

The digestive system is composed of a series of organs that form one long, continuous, compartmentalized tube extending through the ventral body cavity from the mouth to the anus. Known as the **gastrointestinal (G.I.) tract**, it is here that the functions of mechanical digestion, chemical digestion, absorption of nutrients and water, and the storage and release of solid waste material take place. Each of the processes occurs within a compartment of the tract that is specialized to accommodate it. The specialized compartment, or organs, of the G.I. tract are the mouth, pharynx, esophagus, stomach, small intestine, and large intestine.

Also included in the digestion process are a number of structures that are closely associated with the G.I. tract. These structures, which are located within G.I. tract organs or communicate with them by means of duct, are called **accessory organs**. They include the teeth, tongue, salivary glands, liver, and pancreas.

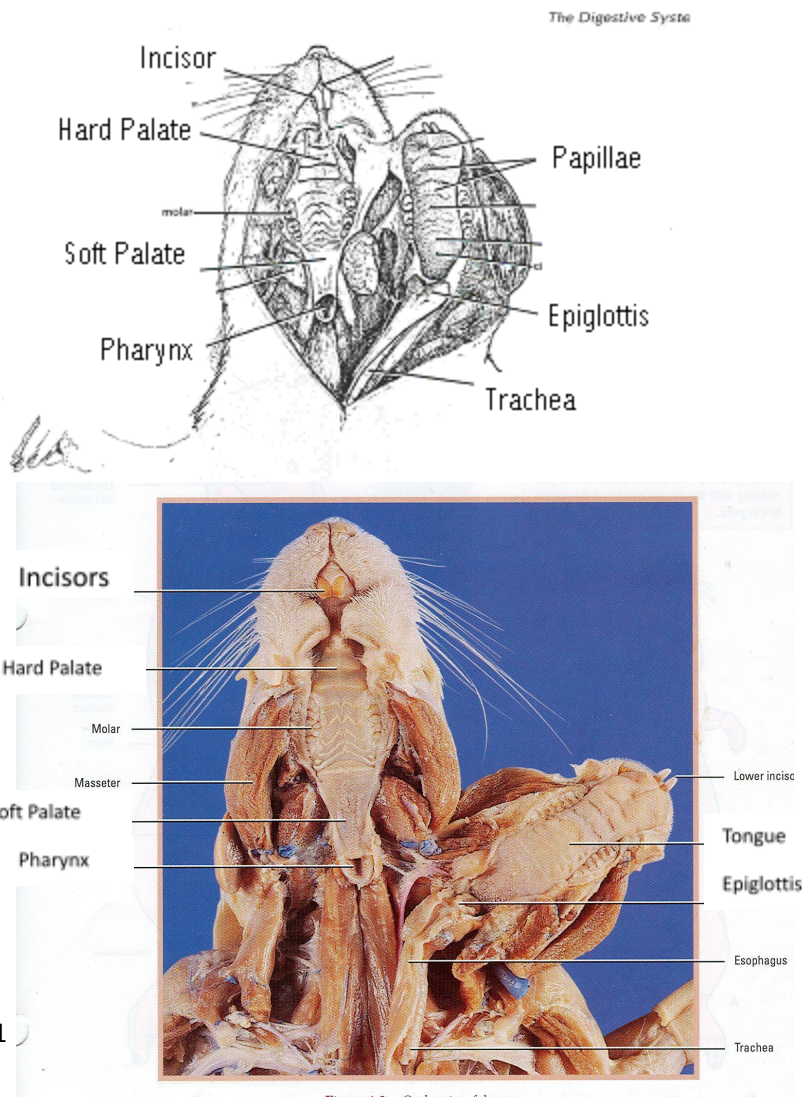
Cranial Digestive Structures

The digestive system is divided into a cranial portion and caudal portion, with the diaphragm serving as the line of division between the two.

Oral Cavity

Procedure: In order to expose the oral cavity for study, cut through the muscles and connective tissue suspending the jaw on one side of your rat. Insert your bone shears (scissors) into the mouth and cut through the masseter and pry open the mouth to expose the following structures.

