

# The Digestive System •

The human digestive system is an extended tube with specialized parts between two openings, the mouth and the anus.

Digestion takes place within a tube called the **digestive tract**, which begins with the mouth and ends with the anus.

The functions of the digestive system are to •  
ingest food, digest it to nutrients that can  
cross plasma membranes, **absorb nutrients**,  
**and eliminate indigestible remains.**

# The Mouth

The mouth, which receives food, is bounded externally by the lips and cheeks.

The lips extend from the base of the nose to the start of the chin.

The red portion of the lips is poorly keratinized, and this allows blood to show through.

Most people enjoy eating food largely because they like its texture and taste. Sensory receptors called taste buds occur primarily on the tongue, and when these are activated by the presence of food, nerve impulses travel by way of cranial nerves to the brain.

The tongue is composed of skeletal muscle whose contraction changes the shape of the tongue. Muscles exterior to the tongue cause it to move about. Fold of mucous membrane on the underside of the tongue attaches it to the floor of the oral cavity. The roof of the mouth separates the nasal cavities from the oral cavity. :

The roof has two parts an anterior (toward the front) **hard palate** and a posterior (toward the back) **soft palate**.

The hard palate contains several bones, but the soft palate is **composed entirely of muscle**.

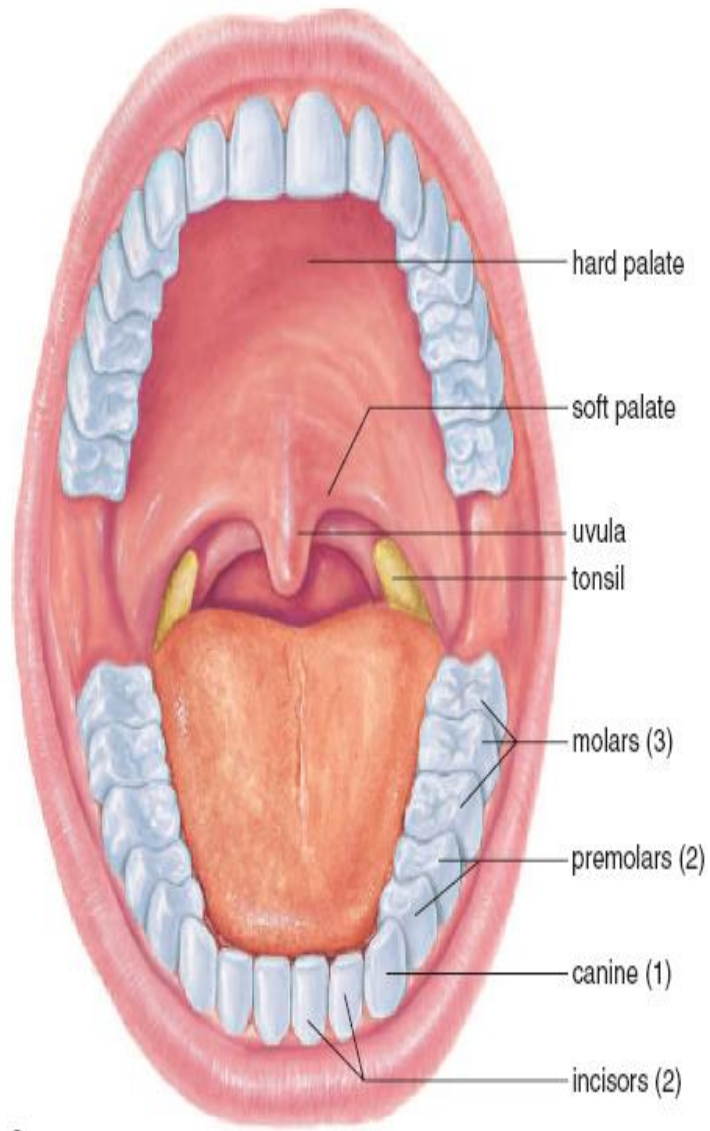
**The soft palate ends in a finger-shaped** projection called the **uvula**.

The tonsils are in the back of the mouth, on either side of the tongue and in the naso pharynx (called adenoids).

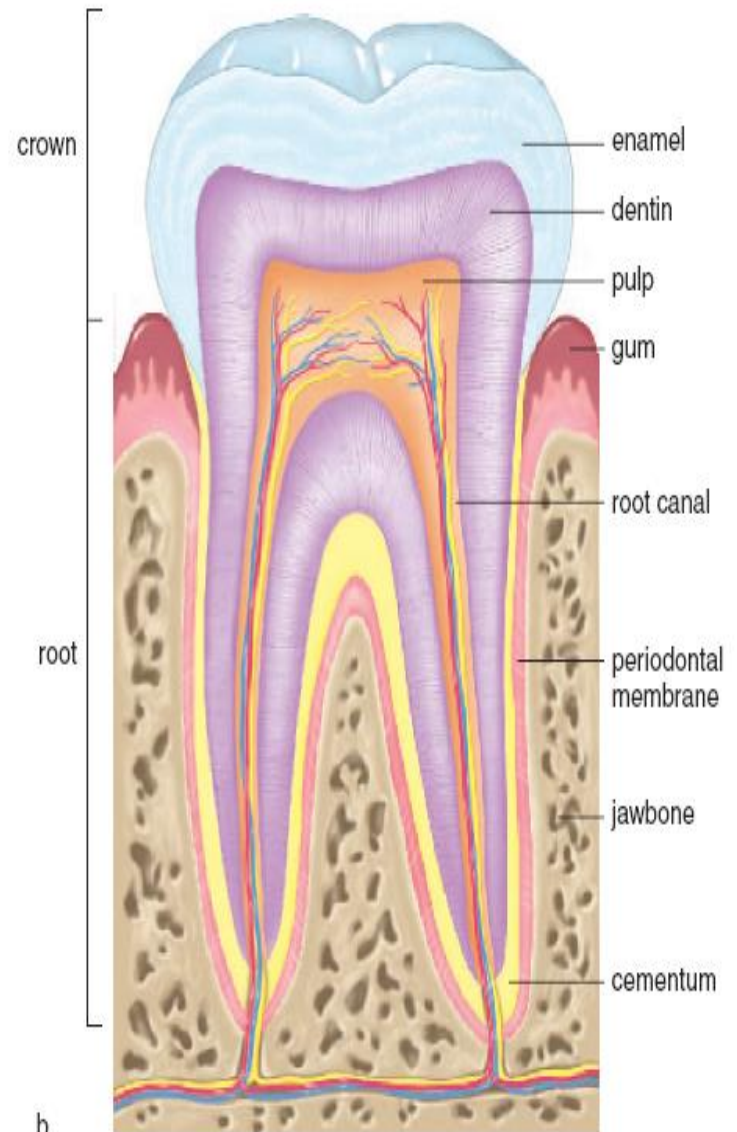
The tonsils help protect the body against infections.

Three pairs of **salivary glands** send juices (saliva) by way of ducts to the mouth.

Saliva contains an enzyme **called salivary amylase that begins the process of digesting starch**.



a.



b.

***The Teeth*** With our teeth we chew food into pieces convenient for swallowing. During the first two years of life, **the smaller 20 deciduous, or baby, teeth appear. These are eventually replaced by 32 adult teeth .**

The third pair of molars, called the **wisdom teeth**, sometimes fail to erupt.

If they push on the other teeth and/or cause pain, they can be removed by a dentist or oral surgeon.

