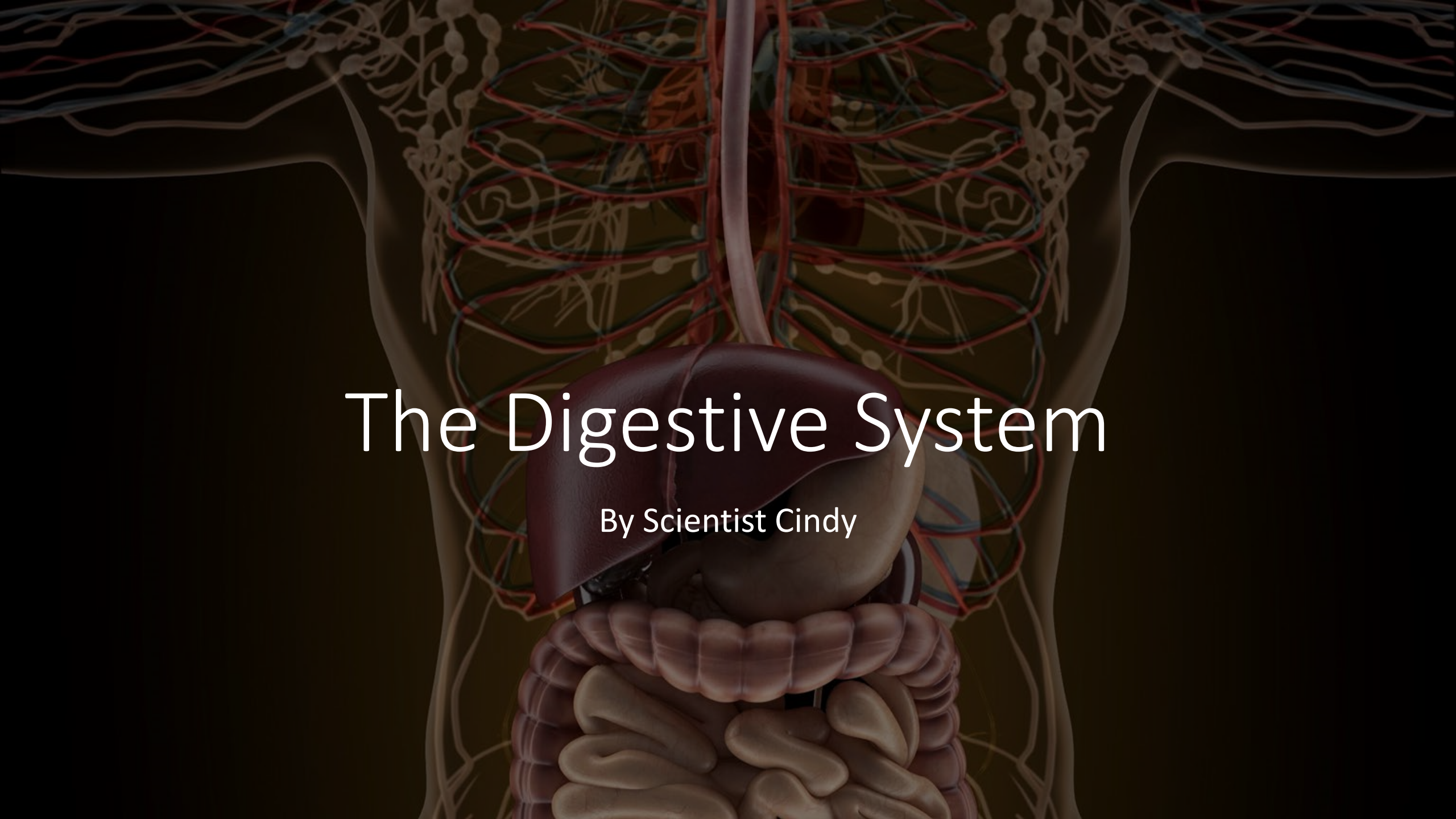
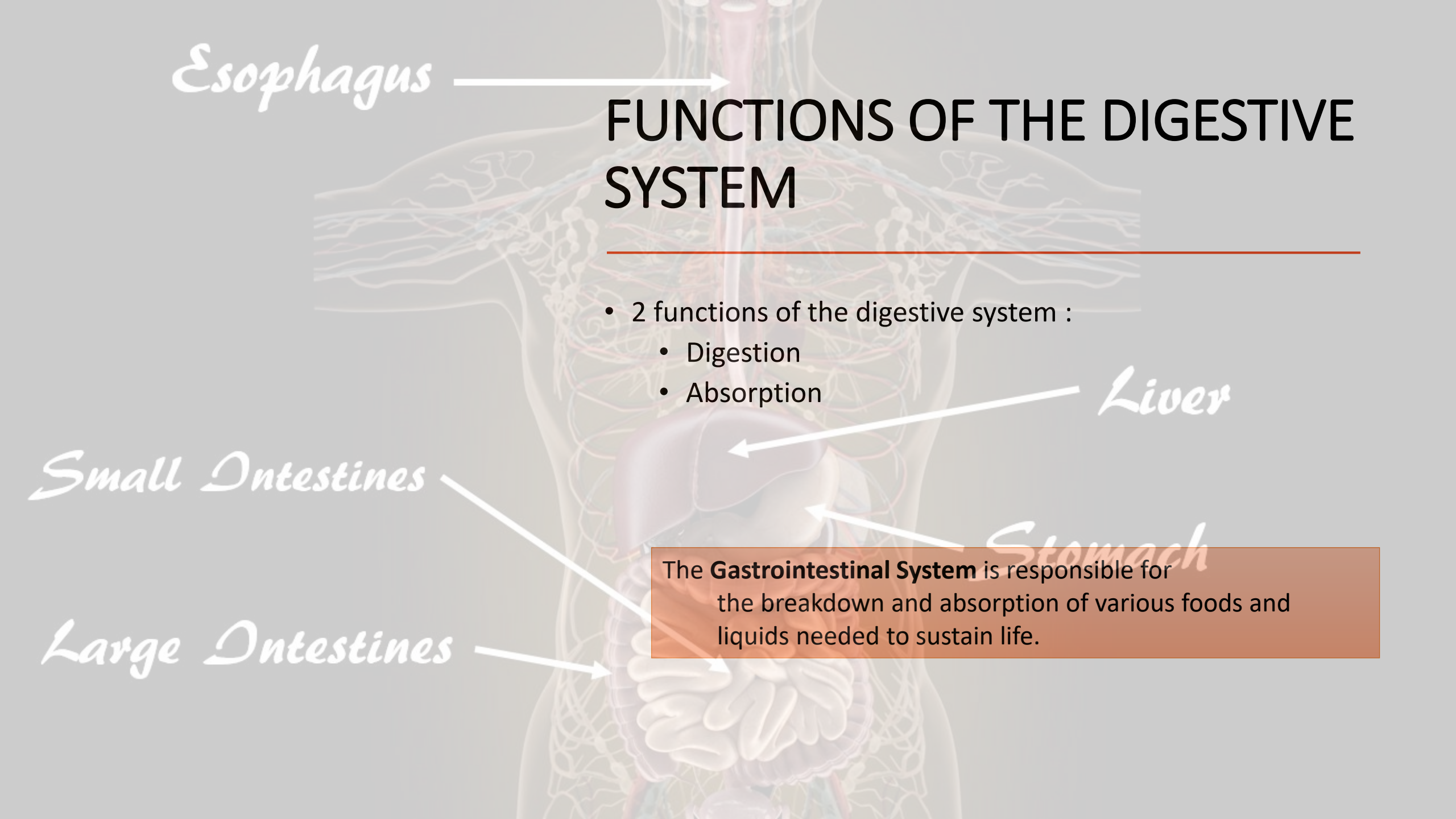


The Digestive System

By Scientist Cindy



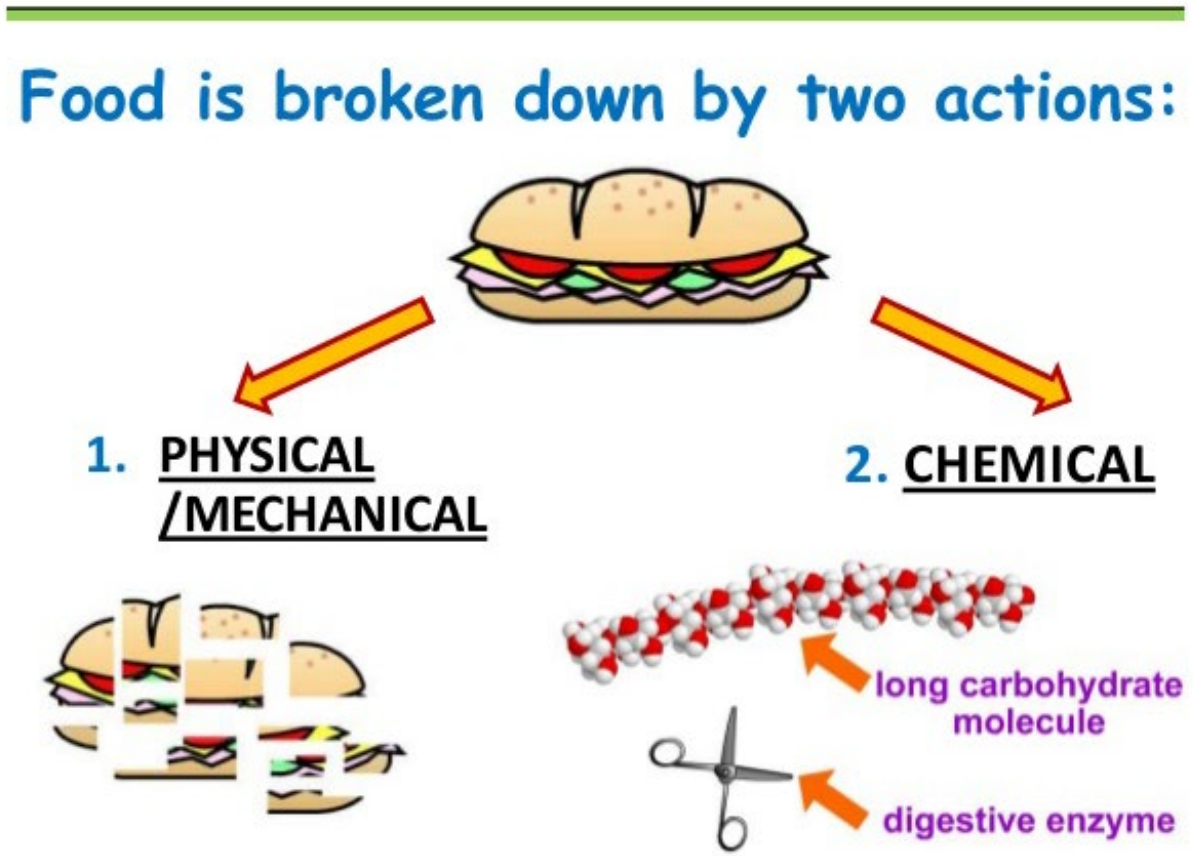
FUNCTIONS OF THE DIGESTIVE SYSTEM

- 2 functions of the digestive system :
  - Digestion
  - Absorption

The **Gastrointestinal System** is responsible for the breakdown and absorption of various foods and liquids needed to sustain life.

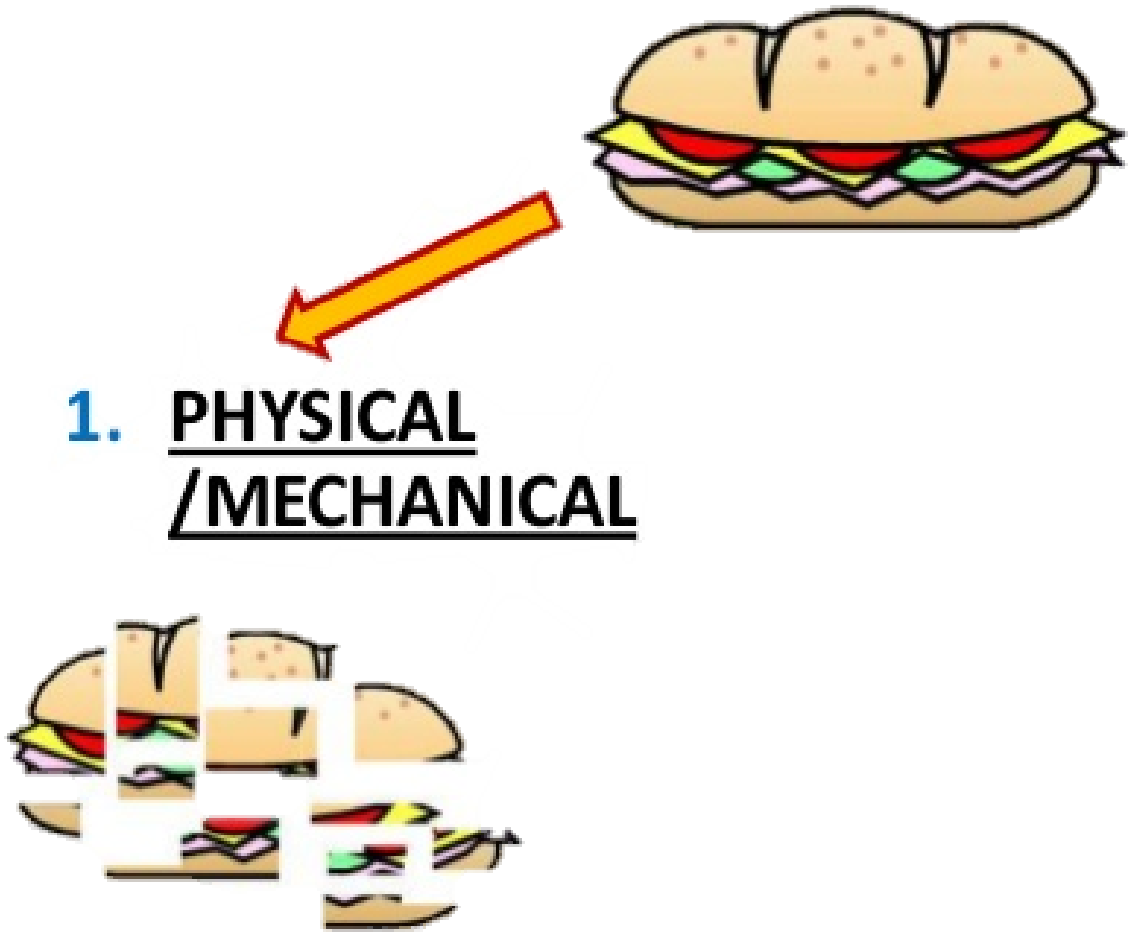
FUNCTIONS OF THE DIGESTIVE SYSTEM

- During digestion, two main processes occur at the same time;
  - Mechanical Digestion
  - Chemical Digestion



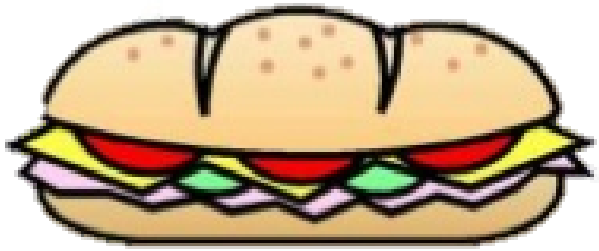
Mechanical Digestion:

- **Mechanical Digestion**: larger pieces of food get broken down into smaller pieces while being prepared for chemical digestion.
- Mechanical digestion starts in the mouth and continues into the stomach.

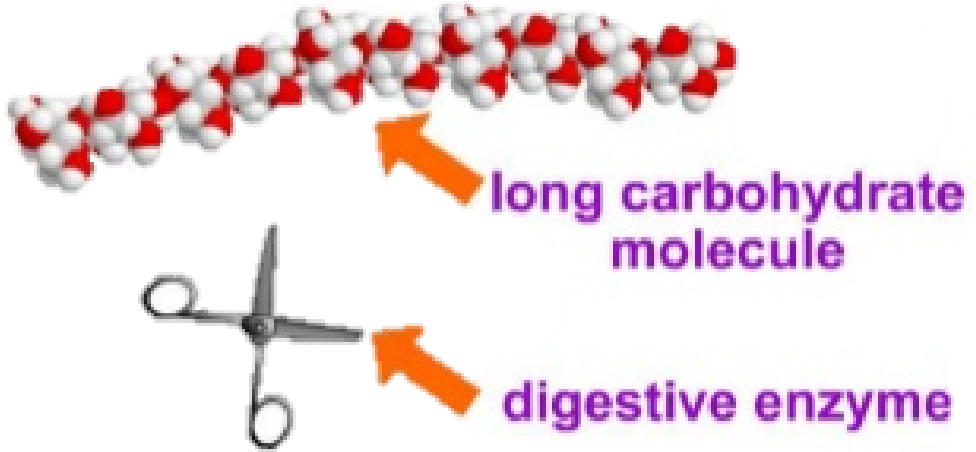


Chemical Digestion:

- **Chemical Digestion**: starts in the mouth and continues into the intestines.
- Several different enzymes break down macromolecules into smaller molecules that can be absorbed.

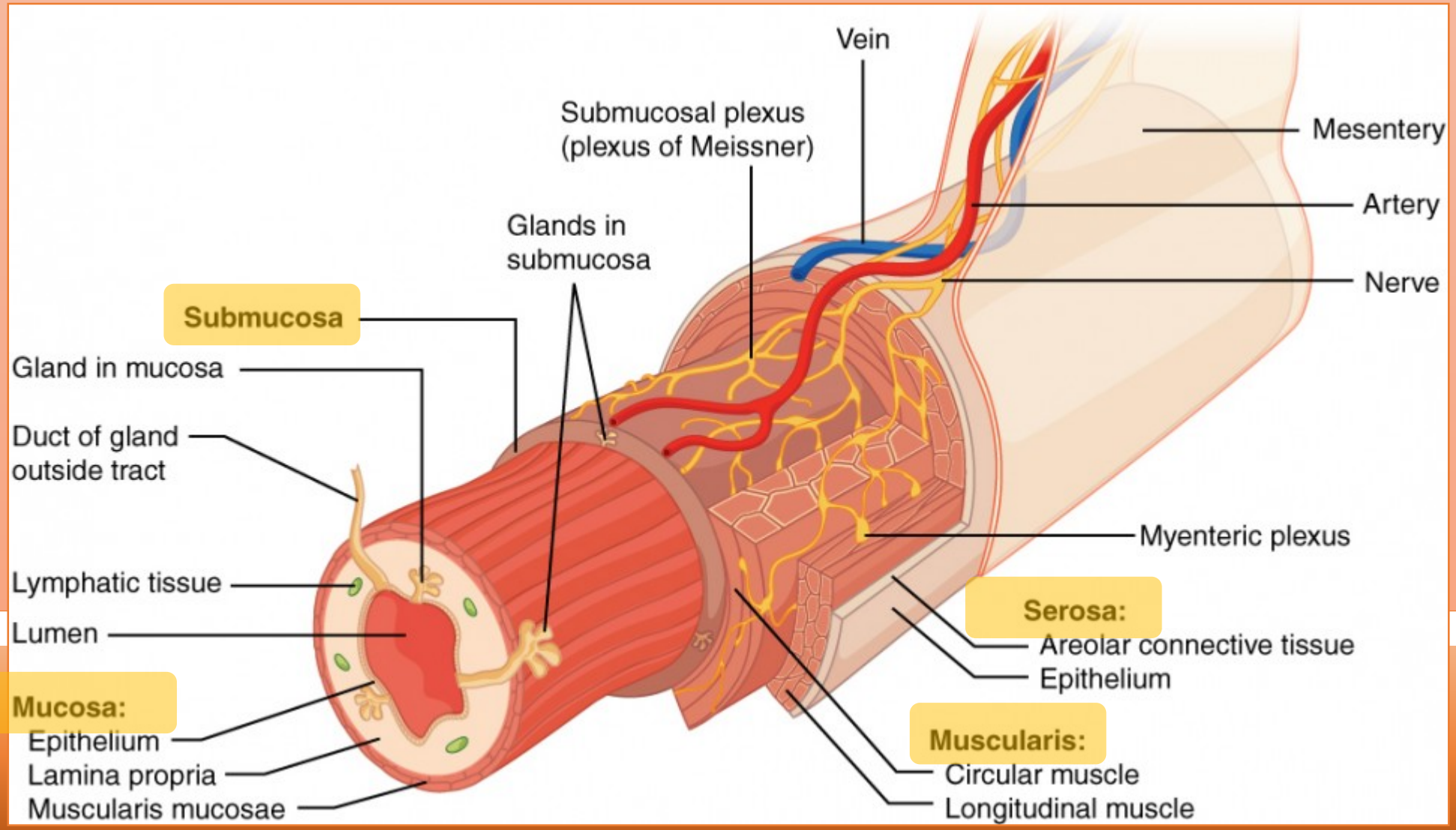


2. **CHEMICAL**



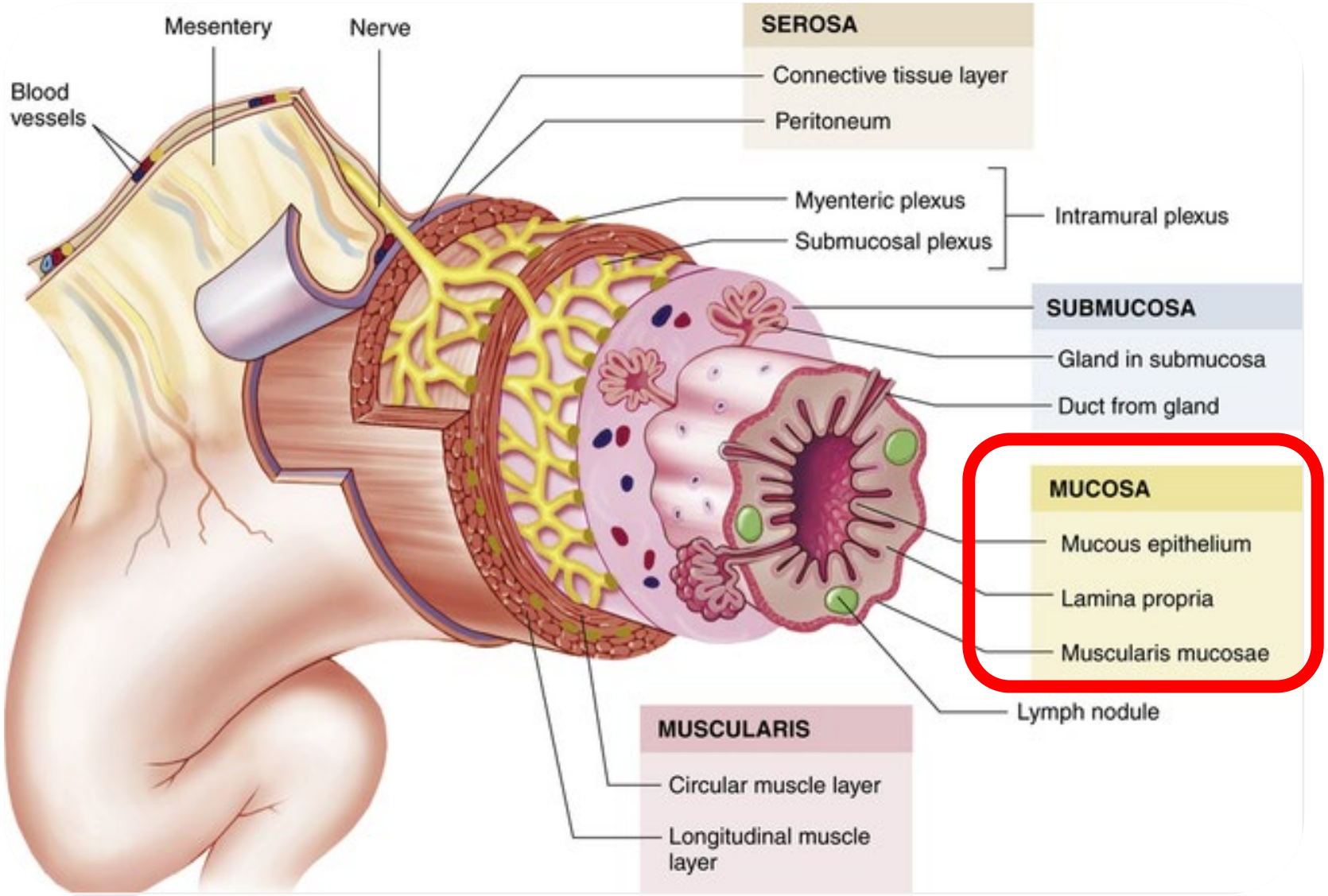
- The GI tract is composed of four layers also known as Tunics.
- From the inside out they are called:
  - Mucosa
  - Submucosa
  - Muscularis
  - Serosa

Tunics



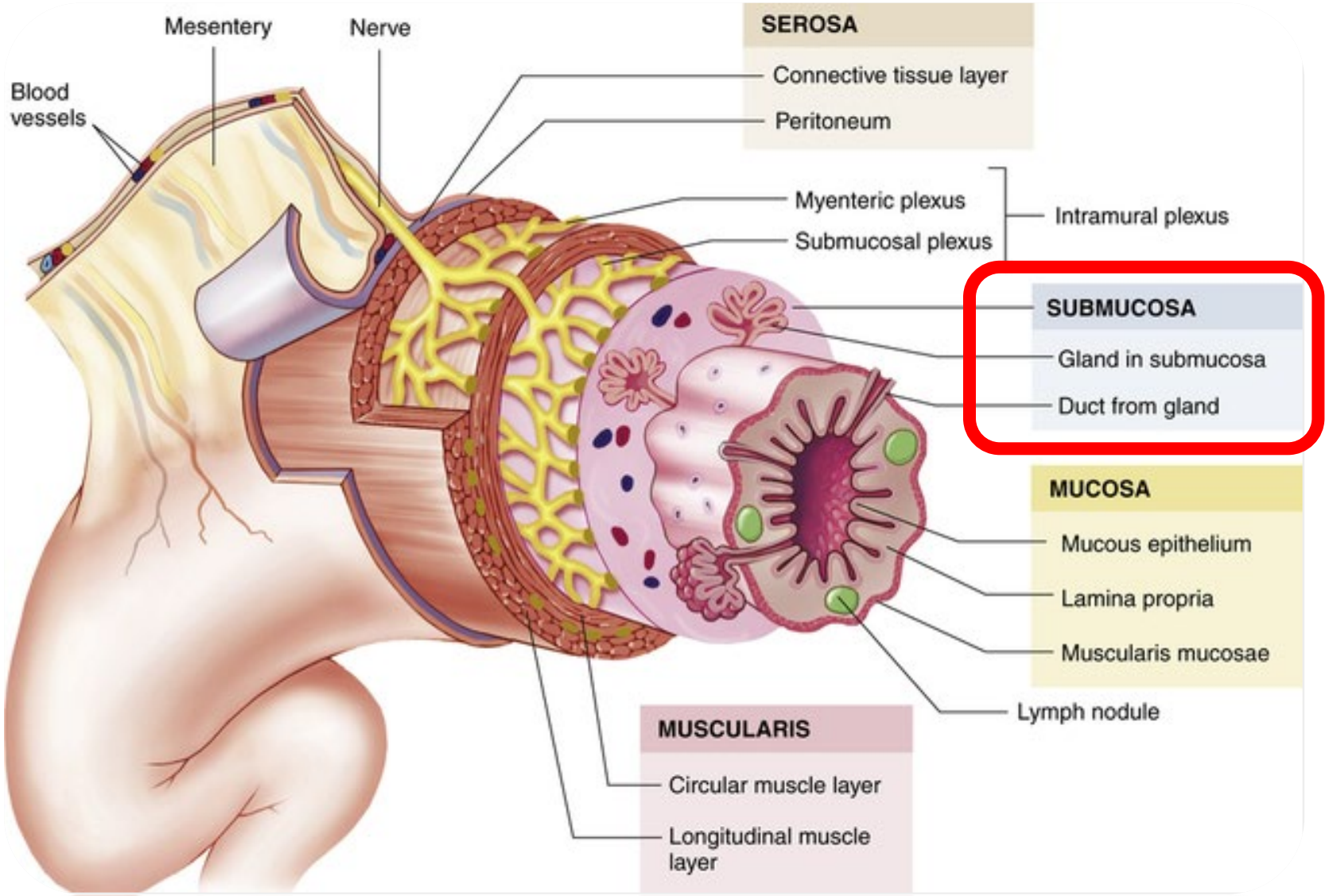
Mucosa:

- The mucosa is the absorptive and secretory layer.
- It is composed of simple epithelium cells and a thin connective tissue.
- Has goblet cells that secrete mucus.
- Has Villi and Micro Villi.



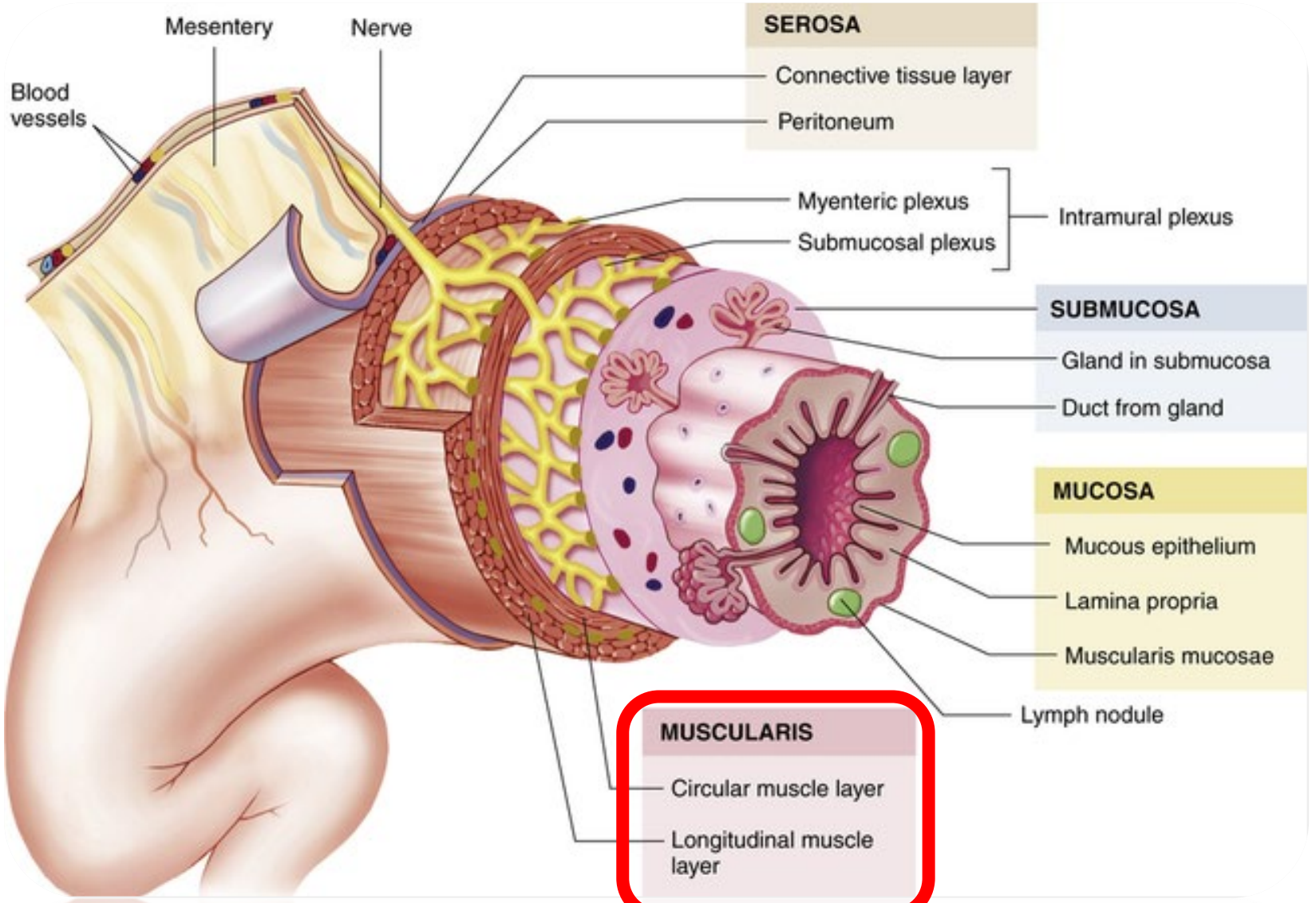
Submucosa:

- The submucosa is relatively thick, highly vascular, and serves the mucosa.
- The absorbed elements that pass through the mucosa are picked up from the blood vessels of the submucosa.
- The submucosa also has glands and nerve plexuses.



