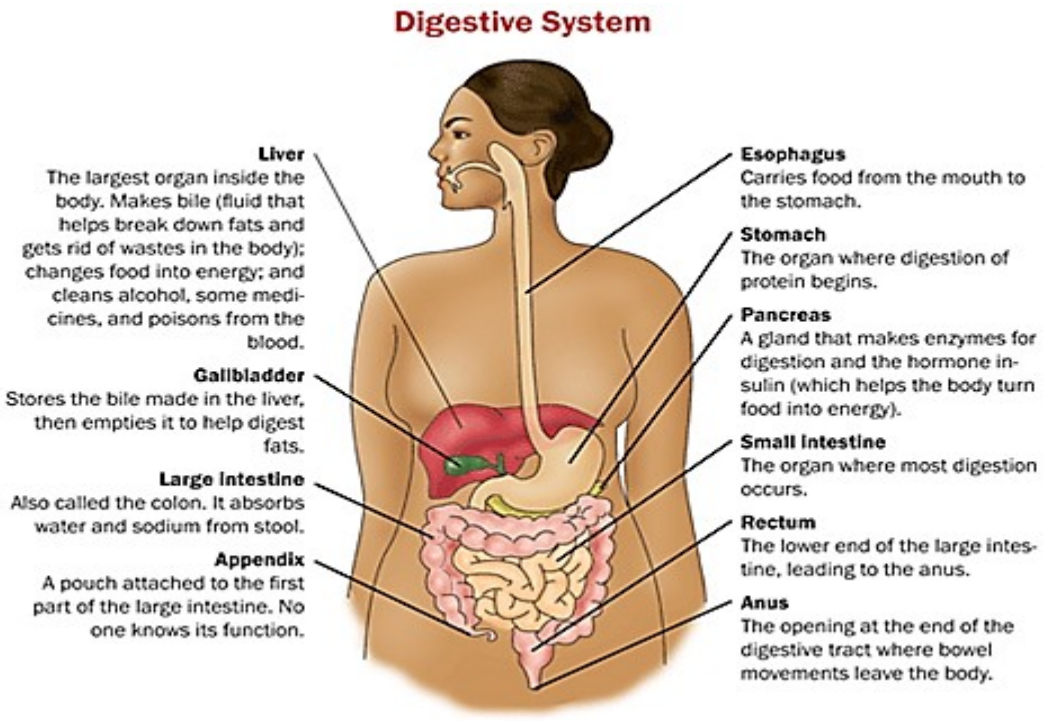
Structural Organization of the Gastrointestinal Tract

M. Pal



Gastrointestinal (GI) tract is organized into regions and layers with structural and functional peculiarities. The tract which begins from the mouth, extending to the anus, is comprised of different layers and tissues. The tissues, composed of different cells, play diverse roles and functions and they constitute the chief determinants of the state of GI functioning.

The main organs that make up the digestive system (in order of their function) are the mouth, esophagus, stomach, small intestine, large intestine, rectum and anus. Helping them along the way are the pancreas, gall bladder and liver.

Mouth

In the human body, the mouth (oral cavity) is a specialized organ for receiving food and breaking up large organic masses. In the mouth, food is changed mechanically by biting and chewing. Humans have four kinds of teeth: *incisors* are chisel-shaped teeth in the front of the mouth for biting; *canines* are pointed teeth for tearing; and *premolars* and *molars* are flattened, ridged teeth for grinding, pounding, and crushing food.

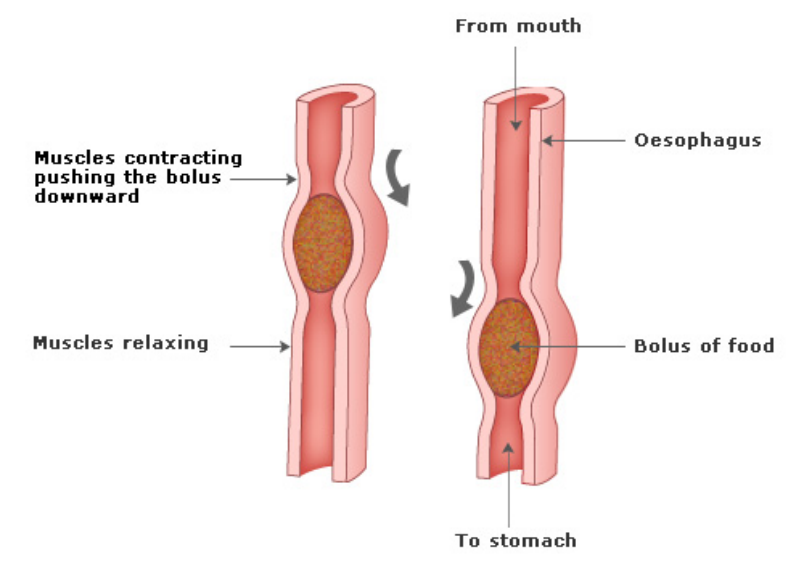
In the mouth, food is moistened by saliva, a sticky fluid that binds food particles together into a soft mass. Three pairs of **salivary glands**—parotid, submaxillary, and sublingual—secrete saliva into the mouth. The saliva contains an enzyme called *amylase,* which digests starch molecules into smaller molecules of the disaccharide maltose.