Each tooth has two main divisions, a crown and a root .The crown has a layer of **enamel**, an extremely hard outer covering of calcium compounds; **dentin**, a thick layer of bonelike material;

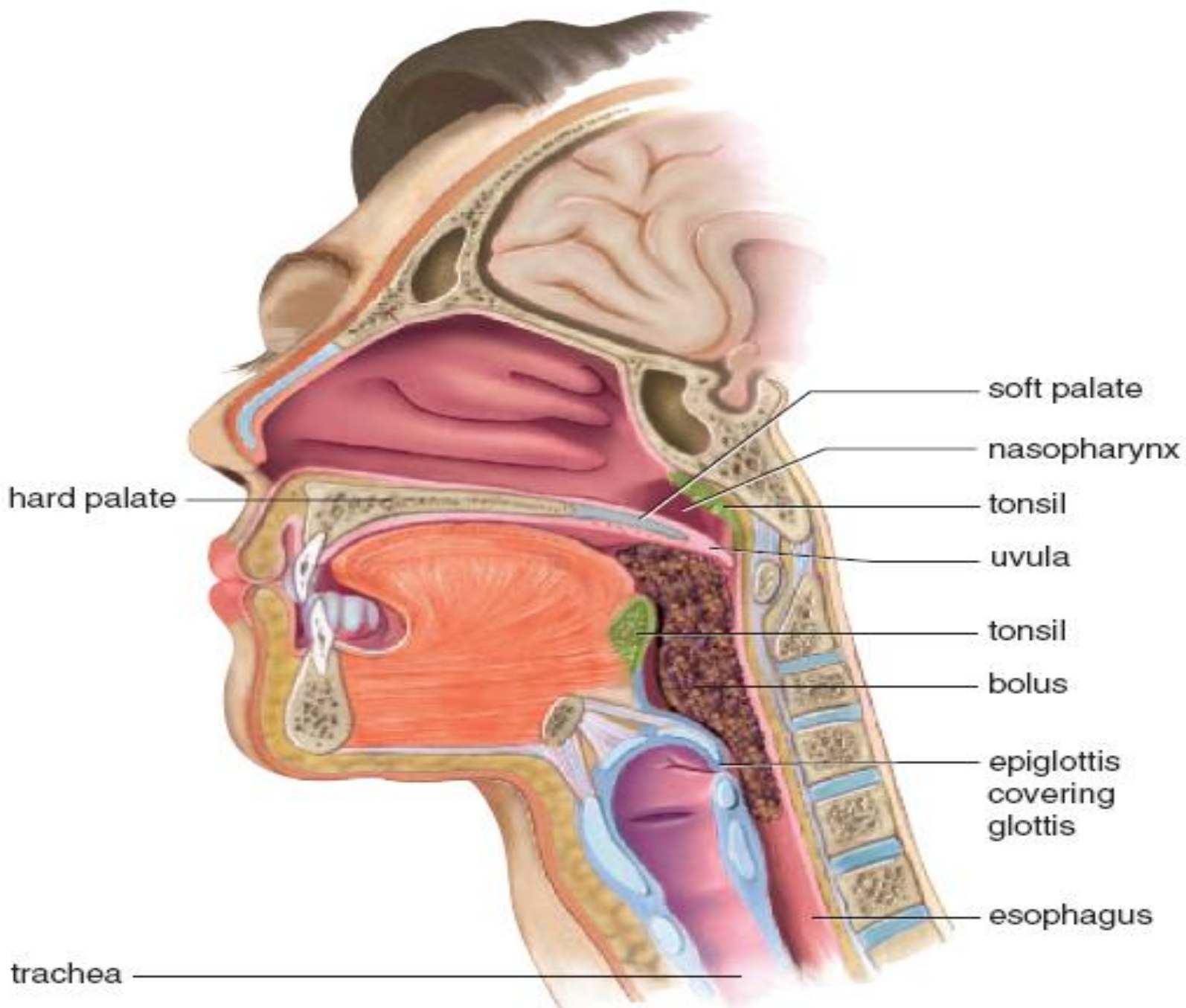
and an **inner pulp**, which contains the nerves and the blood vessels. **Dentin and pulp** are also found in the root.

## **The Pharynx**

The **pharynx is a region that receives food from the mouth and air from the nasal cavities.** The food passage and air passage cross in the pharynx because the trachea is ventral to the esophagus, a long muscular tube that takes food to the stomach.

## **The Esophagus**

The **esophagus is a muscular tube that passes from the pharynx through the thoracic cavity and diaphragm into the abdominal cavity where it joins the stomach.** The esophagus is ordinarily collapsed, but it opens and receives the bolus when swallowing occurs. A rhythmic contraction called **peristalsis pushes the food along the digestive tract.**