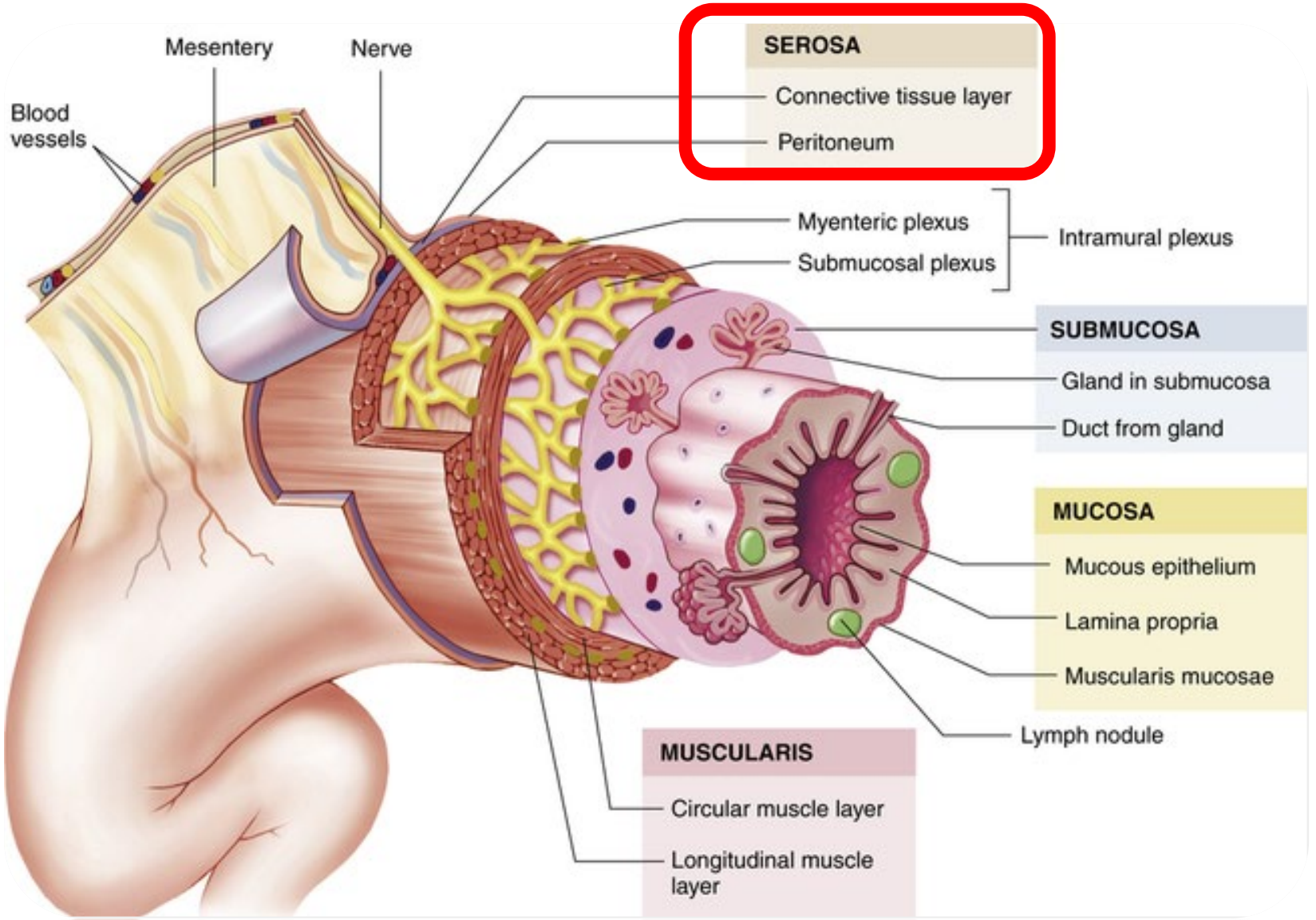
Muscularis:

- The muscularis is responsible for segmental contractions and peristaltic movement in the GI tract.
- The muscularis is composed of two layers of muscle:
  - an inner circular layer of smooth muscle
  - outer longitudinal layer of smooth muscle.
    - *These muscles cause food to move and churn with digestive enzymes down the GI tract.*



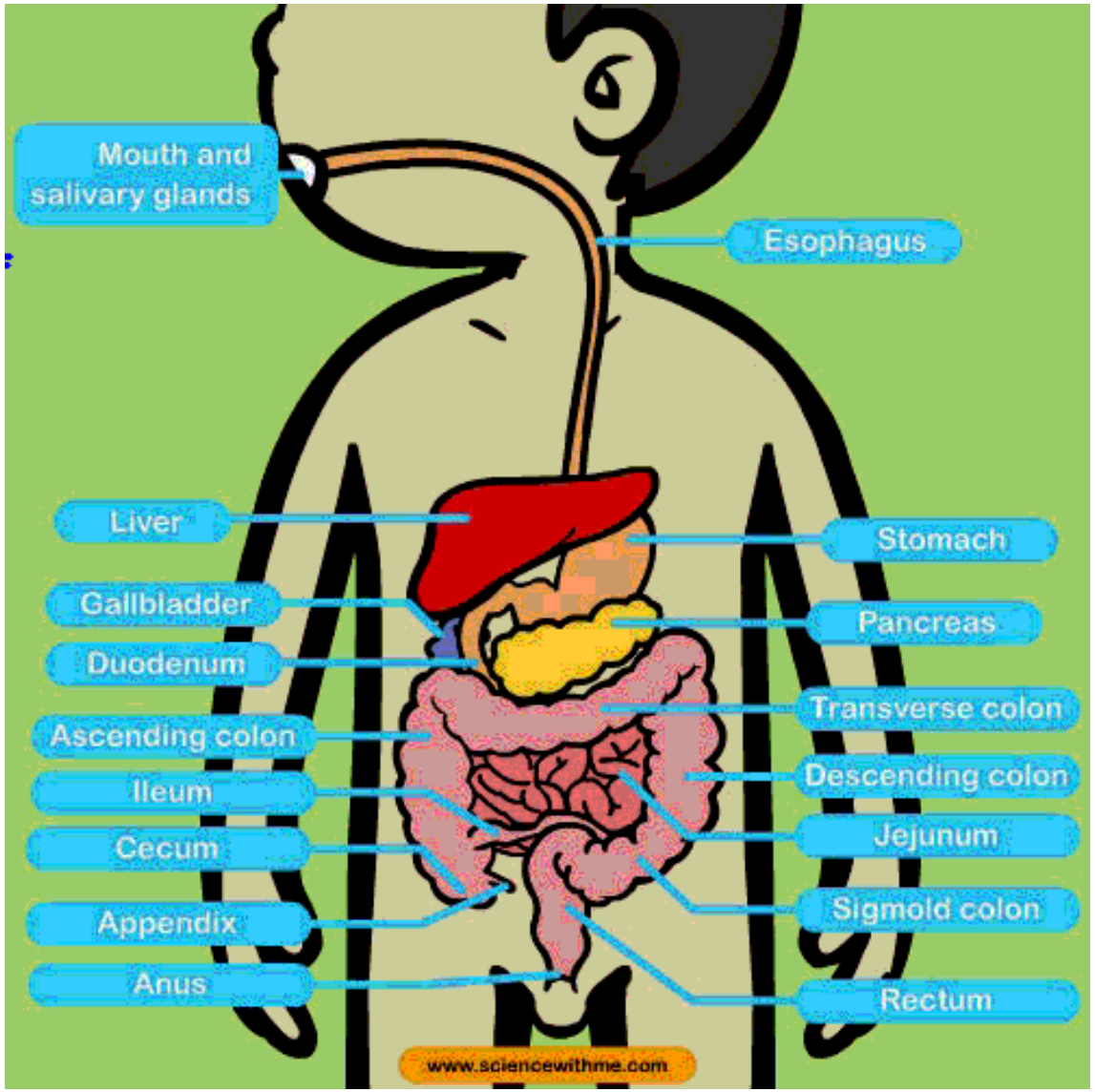
Serosa:

- The last layer is a protective layer.
- It is composed of avascular connective tissue and simple squamous epithelium.
- It secretes lubricating serous fluid.
- This is the visible layer on the outside of the organs.



The GI Tract

- The GI tract includes
  - The Mouth
  - The Esophagus
  - The Stomach
  - The Small Intestine (Duodenum, Jejunum, Ileum)
  - The Large Intestine (Colon)
  - Rectum
  - Anus



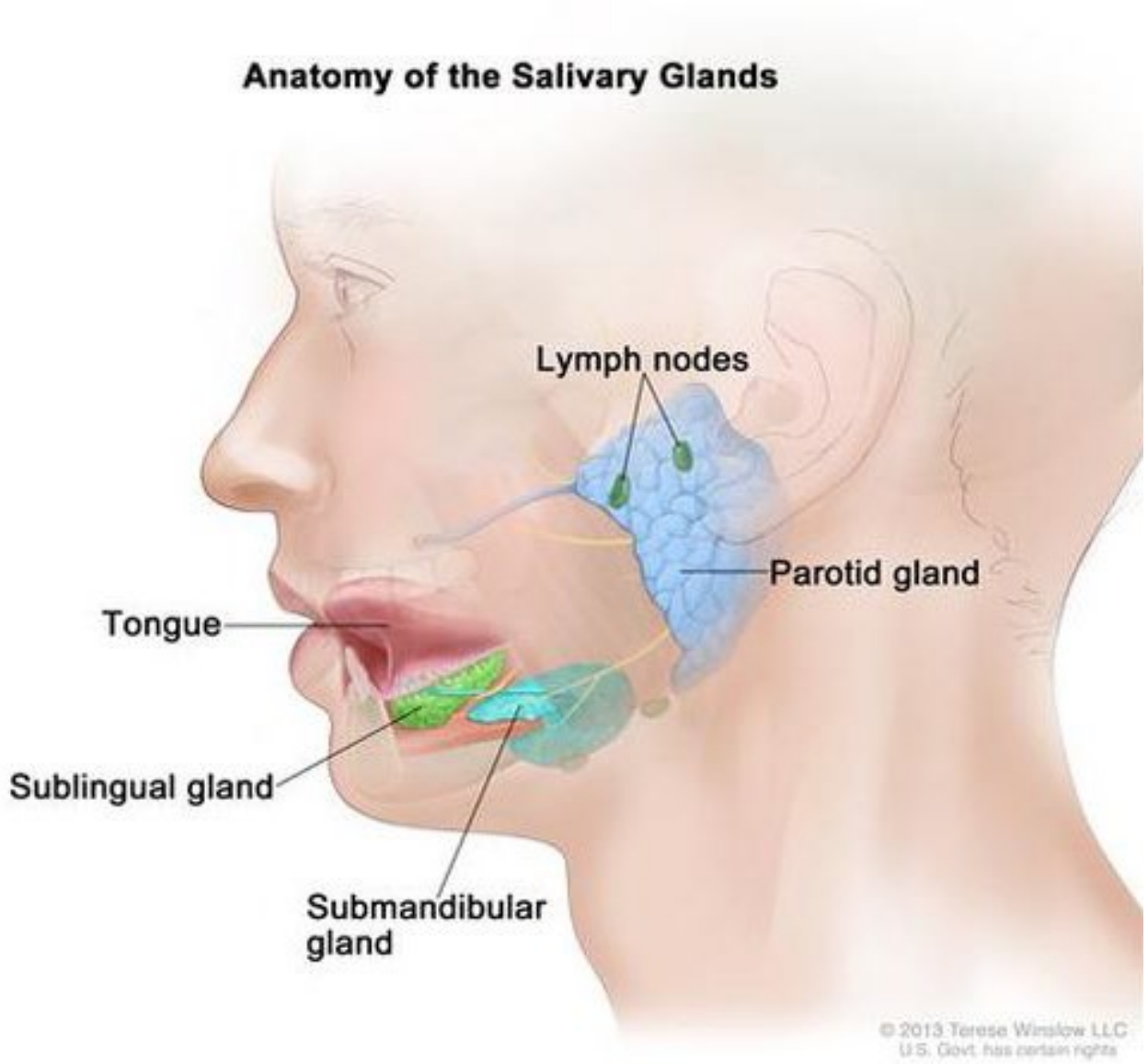
Accessory Organs

1. Salivary glands
2. Tongue
3. Teeth
4. Liver
5. Gallbladder
6. Pancreas
7. Vermiform appendix

Salivary glands

- The 3 salivary glands –
  - Parotid Gland
  - Submandibular Gland
  - Sublingual Gland

- The Salivary Glands are exocrine glands that produce saliva which begins the process of digestion with amylase, and moistens the food creating a bolus.



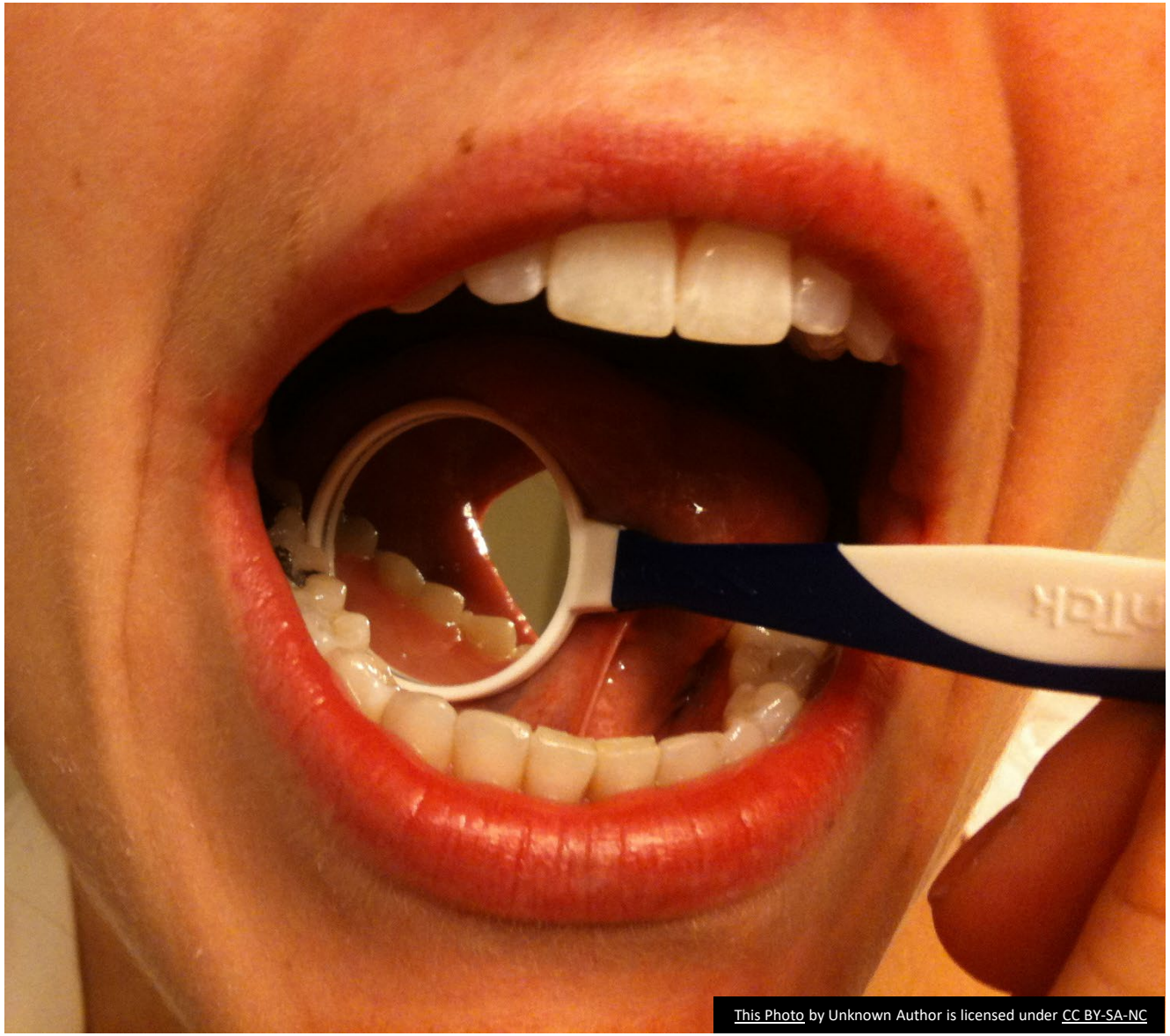
Tongue and Teeth

Tongue

- Manipulates food for chewing/swallowing
- Main taste organ, covered in taste buds

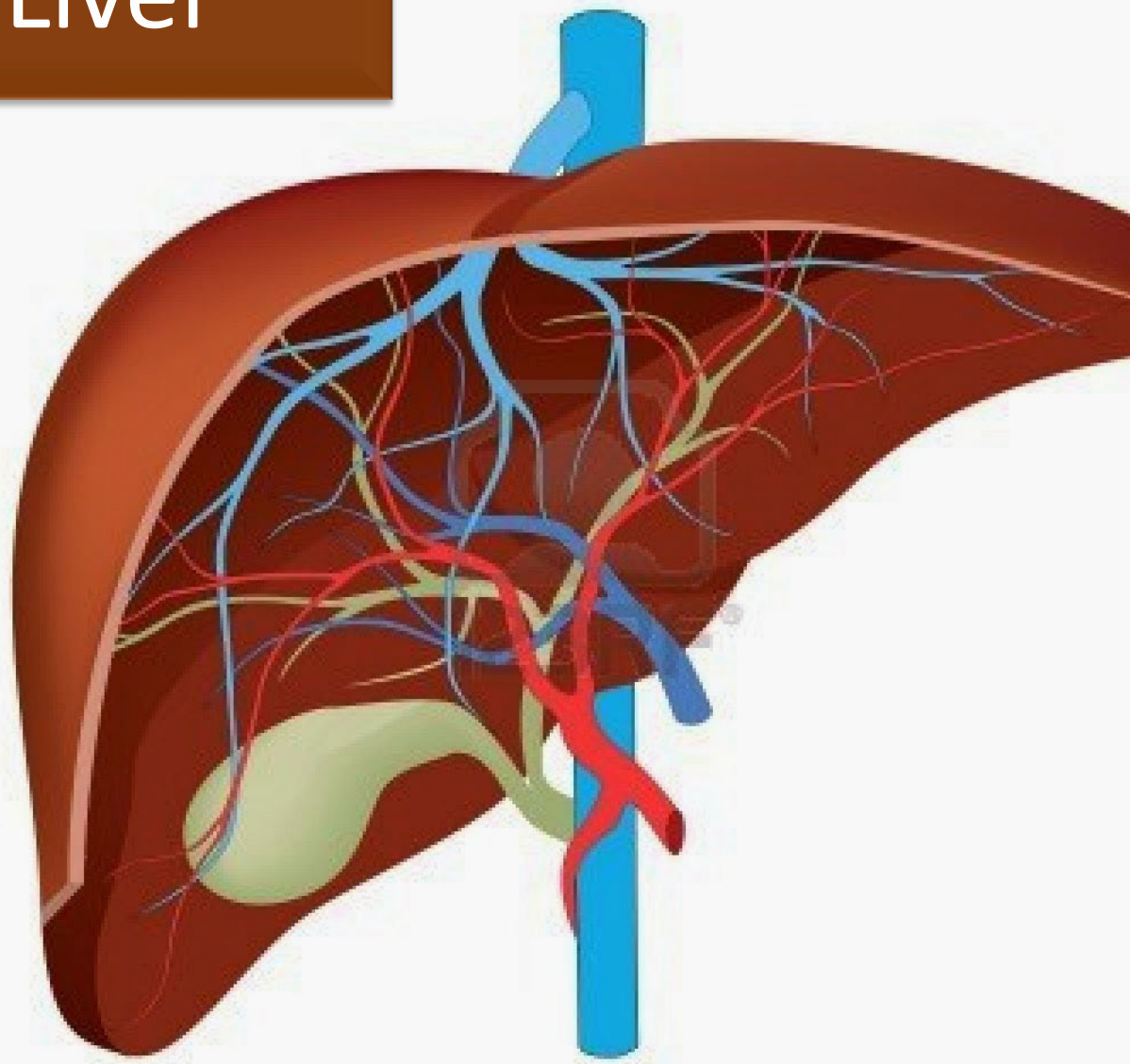
Teeth

- For chewing food up



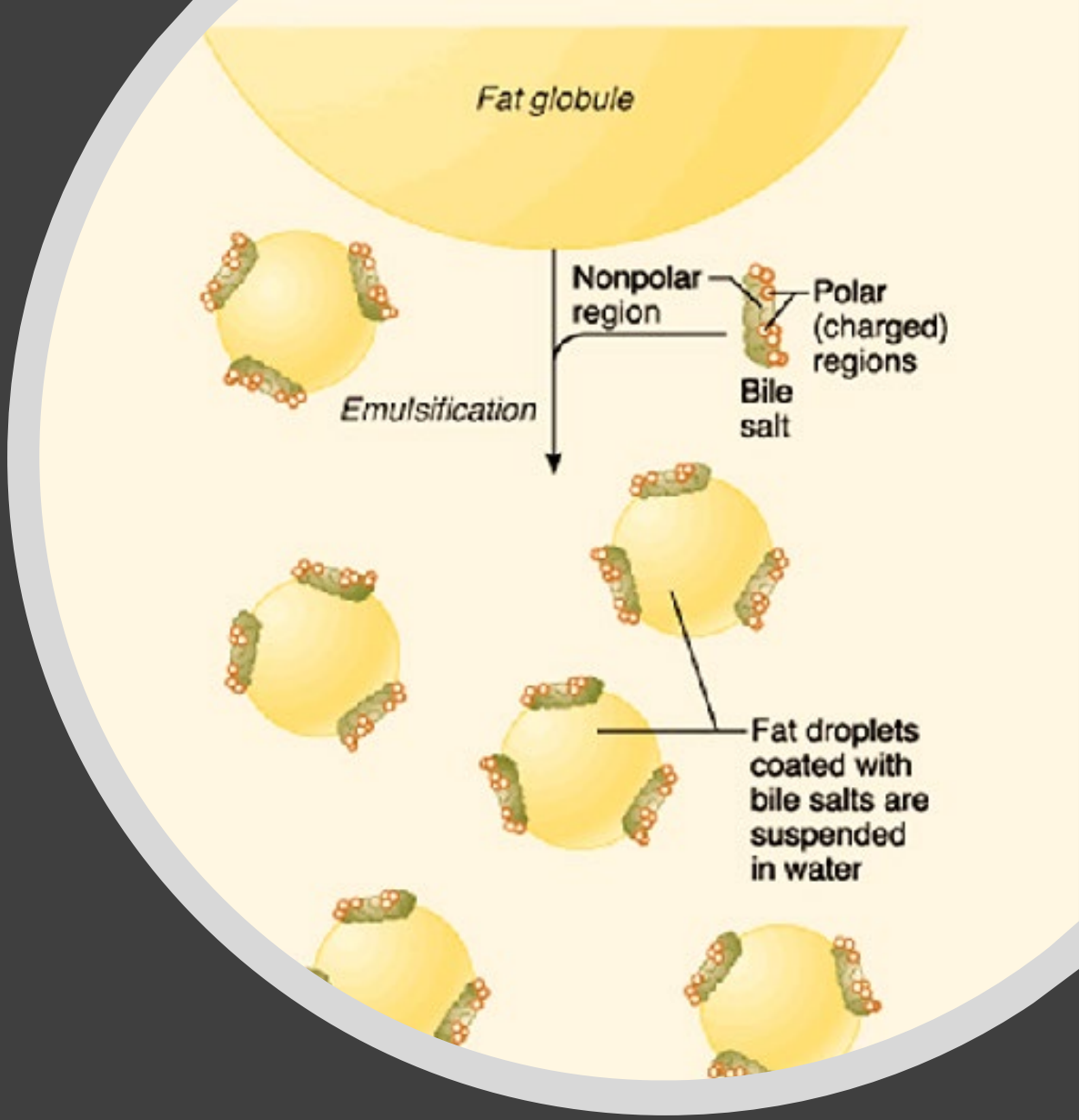
Liver

- Produces and excretes bile required for emulsifying fats.
  - Some of the bile drains directly into the duodenum and some is stored in the gall bladder.
- Helps metabolize proteins, lipids, and carbohydrates.
- Urea is formed in liver from amino acids and compounds of ammonia.
- Breaks down insulin and other hormones.
- Produces coagulation factors.



Liver

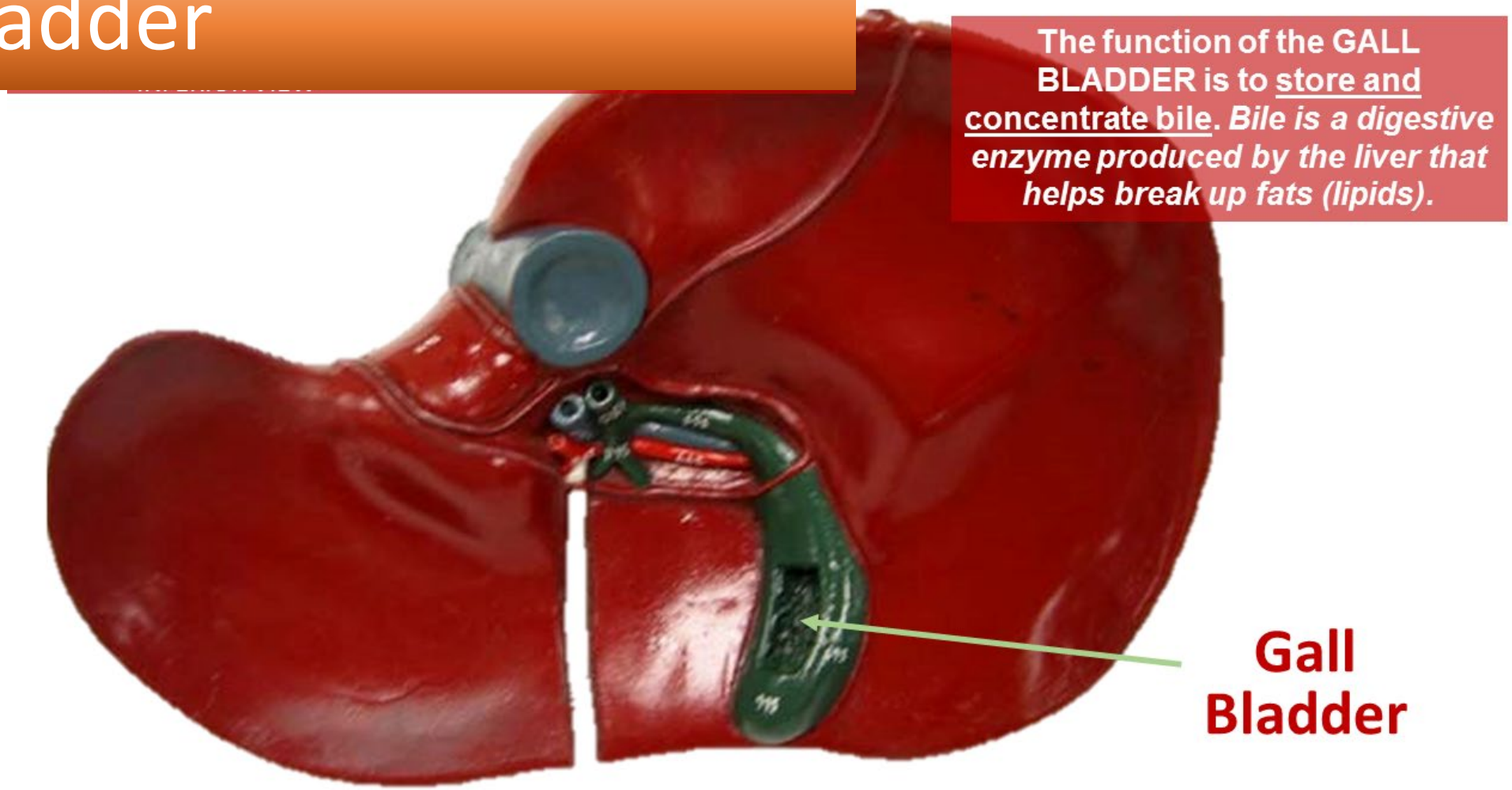
- The liver produces and excretes bile required for emulsifying fats.
  - Some of the bile drains directly into the duodenum and some is stored in the gall bladder.



