CHAPTER 12

Digestion

Chapter Contents

Objectives

After study of this chapter you should be able to:

1. Explain the function of the digestive system.
2. Label a diagram of the digestive tract, and describe the function of each part.
3. Label a diagram of the accessory organs, and explain the role of each in digestion.
4. Identify and use the roots pertaining to the digestive system.
5. Describe the major disorders of the digestive system.
6. Define medical terms used in reference to the digestive system.
7. Interpret abbreviations used in referring to the gastrointestinal system.
8. Analyze case studies concerning gastroenterology.

The function of the digestive system (Fig. 12-1) is to prepare food for intake by body cells. Nutrients must be broken down by mechanical and chemical means into molecules that are small enough to be absorbed into the circulation. Within cells, the nutrients are used for energy and for rebuilding vital cell components. Digestion takes place in the digestive tract proper, also called the alimentary canal or gastrointestinal (GI) tract. Also contributing to the digestive process are several accessory organs that release secretions into the small intestine. Food is moved through the digestive tract by **peristalsis**, wavelike contractions of the organ walls. Peristalsis also moves undigested waste material out of the body.

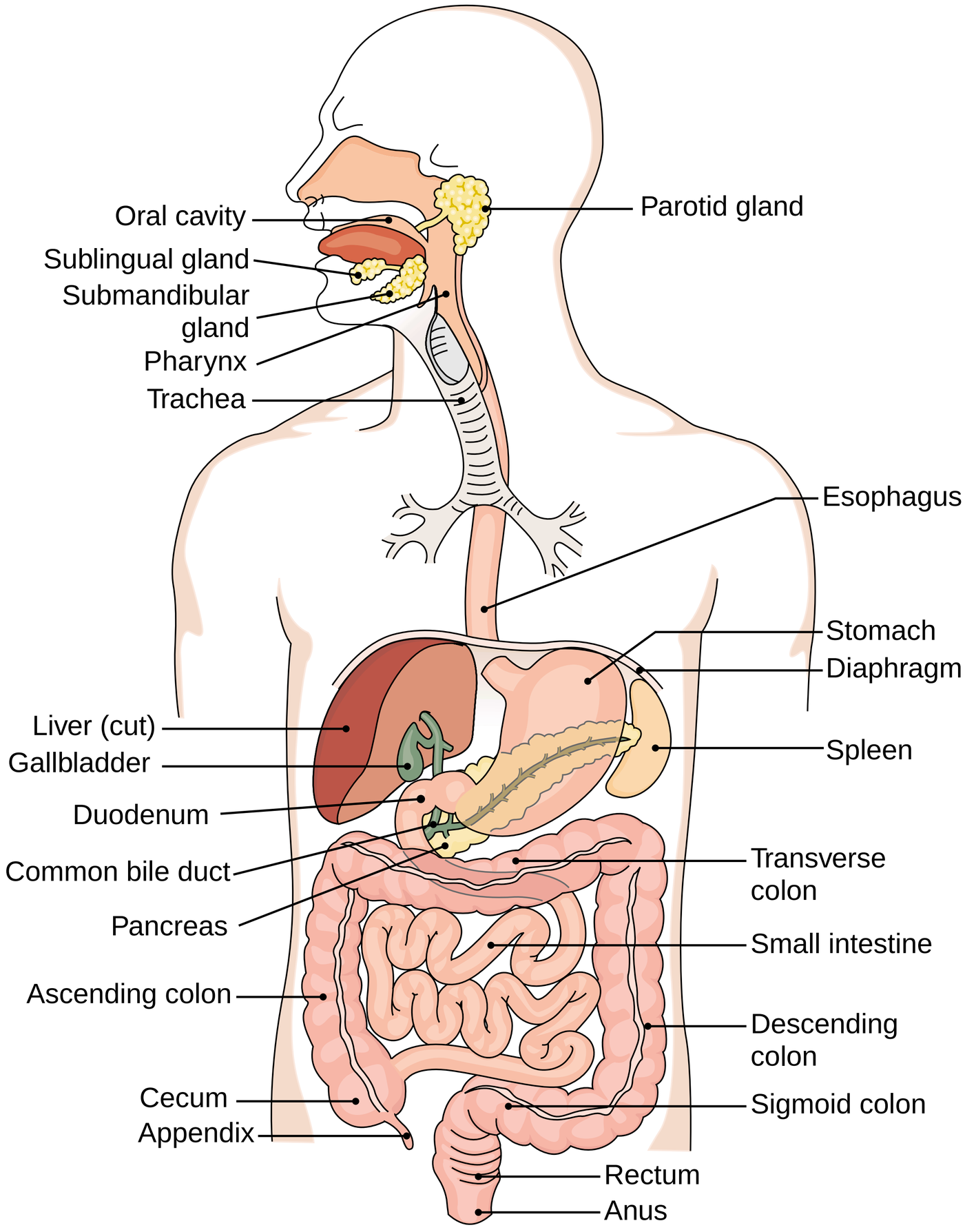


FIGURE 12-1. Digestive system. (Reprinted with permission from Cohen BJ, Wood DL. Memmler's The Human Body in Health and Disease. 9th Ed. Philadelphia: Lippincott Williams & Wilkins, 2000.)

The Mouth to the Small Intestine

Digestion begins in the **mouth** (Fig. 12-2), where food is chewed into small bits by the teeth (Fig. 12-3). In the process of chewing, or **mastication**, the tongue and the **palate**, the roof of the mouth, help to break up the food and mix it with **saliva**, a secretion that moistens the food and begins the digestion of starch. The moistened food is then passed into the pharynx (throat) and through the **esophagus** into the **stomach**. Here

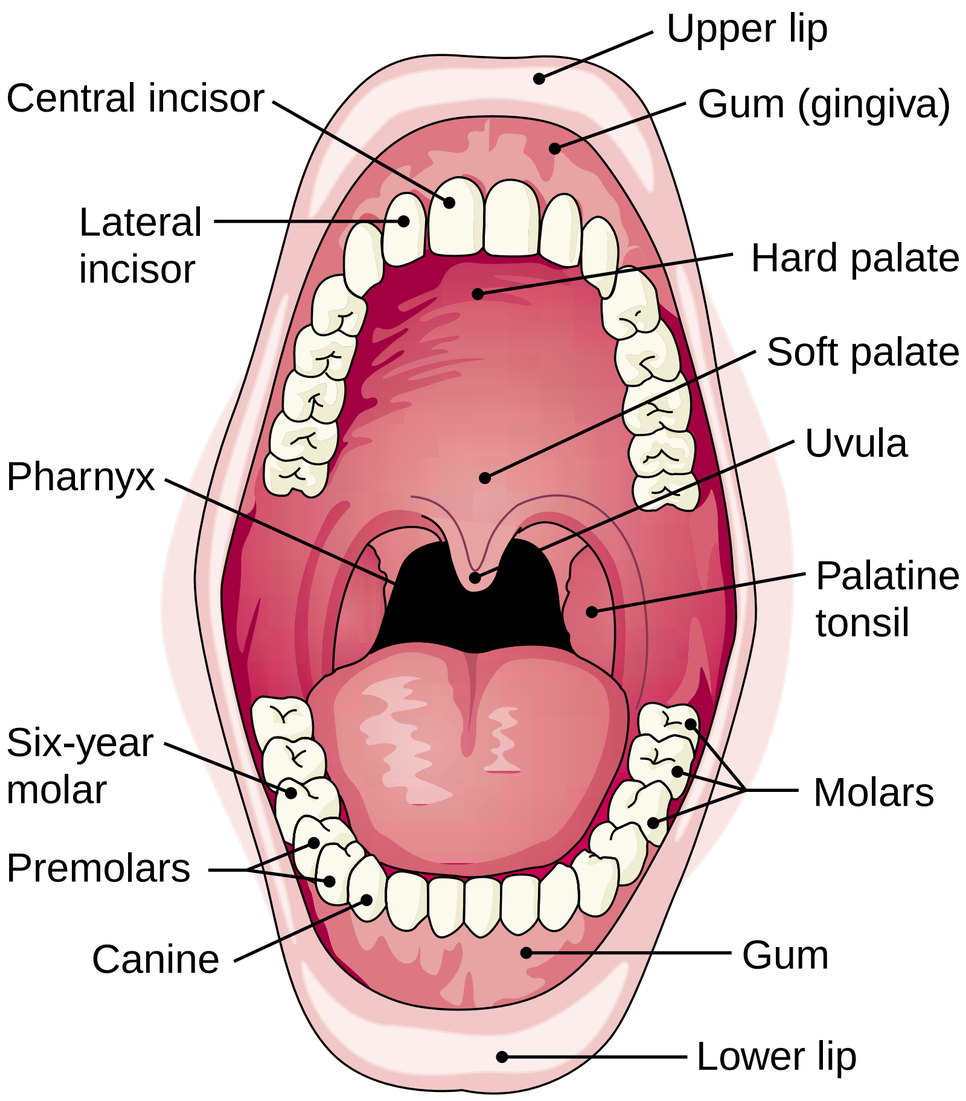


FIGURE 12-2. The mouth, showing the teeth, pharynx, and tonsils. (Reprinted with permission from Cohen BJ, Wood DL. Memmler's The Human Body in Health and Disease. 9th Ed. Philadelphia: Lippincott Williams & Wilkins, 2000.)

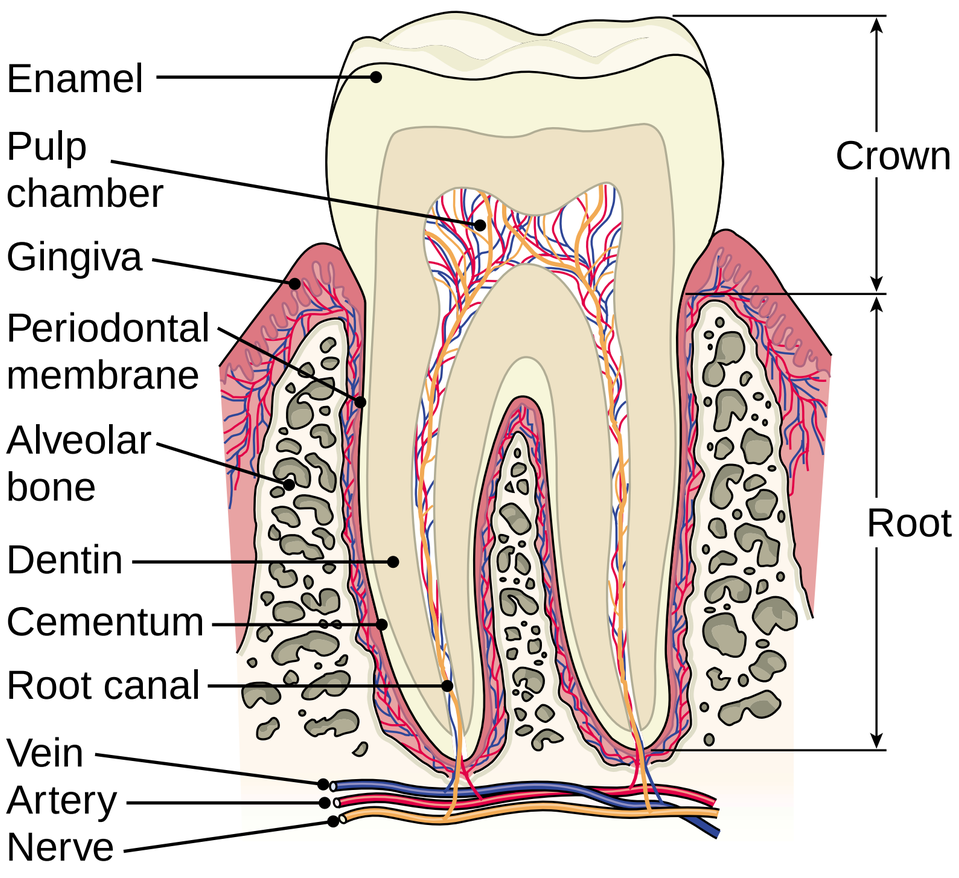


FIGURE 12-3. A molar tooth. (Reprinted with permission from Cohen BJ, Wood DL. Memmler's The Human Body in Health and Disease. 9th Ed. Philadelphia: Lippincott Williams & Wilkins, 2000.)

it is further broken down by churning of the stomach as it is mixed with the enzyme pepsin and with powerful hydrochloric acid (HCl), both of which break down proteins.

The partially digested food passes through the lower portion of the stomach, the **pylorus**, into the first part of the small intestine, the **duodenum**. As the food continues through the **jejunum** and **ileum**, the remaining sections of the small intestine, digestion is completed. The substances active in digestion in the small intestine include enzymes from the intestine itself and secretions from the accessory organs of digestion. The digested nutrients, as well as water, minerals, and vitamins, are absorbed into the circulation, aided by small projections in the lining of the small intestine called **villi**.

The Accessory Organs

The accessory organs of digestion are illustrated in Figure 12-4. The **liver** is a large gland with many functions. A major part of its activity is to process blood brought to it by a special circulatory pathway called the **hepatic portal system**. Its role in digestion is the secretion of **bile**, which breaks down fats. Bile is stored in the **gallbladder** until needed. The common hepatic duct from the liver and the cystic duct from the gallbladder merge to form the **common bile duct**, which empties into the duodenum. The **pancreas** produces a mixture of digestive enzymes that is delivered into the duodenum through the pancreatic duct.

The Large Intestine

Undigested food, water, and digestive juices pass into the large **intestine**. This part of the digestive tract begins in the lower right region of the abdomen with a small pouch, the **cecum**, to which the **appendix** is attached. The large intestine continues as the **colon**, a name that is often used to mean the large intestine because the colon constitutes such a large portion of that organ. The colon travels upward along the right side of the abdomen as the ascending colon, crosses below the stomach as the transverse colon, then continues down the left side of the abdomen as the descending colon. As food is pushed through the colon, water is reabsorbed and stool or **feces** is formed. This waste material passes into the S-shaped **sigmoid colon** and is stored in the **rectum** until eliminated through the **anus**.

BOX 12-1

Homonyms are words that sound alike but have different meanings. One must know the context in which they are used to tell what meaning is meant. For example, the ilium is the upper portion of the pelvis, but the ileum is the last portion of the small intestine. Different adjectives are preferred for each, iliac for the first and ileal for the second.

The word meiosis refers to the type of cell division that halves the chromosomes to form the gametes, but miosis means abnormal contraction of the pupil. Both words come from the Greek word that means a decrease.