hard palate

soft palate

nasopharynx

tonsil

uvula

tonsil

bolus

epiglottis  
covering  
glottis

esophagus

trachea

system  
views both  
ar diges-  
ccessory  
in diges-  
ve recog-

salivary glands

esophagus

diaphragm

liver

gallbladder

common bile duct

duodenum

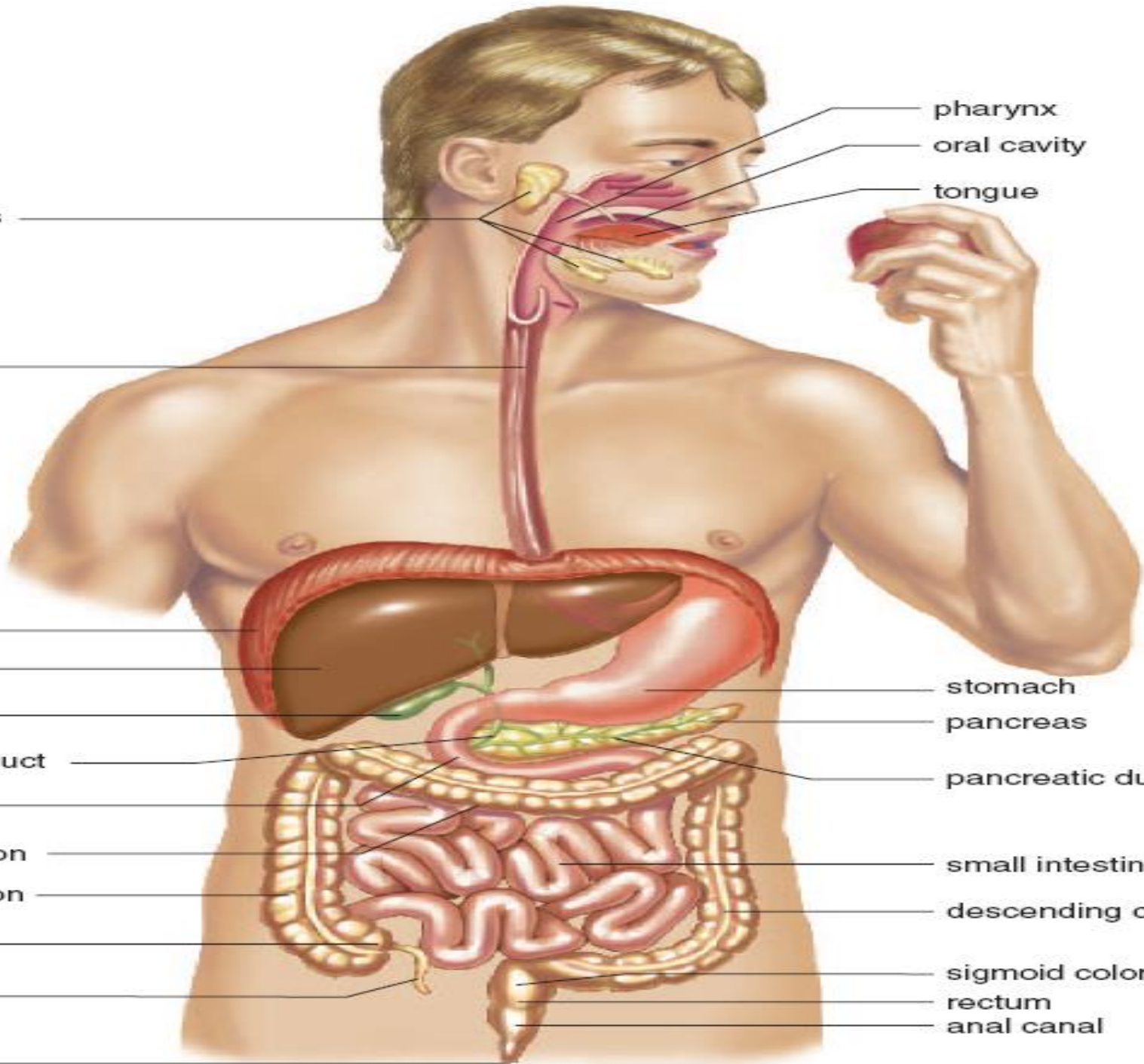
transverse colon

ascending colon

cecum

appendix

anus



pharynx

oral cavity

tongue

stomach

pancreas

pancreatic duct

small intestine

descending colon

sigmoid colon

rectum

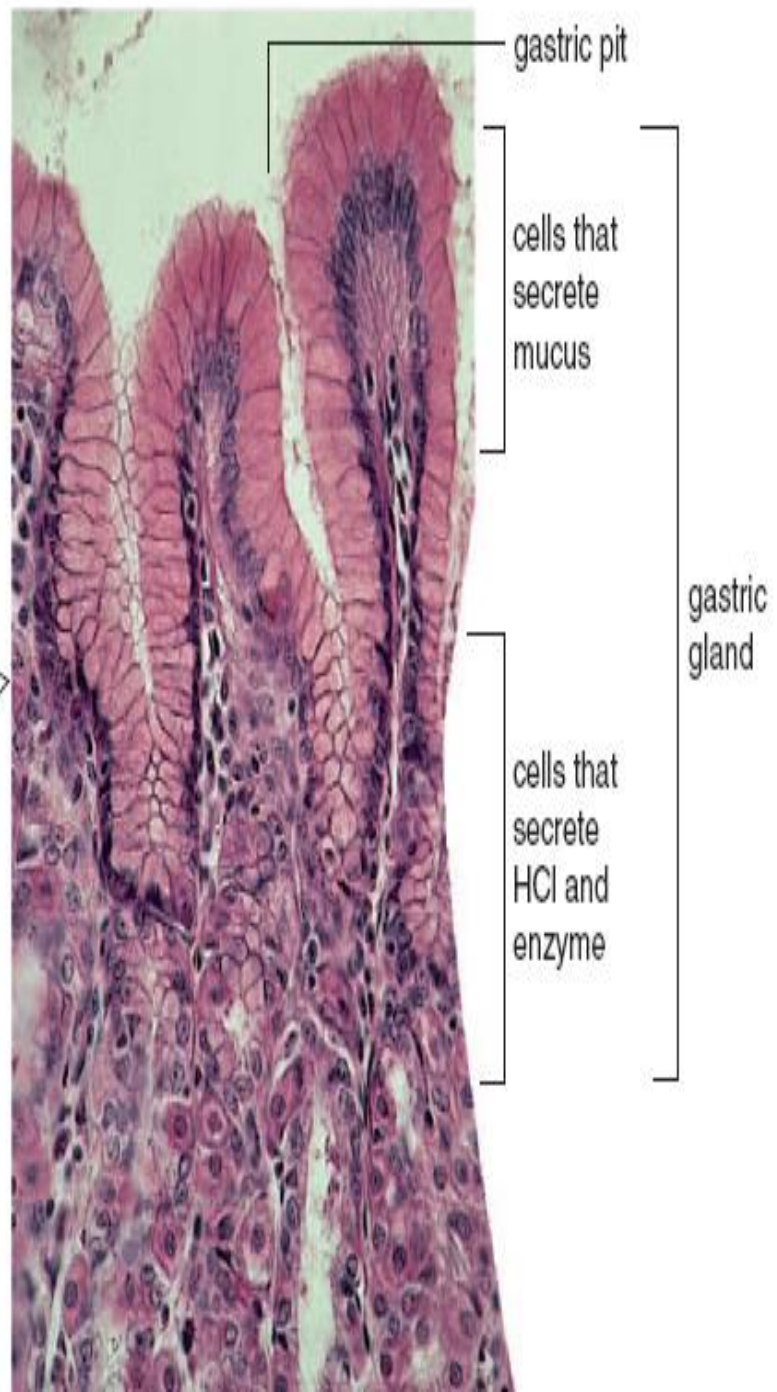
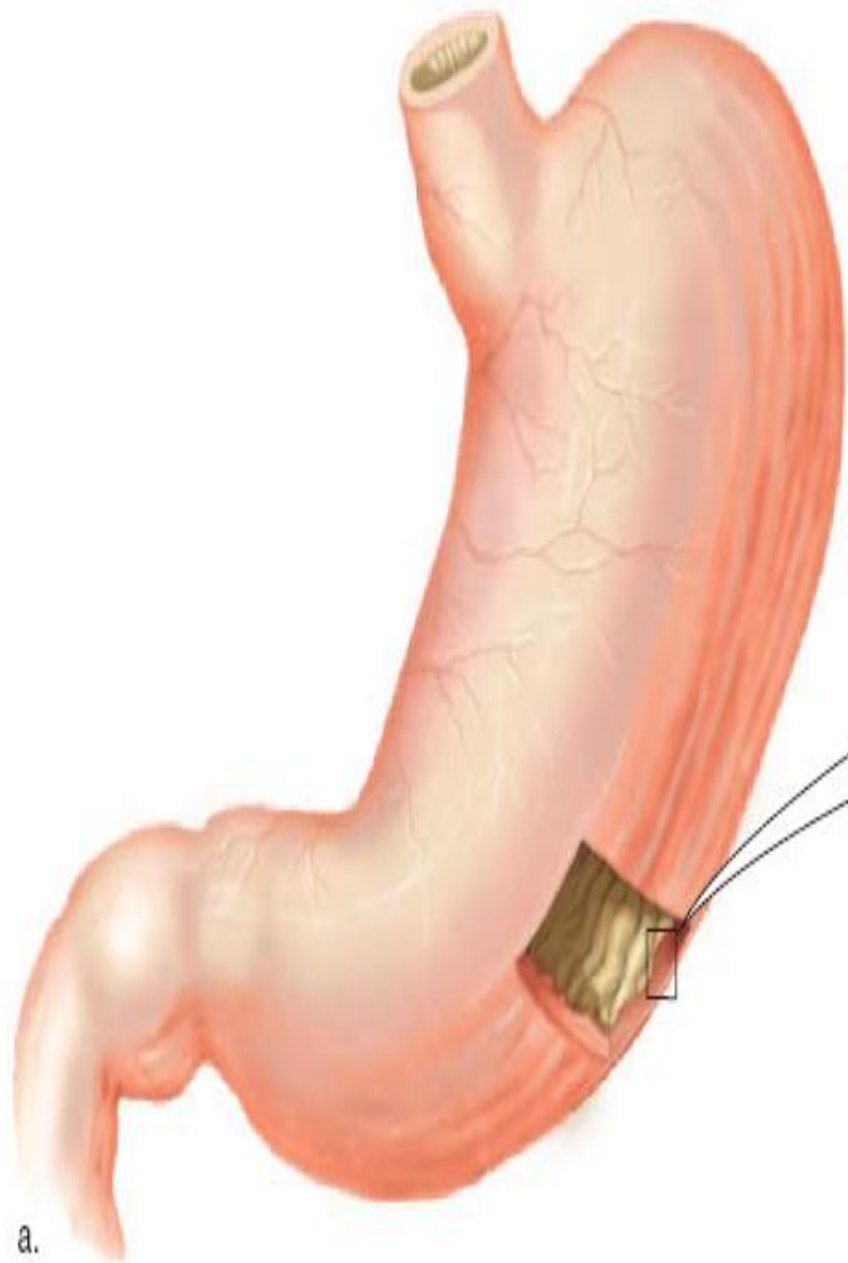
anal canal



## Stomach

The **stomach** is a thick-walled, J-shaped organ that lies on the left side of the body beneath the diaphragm. The stomach is continuous with the esophagus above and the duodenum of the small intestine below. The stomach stores food and aids in digestion. The wall of the stomach has deep folds, which disappear as the stomach fills to an approximate capacity of one liter. Its muscular wall churns, mixing the food with gastric juice. The term *gastric* always refers to the stomach.

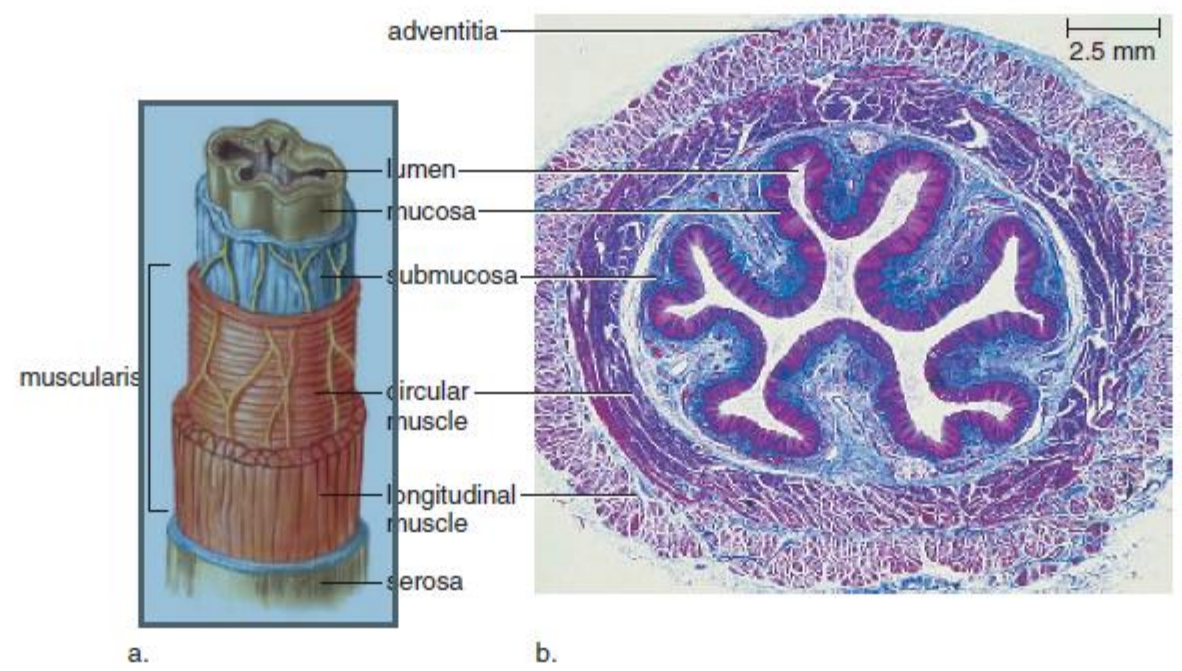
The columnar epithelial lining of the stomach (i.e., the mucosa) has millions of gastric pits, which lead into **gastric glands**. The gastric glands produce gastric juice. **Gastric juice contains an enzyme called pepsin**, which digests protein, plus hydrochloric acid (HCl) and mucus. HCl causes the stomach to have a high acidity with a pH of about 2, and **this is beneficial because it kills most bacteria present in food**. Although HCl does not digest food, it **does break down the connective tissue of meat and activates pepsin**.