FUNCTION:

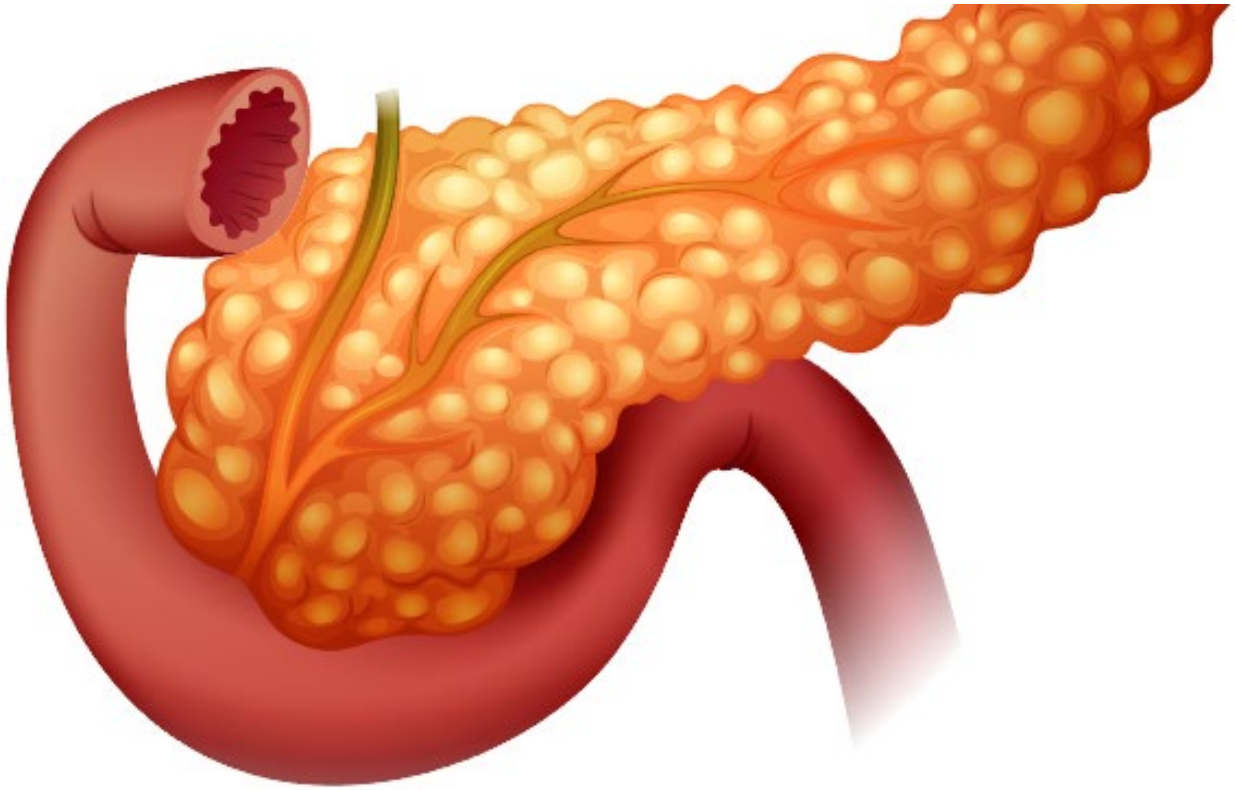
- Bile storage – Stores and Concentrated Biles from the Liver

Gallbladder



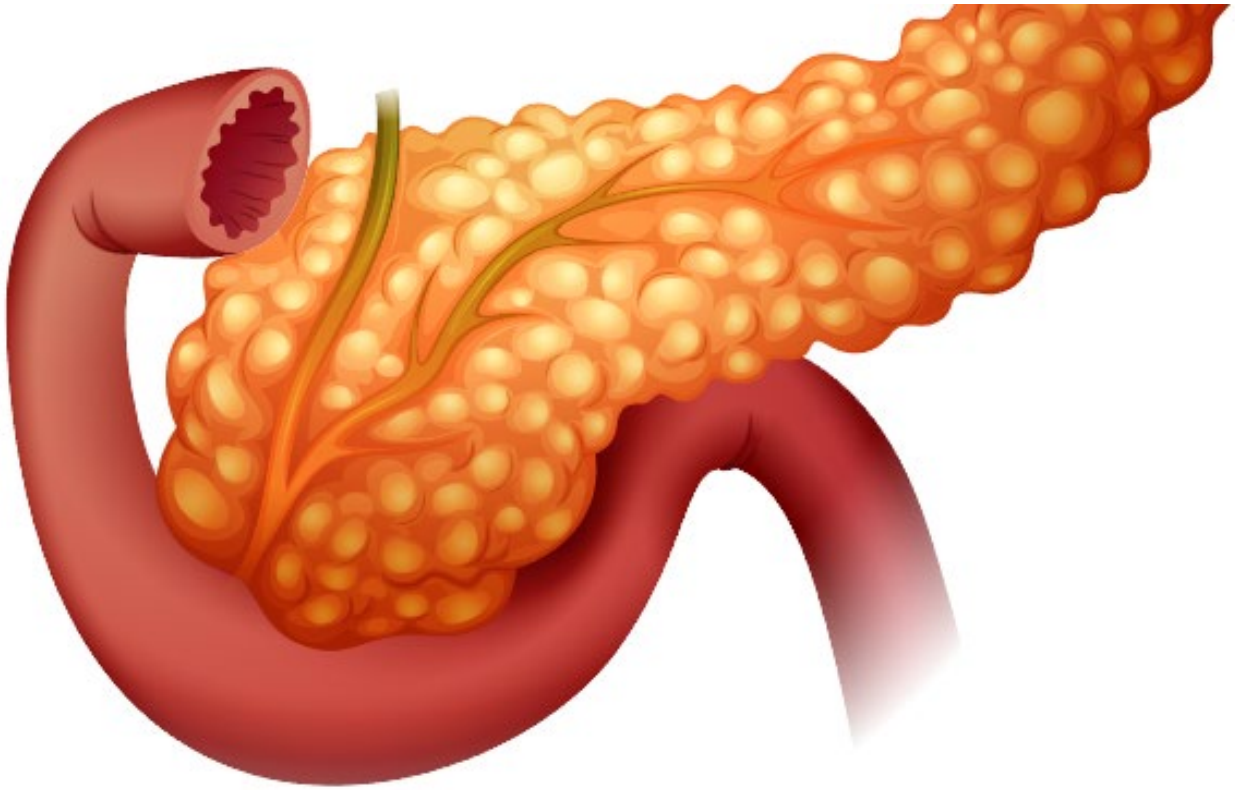
PANCREAS

- Exocrine functions: Digestive enzyme secretion.
  - Trypsinogen – Trypsin: digests protein.
  - Chymotypsinogen – Chymotrypsin: digests proteins.
  - Carboxypeptidases: digests proteins.
  - Lipase-lipid: digests fats.
  - Amylase: digests carbohydrates.



PANCREAS

- Endocrine functions: Hormone secretion.
  - Somatostatin: inhibits insulin in response to the body is getting too much glucose.
  - Glucagon: stimulates the stored glycogen in the liver to convert to glucose. Produced if the body does not have enough glucose.
  - Insulin: made in the beta cells of the Islets of Langerhans of the pancreas. Insulin is a hormone that regulates blood glucose.

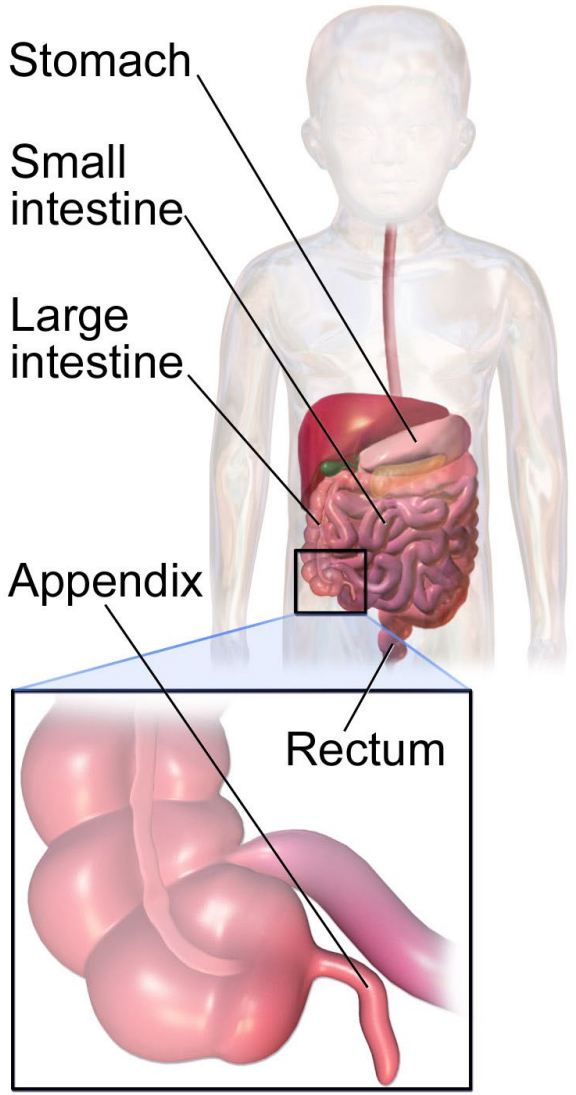


PANCREAS

Vermiform Appendix

There are a few theories on what the appendix does.

- Vestigal organ
- Immune function
- Helps maintain gut flora



Location of the Appendix

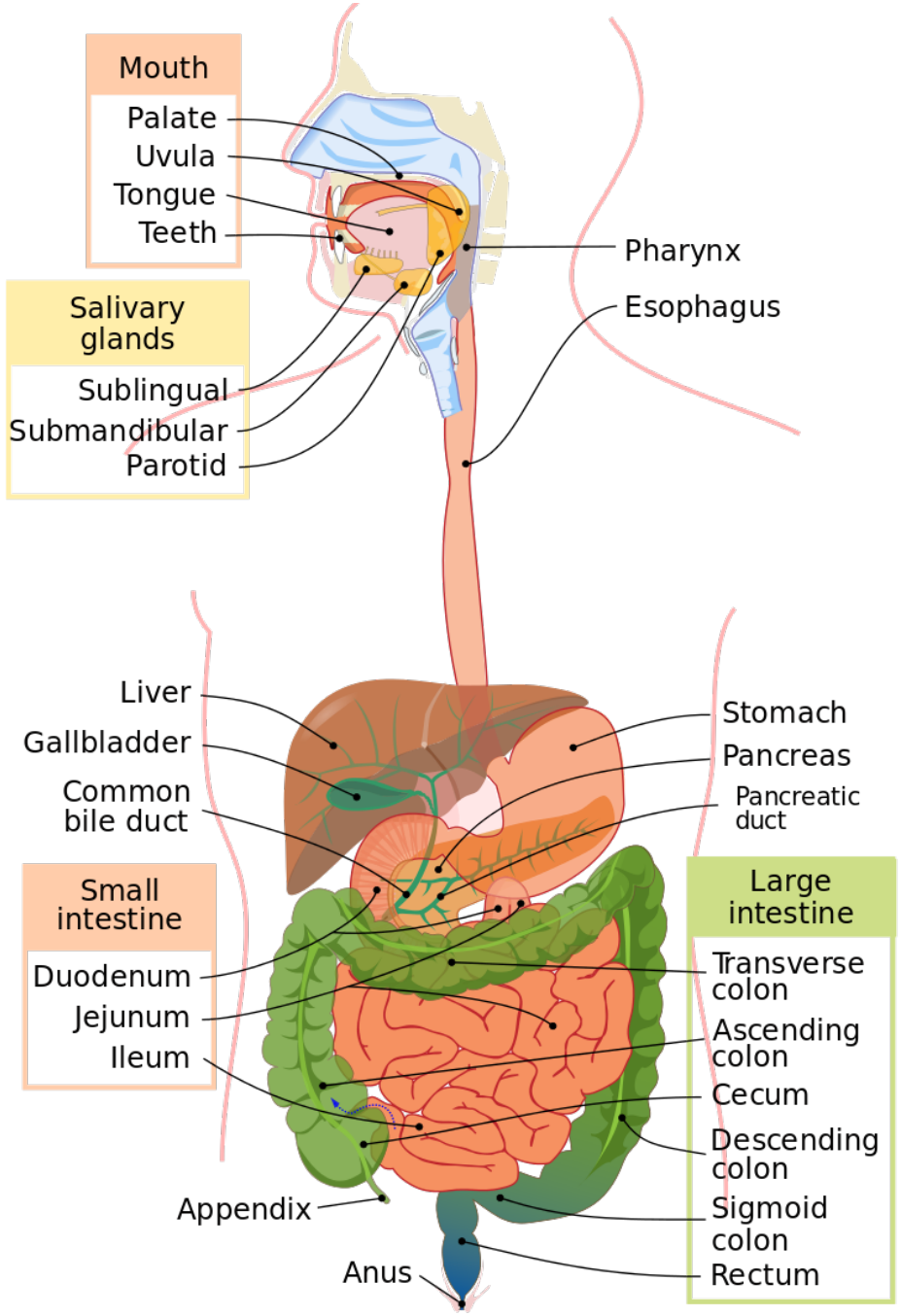
The **gastrointestinal tract**

- The **gastrointestinal tract**, is also called the digestive tract, alimentary canal, or gut

- It is the system of organs that
  - takes in food
  - digests it
  - expels waste

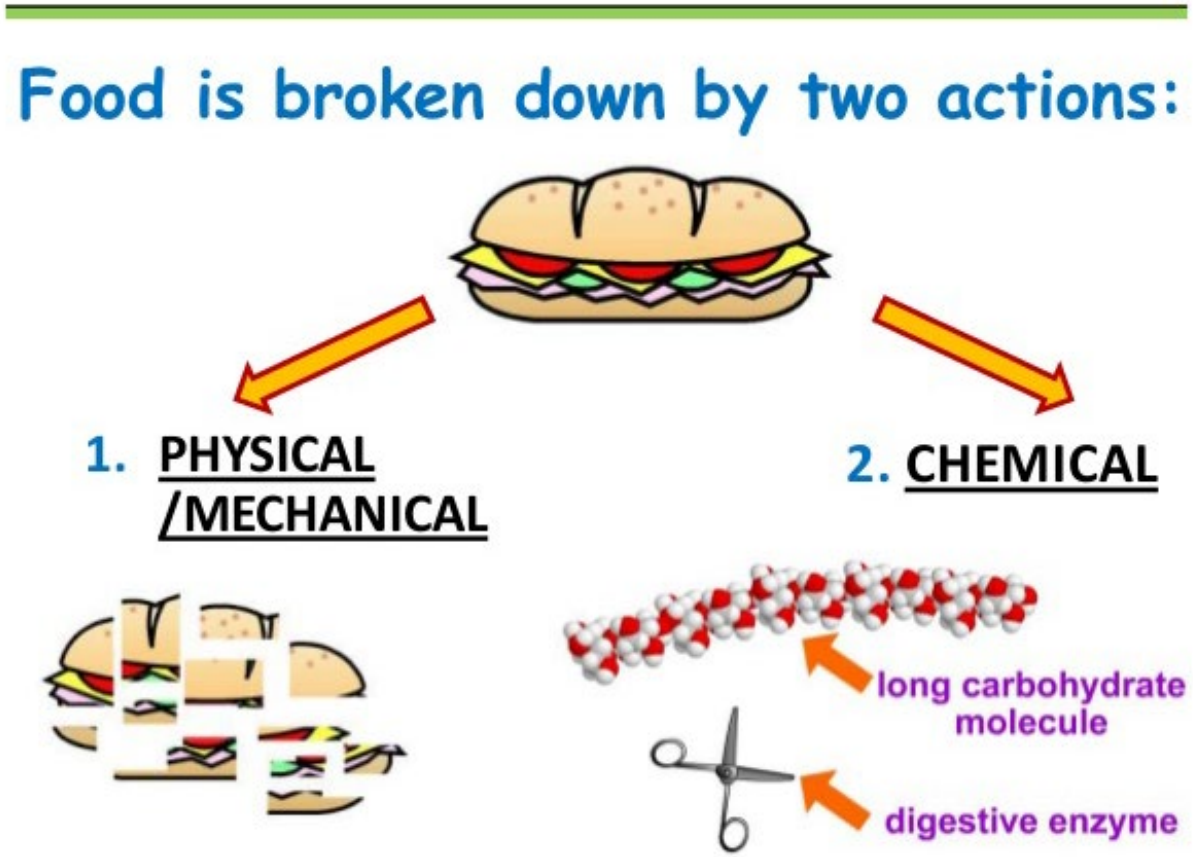
The alimentary canal

The alimentary canal is the long tube of organs that runs from the mouth (where the food enters) to the anus (where indigestible waste leaves).



2 Processes of Digestion

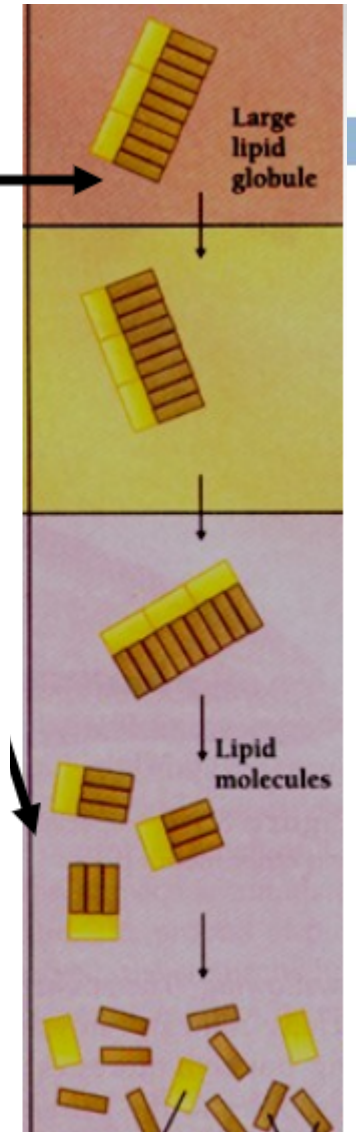
- During digestion two main processes occur at the same time:
- **Mechanical Digestion**:
  - larger pieces of food get broken down into smaller pieces while being prepared for chemical digestion.
  - Mechanical digestion starts in the mouth and continues in to the stomach.
- **Chemical Digestion**:
  - several different enzymes break down macromolecules into smaller molecules that can be more efficiently absorbed.
  - Chemical digestion starts with saliva and continues into the intestines.



Nutrient Digestion – Lipids

Bile and Fat Digestion

The fat/grease you eat



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  - Litmus: pH
    - Turns blue
    - Turns Red
- 4 test tubes to

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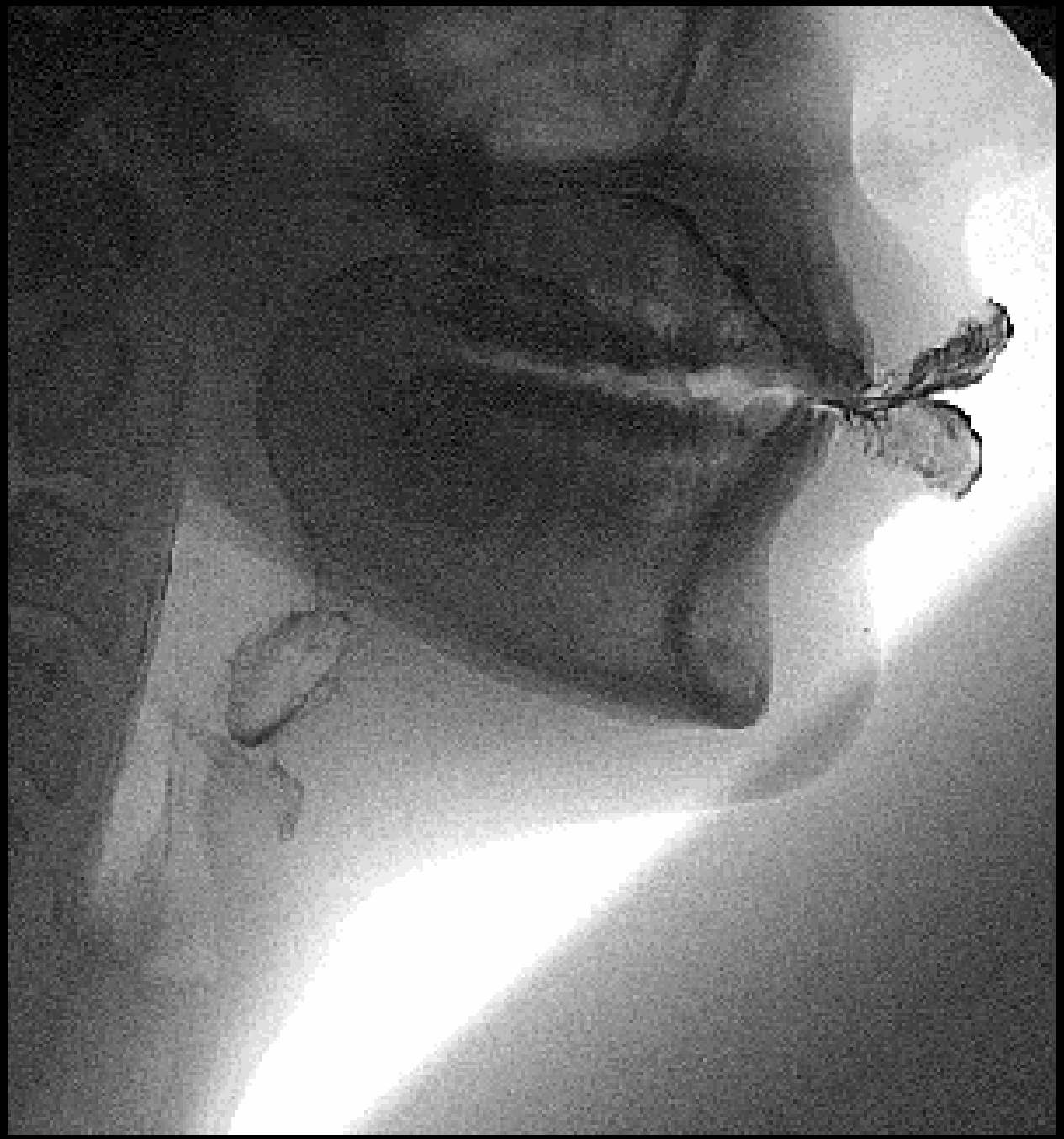


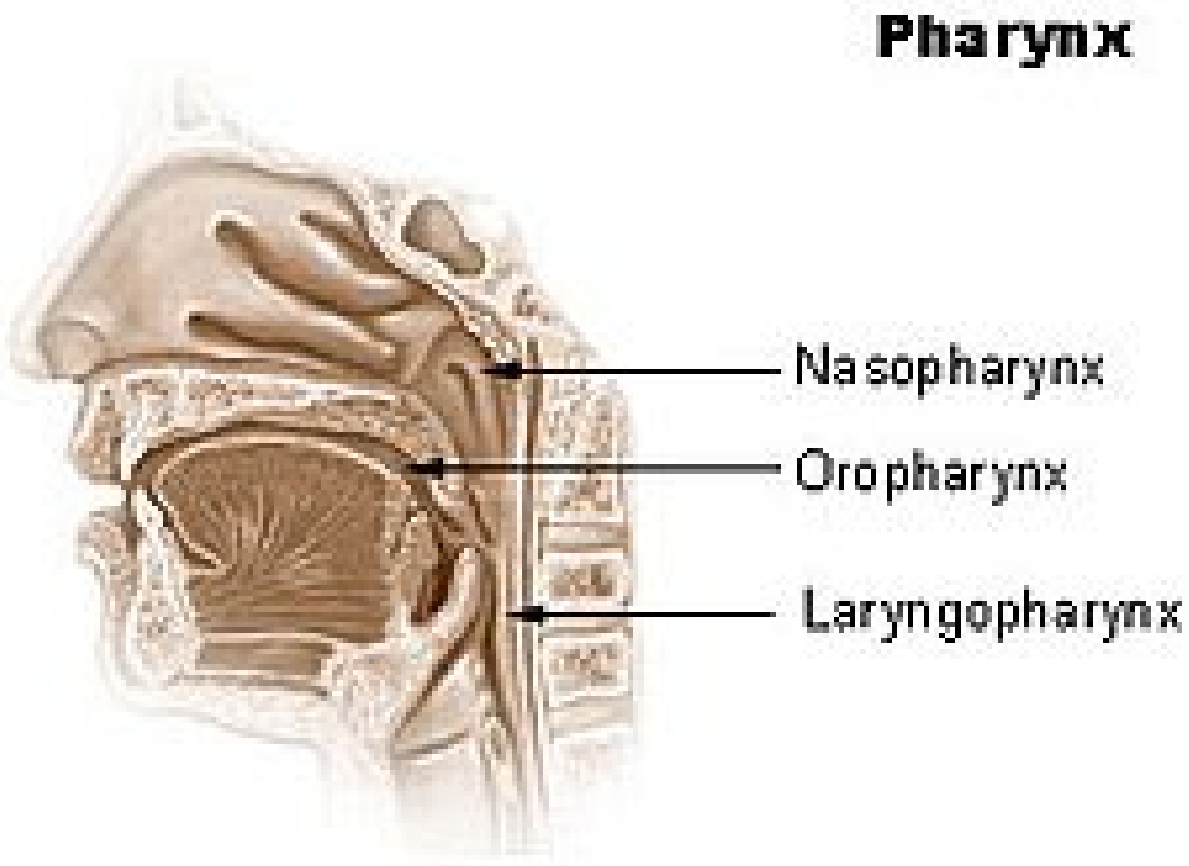
Mastication

Digestion begins in the mouth.

- Saliva moistens the food while
- Teeth chew it up and make it easier to swallow.
- Amylase, which is the digestive enzyme found in saliva, starts to break down starch into simpler sugars before the food even leaves the mouth.

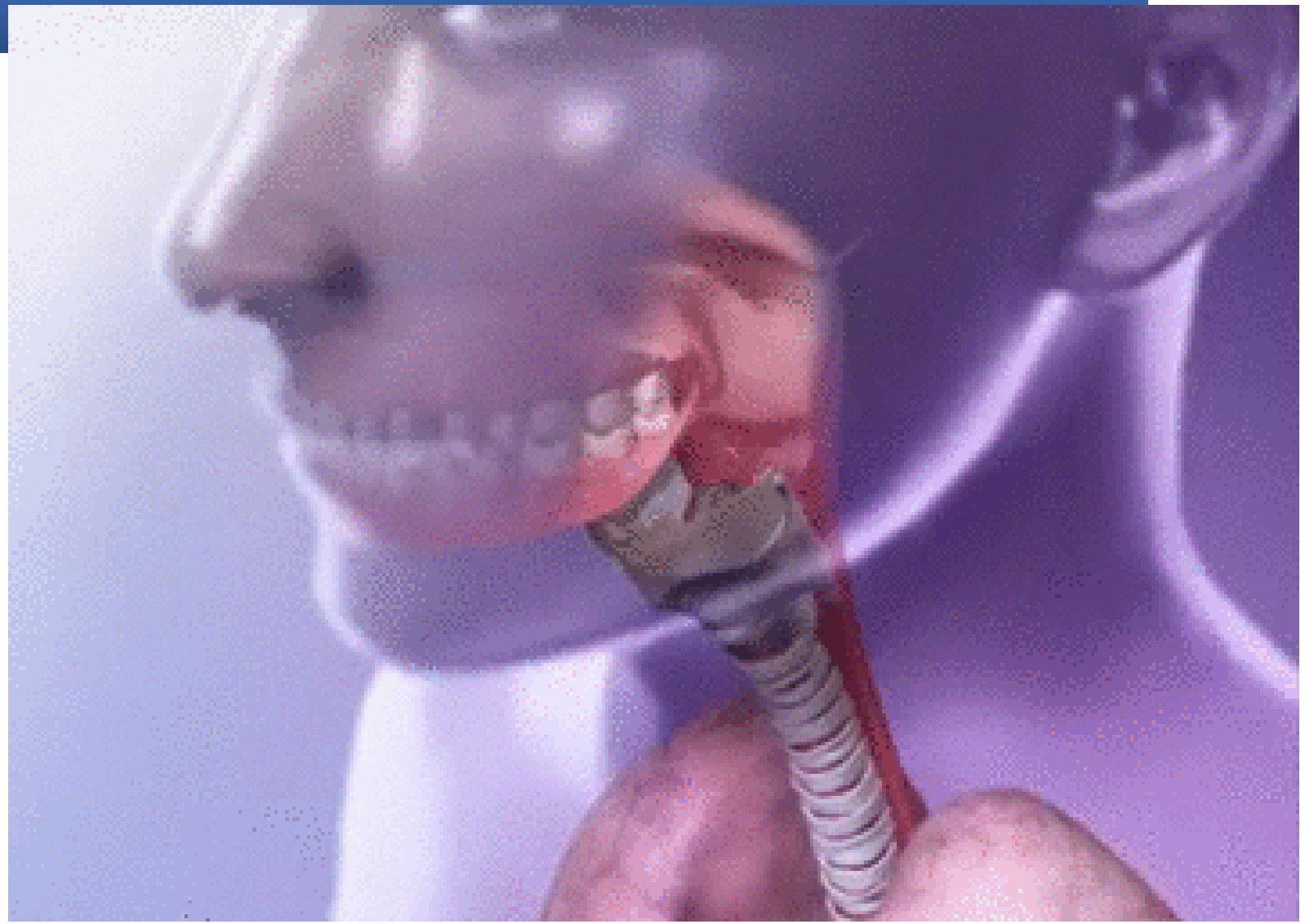
The Pharynx (Throat)
(Nasopharynx, Oropharynx, Laryngopharynx)

- **Swallowing your food happens when the muscles in your tongue and mouth move the food into your oropharynx, then on to the laryngopharynx.**
- **The pharynx is a common passageway for air (in the respiratory system) and for food (in the digestive system).**



THE EPIGLOTTIS

- A small flap of skin called the epiglottis closes over the pharynx to prevent food from entering the trachea and thus choking.
- For swallowing to happen correctly a combination of 25 muscles must all work together at the same time.

