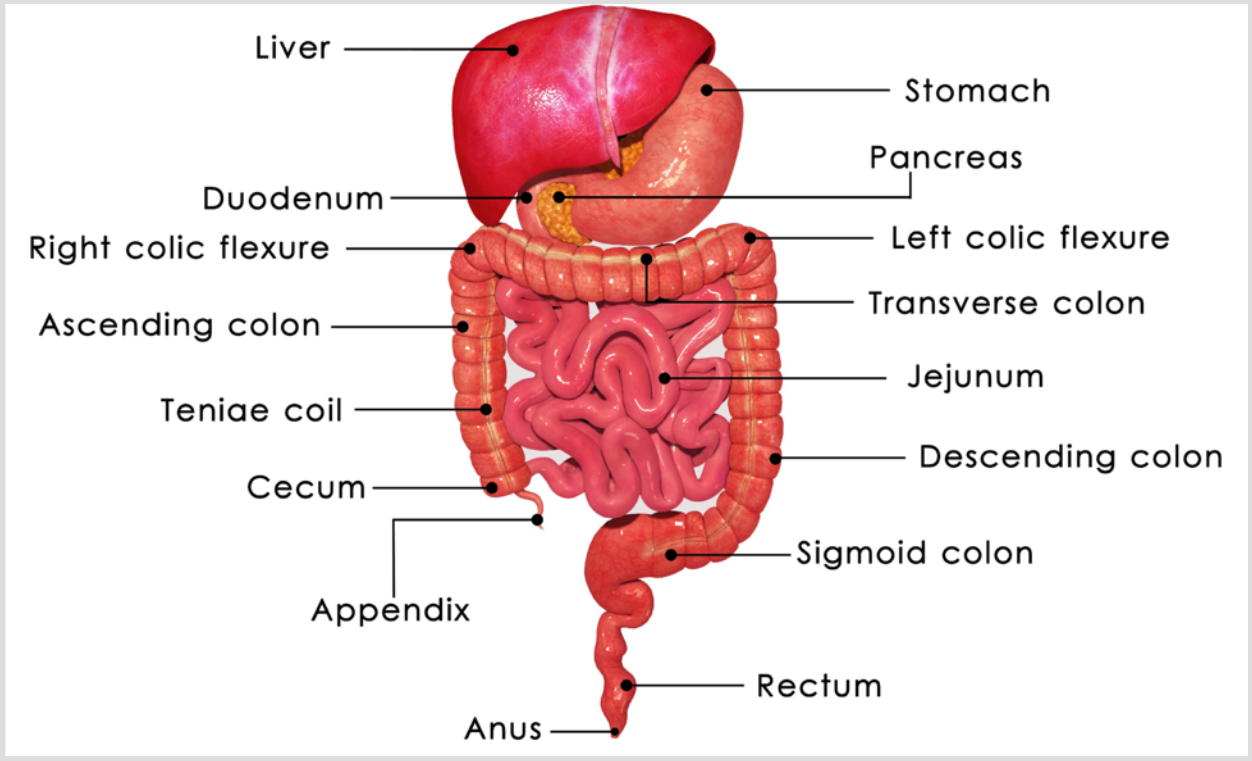
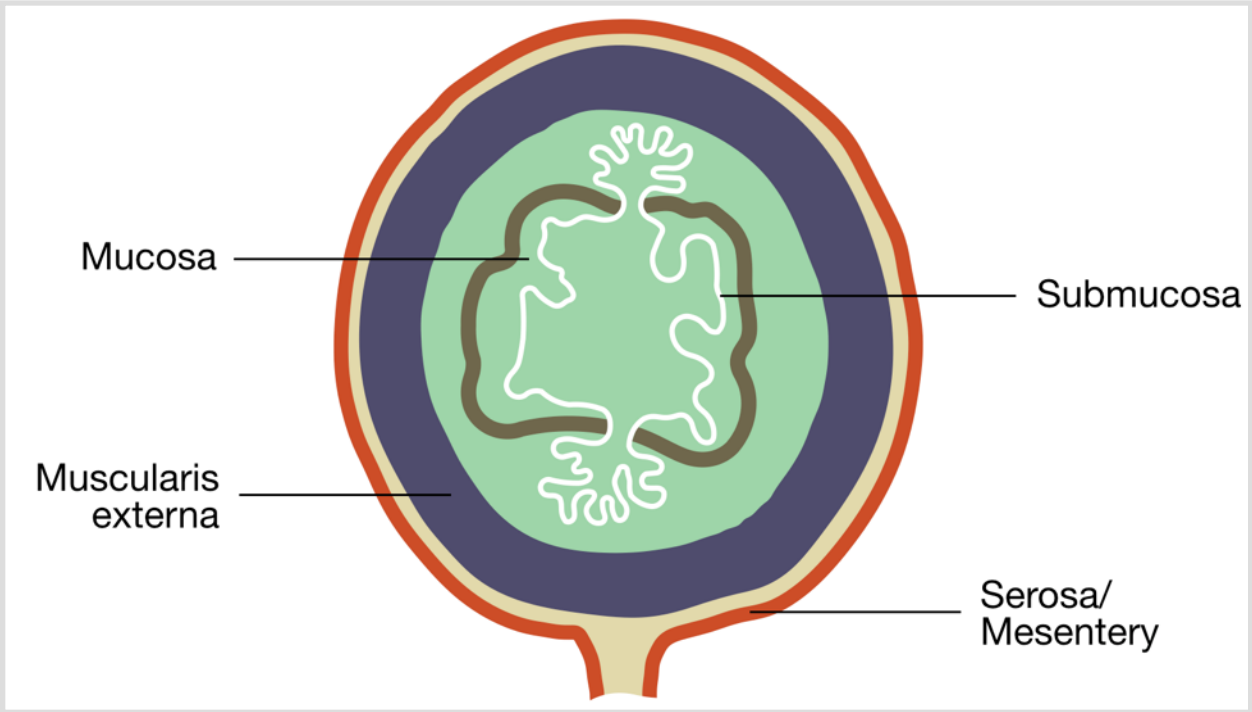
Basic Physiology