## The Small Intestine

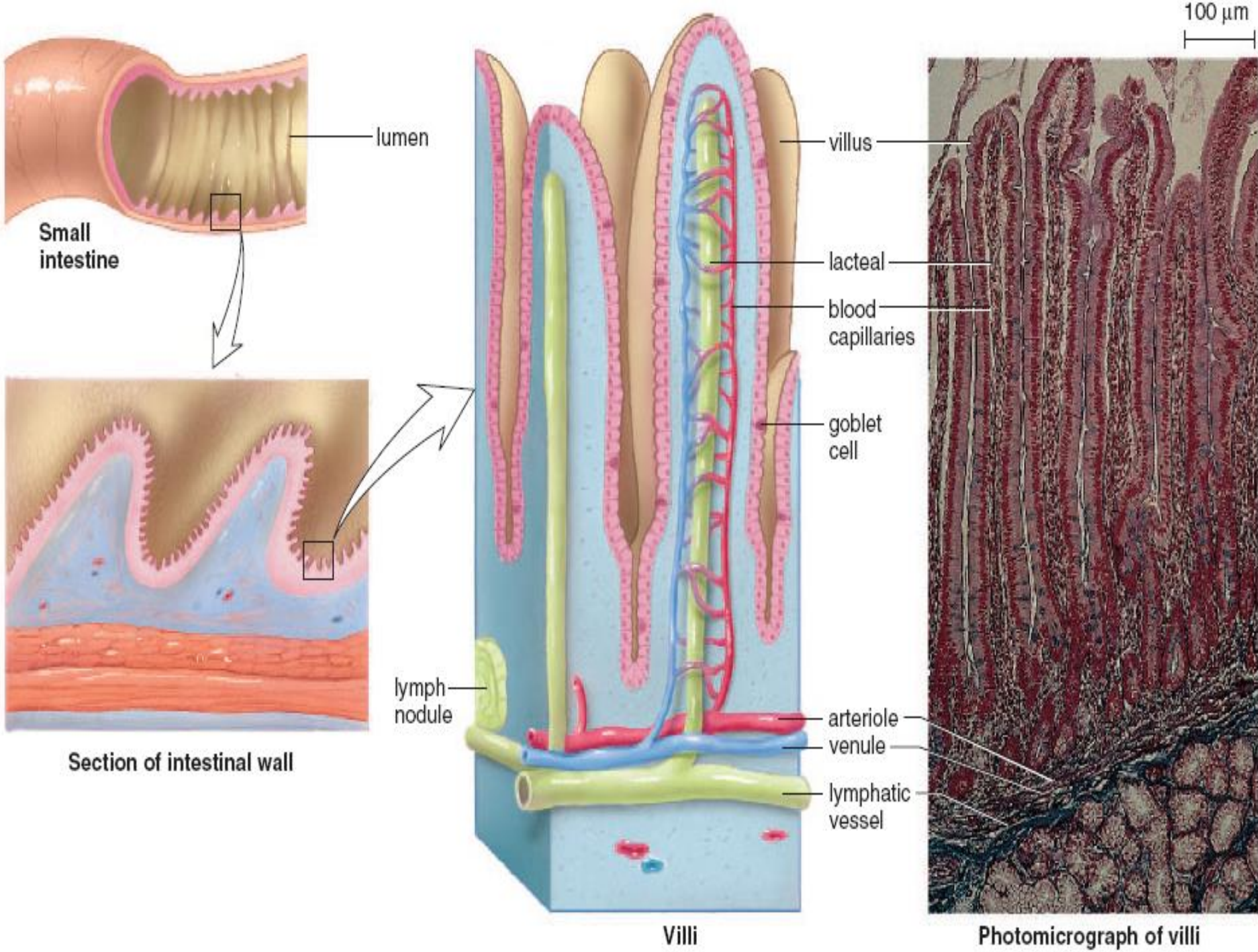
The **small intestine** is named for its small diameter (compared to that of the large intestine), but perhaps it should be called the long intestine. The small intestine averages about 6 meters (18 feet) in length, compared to the large intestine, which is about 1.5 meters (4½ ft) in length. The first 25 cm of the small intestine is called the **duodenum**. Ducts from the liver and pancreas join to form one duct that enters the duodenum. The small intestine receives bile from the liver and pancreatic juice from the pancreas via this duct. **Bile emulsifies fat—emulsification causes fat droplets to disperse in water.** The intestine has a slightly basic pH because pancreatic juice contains sodium bicarbonate (NaHCO<sub>3</sub>), which neutralizes chyme. The enzymes in pancreatic juice and enzymes produced by the intestinal wall complete the process of food digestion

composed only of loose connective tissue  
adventitia.



**Figure 5.4** Wall of the digestive tract.

- a. Several different types of tissues are found in the wall of the digestive tract. Note the placement of circular muscle inside longitudinal
- b. Micrograph of the wall of the esophagus.



## **The Large Intestine**

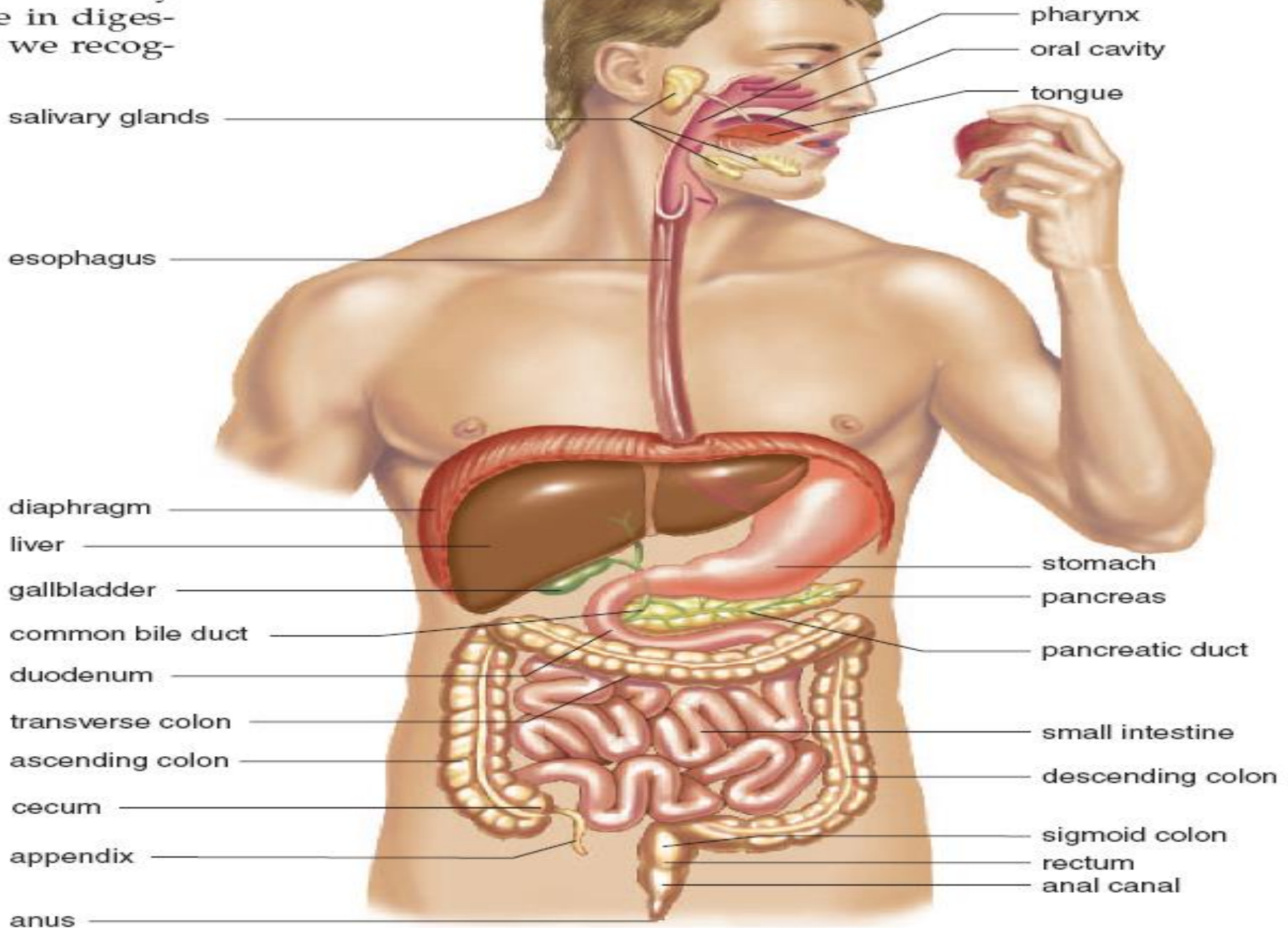
The **large intestine**, which includes the cecum, the colon, the rectum, and the anal canal, is larger in diameter than the small intestine (6.5 cm compared to 2.5 cm), but it is shorter in length. The large **intestine absorbs water, salts, and some vitamins**. It also stores indigestible material until it is eliminated at the anus. The **cecum**, which lies below the junction with the small intestine, is **the blind end of the large intestine**. The cecum has a **small projection called the vermiform**