Similar-sounding names lead to some funny misspellings. The large bone of the upper arm is the humerus, but this bone is often written as humorous. The vagus nerve (cranial nerve X) is named with a root that means “wander,” as in the words vague and vagabond, because this nerve branches to many of the internal organs. Students often write the name as if it had some relation to the famous gambling city in Nevada.

Homonyms may have a more serious side as well. Drug names may sound or look so similar that clinicians confuse them, leading to some dangerous situations.

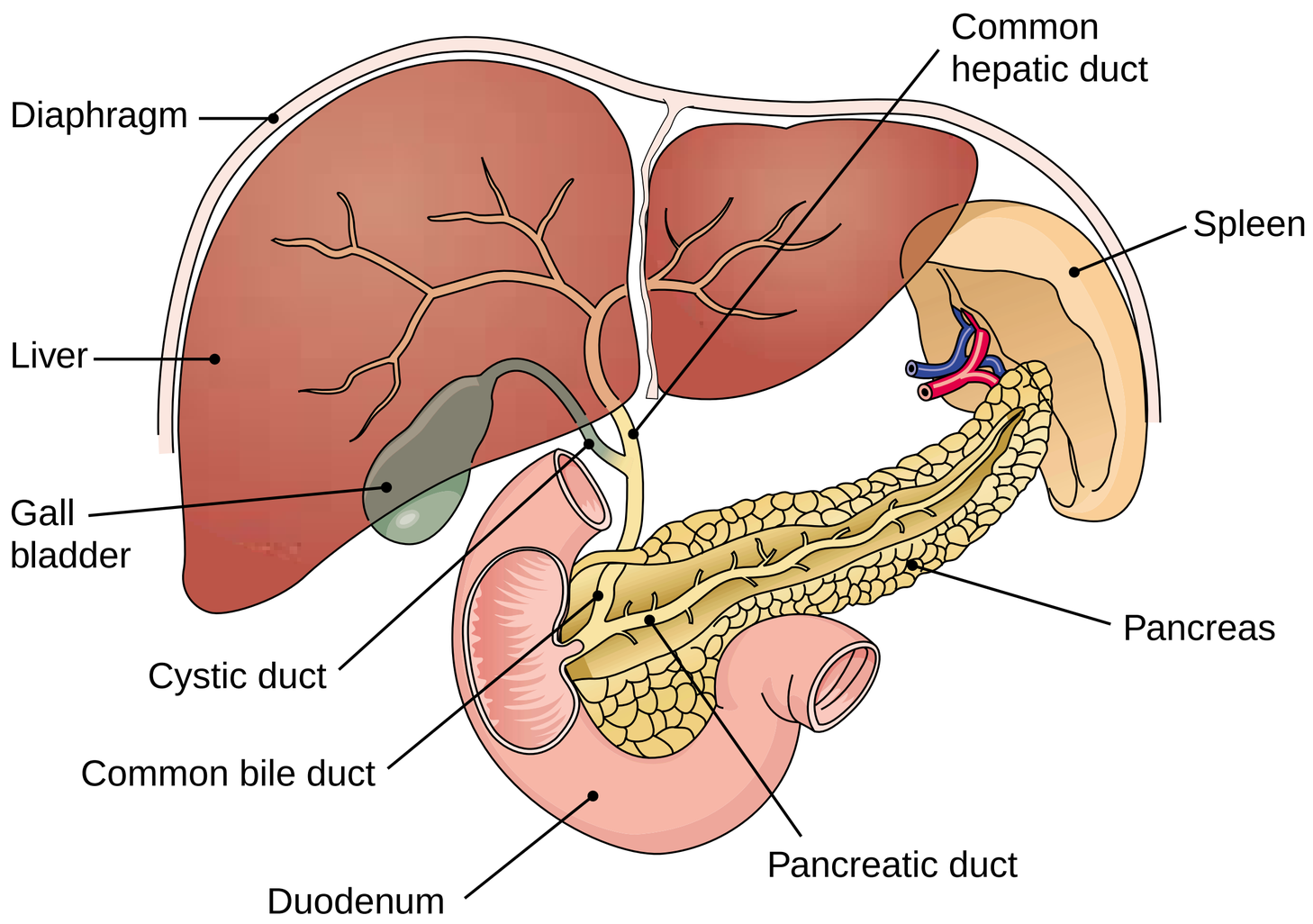


FIGURE 12-4. Accessory organs of digestion. (Reprinted with permission from Cohen BJ, Wood DL. Memmler's The Human Body in Health and Disease. 9th Ed. Philadelphia: Lippincott Williams & Wilkins, 2000.)

Key Terms

NORMAL STRUCTURE AND FUNCTION

anus *Ā-nus*	The distal opening of the digestive tract (root *an/o*)
appendix *a-PEN-diks*	An appendage; usually means the narrow tube attached to the cecum, the vermiform (wormlike) appendix
bile *bīl*	The fluid secreted by the liver that aids in the digestion and absorption of fats (roots *chol/e, bili*)
cecum *SĒ-kum*	A blind pouch at the beginning of the large intestine (root *cec/o*)
colon *KŌ-lon*	The major portion of the large intestine; extends from the cecum to the rectum and is formed by ascending, transverse, and descending portions (root *col/o, colon/o*)
common bile duct	The duct that carries bile into the duodenum; formed by the union of the cystic duct and the common hepatic duct (root *choledoch/o*)
duodenum *dū-ō-DĒ-num*	The first portion of the small intestine (root *duoden/o*)

Normal Structure and Function, continued

esophagus *e-SOF-a-gus*	The muscular tube that carries food from the pharynx to the stomach. The opening of the esophagus into the stomach is controlled by the lower esophageal sphincter (LES) (root *esphag/o*).
feces *FĒ-sēz*	The waste material eliminated from the intestine (adjective, fecal); stool
gallbladder	A sac on the undersurface of the liver that stores bile (root *cholecyst/o*)
hepatic portal system	A special pathway of the circulation that brings blood directly from the abdominal organs to the liver for processing (also called simply the *portal system*). The vessel that enters the liver is the hepatic portal vein (portal vein).
ileum *IL-ē-um*	The terminal portion of the small intestine (root *ile/o*)
intestine *in-TES-tin*	The portion of the digestive tract between the stomach and the anus. It consists of the small intestine and large intestine. It functions in digestion, absorption, and elimination of waste (root *enter/o*).
jejunum *je-JŪ-num*	The middle portion of the small intestine (root *jejun/o*)
liver *LIV-er*	The large gland in the upper right part of the abdomen. In addition to many other functions, it secretes bile for digestion of fats (root *hepat/o*).
mastication *mas-ti-KĀ-shun*	Chewing
pancreas *PAN-krē-as*	A large, elongated gland behind the stomach. It produces hormones that regulate sugar metabolism and also produces digestive enzymes (root *pancreat/o*).
palate *PAL-at*	The roof of the mouth; the partition between the mouth and nasal cavity; consists of an anterior portion formed by bone, the hard palate, and a posterior portion formed of tissue, the soft palate (root *palat/o*)
peristalsis *per-i-STAL-sis*	Wavelike contractions of the walls of an organ
pylorus *pī-LOR-us*	The distal opening of the stomach into the duodenum. The opening is controlled by a ring of muscle, the pyloric sphincter (root *pylor/o*).
rectum *REK-tum*	The distal portion of the large intestine. It stores and eliminates undigested waste (root *rect/o, proct/o*).
saliva *sa-LĪ-va*	The clear secretion released into the mouth that moistens food and contains an enzyme that digests starch. It is produced by three pairs of glands: the parotid, submandibular, and sublingual glands (see Fig. 12-1) (root *sial/o*).
stomach *STUM-ak*	A muscular saclike organ below the diaphragm that stores food and secretes juices that digest proteins (root *gastr/o*)
villi *VIL-ī*	Tiny projections in the lining of the small intestine that absorb digested foods into the circulation (singular, villus)

Roots Pertaining to Digestion

TABLE 12-1 Roots for the Mouth

ROOT	MEANING	EXAMPLE	DEFINITION OF EXAMPLE
or/o	mouth	perioral *per-ē-OR-al*	around the mouth
stoma, stomat/o	mouth	stomatitis *stō-ma-TĪ-tis*	inflammation of the mouth
gnath/o	jaw	prognathous *PROG-na-thus*	having a projecting jaw
labi/o	lip	labiodental *lā-bē-ō-DEN-tal*	pertaining to the lip and teeth (dent/o)
bucc/o	cheek	buccoversion *buk-kō-VER-zhun*	turning toward the cheek
dent/o, dent/i	tooth, teeth	dentifrice *DEN-ti-fris*	a substance used to clean the teeth
odont/o	tooth, teeth	periodontist *per-ē-ō-DON-tist*	dentist who treats the tissues around the teeth
gingiv/o	gum (gingiva)	gingivectomy *jin-ji-VEK-tō-mē*	excision of gum tissue
lingu/o	tongue	sublingual *sub-LING-gwal*	under the tongue
gloss/o	tongue	glossopharyngeal *glos-ō-fa-RIN-gē-al*	pertaining to the tongue and pharynx
sial/o	saliva, salivary gland, salivary duct	sialogram *sī-AL-ō-gram*	radiograph of the salivary glands and ducts
palat/o	palate	palatorrhaphy *pal-at-OR-a-fē*	suture of the palate

Use the adjective suffix *-al* to write a word that has the same meaning as each of the following:

1. pertaining to the mouth oral
2. pertaining to the teeth _____
3. pertaining to the gums _____
4. pertaining to the tongue _____
5. pertaining to the cheek _____
6. pertaining to the lip _____

Fill in the blanks:

7. Micrognathia (*mī-krō-NĀ-thē-a*) is excessive smallness of the _____.
8. Hemiglossal (*hem-ī-GLOS-al*) means pertaining to one half of the _____.
9. Stomatosis (*stō-ma-TŌ-sis*) is any disease condition of the _____.
10. The oropharynx is the part of the pharynx that is located behind the _____.
11. A sialolith (*sī-AL-ō-lith*) is a stone formed in a _____ gland or duct.
12. Orthodontics (*or-thō-DON-tiks*) is the branch of dentistry that deals with straightening (ortho-) of the _____.
13. Xerostomia (*zē-rō-STŌ-mē-a*) is dryness of the _____.

Define each of the following words:

14. orolingual (*or-o-LING-gwal*) _____
15. palatine (*PAL-a-tīn*) _____
16. gingivitis (*jin-ji-VĪ-tis*) _____
17. glossolabial (*glos-ō-LĀ-bē-al*) _____
18. extrabuccal (*ex-tra-BUK-al*) _____

TABLE 12-2 Roots for the Digestive Tract (Except the Mouth)

ROOT	MEANING	EXAMPLE	DEFINITION OF EXAMPLE
esophag/o	esophagus	esophageal* *e-sof-a-JĒ-al*	pertaining to the esophagus
gastr/o	stomach	gastroparesis *gas-trō-pa-RĒ-sis*	partial paralysis of the stomach
pylor/o	pylorus	pylorostenosis *pī-lor-ō-ste-NŌ-sis*	narrowing of the pylorus
enter/o	intestine	dysentery *DIS-en-ter-ē*	infectious disease of the intestine
duoden/o	duodenum	duodenoscopy *du-o-de-NOS-ko-pe*	endoscopic examination of the duodenum
jejun/o	jejunum	jejunotomy *je-jū-NOT-ō-mē*	incision of the jejunum
ile/o	ileum	ileectomy *il-ē-EK-tō-mē*	excision of the ileum
cec/o	cecum	cecoptosis *sē-kop-TŌ-sis*	downward displacement of the cecum
col/o, colon/o	colon	colocentesis *kō-lō-sen-TĒ-sis*	surgical puncture of the colon
sigmoid/o	sigmoid colon	sigmoidoscope *sig-MOY-dō-skōp*	an endoscope for examining the sigmoid colon

TABLE 12-2 Roots for the Digestive Tract, *continued*

ROOT	MEANING	EXAMPLE	DEFINITION OF EXAMPLE
rect/o	rectum	rectocele *REK-tō-sēl*	hernia of the rectum
proct/o	rectum	proctopexy *PROK-tō-pek-sē*	surgical fixation of the rectum
an/o	anus	transanal *ā-nō-REK-tal*	through the anus

*Note addition of e before -al.

Use the adjective suffix *-ic* to write a word that means each of the following:

1. pertaining to the intestine enteric
2. pertaining to the stomach _____
3. pertaining to the colon _____
4. pertaining to the pylorus _____

Use the adjective suffix *-al* to write a word that means each of the following:

5. pertaining to the duodenum duodenal
6. pertaining to the cecum _____
7. pertaining to the jejunum _____
8. pertaining to the ileum _____
9. pertaining to the rectum _____
10. pertaining to the anus _____

Write a word for each of the following definitions:

11. surgical fixation of the stomach _____
12. endoscopic examination of the esophagus _____
13. plastic repair of the pylorus _____
14. inflammation of the ileum _____
15. surgical creation of an opening into the duodenum _____
16. surgical creation of an opening into the ileum _____
17. study of the stomach and intestines _____

Use the root *col/o* to write a word for each of the following definitions:

18. inflammation of the colon _____
19. surgical fixation of the colon _____
20. surgical creation of an opening into the colon _____
21. irrigation (-clysis) of the colon _____

Use the root *colon/o* to write a word for each of the following definitions:

22. any disease of the colon _____
23. endoscopic examination of the colon _____

Two organs of the digestive tract or even two parts of the same organ may be surgically connected by a passage (anastomosis) after removal of damaged tissue. Such a procedure is named for the connected organs plus the ending *-stomy*. Use two roots plus the suffix *-stomy* to write a word that has the same meaning as each of the following definitions:

24. surgical creation of a passage between the esophagus and stomach esophagogastrostomy
25. surgical creation of a passage between the stomach and intestine _____
26. surgical creation of a passage between the stomach and the jejunum _____
27. surgical creation of a passage between the duodenum and the ileum _____
28. surgical creation of a passage between the sigmoid colon and the rectum (proct/o) _____

TABLE 12-3 Roots for the Accessory Organs

ROOT	MEANING	EXAMPLE	DEFINITION OF EXAMPLE
hepat/o	liver	hepatocyte *HEP-a-tō-sīt*	a liver cell
bili	bile	biliary *BIL-ē-ar-ē*	pertaining to the bile or bile ducts
chol/e, chol/o	bile, gall	cholelith *KŌ-lē-lith*	gallstone, biliary calculus
cholecyst/o	gallbladder	cholecystorrhaphy *kō-lē-sis-TOR-a-fē*	suture of the gallbladder
cholangi/o	bile duct	cholangiogram *kō-LAN-jē-ō-gram*	radiograph of the bile ducts
choledoch/o	common bile duct	choledochal *kō-LED-o-kal*	pertaining to the common bile duct
pancreat/o	pancreas	pancreatolysis *pan-krē-a-TOL-i-sis*	dissolving of the pancreas

Exercise 12-3

Use the suffix *-ic* to write a word for each of the following definitions:

1. pertaining to the liver _____
2. pertaining to the gallbladder _____
3. pertaining to the pancreas _____

Use the suffix *-graphy* to write a word for each of the following definitions:

4. radiographic study of the bile ducts _____
5. radiographic study of the liver _____
6. radiographic study of the gallbladder _____
7. radiographic study of the pancreas _____

Use the suffix *-lithiasis* to write a word for each of the following definitions:

8. condition of having a stone in the common bile duct _____
9. condition of having a stone in the pancreas _____

Fill in the blanks:

10. The word biligenesis (*bil-i-JEN-e-sis*) means the formation of _____.
11. Choledochotomy (*kō-led-o-KOT-o-mē*) is incision of the _____.
12. Hepatomegaly (*hep-a-tō-MEG-a-lē*) is enlargement of the _____.
13. A word that means inflammation of the liver is _____.
14. A pancreatotropic (*pan-krē-at-ō-TROP-ik*) substance acts on the _____.
15. Cholangitis is inflammation of a(n) _____.

