

An anatomical illustration of the human digestive system. The liver is shown in a reddish-brown color at the top. Below it is the stomach, depicted in a light, translucent color. The large and small intestines are shown in various shades of red and pink, with the small intestine being more convoluted. The background is dark, and there are semi-transparent colored overlays: a purple one on the left and a red one at the bottom right.

Digestive System

5

INTRODUCTION

The digestive or **gastrointestinal tract** begins with the mouth, where food enters, and ends with the anus, where solid waste material leaves the body. The four functions of the system are **ingestion, digestion, absorption, and elimination**.

First, complex food material taken into the mouth is **ingested**. Second, it is **digested**, or broken down, mechanically and chemically, as it travels through the gastrointestinal tract. Digestive **enzymes** speed up chemical reactions and aid the breakdown (digestion) of complex nutrients. Complex proteins are digested to simpler **amino acids**; complicated sugars are reduced to simple sugars, such as **glucose**; and large fat or lipid molecules are broken down to simpler substances such as **fatty acids** and **triglycerides** (three parts fatty acids and one part glycerol).

Third, via **absorption**, digested food passes through the lining cells or epithelium of the small intestine and into the bloodstream. Nutrients thus travel to all cells of the body. Cells then break down nutrients in the presence of oxygen to release energy. Cells also use amino acid nutrients to build up large protein molecules needed for growth and development. In addition, fat molecules are absorbed into lymphatic vessels from the intestine.

The fourth function of the digestive system is **elimination** of the solid waste materials that cannot be absorbed into the bloodstream. The large intestine concentrates these solid wastes, called **feces**, and the wastes finally pass out of the body through the anus.

ANATOMY AND PHYSIOLOGY

ORAL CAVITY

The gastrointestinal tract begins with the oral cavity. Oral means pertaining to the mouth (or/o). Label Figure 5-1 as you learn the major parts of the oral cavity.

The **cheeks** [1] form the walls of the oval-shaped oral cavity, and the **lips** [2] surround the opening to the cavity.

The **hard palate** [3] forms the anterior portion of the roof of the mouth, and the muscular **soft palate** [4] lies posterior to it. **Rugae** are irregular ridges in the mucous membrane covering the anterior portion of the hard palate. The **uvula** [5], a small soft tissue projection, hangs from the soft palate. It aids production of sounds and speech.

The **tongue** [6] extends across the floor of the oral cavity, and muscles attach it to the lower jawbone. It moves food around during **mastication** (chewing) and **deglutition** (swallowing). **Papillae**, small raised areas on the tongue, contain taste buds that are sensitive to the chemical nature of foods and allow discrimination of different tastes as food moves across the tongue.

The **tonsils** [7], masses of lymphatic tissue located in depressions of the mucous membranes, lie on both sides of the oropharynx (part of the throat near the mouth). They are filters to protect the body from the invasion of microorganisms and produce lymphocytes, disease-fighting white blood cells.

The **gums** [8] are the fleshy tissue surrounding the sockets of the **teeth** [9]. Figure 5-2 shows a dental arch with 16 permanent teeth (there are 32 permanent teeth in the entire oral cavity). Label the figure with the following names of teeth:

- | | |
|----------------------------|---------------------------------------|
| Central incisor [1] | Second premolar [5] |
| Lateral incisor [2] | First molar [6] |
| Canine [3] | Second molar [7] |
| First premolar [4] | Third molar (wisdom tooth) [8] |

COMBINING FORMS

- 1. bucc/o
- 2. cheil/o, labi/o
- 3. palat/o
- 4. palat/o
- 5. uvul/o
- 6. gloss/o, lingu/o
- 7. tonsill/o
- 8. gingiv/o
- 9. dent/i, odont/o

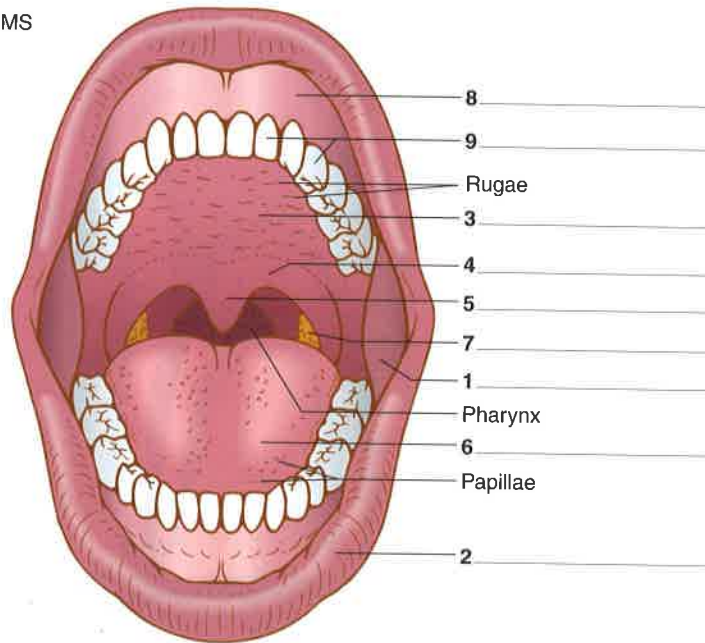


FIGURE 5-1 Oral cavity.

Dentists use special terms to describe the surfaces of teeth (see Figure 5-2). The **labial** surface (labi/o means lip), for incisor and canine teeth, is nearest the lips. The **buccal** surface (bucc/o means cheek), for premolar and molar teeth, lies adjacent to the cheek, as illustrated in Figure 5-2. Dentists refer to both the labial and the buccal surfaces of a tooth as the **facial** surface (faci/o means face). On the side of the tooth directly opposite the facial surface is the **lingual** surface (lingu/o means tongue). The **mesial** surface of a tooth lies nearer to the median line, and the **distal** surface lies farther from the median line. Premolars and molars have an additional **occlusal** surface (occlusion means closing) that comes in contact with a corresponding tooth in the opposing arch (i.e., “matching” top and bottom teeth). The incisors and canines have a sharp **incisal** edge.

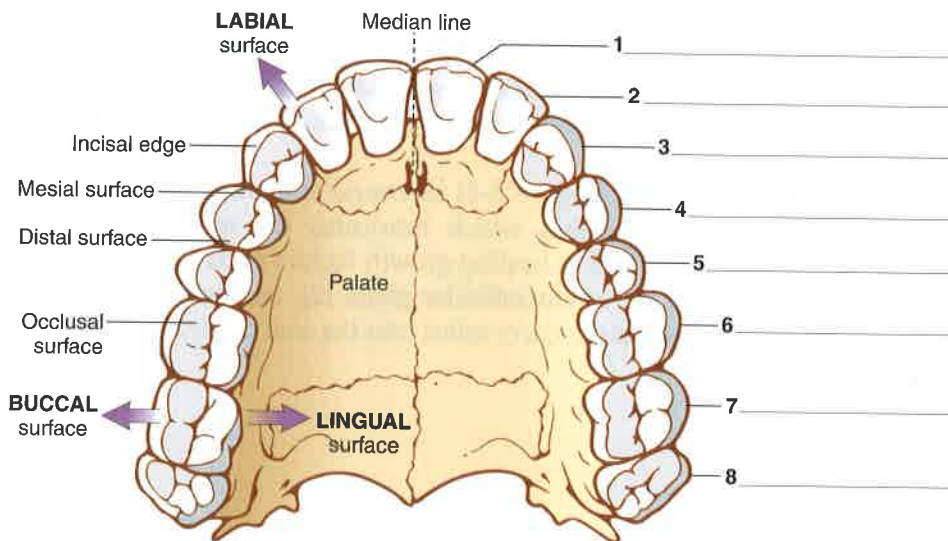


FIGURE 5-2 Upper permanent teeth within the dental arch. Also notice the various surfaces of the teeth. The **buccal** surface faces the cheek, whereas the **lingual** surface faces the tongue. The **labial** surface faces the lips.

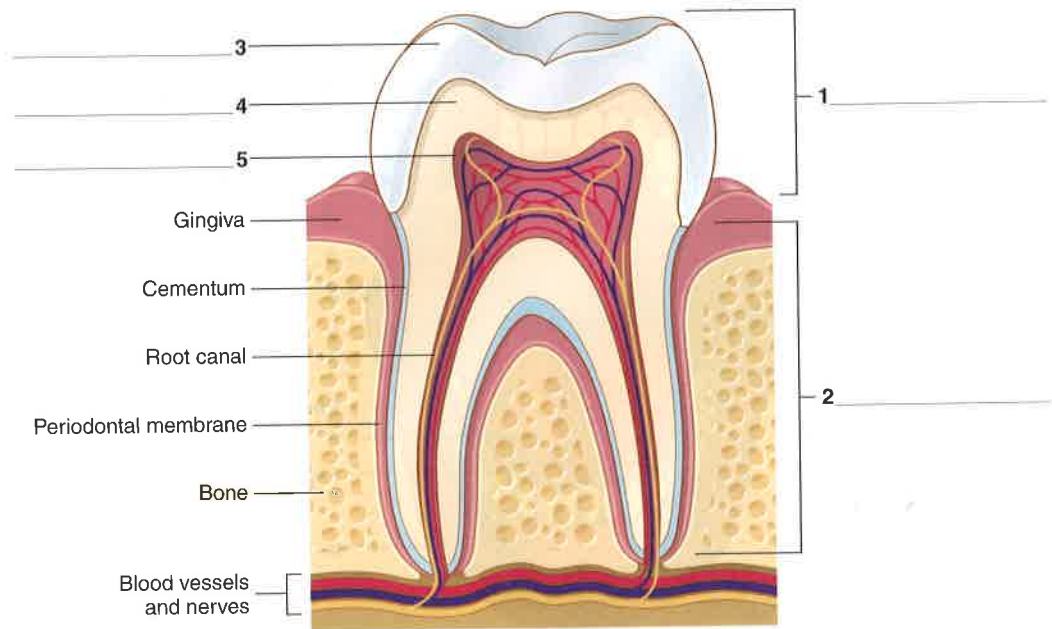


FIGURE 5-3 Anatomy of a tooth.

Figure 5-3 shows the inner anatomy of a tooth. Label it as you read the following description:

A tooth consists of a **crown** [1], which shows above the gum line, and a **root** [2], which lies within the bony tooth socket. The outermost protective layer of the crown, the **enamel** [3], protects the tooth. Enamel is a dense, hard, white substance—the hardest substance in the body. **Dentin** [4], the main substance of the tooth, lies beneath the enamel and extends throughout the crown. Dentin is yellow and composed of bony tissue that is softer than enamel. The **cementum** covers, protects, and supports the dentin in the root. A **periodontal membrane** surrounds the cementum and holds the tooth in place in the tooth socket.

The **pulp** [5] lies underneath the dentin. This soft and delicate tissue fills the center of the tooth. Blood vessels, nerve endings, connective tissue, and lymphatic vessels are within the pulp canal (also called the **root canal**). Root canal therapy often is necessary when disease or abscess (pus collection) occurs in the pulp canal. A dentist opens the tooth from above and cleans the canal of infected tissue, nerves, and blood vessels. The canal is then disinfected and filled with material to prevent the entrance of microorganisms that could cause decay.

Three pairs of **salivary glands** (Figure 5-4) surround and empty into the oral cavity. These exocrine glands produce **saliva**, which lubricates the mouth. Saliva contains important digestive **enzymes** as well as healing growth factors such as cytokines. Saliva is released from a **parotid gland** [1], **submandibular gland** [2], and **sublingual gland** [3] on both sides of the mouth. Narrow ducts carry saliva into the oral cavity. The glands produce about 1.5 liters daily.