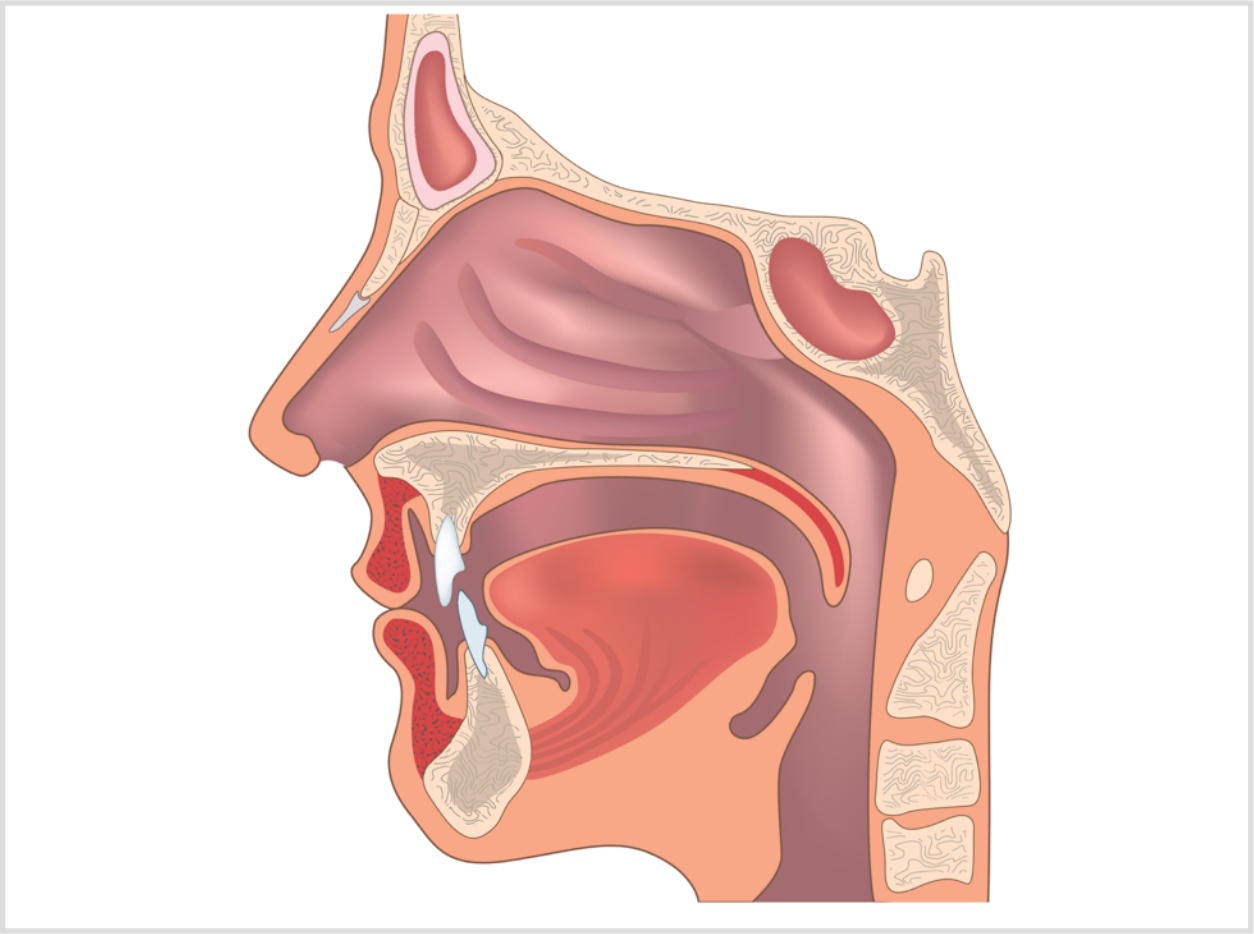
Hey, everyone, in this unit we're going to discuss basic physiology of the digestive tract.