Clinical Aspects of Digestion

Gastrointestinal Tract

INFECTION

A variety of organisms can infect the gastrointestinal tract, from viruses and bacteria to protozoa and worms. Some produce short-lived upsets with **gastroenteritis**, **nausea**, **diarrhea**, and **emesis** (vomiting). Others, such as typhoid, cholera, and dysentery, are more serious, even fatal.

ULCERS

An ulcer is a lesion of the skin or a mucous membrane marked by inflammation and tissue damage. Ulcers caused by the damaging action of gastric, or peptic, juices on the lining of the GI tract are termed **peptic ulcers**. Most peptic ulcers appear in the first portion of the duodenum. The origins of such ulcers are not completely known, although infection with a bacterium, *Helicobacter pylori*, has been identified as a major cause. Heredity and stress may be factors as well as chronic inflammation and exposure to damaging drugs, such as

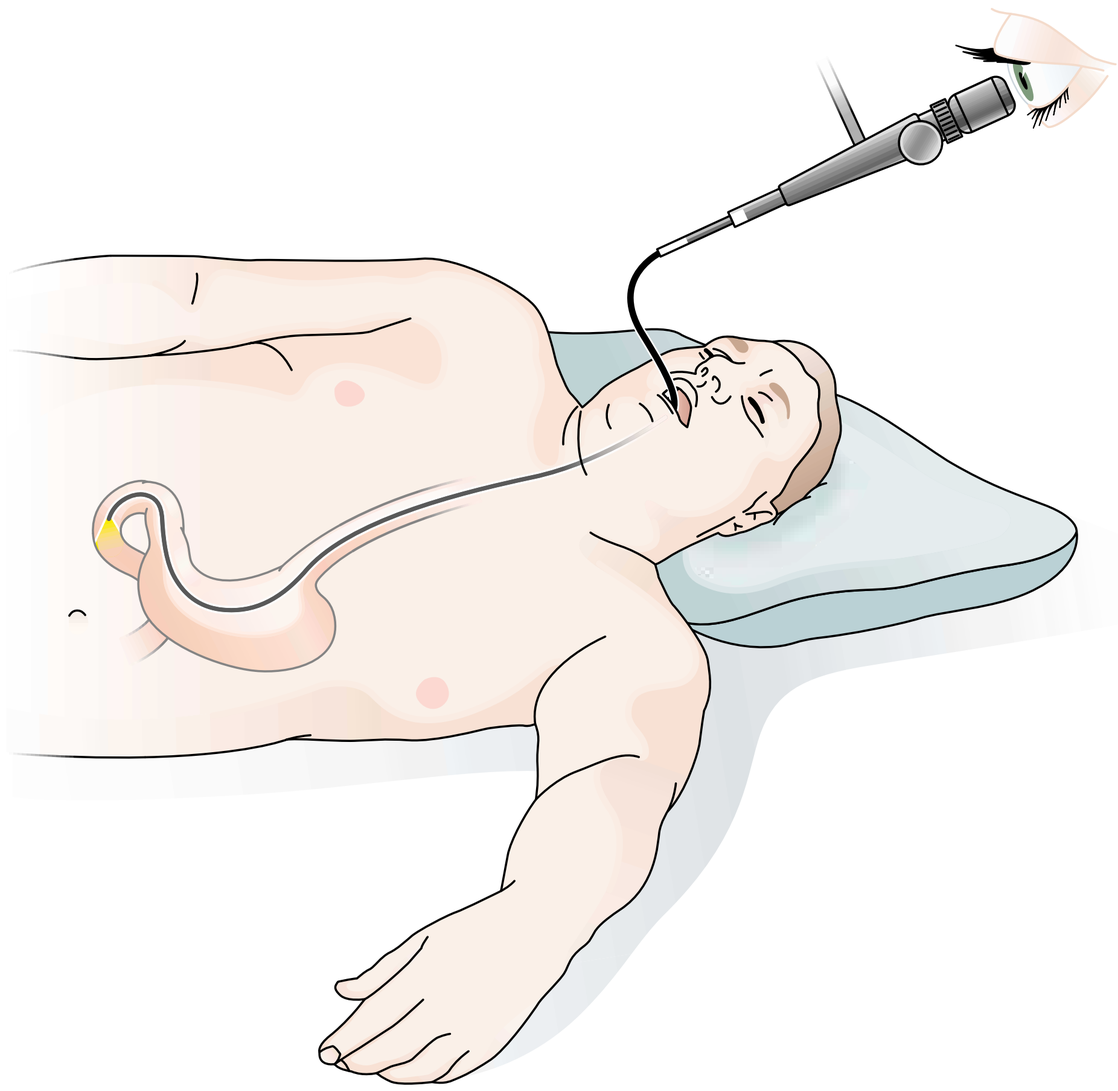


FIGURE 12-5. Patient undergoing gastroscopy.

aspirin, or to irritants in food and drink. Current treatment includes the administration of antibiotics to eliminate *H. pylori* infection and use of drugs that block the action of histamine, which stimulates gastric secretion. Ulcers may lead to hemorrhage or to perforation of the digestive tract wall.

Ulcers can be diagnosed by **endoscopy** (Fig. 12-5) and by radiographic study of the GI tract using a contrast medium, usually barium sulfate. A **barium study** can reveal a variety of GI disorders in addition to ulcers, including tumors and obstructions. A barium swallow is used for study of the pharynx and esophagus; an upper GI series examines the esophagus, stomach, and small intestine.

CANCER

The most common sites for cancer of the GI tract are the colon and rectum. Together these colorectal cancers rank among the most frequent causes of cancer deaths in the United States in both men and women. A diet low in fiber and calcium and high in fat is a major risk factor in colorectal cancer. Heredity is also a factor, as is chronic inflammation of the colon (colitis). **Polyps** (growths) in the intestine often become cancerous and should be removed. Polyps can be identified and even removed by endoscopy.

One sign of colorectal cancer is bleeding into the intestine, which can be detected by testing the stool for blood. Because this blood may be present in very small amounts, it is described as **occult** ("hidden") **blood**. Colorectal cancers are staged according to **Dukes classification**, ranging from A to C according to severity.

The interior of the intestine can be observed with various endoscopes named for the specific area in which they are used, such as proctoscope (rectum), sigmoidoscope (sigmoid colon) (Fig. 12-6), colonoscope (colon).

In some cases of cancer, and for other reasons as well, it may be necessary to surgically remove a portion of the GI tract and create a **stoma** (opening) on the abdominal wall for elimination of waste. Such **ostomy** surgery (Fig. 12-7) is named for the organ involved, such as ileostomy (ileum) or colostomy (colon). When a connection **(anastomosis)** is formed between two organs of the tract, both organs are included in naming, such as gastroduodenostomy (stomach and duodenum) or coloproctostomy (colon and rectum).

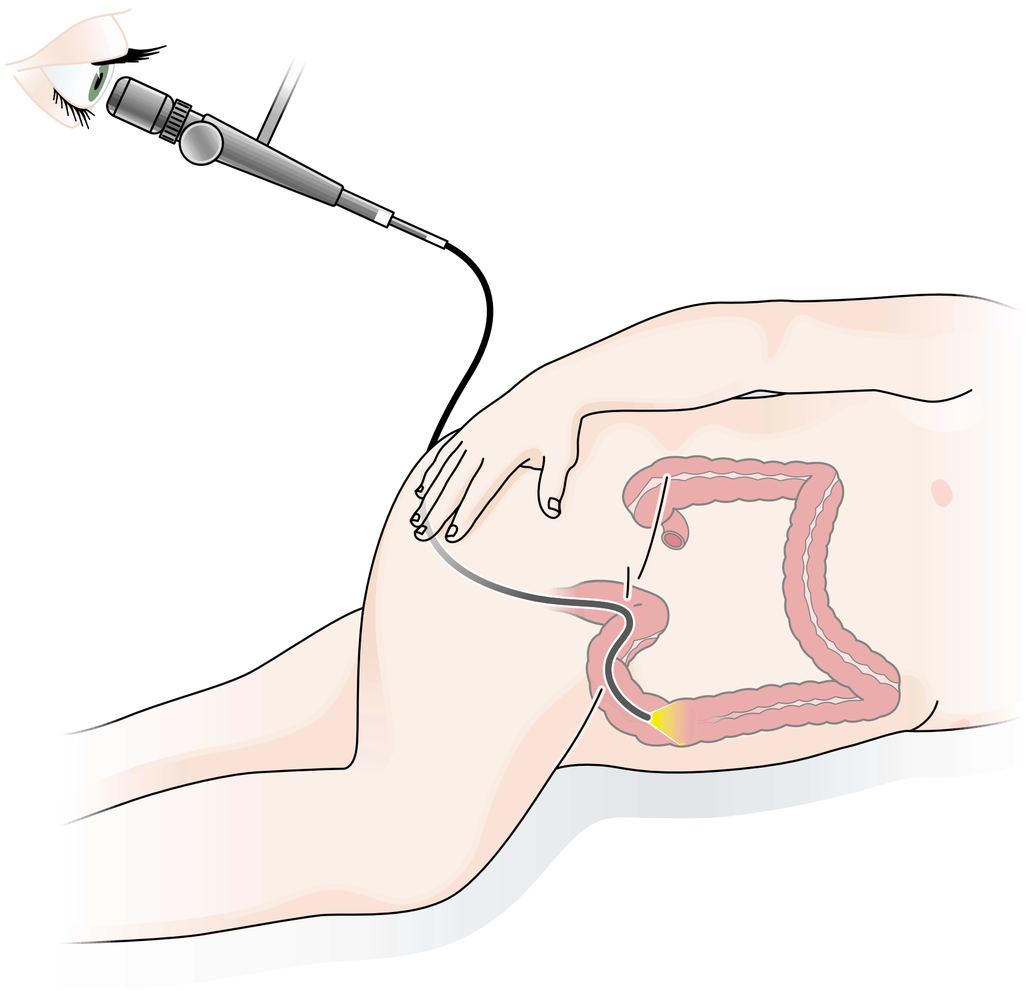


FIGURE 12-6. Sigmoidoscopy. The flexible fiberoptic endoscope is advanced past the proximal sigmoid colon and then into the descending colon.

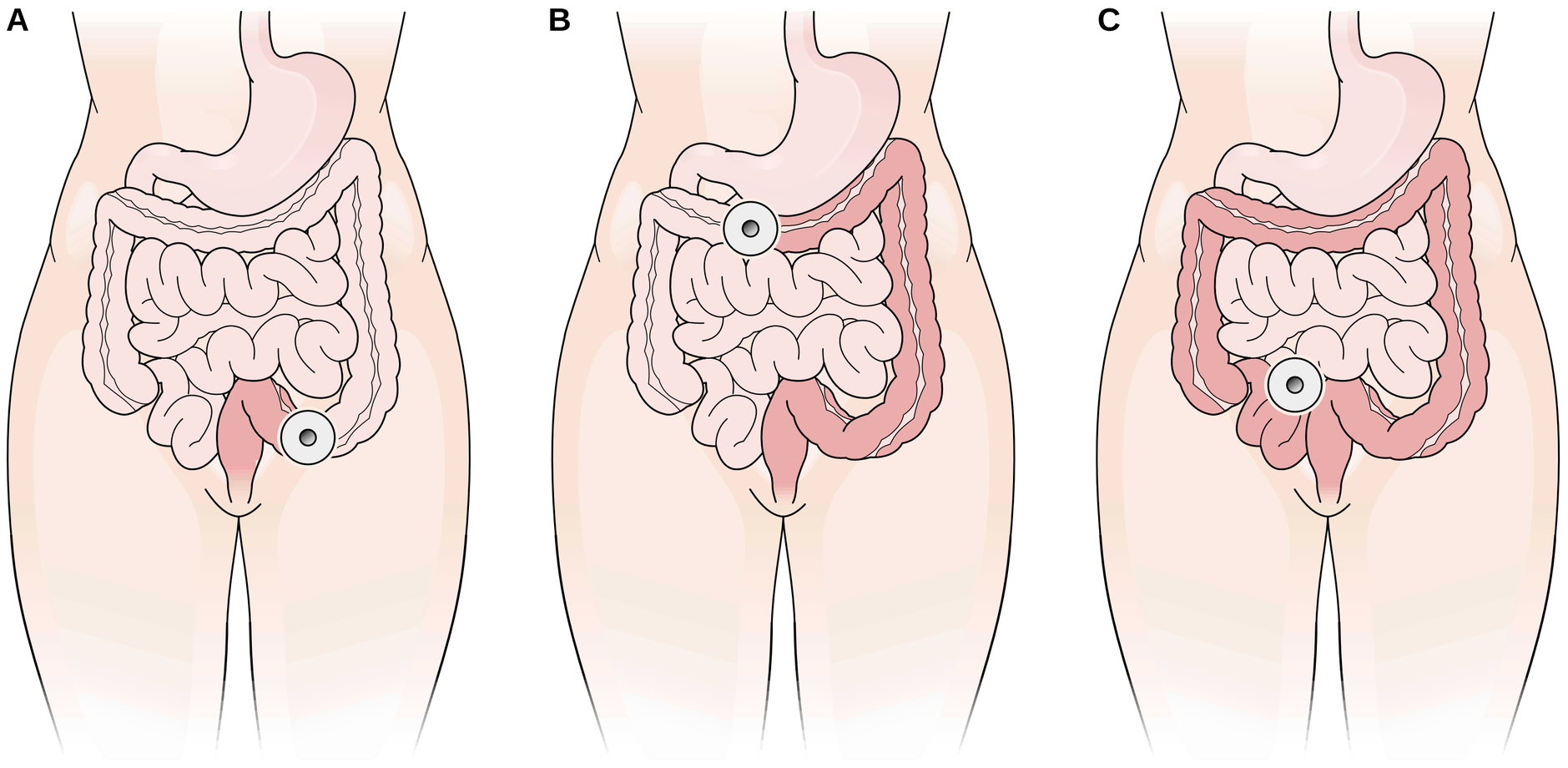


FIGURE 12-7. Location of various colostomies. The shaded portions represent the sections of the bowel that have been removed or are inactive. **(A)** Sigmoid colostomy. **(B)** Transverse colostomy. **(C)** Ileostomy.