1. Locate the **teeth** which consist of four incisors and twelve molars.
2. Locate the **hard palate** which is the rostral portion of the roof of the oral cavity.
3. Locate the **soft palate** which is caudal to the hard palate. The soft palate is a muscular partition between the two chambers of the pharynx and is lined with mucus membrane.
4. Locate the **tongue**. It is the large muscular structure that makes up the floor of the oral cavity. The tongue has **papillae** which are elevations of mucus membrane on the surface of the tongue which contain sensory structures called **taste buds**.
5. Locate the **pharynx** which is caudal to the soft palate. The pharynx serves as the muscular passageway for air traveling to and



from the lungs and for food traveling from the mouth to the esophagus. The pharynx has a movable fold called the **epiglottis** that prevents food from going into the trachea and directs it to the esophagus.

Trachea

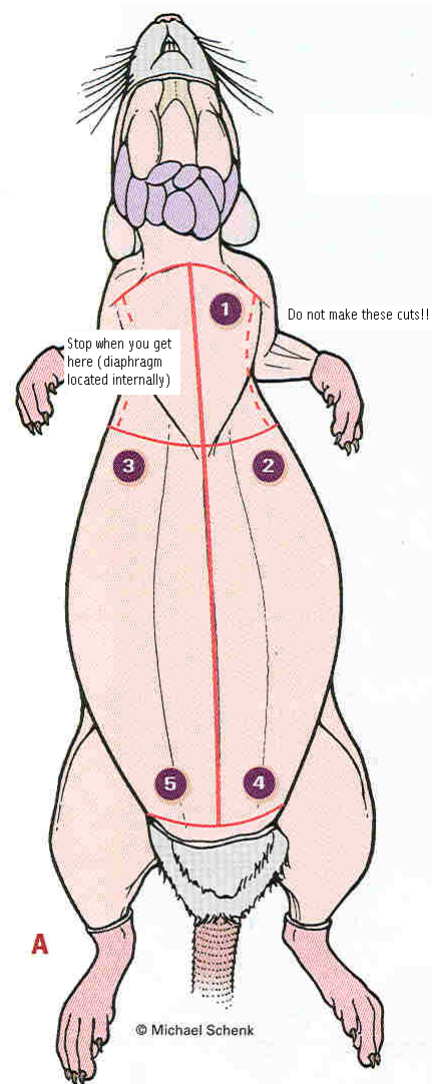
6. The **esophagus** is a long, muscular tube that transports food from the pharynx to the stomach. It lies dorsal to the trachea and travels the length of the thoracic cavity. It is distinguished from the trachea by its lack of cartilage rings. At its caudal end it perforates the diaphragm to unite with the stomach in the abdominal cavity. Because it is located in the thoracic cavity, the esophagus will not be dissected at this time.

Caudal Digestive Structures

Most of the digestive organs lie caudal to the diaphragm within the abdominal cavity.

Procedure: To observe these structures, cut through the abdominal wall by making a longitudinal midventral incision (see diagram). Do not continue this incision cranially, for you want to avoid damaging the large, circular sheet of muscle dividing the thoracic and abdominal cavities, the **diaphragm**. Do not insert your scissors too deeply while cutting, or you will damage the internal organs. From this midventral incision, make another incision on each side of the caudal border on the diaphragm to the dorsal body wall. Again from the midventral incision, make a pair of incisions near the caudal end of the abdomen in opposite directions to the dorsal body wall.

Pull back the flaps of the abdominal wall and examine the **abdominal cavity**. This closed body cavity extends from the diaphragm to the pelvis. **Peritoneum** is an extensive membrane that lines the abdominal cavity and covers the internal organs.



