level of C6 vertebra.** → end laryngopharynx → larynx → epiglottis
→ posterior to the trachea

□ **Runs down posterior to the trachea.** → at level C6

□ **Enters the superior mediastinum and then passes into the posterior mediastinum** where it runs anterior to the vertebral column and posterior to the heart. → of the inferior mediastinum back the heart

□ **Passes through the esophageal hiatus of the diaphragm (T10 vertebra) to enter the abdomen.** → opening in diaphragm at level T10

□ **Enters the stomach at the cardia.** → opening enter into stomach

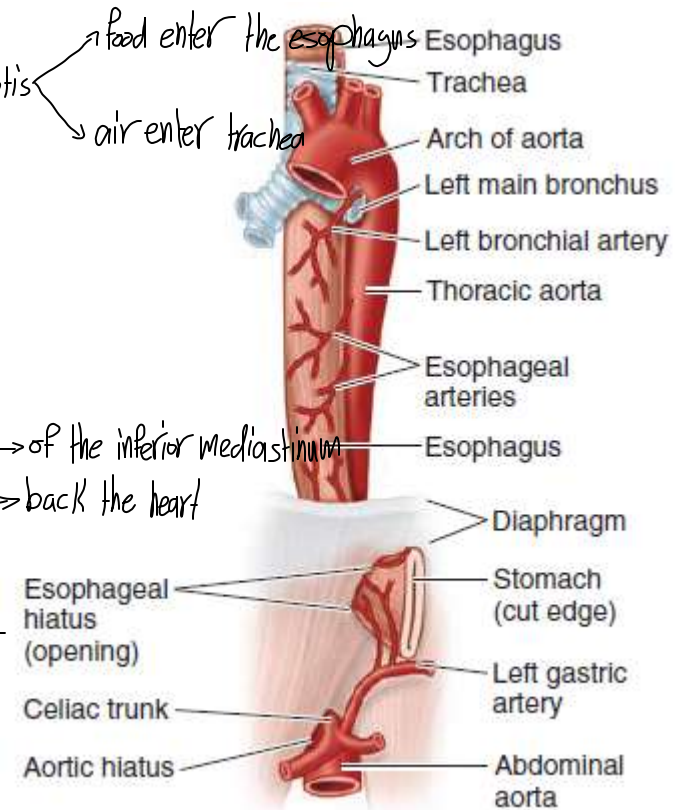


Fig.9: Course of the esophagus in the thorax.

cardiac sphincter on the cardia → the acid exit from stomach into esophagus and pass via cardiac sphincter causes heart burn

- The muscularis layer of the wall of the esophagus is formed of: → three part
 - Upper part – Skeletal muscles
 - Middle part – Skeletal and smooth muscles
 - Lower part – Smooth muscles
- The esophagus is a passageway for the food from the pharynx to the stomach and it, thus, plays a part in deglutition ^{تحلل الطعام}
 - ❑ To facilitate this, the esophagus secretes some mucous. And it pushes food down by a series of muscle contractions and relaxations called peristalsis.

→ to allow the food downward in a regular manner

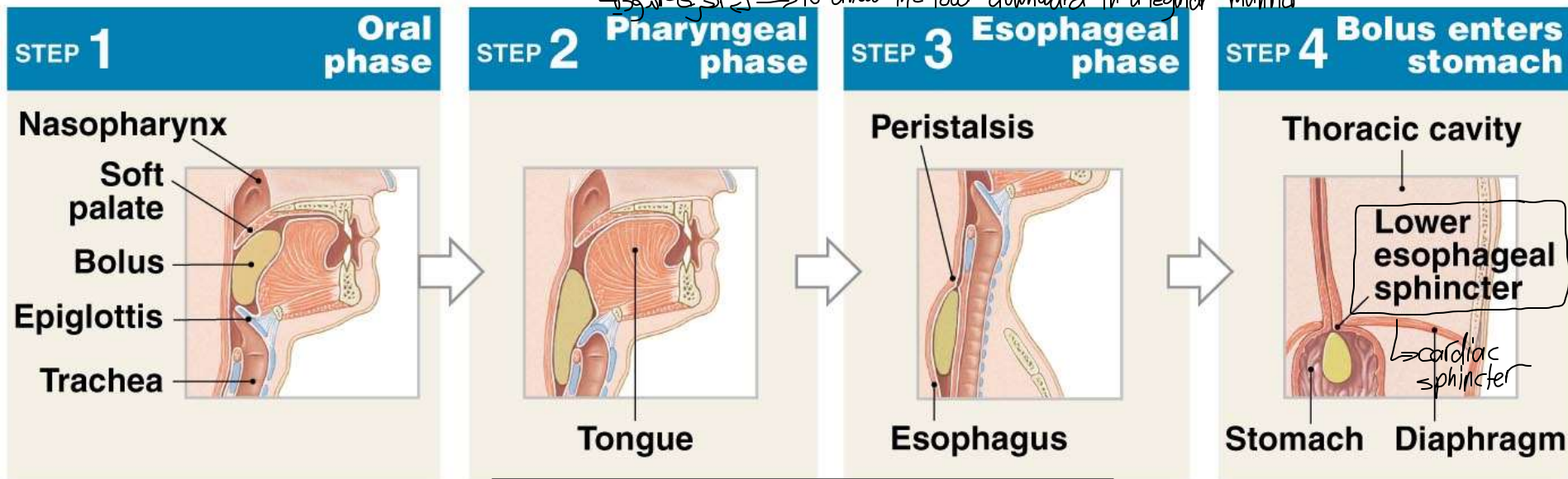


Fig.10: The process of swallowing.