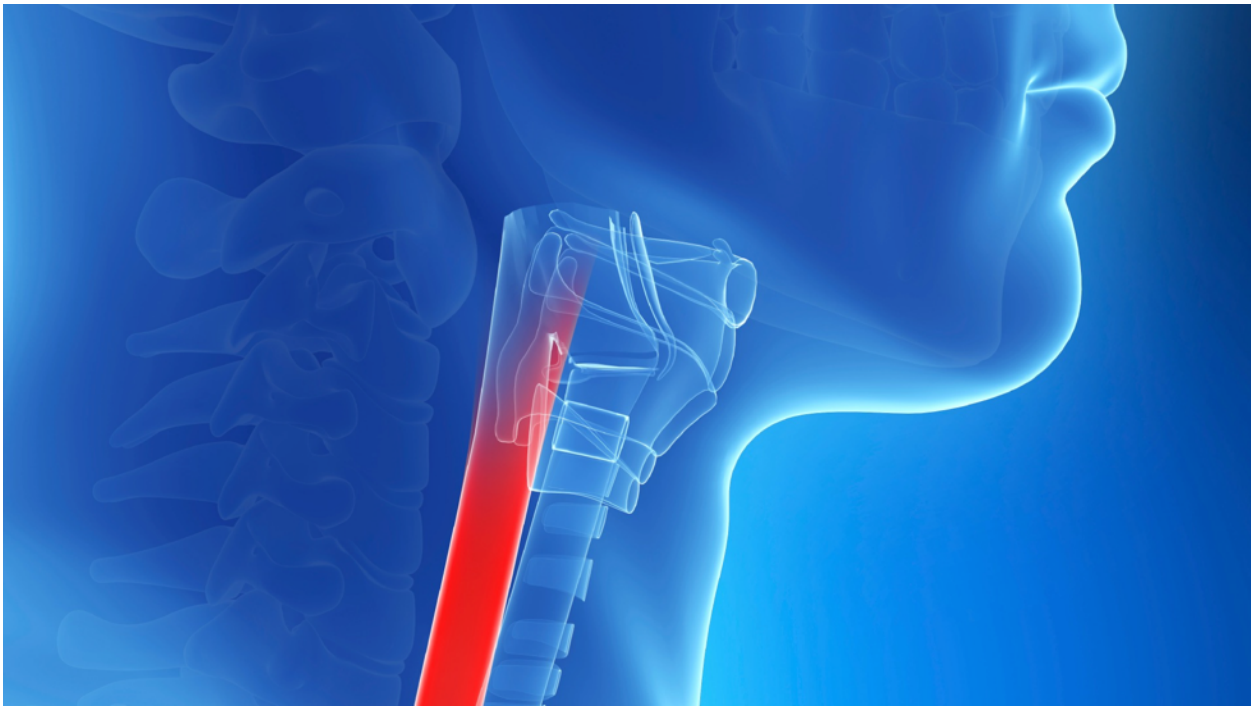
The GI tract is a hollow tube starting with the mouth and ending with the anus, consisting of the mouth, the pharynx, the esophagus, the stomach and intestines, the rectum, and the anus, and also the accessory organs that assist the GI tract like the salivary glands, liver, gallbladder and pancreas. The GI tract has two primary purposes: the first is to break food into nutrients, which are then absorbed to provide us with energy, and the second is to serve as a barrier system that protects against antigens and foreign substances from getting inside of the bloodstream and the body. If you think about it, everything that's inside of the gut is actually outside of the body, and it is kind of strange to think about it that way, but it's important when you're thinking about the physiology of the GI tract.



