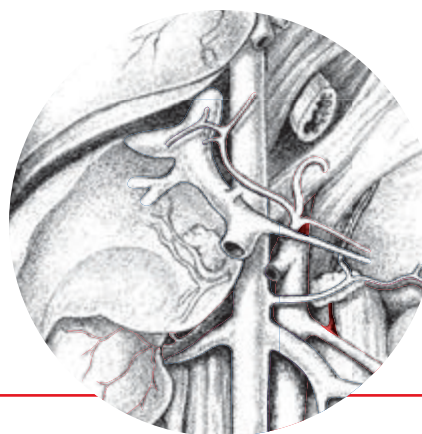


c h a p t e r f o u r

THE DIGESTIVE
SYSTEM

The digestive system is structurally divided into two main parts: a long, winding tube that carries food through its length, and a series of supportive organs outside of the tube. The long tube is called the **gastrointestinal (GI) tract**. The GI tract extends from the mouth to the anus, and consists of the mouth, or oral cavity, the pharynx, the esophagus, the stomach, the small intestine, and the large intestine. It is here that the functions of mechanical digestion, chemical digestion, absorption of nutrients and water, and release of solid waste material take place. The supportive organs that lie outside the GI tract are known as **accessory organs**, and include the teeth, salivary glands, liver, gallbladder, and pancreas.

Because most organs of the digestive system lie within body cavities, you will perform a dissection procedure that exposes the cavities before you begin identifying individual organs. You will also observe the cavities and their associated membranes before proceeding with your study of the digestive system.

EXPOSING THE BODY CAVITIES

With your skinned cat on its dorsal side, examine the cutting lines shown in Figure 4.1 and plan out your dissection. Note that the numbers indicate the sequence of the cutting procedure. Palpate the long, bony sternum and the softer, cartilaginous xiphoid process to find the ventral midline. Then, follow these instructions:

1. Begin your #1 incision by inserting the point of your scissors through the muscle layers about $\frac{1}{4}$ -inch caudal to the tip of the xiphoid process. Make the cut large enough for your finger to poke through, then insert your finger into the body cavity to feel the space beneath the muscle layers. Your incision was very likely made just caudal to the **diaphragm**, an internal muscular partition dividing the thoracic and abdominopelvic cavities. Press your finger gently against the diaphragm; it should feel like the wall of a stretched balloon.
2. Extend the cut laterally in both directions, roughly 4 inches, still working with your scissors. Cut in a curved pattern as shown in Figure 4.1, which follows the contour of the diaphragm. Make your cut through all muscle layers and connective tissue, but be careful to avoid cutting too deeply and damaging the underlying organs. Find the diaphragm again, and with a scalpel, carefully cut it from its attachments to the ventral body wall. Allow the diaphragm to remain on top of the liver.
3. From your first incision, use your scissors to cut in a longitudinal direction roughly $\frac{1}{4}$ -inch to one side of the ventral midline. While cutting, pull upward (toward you) with the scissors to create