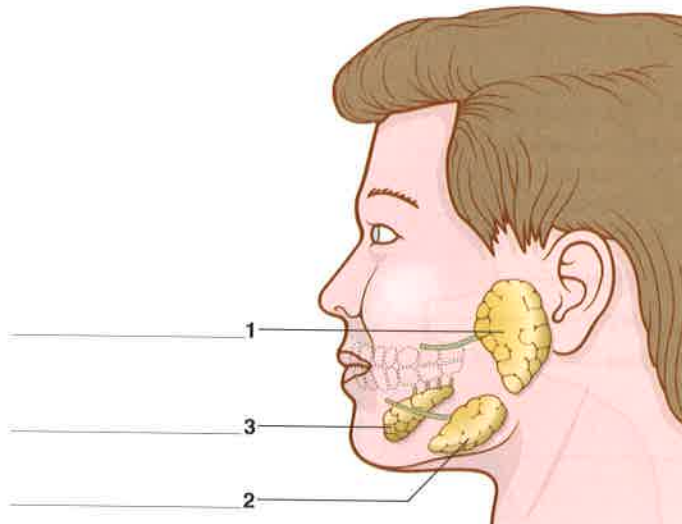


FIGURE 5-4 Salivary glands.

PHARYNX

Refer to Figure 5-5. The **pharynx** or **throat** is a muscular tube, about 5 inches long, lined with a mucous membrane. It serves as a passageway both for air traveling from the nose (nasal cavity) to the windpipe (trachea) and for food traveling from the oral cavity to the **esophagus**. When swallowing (**deglutition**) occurs, a flap of tissue, the epiglottis, covers the trachea so that food cannot enter and become lodged there. See Figure 5-5A and B.

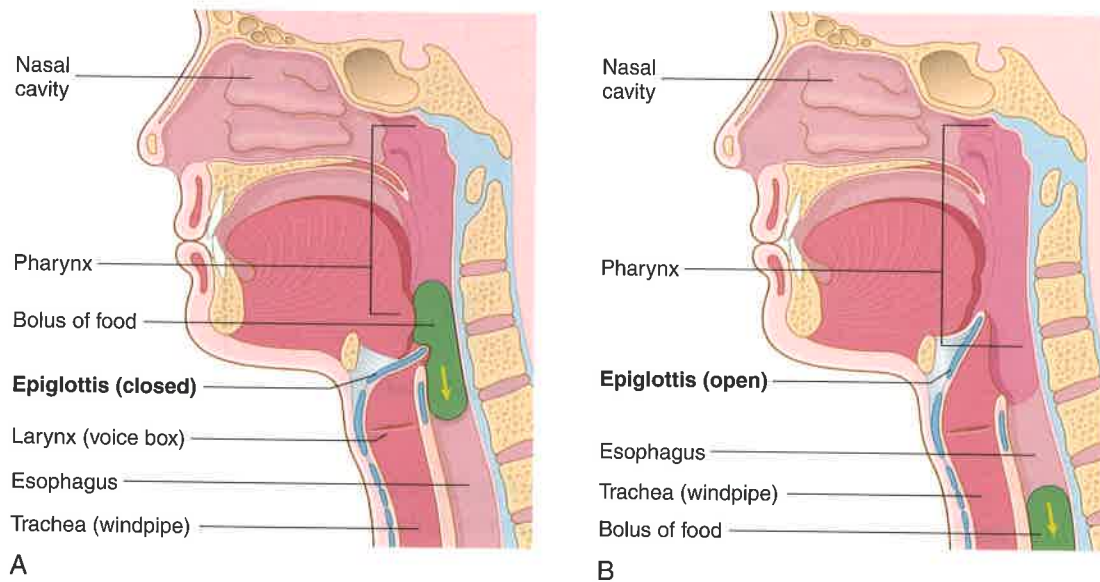


FIGURE 5-5 Deglutition (swallowing). (A) Epiglottis closes over the trachea as the bolus of food passes down the pharynx toward the esophagus. (B) Epiglottis opens as the bolus moves down the esophagus.

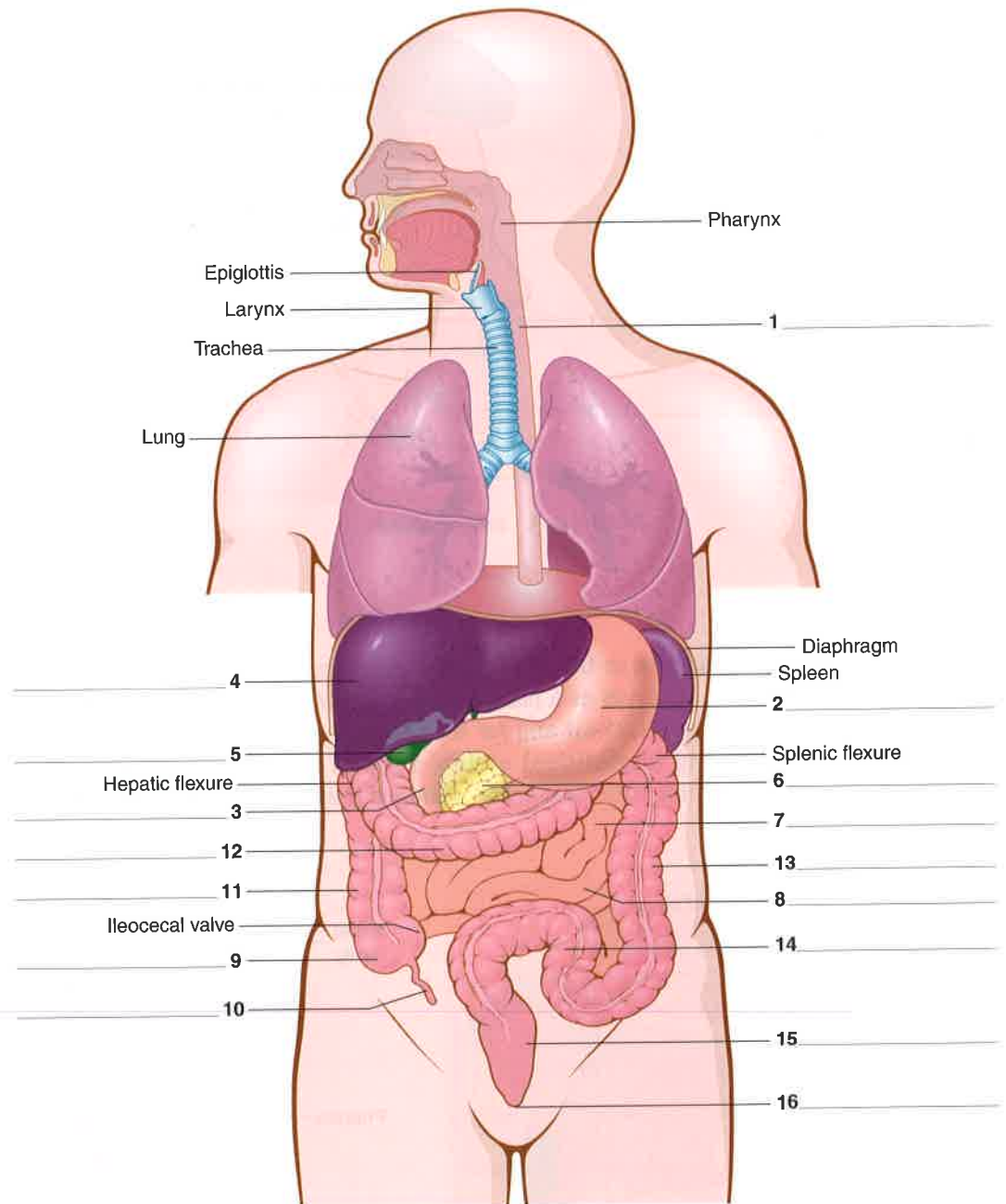


FIGURE 5-6 The gastrointestinal tract.

Figure 5-6 shows the passageway for food as it travels from the esophagus through the gastrointestinal tract. Label it as you read the following paragraphs.

ESOPHAGUS

The **esophagus** [1] is a 9- to 10-inch muscular tube extending from the pharynx to the stomach. **Peristalsis** is the involuntary, progressive, rhythmic contraction of muscles in the wall of the esophagus (and other gastrointestinal organs) propelling a **bolus** (mass of food) down toward the stomach. The process is like squeezing a marble through a rubber tube.

STOMACH

Food passes from the esophagus into the **stomach** [2]. The stomach (Figure 5-7) has three main parts: **fundus** (upper portion), **body** (middle section), and **antrum** (lower portion). Rings of muscle called **sphincters** control the openings into and leading out of the stomach. They prevent food from regurgitating (flowing backward from the normal direction). The **lower esophageal sphincter** relaxes and contracts to move food from the esophagus into the stomach; the **pyloric sphincter** allows food to leave the stomach when it is ready. Folds in the mucous membrane (**mucosa**) lining the stomach are called **rugae**. The rugae contain digestive glands that produce the enzyme **pepsin** (to begin digestion of proteins) and **hydrochloric acid**.

The stomach prepares food for the small intestine, where digestion and absorption into the bloodstream take place. The stomach controls passage of foods into the first part of the small intestine so that it proceeds only when it is chemically ready and in small amounts. Food leaves the stomach in 1 to 4 hours or longer, depending on the amount and type of food eaten.

SMALL INTESTINE (SMALL BOWEL)

(Continue labeling Figure 5-6 on page 146.)

The **small intestine (small bowel)** extends for 20 feet from the pyloric sphincter to the first part of the large intestine. It has three parts. The first section, the **duodenum** [3], is only 1 foot long. It receives food from the stomach as well as **bile** from the **liver** [4] and **gallbladder** [5] and pancreatic juice from the **pancreas** [6]. Enzymes and bile help digest food before it passes into the second part of the small intestine, the **jejunum** [7], about 8 feet long. The jejunum connects with the third section, the **ileum** [8], about 11 feet long. The ileum attaches to the first part of the large intestine.

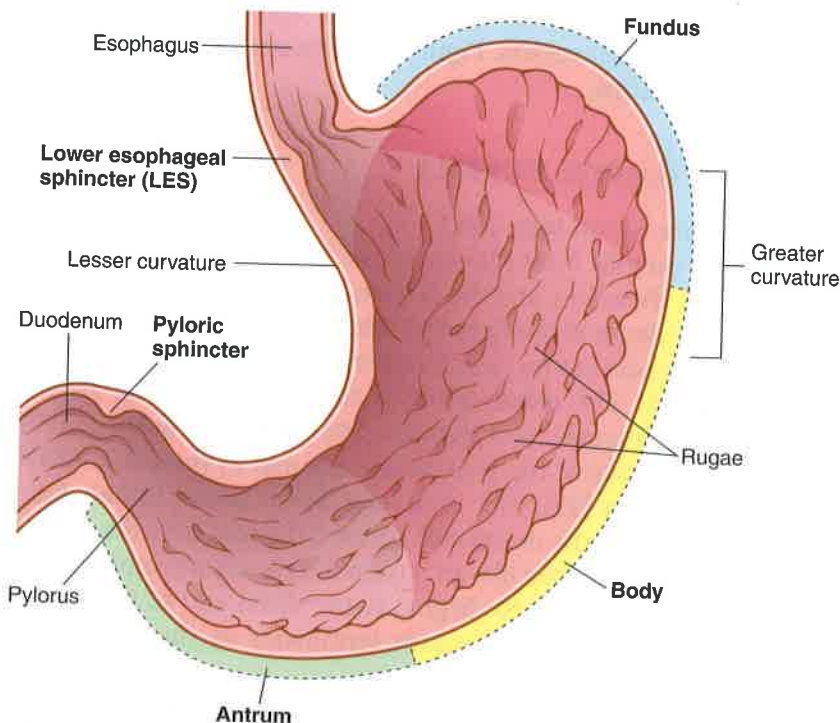


FIGURE 5-7 Parts of the stomach. The **fundus** and **body** (often referred to collectively as the fundus) are a reservoir for ingested food and an area for action by acid and pepsin (gastric enzyme). The **antrum** is a muscular grinding chamber that breaks up food and feeds it gradually into the duodenum.