OBSTRUCTIONS

A hernia is the protrusion of an organ through an abnormal opening. The most common type is an inguinal hernia, described in Chapter 14 (see Fig. 14-4). In a **hiatal hernia**, part of the stomach moves upward into the chest cavity through the space (hiatus) in the diaphragm where the esophagus passes through (see Fig. 6-5). Often this condition produces no symptoms, but it may result in chest pain, **dysphagia** (difficulty in swallowing), or reflux of stomach contents into the esophagus.

In **pyloric stenosis**, the opening between the stomach and small intestine is too narrow. This usually occurs in infants and in male more often than in female subjects. A sign of pyloric stenosis is projectile vomiting. Surgery may be needed to correct it.

Other types of obstruction include **intussusception** (Fig. 12-8), slipping of a part of the intestine into a part below it; **volvulus**, twisting of the intestine (see Fig. 12-8); and **ileus**, intestinal obstruction often caused by lack of peristalsis. **Hemorrhoids** are varicose veins in the rectum associated with pain, bleeding, and, in some cases, prolapse of the rectum.

APPENDICITIS

Appendicitis results from infection of the appendix, often secondary to its obstruction. Surgery is necessary to avoid rupture and **peritonitis**, infection of the peritoneal cavity.

DIVERTICULITIS

Diverticula are small pouches in the wall of the intestine, most commonly in the colon. If these pouches are present in large number the condition is termed **diverticulosis**, which has been attributed to a diet low in fiber. Collection of waste and bacteria in these sacs leads to **diverticulitis**, which is accompanied by pain and sometimes bleeding. Diverticula can be seen by radiographic studies of the lower GI tract using barium as a contrast medium, a so-called barium enema (Fig. 12-9). Although there is no cure, diverticulitis is treated with diet, stool softeners, and drugs to reduce motility (antispasmodics).

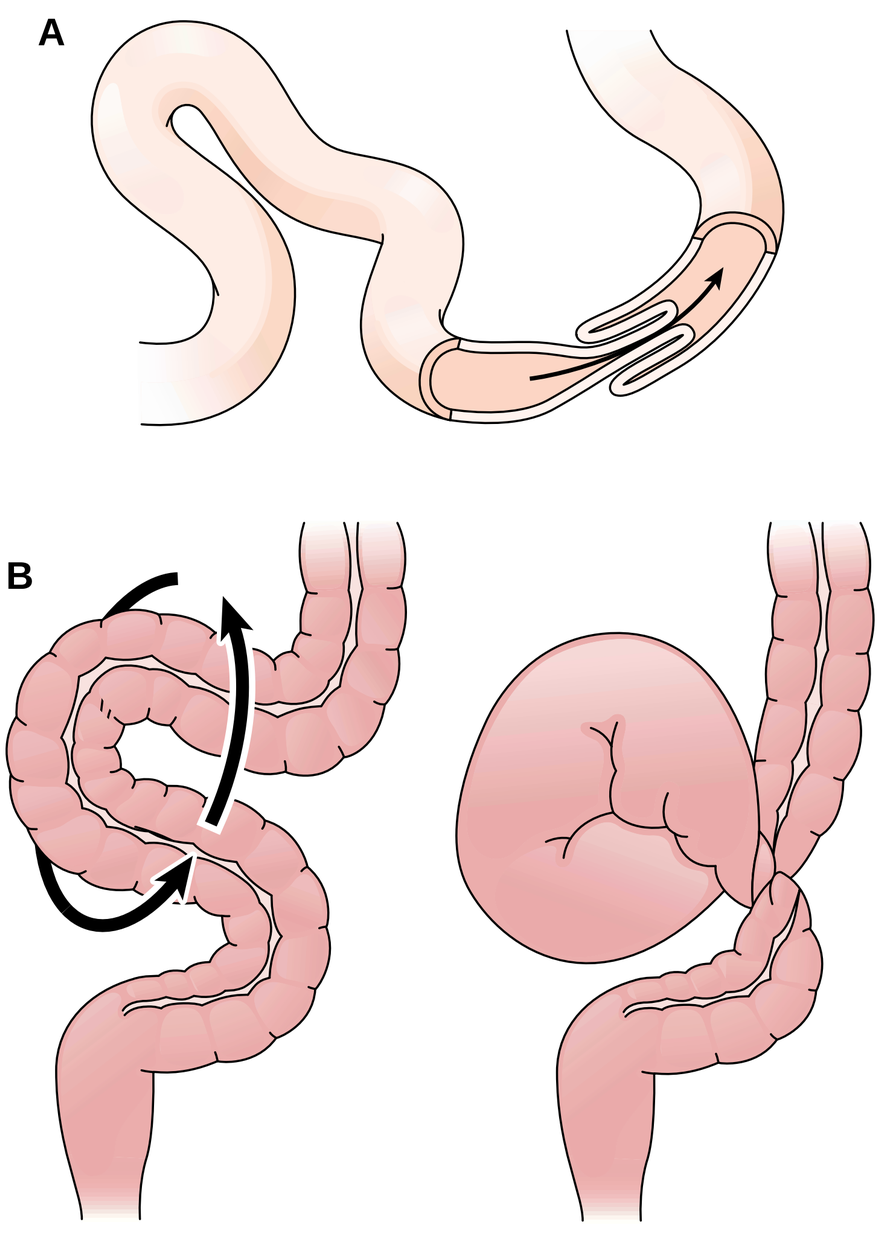


FIGURE 12-8. Intestinal obstruction. **(A)** Intussusception. **(B)** Volvulus, showing counterclockwise twist.

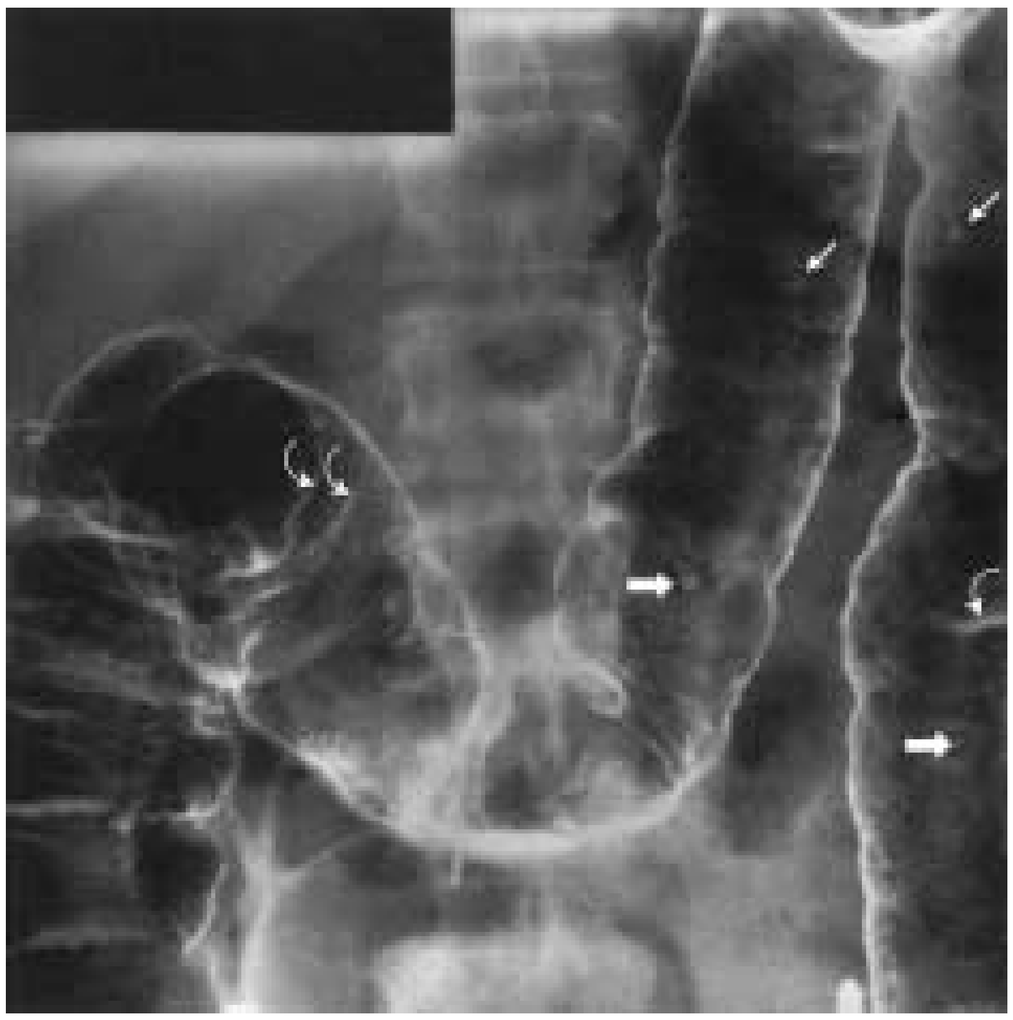


FIGURE 12-9. Lower gastrointestinal series (barium enema) showing lesions of enteritis (*straight arrows*) and thickened mucosa (*curved arrows*). (Reprinted with permission from Erkonen WE, Smith WL. Radiology 101: Basics and Fundamentals of Imaging. Philadelphia: Lippincott Williams & Wilkins, 1998.)

INFLAMMATORY BOWEL DISEASE

Two similar diseases are included under the heading of inflammatory bowel disease (IBD): **Crohn disease** and **ulcerative colitis**, both of which occur mainly in adolescents and young adults. Crohn disease is a chronic inflammation of segments of the intestinal wall, usually in the ileum, causing pain, diarrhea, abscess, and often formation of an abnormal passageway, or **fistula.** Ulcerative colitis involves a continuous inflammation of the lining of the colon and usually the rectum.

Accessory Organs

HEPATITIS

In the United States and other industrialized countries, **hepatitis** is most often caused by viral infection. More than six types of hepatitis virus have now been identified. The most common is hepatitis A virus (HAV), which is spread by fecal–oral contamination, often by food handlers, and in crowded, unsanitary conditions. It may also be acquired by eating contaminated food, especially seafood. Hepatitis B virus (HBV) is spread by blood and other body fluids. It may be transmitted sexually, by sharing needles used for injection, and by close interpersonal contact. Infected individuals may become carriers of the disease. Most patients recover, but the disease may be serious, even fatal, and may lead to liver cancer. Hepatitis C is spread through blood and blood products or by close contact with an infected person. Hepatitis D, the delta virus, is highly pathogenic but only infects those already infected with hepatitis B. Hepatitis E, like HAV, is spread by contaminated food and water. It has caused epidemics in Asia, Africa, and Mexico. Hepatitis G is believed to be spread through contact with blood of an infected person. Vaccines are available for hepatitis A and B.

The name *hepatitis* simply means "inflammation of the liver," but this disease also causes necrosis (death) of liver cells. Hepatitis also may be caused by other infections and by drugs and toxins. Liver function tests performed on blood serum are important in diagnosis.

Jaundice, or **icterus**, is a symptom of hepatitis and other diseases of the liver and biliary system. It appears as yellowness of the skin, whites of the eyes, and mucous membranes caused by the presence of bile pigments, mainly **bilirubin**, in the blood.

CIRRHOSIS

Cirrhosis is a chronic liver disease characterized by **hepatomegaly**, edema, **ascites**, and jaundice. As the disease progresses there is **splenomegaly**, internal bleeding, and brain damage caused by changes in the composition of the blood. A complication of cirrhosis is increased pressure in the portal system that brings blood from the abdominal organs to the liver, a condition called **portal hypertension**. The main cause of cirrhosis is the excess consumption of alcohol.

GALLSTONES

Cholelithiasis refers to the presence of stones in the gallbladder or bile ducts, which is usually associated with **cholecystitis**, inflammation of the gallbladder. Most of these stones are composed of cholesterol, an ingredient of bile. Gallstones form more commonly in women than in men, especially in women on oral contraceptives and in those who have had several pregnancies. The condition is characterized by biliary **colic** (pain) in the right upper quadrant (RUQ), nausea, and vomiting. Drugs may be used to dissolve gallstones, but often the cure is removal of the gallbladder in a **cholecystectomy.** This procedure was originally performed through a major abdominal incision, but now the gallbladder is almost always removed laparoscopically through a small incision in the abdomen.

Ultrasonography and radiography are used for diagnosis of gallstones. **Endoscopic retrograde cholangiopancreatography (ERCP)** (Fig. 12-10) is a technique for viewing the pancreatic and bile ducts and for performing certain techniques to relieve obstructions. Contrast medium is injected into the biliary system from the duodenum and radiographs are taken.