The Abdominal Organs

1. The **coelom** is the body cavity within which the viscera (internal organs) are located. The cavity is covered by a membrane called the peritoneum, which covers three regions

visceral peritoneum - covers the internal organs

mesenteries - attach the internal organs to the dorsal body wall

omentia - connect organ to organ

2. Locate the **liver**, which is a dark colored organ suspended just under the diaphragm. The liver has many functions, one of which is to produce bile which aids in digesting fat. The liver also stores glycogen and receives blood from the G.I. tract and processes it by way of nutrient modification and detoxification (transforms wastes into less harmful substances). Rats do not have a gall bladder which is used for storing bile in other animals. There are four parts to the liver:

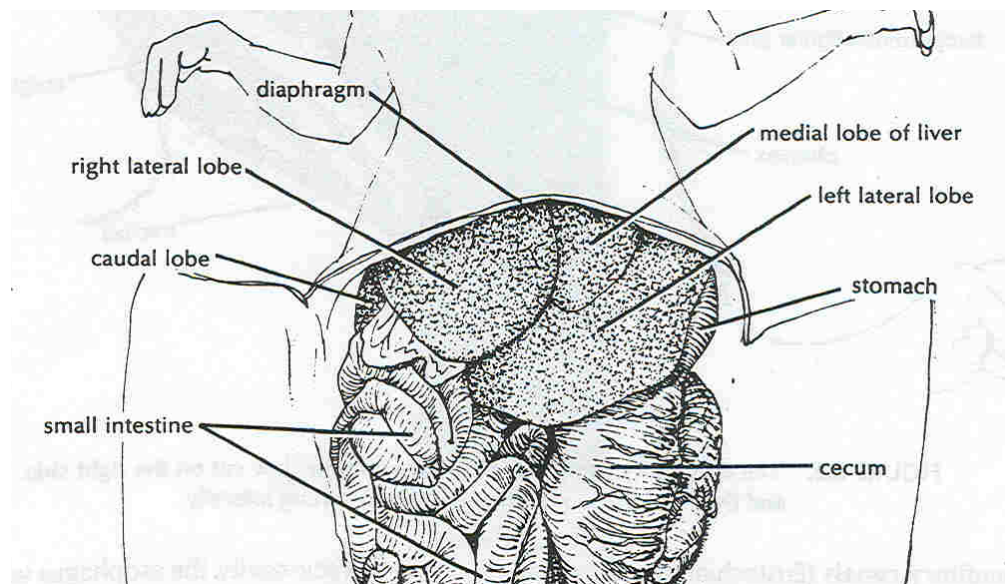
median or cystic lobe -

located atop the organ, there is a central cleft

left lateral lobe - large and partially covered by the stomach

right lateral lobe - partially divided into an anterior and posterior lobule, hidden from view by the median lobe

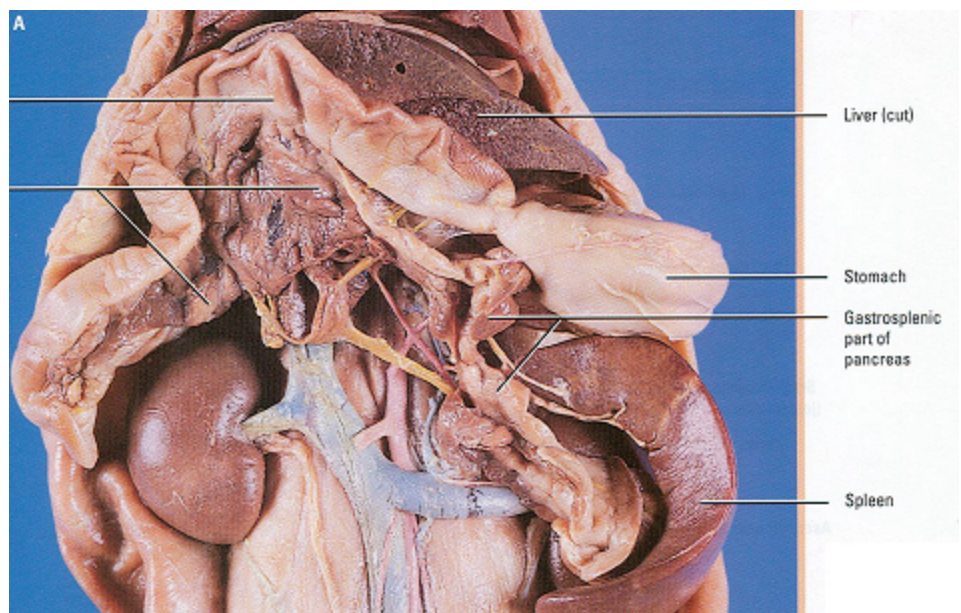
caudate lobe - small and folds around the esophagus and the stomach, seen most easily when liver is raised



3. Locate the **stomach** on the left side just under the diaphragm. The functions of the stomach include food storage, physical breakdown of food, and the digestion of protein. The opening between the esophagus and the stomach is called the **cardiac sphincter**.