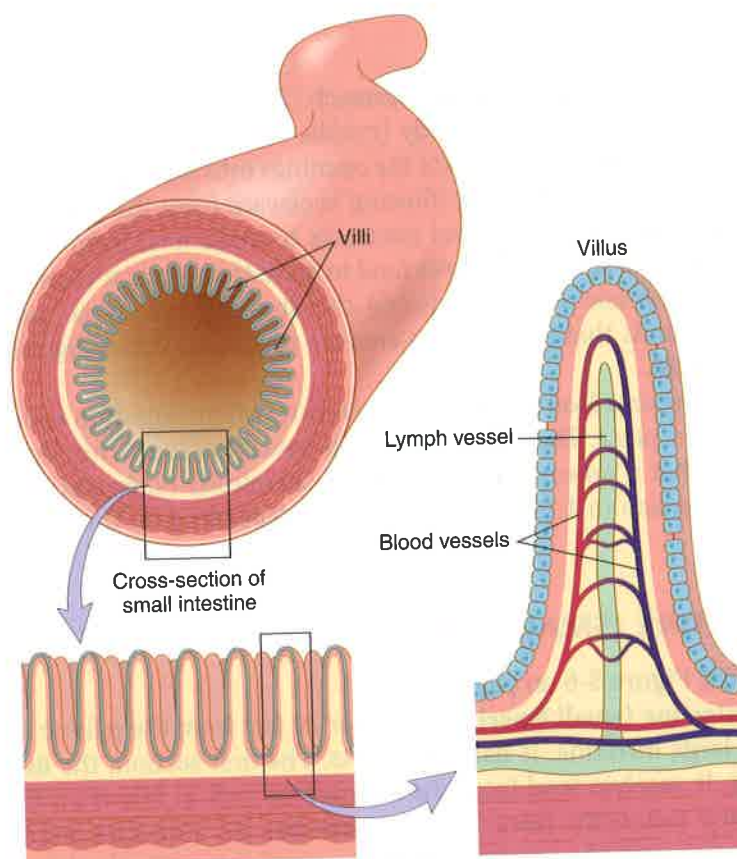


FIGURE 5-8 Villi in the lining of the small intestine.

Millions of tiny, microscopic projections called **villi** line the walls of the small intestine. The tiny capillaries (microscopic blood vessels) in the villi absorb the digested nutrients into the bloodstream and lymph vessels. Figure 5-8 shows several different views of villi in the lining of the small intestine.

LARGE INTESTINE (LARGE BOWEL)

(Continue labeling Figure 5-6 on page 146.)

The **large intestine** extends from the end of the ileum to the anus. It has three main components: the cecum, the colon, and the rectum. The **cecum** [9] is a pouch on the right side that connects to the ileum at the ileocecal valve (sphincter). The **appendix** [10] hangs from the cecum. The appendix has no clear function and can become inflamed and infected when clogged or blocked. The **colon**, about 5 feet long, has four named segments: ascending, descending, transverse, and sigmoid. The **ascending colon** [11] extends from the cecum to the undersurface of the liver, where it turns to the left (hepatic flexure) to become the **transverse colon** [12]. The transverse colon passes horizontally to the left toward the spleen and then turns downward (splenic flexure) into the **descending colon** [13]. The **sigmoid colon** [14], shaped like an S (sigmoid means resembling the Greek letter sigma, which curves like the letter S), begins at the distal end of the descending colon and leads into the **rectum** [15]. The rectum terminates in the lower opening of the gastrointestinal tract, the **anus** [16].

The large intestine receives the fluid waste products of digestion (the material unable to pass into the bloodstream) and stores these wastes until they can be released from the body. Because the large intestine absorbs most of the water within the waste material,

the body can expel solid **feces** (stools). **Defecation** is the expulsion or passage of feces from the body through the anus. Diarrhea, or passage of watery stools, results from reduced water absorption into the bloodstream through the walls of the large intestine.

LIVER, GALLBLADDER, AND PANCREAS

Three important additional organs of the digestive system—the liver, gallbladder, and pancreas—play crucial roles in the proper digestion and absorption of nutrients. Label Figure 5-9 as you study the following:

The **liver** [1], located in the right upper quadrant (RUQ) of the abdomen, manufactures a thick, orange-black, sometimes greenish, fluid called **bile**. Bile contains cholesterol (a fatty substance), bile acids, and several bile pigments. One of these pigments, **bilirubin**, is produced from the breakdown of hemoglobin during normal red blood cell destruction. Bilirubin travels via the bloodstream to the liver, where it is conjugated or converted into a water-soluble form. Conjugated bilirubin is then added to bile and enters the intestine (duodenum). Bacteria in the colon degrade bilirubin into a variety of pigments that give feces a brownish color. Bilirubin and bile leave the body in feces.

If the bile duct is blocked or the liver is damaged and unable to excrete bilirubin into bile, the bilirubin remains in the bloodstream, causing **jaundice (hyperbilirubinemia)**—yellow discoloration of the skin, whites of the eyes, and mucous membranes. Figure 5-10 reviews the path of bilirubin from red blood cell destruction (hemolysis) to elimination with bile in the feces.

(Continue labeling Figure 5-9.)

The liver continuously releases bile, which then travels through the **hepatic duct** to the **cystic duct**. The cystic duct leads to the **gallbladder** [2], a pear-shaped sac under the liver, which stores and concentrates the bile for later use. After meals, in response to the presence of food in the stomach and duodenum, the gallbladder contracts, forcing the bile out the cystic duct into the **common bile duct** [3]. Meanwhile, the **pancreas** [4] secretes pancreatic juices (enzymes) that are released into the **pancreatic duct** [5], which joins with the common bile duct just as it enters the **duodenum** [6]. The duodenum thus receives a mixture of bile and pancreatic juices.

Bile has a detergent-like effect on fats in the duodenum. In the process of **emulsification**, bile breaks apart large fat globules, creating more surface area so that enzymes from the pancreas can digest the fats. Without bile, most of the fat taken into the body remains undigested.

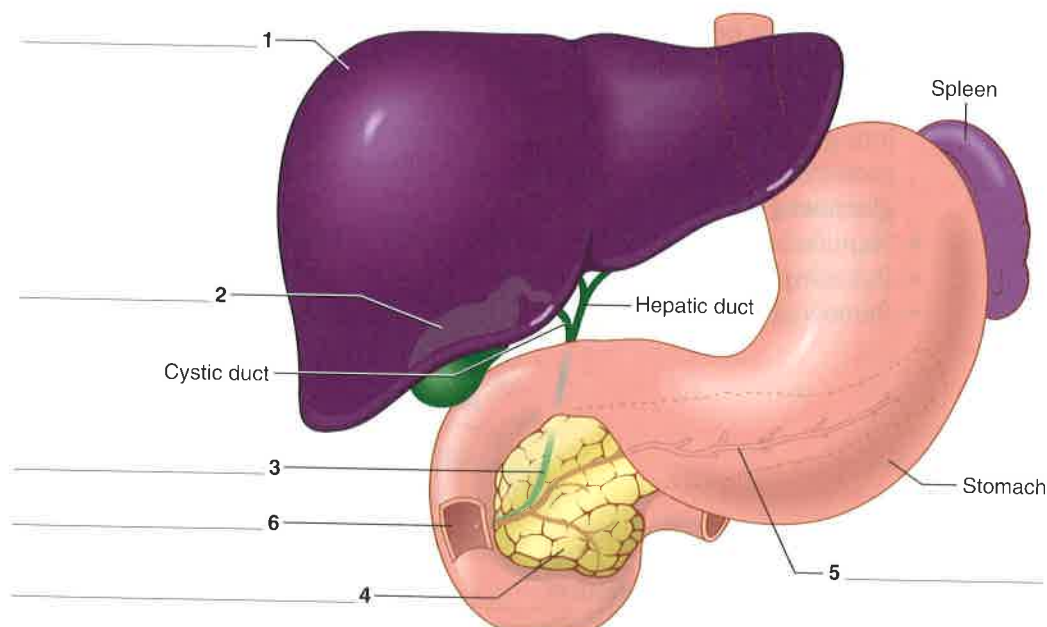


FIGURE 5-9 Liver, gallbladder, and pancreas.

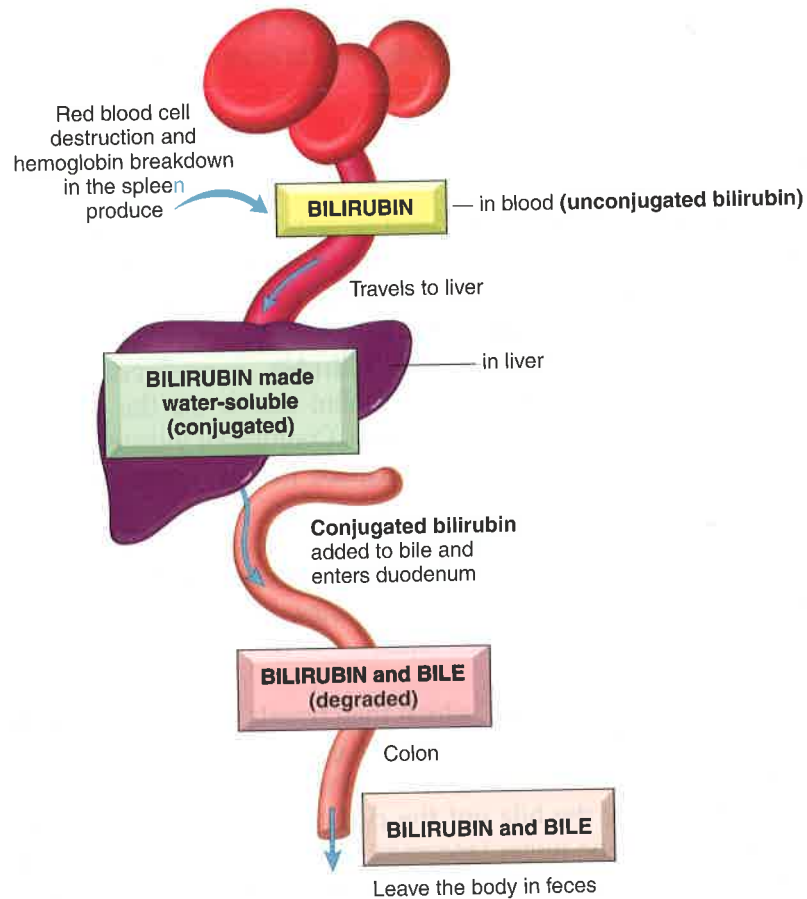


FIGURE 5-10 Bilirubin pathway from bloodstream to elimination in feces. Unconjugated bilirubin (measured in lab tests as “indirect bilirubin”) is prehepatic, free bilirubin. Conjugated bilirubin (measured as “direct bilirubin”) is posthepatic bilirubin.