The Stomach

- A J-shaped dilation of the alimentary tract located inferior to the diaphragm in the left hypochondriac and epigastric regions and even the umbilical region when it's distended.
→ semisolid part to the bolus after mixing with secretion of the stomach → dilation
- **The stomach churns and breaks down food and it mixes the food with its digestive secretions converting it into the semisolid chyme. The stomach also acts as a reservoir for the food.**
→ storage
- The wall of an empty stomach shows several folds called rugae.
→ انبعاجات
→ folds in stomach increase the surface area
- Mucosa – gastric glands:
 - exocrine
 - endocrine
- 3 types of exocrine cells – mucous cells (mucus), parietal cells (HCl and intrinsic factor), and chief cells (pepsinogen and gastric lipase).
→ absorption to the vitamin B12
- Endocrine cells – G cells – secrete gastrin.
- ~~The muscularis of the stomach is formed of 3 layers.~~

Anatomy of the stomach

- The stomach can be divided into 4 regions:

1) The **Cardia** – the part that surrounds the opening of the esophagus.

2) The **Fundus** – Usually filled with gas. → not present food

3) The **Body** – The main part of the stomach. → largest part of stomach → happen inside it the digestive

4) The **Pyloric region** – The distal part of the stomach. Ends at the pylorus which opens into the duodenum and possesses the pyloric sphincter (a thickening in the muscularis layer). → first part of small intestine
in the stomach we have two curvature?

■ The longer left border of the stomach is called the greater curvature. The shorter right border is called the lesser curvature.

■ At the junction between the esophagus and the stomach, there's an angle called the cardiac angle.

↳ angle between Fundus region and esophagus

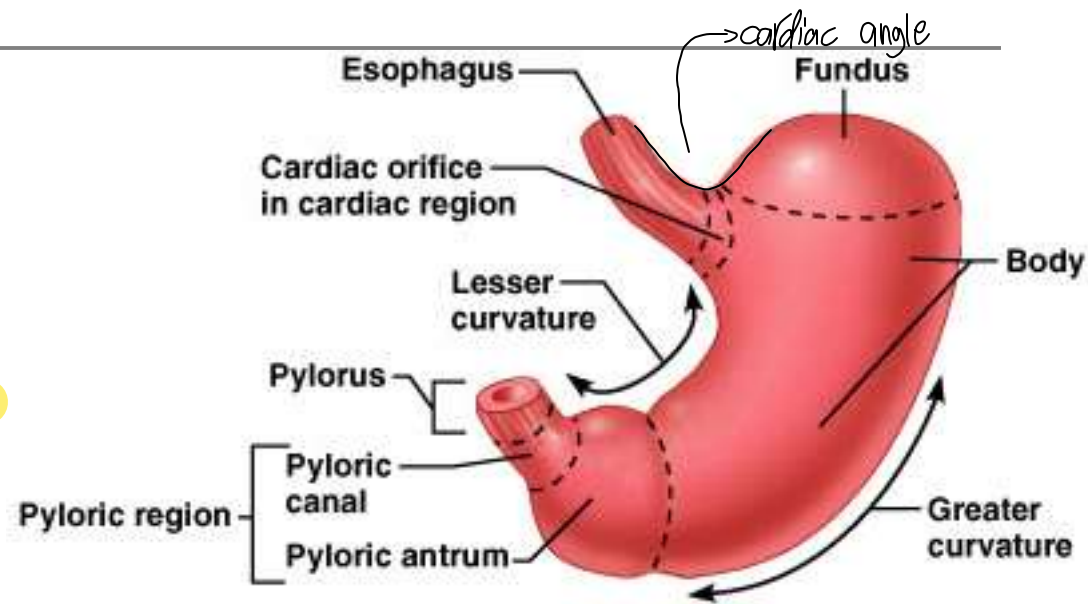


Fig.13: Anatomical features of the stomach.

The Small Intestine

- It's a long coiled tube formed of 3 parts — **duodenum**, **jejunum**, and **ileum**.
 - second part
 - the third part
 - بالترتيب
 - first part
- **Its function is the digestion of food particles delivered from the stomach and the subsequent absorption of nutrients.**
 - in the jejunum
- Its wall is characterized by the presence of folds called the **plicae circulares**.
 - folds in the intestine to increase surface area
- ~~The submucosa of the duodenum features numerous mucous glands.~~ The submucosa of the ileum features numerous large lymphatic nodules called Payer's **patches**.
 - lymphatic nodules in ileum
 - solitary, not present capsule, number little
 - node → clusters, present capsule, number large

■ The duodenum is a C-shaped tube connecting the stomach with jejunum.

- The concavity of the C is directed to the left and is occupied by the head of the pancreas.

- The duodenum receives the duct of the pancreas and the bile duct.

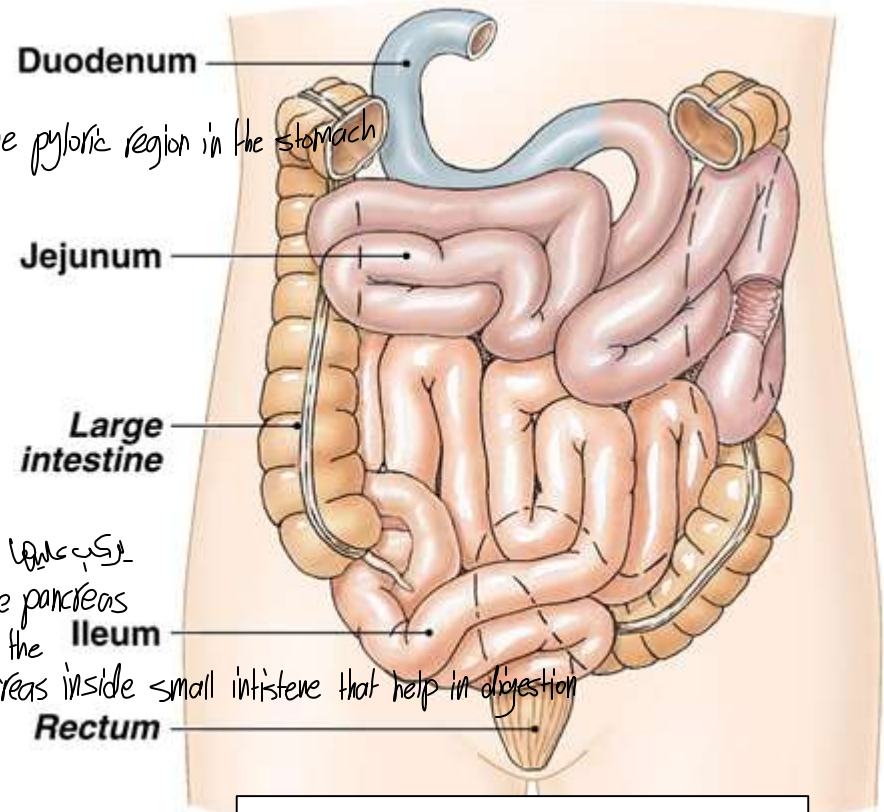


Fig.14: The small intestine.