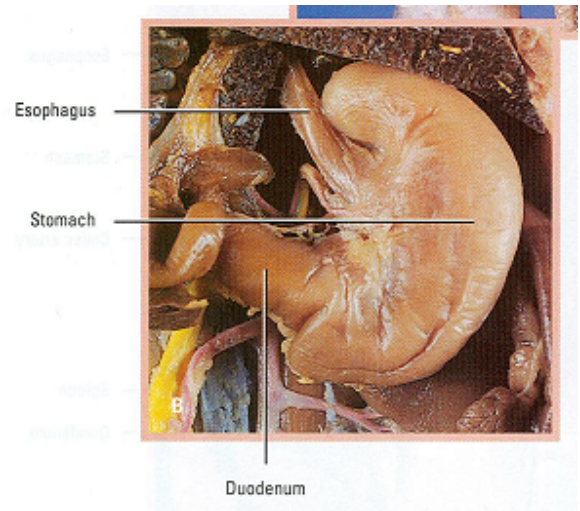
4. The **spleen** is about the same color as the liver and is attached to the greater curvature of the stomach. It is associated with the circulatory system and functions in the destruction of blood cells and blood storage. A person can live without a spleen, but they're more likely to get sick as it helps the immune system function.

5. The **small intestine** is a slender coiled tube that receives partially digested food from the stomach (via the

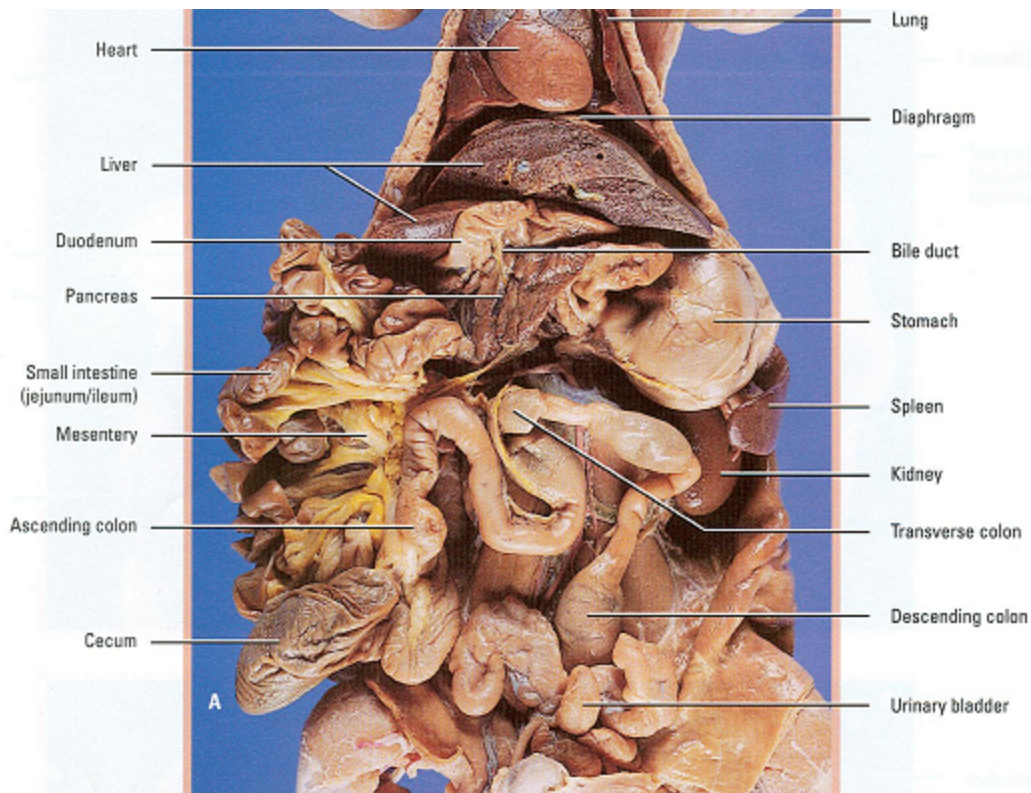


pyloric sphincter) and absorbs nutrients across the walls of its specialized mucosa. It consists of three sections:

- i. **duodenum** – the cranial segment of the small intestine. It extends from the pyloric valve to its union with the jejunum. The duodenum receives digestive enzymes from the liver.
- ii. **jejunum** – the middle segment of the small intestine. It is the greatest in length but is not easily distinguishable from the other two segments.
- iii. **ileum** – the caudal segment. It extends from its union with the jejunum to where the large intestine originates.



Use your scissors to cut the mesentery of the small intestine, but do not remove it from its attachment to the stomach and rectum. If you are careful you will be able to stretch it out and untangle it so that you can see the relative lengths of the large and the small intestine.



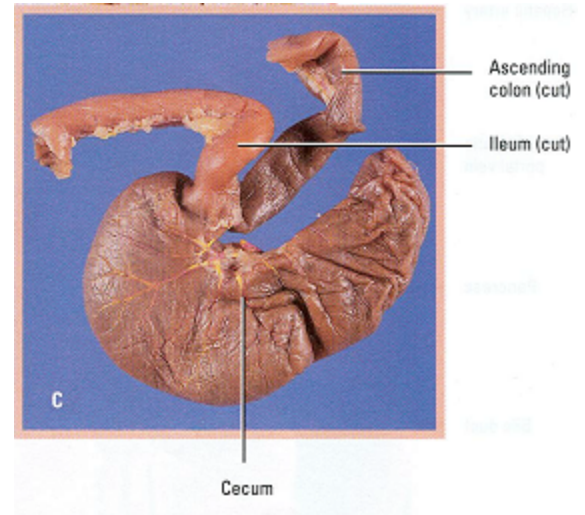
6. The **pancreas** is a brownish, flattened gland found in the tissue between the stomach and small intestine. The pancreas produces digestive enzymes that are sent to the intestine via small ducts (the pancreatic duct). The pancreas also secretes insulin which is important

in the regulation of glucose metabolism. Find the pancreas by looking for a thin, almost membrane looking structure that has the consistency of cottage cheese.

7. Locate the **colon**, which is the large tube that extends from the small intestine and leads to the anus. The colon is also known as the **large intestine**. The colon is where the final stages of digestion and water absorption occurs and it contains a variety of bacteria to aid in digestion.

8. Locate the **cecum** - a large sac in the lower third of the abdominal cavity, it is a dead-end pouch and is similar to the appendix in humans. It also is the point at which the small intestine becomes the large intestine.

9. Locate the **rectum** - the short, terminal section of the colon between the descending colon and the anus. The rectum temporarily stores feces before they are expelled from the body out the **anus** or external opening.



***The organs of the digestive system and their function are summarized on a table on the next page.

ORGAN/STRUCTURE	FUNCTION
Teeth	Mechanically breakdown food
Salivary glands	Secrete digestive enzymes (e.g., amylase) to begin chemical breakdown of foods and lubricate food for swallowing
Esophagus	Transports food to stomach
Stomach	Produces hydrochloric acid and pepsinogen that aid in the chemical breakdown of food
Duodenum	Receives chyme from the stomach along with bile and digestive enzymes from the liver and pancreas; furthers chemical digestion of food
Liver*	Produces bile, converts glucose to glycogen for storage, detoxifies many constituents of the absorbed digested compounds
Pancreas*	Produces digestive enzymes and delivers them through pancreatic ducts to duodenum
Jejunum	Responsible for majority of nutrient absorption and some reabsorption of water
Ileum	Continues process of nutrient absorption and reabsorption of water
Cecum	In herbivores, a large structure containing anaerobic bacteria and protozoans responsible for the breakdown of cellulose. This structure has a reduced appearance and function in carnivores and omnivores
Colon	Responsible for reabsorption of water and electrolytes; produces feces
Rectum	Final site of water reabsorption and feces dehydration
Anus	Regulates egestion of undigested food (feces) from the body