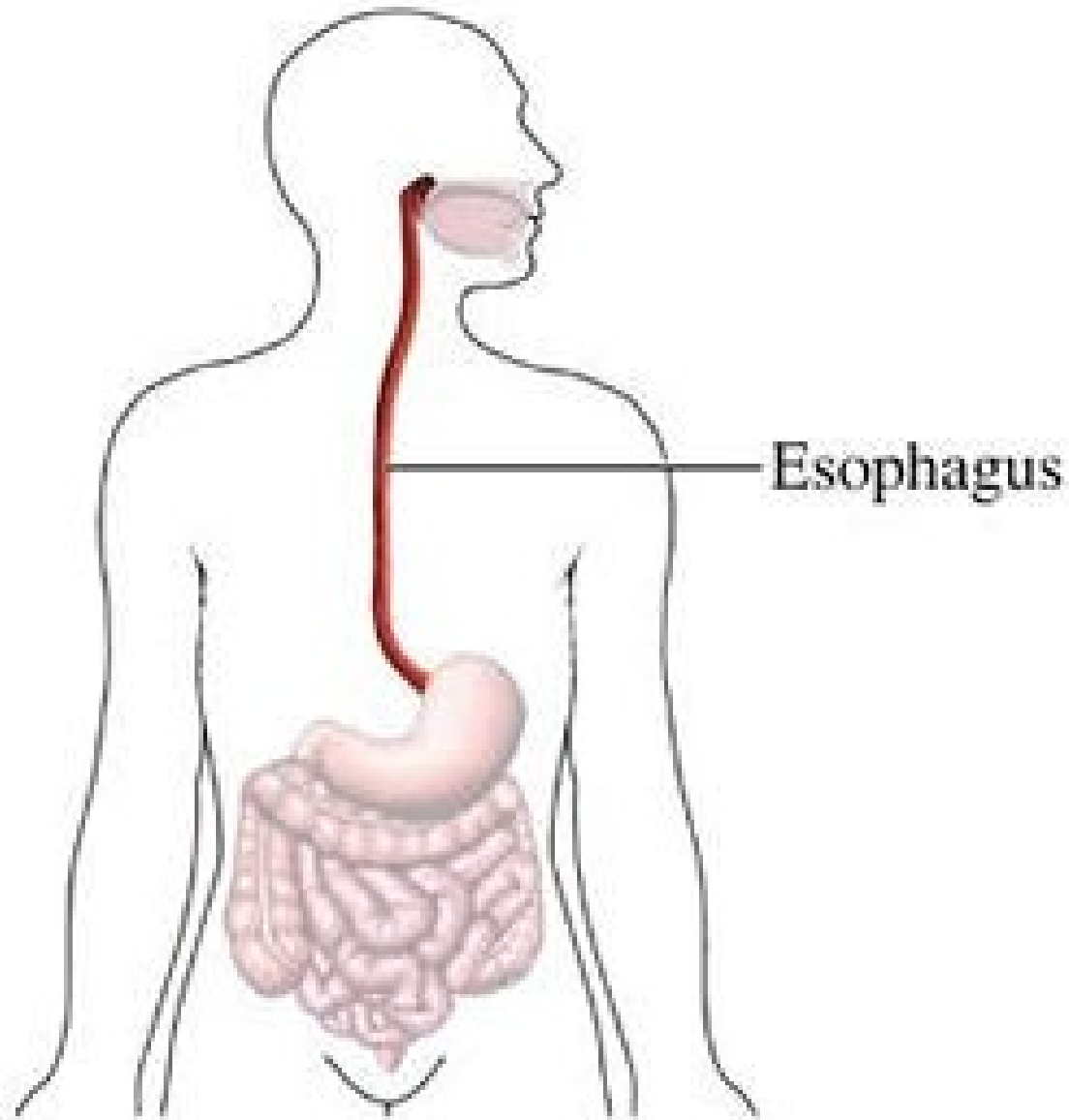


ENZYME SUMMARY

Enzyme	Produced In	Site of Release	pH Level
Carbohydrate Digestion:			
Salivary amylase	Salivary glands	Mouth	Neutral
Pancreatic amylase	Pancreas	Small intestine	Basic
Maltase	Small intestine	Small intestine	Basic
Protein Digestion:			
Pepsin	Gastric glands	Stomach	Acidic
Trypsin	Pancreas	Small intestine	Basic
Peptidases	Small intestine	Small intestine	Basic
Nucleic Acid Digestion:			
Nuclease	Pancreas	Small intestine	Basic
Nucleosidases	Pancreas	Small intestine	Basic
Fat Digestion:			
Lipase	Pancreas	Small intestine	Basic

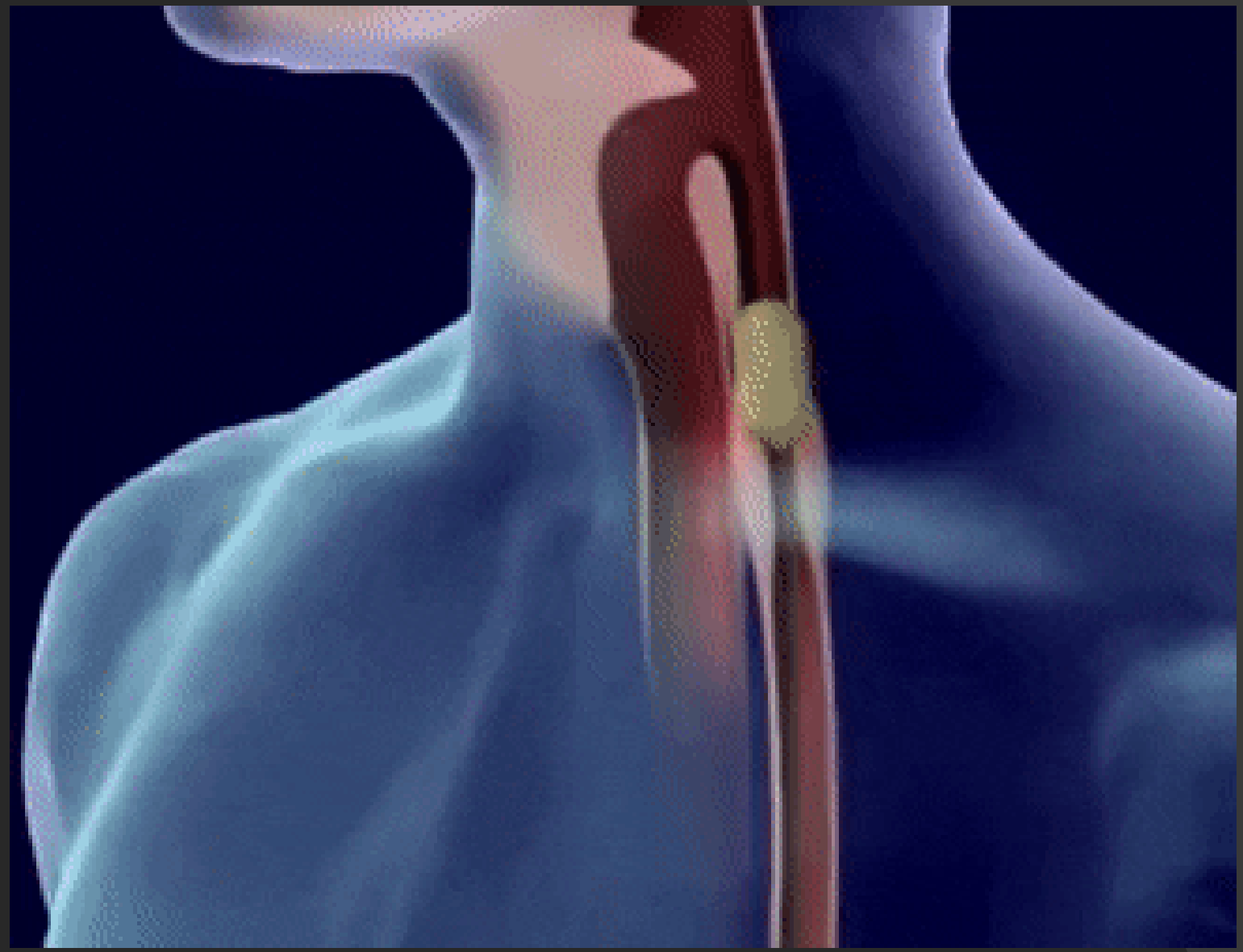
ESOPHAGUS

- The **esophagus** is the muscular tube through which food passes from the pharynx (throat) to the stomach.
- This is where the second stage of digestion is initiated (the first stage is in the mouth with teeth and tongue masticating food and mixing it with saliva).

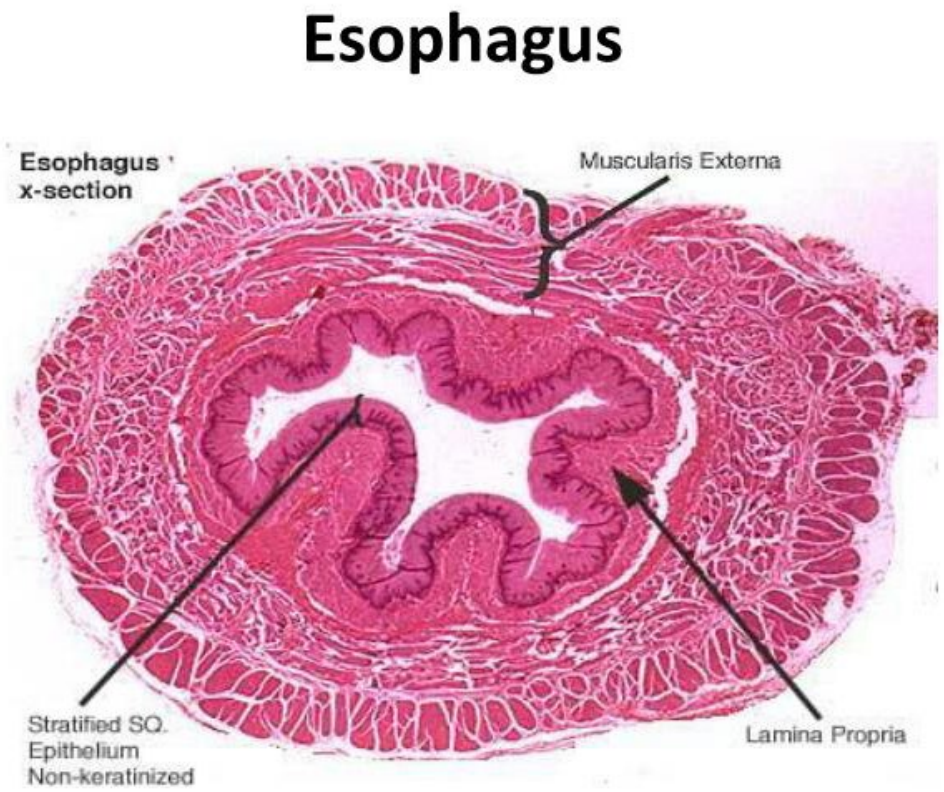


peristalsis

- After passing through the throat, the food moves into the esophagus and is pushed down into the stomach by the process of *peristalsis.*
- *peristalsis* is the involuntary wavelike muscle contractions that occur along the G.I. tract.
- *peristalsis* is how food is pushed through the G.I. tract
- The esophagus is lined with mucus membranes, and uses peristaltic action to move swallowed food down to the stomach.



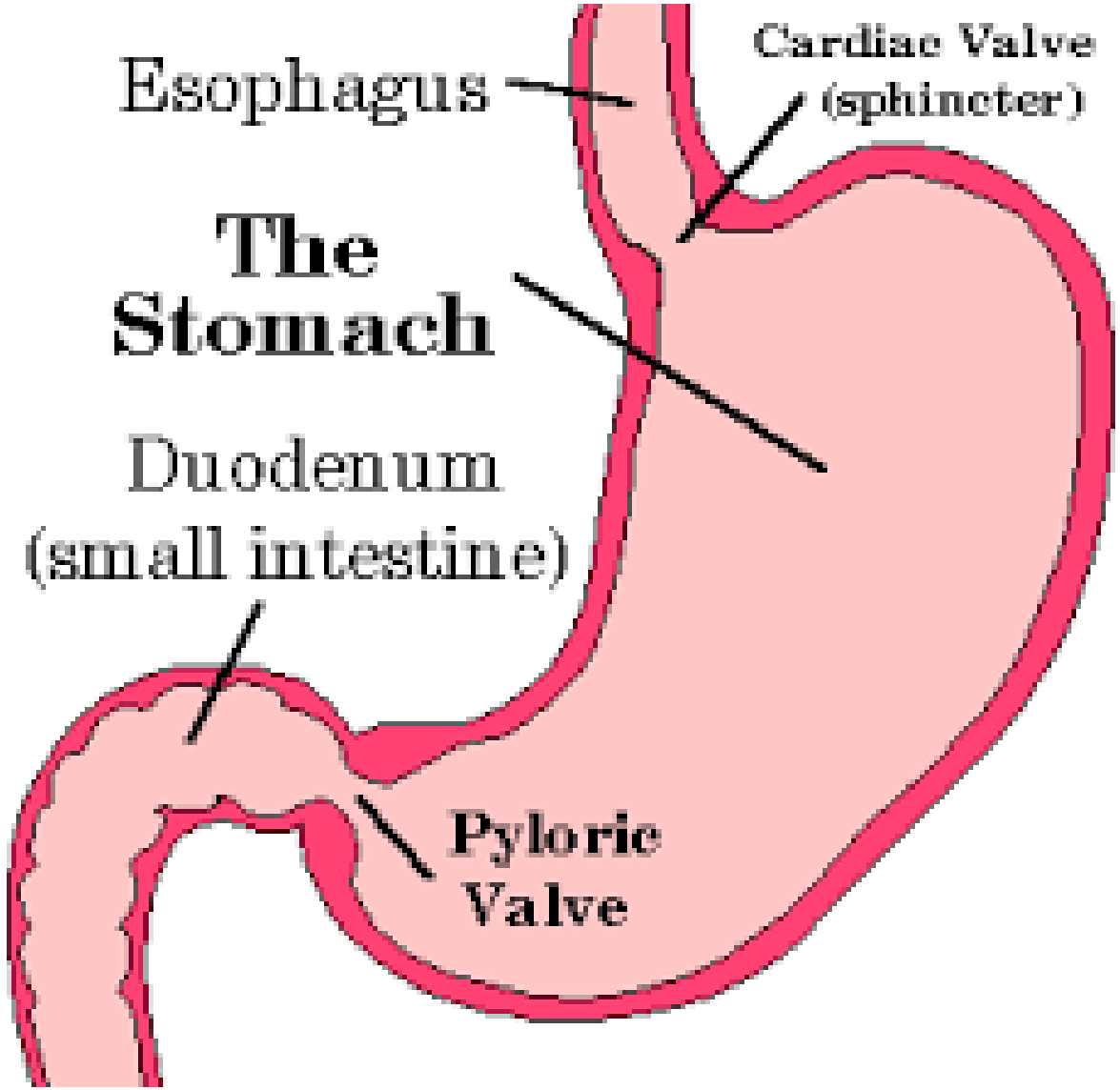
Histology of the Esophagus



- The esophagus is lined by a *stratified squamous epithelium.*
  - rapidly turned over
  - serves as a protective layer
  - effect due to the high volume transit of food, saliva, and mucus into the stomach.
- The *lamina propria* of the esophagus is sparse.
- The mucus secreting glands are located in the submucosa, and are connective structures called *papillae*.
- The muscularis propria of the esophagus consists of *striated muscle* in the upper third (superior) part of the esophagus.
- The middle third consists of a combination of *smooth muscle* and striated muscle, and the bottom (inferior) third is only smooth muscle.

CARDIAC SPHINCTER

- This part of the esophagus is called the lower esophageal sphincter a.k.a. the cardiac sphincter.
- This aids in keeping food down and not being regurgitated.



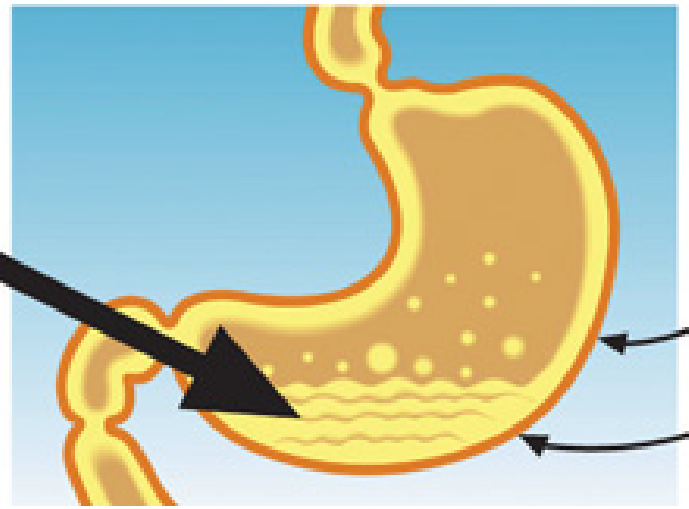
Chemical Digestion of proteins

Mechanical Digestion

Acid (Hydrochloric)

Pepsin (Enzyme)

Gastric juices

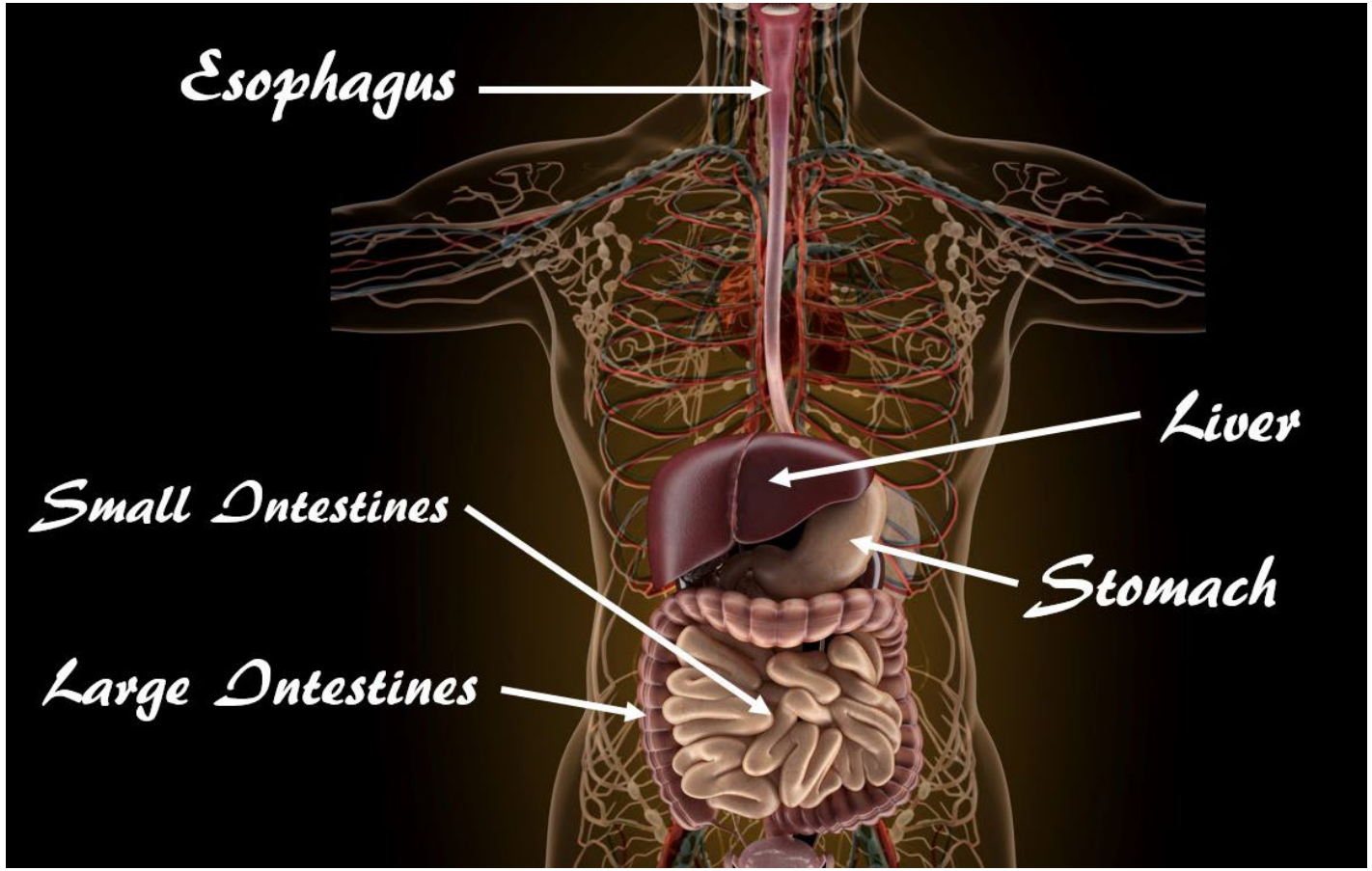


Muscular contractions (Peristalsis)

The **stomach**

The **stomach** is a thick walled organ that lies between the esophagus and the first part of the small intestine (the duodenum).

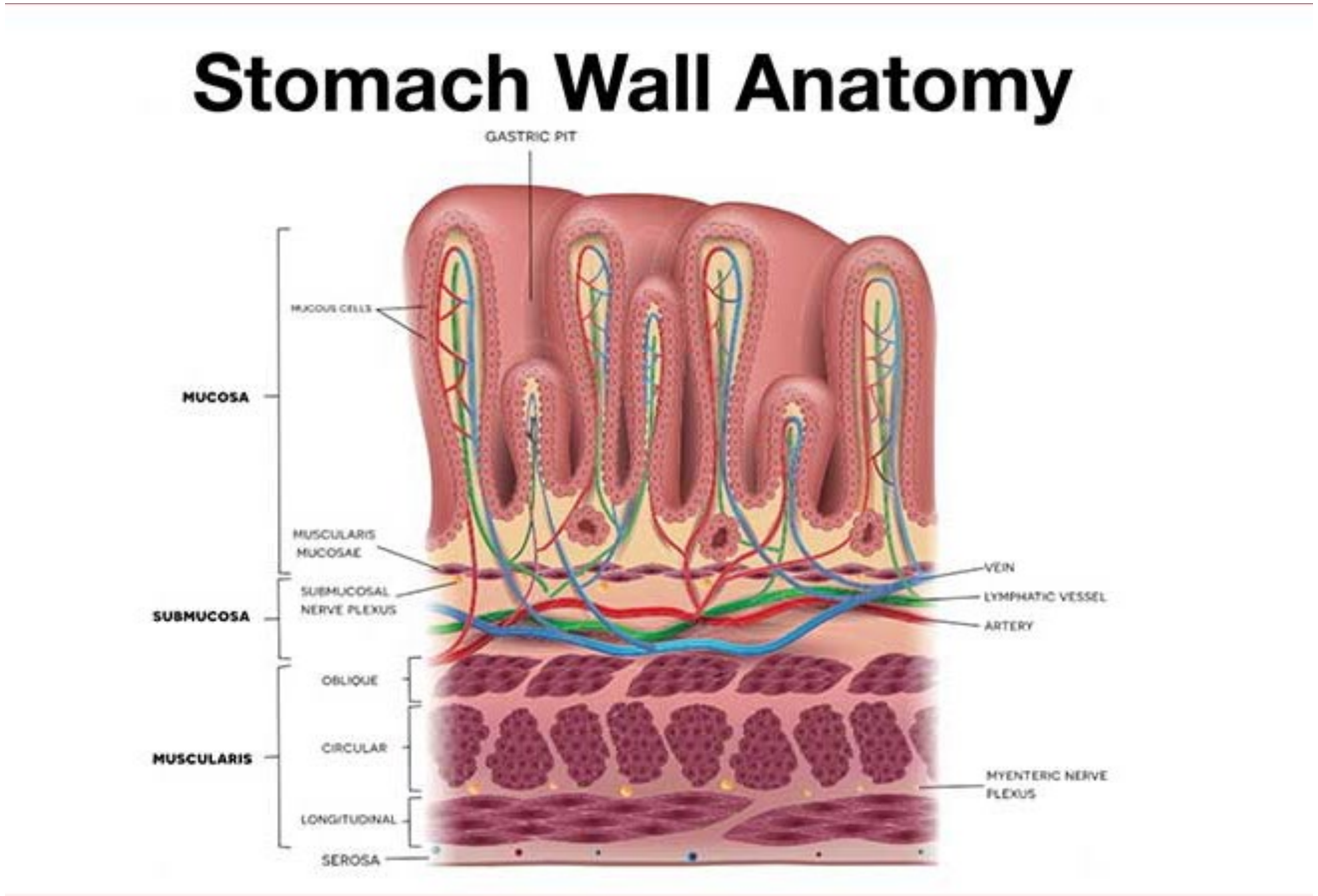
- It is on the left side of the abdominal cavity.
- The fundus of the stomach lying against the diaphragm.



The **stomach**

A mucous membrane lines the stomach which contains glands (*chief cells*) that secrete gastric juices.

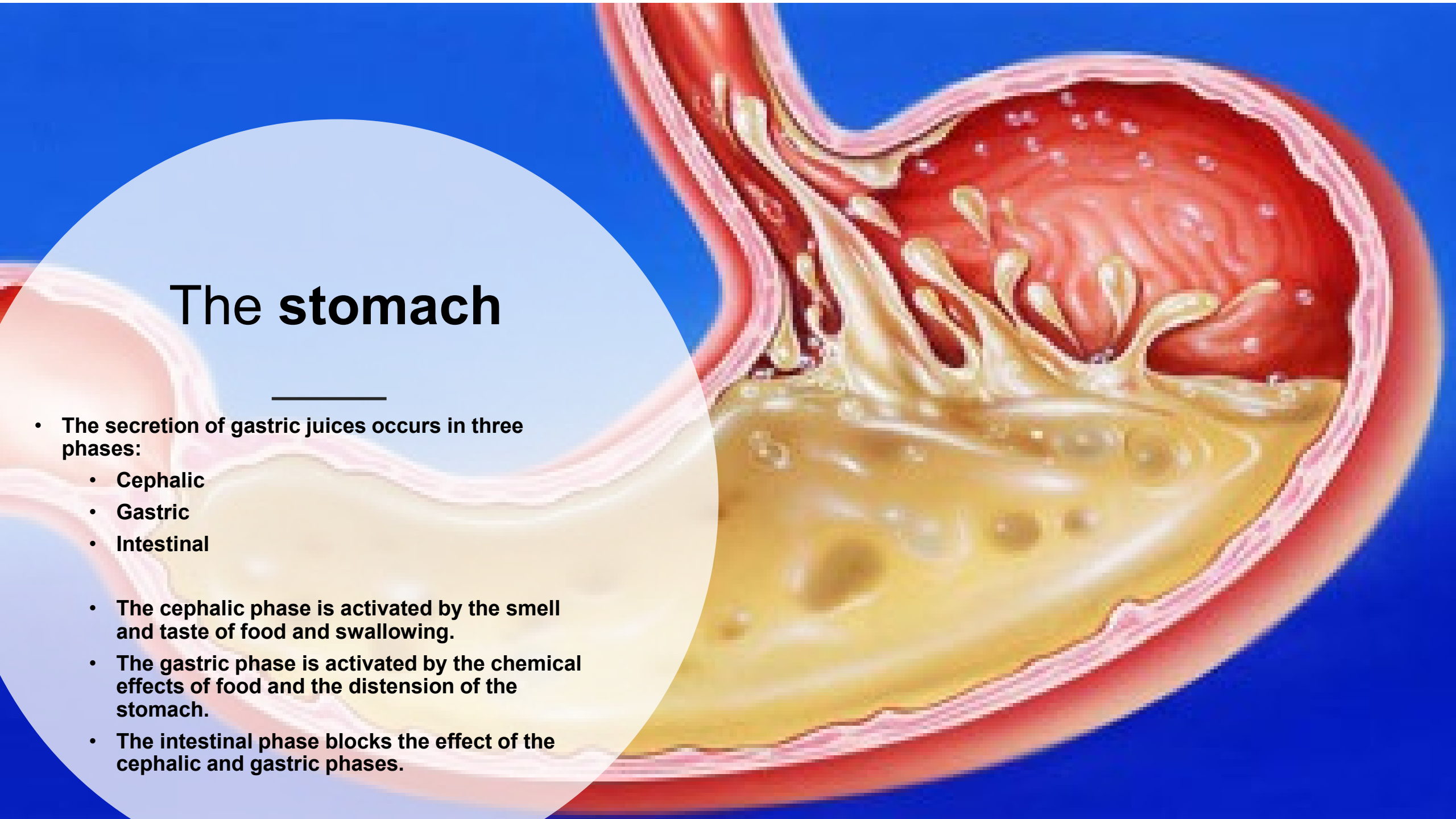
- The gastric glands begin secreting before food enters the stomach due to the parasympathetic impulses of the vagus nerve.

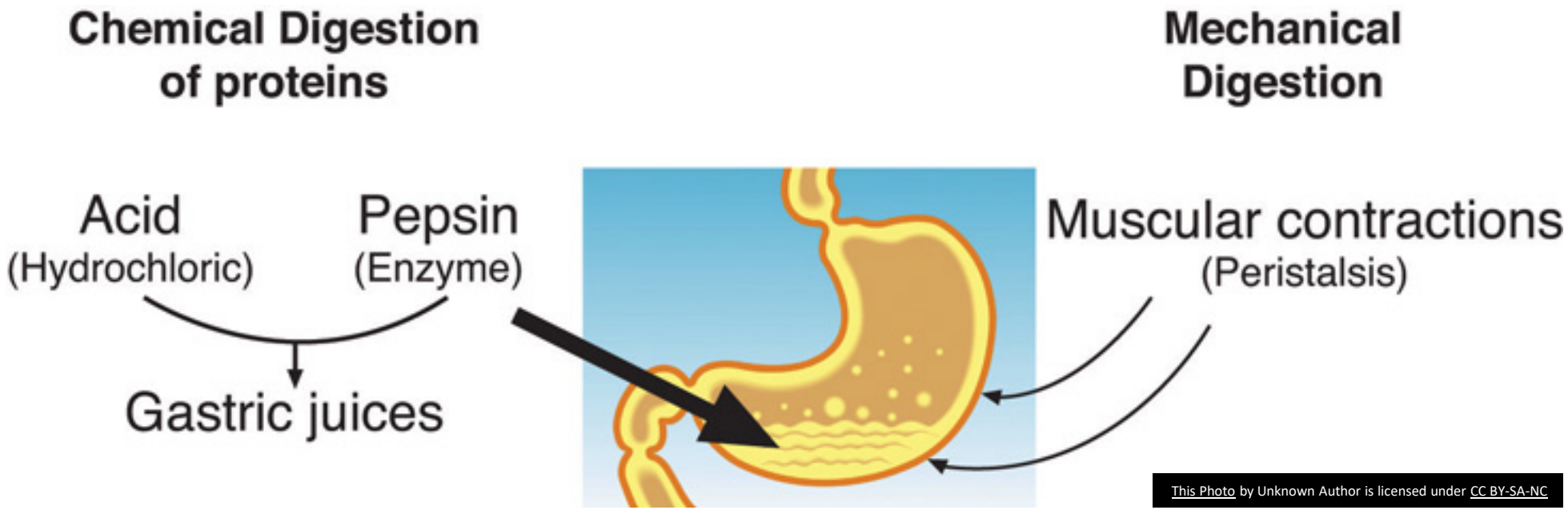


The **stomach**

- **The secretion of gastric juices occurs in three phases:**
  - **Cephalic**
  - **Gastric**
  - **Intestinal**

- **The cephalic phase is activated by the smell and taste of food and swallowing.**
- **The gastric phase is activated by the chemical effects of food and the distension of the stomach.**
- **The intestinal phase blocks the effect of the cephalic and gastric phases.**



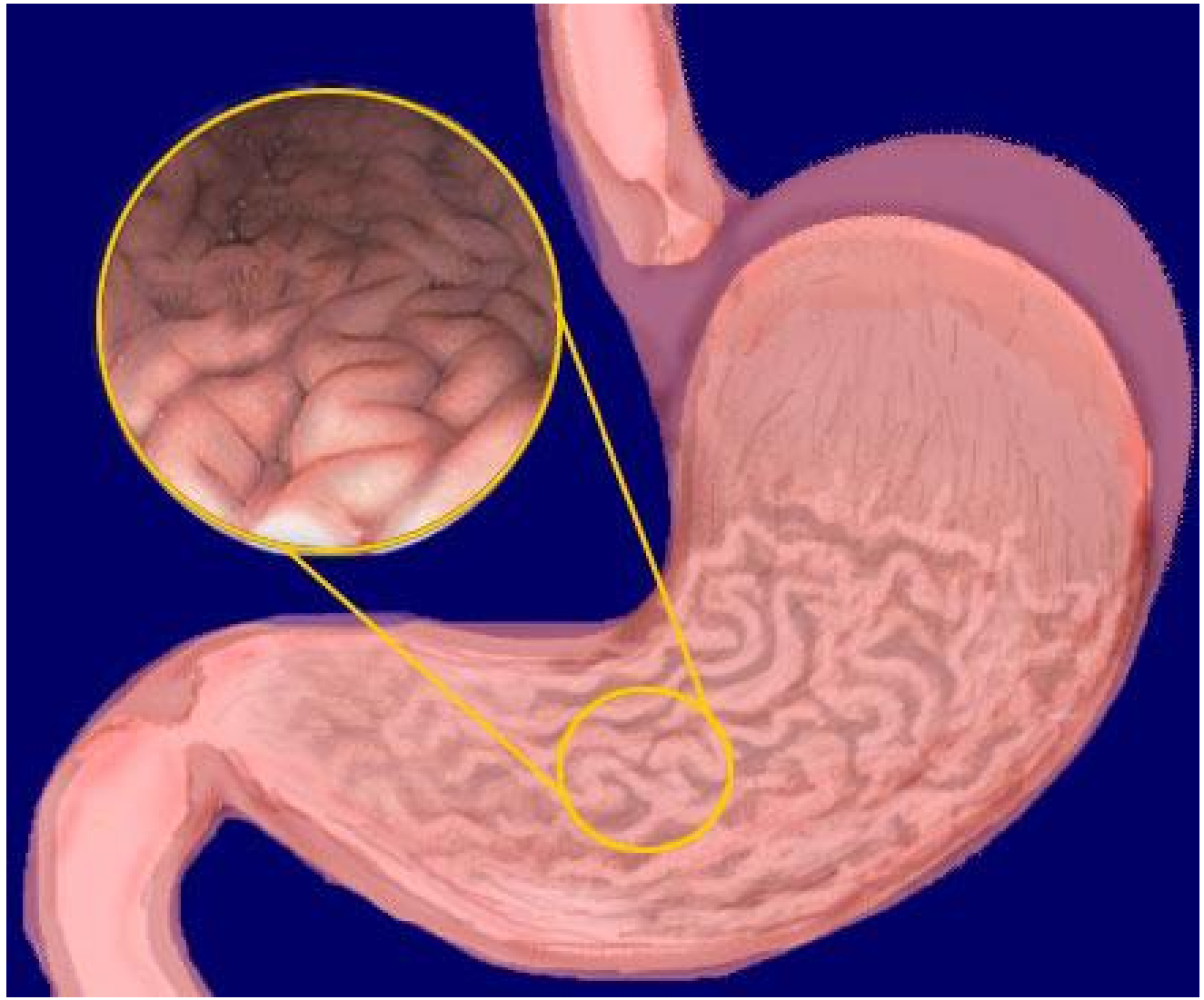


The **stomach**

- Gastric juice also contains an enzyme named **pepsin**, which digests proteins.
- Hydrochloric acid causes the stomach to maintain a pH of about 2 (acidic).
  - Acid helps kill off bacteria that comes into the digestive system.
  - It may cause or compound damage to the stomach wall or its layer of mucus, causing a peptic ulcer.