Besides producing bile, the liver has several other vital and important functions:

- Maintaining normal blood **glucose** (sugar) levels. The liver removes excess glucose from the bloodstream and stores it as **glycogen** (starch) in liver cells. When the blood sugar level becomes dangerously low, the liver converts stored glycogen back into glucose via a process called **glycogenolysis**. In addition, the liver can convert proteins and fats into glucose, when the body needs sugar, by a process called **gluconeogenesis**.
- Manufacturing blood proteins, particularly those necessary for blood clotting
- Releasing bilirubin, a pigment in bile
- Removing poisons (toxins) from the blood

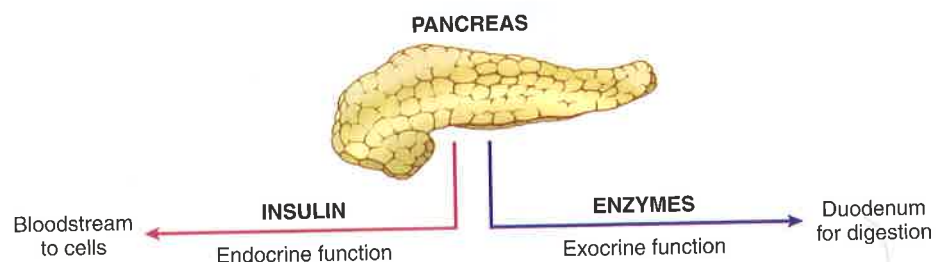


FIGURE 5-11 The pancreas and its functions.

The **portal vein** brings blood to the liver from the intestines. Digested foods pass into the portal vein directly after being absorbed into the capillaries of the small intestine, thus giving the liver the first chance to use the nutrients.

The **pancreas** (Figure 5-11) is both an exocrine and an endocrine organ. As an exocrine gland, it produces enzymes to digest starch, such as **amylase** (amyl/o = starch, -ase = enzyme), to digest fat, such as **lipase** (lip/o = fat), and to digest proteins, such as **protease** (prote/o = protein). These pass into the duodenum through the pancreatic duct.

As an endocrine gland (secreting into the bloodstream), the pancreas secretes **insulin**. This hormone, needed to help release sugar from the blood, acts as a carrier to bring glucose into cells of the body to be used for energy.

Figure 5-12 is a flow chart that traces the pathway of food through the gastrointestinal tract.

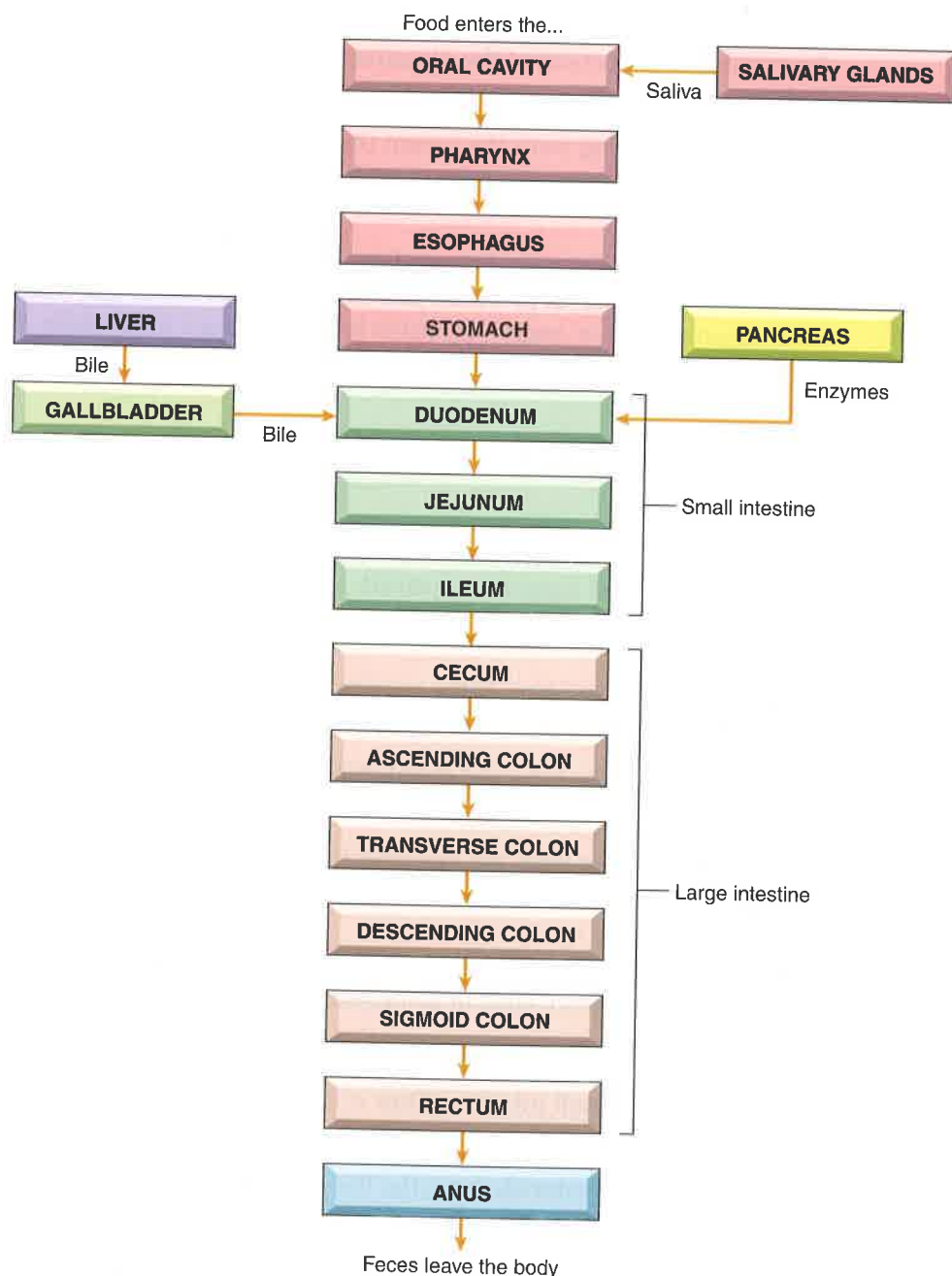


FIGURE 5-12 Pathway of food through the gastrointestinal tract.



VOCABULARY

The following list reviews many of the terms introduced in this chapter. Short definitions and additional information reinforce your understanding of the terms. All of the terms are included in the Pronunciation of Terms section later in the chapter.

absorption	Passage of materials through the walls of the small intestine into the bloodstream.
amino acids	Small building blocks of proteins (like links in a chain), released when proteins are digested.
amylase	Enzyme secreted by the pancreas to digest starch.
anus	Terminal end or opening of the digestive tract to the outside of the body.
appendix	Blind pouch hanging from the cecum (in the right lower quadrant [RLQ]). It literally means hanging (pend/o) on to (ap-, which is a form of ad-).
bile	Digestive juice made in the liver and stored in the gallbladder. It breaks up (emulsifies) large fat globules. Bile originally was called gall (Latin <i>bilis</i> , meaning gall or anger), probably because it has a bitter taste. It is composed of bile pigments (colored materials), cholesterol, and bile salts.
bilirubin	Pigment released by the liver in bile.
bowel	Intestine.
canine teeth	Pointed, dog-like teeth (canine means pertaining to dog) next to the incisors. Also called cuspids or eyeteeth.
cecum	First part of the large intestine.
colon	Large intestine, consisting of the cecum; the ascending, transverse, and descending segments of the colon; and the rectum.
common bile duct	Carries bile from the liver and gallbladder to the duodenum. Also called the choledochus.
defecation	Elimination of feces from the digestive tract through the anus.
deglutition	Swallowing.
dentin	The primary material found in teeth. It is covered by the enamel in the crown and a protective layer of cementum in the root.
digestion	Breakdown of complex foods to simpler forms.
duodenum	First part of the small intestine. Duo = 2, den = 10; the duodenum measures 12 inches long.
elimination	Act of removal of materials from the body; in the digestive system, the removal of indigestible materials as feces.

emulsification	Physical process of breaking up large fat globules into smaller globules, thereby increasing the surface area that enzymes can use to digest the fat.
enamel	Hard, outermost layer of a tooth.
enzyme	A chemical that speeds up a reaction between substances. Digestive enzymes break down complex foods to simpler substances. Enzymes are given names that end in -ase.
esophagus	Tube connecting the throat to the stomach. Eso- means inward; phag/o means swallowing.
fatty acids	Substances produced when fats are digested.
feces	Solid wastes; stool.
gallbladder	Small sac under the liver; stores bile. <i>Remember:</i> gallbladder is one word!
glucose	Simple sugar.
glycogen	Starch; glucose is stored in the form of glycogen in liver cells.
hydrochloric acid	Substance produced by the stomach; necessary for digestion of food.
ileum	Third part of the small intestine; from the Greek <i>eilos</i> , meaning twisted. When the abdomen was viewed at autopsy, the intestine appeared twisted, and the ileum often was an area of obstruction.
incisor	One of four front teeth in the dental arch.
insulin	Hormone produced by the endocrine cells of the pancreas. It transports sugar from the blood into cells and stimulates glycogen formation by the liver.
jejunum	Second part of the small intestine. The Latin <i>jejunos</i> means empty; this part of the intestine was always empty when a body was examined after death.
lipase	Pancreatic enzyme necessary to digest fats.
liver	A large organ located in the RUQ of the abdomen. The liver secretes bile; stores sugar, iron, and vitamins; produces blood proteins; and destroys worn-out red blood cells. The normal adult liver weighs about 2½ to 3 pounds.
lower esophageal sphincter (LES)	Ring of muscles between the esophagus and the stomach. Also called cardiac sphincter .
mastication	Chewing.
molar teeth	The sixth, seventh, and eighth teeth from the middle on either side of the dental arch. Premolar teeth are the fourth and fifth teeth, before the molars.
palate	Roof of the mouth. The hard palate lies anterior to the soft palate and is supported by the upper jawbone (maxilla). The soft palate is the posterior fleshy part between the mouth and the throat.

pancreas	Organ under the stomach; produces insulin (for transport of sugar into cells) and enzymes (for digestion of foods).
papillae (<i>singular: papilla</i>)	Small elevations on the tongue. A papilla is a nipple-like elevation.
parotid gland	Salivary gland within the cheek, just anterior to the ear.
peristalsis	Rhythmic contractions of the tubular organs. In the gastrointestinal tract, peristalsis moves the contents through at different rates: stomach, 0.5 to 2 hours; small intestine, 2 to 6 hours; and colon, 6 to 72 hours. Peri- means surrounding; -stalsis is constriction.
pharynx	Throat, the common passageway for food from the mouth and for air from the nose.
portal vein	Large vein bringing blood to the liver from the intestines.
protease	Enzyme that digests protein.
pulp	Soft tissue within a tooth, containing nerves and blood vessels.
pyloric sphincter	Ring of muscle at the end of the stomach, near the duodenum. From the Greek <i>pyloros</i> , meaning gatekeeper. It is normally closed, but opens when a wave of peristalsis passes over it.
pylorus	Distal region of the stomach, opening to the duodenum.
rectum	Last section of the large intestine, connecting the end of the colon and the anus.
rugae	Ridges on the hard palate and the wall of the stomach.
saliva	Digestive juice produced by salivary glands.
salivary glands	Parotid, sublingual, and submandibular glands.
sigmoid colon	Fourth and last, S-shaped segment of the colon, just before the rectum; empties into the rectum.
sphincter	Circular ring of muscle that constricts a passage or closes a natural opening.
stomach	Muscular organ that receives food from the esophagus. The stomach's parts are the fundus (proximal section), body (middle section), and antrum (distal section).
triglycerides	Fat molecules composed of three parts fatty acids and one part glycerol.
uvula	Soft tissue hanging from the middle of the soft palate. The Latin <i>uva</i> means bunch of grapes.
villi (<i>singular: villus</i>)	Microscopic projections in the wall of the small intestine that absorb nutrients into the bloodstream.

TERMINOLOGY

Write the meaning of the medical term in the space provided. Check the Pronunciation of Terms on pages 180 to 185 for any unfamiliar words.