■ The jejunum is located mostly in the left upper quadrant of the abdomen. Most absorption takes place here.

■ The ileum is located mostly in the right lower quadrant. It opens into the cecum. This opening is guarded by the ileocecal valve.

↳ beginning large intestine

↳ opening between ileum and cecum

Features that increase the surface area of the small intestine:

■ **Circular folds (Plicae circulares)**

- Permanent ridges of mucosa and submucosa.
- Cause chyme to spiral, delaying its passage allowing more time for absorption.

■ **Villi**

- Fingerlike projections of mucosa
- Contains arteriole, venule, blood capillary, and lacteal (lymphatic).

■ **Microvilli**

- Projections of apical membrane of absorptive cells.
- Contains digestive enzymes.

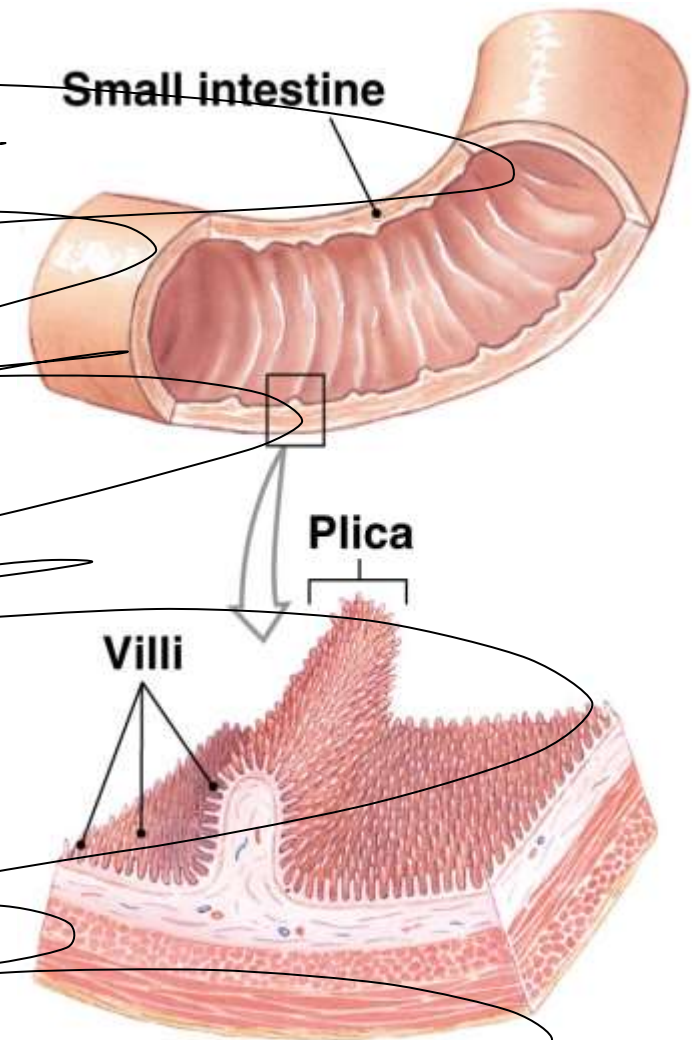


Fig.15: Plicae and villi.

The Large Intestine

→ beginning from cecum (end of ileum)

↳ not absorption nutrient, absorb water

↳ two layer → inner (circular), outer layer (longitudinal)

- The terminal portion of the alimentary canal.

- **Overall function is to complete absorption (mainly water), produce certain vitamins (Vitamin K produced by intestinal bacteria), and form and expel undigested food (feces).**

→ three function

- The longitudinal muscle layer of the muscularis is arranged in bundles called **taenia coli**. Because of their tone, they form pouches in the large intestine called **haustra**.
- the longitudinal layer that arranged in the bundle
- 4 major regions – **cecum, colon, rectum, and anal canal.**
- direct after ileum → largest part (4 part)
- **The cecum is a blind pouch.** To it is attached a blind tube called the **appendix**. **The appendix contains several lymphatic nodules and, thus, plays an immune role.**
- result the bundle that present in the large intestine → make several contraction → squeeze
- in the end this canal present anus
- as peyer's patches
- **Colon** divided into **ascending, transverse, descending** and **sigmoid colon**. The colon is the part in which the **main function of the large intestine takes place.** (almost the absorption of water and expel feces)

→ (مفتحة جزئياً) → opening on the ileum just by sphincter (not open completely to ileum)