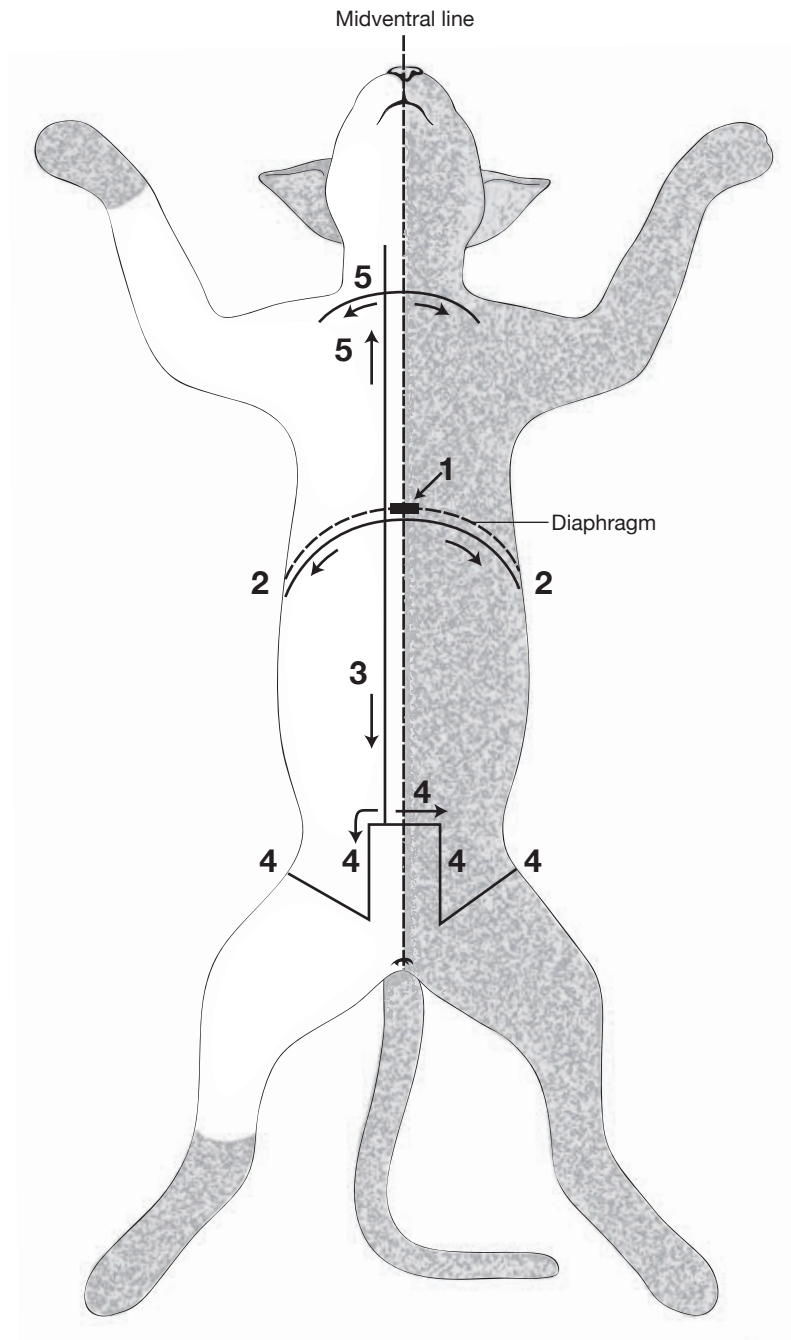


Figure 4.1 – Cutting guide for exposing body cavities (the numbers correspond to the sequences in the text).