PARTS OF THE BODY

COMBINING FORM	MEANING	TERMINOLOGY	MEANING
an/o	anus	perianal _____	
append/o	appendix	appendectomy _____	
appendic/o		appendicitis _____	
		<i>Figure 5-13.</i>	
bucc/o	cheek	buccal mucosa _____	
		<i>A mucosa is a mucous membrane lining cavities or canals that open to the outside of the body.</i>	
cec/o	cecum	cecal _____	
celi/o	belly, abdomen	celiac _____	
		<i>Abdomin/o and lapar/o also mean abdomen. With combining forms that have the same basic meaning, no rule exists for the proper usage of one or the other. You will learn to recognize each in its proper context.</i>	
cheil/o	lip	cheilosis _____	
		<i>Labi/o also means lip.</i>	
cholecyst/o	gallbladder	cholecystectomy _____	
		<i>Don't confuse cholecyst/o with cyst/o, which means urinary bladder!</i>	

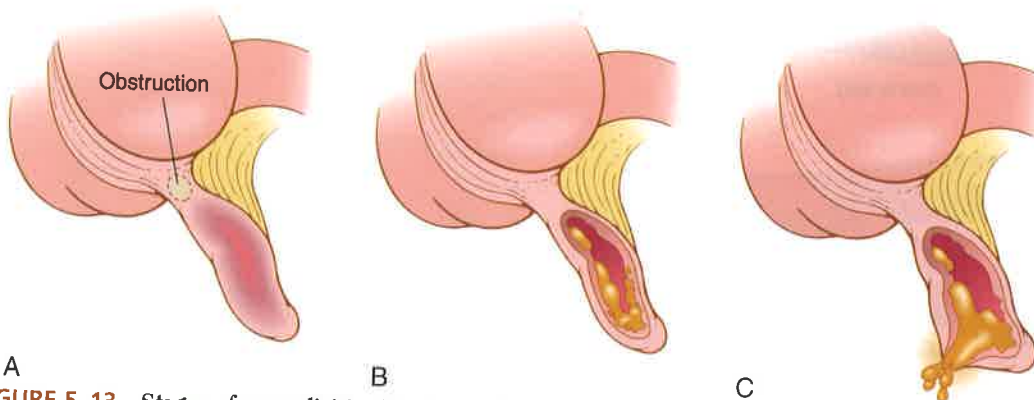


FIGURE 5-13 Stages of appendicitis. **(A)** Obstruction and bacterial infection cause red, swollen, and inflamed appendix. **(B)** Pus and bacteria invade the wall of the appendix. **(C)** Pus perforates (ruptures through) the wall of the appendix into the abdomen, leading to peritonitis (inflammation of the peritoneum). (Modified from Damjanov I: Pathology for the Health-Related Professions, 3rd ed., Philadelphia, Saunders, 2006, p. 260.)

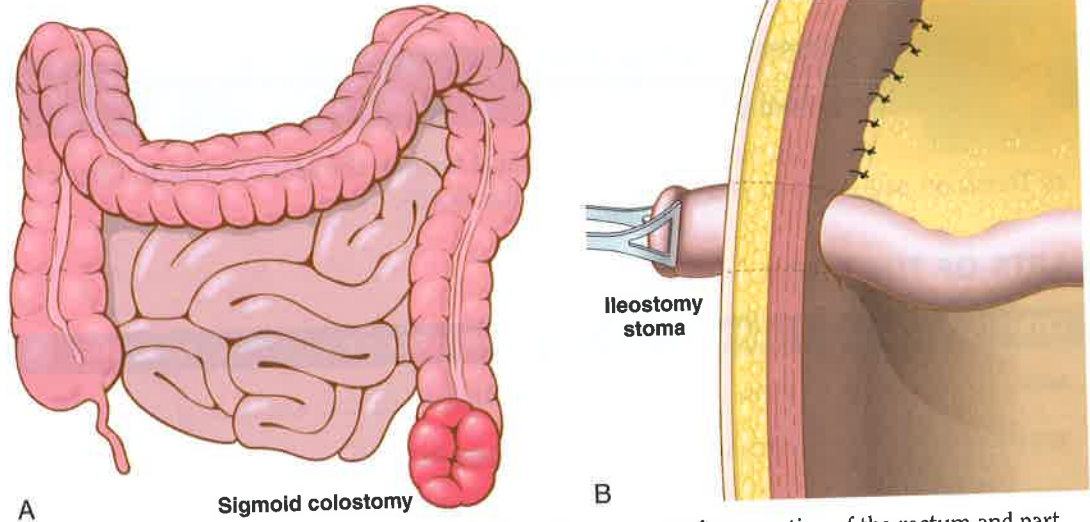


FIGURE 5-14 Different types of stomas. (A) Sigmoid colostomy after resection of the rectum and part of the sigmoid colon. The stoma is at the end of the colon and attached to the abdominal wall. (B) Ileostomy after resection of the entire colon. The ileum is drawn through the abdominal wall to form an ileostomy stoma.

COMBINING FORM	MEANING	TERMINOLOGY	MEANING
choledoch/o	common bile duct	choledochotomy	_____
col/o	colon, large intestine	colostomy	_____
		The suffix <i>-stomy</i> , when used with a combining form for an organ, means an opening to the outside of the body. A stoma is an opening between an organ and the surface of the body (Figure 5-14).	
colon/o	colon	colonic	_____
		colonoscopy	_____

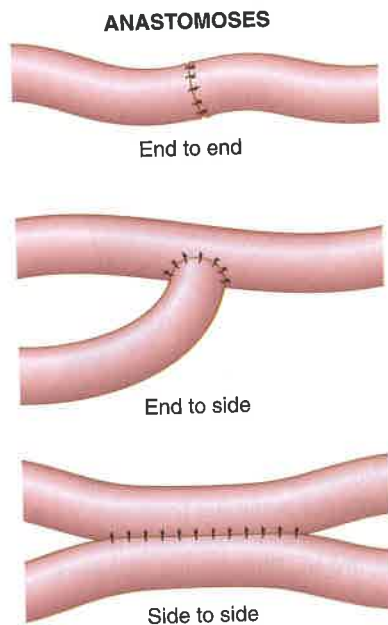


FIGURE 5-15 Three types of anastomoses. These are examples of an enteroenterostomy. The suffix *-stomy*, when used with two or more combining forms (enter/o and enter/o) indicates the surgical creation of a new opening between those parts of the body.

COMBINING FORM	MEANING	TERMINOLOGY	MEANING
dent/i	tooth	<u>dentibuccal</u> _____ <i>Odont/o also means tooth.</i>	
duoden/o	duodenum	<u>duodenal</u> _____	
enter/o	intestines, usually small intestine	<u>enterocolitis</u> _____ <i>When two combining forms for gastrointestinal organs are in a term, the one for the organ closer to the mouth appears first.</i>	
		<u>enteroenterostomy</u> _____ <i>New opening between two previously unconnected parts of the small intestine. This is an anastomosis, which is any surgical connection between two parts, such as vessels, ducts, or bowel segments (ana = up, stom = opening, -sis = state of) (Figure 5-15).</i>	
		<u>mesentery</u> _____ <i>Part of the double fold of peritoneum that stretches around the organs in the abdomen, the mesentery holds the organs in place. Literally, it lies in the middle (mes-) of the intestines, a membrane attaching the intestines to the muscle wall at the back of the abdomen (Figure 5-16).</i>	
		<u>parenteral</u> _____ <i>Par (from para-) means apart from in this term. An intravenous line brings parenteral nutrition directly into the bloodstream, bypassing the intestinal tract (enteral nutrition). Parenteral injections may be subcutaneous or intramuscular as well.</i>	

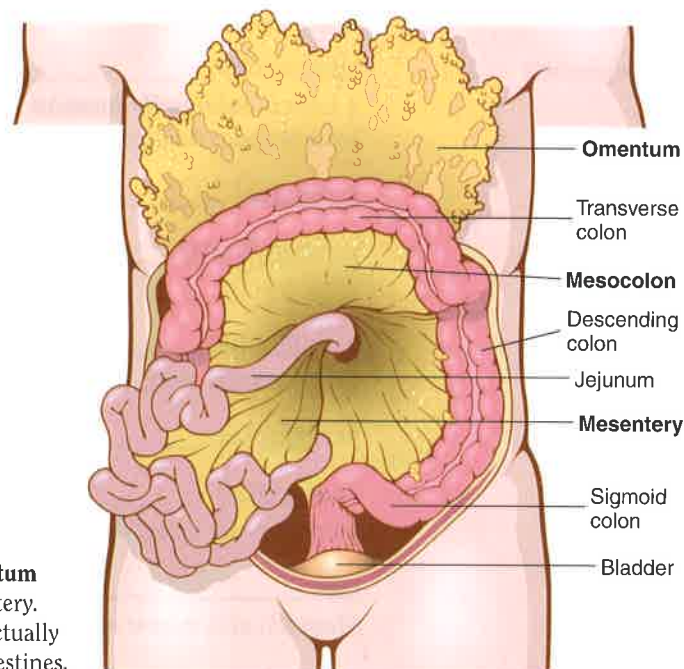


FIGURE 5-16 Mesentery. The **omentum** and **mesocolon** are parts of the mesentery. The omentum (raised in this figure) actually hangs down like an apron over the intestines.

COMBINING FORM	MEANING	TERMINOLOGY	MEANING
esophag/o	esophagus	<u>esophageal</u> _____ Note: Changing the suffix from <i>-al</i> to <i>-eal</i> softens the final <i>g</i> (<i>ě-sŏf-ă-JĔ-ăl</i>).	
faci/o	face	<u>facial</u> _____	
gastr/o	stomach	<u>gastrostomy</u> _____	
gingiv/o	gums	<u>gingivitis</u> _____	
gloss/o	tongue	<u>hypoglossal</u> _____ <i>Lingu/o</i> also means tongue.	
hepat/o	liver	<u>hepatoma</u> _____ Also called hepatocellular carcinoma . <u>hepatomegaly</u> _____	
ile/o	ileum	<u>ileocecal sphincter</u> _____ Also called the <i>ileocecal valve</i> . <u>ileitis</u> _____ <u>ileostomy</u> _____ See Figure 5-14B, page 156.	
jejun/o	jejunum	<u>choledochojejunostomy</u> _____ An <i>anastomosis</i> . <u>gastrojejunostomy</u> _____ This is part of a gastric bypass procedure.	
labi/o	lip	<u>labial</u> _____	
lapar/o	abdomen	<u>laparoscopy</u> _____ A form of minimally invasive surgery (MIS) . Examples are <i>laparoscopic cholecystectomy</i> and <i>laparoscopic appendectomy</i> .	
lingu/o	tongue	<u>sublingual</u> _____	
mandibul/o	lower jaw, mandible	<u>submandibular</u> _____	
odont/o	tooth	<u>orthodontist</u> _____ <i>Orth/o</i> means <i>straight</i> . <u>periodontist</u> _____ <u>endodontist</u> _____ <i>Performs root canal therapy</i> .	
or/o	mouth	<u>oral</u> _____ <i>Stomat/o</i> also means <i>mouth</i> .	
palat/o	palate	<u>palatoplasty</u> _____ <i>Procedure to repair cleft palate and cleft lip; repair of a cleft palate</i> .	