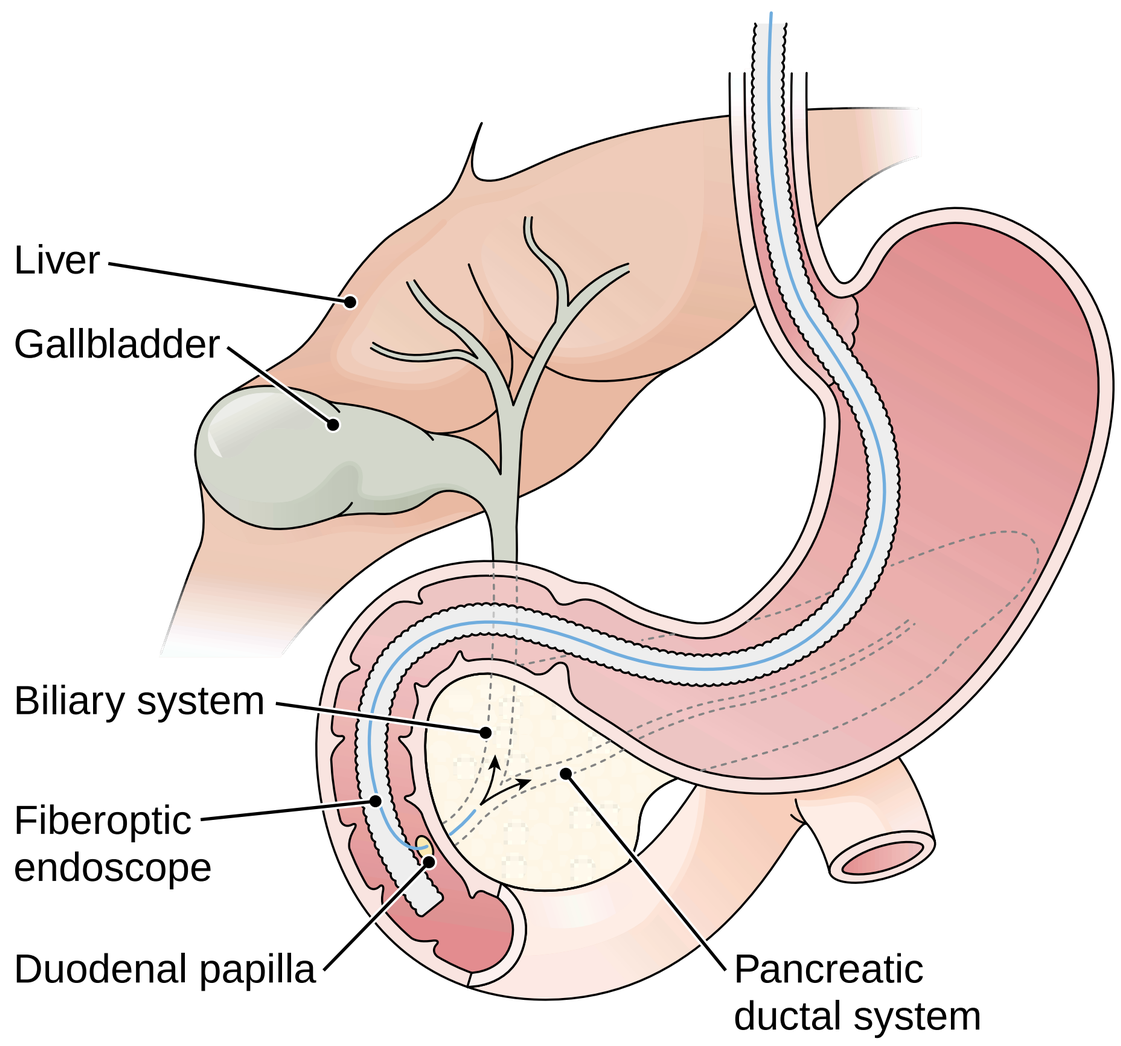


FIGURE 12-10. Endoscopic retrograde cholangiopancreatography (ERCP). A contrast medium is injected into the pancreatic and bile ducts in preparation for radiography.

PANCREATITIS

Pancreatitis, or inflammation of the pancreas, may result from alcohol abuse, drug toxicity, bile obstruction, infections, and other causes. Blood tests in acute pancreatitis show increased levels of the enzymes amylase and lipase. Glucose and bilirubin levels may also be elevated. Often the disease subsides with only treatment of the symptoms.

Key Clinical Terms

DISORDERS

appendicitis *a-pen-di-SĪ-tis*	Inflammation of the appendix
ascites *a-SĪ-tēz*	Accumulation of fluid in the abdominal cavity; a form of edema. May be caused by heart disease, lymphatic or venous obstruction, cirrhosis, or changes in plasma composition.
bilirubin *bil-i-RŪ-bin*	A pigment released in the breakdown of hemoglobin from red blood cells; mainly excreted by the liver in bile
cholecystitis *kō-lē-sis-TĪ-tis*	Inflammation of the gallbladder
cholelithiasis *kō-lē-li-THĪ-a-sis*	The condition of having stones in the gallbladder; also used to refer to stones in the common bile duct
cirrhosis *sir-RŌ-sis*	Chronic liver disease with degeneration of liver tissue
colic *KOL-ik*	Acute abdominal pain, such as biliary colic caused by gallstones in the bile ducts
Crohn disease *krōn*	A chronic inflammatory disease of the gastrointestinal tract usually involving the ileum
diarrhea *dī-a-RE-a*	The frequent passage of watery bowel movements
diverticulitis *dī-ver-tik-ū-LĪ-tis*	Inflammation of diverticula (small pouches) in the wall of the digestive tract, especially in the colon
diverticulosis *dī-ver-tik-ū-LŌ-sis*	The presence of diverticula, especially in the colon
dysphagia *dis-FĀ-jē-a*	Difficulty in swallowing
emesis *EM-e-sis*	Vomiting
fistula *FIS-tū-la*	An abnormal passageway between two organs or from an organ to the body surface, such as between the rectum and anus (anorectal fistula)

Disorders, continued

gastroenteritis *gas-trō-en-ter-Ī-tis*	Inflammation of the stomach and intestine
hemorrhoids *HEM-ō-roydz*	Varicose veins in the rectum associated with pain, bleeding, and sometimes prolapse of the rectum
hepatitis *hep-a-TĪ-tis*	Inflammation of the liver; commonly caused by a viral infection
hepatomegaly *hep-a-tō-MEG-a-lē*	Enlargement of the liver
hiatal hernia *hī-Ā-tal*	A protrusion of the stomach through the opening (hiatus) in the diaphragm through which the esophagus passes (see Fig. 6-5)
icterus *IK-ter-us*	Jaundice
ileus *IL-ē-us*	Intestinal obstruction. May be caused by lack of peristalsis (adynamic, paralytic ileus) or by contraction (dynamic ileus). Intestinal matter and gas may be relieved by passage of a tube for drainage.
intussusception *in-tu-su-SEP-shun*	Slipping of one part of the intestine into another part below it. Occurs mainly in male infants in the ileocecal region (see Fig. 12-8). May be fatal if untreated for more than 1 day.
jaundice *JAWN-dis*	A yellowish color of the skin, mucous membranes, and whites of the eye caused by bile pigments in the blood (from French *jaune* meaning "yellow"). The main pigment is bilirubin, a byproduct of the breakdown of red blood cells.
nausea *NAW-zha*	An unpleasant sensation in the upper abdomen that often precedes vomiting. Typically occurs in digestive upset, motion sickness, and sometimes early pregnancy.
occult blood	Blood present in such small amounts that it can be detected only microscopically or chemically; in the feces, a sign of intestinal bleeding (*occult* means "hidden")
pancreatitis *pan-krē-a-TĪ-tis*	Inflammation of the pancreas
peptic ulcer *PEP-tik UL-ser*	A lesion in the mucous membrane of the esophagus, stomach, or duodenum caused by the action of gastric juice
peritonitis *per-i-tō-NĪ-tis*	Inflammation of the peritoneum, the membrane that lines the abdominal cavity and covers the abdominal organs. May result from perforation of an ulcer, rupture of the appendix, or infection of the reproductive tract, among other causes.
polyp *POL-ip*	A tumor that grows on a stalk and bleeds easily
portal hypertension	An abnormal increase in pressure in the hepatic portal system. May be caused by cirrhosis, infection, thrombosis, or tumors.

Disorders, continued

pyloric stenosis	Narrowing of the opening between the stomach and the duodenum; pylorostenosis
splenomegaly *splē-nō-MEG-a-lē*	Enlargement of the spleen
ulcerative colitis *UL-ser-a-tiv kō-LĪ-tis*	Chronic ulceration of the colon of unknown cause
volvulus *VOL-vū-lus*	Twisting of the intestine resulting in obstruction. Usually involves the sigmoid colon and occurs most often in children and in the elderly. May be caused by congenital malformation, foreign body, or adhesion. Failure to treat immediately may result in death (see Fig. 12-8).

DIAGNOSIS AND TREATMENT

anastomosis *a-nas-to-MŌ-sis*	A passage or communication between two vessels or organs. May be normal or pathologic, or may be created surgically.
barium study	Use of barium sulfate as a liquid contrast medium for fluoroscopic or radiographic study of the digestive tract. Can show obstruction, tumors, ulcers, hiatal hernia, and motility disorders, among others.
cholecystectomy *kō-lē-sis-TEK-tō-mē*	Surgical removal of the gallbladder
Dukes classification	A system for staging colorectal cancer based on degree of penetration of the bowel wall and lymph node involvement; severity is graded from A to C
endoscopy *en-DOS-kō-pē*	Use of a fiberoptic endoscope for direct visual examination. GI studies include esophagogastroduodenoscopy, proctosigmoidoscopy (rectum and distal colon), and colonoscopy (all regions of the colon) (see Fig. 12-5).
ERCP	Endoscopic retrograde cholangiopancreatography; a technique for viewing the pancreatic and bile ducts and for performing certain techniques to relieve obstructions. Contrast medium is injected into the biliary system from the duodenum and radiographs are taken (see Fig. 12-9).
ostomy *OS-tō-mē*	An opening into the body; generally refers to an opening created for elimination of body waste. Also refers to the operation done to create such an opening (see stoma).
stoma *STŌ-ma*	A surgically created opening to the body surface or between two organs (literally “mouth”)

Supplementary Terms

NORMAL STRUCTURE AND FUNCTION

bolus *BŌ-lus*	A mass, such as the rounded mass of food that is swallowed
cardia *KAR-dē-a*	The part of the stomach near the esophagus, named for its closeness to the heart
chyme *kīm*	The semiliquid partially digested food that moves from the stomach into the small intestine
defecation *def-e-KĀ-shun*	The evacuation of feces from the rectum
deglutition *deg-lū-TISH-un*	Swallowing
duodenal bulb	The part of the duodenum near the pylorus; the first bend (flexure) of the duodenum
duodenal papilla	The raised area where the common bile duct and pancreatic duct enter the duodenum (see Fig. 12-10); papilla of Vater (*FA-ter*)
greater omentum *ō-MEN-tum*	A fold of the peritoneum that extends from the stomach over the abdominal organs
hepatic flexure	The right bend of the colon, forming the junction between the ascending colon and the transverse colon (see Fig. 12-1)
ileocecal valve *il-ē-ō-SĒ-kal*	A valvelike structure between the ileum of the small intestine and the cecum of the large intestine
mesentery *MES-en-ter-ē*	The portion of the peritoneum that folds over and supports the intestine
mesocolon *mes-ō-KŌ-lon*	The portion of the peritoneum that folds over and supports the colon
papilla of Vater	See duodenal papilla
peritoneum *per-i-tō-NĒ-um*	The serous membrane that lines the abdominal cavity and supports the abdominal organs
rugae *RŪ-jē*	The large folds in the lining of the stomach seen when the stomach is empty
sphincter of Oddi *OD-ē*	The ring of muscle at the opening of the common bile duct into the duodenum
splenic flexure	The left bend of the colon, forming the junction between the transverse colon and the descending colon (see Fig. 12-1)
uvula *Ū-vū-la*	A hanging fleshy mass. Usually means the mass that hangs from the soft palate (see Fig. 12-2).

DISORDERS

achalasia *ak-a-LĀ-zē-a*	Failure of a smooth muscle to relax, especially the lower esophageal sphincter, so that food is retained in the esophagus
achlorhydria *ā-klor-HĪ-drē-a*	Lack of hydrochloric acid in the stomach; opposite is hyperchlorhydria
anorexia an-ō-REK-sē-a	Loss of appetite. Anorexia nervosa is a psychologically induced refusal or inability to eat (adjective, anorectic, anorexic).
aphagia *a-FĀ-jē-a*	Refusal or inability to eat; inability to swallow or difficulty in swallowing
aphthous ulcer *AF-thus*	A small ulcer in the mucous membrane of the mouth
bulimia *bū-LIM-ē-a*	Excessive, insatiable appetite. A disorder characterized by overeating followed by induced vomiting, diarrhea, or fasting.
cachexia *ka-KEK-sē-a*	Profound ill health, malnutrition, and wasting
caries *KA-rēz*	Tooth decay
celiac disease *SĒ-lē-ak*	A disease characterized by the inability to absorb foods containing gluten
cheilosis *kī-LŌ-sis*	Cracking at the corners of the mouth, often caused by B vitamin deficiency (root *cheil/o* means "lip")
cholestasis *kō-lē-STA-sis*	Stoppage of bile flow
constipation *con-sti-PĀ-shun*	Infrequency or difficulty in defecation and the passage of hard, dry feces
dyspepsia *dis-PEP-sē-a*	Poor or painful digestion
eructation *e-ruk-TĀ-shun*	Belching
familial adenomatous polyposis (FAP)	A heredity condition in which multiple polyps form in the colon and rectum, predisposing to colorectal cancer
flatulence *FLAT-ū-lens*	Condition of having gas or air in the GI tract
flatus *FLĀ-tus*	Gas or air in the gastrointestinal tract; gas or air expelled through the anus
gastroesophageal reflux disease (GERD)	Backflow of gastric contents into the esophagus. May result in inflammation and damage to the esophagus; heartburn.
hematemesis *hē-ma-TEM-e-sis*	Vomiting of blood

Disorders, continued

irritable bowel syndrome (IBS)	A chronic stress-related disease characterized by diarrhea, constipation, and pain associated with rhythmic contractions of the intestine. Mucous colitis; spastic colon.
megacolon *meg-a-KŌ-lon*	An extremely dilated colon. Usually congenital but may occur in acute ulcerative colitis.
melena *MEL-ē-na*	Black tarry feces resulting from blood in the intestines. Common in newborns. May also be a sign of gastrointestinal bleeding.
obstipation *ob-sti-PĀ-shun*	Extreme constipation
pernicious anemia *per-NISH-us*	A form of anemia caused by failure of the stomach to secrete a substance (intrinsic factor) needed for the absorption of vitamin B_{12}
pilonidal cyst *pī-lō-NĪ-dal*	A dermal cyst in the region of the sacrum, usually at the top of the cleft between the buttocks. May become infected and begin to drain.
regurgitation *rē-gur-ji-TĀ-shun*	A backward flowing, such as the backflow of undigested food

DIAGNOSIS AND TREATMENT

appendectomy *ap-en-DEK-tō-mē*	Surgical removal of the appendix
Billroth operations	Gastrectomy with anastomosis of the stomach to the duodenum (Billroth I) or to the jejunum (Billroth II) (Fig. 12-11)
gavage *ga-VAHZH*	Process of feeding through a nasogastric tube into the stomach
lavage *la-VAJ*	Washing out of a cavity; irrigation
manometry *man-OM-e-trē*	Measurement of pressure; pertaining to the GI tract, measurement of pressure in the portal system as a sign of obstruction
Murphy sign	Inability to take a deep breath when fingers are pressed firmly below the right arch of the ribs (below the liver). Signifies gallbladder disease.
nasogastric (NG) **tube**	Tube that is passed through the nose into the stomach (Fig. 12-12). May be used for emptying the stomach, administering medication, giving liquids, or sampling stomach contents.
parenteral hyperalimentation	Complete intravenous feeding for one who cannot take in food. Total parenteral nutrition (TPN).
percutaneous endoscopic gastrostomy (PEG) **tube**	Tube inserted into the stomach for long-term feeding (Fig. 12-13)
vagotomy *vā-GOT-ō-mē*	Interruption of impulses from the vagus nerve to reduce stomach secretions in the treatment of gastric ulcer. Originally done surgically but may also be done with drugs.

