Digestive System

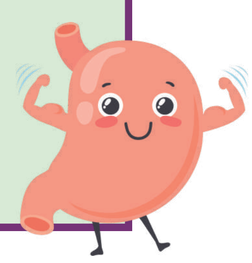
- The digestive system is a long, muscular tube that transports food through various organs that break the food down and process the nutrients.
    - This is the body's way of attaining what is needed for energy, cell growth, and maintenance.

There are four layers to the digestive tract: the mucosa, submucosa, muscular layer, and serosa.

- The mucosa is the inner lining of the digestive tract.
    - This part is made up of epithelial tissue so that the flood slides along.
- The submucosa is made of dense irregular connective tissue.
    - This layer has a bunch of blood vessels, glands, and lymphatic vessels.
- The muscular layer is made of smooth muscle that is in charge of moving the food along the digestive tract.
- The serosa is on the outside of the tube and firmly attaches it to the adjacent organs and structures.

The purposes of the digestive tract are:

- Ingestion – Food and liquids (for hydration) are ingested through the mouth.
- Mechanical digestion – The teeth shred the food, making it easier to break down and reducing the risk of choking. The tongue compresses the food so that it will fit into the digestive tract. Then, the food goes through churning and mixing, which will break it down further.
- Chemical digestion – The chemicals and enzymes break down the food until it can be absorbed by the GI tract.
- Secretion – The digestive tract secretes large amounts of acids, juices, and buffers as the food passes.
- Absorption – The digestive tract absorbs the nutrients from the food.
- Defecation – This system gets rid of the leftover fiber and waste that cannot be used for nutrients.



Digestive System

Oral Cavity

- Digestion starts in the mouth. This is where the food is ingested. But before the food moves on into the esophagus, it is broken down in the mouth.
  - The teeth are four-layered structures designed to grind up and crush the food. Each tooth is designed to serve a certain purpose when chewing. Some are good for tearing, some for crushing, and some for gripping.
  - Another way that the food is broken down is through chemical digestion.

The four layers of teeth are enamel, dentin, cementum, and pulp.

Sublingual glands are located underneath the tongue. These glands only produce 3-4% of saliva.

- Parotid glands: These are the largest salivary glands of the body. They are located below each ear and produce over half the saliva needed for chemical digestion (but this is only in a stimulated state, otherwise the submandibular glands produce the most).
- Submandibular glands: These glands produce 70% of the saliva when they are in an unstimulated state. Otherwise the parotid glands produce the most.

Continuation of the Oral Cavity/ Esophagus

- Deglutition (swallowing) is the process of transferring the bolus (chewed-up food) into the esophagus. This is a retraction of the tongue that shoves the bolus back and past the oropharynx. Then the epiglottis covers the larynx so that the bolus doesn't go down the trachea, and the soft pallet covers the nasopharynx. This triggers the reflex response and allows peristalsis to begin. The esophageal phase of swallowing is when peristalsis brings the bolus down to the stomach with wave-like contractions. This stage takes around 9 seconds.

Digestive System

The Stomach

- The stomach is in charge of both chemical and mechanical digestion. Not only does the stomach churn and break down the bolus by contractions, but it also releases acidic juices that break the food down chemically.

  The food is called bolus down the esophagus, until it absorbs the juices and acids of the stomach. The stomach can hold up to 1.5 liters of material.

  That material is called chyme

- The stomach has a unique structure. Instead of a straight and striated smooth muscle layer, it has an extra layer of oblique smooth muscle that really helps with the churning. There is a longitudinal layer, a circular layer (one that goes all the way around the stomach), and an oblique layer.

- The inside of the stomach has large wrinkles called rugae that increase surface area and allow the organ to hold more chyme.
- The fundus is the top of the stomach that connects to the esophagus.
- The cardia is the medial portion of the stomach that holds the mucous glands that protect the esophagus from the acids of the stomach.
- The body of the stomach is in charge of holding most of the chyme and churning it. This portion functions as a mixing bowl.
- The pyloric part is the end of the stomach and forms the chyme into a tubular shape. This part allows the chyme to pass into the duodenum of the small intestine.
  - The antrum is the part that connects to the body of the stomach.
  - The pyloric canal transports the chyme from the antrum to the duodenum.
  - The pyloric orifice is the outlet that opens up into the duodenum.
  - The pyloric sphincter is a ring of muscle that controls the release of chyme. This is a very important part of the stomach.
    - (Make sure to know this because you will be quizzed on this quite often.)

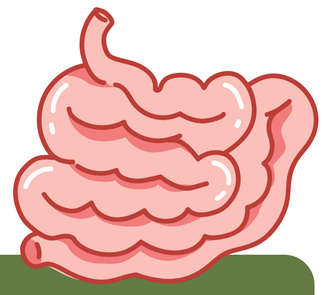
Digestive System

Continuation of the Stomach

- There are gastric glands that produce 1500 mL of gastric juices every day to help chemically break down the bolus. These cells (parietal and chief cells) are found in depressions in the fundus and body called gastric pits.
    - There is also a substance called pepsinogen. This proenzyme is converted into pepsin by the HCl in the stomach. This is an important part of digesting milk for an infant. It produces enzymes called rennin and gastric lipase.
    - Parietal cells make and secrete intrinsic factors, which is a glycoprotein that is meant to take in B12. These cells also help make hydrochloric acid, which is why the stomach is so acidic.