The **stomach**

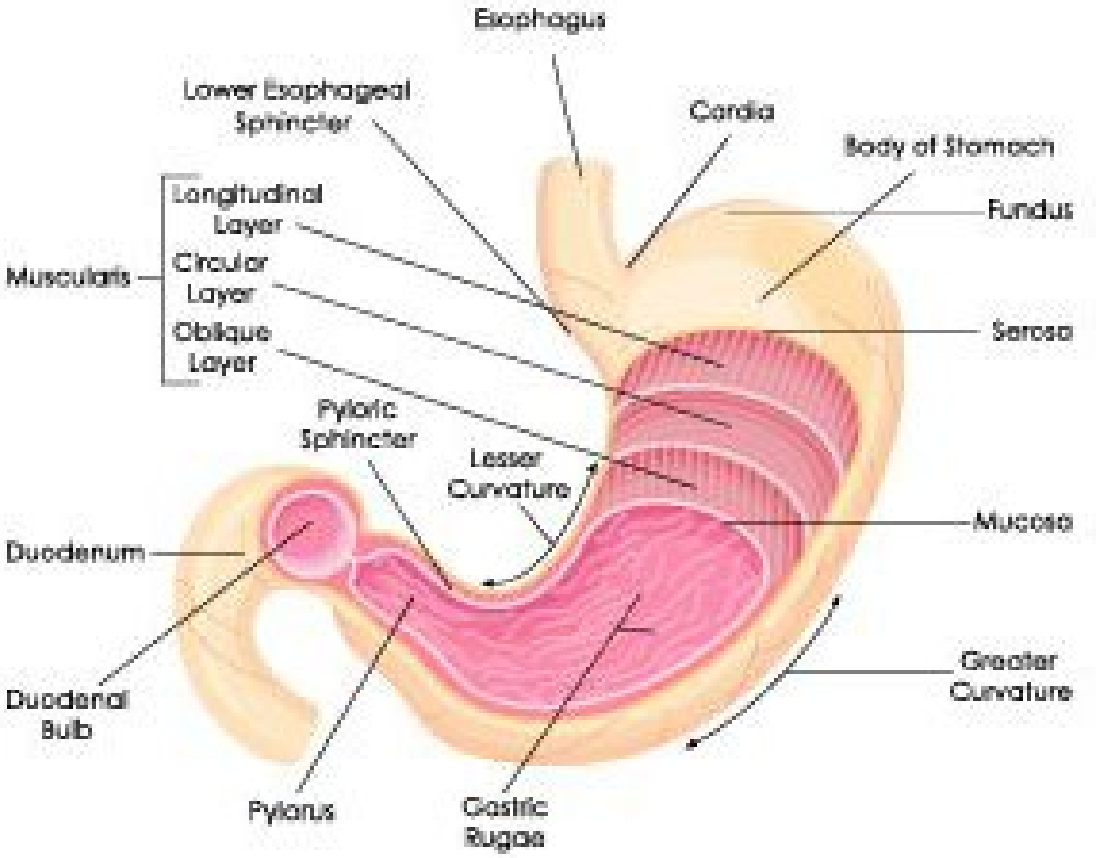
- On the inside of the stomach there are folds of skin call the gastric rugae.
- Gastric rugae make the stomach very extendable, especially after a very big meal.



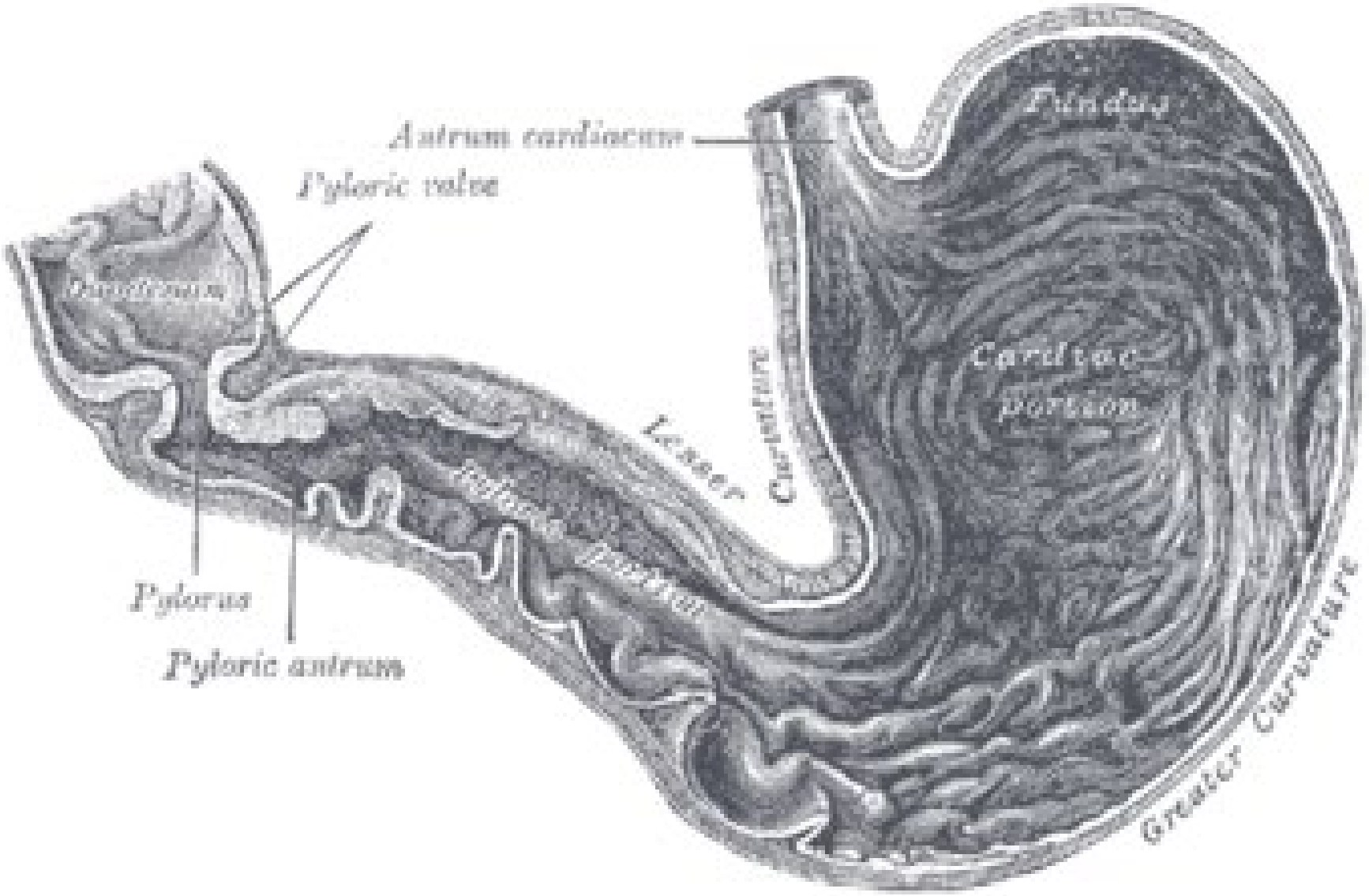
The stomach

The stomach is divided into four sections, each of which has different cells and functions.

- 1) Cardiac region, where the contents of the esophagus empty into the stomach,
- 2) Fundus, formed by the upper curvature of the organ,
- 3) Body, the main central region, and
- 4) Pylorus or atrium, the lower section of the organ that facilitates emptying the contents into the small intestine.



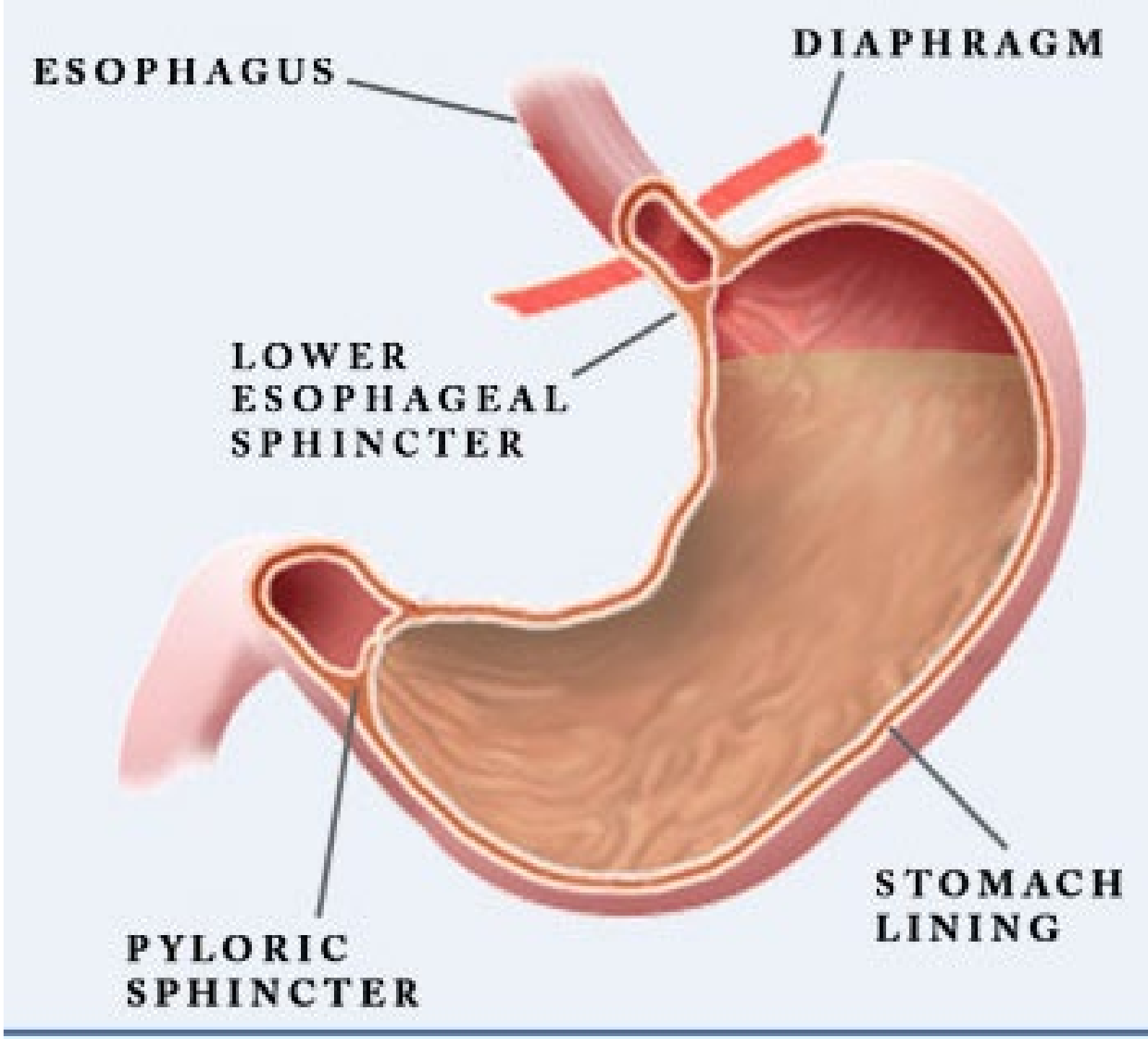
STOMACH


Fundus
Antrum cardiacum
Pyloric valve
Duodenum
Lesser Curvature
Cardiac portion
Pylorus
Pyloric antrum
Greater Curvature

Stomach Sphincters

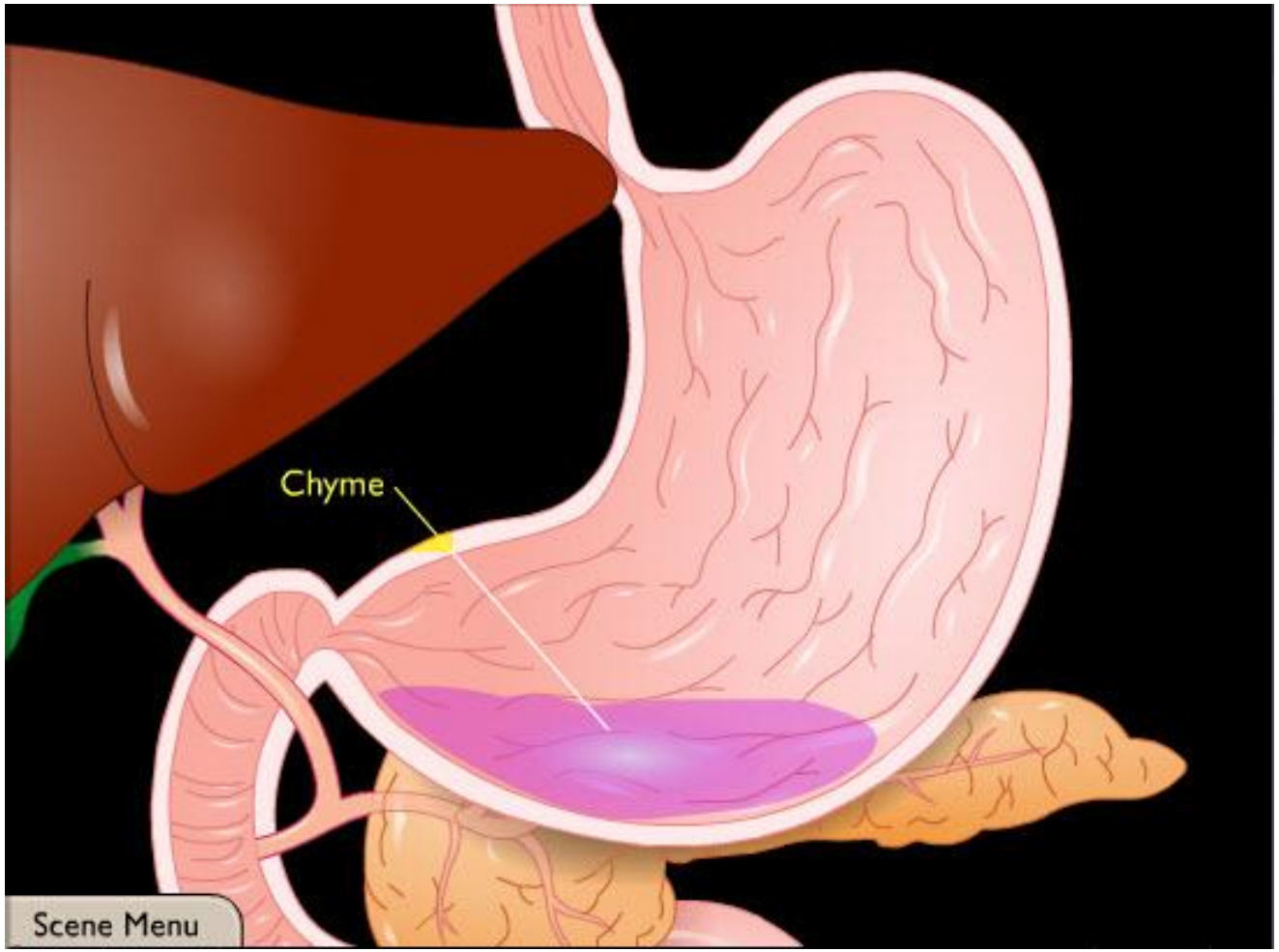
Two smooth muscle valves, or sphincters, keep the contents of the stomach contained.

- 1) Cardiac or esophageal sphincter
- 2) Pyloric sphincter



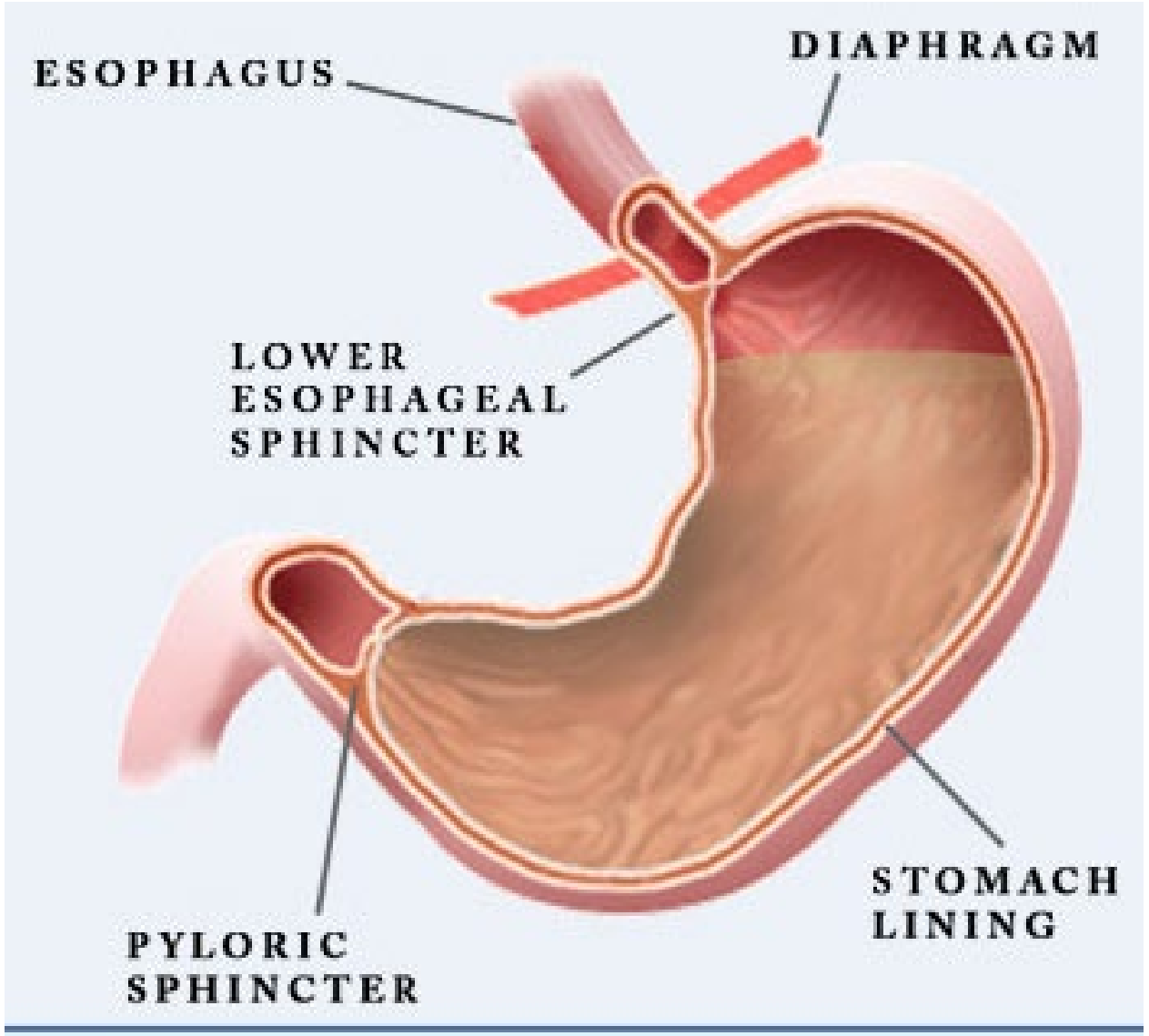
Chyme

- After receiving the **bolus** (chewed food) the stomach undergoes smooth muscular contractions (peristalsis) mixed and churned with gastric juices the bolus is transformed into a semi-liquid substance called **chyme**.



Digestion in the stomach

- Stomach muscles mix up the food with enzymes and acids to make smaller digestible pieces.
- The pyloric sphincter, a walnut shaped muscular tube at the stomach outlet, keeps chyme in the stomach until it reaches the right consistency to pass into the small intestine.
- The food leaves the stomach in small squirts rather than all at once.



Digestion in the stomach

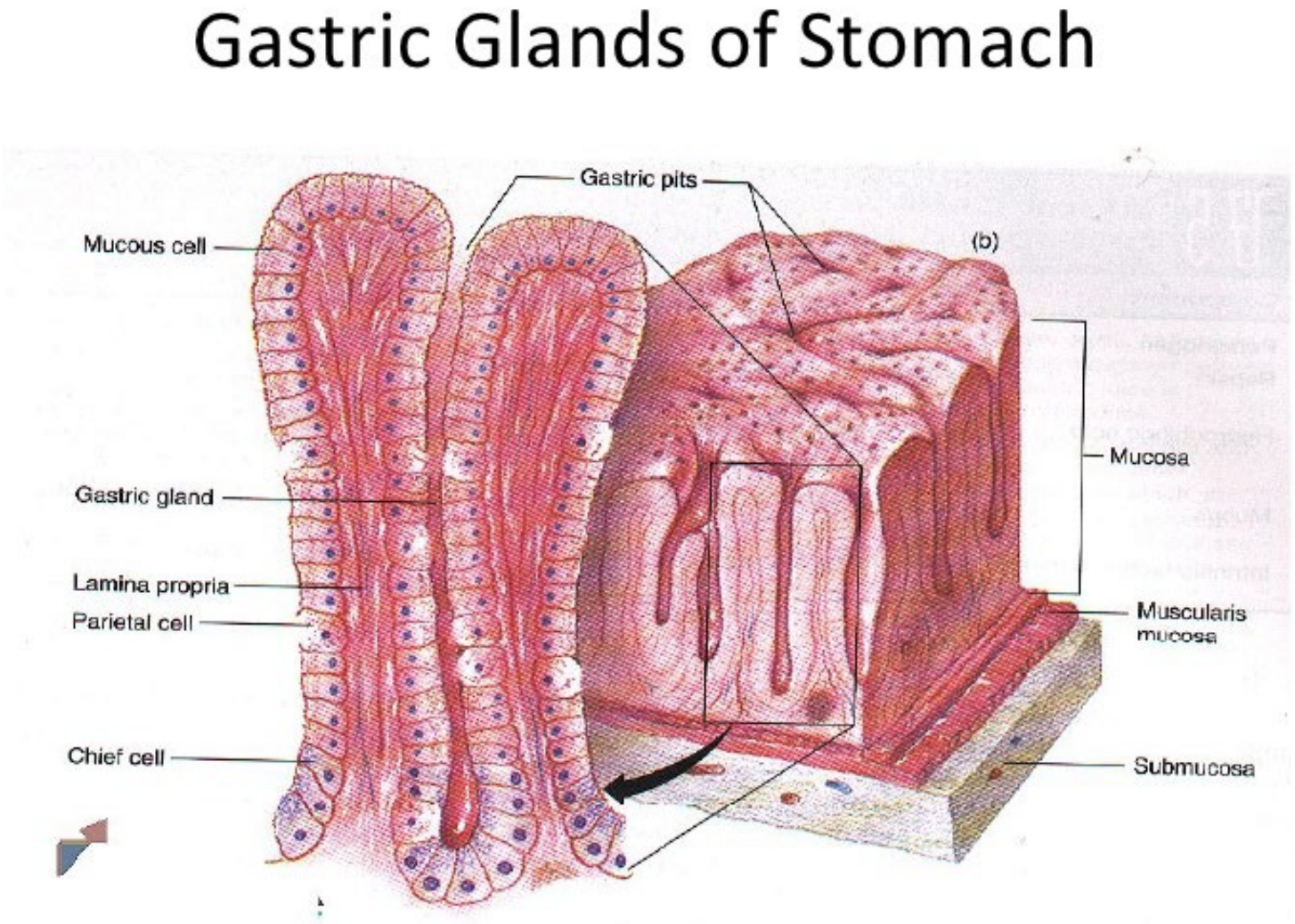
Water, alcohol, salt, and simple sugars can be absorbed directly through the stomach wall.

However, most substances in our food need a little more digestion and must travel into the intestines before they can be absorbed.

Gastric Glands

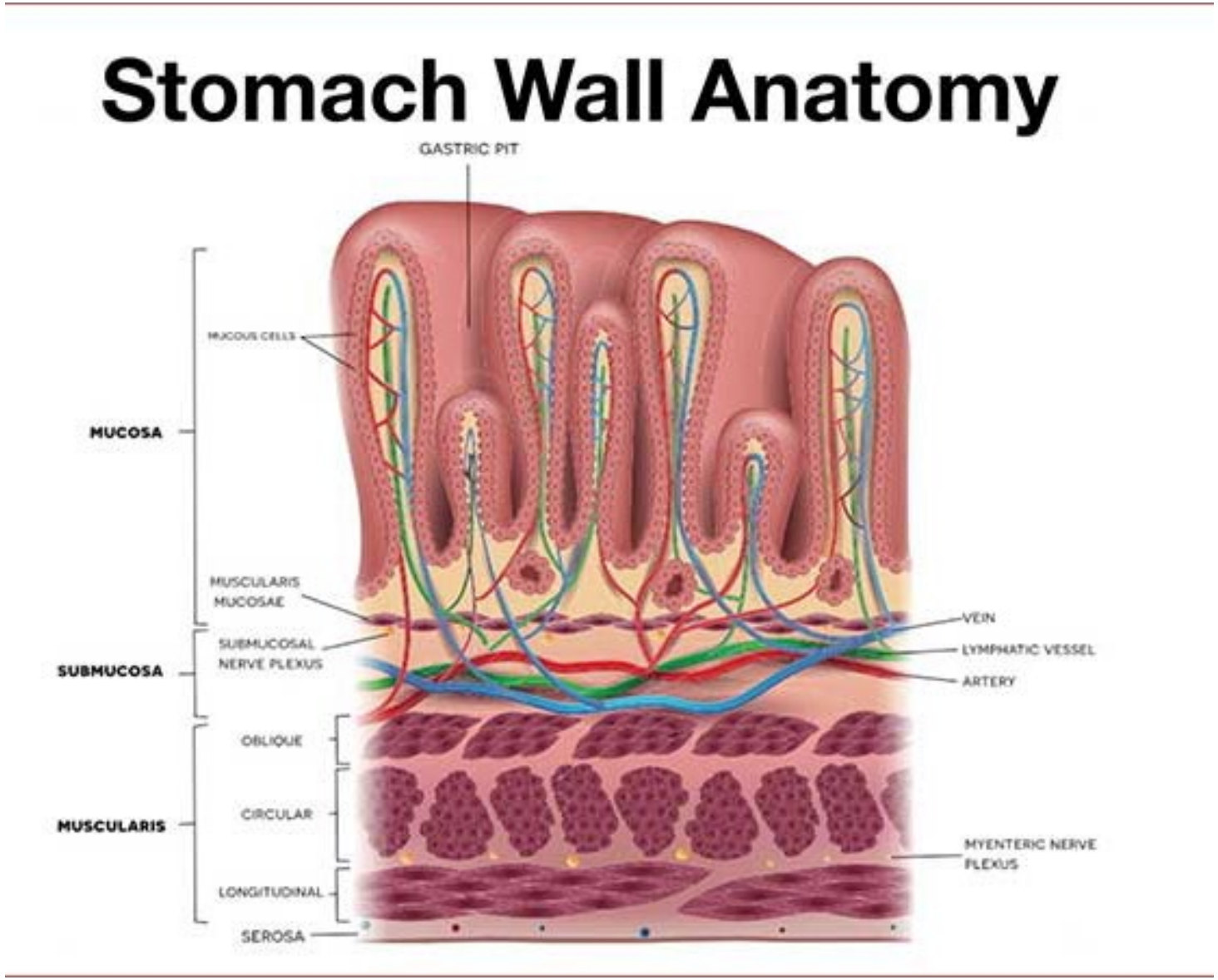
There are many different gastric glands and they secret many different chemicals.

- Parietal cells secrete hydrochloric acid and intrinsic factor
- Chief cells secrete pepsinogen
- Goblet cells secrete mucus
- Argentaffin cells secrete serotonin and histamine
- G cells secrete the hormone gastrin.



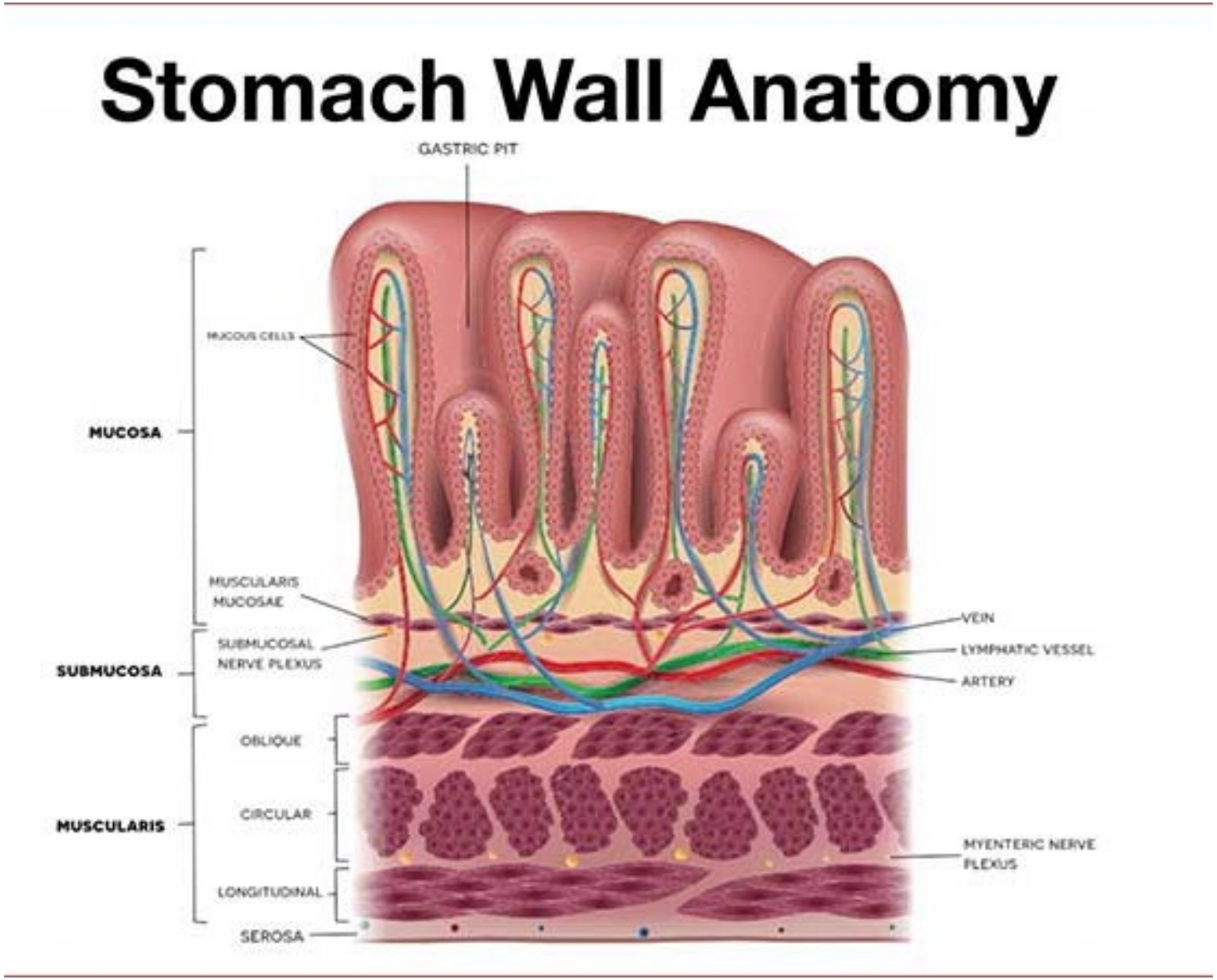
Histology of the human stomach

- the first main layer is the mucosa.
    - This consists of an epithelium, the lamina propria underneath, and a thin bit of smooth muscle called the muscularis mucosa.
- The submucosa lies under this and consists of fibrous connective tissue, separating the mucosa from the next layer, the muscularis externa.
- The muscularis in the stomach differs from that of other GI organs in that it has three layers of muscle instead of two. Under these muscle layers is the adventitia, layers of connective tissue continuous with the omenta.
- The epithelium of the stomach forms deep pits, called fundic or oxyntic glands.
    - Different types of cells are at different locations down the pits. The cells at the base of these pits are chief cells, responsible for production of pepsinogen, an inactive precursor of pepsin, which degrades proteins. The secretion of pepsinogen prevents self-digestion of the stomach cells.