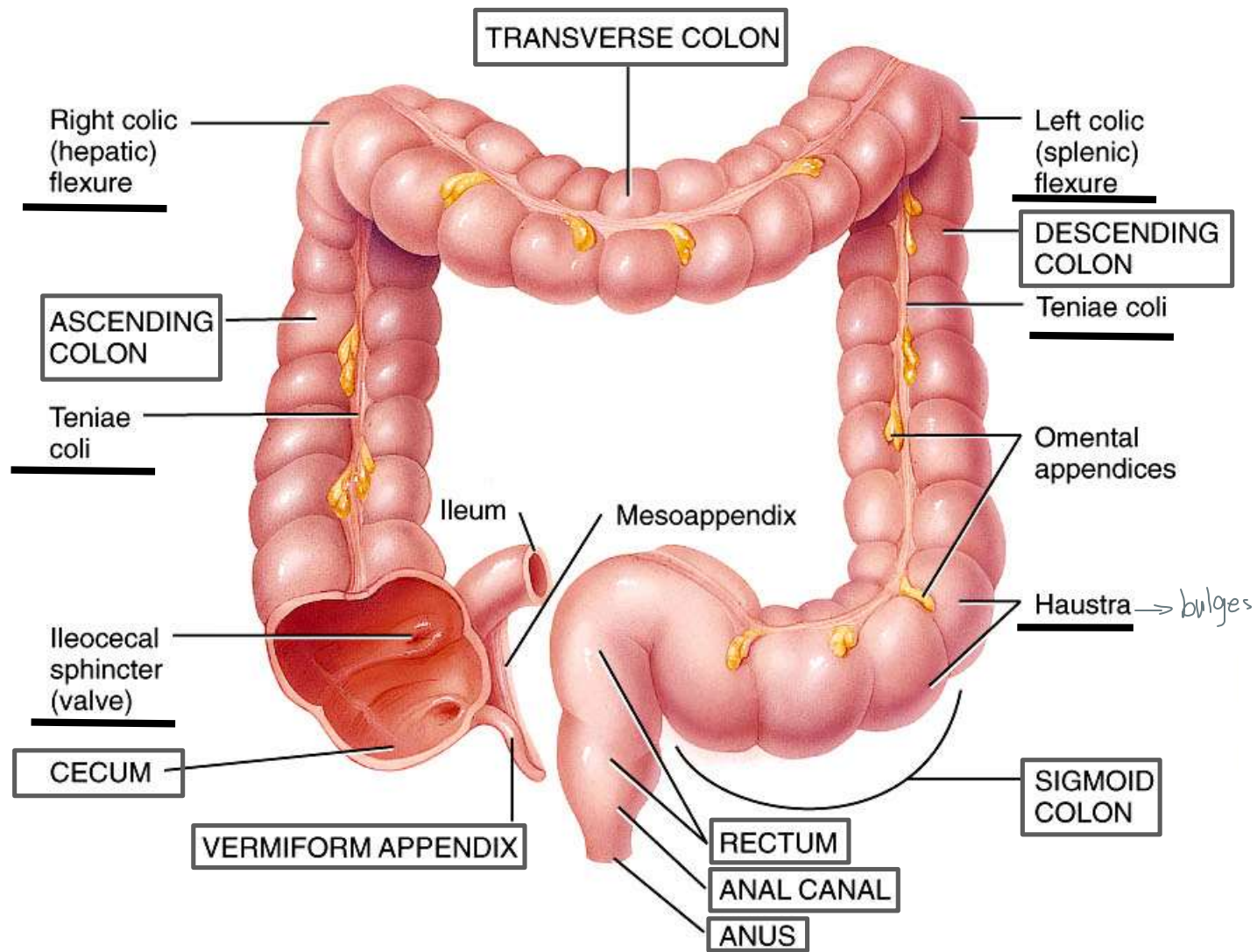


Fig.16: The large intestine.

- The **rectum** acts as a **reservoir for the feces**. It ^{→ storage even the expel} lies **anterior to the sacrum** and **coccyx**. ^{→ last two part in vertebrae column}

- The **anal canal** ^{→ the canal in the end of the rectum} is ~~characterized by the presence of longitudinal folds called the anal columns~~. The opening of anal canal (anus) is guarded by **the internal anal sphincter** ^{→ the inner sphincter (involuntary)} of **smooth muscle** ^{→ not able to control in it} and the **external anal sphincter** ^{→ outside sphincter → (voluntary)} of **skeletal muscle**.

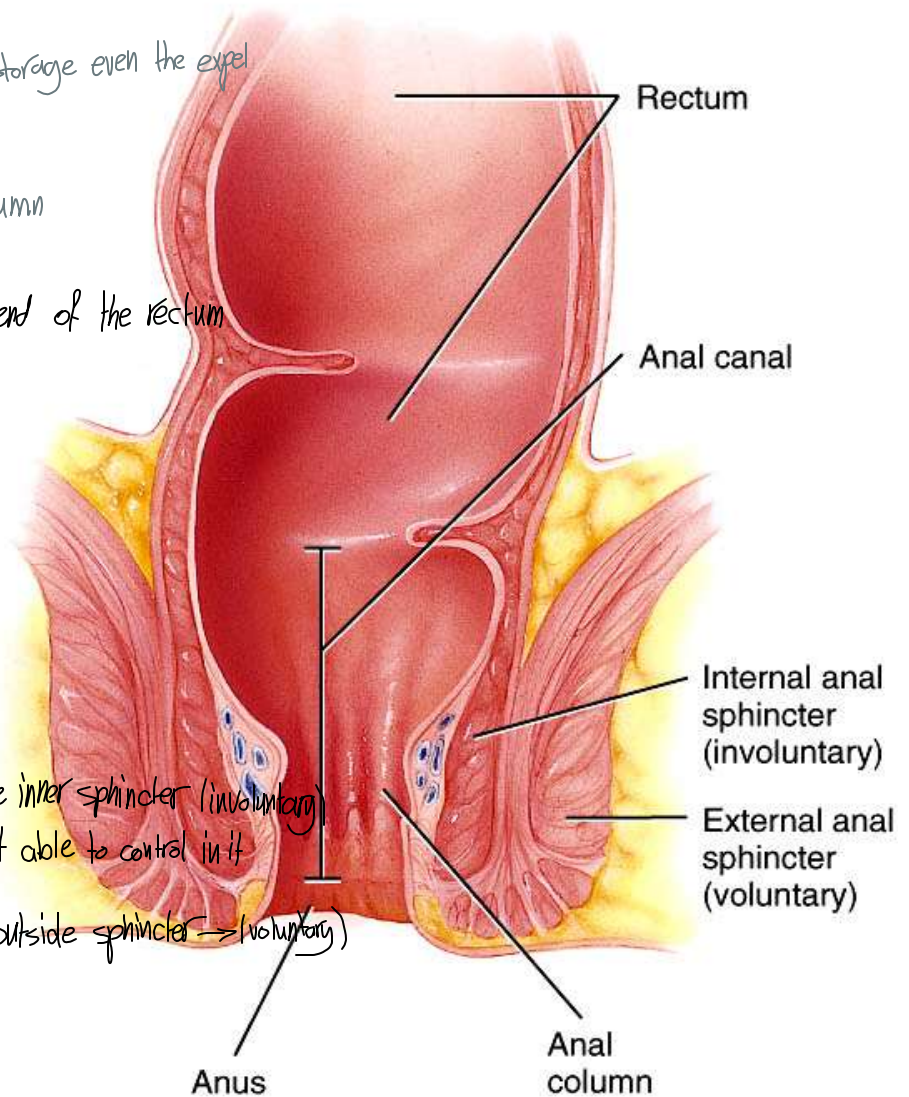


Fig.17: The anal canal.