COMBINING FORM	MEANING	TERMINOLOGY	MEANING
pancreat/o	pancreas	pancreatitis _____	
peritone/o	peritoneum	peritonitis _____ <i>The e of the root has been dropped in this term.</i>	
pharyng/o	throat	pharyngeal _____ palatopharyngoplasty _____ <i>Used to treat cases of snoring or sleep apnea caused by obstructions in the throat or nose.</i>	
proct/o	anus and rectum	proctologist _____	
pylor/o	pyloric sphincter	pyloroplasty _____	
rect/o	rectum	rectocele _____	
sialaden/o	salivary gland	sialadenitis _____	
sigmoid/o	sigmoid colon	sigmoidoscopy _____	
stomat/o	mouth	stomatitis _____	
uvul/o	uvula	uvulectomy _____	

SUBSTANCES


COMBINING FORM	MEANING	TERMINOLOGY	MEANING
amyl/o	starch	amylase _____ <i>The suffix -ase means enzyme.</i>	
bil/i	gall, bile	biliary _____ <i>The biliary tract includes the organs (liver and gallbladder) and ducts (hepatic, cystic, and common bile ducts) that secrete, store, and empty bile into the duodenum.</i>	
bilirubin/o	bilirubin (bile pigment)	hyperbilirubinemia _____	
chol/e	gall, bile	cholelithiasis _____ <i>Lith/o means stone or calculus; -iasis means abnormal condition.</i>	
chlorhydr/o	hydrochloric acid	achlorhydria _____ <i>Absence of gastric juice is associated with gastric carcinoma.</i>	
gluc/o	sugar	gluconeogenesis _____ <i>Liver cells make new sugar from fats and proteins.</i>	
glyc/o	sugar	hyperglycemia _____	
glycogen/o	glycogen, animal starch	glycogenolysis _____ <i>Liver cells change glycogen back to glucose when blood sugar levels drop.</i>	

COMBINING FORM	MEANING	TERMINOLOGY	MEANING
lip/o	fat, lipid	lipoma _____	
lith/o	stone	lithogenesis _____	
prote/o	protein	protease _____	
sial/o	saliva, salivary	sialolith _____	
steat/o	fat	steatorrhea _____ <i>Improperly digested (malabsorbed) fats will appear in the feces.</i>	

SUFFIXES

SUFFIX	MEANING	TERMINOLOGY	MEANING
-ase	enzyme	lipase _____ <i>Enzymes speed up chemical reactions. Lipase aids in the digestion of fats. In all types of liver disease, liver enzyme levels may be elevated, indicating damage to liver cells. Signs and symptoms include malaise, anorexia, hepatomegaly, jaundice, and abdominal pain.</i>	
-chezia	defecation, elimination of wastes	hematochezia _____ <i>(hē-mă-tō-KĒ-zē-ă) Bright red blood is found in the feces.</i>	
-iasis	abnormal condition	choledocholithiasis _____	
-prandial	meal	postprandial _____ <i>Post cibum (p.c.), seen on written prescriptions, also means after meals.</i>	

PATHOLOGY OF THE DIGESTIVE SYSTEM

This section presents medical terms that describe signs and symptoms  (clinical indications of illness) and pathologic conditions of the gastrointestinal tract. Sentences following each definition describe the **etiology** (eti/o = cause) of the illness and treatment. When the etiology (cause) is not understood, the condition is **idiopathic** (idi/o = unknown). You can find a list of drugs prescribed to treat gastrointestinal signs and symptoms and conditions on page 888 in Chapter 21, Pharmacology.



Signs and Symptoms

A **sign** is an **objective** finding—such as an increase in body temperature, a rash, or a sound heard on listening to the chest—indicating the presence of disease as perceived by an examiner. However, a **symptom** is a **subjective** sensation or change in health—such as itching, pain, fatigue, or nausea—as experienced by the patient. Clearly, the same feature may be noticed by both doctor and patient, which makes it at once both a sign and a symptom!

SIGNS AND SYMPTOMS**anorexia****Lack of appetite.**

Anorexia (-orexia = appetite) often is a sign of malignancy or liver disease. **Anorexia nervosa** is loss of appetite associated with emotional problems such as anger, anxiety, and irrational fear of weight gain. It is an eating disorder and is discussed, along with a similar eating disorder, bulimia nervosa, in Chapter 22.

ascites**Abnormal accumulation of fluid in the abdomen.**

This condition occurs when fluid passes from the bloodstream and collects in the peritoneal cavity. It can be a sign of neoplasm or inflammatory disorders in the abdomen, venous hypertension (high blood pressure) caused by liver disease (cirrhosis), or heart failure (Figure 5-17). Treatment for ascites includes administration of diuretic drugs and paracentesis to remove abdominal fluid.

borborygmus (plural: borborygmi)**Rumbling or gurgling noise produced by the movement of gas, fluid, or both in the gastrointestinal tract.**

A sign of hyperactive intestinal peristalsis, borborygmi (bowel sounds) often are present in cases of gastroenteritis and diarrhea.

constipation**Difficulty in passing stools (feces).**

When peristalsis is slow, stools are dry and hard. A diet of fruit, vegetables, and water is helpful. **Laxatives** and **cathartics** are medications to promote movement of stools.

diarrhea**Frequent passage of loose, watery stools.**

Abrupt onset of diarrhea immediately after eating suggests acute infection or toxin in the gastrointestinal tract. Untreated, severe diarrhea may lead to dehydration. Antidiarrheal drugs are helpful.

dysphagia**Difficulty in swallowing.**

This sensation feels like a “lump in the throat” when a swallowed bolus fails to progress, either because of a physical obstruction (obstructive dysphagia) or because of a motor disorder in which esophageal peristalsis is not coordinated (motor dysphagia).



FIGURE 5-17 Ascites in a male patient. The photograph was taken after paracentesis (puncture to remove fluid from the abdomen) was performed. Notice the gynecomastia (condition of female-type breasts) in this patient due to an excess of estrogen, which can accompany cirrhosis, especially in persons with alcoholism. (From Lewis SM et al: Medical-Surgical Nursing, 7th ed., St. Louis, Mosby, 2007, p. 1105.)

eructation	Gas expelled from the stomach through the mouth. Eructation produces a characteristic sound and also is called belching .
flatus	Gas expelled through the anus. Flatulence is the presence of excessive gas in the stomach and the intestines.
hematochezia	Passage of fresh, bright red blood from the rectum. The cause of hematochezia usually is bleeding due to colitis or from ulcers or polyps in the colon or rectum.
jaundice (icterus)	Yellow-orange coloration of the skin and whites of the eyes caused by high levels of bilirubin in the blood (hyperbilirubinemia). Jaundice can occur when (1) excessive destruction of erythrocytes, as in hemolysis , causes excess bilirubin in the blood; (2) malfunction of liver cells (hepatocytes) due to liver disease prevents the liver from excreting bilirubin with bile; or (3) obstruction of bile flow , such as from cholelithiasis or tumor, prevents bilirubin in bile from being excreted into the duodenum.
melena	Black, tarry stools; feces containing digested blood. This clinical sign usually reflects a condition in which blood has had time to be digested (acted on by intestinal juices) and results from bleeding in the upper gastrointestinal tract (duodenal ulcer). A positive result on stool guaiac testing (see page 193) indicates blood in the stool.
nausea	Unpleasant sensation in the stomach associated with a tendency to vomit. Common causes are sea and motion sickness and early pregnancy. Nausea and vomiting may be symptomatic of a perforation (hole in the wall) of an abdominal organ; obstruction of a bile duct, stomach, or intestine; or exposure to toxins (poisons).
steatorrhea	Fat in the feces; frothy, foul-smelling fecal matter. Improper digestion or absorption of fat can cause fat to remain in the intestine. This may occur with disease of the pancreas (pancreatitis) when pancreatic enzymes are not excreted. It also is a sign of intestinal disease that involves malabsorption of fat.

PATHOLOGIC CONDITIONS

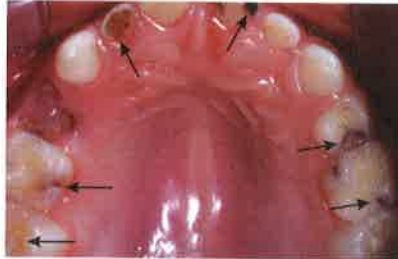
ORAL CAVITY AND TEETH

aphthous stomatitis	Inflammation of the mouth with small, painful ulcers. The ulcers associated with this condition are commonly called canker (KĀNK-ĕr) sores ; the cause is unknown (Figure 5-18B).
dental caries	Tooth decay. Dental plaque results from the accumulation of foods, proteins from saliva, and necrotic debris on the tooth enamel. Bacteria grow in the plaque and cause production of acid that dissolves the tooth enamel, resulting in a cavity (area of decay) (Figure 15-18C). If the bacterial infection reaches the pulp of the tooth, root canal therapy may be necessary.

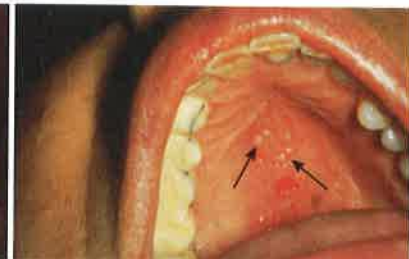


A Normal teeth and gums

B Aphthous stomatitis



C Dental caries



D Herpetic stomatitis



E Oral leukoplakia



F Gingivitis

FIGURE 5-18 Normal teeth and gums and pathologic conditions. (A) Normal teeth and gums. (B) Aphthous stomatitis. (C) Dental caries. (D) Herpetic stomatitis. (E) Oral leukoplakia. (F) Gingivitis. (A, From Christensen GJ: *A Consumer's Guide to Dentistry*, St. Louis, Mosby, 2002; B, from Feldman M et al: *Sleisenger and Fordtran's Gastrointestinal and Liver Disease*, 8th ed., Philadelphia, Saunders, 2006; C, courtesy Dr. Frank Hodges, from Bird D, Robinson D: *Torres and Ehrlich Modern Dental Assisting*, 8th ed., Philadelphia, Saunders, 2005; D, from Swartz MH: *Textbook of Physical Diagnosis, History and Examination*, 5th ed., Philadelphia, Saunders, 2006; E, from Callen JP et al: *Color Atlas of Dermatology*, 2nd ed., Philadelphia, Saunders, 2002; F, from Bird D, Robinson D: *Torres and Ehrlich Modern Dental Assisting*, 8th ed., Philadelphia, Saunders, 2005.)

herpetic stomatitis

Inflammation of the mouth caused by infection with the herpesvirus.

Painful fluid-filled blisters on the lips, palate, gums, and tongue, commonly called **fever blisters** or **cold sores** (Figure 15-18D). It is caused by herpes simplex virus type 1 (HSV1). Treatment is with medication to relieve symptoms. Herpes genitalis (due to HSV2) occurs on the reproductive organs. Both conditions are highly contagious.

oral leukoplakia

White plaques or patches on the mucosa of the mouth.

This precancerous lesion (Figure 15-18E) can result from chronic tobacco use (pipe smoking or chewing tobacco). Malignant potential is assessed by microscopic study of biopsied tissue.

periodontal disease

Inflammation and degeneration of gums, teeth, and surrounding bone.

Gingivitis (Figure 15-18F) occurs as a result of accumulation of **dental plaque** and **dental calculus** or **tartar** (a yellow-brown calcified deposit on teeth). In **gingivectomy**, a periodontist uses a metal instrument to scrape away plaque and tartar from teeth; any pockets of pus are then drained and removed to allow new tissue to form. Localized infections are treated with systemic antibiotics.

UPPER GASTROINTESTINAL TRACT

achalasia

Failure of the lower esophagus sphincter (LES) muscle to relax.

Achalasia (-chaliasa = relaxation) results from the loss of peristalsis so that food cannot pass easily through the esophagus. Both failure of the LES to relax and the loss of peristalsis cause dilatation (widening) of the esophagus above the constriction. Physicians recommend a bland diet low in bulk and mechanical stretching of the LES to relieve symptoms.

esophageal cancer

Malignant tumor of the esophagus.

The most common symptom of esophageal cancer is difficulty swallowing (dysphagia). Smoking and chronic alcohol use are major risk factors. Long-term irritation of the esophagus caused by gastric reflux is a premalignant condition called **Barrett esophagus**. Surgery, radiation therapy, and chemotherapy are treatment options.

esophageal varices

Swollen, varicose veins at the lower end of the esophagus.