Histology of the human stomach

- Further up the pits, parietal cells produce gastric acid and a vital substance, intrinsic factor.
    - The functions of gastric acid
        1. kills most of the bacteria in food,
        2. stimulates hunger
        3. activates pepsinogen into pepsin
        4. denatures the complex protein molecule as a precursor to protein digestion through enzyme action in the stomach and small intestines.



Histology of the human stomach

- Near the top of the pits, closest to the contents of the stomach, there are mucous-producing cells called goblet cells that help protect the stomach from self-digestion.
- The muscularis externa is made up of three layers of smooth muscle.

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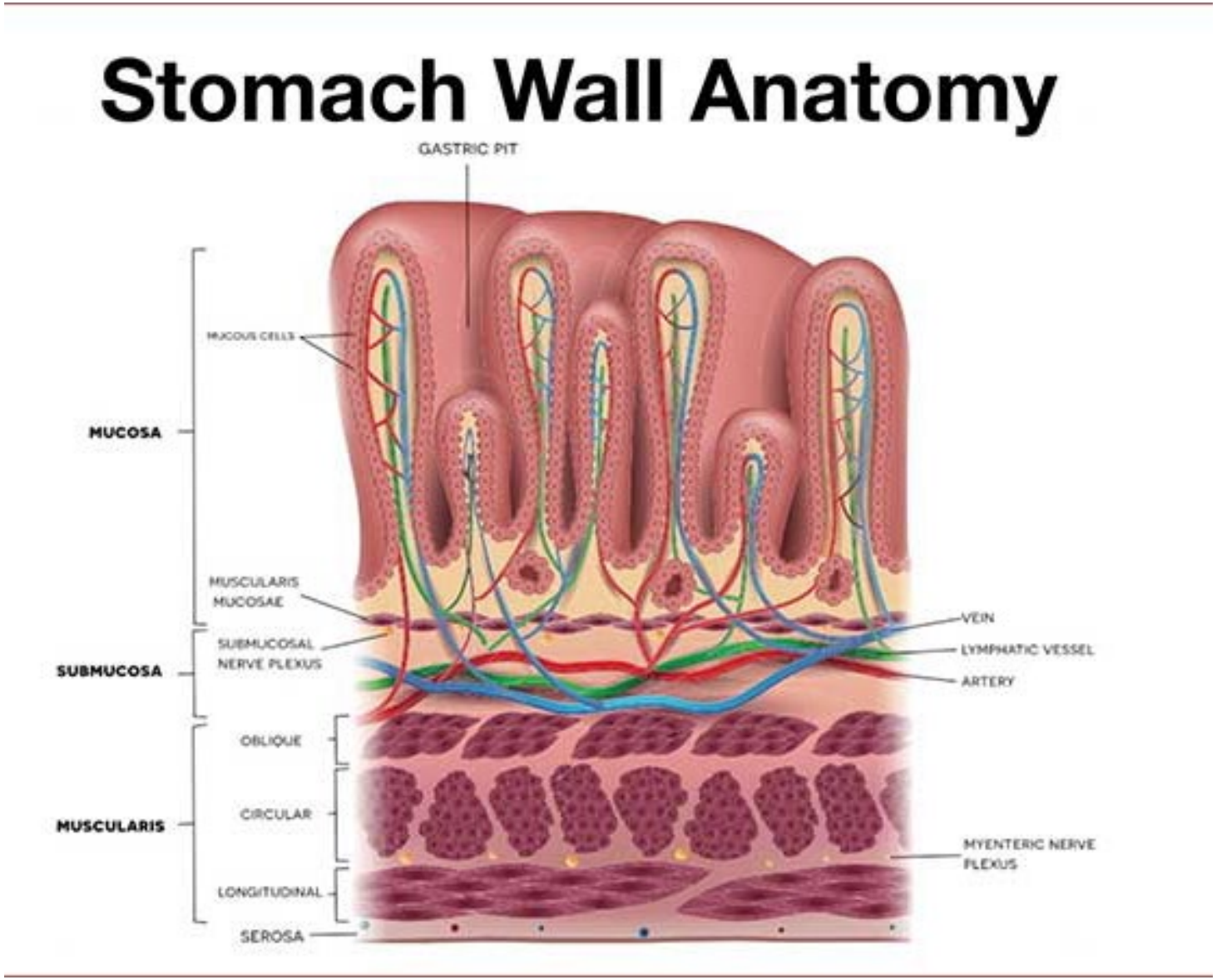
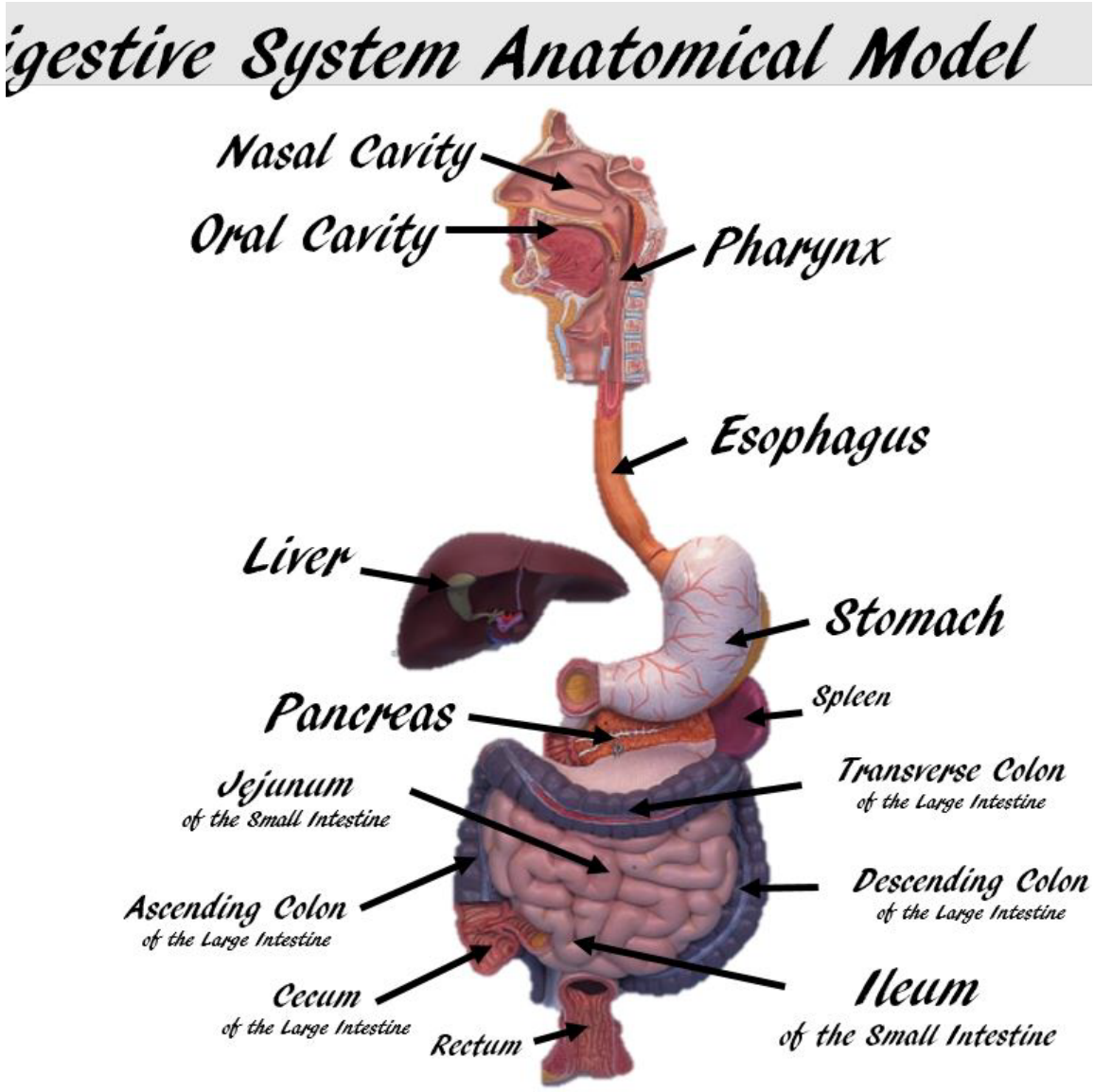


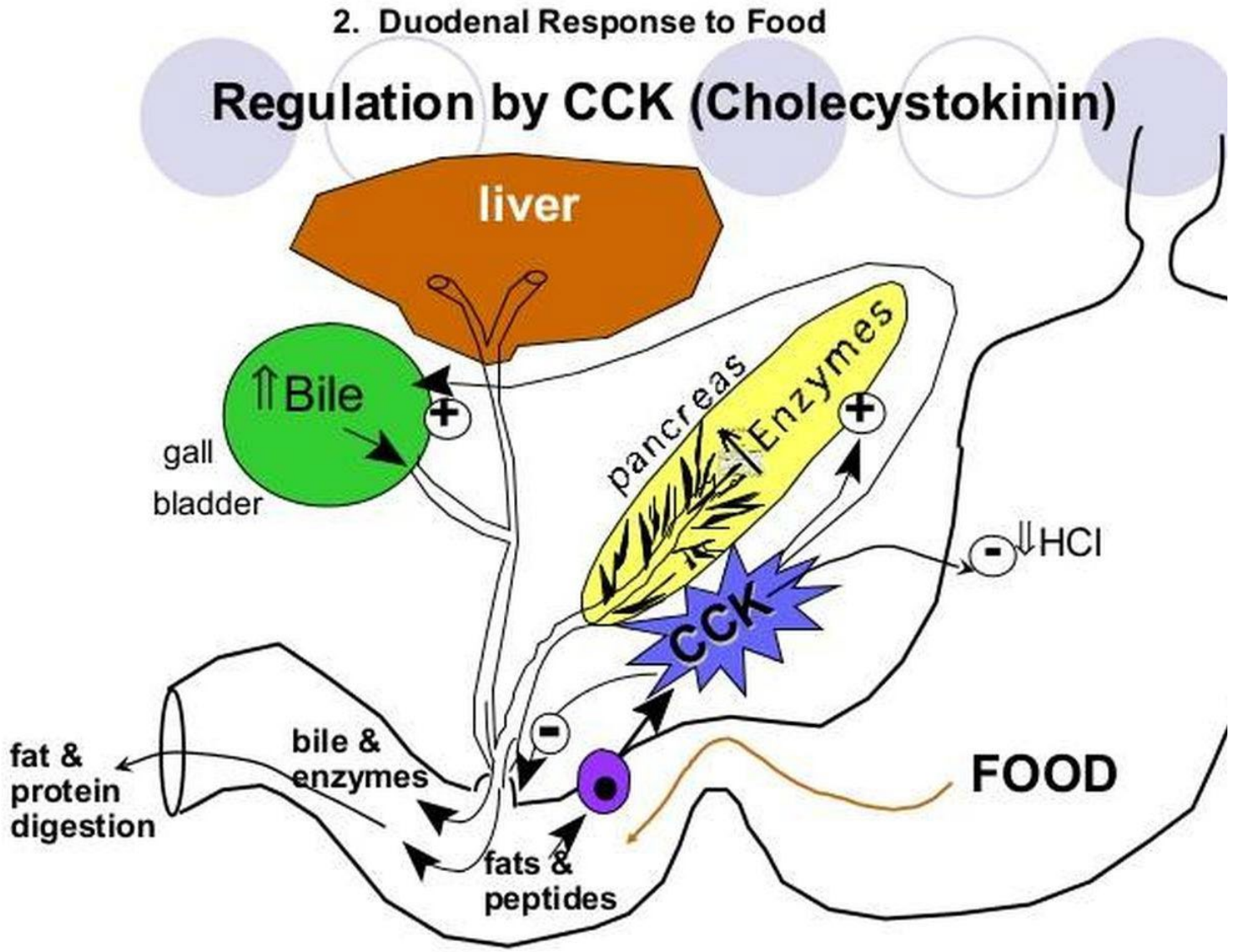
Control of secretion and motility

- The movement and the flow of chemicals into the stomach are controlled by both the nervous system and by the various digestive system hormones.
- The hormone gastrin causes an increase in the secretion of HCL, pepsinogen and intrinsic factor from parietal cells in the stomach. It also causes increased motility in the stomach. Gastrin is released by G-cells into the stomach. It is inhibited by pH normally less than 4 (high acid), as well as the hormone somatostatin.



Cholecystokinin (CCK)

- Cholecystokinin (CCK) has most effect on the gall bladder, but it also decreases gastric emptying.



secretin

- Secretin is a hormone released into the bloodstream by the duodenum (especially in response to acidity) to stimulate secretion by the liver and pancreas.

GI Hormones

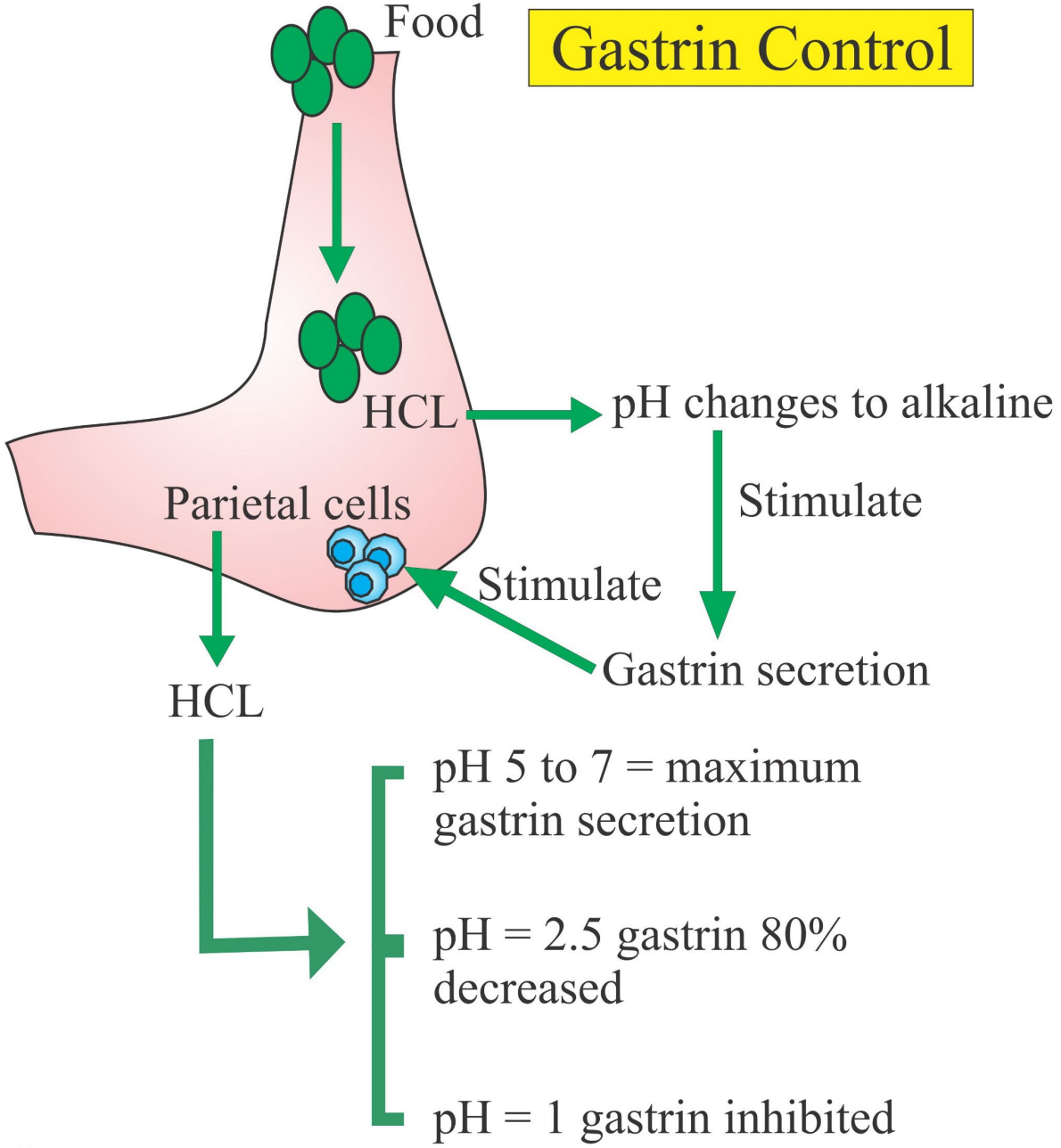
Secreted By	Source & Stimulus	Target Organ	Respone
Stomach mucosa	Stomach in response to food	Stomach, small intestine	*release of HCL *Increase of intestine movement *release of pepsinoge
Small Intestine	Duodenum in response to acidic chyme	Pancreas	*secrection of alkaline *digestive pro-enzyme *Inhibits intestine moti
Small Intestine	Intestinal cells in response to food	Pancreas, gallbladder	*Secretion of proenzymes and bile
	Intestinal cells in response to fat	Stomach, Pancreas	*Insulin secretion *Inhibits gastric secret and motality

GASTRIN

- Gastrin is a hormone that is produced by ‘G’ cells in the lining of the stomach and upper small intestine.
- During a meal, gastrin stimulates the stomach to release gastric acid.
- Gastric Acid –
  - breaks down protein
  - absorbs certain vitamins
  - kills harmful bacteria
  - Stimulates the release of bile from the gallbladder
  - Stimulates the release of pancreatic enzymes from the pancreas
  - Stimulates expansion of the stomach lining
  - Increases muscle contractions of the gut

How is gastrin controlled?

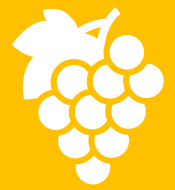
- Before a meal, the anticipation of eating stimulates the release of Gastrin.
- During a meal, Gastrin release is stimulated by stretch receptors in the stomach wall.
- the hormone somatostatin inhibits or slows the production and release of gastrin.
- Somatostatin is released when the stomach empties at the end of a meal or when pH gets too low.



Small Intestines

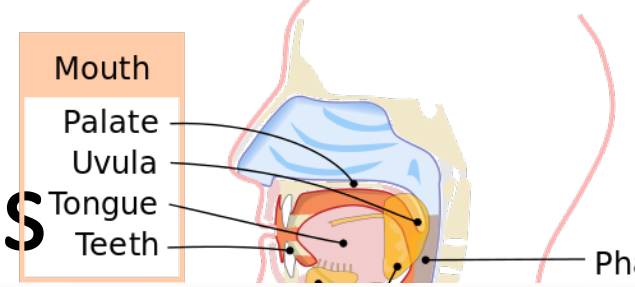
The small intestine is the site where most of the chemical and mechanical digestion is carried out.

Tiny projections called villi line the small intestine which absorbs digested food into the capillaries.



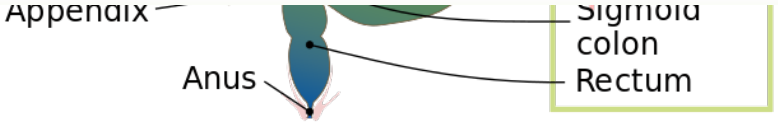
Most of the food absorption takes place in the jejunum and the ileum.

Small Intestines



Unemulsified triglycerides

Foodstuff	Enzyme(s) and source	Site of action	Path of absorption
Starch and disaccharides			• Glucose and galactose are absorbed
Nucleic acid digestion			
Nucleic acids	Pancreatic ribonuclease and deoxyribonuclease	Small intestine	• Units enter intestinal cells by active transport via membrane carriers. • Units are absorbed into capillary blood in the villi and transported to the liver via the hepatic portal vein.
Pentose sugars, N-containing bases, phosphate ions	Brush border enzymes (nucleosidases and phosphatases)	Small intestine	
Galactose, Glucose, Fructose	amylase, lactase, maltase, and sucrase)		



- The three main sections of the small intestine are the duodenum, the jejunum, the ileum.

- The duodenum

- In anatomy of the digestive system, the duodenum is a hollow jointed tube connecting the stomach to the jejunum. It is the first and shortest part of the small intestine. It begins with the duodenal bulb and ends at the ligament of Treitz. The duodenum is almost entirely retro peritoneal. The duodenum is also where the bile and pancreatic juices enter the intestine.

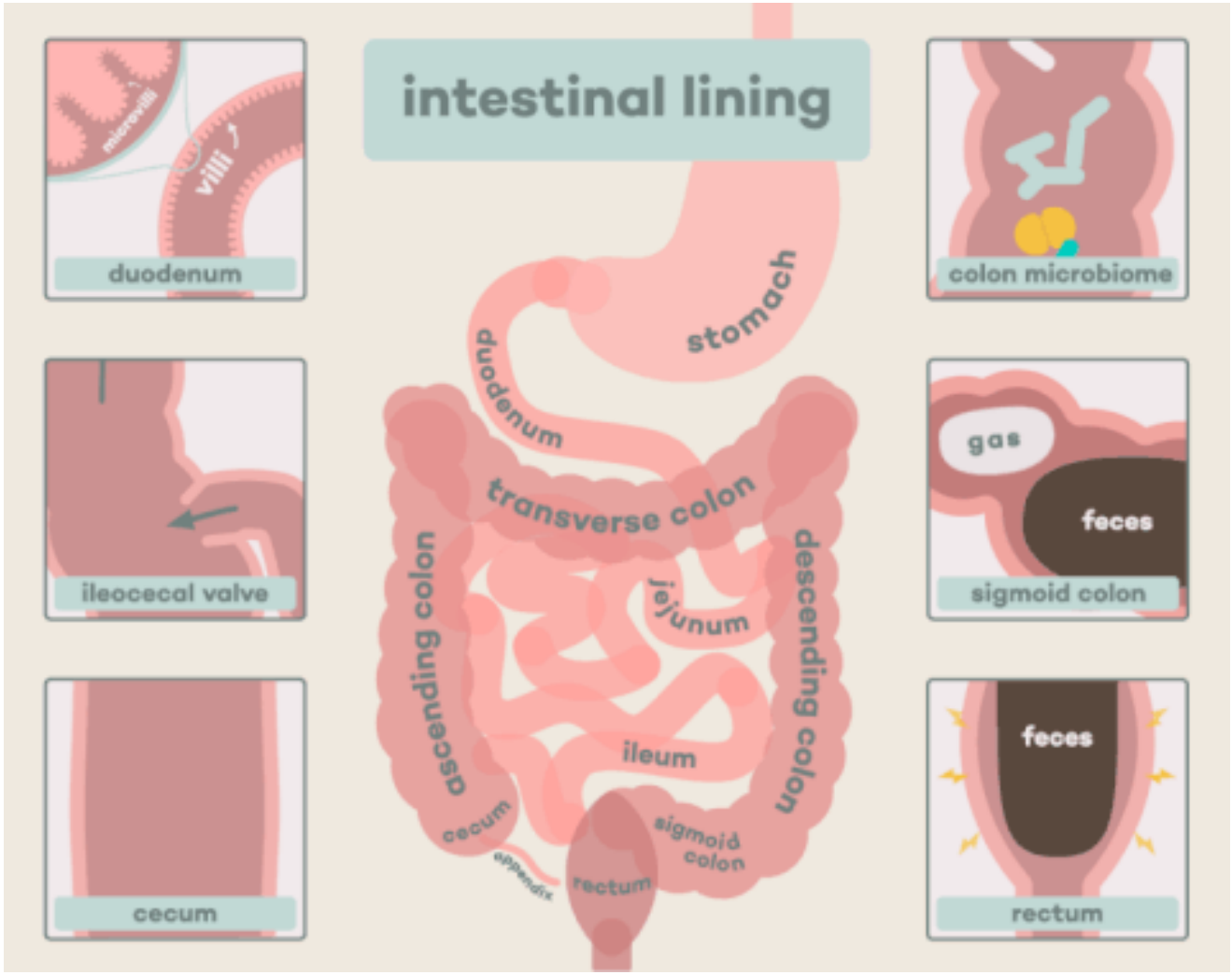
- The jejunum

- The jejunum is a part of the small bowel, located between the distal end of duodenum and the proximal part of ileum. The jejunum and the ileum are suspended by an extensive mesentery giving the bowel great mobility within the abdomen. The inner surface of the jejunum, its mucous membrane, is covered in projections called villi, which increase the surface area of tissue available to absorb nutrients from the gut contents. It is different from the ileum due to fewer goblet cells and generally lacks Peyer's patches.

- The ileum

- Its function is to absorb vitamin B12 and bile salts. The wall itself is made up of folds, each of which has many tiny finger-like projections known as villi, on its surface. In turn, the epithelial cells which line these villi possess even larger numbers of micro villi. The cells that line the ileum contain the protease and carbohydrate enzymes responsible for the final stages of protein and carbohydrate digestion. These enzymes are present in the cytoplasm of the epithelial cells. The villi contain large numbers of capillaries which take the amino acids and glucose produced by digestion to the hepatic portal vein and the liver.

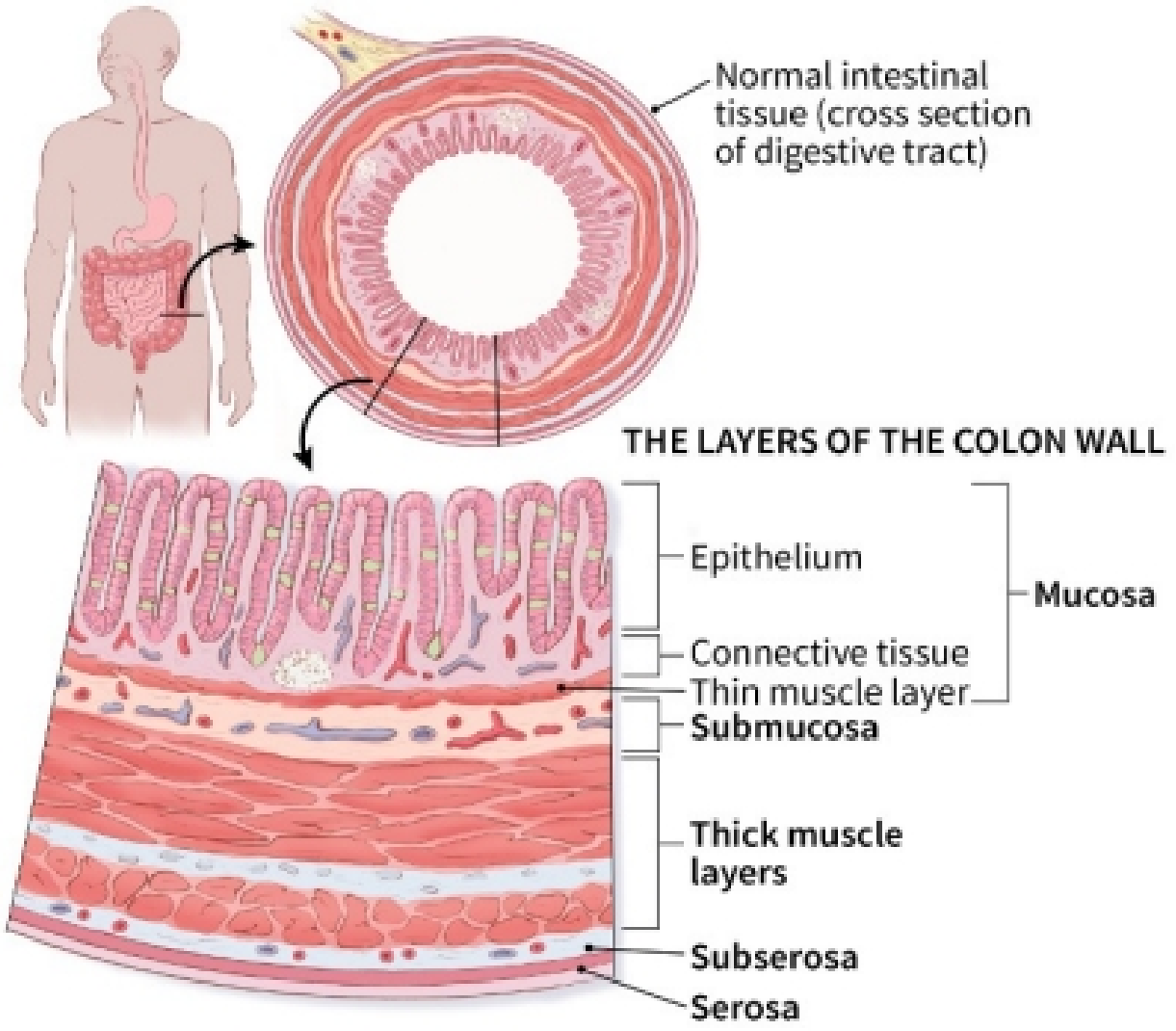
- The terminal ileum continues to absorb bile salts, and is also crucial in the absorption of fat-soluble vitamins (Vitamin A, D, E and K). For fat-soluble vitamin absorption to occur, bile acids must be present.



The large intestine (colon)

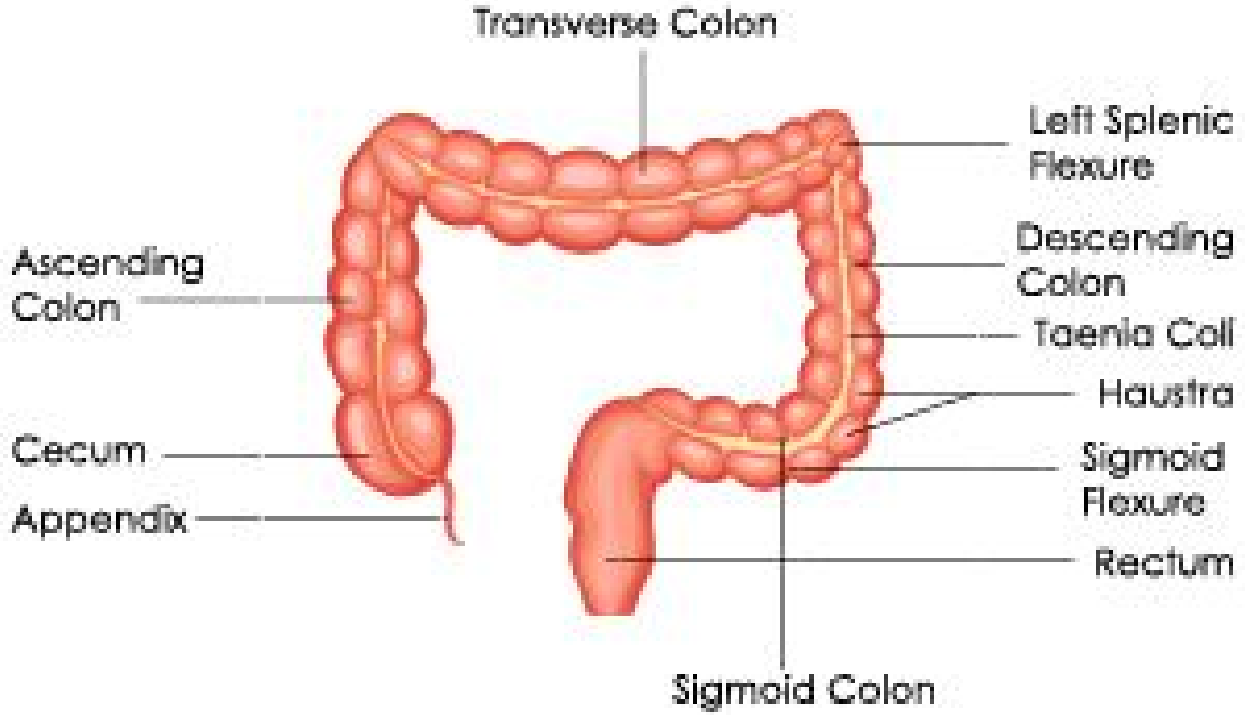
- The large intestine (colon) extends from the end of the ileum to the anus. It is about 5 feet long, being one-fifth of the whole extent of the intestinal canal.
- It's caliber is largest at the commencement at the cecum, and gradually diminishes as far as the rectum, where there is a dilatation of considerable size just above the anal canal.