Small Intestine

- The small intestine is in charge of absorbing 90% of the nutrients from the chyme. It is split into three sections: the duodenum, jejunum, and ileum (know this).



- The duodenum is the first section of the small intestine. Its role is mixing the chyme and absorbing a lot of nutrients. It also neutralizes the acids in the chyme before there is damage to the absorptive part of the small intestine. This section has a few circular folds with small villi.
- The jejunum is the middle part of the small intestine and is in charge of absorbing the majority of the nutrients in food. This is done through the many circular folds and the really long villi.
- The Ileum only has a few circular folds even though it is the longest part of the small intestine. This section is 11.5 feet long and ends with the ileocecal valve that regulated the amount of material that goes into the cecum.

Digestive System

Large Intestine

- The large intestine is in charge of absorbing the water from the chyme and turning it into feces, absorbing the vitamins that are made by the bacteria, and storing feces before defecation.
- The first part of the large intestine is called the cecum. This is the part that begins compacting the material.
- The next part is the ascending colon. This is on the right side of the body and goes up to the transverse colon. This part of the colon goes from the right side of the body to the left. Then it meets up with the descending colon that goes down the the iliac fossa. The descending colon stops at what is called the sigmoid flexure.

There are pockets along the colon called haustra that hold the material until a mass movement happens. A mass movement is when there is a contraction in the large intestine that pushes the material along the colon.

Rectum and Anus

The rectum makes up the last few inches of the digestive tract. It relaxes and stretches to allow a large amount of feces. This part also absorbs the last of the water and electrolytes from the feces. Once the feces moves into this section of the colon, it triggers defecation. The anal sphincter is the part of the body that controls when the feces leaves the body. It is a thick ring of smooth muscle surrounded by striated muscle, which lets you relax the sphincter voluntarily so that you can have a bowl movement.

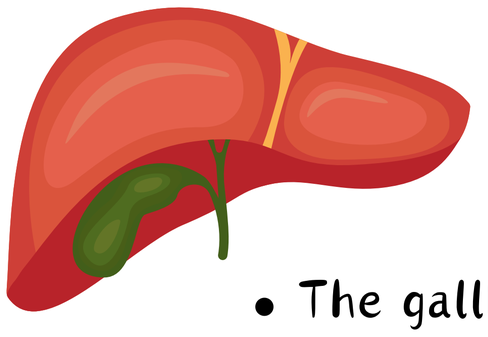
Digestive System

Accessory Digestive Organs

Pancreas

- The pancreas is another accessory organ that is extremely involved in hormone production.
- The pancreas produces endopeptidases, exopeptidases, pancreatic lipase, colipase, amylase, bicarbonate, insulin, glucagon, and somatostatin.
    - The three to focus on are insulin, glucagon, and somatostatin.
- Insulin assists the body in using sugar for energy. It allows the body to store the energy properly.
- Glucagon raises the blood sugar levels by telling the liver to release glucose into the bloodstream.
- Somatostatin stops the release of pancreatic hormones. It also stops the enzymes that are made for digestion.

Gallbladder



- The gallbladder is another accessory organ that helps with digestion.
- It stores and concentrates bile. Bile is made by the liver, but the liver doesn't have room to store as much bile as the body needs.
- The gallbladder is located underneath the liver.
- The gallbladder is the organ that regulates the amount of bile going to the small intestine.

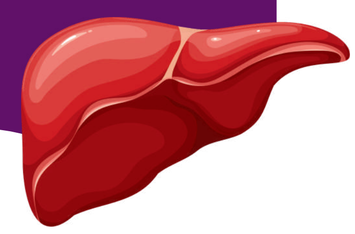
Digestive System

Accessory Digestive Organs

Liver

- The liver is one of the most complex and important organs in the body.
- Although it is not directly involved with digestion (it doesn't hold bolus, chyme, or feces at any point), it is still a huge part of digestion.
- The liver produces bile that breaks down fats into fatty acids so that they can be absorbed by the small intestine. Without bile, the process of digestion is almost useless.

Bile contains a waste product of hemoglobin called bilirubin so that the waste from hemoglobin is expelled.



- Bile also neutralizes the acidity of the HCl that the chyme picked up from the stomach. This prevents the chyme from damaging the absorptive surface or burning holes in the digestive tract. Bile also fights against the bad microorganisms in food.
- The liver also filters through the blood and removes alcohol and bacteria. Another function is that it stores vitamins, fat, and sugar for future use. This ties in with how the liver monitors the chemical levels in the blood. It will release more sugar if if the blood sugar gets low. The list for the liver goes on. It contains over half the white blood cells and macrophages needed to protect the body.

Other Accessory Digestive Organs

- Other accessories to digestion are teeth and the salivary glands. Teeth are one of the biggest factors of mechanical digestion. Salivary glands aid in chemical digestion by producing saliva when the brain is stimulated to the presence of food. One important part of saliva is salivary amylase. Amylase breaks down carbs and starches.