1) ***Parotid glands (largest); contains only serous cells 2) Submandibular glands; contains both serous and mucous cells 3) Sublingual glands (underneath the tongue; secretions are mostly mucus…thick and stringy !)***

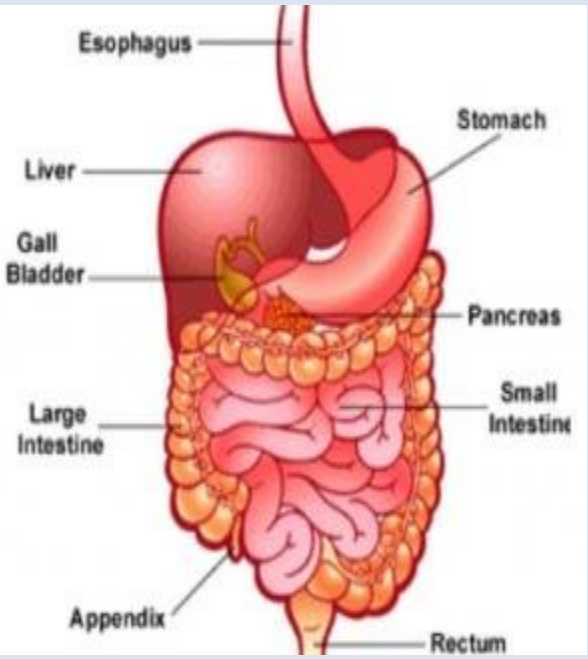
During chewing, the tongue moves food about and manipulates it into a mass called a *bolus.* The bolus is pushed back into the pharynx (throat) and is forced through the opening to the esophagus.

Esophagus

The **esophagus** is a thick-walled muscular tube located behind the windpipe that extends through the neck and chest to the stomach. The bolus of food moves through the esophagus by **peristalsis:** a rhythmic series of muscular contractions that propels the bolus along. The contractions are assisted by the pull of gravity.



Stomach



The esophagus joins the stomach at a point just below the diaphragm. A valvelike ring of muscle called the *cardiac sphincter* surrounds the opening to the stomach. The sphincter relaxes as the bolus passes through and then quickly closes.

The *stomach* is an expandable pouch located high in the abdominal cavity. Layers of stomach muscle contract and churn the bolus of food with gastric juices to form a soupy liquid called **chyme.**

The stomach stores food and prepares it for further digestion. In addition, the stomach plays a role in protein digestion. Gastric glands called *chief cells* secrete pepsinogen. Pepsinogen is converted to the enzyme pepsin in the presence of hydrochloric acid. Hydrochloric acid is secreted by *parietal cells* in the stomach lining. The pepsin then digests large proteins into smaller proteins called *peptides.* To protect the stomach lining from the acid, a third type of cell secretes mucus that lines the stomach cavity. An overabundance of acid due to mucus failure may lead to an ulcer.

Small intestine

The soupy mixture called chyme spurts from the stomach through a sphincter into the **small intestine.** An adult's small intestine is about 23 feet long and is divided into three sections: the first 10 to 12 inches form the **duodenum;** the next 10 feet form the **jejunum;** and the final 12 feet form the **ileum.** The inner surface of the small intestine contains numerous fingerlike projections called *villi* (the singular is *villus*). Each villus has projections of cells called *microvilli* to increase the surface area.

Pancreas

The pancreas secretes digestive enzymes into the duodenum that break down protein, fats and carbohydrates. The pancreas also makes insulin, passing it directly into the bloodstream. Insulin is the chief hormone in your body for metabolizing sugar.