DRUGS

antacid *ant-AS-id*	Agent that counteracts acidity, usually gastric acidity
antidiarrheal *an-ti-dī-a-RĒ-al*	Treats or prevents diarrhea by reducing intestinal motility or absorbing irritants and soothing the intestinal lining
antiemetic *an-tē-e-MET-ik*	Agent that relieves or prevents nausea and vomiting
antiflatulent *an-ti-FLAT-ū-lent*	Agent that prevents or relieves flatulence
antispasmodic *an-ti-spas-MOD-ik*	Agent that relieves spasm, usually of smooth muscle
emetic *e-MET-ik*	An agent that causes vomiting
histamine H_2 antagonist	Drug that decreases secretion of stomach acid by interfering with the action of histamine at H_2 receptors. Used to treat ulcers and other gastrointestinal problems.
laxative *LAK-sa-tiv*	Promotes elimination from the large intestine. Types include stimulants, substances that retain water (hyperosmotics), stool softeners, and bulk-forming agents.

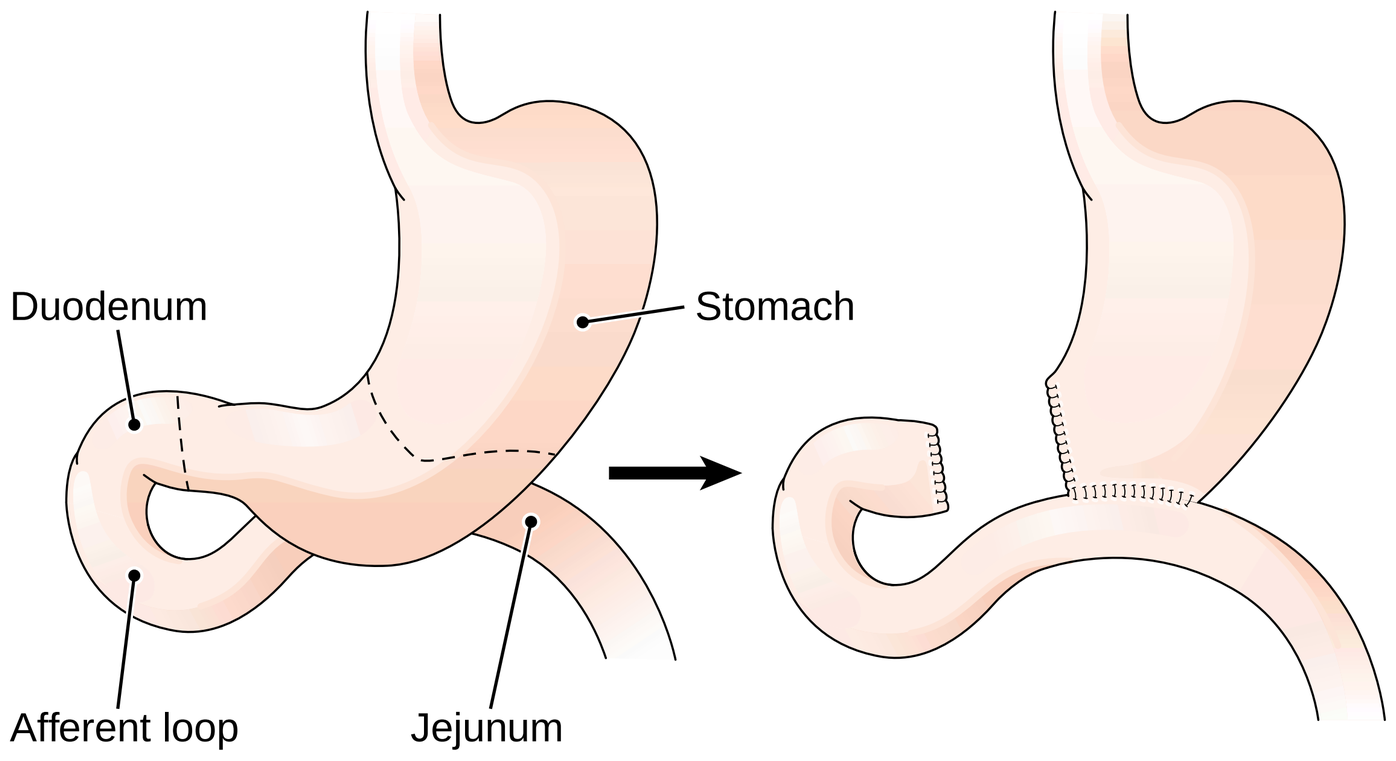


FIGURE 12-11. Gastrojejunostomy (Billroth II operation). The *dotted lines* show the portion removed

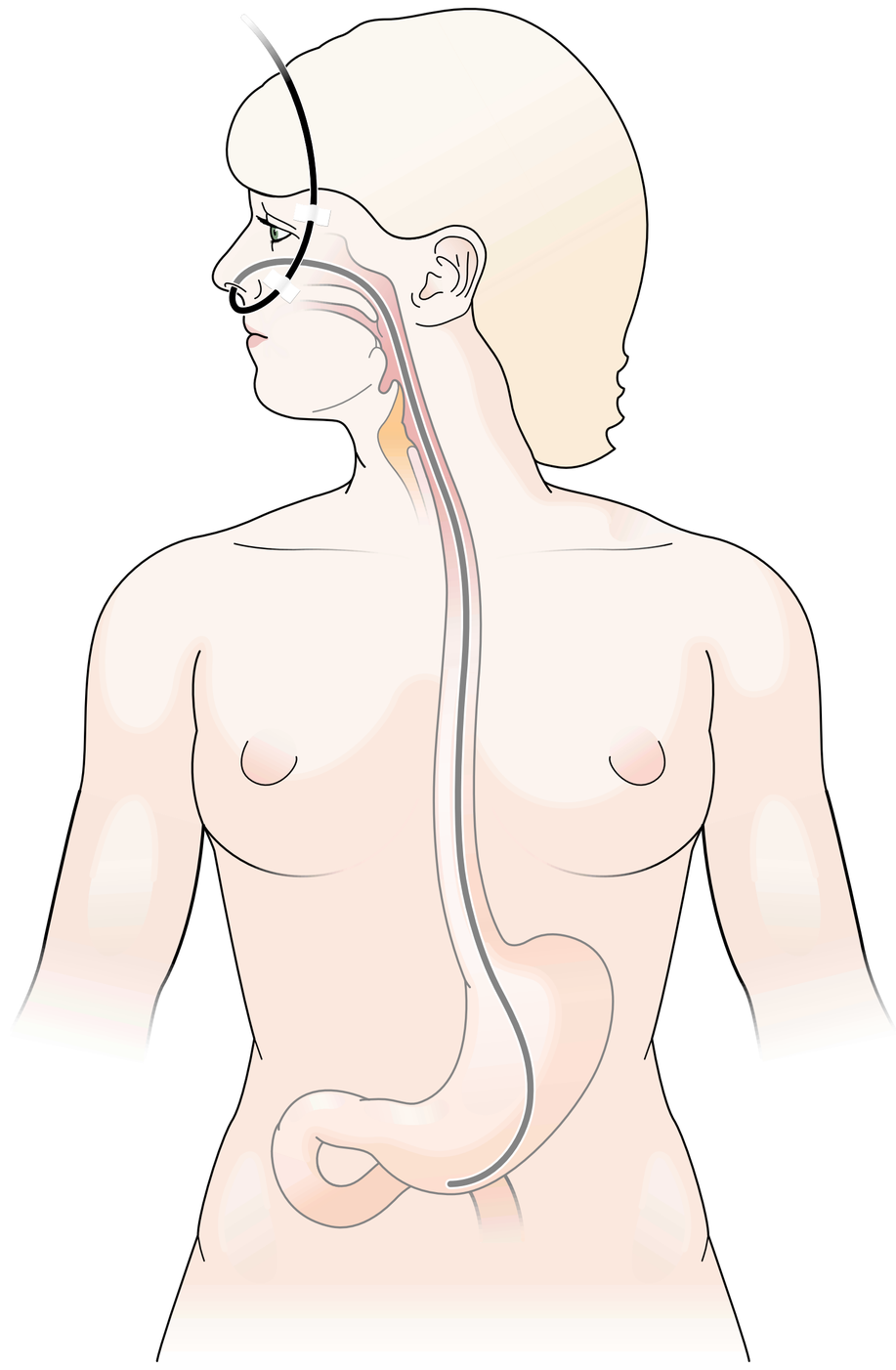


FIGURE 12-12. A nasogastric (NG) tube in place.

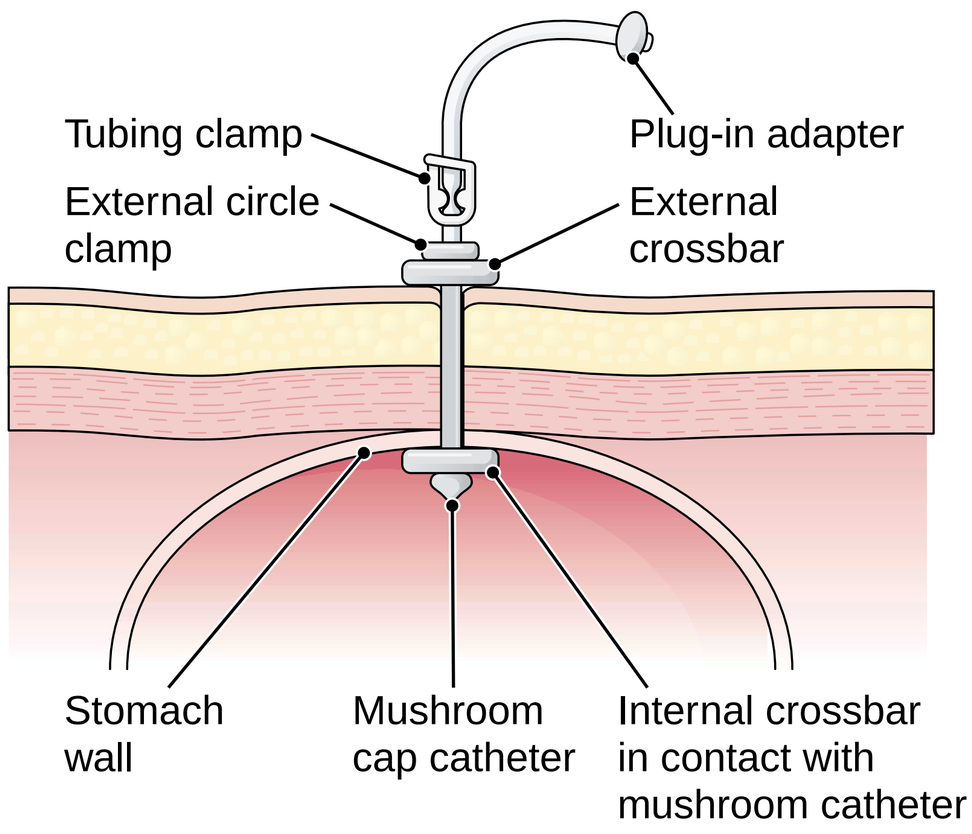


FIGURE 12-13. Percutaneous endoscopic gastrostomy (PEG) tube in place in the stomach.