The GI tract is divided into four layers. The innermost layer is the mucosa; this is a specialized layer of epithelial cells supported by underlying connective tissue called the lamina propria. The lamina propria contains blood vessels, nerves, lymphoid tissues, and glands that support the mucosa. The epithelial layer is sometimes single-celled and other times it's stratified into multiple layers. The next layer is the submucosa, and this consists of fat, fibrous connective tissue and larger vessels and nerves. Underneath the submucosa is the muscularis externa; this is a smooth muscle layer with inner circular and longitudinal layers of muscle fibers separated by the myenteric plexus or Auerbach's plexus. Last, the outermost layer is the serosa/mesentery. This is formed by fat and another layer of epithelial cells called the mesenterium.

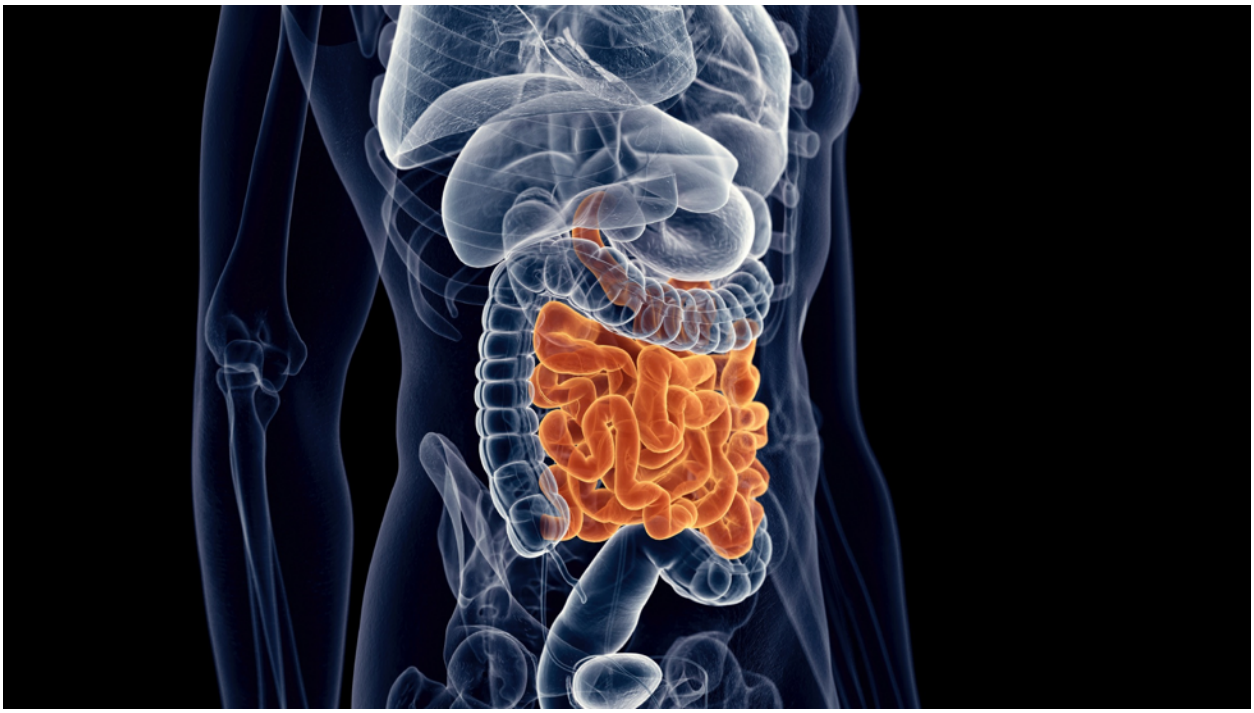


Let's take a closer look at each of the components of the GI tract. The first is the oral cavity. An important thing to understand is that the digestion of carbohydrates starts here in the mouth. The enzyme amylase is a component of saliva and it begins to break down complex carbohydrates. As a side note, there are genetic differences in salivary amylase production between individuals, and this is one of the many factors that determines the difference between carbohydrate tolerance among individuals. Small molecules like glucose and water can also be absorbed in the mouth. There are three pairs of salivary glands that communicate with the oral cavity, the parotids, sub-mandibulars, and sub-linguals. Salivation occurs in response to taste or the appearance of food, and salivary glands not only help produce enzymes to digest carbohydrates, but also immune substances that can assist us in fighting microorganisms that we might be exposed to. This is why adequate chewing of food is so crucial for digestive health, and it's really often overlooked, so we need to educate our patients about this, and it can actually make a really big difference in digestion.