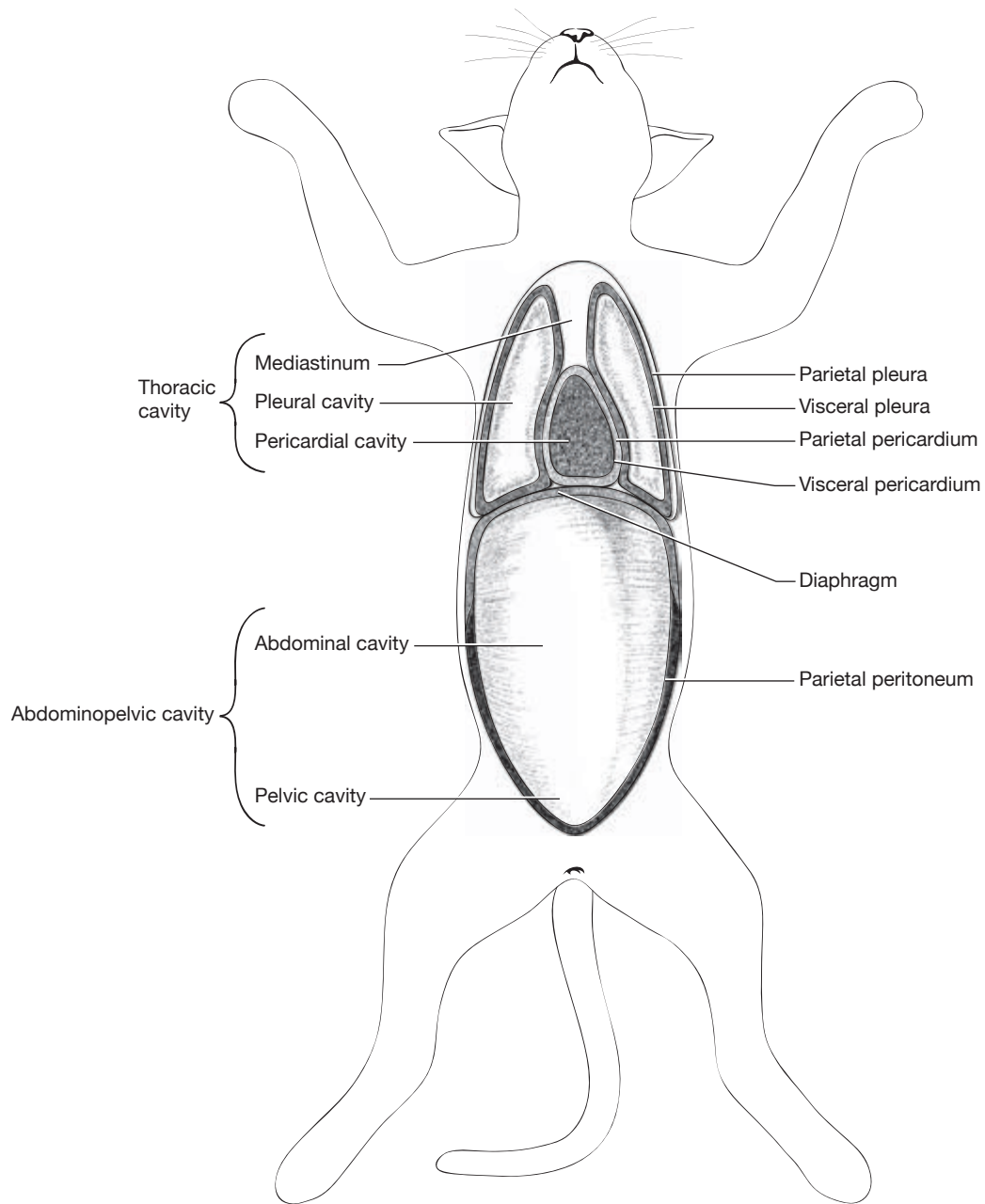


Figure 4.2 - Ventral body cavities.

a space between the body wall and the visceral organs. If performed carefully, this technique will help prevent the scissors from cutting into the organs.

4. Extend your cut down one side of the ventral midline caudally at first, but stop when you feel the resistance of a membrane near the urinary bladder. Then cut laterally about $\frac{1}{2}$ inch, then caudally another $\frac{1}{2}$ inch, then continue the horizontal cut to the iliac crest (see Figure 4.1). These cuts will enable you to cut around the genital region without damaging it.
5. Now you are ready to expose the thoracic cavity. Extend your midventral incision toward the neck region from the #1 incision near the xiphoid process, and cut in a cranial direction. As you reach the neck region, you will have to proceed very slowly to avoid damaging the arteries (colored red with latex), veins (colored blue with latex), and nerves (white). Cut only muscle tissue to expose the organs lying deep in the neck, including the trachea, thyroid gland, and larynx.
6. With your cutting complete, reflect the thoracic and abdominal walls to reveal the internal cavities. You will have to fracture ribs to reflect the thoracic wall, so press the walls laterally until you hear the snapping sound. Since the fractured ends of the ribs can be sharp, take care to avoid cutting yourself.

VENTRAL BODY CAVITIES AND MEMBRANES

Now that you've exposed the ventral body cavities and their associated membranes, identify them from the descriptions that follow (Figure 4.2). The ventral body cavity is also known as the **coelom**, or **coelomic cavity**.