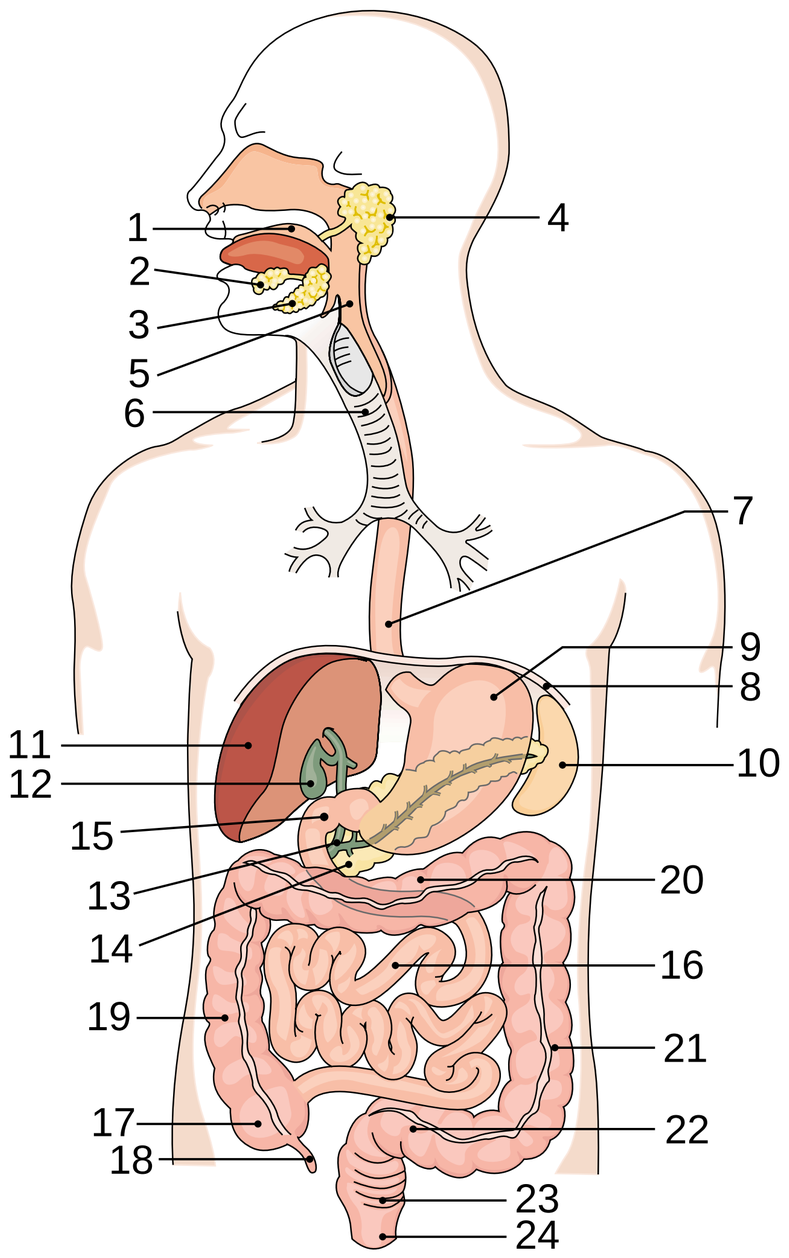
ABBREVIATIONS

BE	Barium enema (for radiographic study of the colon)
BM	Bowel movement
CBD	Common bile duct
ERCP	Endoscopic retrograde cholangio-pancreatography
FAP	Familial adenomatous polyposis
GERD	Gastroesophageal reflux disease
GI	Gastrointestinal
HAV	Hepatitis A virus
HBV	Hepatitis B virus
HCV	Hepatitis C virus
HDV	Hepatitis D virus
HEV	Hepatitis E virus
HCl	Hydrochloric acid
IBD	Inflammatory bowel disease
IBS	Inflammatory bowel syndrome
NG	Nasogastric (tube)
N & V	Nausea and vomiting
N/V/D	Nausea, vomiting, and diarrhea
ponv	Postoperative nausea and vomiting
TPN	Total parenteral nutrition
UGI	Upper gastrointestinal (radiograph series)

Labeling Exercise 12-1

The Digestive System

Write the name of each numbered part on the corresponding line of the answer sheet.



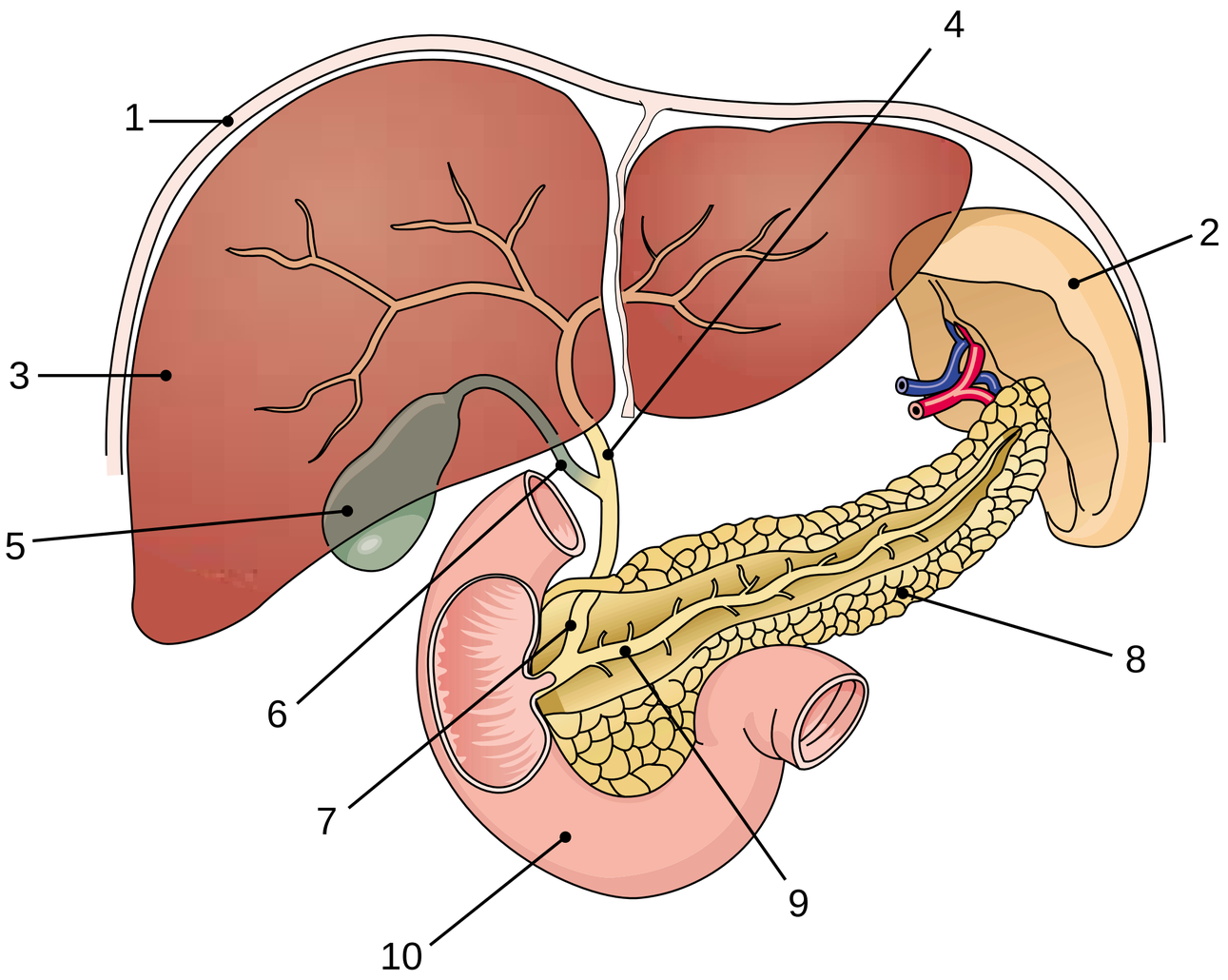
Anus
Appendix
Ascending colon
Cecum
Common bile duct
Descending colon
Diaphragm
Duodenum
Esophagus
Gallbladder
Liver
Oral cavity
Pancreas
Parotid gland
Pharynx
Rectum
Sigmoid colon
Small intestine
Spleen
Stomach
Sublingual gland
Submandibular gland
Trachea
Transverse colon

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____

Labeling Exercise 12-2

Accessory Organs of Digestion

Write the name of each numbered part on the corresponding line of the answer sheet.



Common bile duct
Common hepatic duct
Cystic duct
Diaphragm
Duodenum
Gallbladder
Liver
Pancreas
Pancreatic duct
Spleen

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

Chapter Review 12-1

Match the following terms and write the appropriate letter to the left of each number:

_____	1. polysialia	a. pertaining to the lip
_____	2. gingiva	b. gum
_____	3. agnathia	c. absence of the jaw
_____	4. hypoglossal	d. excess secretion of saliva
_____	5. labial	e. sublingual

_____	6. choledochal	a. jaundice
_____	7. lithiasis	b. pertaining to the common bile duct
_____	8. cholangiectasis	c. crushing of a biliary calculus
_____	9. icterus	d. condition of having stones
_____	10. cholelithotripsy	e. dilation of a bile duct

_____	11. gastropathy	a. narrowing of the pylorus
_____	12. pylorostenosis	b. substance that induces vomiting
_____	13. gastrocele	c. hernia of the stomach
_____	14. pylorospasm	d. any disease of the stomach
_____	15. emetic	e. sudden contraction of the pylorus

_____	16. cecopexy	a. stoppage of bile flow
_____	17. proctocele	b. hernia of the rectum
_____	18. cholestasis	c. surgical fixation of the cecum
_____	19. proctorrhaphy	d. surgical puncture of the colon
_____	20. colocentesis	e. surgical repair of the rectum

SUPPLEMENTARY TERMS

_____	21. cachexia	a. malnutrition and wasting
_____	22. caries	b. chewing
_____	23. deglutition	c. tooth decay
_____	24. gavage	d. swallowing
_____	25. mastication	e. feeding through a tube

_____ 26. bolus	a. inability to eat
_____ 27. cardia	b. partially digested food
_____ 28. peritoneum	c. part of the stomach near the esophagus
_____ 29. aphagia	d. a mass, as of food
_____ 30. chyme	e. serous membrane in the abdomen

Fill in the blanks:

31. The palatine tonsils are located on either side of the _____.
32. Stomatosis is any disease condition of the _____.
33. Dentin is the main substance of the _____.
34. Glossorrhaphy is suture of the _____.
35. From its name you might guess that the buccinator muscle is in the _____.
36. An enterovirus is a virus that infects the _____.
37. A wave of contractions in an organ wall, such as the contractions that move material through the digestive tract, is called _____.
38. The blind pouch at the beginning of the colon is the _____.
39. The anticoagulant heparin is found throughout the body, but it is named for its presence in the _____.
40. The substance cholesterol is named for its chemical composition (sterol) and for its presence in _____.
41. The organ that produces bile is the _____.
42. The organ that stores bile is the _____.

True-False. Examine each of the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

43. The epigastrium is the region of the abdomen above the stomach. _____ _____
44. The first portion of the small intestine is the jejunum. _____ _____
45. The cystic duct carries bile to and from the gallbladder. _____ _____
46. Cirrhosis is a disease of the esophagus. _____ _____
47. The appendix is attached to the ileum. _____ _____
48. The common hepatic duct and the cystic duct merge to form the common bile duct. _____ _____
49. Enteropathy is any disease of the intestine. _____ _____
50. The hepatic portal system carries blood to the spleen. _____ _____

Word building. Write a word for each of the following definitions:

51. a dentist who specializes in straightening of the teeth _____
52. surgical repair of the palate _____
53. surgical excision of the stomach _____
54. inflammation of the pancreas _____
55. pertaining to the ileum and cecum _____
56. hernia of the rectum _____
57. surgical creation of a passage between the stomach and the duodenum _____
58. medical specialist who treats diseases of the stomach and intestine _____
59. surgical creation of an opening into the colon _____
60. inflammation of the ileum _____
61. within (intra-) the liver _____

Plurals. Write the plural form of each of the following words:

62. diverticulum _____
63. gingiva _____
64. calculus _____
65. anastomosis _____

Write the meaning of each of the following abbreviations:

66. IBD _____
67. TPN _____
68. HAV _____
69. GI _____
70. HCl _____
71. ERCP _____
72. PEG (tube) _____
73. GERD _____

Word analysis. Define each of the following words, and give the meaning of the word parts in each. Use a dictionary if necessary.

74. parenteral (*par-EN-ter-al*) _____
    a. par(a)- _____
    b. enter/o _____
    c. -al _____

75. cholecystectomy _____
    a. chol/e _____
    b. cyst/o _____
    c. ec- _____
    d. -tomy _____

76. myenteric (*m-i-en-TER-ik*) _____
    a. my/o _____
    b. enter/o _____
    c. -ic _____

Case Studies

Case Study 12-1: Cholecystectomy

G.L., a 42-year-old obese Caucasian woman, entered the hospital with nausea and vomiting, flatulence and eructation, a fever of 100.5°F, and continuous right upper quadrant and subscapular pain. Examination on admission showed rebound tenderness in the RUQ with a positive Murphy sign. Her skin, nails, and conjunctivae were yellowish, and she complained of frequent clay-colored stools. Her leukocyte count was 16,000. An ERCP and ultrasound of the abdomen suggested many small stones in her gallbladder and possibly the common bile duct. Her diagnosis was cholecystitis with cholelithiasis.

A laparoscopic cholecystectomy was attempted, with an intraoperative cholangiogram and common bile duct exploration. Because of G.L.'s size and some unexpected bleeding, visualization was difficult and the procedure was converted to an open approach. Small stones and granular sludge were irrigated from her common duct, and the gallbladder was removed. She had a T-tube inserted into the duct for bile drainage; this tube was removed on the second postoperative day. She had an NG tube in place before and during the surgery, which was also removed on day two. She was discharged on the fifth postoperative day with a prescription for prn pain medication and a low-fat diet.

Case Study 12-2: Surgical Pathology Report

Gross Description: The specimen is received in formalin labeled "ruptured duodenal diverticula" and consists of enteric tissue measuring approximately $6.3 \times 2.8 \times 0.7$ cm. The serosal surface is markedly dull in appearance and fibrotic. The mucosal surface is hemorrhagic. Representative sections are taken for microscopic examination.

Microscopic Description: Sectioned slide shows segments of duodenal tissues with areas of gangrenous change in the bowel wall, and acute and chronic inflammatory infiltrates. There are chronic and focal acute inflammatory cell infiltrates with hemorrhage in the mesenteric fatty tissue. There are areas of acute inflammatory exudates noted in the fatty tissue. Histopathologic changes are consistent with ruptured duodenal diverticula.

Case Study 12-3: Colonoscopy With Biopsy

S.M., a 24-year-old man, had a recent history of lower abdominal pain with frequent loose mucoid stools. He described symptoms of occasional dysphagia, dyspepsia, nausea, and aphthous ulcers of his tongue and buccal mucosa. A previous barium enema showed some irregularities in the sigmoid and

Case Studies, continued

rectal segments of his large bowel. Stool samples for culture, ova, and parasites were negative. His tentative diagnosis was irritable bowel syndrome.

He followed a lactose-free, low-residue diet and took Imodium to reduce intestinal motility. His gastroenterologist recommended a colonoscopy. After a 2-day regimen of soft to clear liquid diet, laxatives, and an enema the morning of the procedure, he reported to the endoscopy unit. He was transported to the procedure room. ECG electrodes, a pulse oximeter sensor, and a blood pressure cuff were applied for monitoring, and an IV was inserted in S.M.'s right arm. An IV bolus of Demerol and a bolus of Versed were given, and S.M. was positioned on his left side. The colonoscope was gently inserted through the anal sphincter and advanced proximally. S.M. was instructed to take a deep breath when the scope approached the splenic flexure and the hepatic flexure to facilitate comfortable passage.

The physician was able to advance past the ileocecal valve, examining the entire length of the colon. Ulcerated granulomatous lesions were seen throughout the colon, with a concentration in the sigmoid segment. Many biopsy specimens were taken. The mucosa of the distal ileum was normal. Pathology examination of the biopsy samples was expected to establish a diagnosis of IBD.