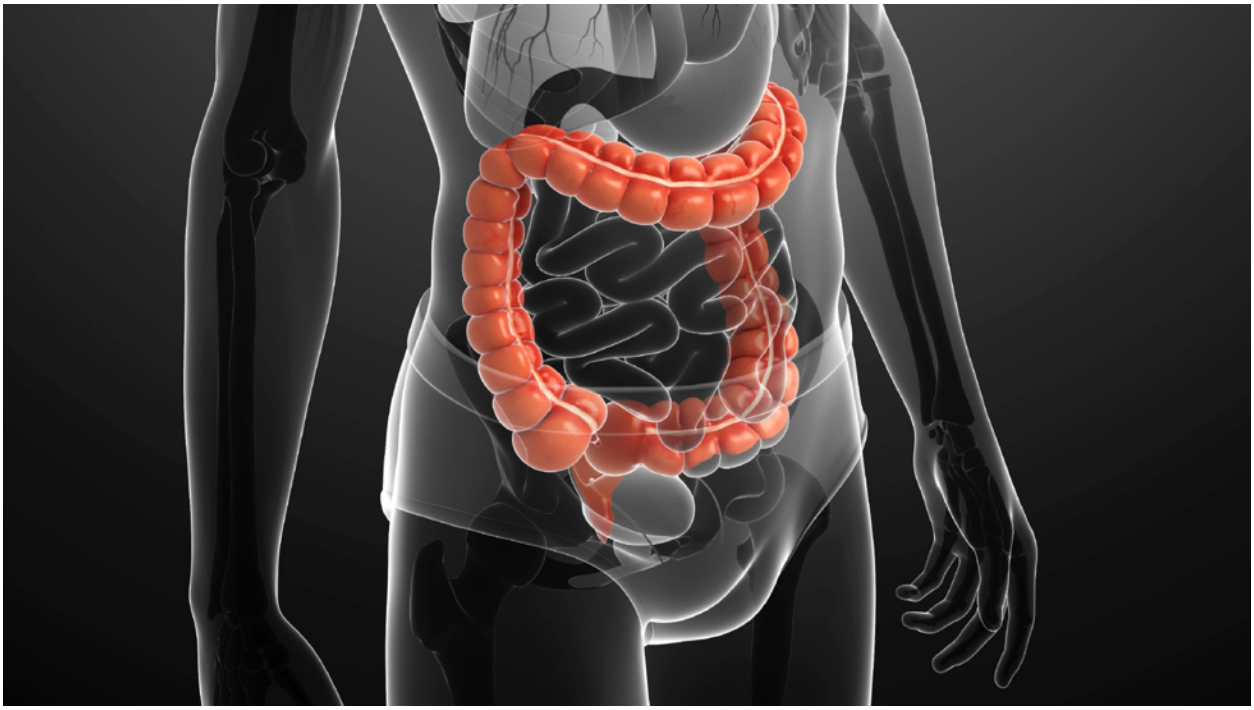


From the mouth, food passes through the pharynx and esophagus by the action of swallowing. The esophagus is a muscular tube that's roughly 10 inches or 25 centimeters in length, and it extends from the pharynx to the stomach after passing through the diaphragm. The esophagus primarily functions as a transport system between the mouth and the stomach.

From the esophagus, food passes into the stomach, which is a J-shaped expanded bag that's divided into four regions: the cardia, the fundus, the body, and the pylorus. The primary functions of the stomach are: number one, short-term storage of food; number two, mechanical breakdown of food; number three, chemical digestion of food via stomach acid and enzymes; number four, killing of microorganisms that we swallow, also by stomach acid; and number five, absorption of some substances like alcohol.