.

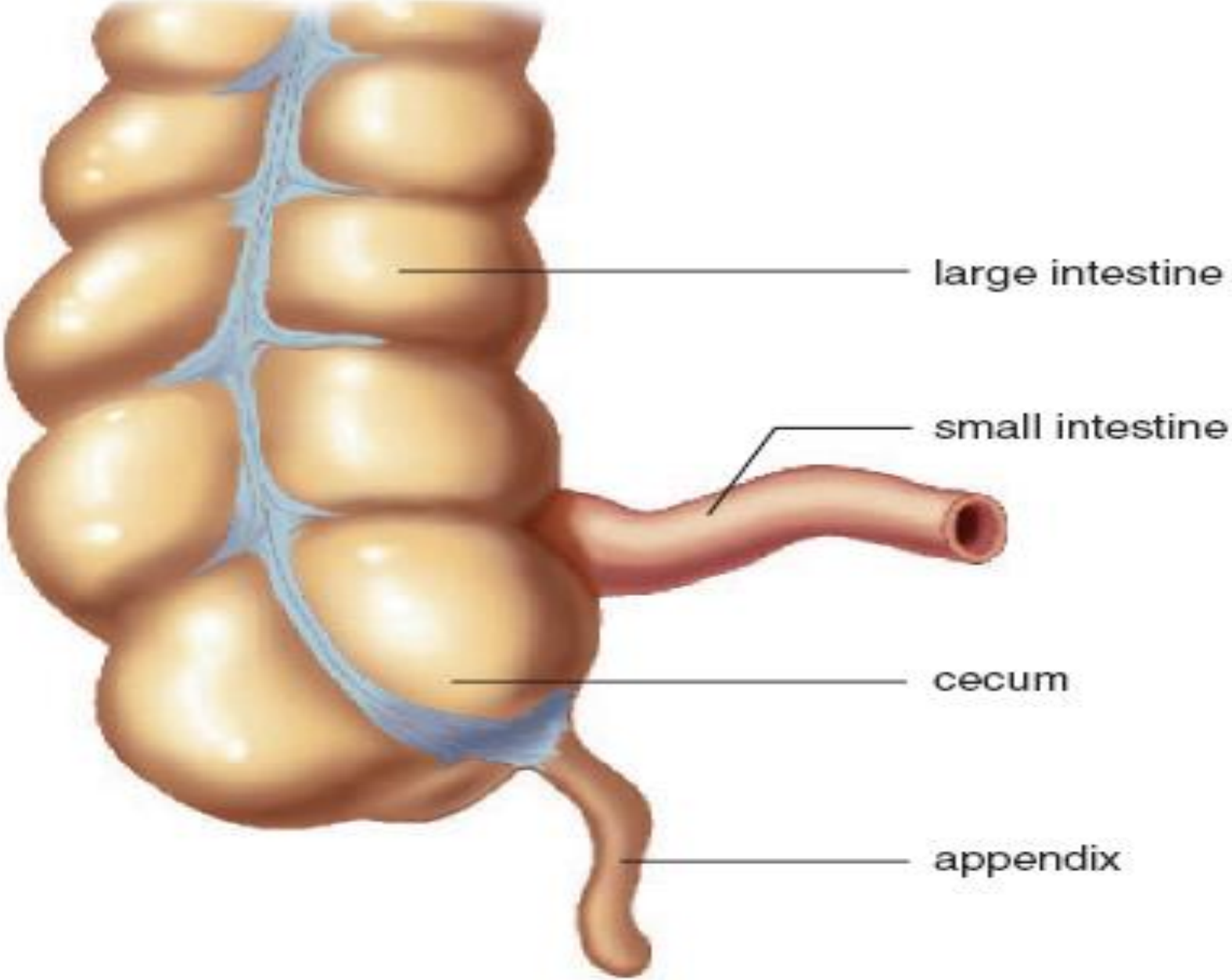
**appendix** (*vermiform* means wormlike) .In humans, •  
the appendix also may play a role in **fighting**  
**infections**.

The **colon** includes the ascending colon, which goes •  
up the right side of the body to the level of the liver;  
the transverse colon, which crosses the abdominal  
cavity just below the liver and the stomach; the  
descending colon, which passes down the left side of  
the body; and the sigmoid colon, which enters the  
rectum, the last 20 cm of the large intestine. The  
rectum opens at the **anus**, where **defecation**, the  
expulsion of feces, occurs. When feces are forced into  
the rectum by peristalsis, a defecation reflex

digestive system  
reviews both  
ocular diges-  
in accessory  
le in diges-  
y, we recog-