The Liver and Gallbladder

↳ in the opposite side (contralateral named not ipsilateral)

- The liver is the largest internal organ and the heaviest gland in the body.
- It's located ^{↳ inferior} beneath the diaphragm in the right hypochondriac region and extends into the epigastric region. → and if was full reach the umbilical region
- Anatomically, it's divided into right and left lobes. The right lobe also has the quadrate and caudate lobes. → as anatomy in the right lobe
↳ as function serve left lobe
- **Functions of the liver:**
 - 1) **Metabolism of carbohydrates, lipids and proteins.**
 - 2) **Detoxification.** → remove toxicity for any thing (food, drug), activation to some drug
 - 3) **Synthesis of bile and proteins.**
 - 4) **Storage of glycogen, vitamins and minerals.**
 - 5) **Activation of vitamin D.** (1.25 active form for vitamin D)
 - 6) **Phagocytosis of RBCs.** → (spleen and liver)

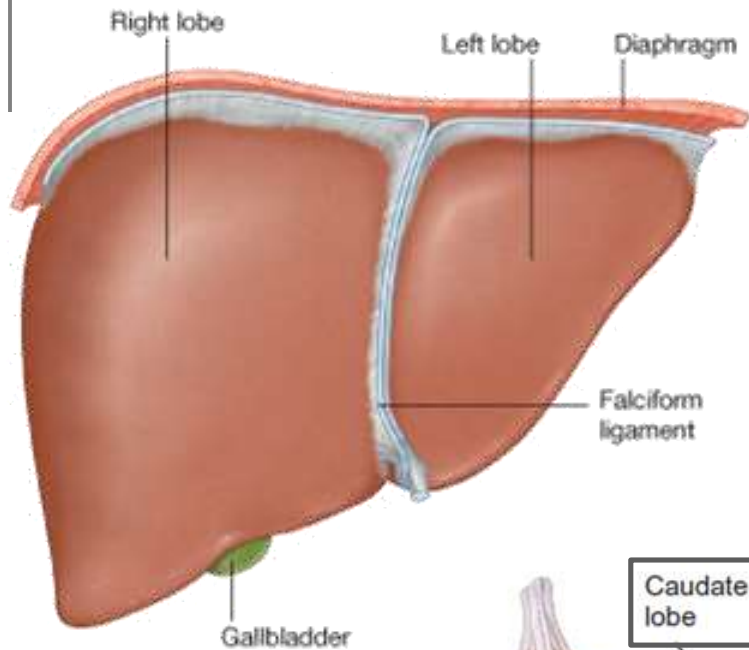
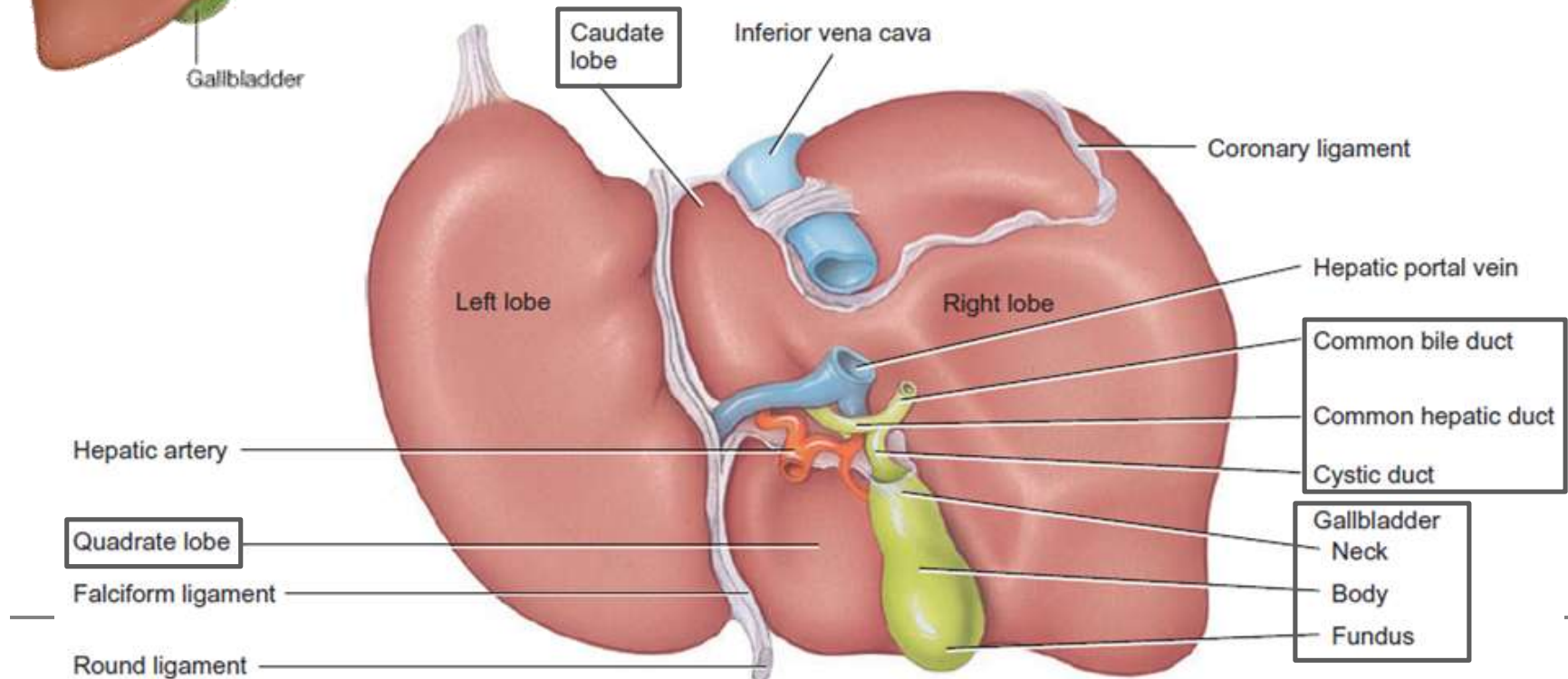