CASE STUDY QUESTIONS

Multiple choice: Select the best answer and write the letter of your choice to the left of each number.

_____ 1. Flatulence and eructation represent:
   a. regurgitation of chyme
   b. distention of the esophagus
   c. passage of gas or air from the GI tract
   d. muscular movement of the alimentary tract
   e. sounds heard only by abdominal auscultation

_____ 2. Murphy sign is tested for:
   a. under the ribs on the left
   b. near the spleen
   c. in the lower right abdomen
   d. under the ribs on the right
   e. in the lower left abdomen

_____ 3. The NG tube is inserted through the _____ and terminates in the _____:
   a. nose/stomach
   b. nostril/gallbladder
   c. glottis/nephron
   d. anus/cecum
   e. Nissen/glottis

_____ 4. Enteric tissue is found in the:
   a. gallbladder
   b. stomach
   c. esophagus
   d. liver
   e. intestine

Case Studies, continued

_____ 5. The mucosal surface of a digestive organ is the:
- a. outer surface
- b. medulla
- c. cortex
- d. inner surface
- e. central opening

_____ 6. Diverticula are:
- a. small pouches in the wall of the colon
- b. communications between two organs
- c. ducts in the liver
- d. intestinal obstructions
- e. polyps in the intestine

_____ 7. Dysphagia and dyspepsia are difficulty or pain with:
- a. chewing and intestinal motility
- b. speaking and motility
- c. swallowing and digestion
- d. breathing and absorption
- e. swallowing and nutrition

_____ 8. The buccal mucosa is in the:
- a. nostril, medial side
- b. mouth, inside of the cheek
- c. greater curvature of the stomach
- d. lesser curvature near the duodenum
- e. base of the tongue

_____ 9. A gastroenterologist is a physician who specializes in study of:
- a. respiration and pathology
- b. mouth and teeth
- c. stomach, intestines, and related structures
- d. musculoskeletal system
- e. nutritional and weight loss diets

_____ 10. The splenic and hepatic flexures are bends in the colon near the:
- a. liver and splanchnic vein
- b. common bile duct and biliary tree
- c. spleen and appendix
- d. spleen and liver
- e. mesenteric vessels and liver

_____ 11. Intestinal motility refers to:
- a. chewing
- b. peristalsis
- c. absorption
- d. antiemetics
- e. ascites

Case Studies, continued

_____ 12. A colonoscopy is:
- a. a radiograph of the small intestine
- b. an endoscopic study of the esophagus
- c. an upper endoscopy with biopsy
- d. a type of barium enema
- e. an endoscopic examination of the large bowel

_____ 13. The ileocecal valve is:
- a. part of a colonoscope
- b. at the distal ileum
- c. near the appendix
- d. a and b
- e. b and c

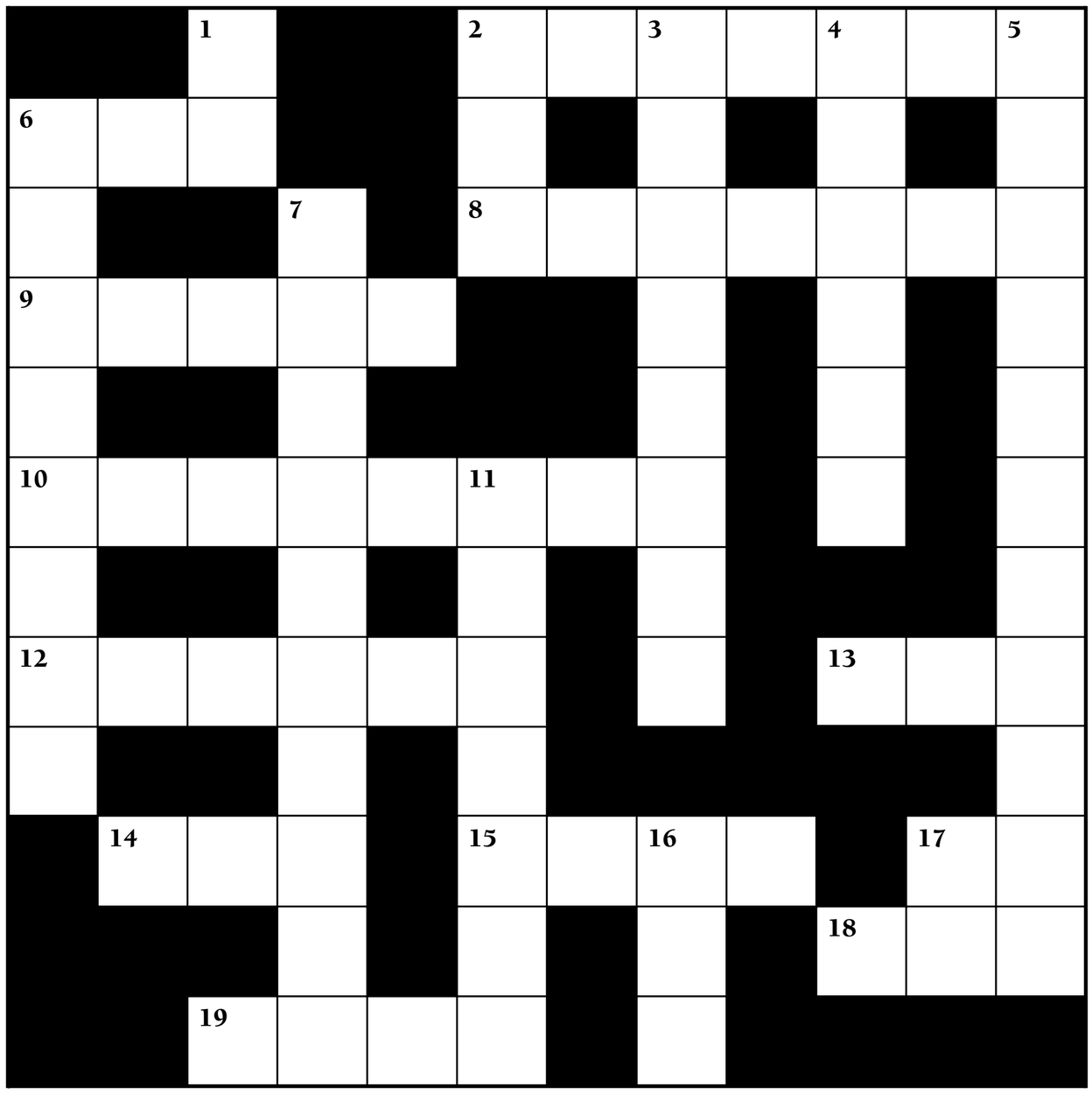
Write the meaning of each of the following abbreviations:

14. ERCP _____
15. RUQ _____
16. NG _____
17. IBD _____

Give the word or words in the case studies with each of the following meanings:

18. pertaining to the first part of the small intestine _____
19. pertaining to the membrane that supports the intestine _____
20. localized _____
21. fluid that escapes from blood vessels as a result of inflammation _____
22. presence of hidden or microscopic blood _____
23. jaundice _____
24. drug that treats nausea and vomiting _____
25. stones in the gallbladder _____
26. endoscopic surgery of the gallbladder _____
27. inflammation of the gallbladder _____
28. radiographic study of the gallbladder and biliary system _____
29. ring of muscle that regulates the distal opening of the colon _____
30. surgical excision of tissue for pathology examination _____

Chapter 12 Crossword
Digestion



ACROSS

2. Pertaining to the jaw
6. Major portion of the large intestine: root
8. Mouth: combining form
9. Tooth: combining form
10. Small appendage to the cecum
12. Stomach: combining form
13. Inflammatory condition of the bowel (abbreviation)
14. Parenteral hyperalimentation (abbreviation)
15. Technique for viewing the accessory ducts (abbreviation)
17. Two, twice: prefix
18. Blind pouch at the beginning of the large intestine: root
19. Last portion of the small intestine: combining form

DOWN

1. 1/1000 of 1 liter (abbreviation)
2. Results in flatulence
3. Loss of appetite
4. Pertaining to the opening in the diaphragm that the esophagus passes through
5. Pertaining to the gallbladder
6. Bile duct: root
7. Enteric
11. First portion of the small intestine: combining form
16. Duct that carries bile into the intestine (abbreviation)
17. Down, without, removal: prefix

CHAPTER 12 Answer Section

Answers to Chapter Exercises

EXERCISE 12-1

1. oral (*OR-al*); stomal (*STŌ-mal*)
2. dental (*DEN-tal*)
3. gingival (*JIN-ji-val*)
4. lingual (LING-gwal); glossal (*GLOS-sal*)
5. buccal (*BUK-al*)
6. labial (*LĀ-bē-al*)
7. jaw
8. tongue
9. mouth
10. mouth
11. salivary
12. teeth
13. mouth
14. pertaining to the mouth and tongue
15. pertaining to the palate
16. inflammation of the gums
17. pertaining to the tongue and lip
18. outside the cheek

EXERCISE 12-2

1. enteric (*en-TER-ik*)
2. gastric (*GAS-trik*)
3. colic (*KOL-ik*); also colonic (*kō-LON-ik*)
4. pyloric (*p-i-LOR-ik*)
5. duodenal (*dū-ō-DĒ-nal*)
6. cecal (*SĒ-kal*)
7. jejunal (*je-JUN-al*)
8. ileal (*IL-ē-al*); also ileac (IL-ē-ak)
9. rectal (*REK-tal*)
10. anal (*Ā-nal*)
11. gastropexy (*GAS-trō-pek-sē*)
12. esophagoscopy (*e-sof-a-GOS-kō-pē*)
13. pyloroplasty (*pī-LOR-ō-plas-tē*)
14. ileitis (*il-ē-Ī-tis*)
15. duodenostomy (*dū-ō-de-NOS-tō-mē*)
16. ileostomy (*il-ē-OS-tō-mē*)
17. gastroenterology (*gas-trō-en-ter-OL-ō-jē*)
18. colitis (*kō-LĪ-tis*)
19. colopexy (*KŌ-lō-pek-sē*)
20. colostomy (*kō-LOS-tō-mē*)
21. coloclysis (*kō-lō-KLĪ-sis*)
22. colonopathy (*kō-lō-NOP-a-thē*)
23. colonoscopy (*kō-lon-OS-kō-pē*)
24. esophagogastrostomy (*e-sof-a-gō-gas-TROS-tō-mē*)
25. gastroenterostomy (*gas-trō-en-ter-OS-tō-mē*)
26. gastrojejunostomy (*gas-trō-je-jū-NOS-tō-mē*)
27. duodenoileostomy (*dū-ō-dē-nō-il-ē-OS-tō-mē*)
28. sigmoidoproctostomy (*sig-moy-dō-prok-TOS-tō-mē*)

EXERCISE 12-3

1. hepatic (*he-PAT-ik*)
2. cholecystic (*kō-lē-SIS-tik*)
3. pancreatic (*pan-krē-AT-ik*)
4. cholangiography (*kō-lan-jē-OG-ra-fē*)
5. hepatography (*hep-a-TOG-ra-fē*)
6. cholecystography (*kō-lē-sis-TOG-ra-fē*)
7. pancreatography (*pan-krē-a-TOG-ra-fē*)
8. choledocholithiasis (*kō-led-o-kō-li-THI-a-sis*)
9. pancreatolithiasis (*pan-krē-a-tō-li-THĪ-a-sis*)
10. bile
11. common bile duct
12. liver
13. hepatitis
14. pancreas
15. bile duct

LABELING EXERCISE 12-1 THE DIGESTIVE SYSTEM

1. oral cavity
2. sublingual gland
3. submandibular gland
4. parotid gland
5. pharynx
6. trachea
7. esophagus
8. diaphragm
9. stomach
10. spleen
11. liver
12. gallbladder
13. common bile duct
14. pancreas
15. duodenum
16. small intestine
17. cecum
18. appendix
19. ascending colon
20. transverse colon
21. descending colon
22. sigmoid colon
23. rectum
24. anus

LABELING EXERCISE 12-2 ACCESSORY ORGANS OF DIGESTION

1. diaphragm
2. spleen
3. liver
4. common hepatic duct
5. gallbladder
6. cystic duct
7. common bile duct
8. pancreas
9. pancreatic duct
10. duodenum

Answers to Chapter Review 12-1

1. d
2. b
3. c
4. e
5. a
6. b
7. d
8. e
9. a
10. c
11. d
12. a
13. c
14. e
15. b
16. c
17. b
18. a
19. e
20. d
21. a
22. c
23. d
24. e
25. b
26. d
27. c
28. e
29. a
30. b
31. palate
32. mouth
33. teeth
34. tongue
35. cheek
36. intestine
37. peristalsis
38. cecum
39. liver
40. bile
41. liver
42. gallbladder
43. T
44. F duodenum
45. T
46. F liver
47. F cecum
48. T
49. T
50. F liver
51. orthodontist
52. palatorrhaphy
53. gastrectomy
54. pancreatitis
55. ileocecal
56. rectocele; proctocele
57. gastroduodenostomy
58. gastroenterologist
59. colostomy
60. ileitis
61. intrahepatic
62. diverticula
63. gingivae
64. calculi
65. anastomoses
66. inflammatory bowel disease
67. total parenteral nutrition
68. hepatitis A virus
69. gastrointestinal
70. hydrochloric acid
71. endoscopic retrograde cholangiopancreatography
72. percutaneous endoscopic gastrostomy (tube)
73. gastroesophageal reflux disease
74. referring to any route other than the alimentary canal
    a. beside
    b. intestine
    c. pertaining to
75. surgical removal of the gallbladder
    a. gall, bile
    b. bladder
    c. out
    d. to cut
76. pertaining to the muscular coat of the intestine
    a. muscle
    b. intestine
    c. pertaining to

Answers to Case Study Questions

1. c
2. d
3. a
4. e
5. d

6. a
7. c
8. b
9. c
10. d
11. b
12. e
13. e
14. endoscopic retrograde cholangiopancreatography
15. right upper quadrant
16. nasogastric
17. inflammatory bowel disease
18. duodenal
19. mesenteric
20. focal
21. exudate
22. occult blood
23. icterus
24. antiemetic
25. cholelithiasis
26. laparoscopic cholecystectomy
27. cholecystitis
28. cholangiogram
29. sphincter
30. biopsy

ANSWERS TO CROSSWORD PUZZLE

Digestion