Liver disease (such as cirrhosis and chronic hepatitis) causes increased pressure in veins near and around the liver (**portal hypertension**). This leads to enlarged, tortuous esophageal veins with danger of hemorrhage (bleeding). Treatment includes drug therapy to lower portal hypertension and banding or tying off the swollen esophageal veins (Figure 5-19A and B).

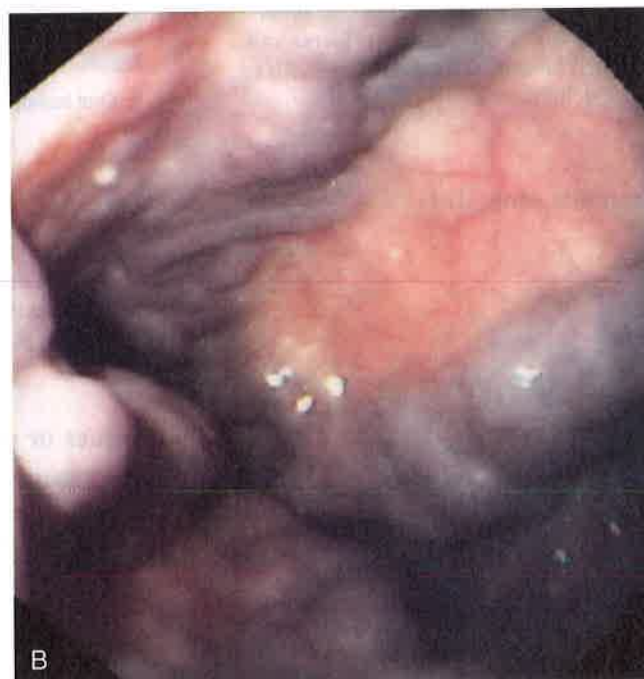
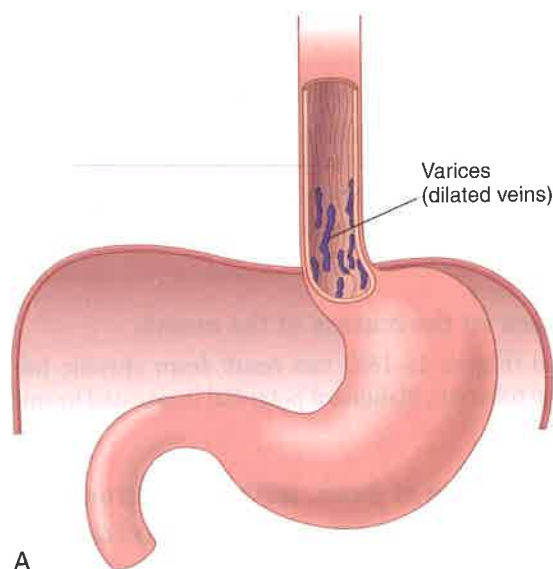


FIGURE 5-19 (A) Esophageal varices. (B) Endoscopic view of esophageal varices. (A, From Damjanov I: Pathology for the Health-Related Professions, 3rd ed., Philadelphia, Saunders, 2006, p. 246; B, from Gould BE: Pathophysiology for Health Professions, 3rd ed., Philadelphia, Saunders, 2006, p. 466.)

gastric cancer**Malignant tumor of the stomach.**

Chronic gastritis associated with bacterial infection is a major risk factor for gastric carcinoma. Gastric endoscopy and biopsy diagnose the condition. Cure depends on early detection and surgical removal of the cancerous tissue.

gastroesophageal reflux disease (GERD)**Solids and fluids return to the mouth from the stomach.**

Heartburn is the burning sensation caused by regurgitation of hydrochloric acid from the stomach to the esophagus. Chronic exposure of esophageal mucosa to gastric acid and pepsin (an enzyme that digests protein) leads to **reflux esophagitis**. Drug treatment for GERD includes antacid (acid-suppressive) agents and medication to increase the tone of the LES.

hernia**Protrusion of an organ or part through the muscle normally containing it.**

A **hiatal hernia** occurs when the upper part of the stomach protrudes upward through the diaphragm (Figure 5-20A). This condition can lead to GERD. An **inguinal hernia** occurs when a small loop of bowel protrudes through a weak lower abdominal muscle (Figure 5-20B). Surgical repair of inguinal hernias is known as herniorrhaphy (-rrhaphy means suture).

peptic ulcer**Open sore in the lining of the stomach or duodenum.**

A bacterium, *Helicobacter pylori* (*H. pylori*), is responsible for peptic ulcer disease. The combination of bacteria, hyperacidity, and gastric juice damages epithelial linings. Drug treatment includes antibiotics, antacids, and agents to protect the lining of the stomach and intestine.

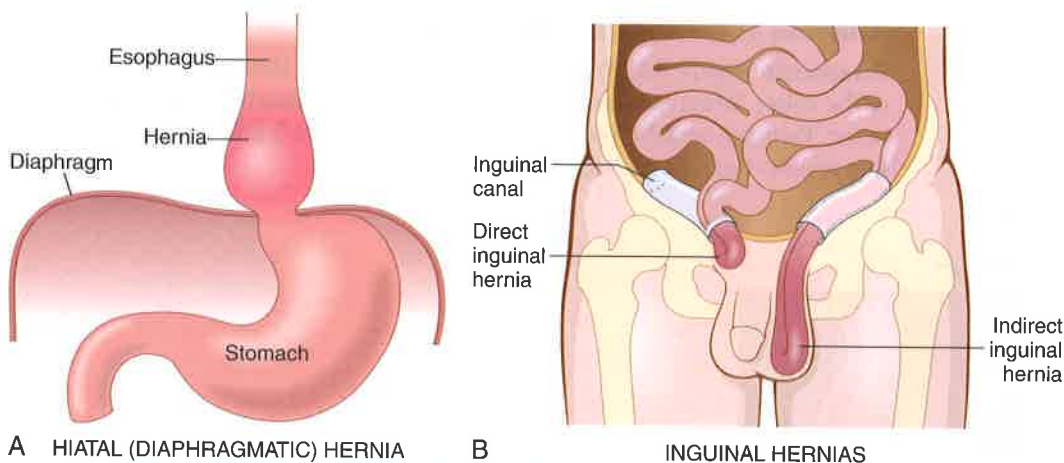


FIGURE 5-20 Hernias. (A) Hiatal hernia. (B) Inguinal hernias. A **direct inguinal hernia** occurs through the abdominal wall in an area of muscular weakness. An **indirect inguinal hernia** occurs through the inguinal canal (passageway in the lower abdomen), where the herniated tissue/bowel descends into the scrotal sac.

LOWER GASTROINTESTINAL TRACT (SMALL AND LARGE INTESTINES)**anal fistula****Abnormal tube-like passageway near the anus.**

The fistula often results from a break or **fissure** in the wall of the anus or rectum, or from an **abscess** (infected area) there (Figure 5-21A).

colonic polyps**Polyps (benign growths) protrude from the mucous membrane of the colon.**

Figure 5-21A illustrates two types of polyps: **pedunculated** (attached to the membrane by a stalk) and **sessile** (sitting directly on the mucous membrane). Figure 5-21B shows multiple polyps of the colon. Polyps often are removed (polypectomy) for biopsy and to prevent growth leading to malignancy.

colorectal cancer**Adenocarcinoma of the colon or rectum, or both.**

Colorectal cancer (Figure 5-22) can arise from polyps in the colon or rectal region. Diagnosis is determined by detecting melena (blood in stool) and by colonoscopy. Prognosis depends on the stage (extent of spread) of the tumor, including size, depth of invasion, and involvement of lymph nodes. Surgical treatment may require excision of a major section of colon with rejoining of the cut ends (anastomosis). Chemotherapy and radiotherapy are administered as needed.

Crohn disease (Crohn's)**Chronic inflammation of the intestinal tract (terminal ileum and colon).**

Signs and symptoms include diarrhea, severe abdominal pain, fever, anorexia, weakness, and weight loss. Both Crohn disease (or just "Crohn's") and ulcerative colitis are forms of **inflammatory bowel disease (IBD)**. Treatment is with drugs to control symptoms or by surgical removal of diseased portions of the intestine, with anastomosis of remaining parts.

diverticulosis**Abnormal outpouchings in the intestinal wall.**

Diverticula (Figure 5-23A) are pouch-like herniations through the muscular wall of the colon. When fecal matter becomes trapped in diverticula, **diverticulitis** can occur. Pain and rectal bleeding are symptoms. Figure 5-23B shows diverticulosis in a section through the sigmoid colon.

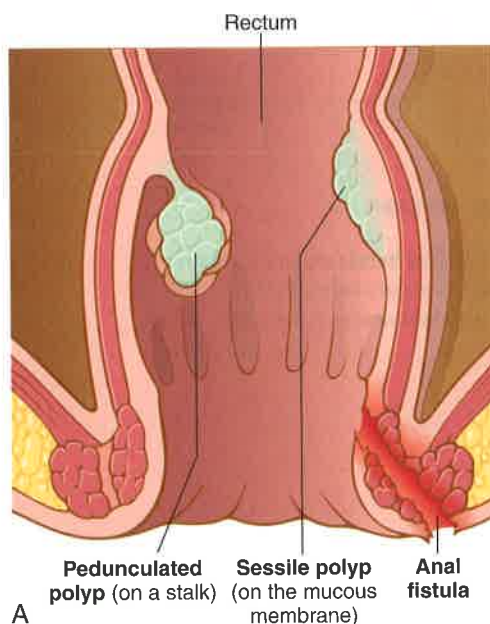
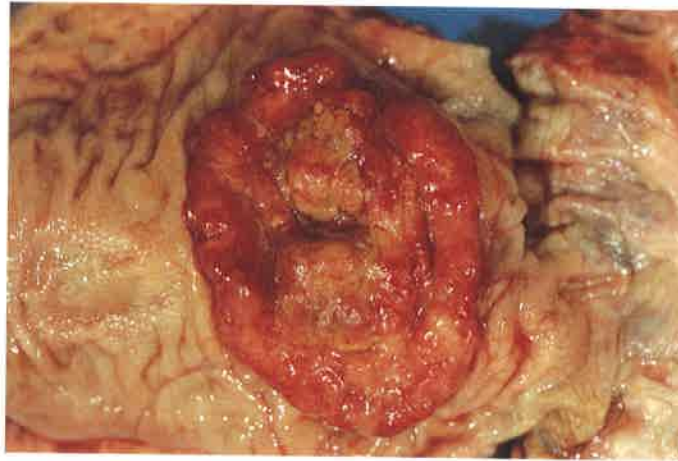


FIGURE 5-21 Anal fistula and colonic polyps. (A) Anal fistula and two types of polyps. **(B)** Multiple polyps of the colon. (B, From Damjanov I: Pathology for the Health-Related Professions, 3rd ed., Philadelphia, Saunders, 2006, p. 266.)

FIGURE 5-22 Adenocarcinoma of the colon. This tumor has “heaped-up” edges and an ulcerated central portion. (From Damjanov I: Pathology for the Health-Related Professions, 3rd ed., Philadelphia, Saunders, 2006, p. 268.)



dysentery

Painful, inflamed intestines commonly caused by bacterial infection.

Often occurring in the colon, dysentery results from ingestion of food or water containing bacteria (salmonellae or shigellae), amebae (one-celled organisms), or viruses. Symptoms are bloody stools and abdominal pain.

hemorrhoids

Swollen, twisted, varicose veins in the rectal region.