Thoracic Cavity

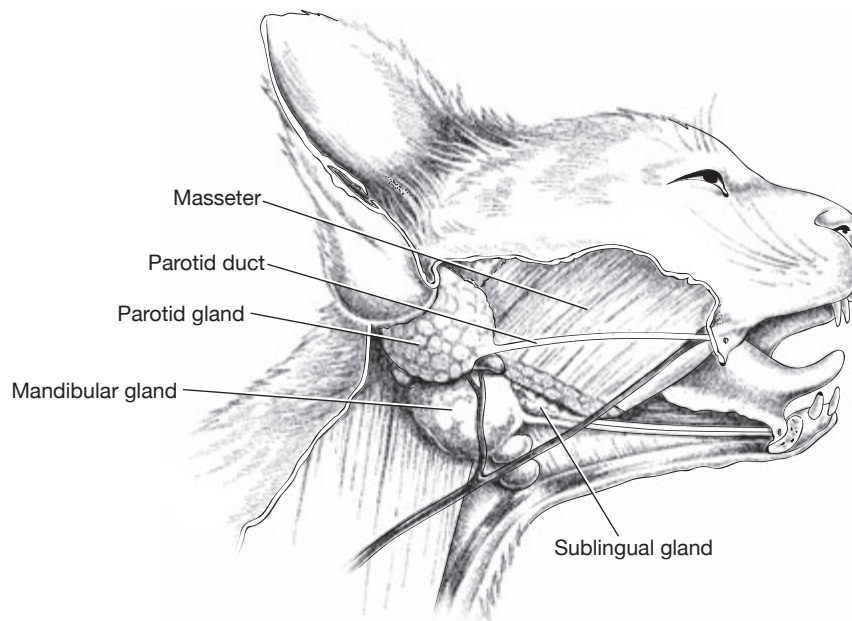
The thoracic cavity is the potential space located cranial to the diaphragm. It is lined by a moist membrane called the **parietal pleura**. The parietal pleura continues inward to cover both lungs, forming the **visceral pleura**. Between the two pleural membranes is a moist space called the **pleural cavity**. The thoracic cavity also includes the **pericardial cavity** along its midline, which contains the heart. The pericardial cavity is sandwiched between two layers of the **pericardium**, which includes an outer **parietal pericardium** (or pericardial sac) and an inner **visceral pericardium**. In addition, the potential space located cranial to the heart is known as the **mediastinum**, which contains the major vessels of the heart and the thymus gland.

Abdominopelvic Cavity

The abdominopelvic cavity is the large cavity located caudal to the diaphragm. It is lined by a membrane attached to the inner body wall called the **parietal peritoneum**. The parietal peritoneum extends inward to wrap around many of the organs of the abdominopelvic cavity. The part of the peritoneum covering most of the visceral organs is known as the **visceral peritoneum**. The cavity between the two peritoneal membranes is called the **peritoneal cavity**, and contains a small amount of fluid that helps reduce friction between adjacent visceral organs. The peritoneum also includes numerous extensions, or folds, which will be described later in this chapter. The abdominopelvic cavity contains many visceral organs, including the stomach, small intestine, large intestine, liver, pancreas, gallbladder, internal reproductive organs, and more. Its larger cranial portion is the **abdominal cavity**, which extends from the diaphragm to the level of the iliac crest. The smaller caudal area is the bowl-shaped **pelvic cavity**.

CRANIAL DIGESTIVE STRUCTURES

The organs and associated structures of the digestive system will be described sequentially from the salivary glands around the mouth to the anus. The system has been divided into a cranial por-



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Figure 4.3 – Salivary glands (lateral view of the head and neck).

tion and a caudal portion, with the diaphragm serving as the line of division between the two. The cranial digestive structures include the salivary glands, oral cavity, pharynx, and esophagus. Locate each structure in your cat and identify its characteristic features.

Salivary Glands

To expose the **salivary glands**, carefully remove any connective tissue and fat that remains on the lateral side of the head and neck, especially on the surface of the masseter muscle. Be very careful to avoid damaging blood vessels, nerves, and small tubes that you see as you clean.

The salivary glands are located in the head region surrounding the oral cavity. They are soft, lobular structures that connect to the oral cavity by way of a duct. Salivary glands are exocrine glands that secrete a watery fluid, saliva, into ducts that carry it into the oral cavity when food is present. The cat has three major salivary glands and two minor glands.

PAROTID GLANDS: the largest of the salivary glands, they are paired structures located superficial to the masseter muscle on each side of the head just below the ear (Figure 4.3). Emerging from its rostral surface is the **parotid duct**, which crosses over the masseter muscle before entering the vestibule (space between the teeth and the lip). It opens opposite to the third upper premolar tooth.

MANDIBULAR GLANDS: paired glands, each located immediately ventral to the parotid gland and posterior to the angle of the mandible (Figure 4.3). The duct emerges from the anterior edge of each gland, then extends laterally beneath the digastric muscle to enter the floor of the oral cavity just anterior to the lingual frenulum (beneath the tongue).