Fig.18: The liver.

The caudate and quadrate lobes are anatomically part of the right lobe, but functionally part of the left



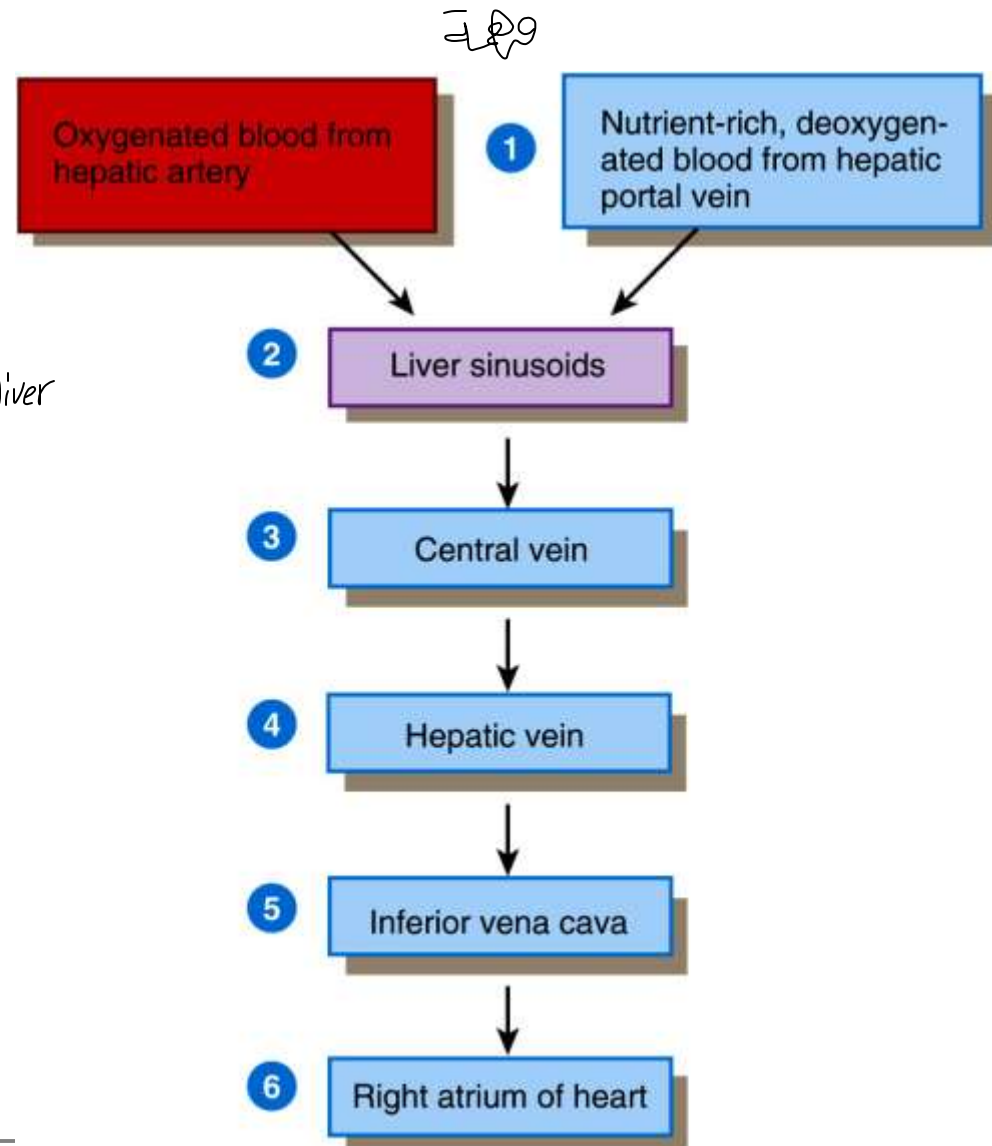
■ Liver is composed of:

- ❑ **Hepatocytes** – major functional cells of liver.
 - ❑ **Ito cells** (stores vitamin A) and **Kupffer cells** (phagocytosis).
 - ❑ **Bile canaliculi** – narrow spaces between hepatocytes that collect bile secreted from the hepatocytes. Canaliculi unite to form small bile ducts. Eventually bile leaves the liver through the right and left hepatic ducts. These unite to form the common hepatic duct
 - ❑ **Hepatic sinusoids** – highly permeable blood capillaries receiving oxygenated blood from hepatic artery and deoxygenated nutrient-rich blood from hepatic portal vein.
 - ❑ **portal triad** composed of: bile duct, branch of the hepatic artery and a branch of the portal vein. → (hepatic portal vein) → from digestive system to liver
- ↳ oxygenated blood into liver
- blood capillaries receive oxygenated blood from hepatic artery (part from abdominal aorta)
- all organ in digestive system pour in hepatic portal vein → liver (detoxification) → inferior vena cava → right atrium
- space between hepatocytes cell (functional unite of liver) → pour bile secretion into canaliculi (small canal) → collection from canaliculi to formation small bile ducts → collection together to form right and left hepatic duct → common hepatic duct → gallbladder duct (cystic duct) with common hepatic duct formation common bile duct (pour in duodenum)