Varicose veins can be internal (within the rectum) or external (outside the anal sphincter). Pregnancy and chronic constipation, which put pressure on anal veins, often cause hemorrhoids.

ileus

Loss of peristalsis with resulting obstruction of the intestines.

Surgery, trauma, or bacterial injury to the peritoneum can lead to a **paralytic ileus** (acute, transient loss of peristalsis).

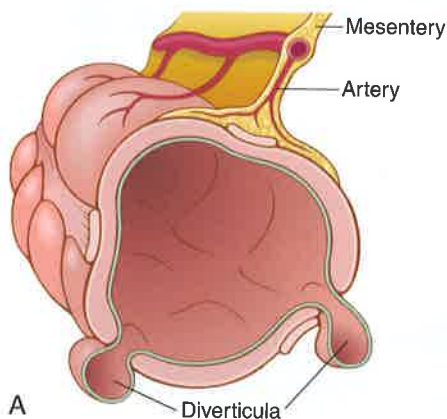


FIGURE 5-23 Diverticula and diverticulosis. (A) Diverticula form when the mucous membrane lining of the colon bulges through the muscular wall. (B) Diverticulosis can result when fecal material lodges in diverticula. Avoidance of foods with seeds and nuts decreases the risk of this condition. (B, From Kumar V et al: Robbins Basic Pathology, 8th ed., Philadelphia, Saunders, 2007, p. 604.)

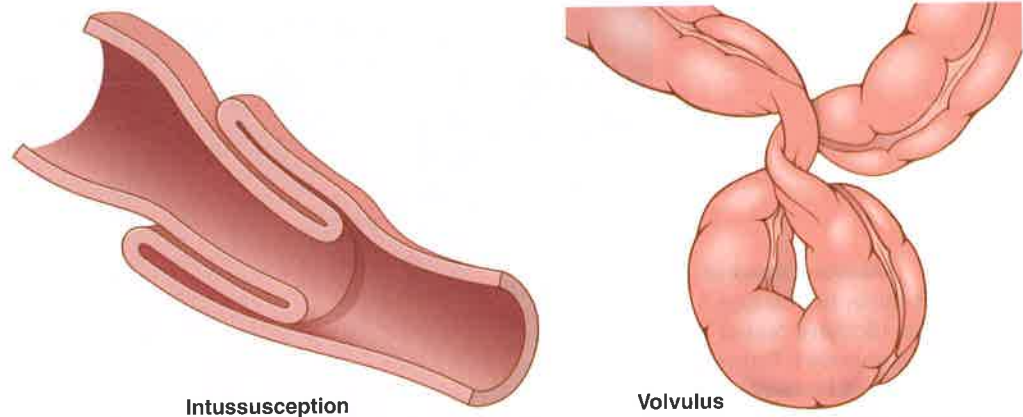


FIGURE 5-24 Intussusception and volvulus. (From Damjanov I: Pathology for the Health-Related Profession, 3rd ed., Philadelphia, Saunders, 2006, p. 261.)

intussusception

Telescoping of the intestines.

In this condition, one segment of the bowel collapses into the opening of another segment (Figure 5-24). It often occurs in children and at the ileocecal region. Intestinal obstruction with pain and vomiting can occur. Surgical removal of the affected segment of bowel with anastomosis frequently is necessary to correct the obstruction.

irritable bowel syndrome (IBS)

Group of gastrointestinal symptoms associated with stress and tension.

Gastrointestinal symptoms are diarrhea, constipation, bloating, and/or lower abdominal pain. On extensive examination, the intestines appear normal, yet symptoms persist. Treatment is symptomatic, with a diet high in bran and fiber to soften stools and establish regular bowel habits.



FIGURE 5-25 (A) Gallstones. Mechanical manipulation during laparoscopic cholecystectomy has caused fragmentation of several cholesterol gallstones, revealing interiors that are pigmented because of entrapped bile pigments. The gallbladder mucosa is reddened and irregular as a result of acute and chronic inflammation (cholecystitis). **(B) Liver with alcoholic cirrhosis.** The normal liver cells (hepatocytes) have been replaced by nodules that are yellow because of their high fat content. (A, From Kumar V et al: Robbins Basic Pathology, 8th ed., Philadelphia, Saunders, 2007, p. 668; B, from Damjanov I: Pathology for the Health-Related Professions, 3rd ed., Philadelphia, Saunders, 2006, p. 286.)

ulcerative colitis**Chronic inflammation of the colon with presence of ulcers.**

This idiopathic, chronic, recurrent diarrheal disease (an **inflammatory bowel disease**) presents with rectal bleeding and pain. Often beginning in the colon, the inflammation spreads proximally, involving the entire colon. Drug treatment and careful attention to diet are recommended. Resection of diseased bowel with ileostomy may be necessary. Patients with ulcerative colitis have a higher risk of colon cancer.

volvulus**Twisting of the intestine on itself.**

Volvulus causes intestinal obstruction. Severe pain, nausea and vomiting, and absence of bowel sounds are clinical features. Surgical correction is necessary to prevent necrosis of the affected segment of the bowel (see Figure 5-24).

LIVER, GALLBLADDER, AND PANCREAS**cholelithiasis****Gallstones in the gallbladder (Figure 5-25A).**

Calculi (stones) prevent bile from leaving the gallbladder and bile ducts (Figure 5-26). Many patients remain asymptomatic and do not require treatment; however, if a patient experiences episodes of **biliary colic** (pain from blocked cystic or common bile duct), treatment may be required. Currently, laparoscopic or minimally invasive surgery (**laparoscopic cholecystectomy**) is performed to remove the gallbladder and stones (Figure 5-27).

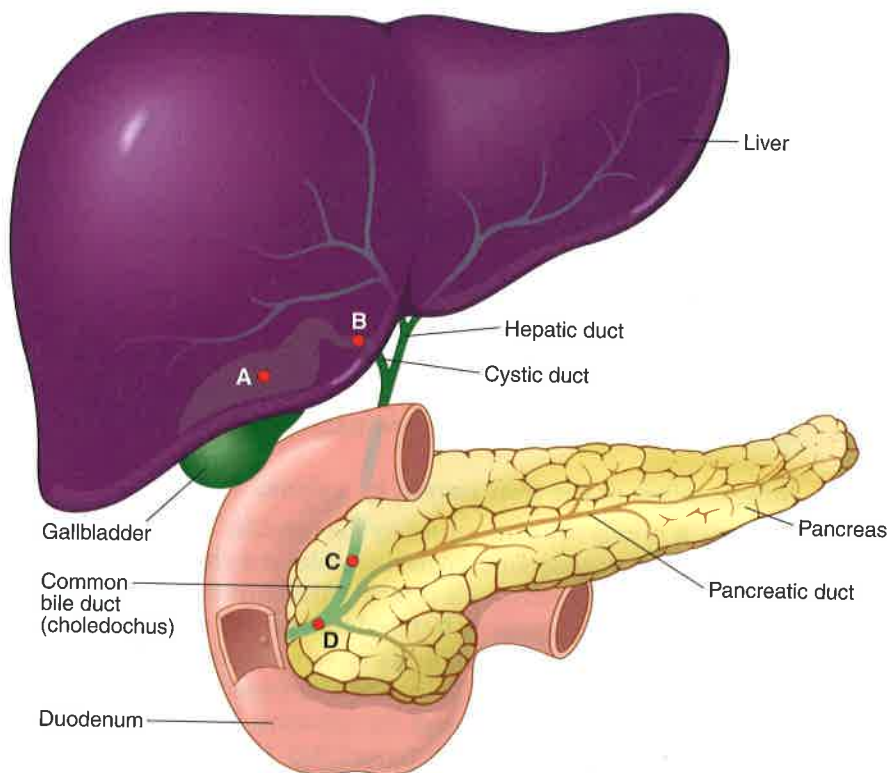


FIGURE 5-26 Gallstone positions. (A) Stone in the gallbladder causing mild or no symptoms. (B) Stone obstructing the cystic duct, causing pain. (C) Stone obstructing the common bile duct, causing pain and jaundice. (D) Stone at the lower end of the common bile duct and pancreatic duct, causing pain, jaundice, and pancreatitis.

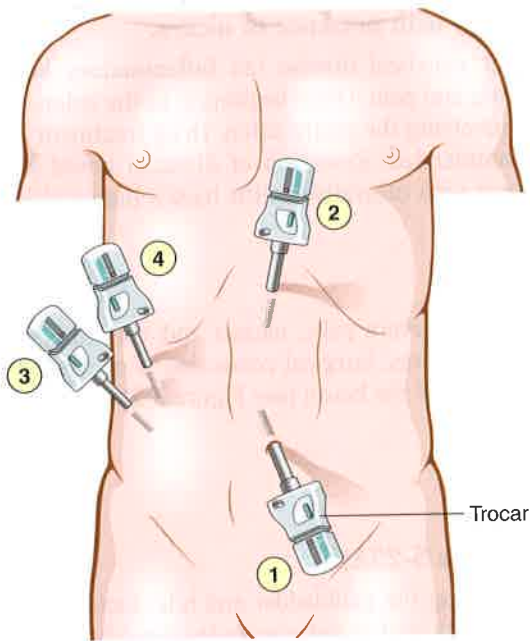


FIGURE 5-27 Trocars in place for laparoscopic cholecystectomy. Trocars are used to puncture and enter the abdomen. These devices are metal sleeves consisting of a hollow metal tube (cannula) into which fits an obturator (a solid, removable metal instrument with a sharp, three-cornered tip) used to puncture the wall of a body cavity. Once the obturator is removed, an endoscope and other instruments can be introduced through the trocar to perform laparoscopic surgery. *Circled numbers* show common positions for trocar insertion: **1** is an umbilical 10/11-mm trocar (the largest trocar diameter is 15). **2** is a 10/11-mm trocar at the midline. **3** and **4** are 5-mm trocars placed in the right upper quadrant of the abdomen.

cirrhosis

Chronic degenerative disease of the liver.

Cirrhosis is commonly the result of chronic alcoholism, or viral hepatitis, or other causes. Lobes of the liver become covered with fibrous tissue, hepatic cells degenerate, and the liver is infiltrated with fat. Cirrh/o means yellow-orange, which describes the liver's color caused by fat accumulation (see Figure 5-25B).

pancreatic cancer

Malignant tumor of the pancreas.

Pancreatic carcinoma occurs more often in men than in women. Although the cause is unknown, it is more common in smokers and people who are obese. Symptoms and signs are abdominal pain, fatigue, jaundice, and anorexia. Surgical treatment is a **pancreatoduodenectomy (Whipple procedure)**.

pancreatitis

Inflammation of the pancreas.

Digestive enzymes attack pancreatic tissue and damage the gland. Other etiologic factors include chronic alcoholism, drug toxicity, gallstone obstruction of the common bile duct, and viral infections. Treatment includes medications to relieve epigastric pain, intravenous fluids, and subtotal pancreatectomy if necessary.

viral hepatitis

Inflammation of the liver caused by a virus.

Hepatitis A is viral hepatitis caused by the hepatitis A virus (HAV). It is a benign disorder spread by contaminated food or water and characterized by slow onset of symptoms. Complete recovery is expected. **Hepatitis B** is caused by the hepatitis B virus (HBV) and is transmitted by blood transfusion, sexual contact, or the use of contaminated needles or instruments. Severe infection can cause destruction of liver cells, cirrhosis, or death. A vaccine that provides immunity is available and recommended for persons at risk for exposure. **Hepatitis C** is caused by the hepatitis C virus (HCV) and is transmitted by blood transfusions or needle inoculation (such as among intravenous drug users sharing needles). The acute illness may progress to chronic hepatitis and hepatocellular carcinoma.

In all types, liver enzyme levels may be elevated, indicating damage to liver cells. Signs and symptoms include malaise, anorexia, hepatomegaly, jaundice, and abdominal pain.