- It differs from the small intestine in by the greater caliber, more fixed position, sacculated form, and in possessing certain appendages to its external coat, the appendices epiploicæ.
- Further, its longitudinal muscular fibers do not form a continuous layer around the gut, but are arranged in three longitudinal bands or tæniæ.



The large intestine

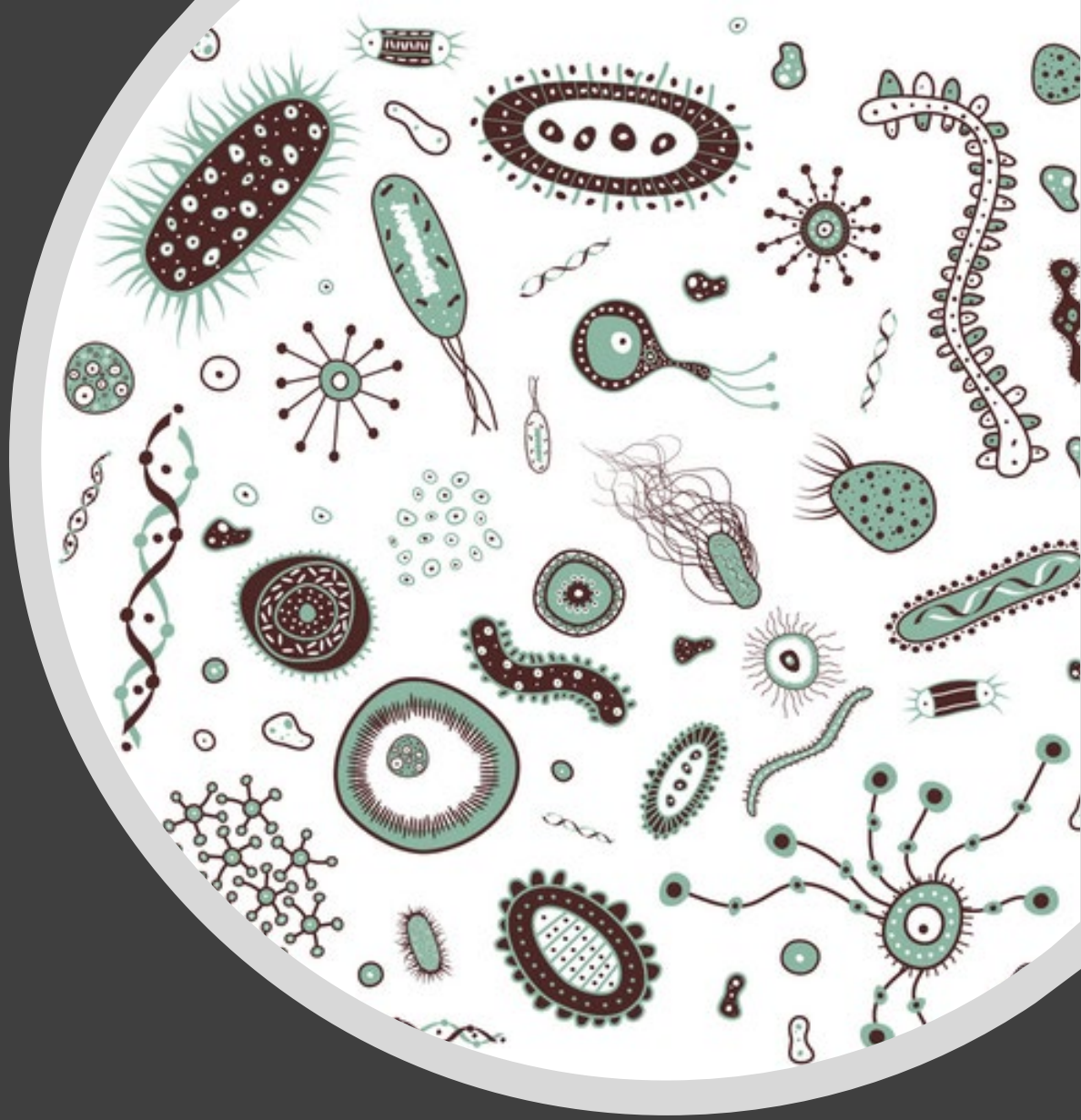
- The large intestine is divided into the cecum, ascending colon, transverse colon, the descending, sigmoid colon (flexure) rectum, and anal canal.



LARGE INTESTINE

BENEFICIAL BACTERIA

- There are many beneficial bacteria but some of the most common and important are *Lactobacillus Acidophilus* and various species of *Bifidobacterium.* These are available as "probiotics" from many sources.
  - *synthesize* vitamins, like *B12*, *biotin*, and *vitamin K*
  - breakdown toxins
  - stop proliferation of harmful organisms
  - stimulate the immune system
  - produce short chain fatty acids (SCFAs) that are required for the health of colon cells and help prevent colon cancer.



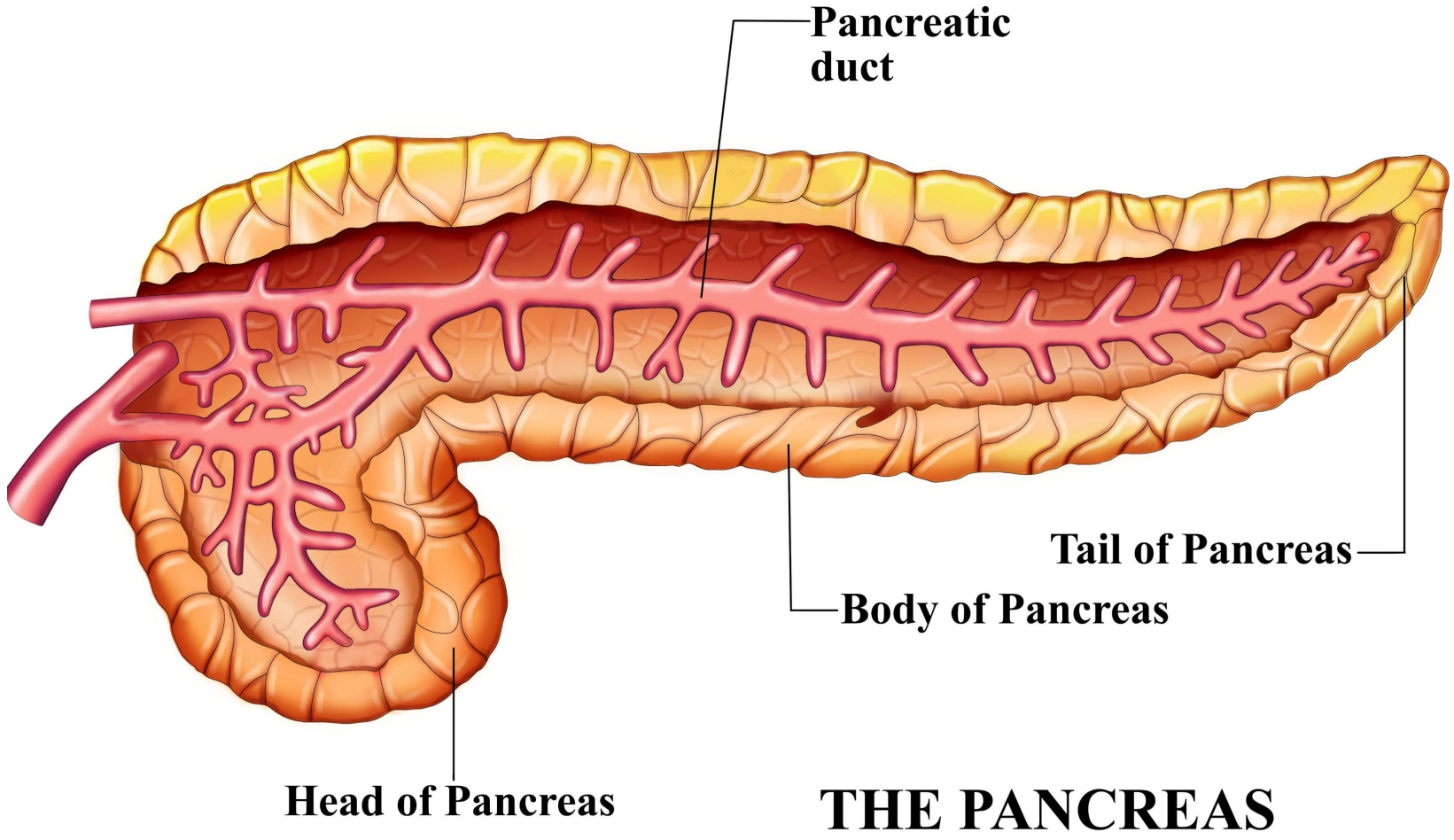
Pancreas

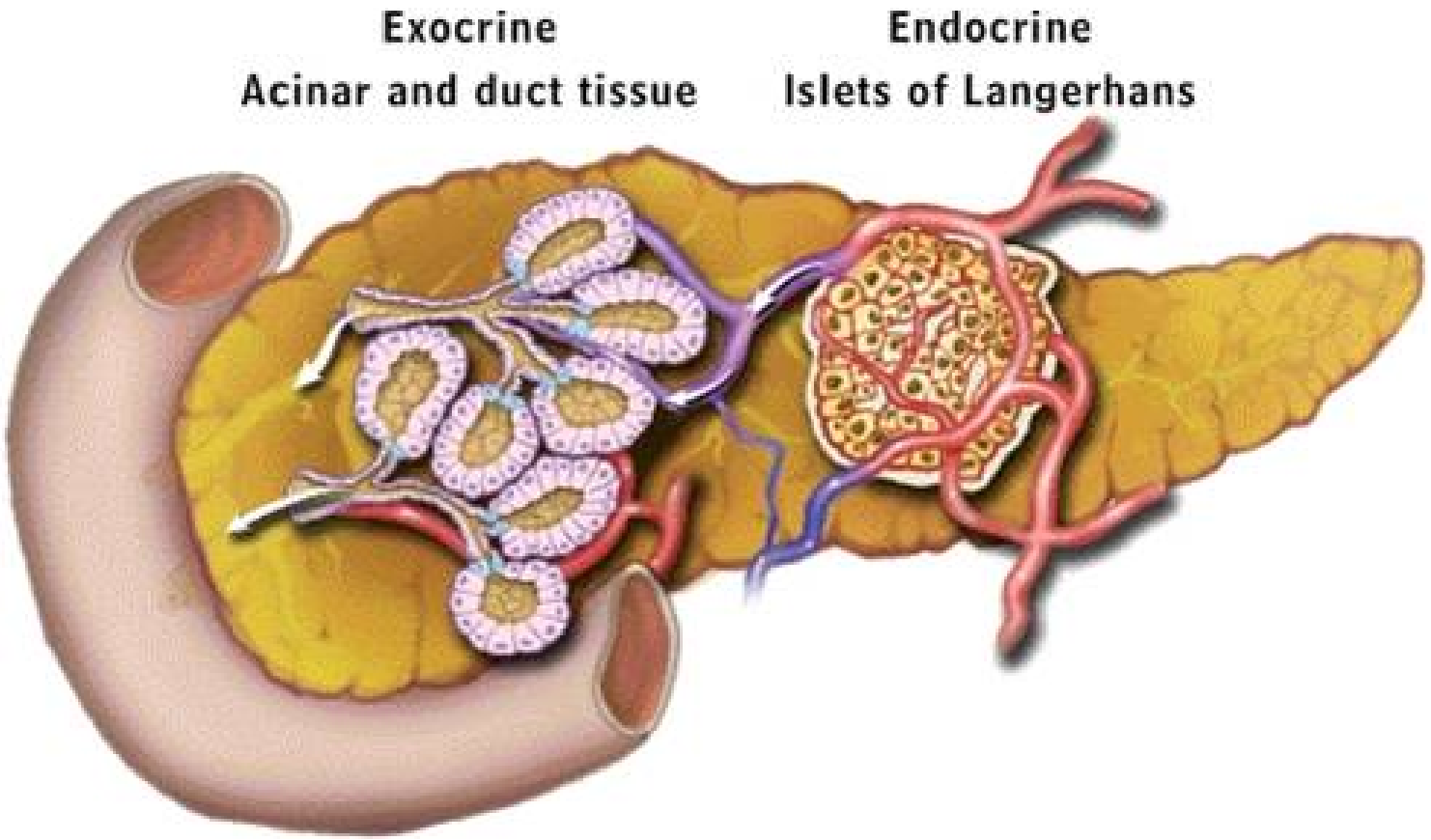
The Pancreas Has 3 regions:

- the head
- the body
- The tail

The function of the pancreas is to:

- produce enzymes that break down digestible foods (exocrine pancreas)
- secrete hormones that affect carbohydrates metabolism (endocrine pancreas).



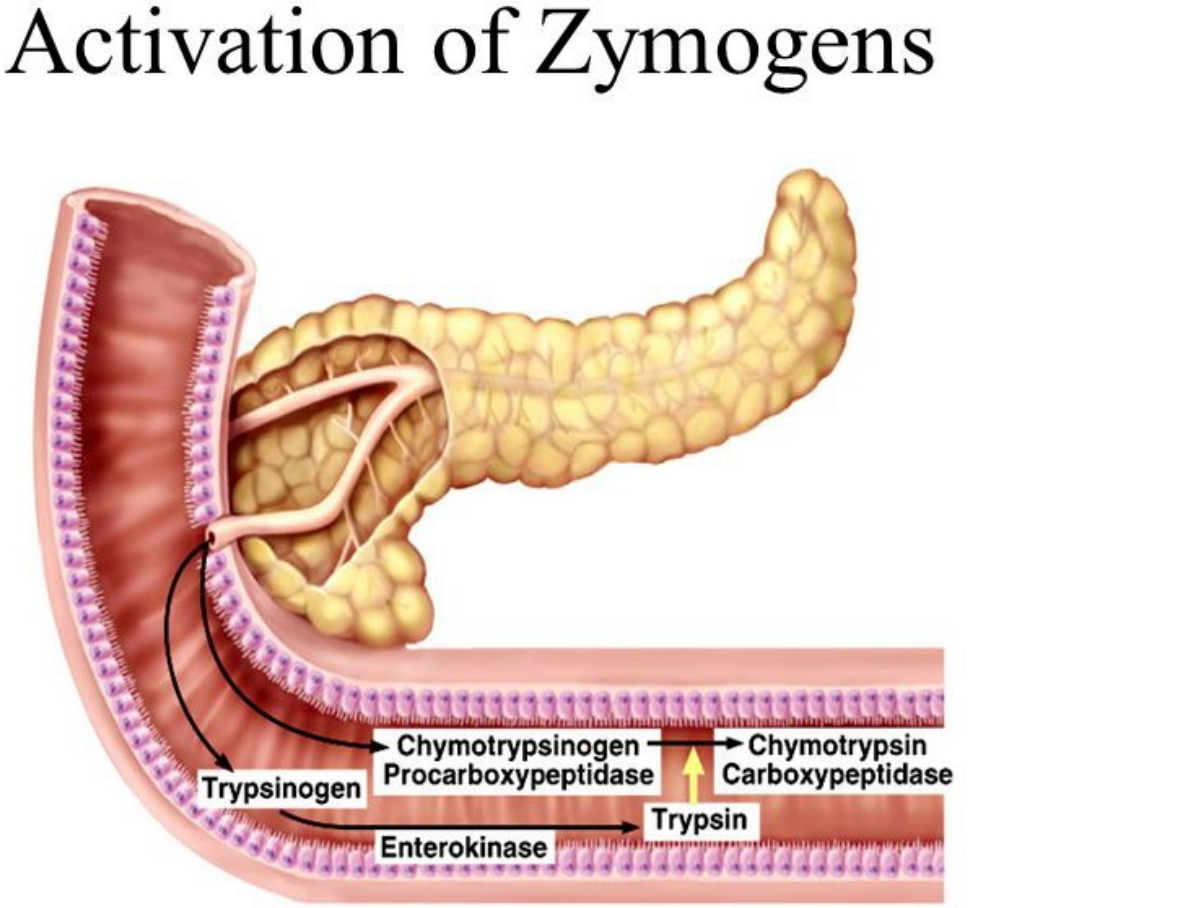


Exocrine Function of the Pancreas

- The pancreas contain exocrine cells.
- These exocrine cells contain ducts.
- These exocrine cells contain precursor digestive enzymes (mainly trypsinogen, chymotrypsinogen, pancreatic lipase, and amylase).
- These granules are termed zymogen granules (zymogen referring to the inactive precursor enzymes.)
    - It is important to synthesize inactive enzymes in the pancreas to avoid auto degradation, which can lead to pancreatitis.

zymogens: trypsinogen and chymotrypsinogen.

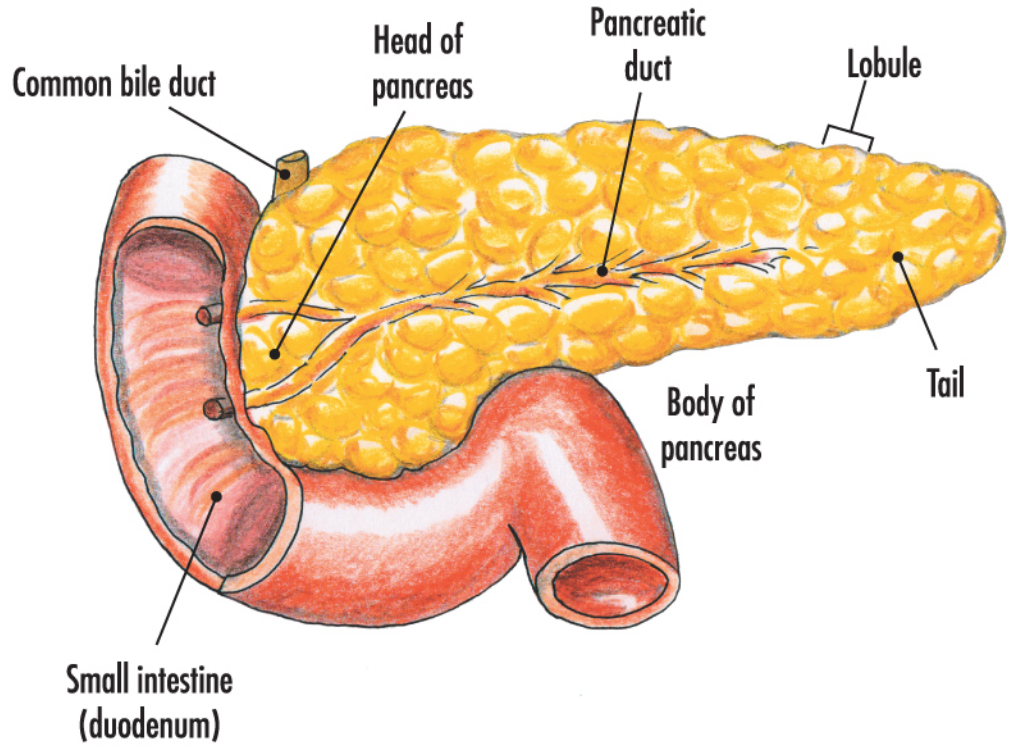
- The pancreas creates the zymogens: trypsinogen and chymotrypsinogen.
  - These zymogens are inactivated forms of trypsin and chymotrypsin.
  - trypsinogen reacts with enterokinase present in the intestines to form trypsin.
  - trypsin functions to activate trypsinogen and chymotrypsinogen to their active forms.

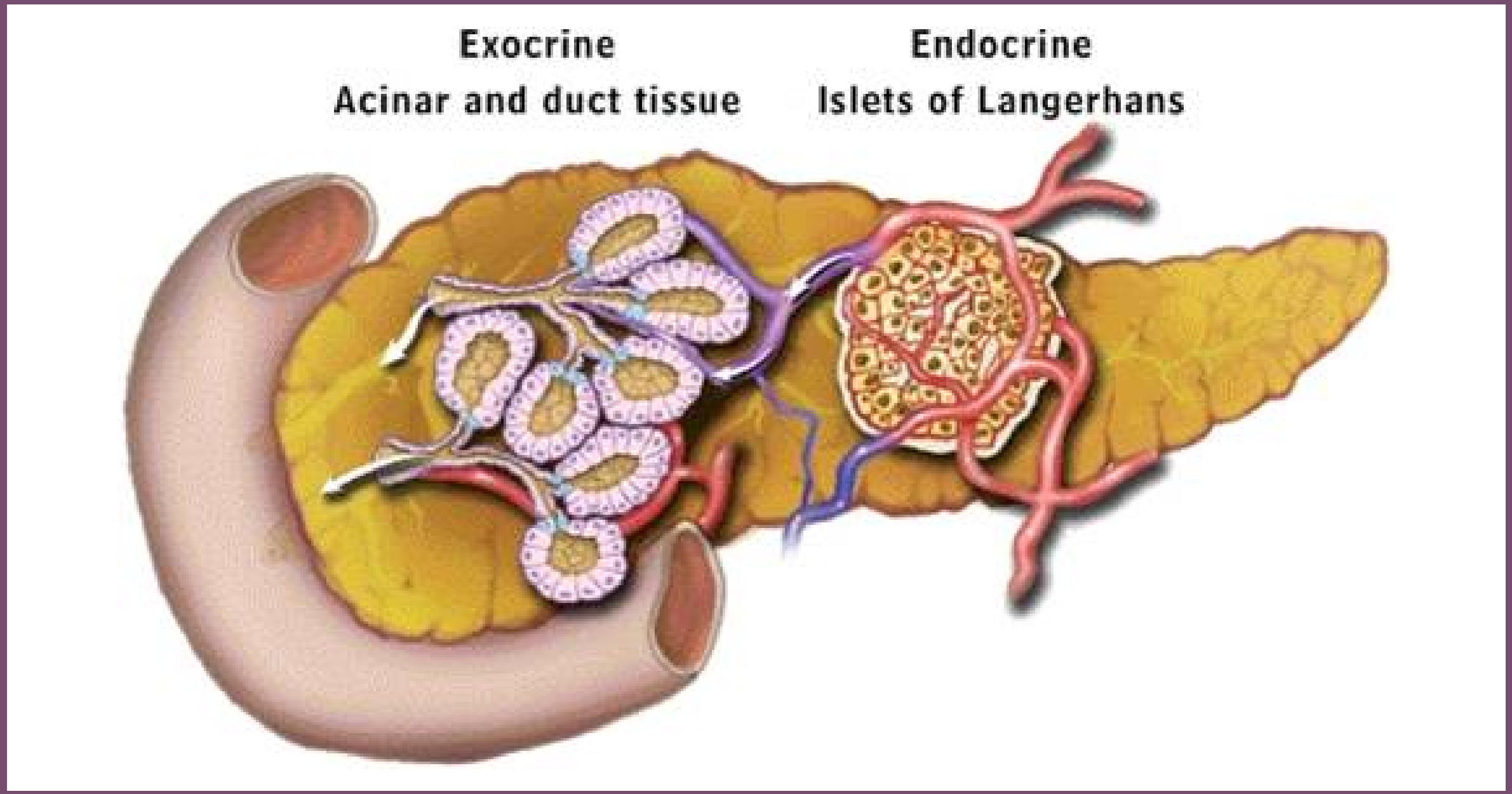


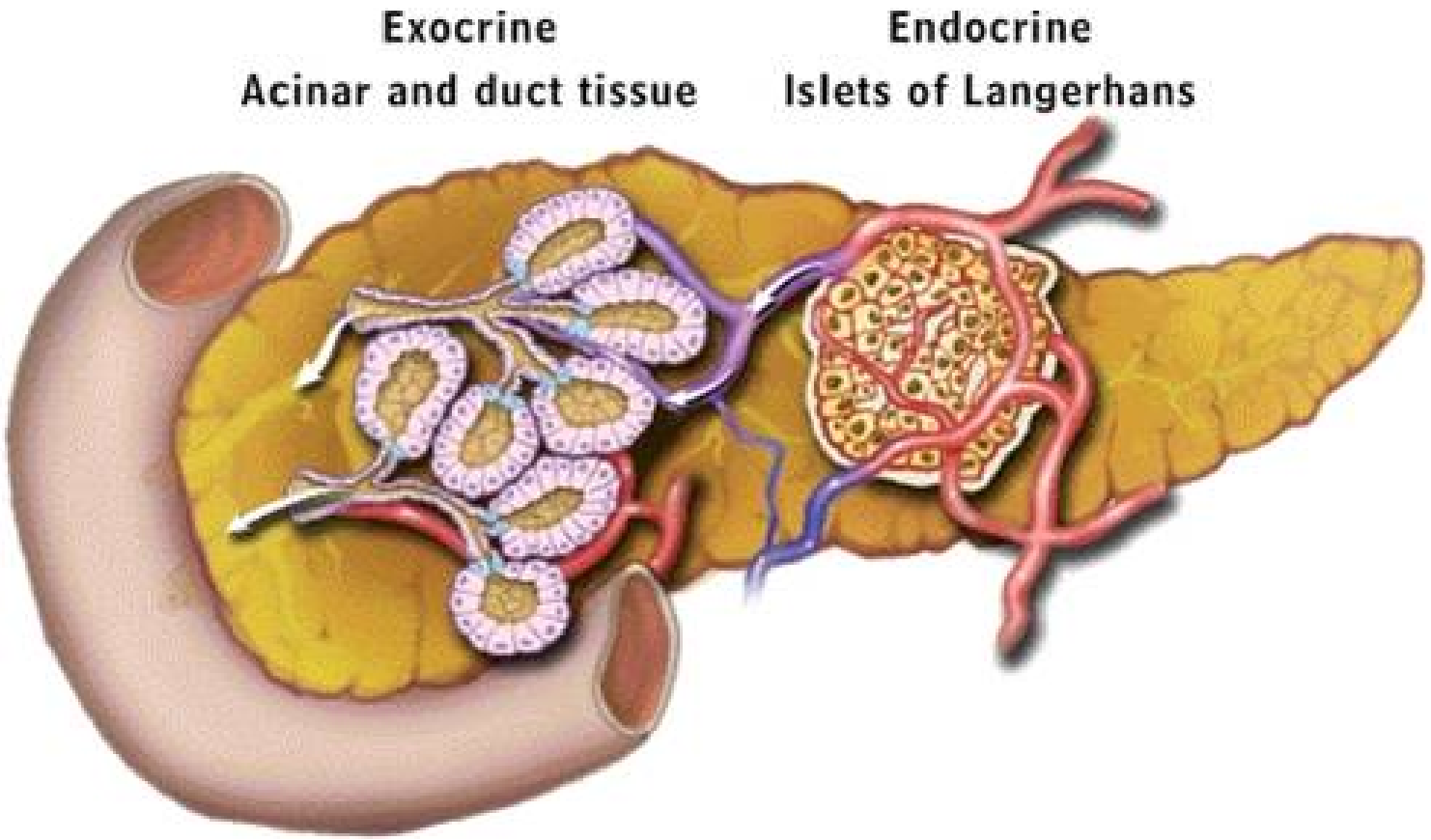
- Trypsinogen converted to trypsin by intestinal epithelium
- Trypsin converts other 2 as well as digests dietary protein

zymogens: trypsinogen and chymotrypsinogen.

- Pancreatic secretions accumulate in intralobular ducts that drain the main pancreatic duct, which drains directly into the duodenum.




Exocrine
Acinar and duct tissue
Endocrine
Islets of Langerhans



Endocrine Cells of the Pancrease

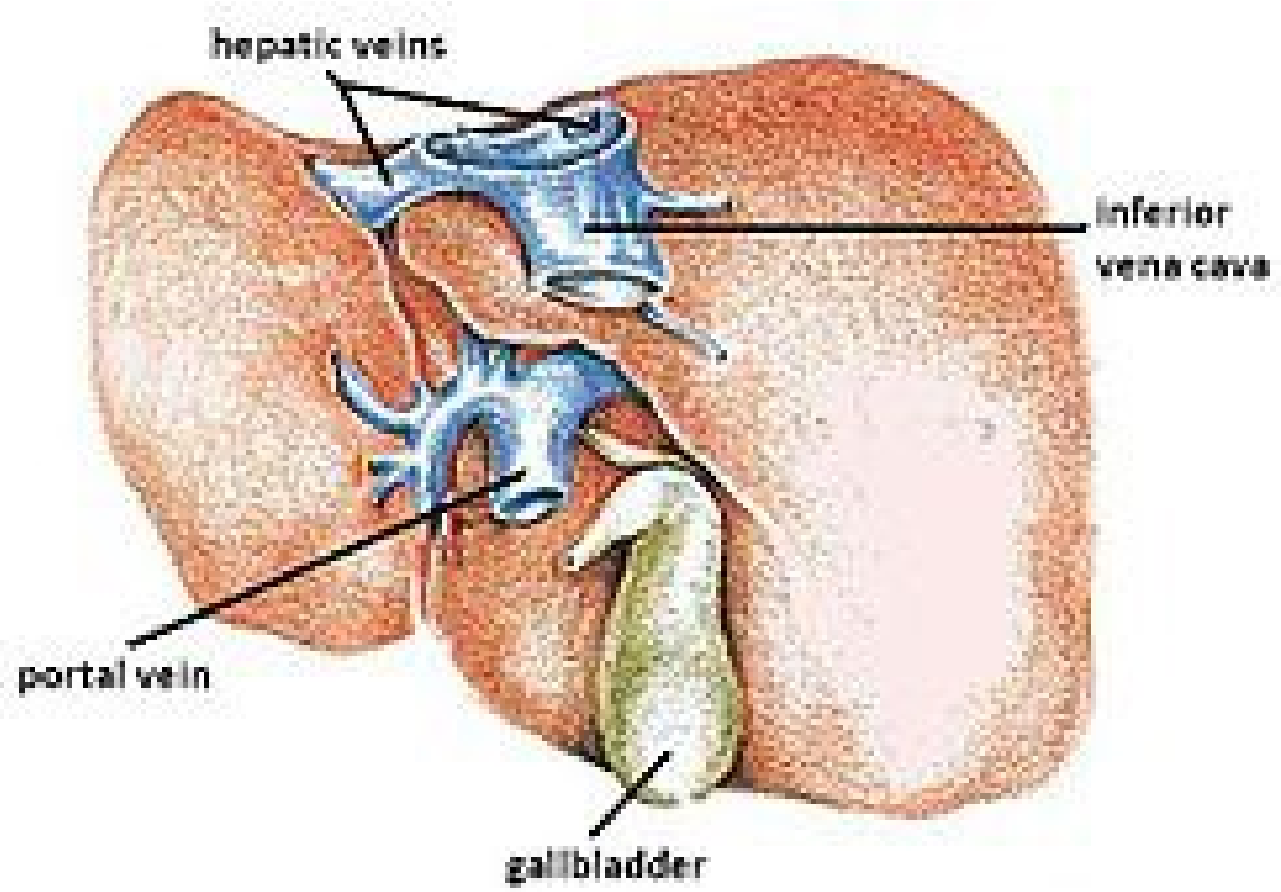
- The endocrine cells of the pancreas are located in ***the islets of Langerhans***.
  - They are:
    - Insulin-producing beta cells (50-80% of the islet cells)
    - Glucagon-releasing alpha cells (15-20%)
    - Somatostatin-producing delta cells (3-10%)
    - Pancreatic polypeptide-containing PP cells (remaining %)

Liver

- The liver plays a major role in metabolism and has a number of functions in the body including
  - Glycogen storage
  - Plasma protein synthesis
  - Drug detoxification
  - Bile production
  - Regulates a wide variety of high-volume biochemical reactions

The liver

- The liver is considered both an ORGAN and a GLAND.
- The liver is supplied by two main blood vessels on its right lobe:
  - the hepatic artery
    - The hepatic artery normally comes off the celiac trunk.
  - the portal vein
    - The portal vein brings venous blood from the spleen, pancreas, and small intestine, so that the liver can process the nutrients and byproducts of food digestion.
    - The hepatic veins drain directly into the inferior vena cava.