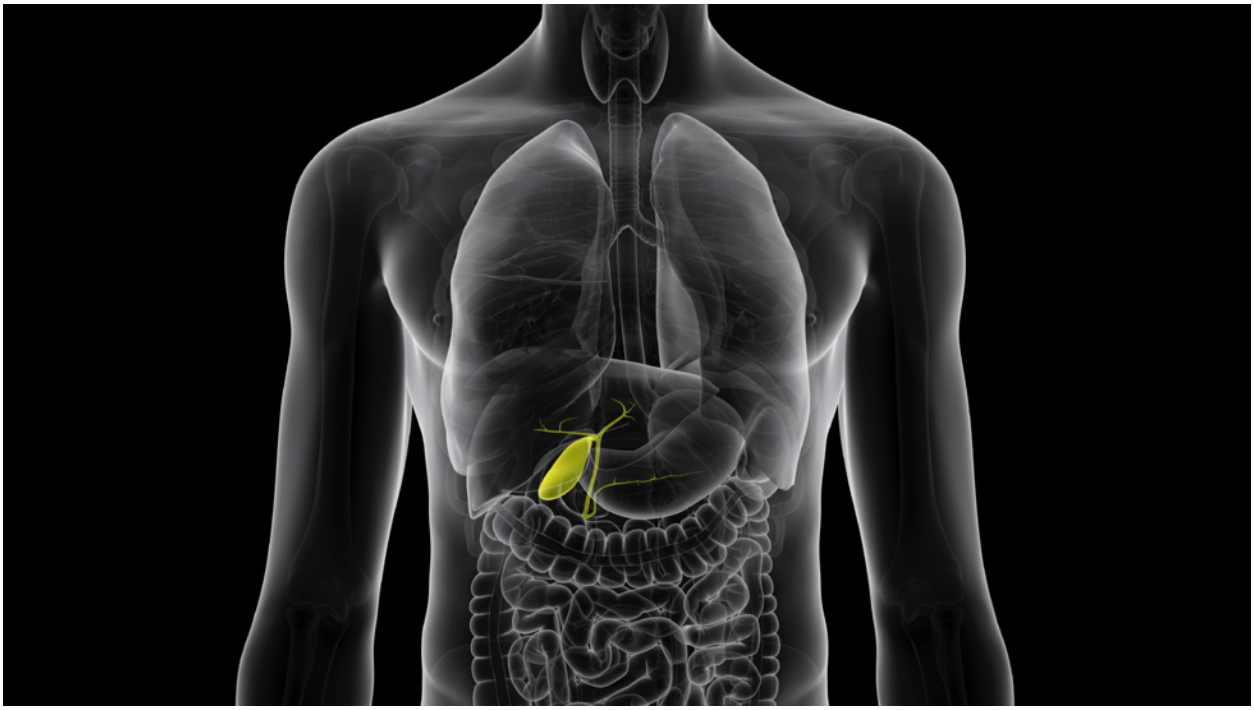


From the stomach, chyme, which is a sludge-like substance which consists of food mixed with stomach acid and enzymes, passes into the small intestine. The small intestine is composed of three sections in descending order: the duodenum, the jejunum, and the ileum. It averages about 18 feet, or six meters in length, and is compressed into multiple folds, and it occupies a large portion of the abdominal cavity. The duodenum has a mixing function; it combines enzymes that are produced by the pancreas and bile salts that are produced by the liver and stored in the gallbladder with chyme from the stomach. The jejunum is where the majority of digestion and absorption occurs. The ileum is the longest segment, and it empties into the cecum, which is the first section of the colon at the ileocecal junction. The small intestine overall performs a majority of the digestion and absorption of nutrients, and, as we'll discuss later, this is why bacterial overgrowth in the small intestine can be such a big problem.