SUBLINGUAL GLANDS: small, paired glands located at the anterior end of each mandibular gland. The sublingual duct extends parallel to the submandibular duct, although it is smaller and difficult to observe.

MOLAR GLANDS: a minor pair of salivary glands in the cat, each located at the angle of the jaw immediately deep to the skin (not shown). Several small, inconspicuous ducts open at the inner surface of the cheeks.

ZYGOMATIC GLANDS: a minor pair of salivary glands, each located in the floor of the eye orbit (not shown). A small duct from each gland opens at the posterolateral part of the roof of the mouth.

The salivary glands of humans include the large parotid glands, the submandibular glands, and the sublingual glands. The parotids are located similarly to those of the cat, and the parotid duct opens into the vestibule opposite the second maxillary molar tooth. The submandibulars are paralleled by the mandibulars in the cat. The sublinguals are located anterior to the submandibulars at the base of the tongue, and the sublingual duct opens into the floor of the oral cavity directly above the glands. Humans do not have molar and zygomatic glands.

Oral Cavity

To expose the mouth, or **oral cavity**, cut through the muscles and connective tissue suspending

the jaw on one side of your cat. Using bone shears, cut the condyloid portion of the mandible on the same side. Pry the mouth open, and locate the following structures of the oral cavity (Figure 4.4).

VESTIBULE: the part of the oral cavity located between the teeth and cheeks. Notice the **labial frenulum**, which is a fold of tissue through the midline of the vestibule connecting the upper and lower lips.

TEETH: the dental formula for the cat is as follows: for the upper jaw, 6 incisors, 2 canines, 3 premolars, and 2 molars (6:2:3:2); for the lower jaw, 6 incisors, 2 canines, 4 premolars, and 2 molars (6:2:4:2). This dentition reflects adaptations for a carnivorous diet. *The comparative dental formula for adult humans is the same for both jaws: 4 incisors, 2 canines, 4 premolars, and 6 molars. Also, the human canines are shorter and more blunt, and the molars are more flat, which reflect the omnivore diet that includes less cutting and ripping, and more grinding.*

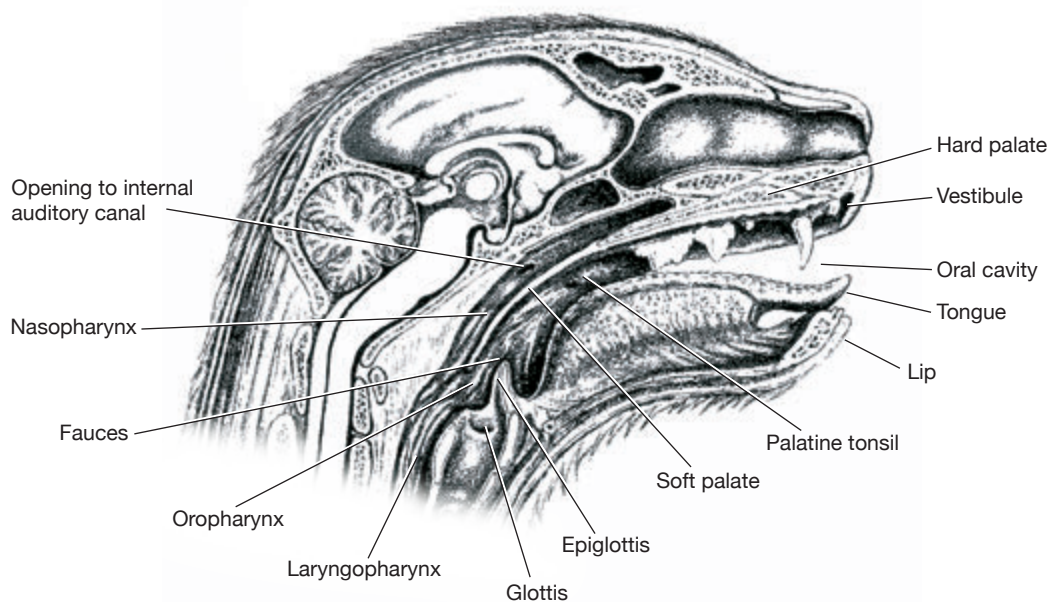


Figure 4.4 – Oral cavity and pharynx.