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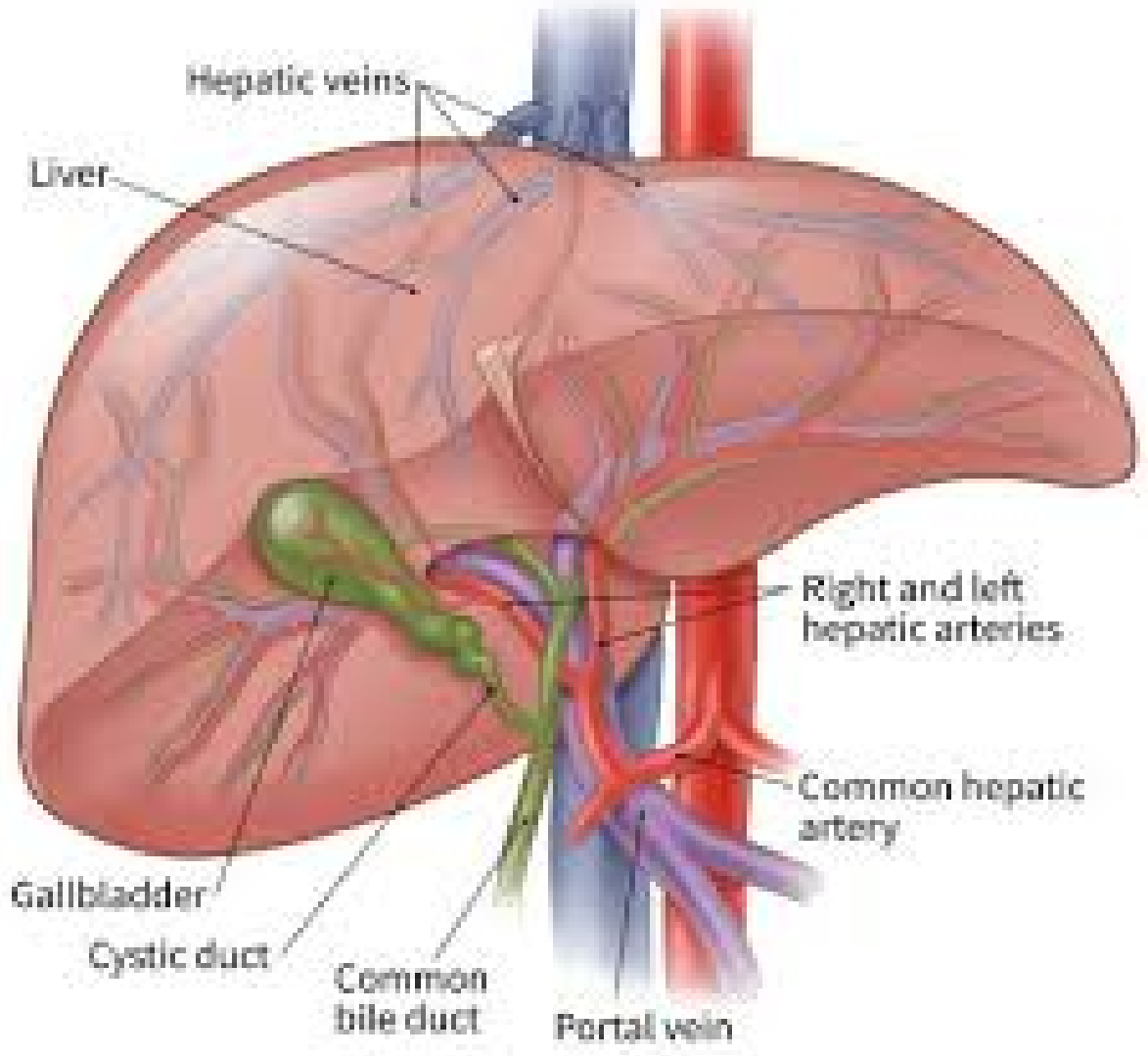
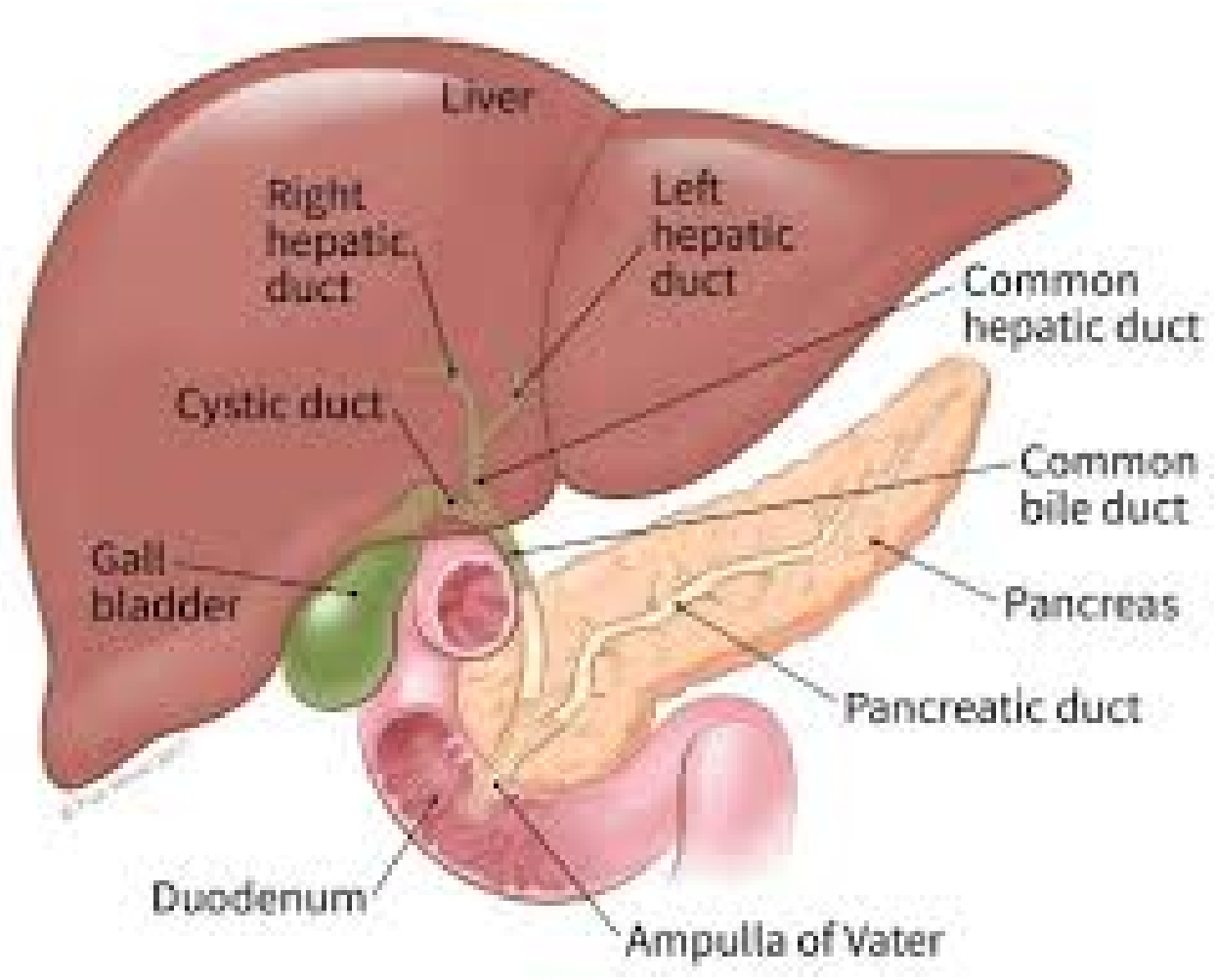


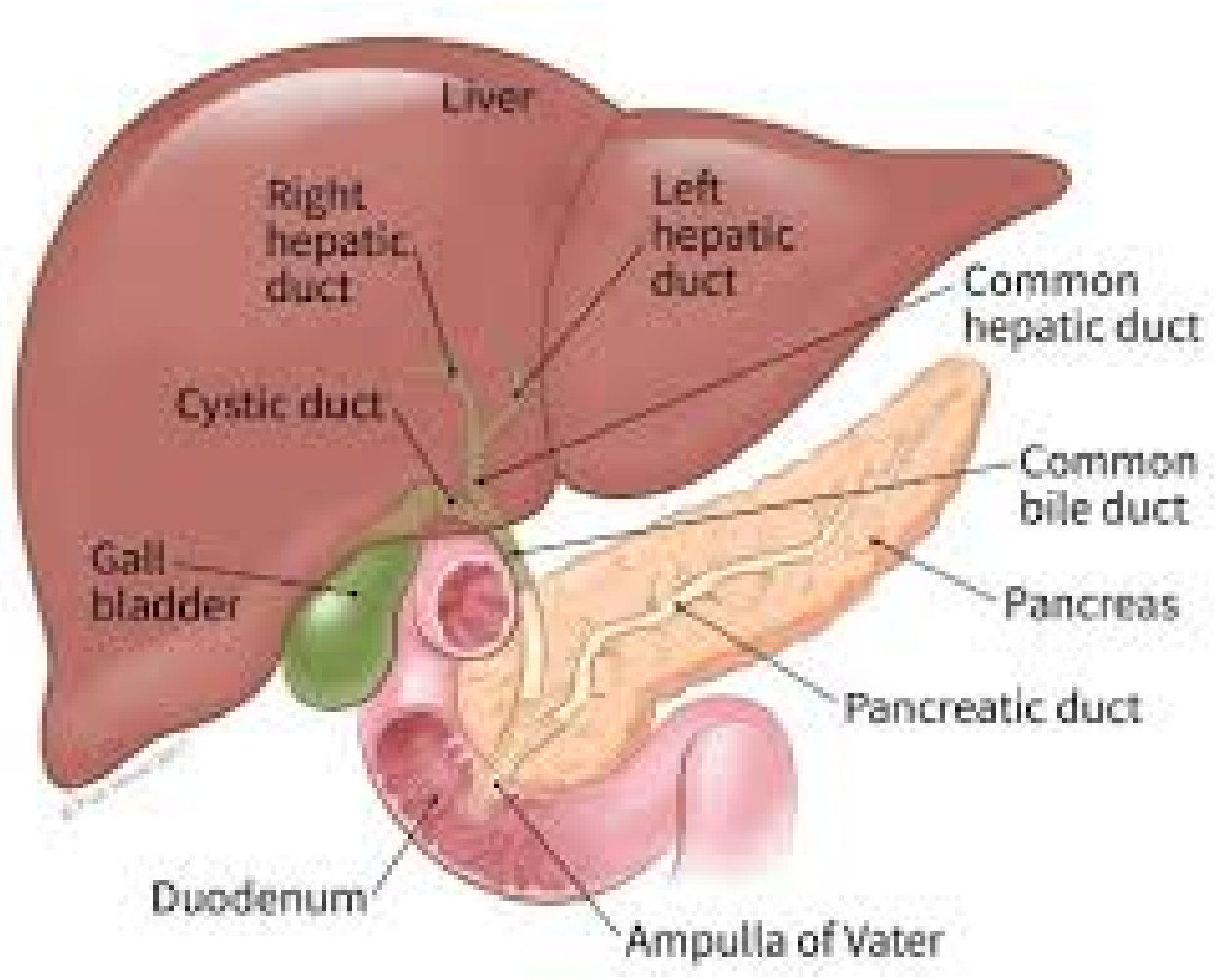
Ductal System

- The bile produced in the liver is collected in bile canaliculi, which merge from bile ducts.
- These eventually drain into the right and left hepatic ducts.
- The right and left hepatic ducts merge to form the common hepatic duct.



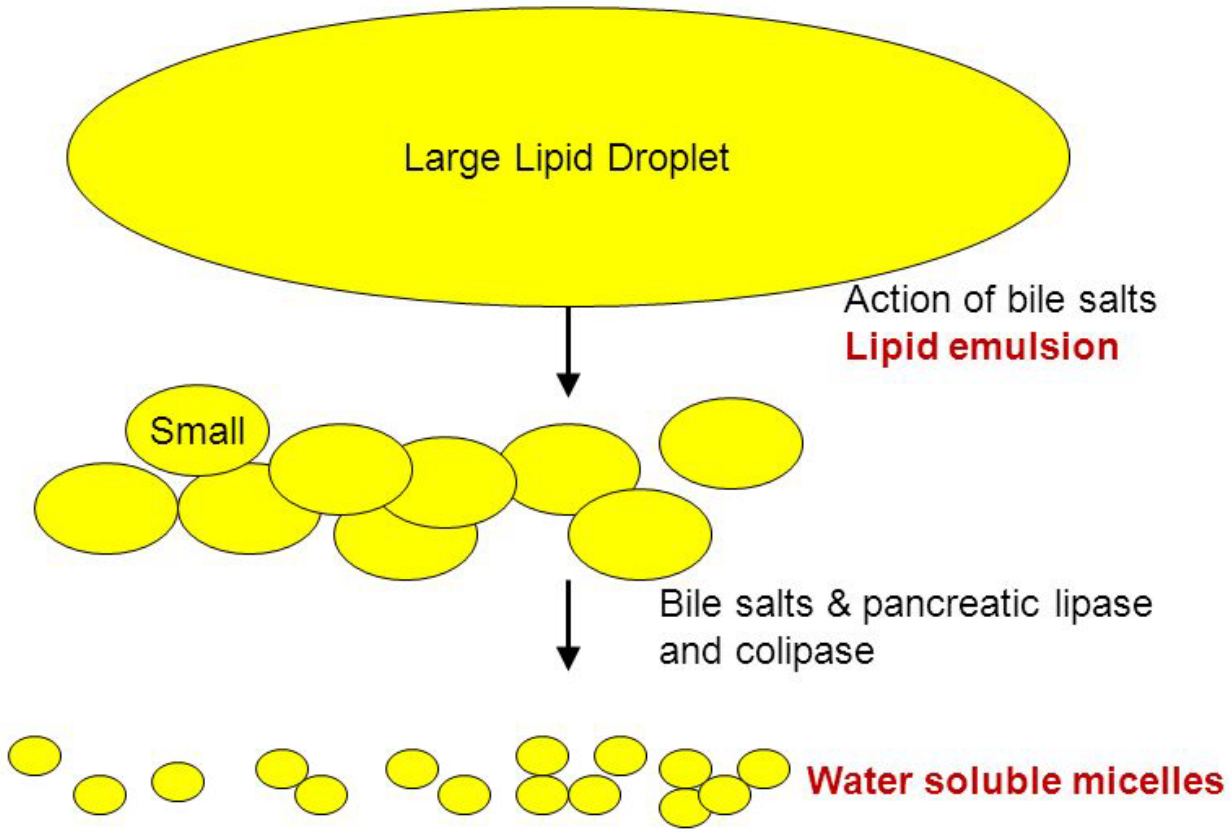
Ductal System

- The cystic duct (from the gallbladder) joins with the common hepatic duct to form the common bile duct.
- Bile can either drain directly into the duodenum via the common bile duct or be temporarily stored in the gallbladder via the cystic duct.
- The common bile duct and the pancreatic duct enter the duodenum together at the ampulla of Vater.
- The branching's of the bile ducts resemble those of a tree, and indeed term "biliary tree" is commonly used in this setting.



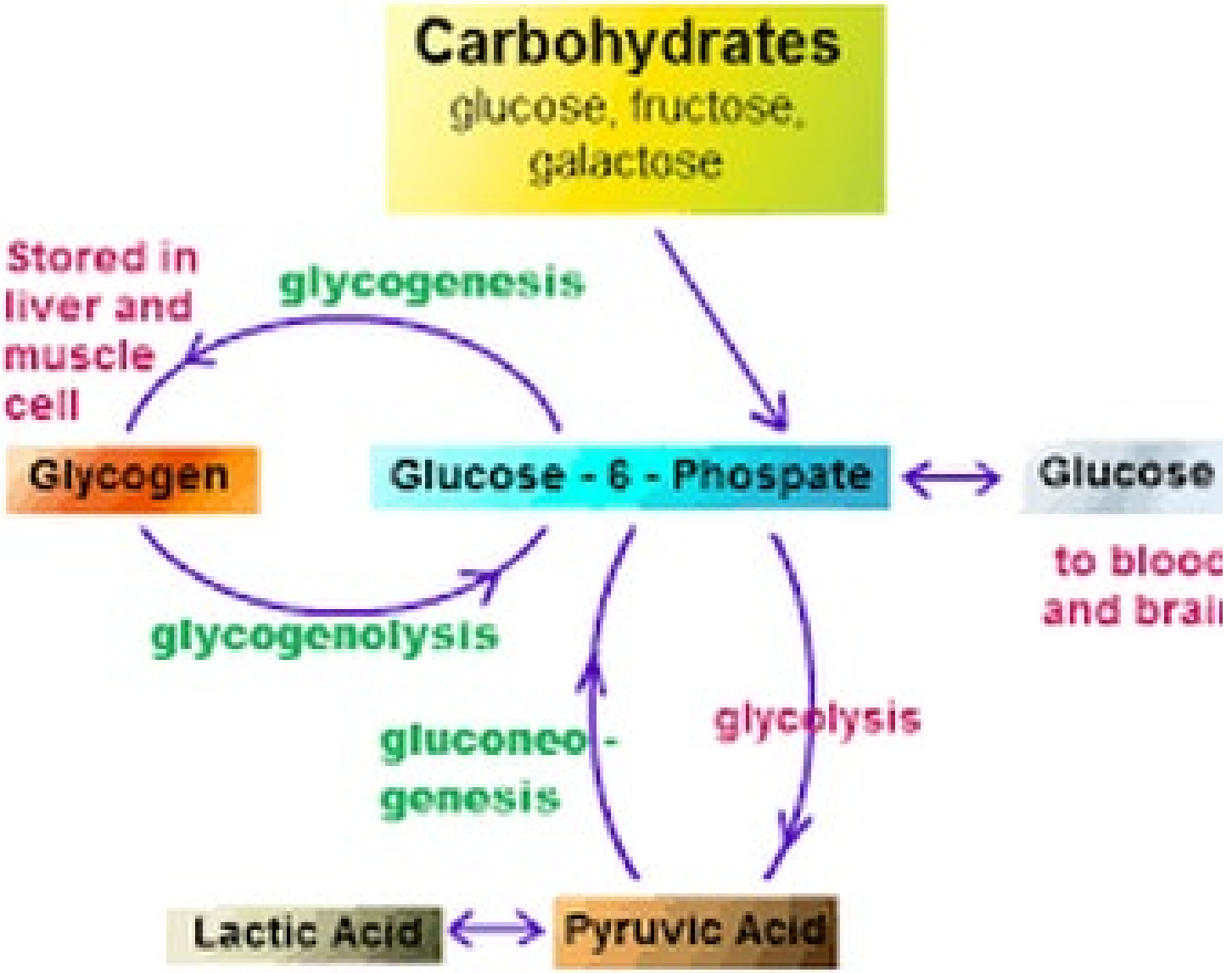
Nutrient Digestion - Lipids

- The various functions of the liver are carried out by the liver cells or hepatocytes.
- The liver produces and excretes bile, required for dissolving fats.
- Some of the bile drains directly into the duodenum, and some is stored in the gallbladder.

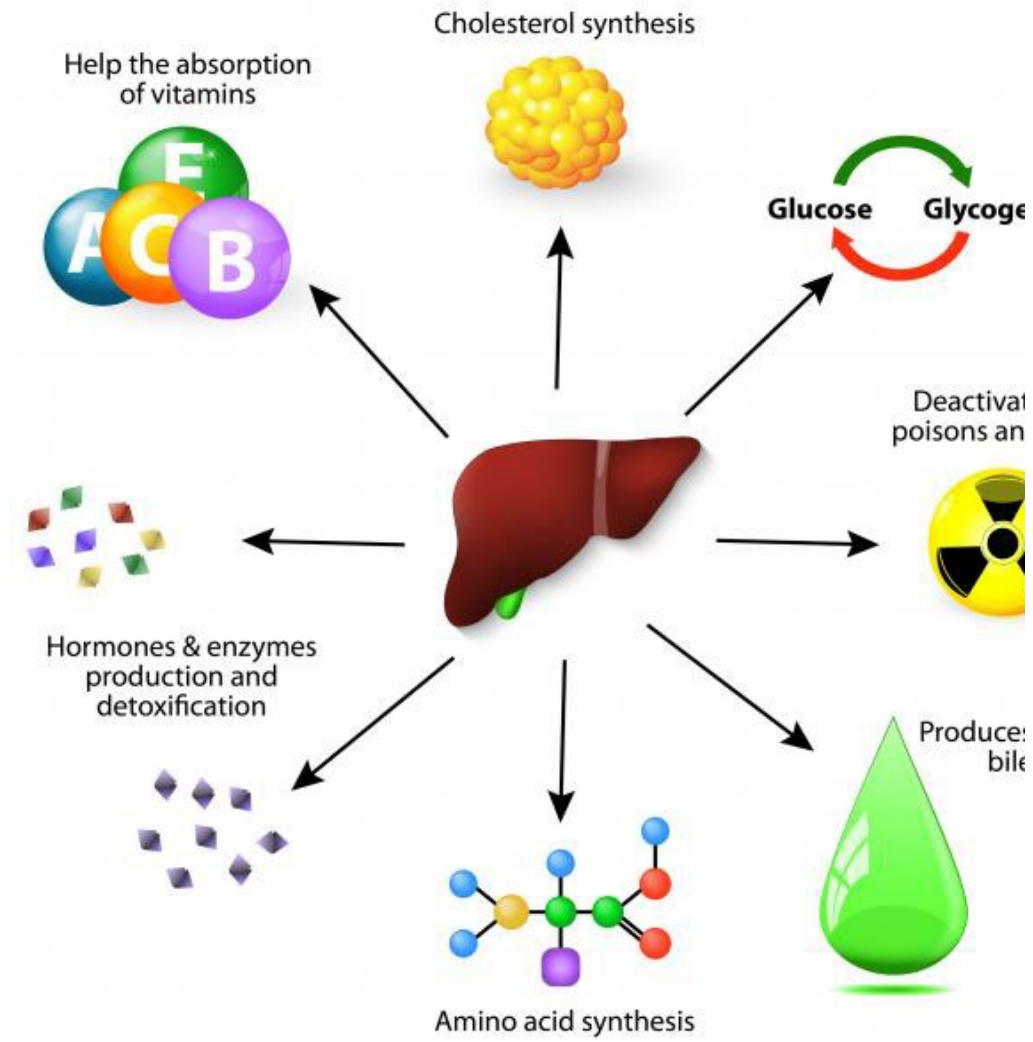


carbohydrate metabolism

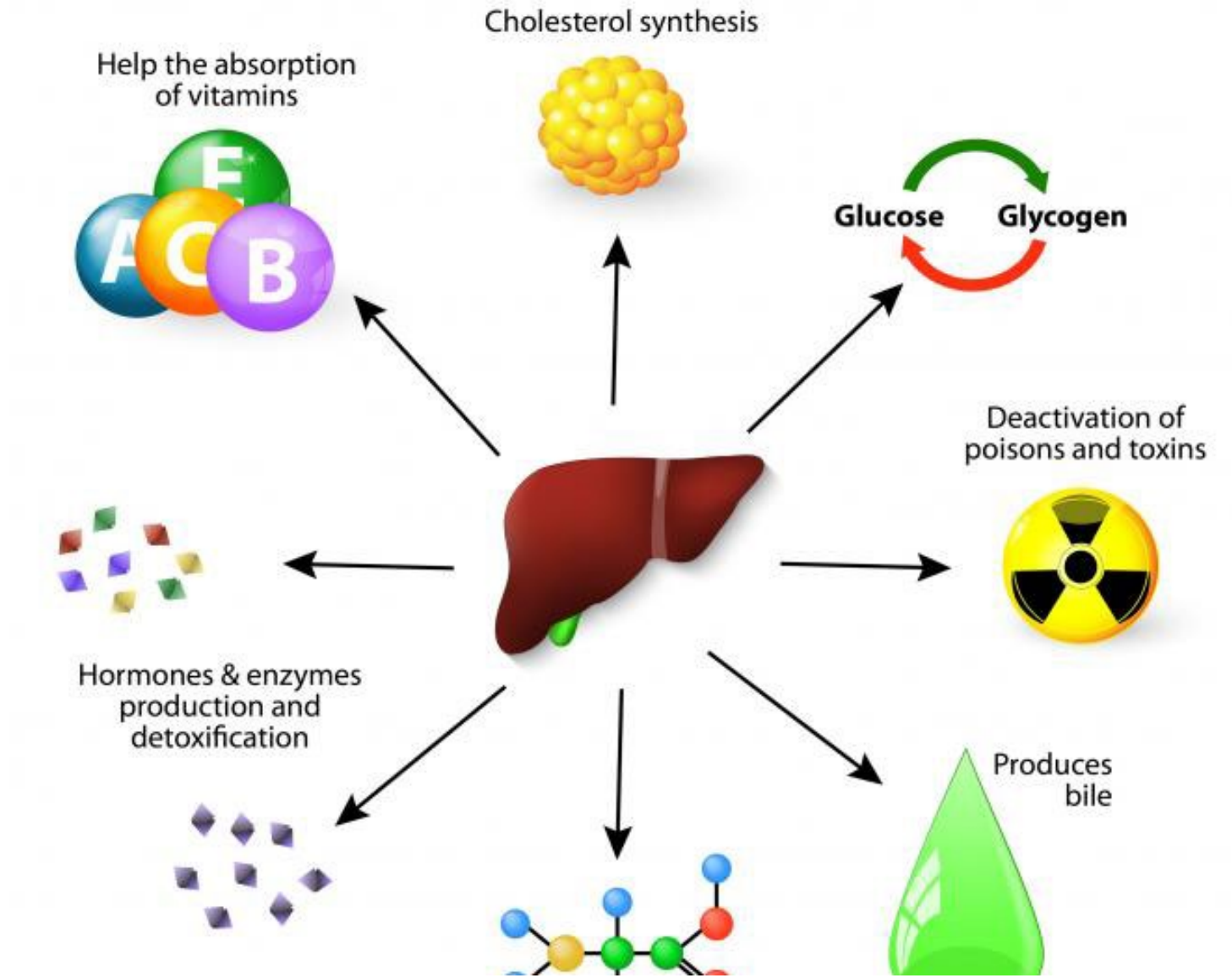
- The liver performs several roles in carbohydrate metabolism:
  - Gluconeogenesis (the formation of glucose from certain amino acids, lactate or glycerol)
  - Glycogenolysis (the formation of glucose from glycogen)
  - Glycogenesis (the formation of glycogen from glucose)



- The breakdown of insulin and other hormones



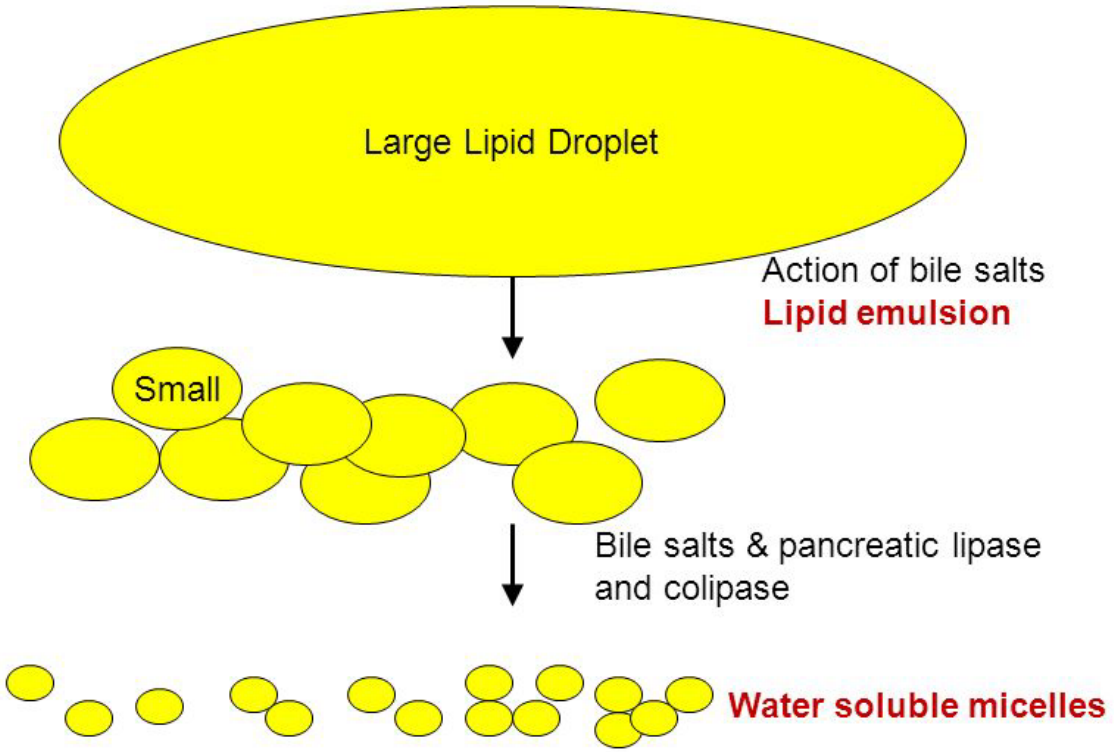
- The liver is responsible for protein metabolism.
- The liver also performs several roles in lipid metabolism:
  - Cholesterol synthesis
  - Production of triglycerides (fats)
- Breaks down hemoglobin
- Breaks down toxic substances
- Drug metabolism
- Converts ammonia to urea
- Stores glucose in the form of glycogen



Gallbladder

- The gallbladder stores bile, which is released when food containing fat enters the digestive tract.
- The release of bile from the gallbladder stimulates the secretion of cholecystokinin (CCK).
- The bile emulsifies fats and neutralizes acids in partly digested food.
- After being stored in the gallbladder, the bile becomes more concentrated than when it left the liver, increasing its potency and intensifying its effect on fats.

Nutrient Digestion - Lipids



Anus

- The Anus has two anal sphincters
  - Internal Anal Sphincter
  - External Anal Sphincter
- These hold the anus closed until defecation occurs.
  - The internal sphincter - consists of smooth muscle and its action is involuntary
  - The external sphincter The other consists of striated muscle and its action is voluntary.