Blood flow through the liver

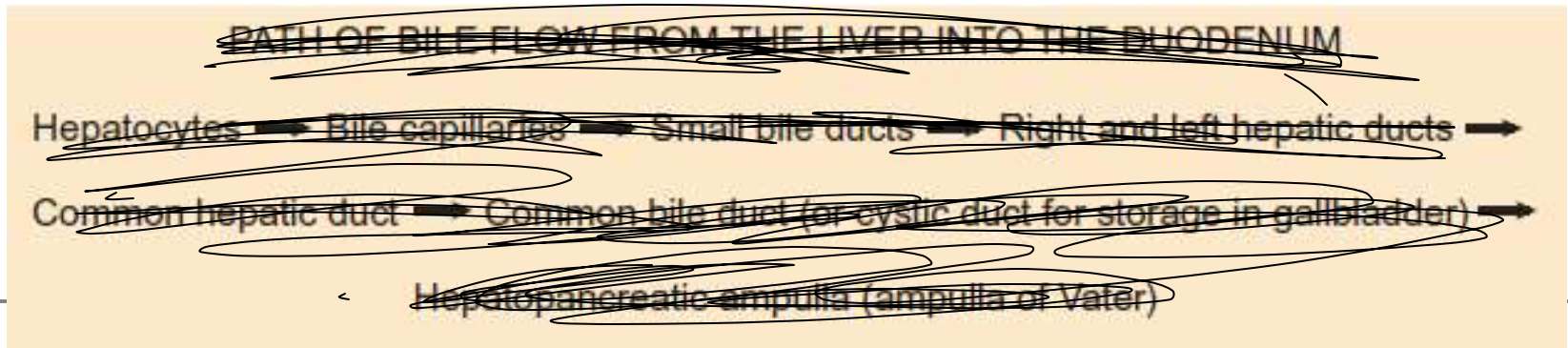
- Liver receives blood from:

- a) Hepatic artery carrying oxygenated blood. → supply liver
- b) Hepatic portal vein carrying deoxygenated blood with newly absorbed nutrients and possibly drugs, microbes or toxins from the alimentary tract.



The Gallbladder → الكبد الصفراوية → inferiorly with liver

- The gallbladder is a **pear-shaped** organ situated on the **under surface of the liver**.
- It's composed of 3 parts: a large fundus which protrudes from the anterior margin of the liver, a body, and a narrow neck (the last two are located under the liver). The neck opens into the cystic duct. The cystic duct joins the common hepatic duct to form the common bile duct.
- **Function: storage and concentration of bile and the release of bile into the small intestine when needed.** by common hepatic duct not common bile duct



The Pancreas → accessory structure (gland) in digestive system

- The pancreas → in the C-shaped to duodenum is an **elongated gland** located **posterior to the stomach**. It **has both exocrine and endocrine functions**.
- It is formed of: **head, neck, body, and tail**.
- ~~The **head** is the expanded right part of the pancreas. It's located in the concavity of the duodenum. The **neck** is a constricted region after the head. To its left, the **body** passes upwards and to the left. The **tail** is the left tapering end of the pancreas that's related to the spleen.~~
- Histology: 99% of cells are **exocrine acini** that **secrete pancreatic juice** (mixture of fluid and digestive enzymes). 1% of cells form the endocrine **pancreatic islets** (islets of Langerhans) that **secrete hormones** like **glucagon**, **insulin** and others.

↳ alpha cell

↳ Beta cell

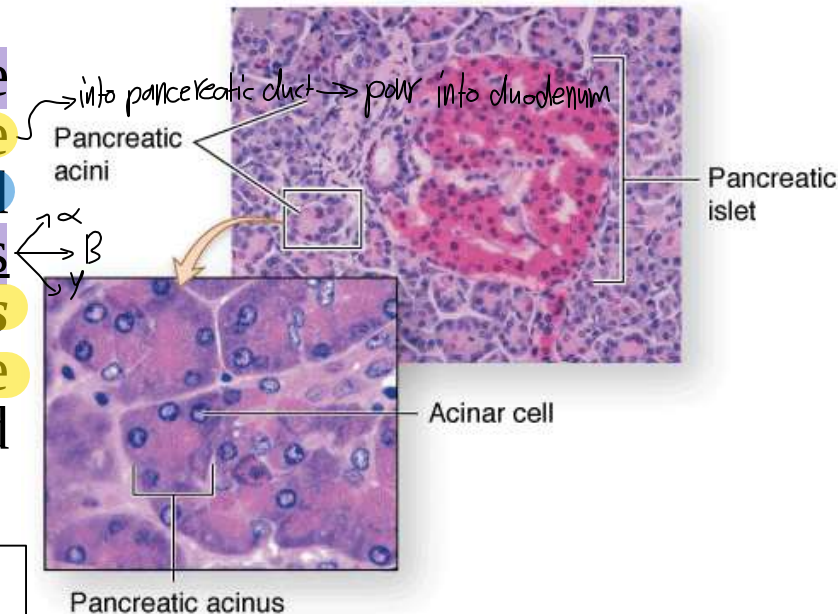


Fig.20: Histology of the pancreas.