HARD PALATE: the rostral portion of the roof of the oral cavity. It is formed by the maxillary and palatine bones and is lined with mucous membrane.

SOFT PALATE: caudal to the hard palate, it is a muscular partition between the oral cavity and nasal cavity, and is lined with mucous membrane.

TONGUE: the large, muscular organ that makes up the floor of the oral cavity. It is attached to the floor of the mouth by a ventral fold of tissue called the **lingual frenulum**. The frenulum can be seen when the tongue is lifted from the floor. The tongue's surface contains four types of elevated structures called **papillae**, which house the taste buds for the reception of taste. In the cat, the most common papillae are the **filiform**, which include sharp projections to give the cat a friction surface for grooming. Other papillae include the mushroom-shaped **fungiform**, the large, rounded **vallate**, and the leaf-shaped **foliate**. *The human tongue is very similar, except filiform papillae are less abundant and not as sharply pointed, and foliate papillae are not present.*

PALATOGLOSSAL ARCHES: lateral folds on both sides of the oral cavity wall, extending from the caudal portion of the tongue to the soft palate. They represent the boundary between the oral cavity and the pharynx.

FAUCES: the opening at the extreme caudal portion of the oral cavity between the palatoglossal arches. The fauces leads into the oropharynx.

Pharynx

The **pharynx** is the chamber located caudal to the fauces, extending from the oral cavity to the larynx (Figure 4.4). It provides a passageway for air traveling to and from the lungs and for food traveling from the mouth to the esophagus. It is commonly divided into three sections, the nasopharynx, oropharynx, and laryngopharynx.

NASOPHARYNX: the cranial part of the pharynx. To view it, make a longitudinal incision along the midline of the soft palate, and carefully pry the two sections apart as far as pos-

sible. If one is available, shine a light into the cavity. In the lateral walls of the nasopharynx are the openings to the paired **internal auditory canals**, which communicate with the middle ear.

OROPHARYNX: located between the palatoglossal arches and the free caudal margin of the soft palate. The oropharynx communicates with the oral cavity through the fauces. Embedded within its laterodorsal walls are a pair of **palatine tonsils**, each of which lies partially recessed in a shallow depression called the tonsillar fossae.

LARYNGOPHARYNX: the caudal part of the pharynx. It extends from the oropharynx to the larynx. Its slit-like opening to the larynx is called the **glottis**, which is protected from passing food particles by a movable fold known as the **epiglottis**.

Esophagus

The **esophagus** is long, muscular tube that transports swallowed material from the pharynx to the stomach. It lies dorsal to the trachea and travels the length of the thoracic cavity. At its caudal end it penetrates the diaphragm to unite with the stomach in the abdominal cavity. Because it is located in the thoracic cavity dorsal to the heart and lungs, the esophagus will not be dissected at this time, but you will be able to observe it during your study of the respiratory system (Chapter 5).

CAUDAL DIGESTIVE STRUCTURES

The structures of the digestion system located caudal to the diaphragm include the liver, gallbladder, stomach, pancreas, small intestine, and large intestine. To observe these organs and their associated structures, pull back the flaps of the abdominal wall to expose the abdominopelvic cavity.

Peritoneum

The **peritoneum** is the extensive serous membrane of the abdominopelvic cavity, which you observed when you initially opened the cavity. The **peritoneal folds** are extensions of the visceral