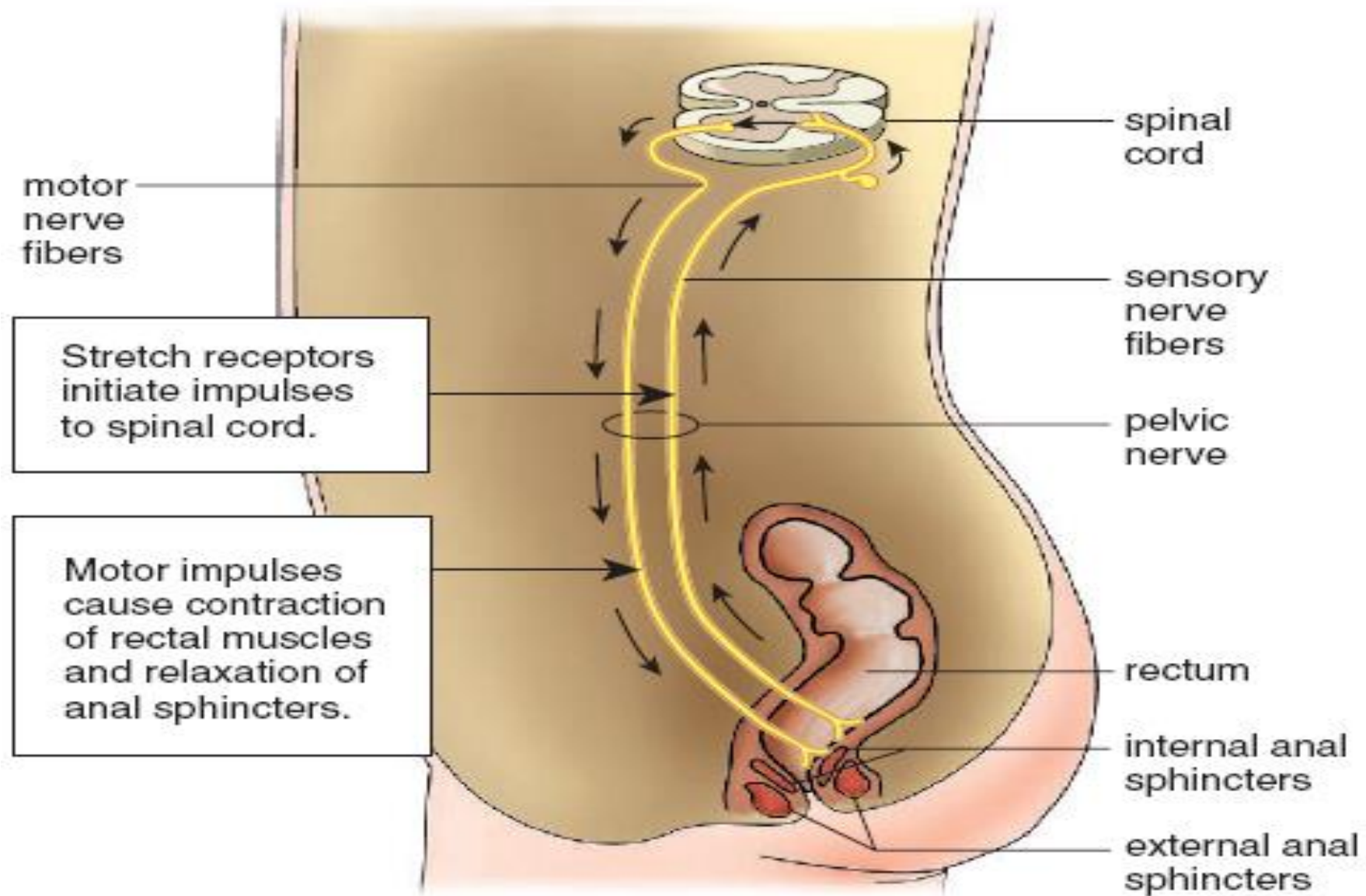


large intestine

small intestine

cecum

appendix



## Three Accessory Organs

The pancreas, liver, and gallbladder are accessory digestive organs. Figure 5.1 shows how the pancreatic duct from the pancreas and the common bile duct from the liver and gallbladder join before entering the duodenum.

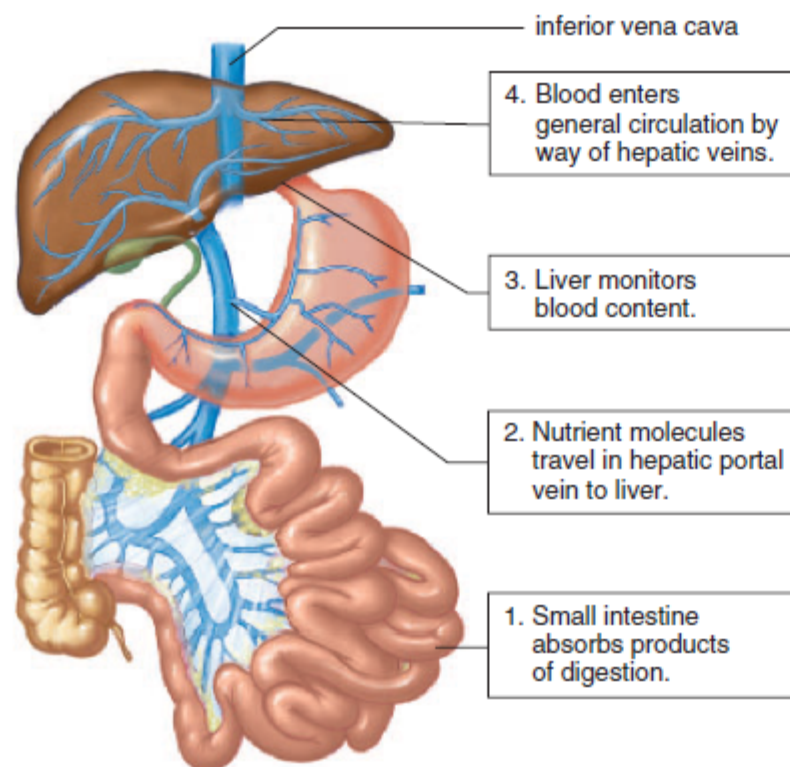
**The Pancreas** The **pancreas** lies deep in the abdominal cavity, resting on the posterior abdominal wall. It is an elongated and somewhat flattened organ that has both an endocrine and an exocrine function. As an endocrine gland, **it secretes insulin and glucagon**, hormones that help keep the blood glucose level within normal limits. In this chapter, we are interested in its exocrine function. Most pancreatic cells produce pancreatic juice, **which contains sodium bicarbonate (NaHCO<sub>3</sub>) and digestive enzymes for all types of food. Sodium bicarbonate neutralizes chyme**; whereas pepsin acts best in an acid pH of the stomach, pancreatic enzymes require a slightly basic pH. **Pancreatic amylase** digests starch, **trypsin** digests protein, and **lipase** digests fat. In cystic fibrosis, a thick mucus blocks the pancreatic duct, and the patient must take supplemental pancreatic enzymes by mouth for proper digestion to occur.

## The Liver

The **liver**, which is the largest gland in the body, lies mainly in the upper right section of the abdominal cavity, under the diaphragm. The liver has two main lobes, the right lobe and the smaller left lobe, which crosses the midline and lies above the stomach. The liver contains approximately 100,000 lobules that serve as the structural and functional units of the liver. Triads consisting of these three structures are located between the lobules: a bile duct that takes bile away from the liver; a branch of the hepatic artery that brings O<sub>2</sub>-rich blood to the liver; and a branch of the hepatic portal vein that transports nutrients from the intestines. The central veins of lobules enter a hepatic vein. Trace the path of blood in from the intestines to the liver via the hepatic portal vein and from the liver to the inferior vena cava via the hepatic veins.

## The Gallbladder

The **gallbladder** is a pear-shaped, muscular sac attached to the surface of the liver. About 1,000 ml of bile are produced by the liver each day, and any excess is stored in the gallbladder. Water is reabsorbed by the gallbladder so that bile becomes a thick, mucus like material. When needed, bile leaves the gallbladder and proceeds to the duodenum via the common bile duct.



**Figure 5.11 Hepatic portal system.**

The hepatic portal vein takes the products of digestion from the digestive system to the liver, where they are processed before entering a hepatic vein.

emulsify fat in the small intestine. When fat is emulsified, it

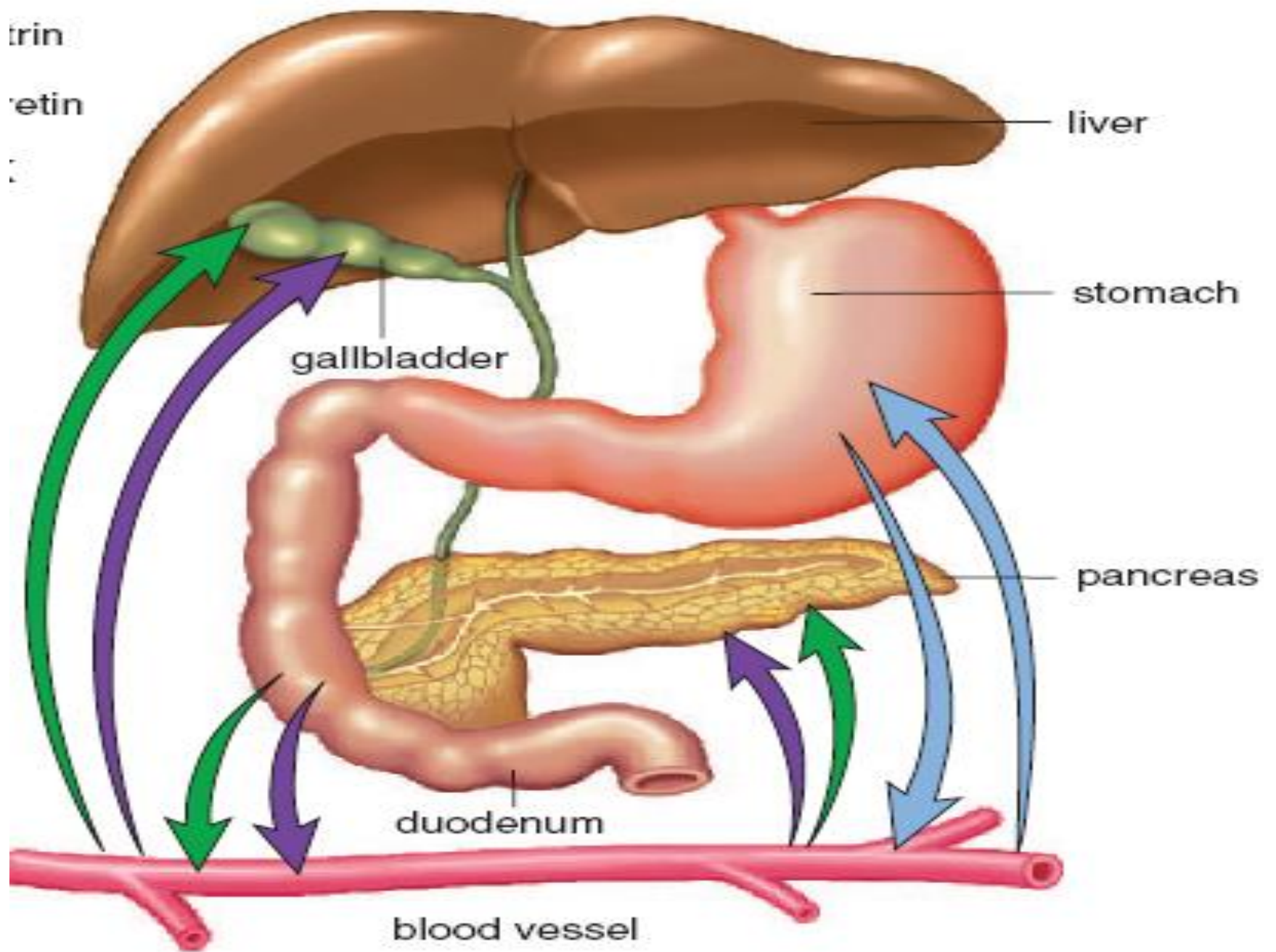
## Chapter 5 Digestive System and Nutrition

tint to the whites of the eyes and also to the skin of dark pigmented persons. Bilirubin is deposited in the skin of an abnormally large amount in the blood. In hemolytic jaundice, red blood cells have been broken down in abnormally large amounts; in obstructive jaundice, bile ducts are blocked or liver cells are damaged.