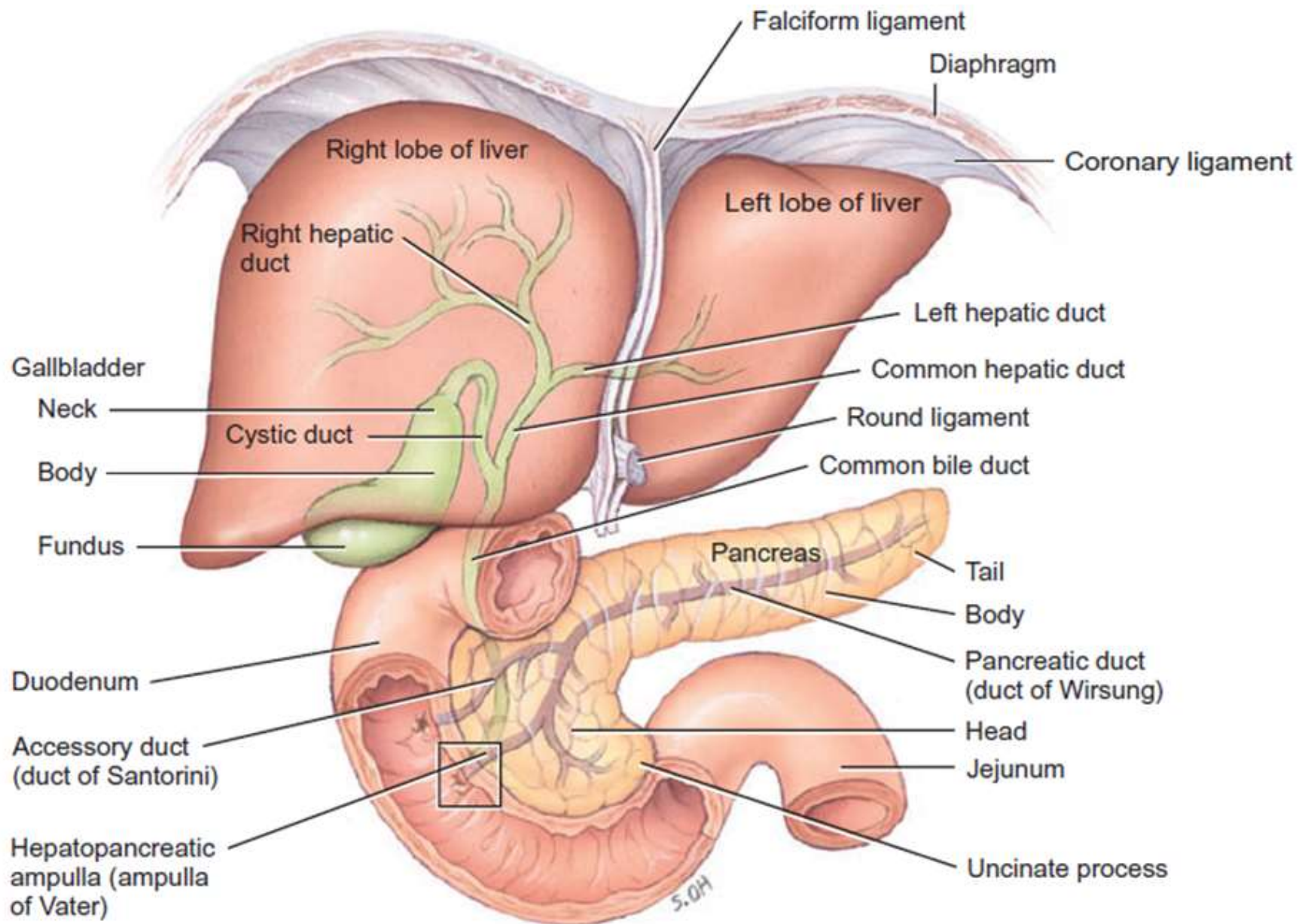


Fig.21: The pancreas.

- Pancreatic juice secreted into the main and accessory pancreatic ducts and then pass to the small intestine:

- The **main pancreatic duct** joins the common bile duct to form the **hepatopancreatic ampulla** (of Vater). This opens into the duodenum at the **major duodenal papilla** which's guarded by the **sphincter of Oddi**.

- The **accessory pancreatic duct** opens into the **minor duodenal papilla** superior to the major duodenal papilla.

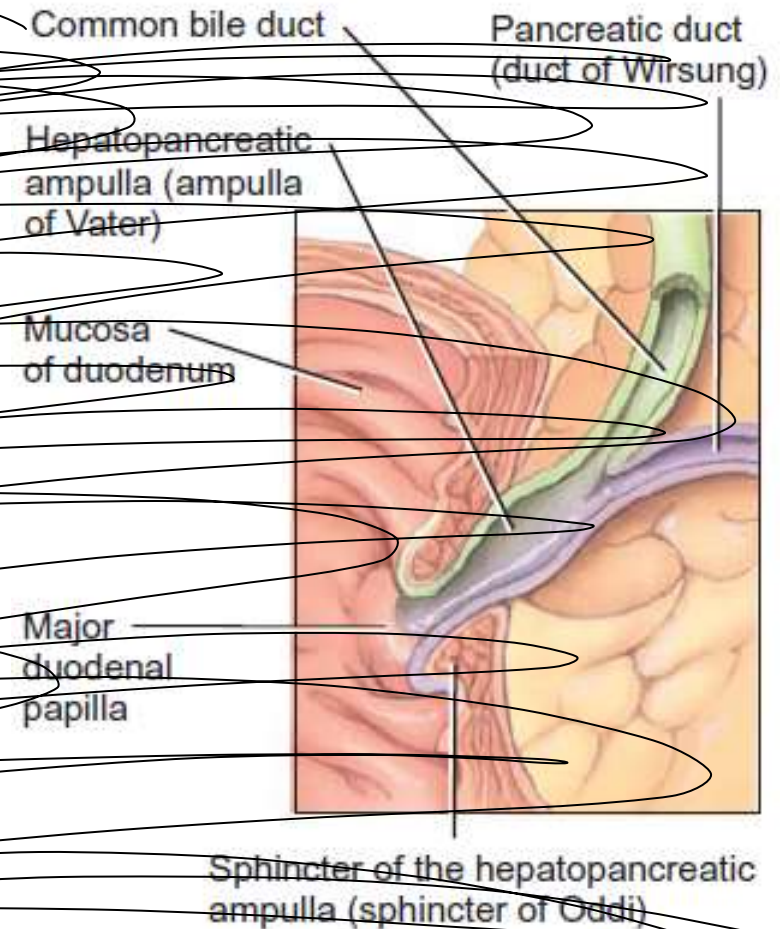


Fig.22: The hepatopancreatic ampulla.