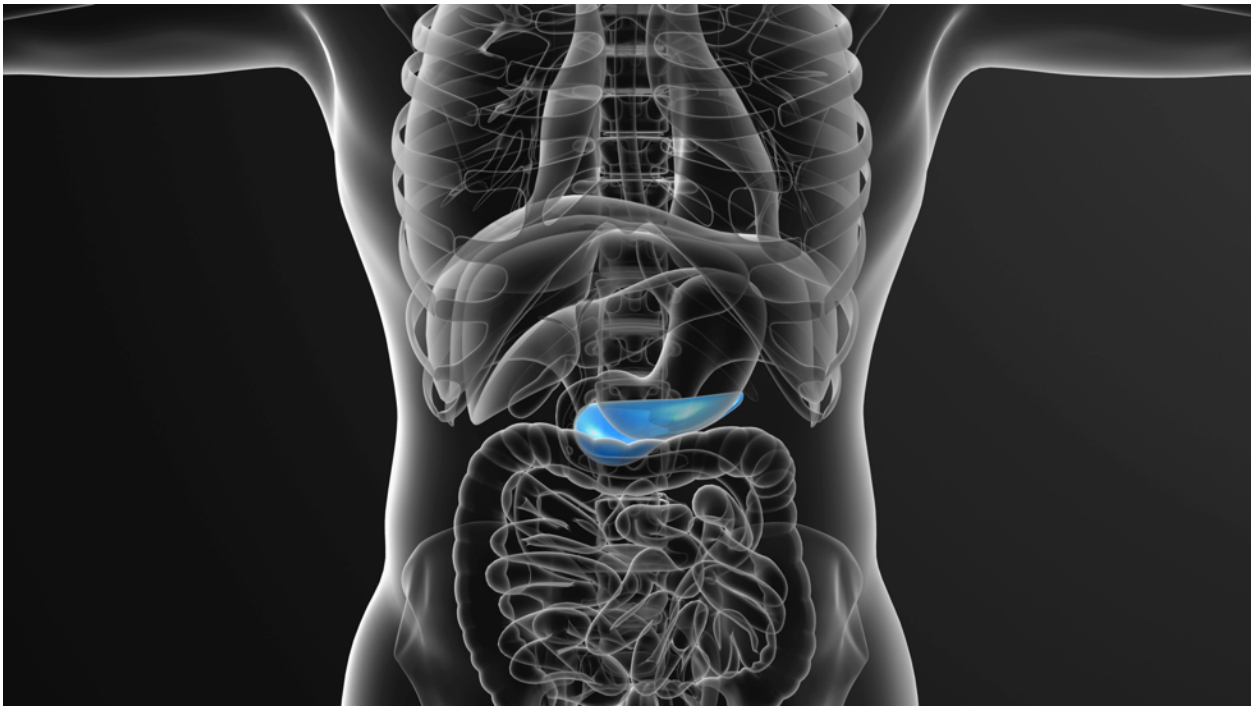


From the small intestine, material passes into the large intestine, and this consists of the appendix, the cecum, the ascending, transverse, descending and sigmoid colon, and the rectum. The length of the large intestine is about 4.5 feet, 1.5 meters, much shorter than the small intestine, and it has three primary functions: number one, the accumulation of undigested food to form feces; number two, the digestion of some food by bacteria; and number three, the reabsorption of water, salts, carbohydrates and vitamins.

The liver is situated in the upper-right quadrant of the abdomen. It has several important functions. Its main role in digestion is the production of bile and the metabolism of nutrients. All nutrients that are absorbed by the gut pass through the liver, and they're processed there before traveling to the rest of the body. Bile is produced by the liver as I mentioned, and then enters the intestines at the duodenum, where bile salts break down fats, lipids, into smaller particles so that they can be acted on by pancreatic enzymes.



The gallbladder is a hollow, pear-shaped organ that sits in the depression of the posterior surface of the liver's right lobe, and it consists of a fundus, body, and neck, and it empties via the cystic duct into the biliary duct. Its main function is the storage and concentration of bile produced by the liver, which again helps to digest fat. Bile is released by the gall bladder in response to hormonal signals from the duodenum, the small intestine, signaled by the presence of food, so when food passes from the stomach to the duodenum, that sends a hormonal signal to the gallbladder to release the bile.



The pancreas is a pinkish-grey organ that lies behind the stomach, and its head communicates with the duodenum and its tail extends beyond the spleen. The primary function of the pancreas as it relates to the gut is the production of enzymes to break down food, and the enzymes include things like carbohydrases, which are enzymes that break down carbohydrates, lipases that break down fat, nucleases that break down nucleic acids, and proteolytic enzymes, which break down protein. And they're secreted in inactive form so that the pancreas itself doesn't get digested and only become active once they enter the duodenum.

Okay, that's it for now. In the next presentation we'll discuss the role of the gut microbiome in the intestinal barrier system in health and disease. In this presentation, as I'm sure you noticed, and the next one, I'm just giving you an overview of these topics because the focus of the ADAPT training is on practical application. I'm assuming that many of you have had in-depth treatment of these topics in medical school, a lot of this information is readily available online and in textbooks, so I just want to give you what you need to know in order to be able to successfully apply this information in your practice. All right, I will see you soon.