Jaundice can also result from **hepatitis**, inflammation of the liver. Viral hepatitis occurs in several forms. Hepatitis is usually acquired from sewage-contaminated drinking water. Hepatitis B, which is usually spread by sexual contact, can also be spread by blood transfusions or contact with contaminated needles. The hepatitis B virus is more contagious than the AIDS virus, which is spread in the same way. There is, however, now a vaccine available for hepatitis B. Hepatitis C, which is usually acquired by contact with infected blood and for which there is no vaccine, can lead to chronic hepatitis, liver cancer, and death.

**Cirrhosis** is another chronic disease of the liver. In this disease the organ becomes fatty, and liver tissue is then replaced by inactive fibrous scar tissue. Cirrhosis of the liver is often seen in alcoholics due to malnutrition and to the excessive amounts of alcohol (a toxin) the liver is forced to process.

The liver has amazing generative powers and can usually recover if the rate of regeneration exceeds the rate of destruction. During liver failure, however, there may not be enough time to let the liver heal itself. Liver transplantation is usually the preferred treatment for liver failure, but a



1. List the organs of the digestive tract, and state the contribution of each to the digestive process. 82–88 •
2. Discuss the absorption of the products of digestion into the lymphatic and cardiovascular systems. 87 •
3. Name and state the functions of the hormones that assist the nervous system in regulating digestive secretions. 88 •
4. Name the accessory organs, and describe the part •
5. Choose and discuss any three functions of the liver. 90–91
6. Name and discuss two serious illnesses of the liver. •  
they play in the digestion of food 91

7. Discuss the digestion of starch, protein, and fat, listing all the steps that occur with each of these. 92–93 •
8. How does the digestive system help maintain homeostasis? 94–9 •
9. How does the circulatory system assist the digestive system in maintaining homeostasis? 94–95 •
10. What is the chief contribution of each of these constituents of the diet: a. carbohydrates; b. proteins; c. fats; d. fruits and vegetables? 96–98, 100 •
11. Why should the amount of saturated fat be curtailed in the diet? 98 •
12. Name and discuss three eating disorders. 104–5 •



**THANK YOU**  
**Will MEET IN NEW LECTURE**

# **Respiratory System**

## **Respiratory Tract**

Air passes through a series of tubes before gas exchange takes place across a very extensive moist surface.

## **Mechanism of Breathing**

Respiration **Consist** breathing, external and internal respiration, and cellular respiration During inspiration, the pressure in the lungs decreases, and air comes rushing in. During expiration, increased pressure in the thoracic cavity causes air to leave the lungs.

## **Gas Exchanges in the Body**

External respiration occurs in the lungs where oxygen diffuses into the blood and carbon dioxide diffuses out of the blood.

Internal respiration occurs in the tissues where oxygen diffuses out of the blood and carbon dioxide diffuses into the blood.

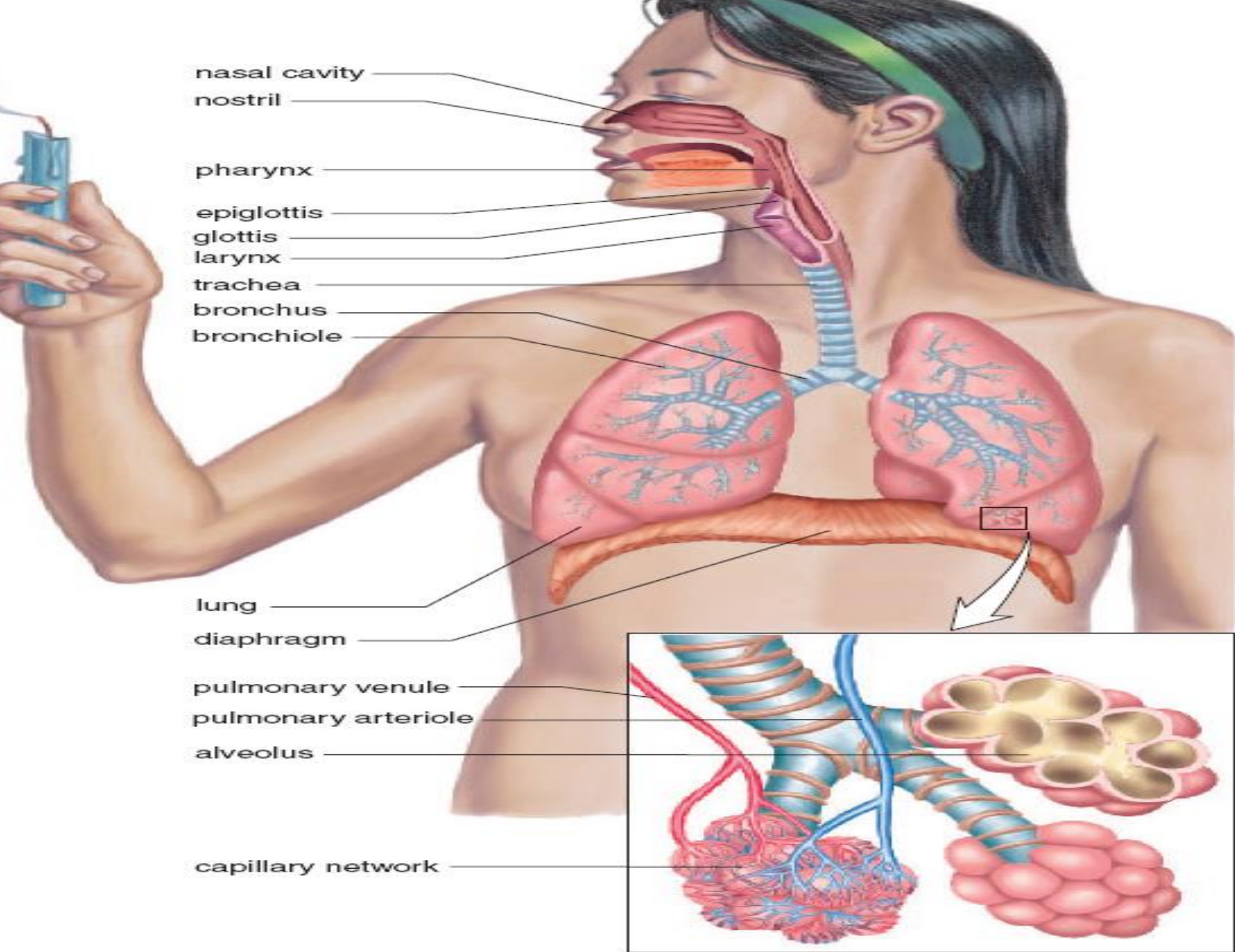
The respiratory pigment hemoglobin transports oxygen from the lungs to the tissues and aids in the transport of carbon dioxide from the tissues to the lungs