Liver

The liver has many functions, but its main job within the digestive system is to process the nutrients absorbed from the small intestine. Bile from the liver secreted into the small intestine also plays an important role in digesting fat and some vitamins.

The liver is the body's chemical "factory." It takes the raw materials absorbed by the intestine and makes all the various chemicals the body needs to function.

The liver also detoxifies potentially harmful chemicals. It breaks down and secretes many drugs that can be toxic to the body.

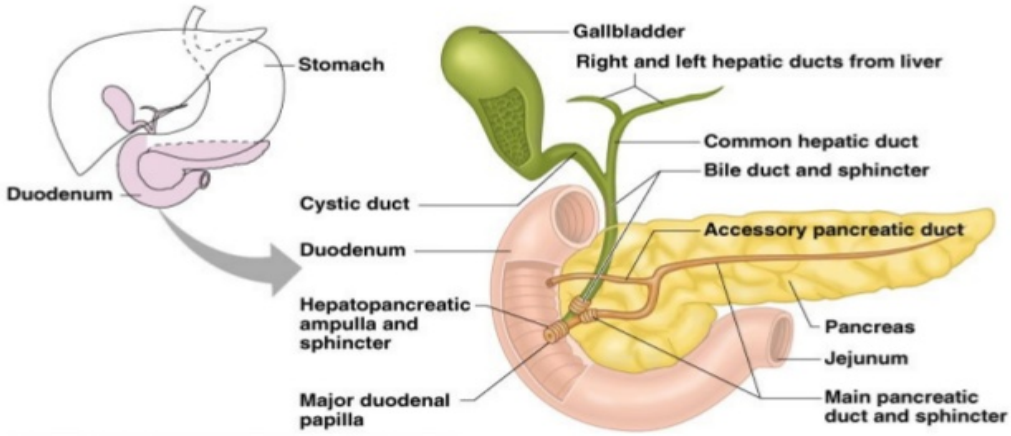


Figure 14.6

Gallbladder

The gallbladder stores and concentrates bile from the liver, and then releases it into the duodenum in the small intestine to help absorb and digest fats.

Most **absorption** in the small intestine occurs in the jejunum. The products of digestion enter cells of the villi, move across the cells, and enter blood vessels called *capillaries.* Diffusion accounts for the movement of many nutrients, but facilitated diffusion is responsible for the movement of glucose and amino acids. The products of fat digestion pass as small droplets of fat into lacteals, which are branches of the lymphatic system.

Absorption is completed in the final part of the small intestine, the *ileum.* Substances that have not been digested or absorbed then pass into the large intestine.

Colon (large intestine)

The large intestine, or colon, is responsible for processing waste so that emptying the bowels is easy and convenient. It's a 6-foot long muscular tube that connects the small intestine to the rectum. The large intestine is made up of the cecum, the ascending (right) colon, the transverse (across) colon, the descending (left) colon, and the sigmoid colon, which connects to the rectum. Stool, or waste left over from the digestive process, is passed through the colon by means of peristalsis, first in a liquid state and ultimately in a solid form. As stool passes through the colon, water is removed. Stool is stored in the sigmoid (S-shaped) colon until a "mass movement" empties it into the rectum once or twice a day.

It normally takes about 36 hours for stool to get through the colon. The stool itself is mostly food debris and bacteria. These “good” bacteria perform several useful functions, such as synthesizing various vitamins, processing waste products and food particles and protecting against harmful bacteria. When the descending colon becomes full of stool, or feces, it empties its contents into the rectum to begin the process of elimination (a bowel movement).

Rectum

The rectum is a straight, 8-inch chamber that connects the colon to the anus. The rectum's job is to receive stool from the colon, let you know that there is stool to be evacuated (pooped out) and to hold the stool until evacuation happens. When anything (gas or stool) comes into the rectum, sensors send a message to the brain. The brain then decides if the rectal contents can be released or not.

If they can, the sphincters relax and the rectum contracts, disposing its contents. If the contents cannot be disposed, the sphincter contracts and the rectum accommodates so that the sensation temporarily goes away.

Anus

The anus is the last part of the digestive tract. It is a 2-inch long canal consisting of the pelvic floor muscles and the two anal sphincters (internal and external). The lining of the upper anus is able to detect rectal contents.

The anus is surrounded by sphincter muscles that are important in allowing control of stool. The pelvic floor muscle creates an angle between the rectum and the anus that stops stool from coming out when it’s not supposed to. The internal sphincter is always tight, except when stool enters the rectum.