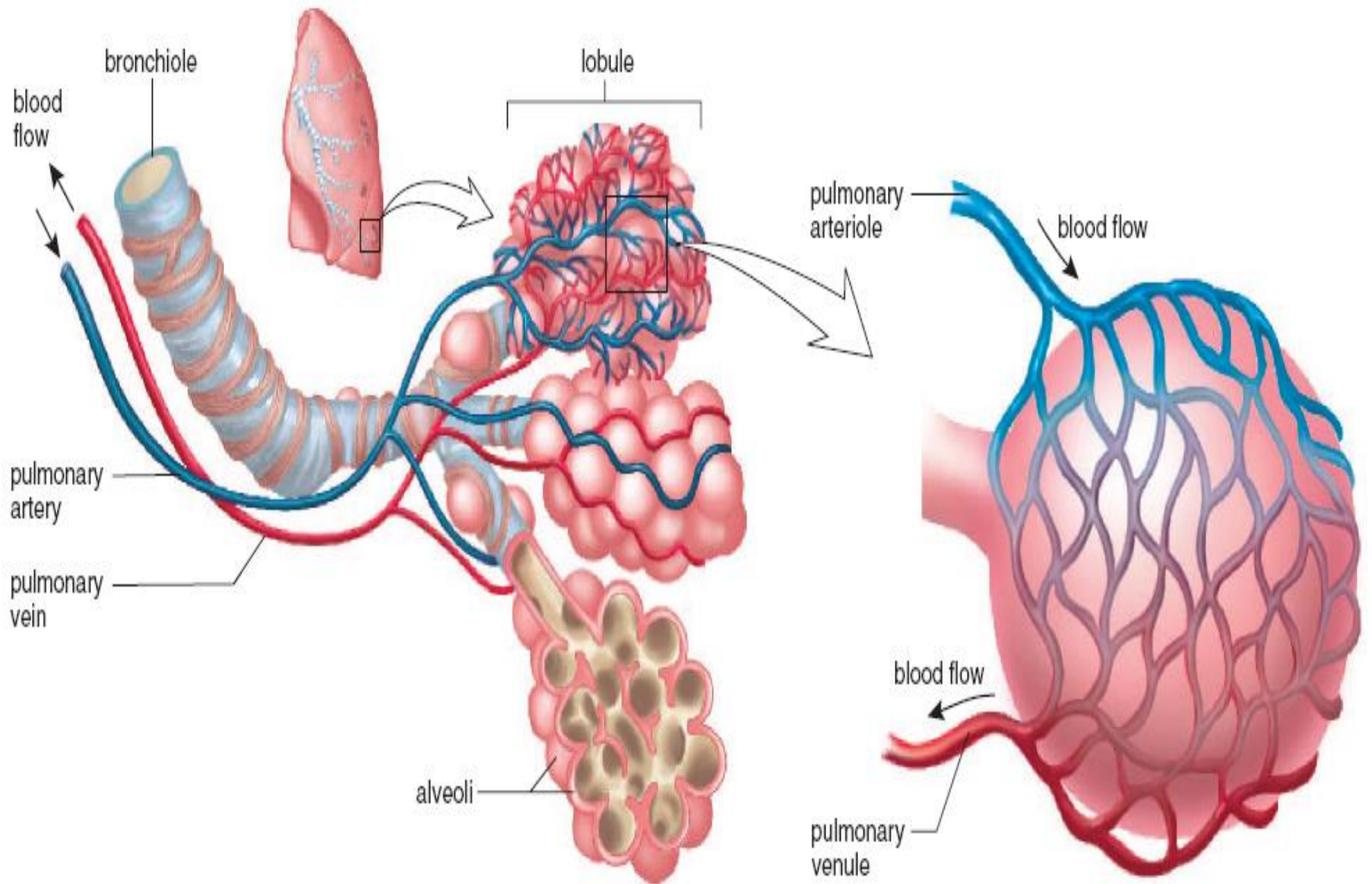
## **Respiration and Health**

The respiratory tract is especially subject to disease because it is exposed to infectious agents. Smoking tobacco contributes to three major lung disorders—**chronic bronchitis, emphysema, and cancer.**

## **Homeostasis**

The respiratory system works with the other systems of the body to maintain homeostasis





Blood supply of alveoli

Capillary network of one alveolus

## Respiratory Tract

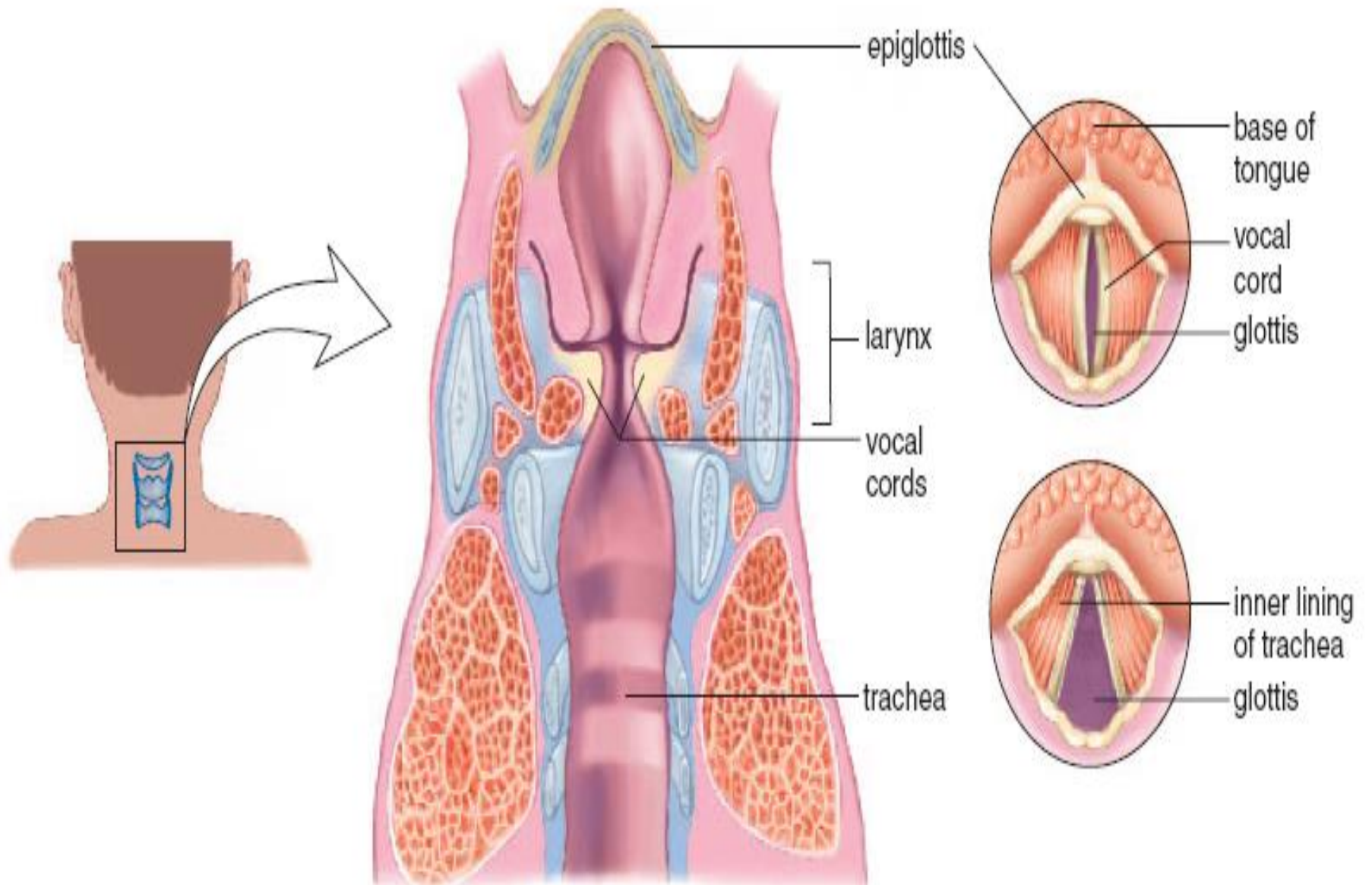
During **inspiration or inhalation (breathing in)** and **expiration or exhalation (breathing out)**, air is conducted toward or away from the lungs by a series of cavities, tubes, and openings, illustrated in Figure 9.2. Table 9.1

traces the path of air from the nose to the lungs. As air moves in along the airways, **it is filtered, warmed, and moistened**. Filtering is accomplished by coarse hairs, cilia, and mucus in the region of the nostrils and by cilia alone in the rest of the nasal cavity and the other airways of the respiratory tract

. In the nose, the hairs and the cilia act as a •  
screening device.

In the trachea and other airways, the cilia beat •  
**upward**, carrying mucus, dust, and occasional  
bits of food that “**went down the wrong way**” into  
the pharynx, where the accumulation can be  
swallowed or expectorated. The air is warmed  
by heat given off by the blood vessels lying close  
to the surface of the lining of the airways, and it  
is moistened by the wet surface of these  
passages.





# Gas Exchanges in the Body

External respiration occurs in the lungs where oxygen diffuses into the blood and carbon dioxide diffuses out of the blood.

Internal respiration occurs in the tissues where oxygen diffuses out of the blood and carbon dioxide diffuses into the blood.

The respiratory pigment hemoglobin transports oxygen from the lungs to the tissues and aids in the transport of carbon dioxide from the tissues to the lungs