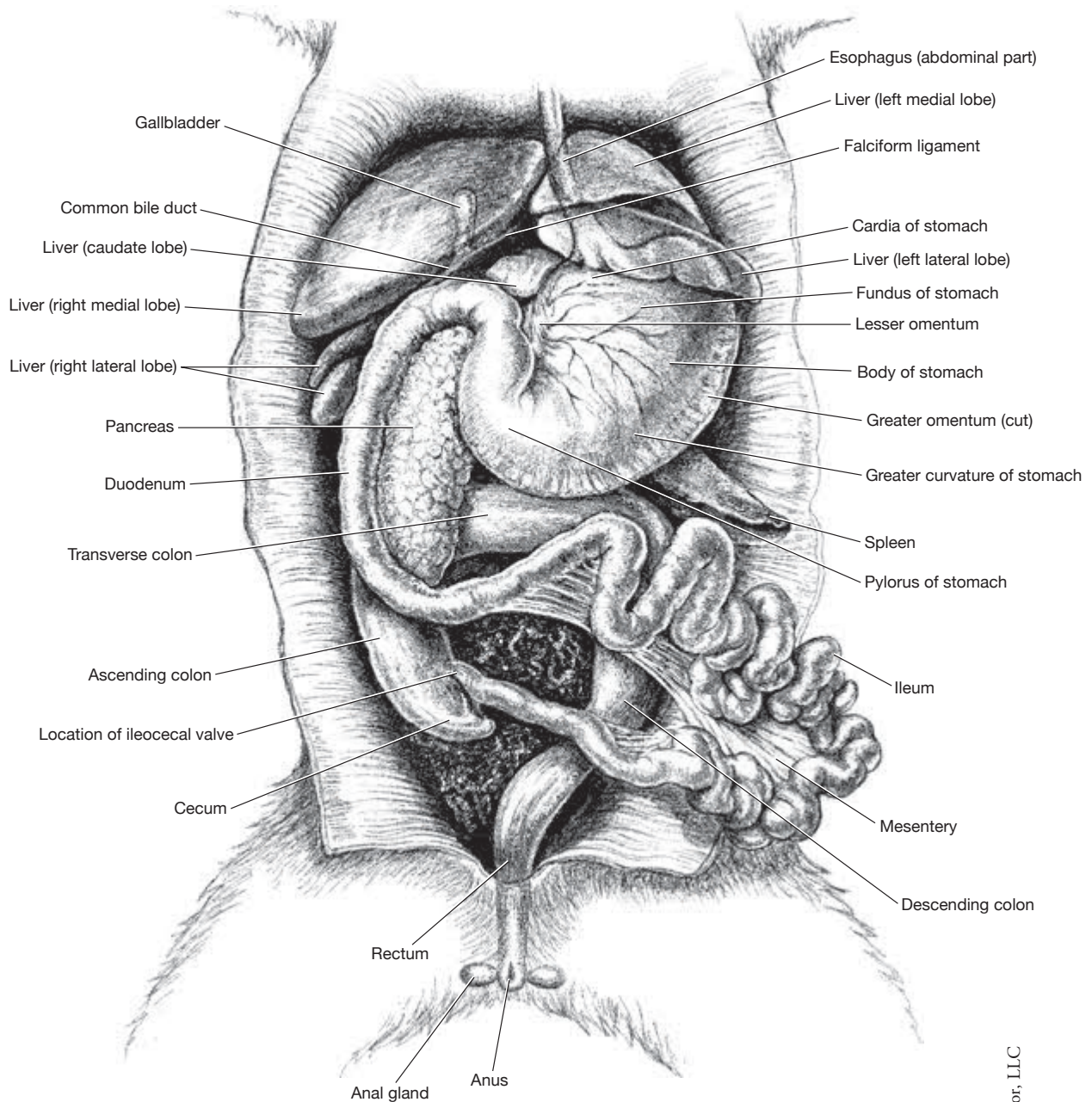


Figure 4.5 – Organs and peritoneum of the abdominopelvic cavity.

and parietal peritonea, and include the following (Figure 4.5):

FALCIFORM LIGAMENT: a double-layered extension of the visceral peritoneum of the liver. It anchors the liver to the dorsal wall of the abdomen and the diaphragm, and separates the liver into right and left lobes.

MESENTERY: a double layer of peritoneum that extends from the visceral peritoneum of the small and large intestines to the dorsal abdominal wall. The portion that suspends the small intestine is called the **mesentery proper**, the part supporting the large intestine is the **mesocolon**, and the part attached to the rectum is the **mesorectum**. Note that

the pancreas is located within the mesentery proper.

LESSER OMENTUM: a double layer of peritoneum extending from the lesser curvature of the stomach and the duodenum of the small intestine to the liver. Notice the common bile duct, which is located on the free edge of the lesser omentum. This duct transports bile from the liver and gallbladder to the duodenum.

GREATER OMENTUM: a double layer of peritoneum that extends from the greater curvature of the stomach to the dorsal abdominal wall. The double-layered sac extending ventrocaudally to the small intestine is called the **omental bursa**, or lesser peritoneal sac,

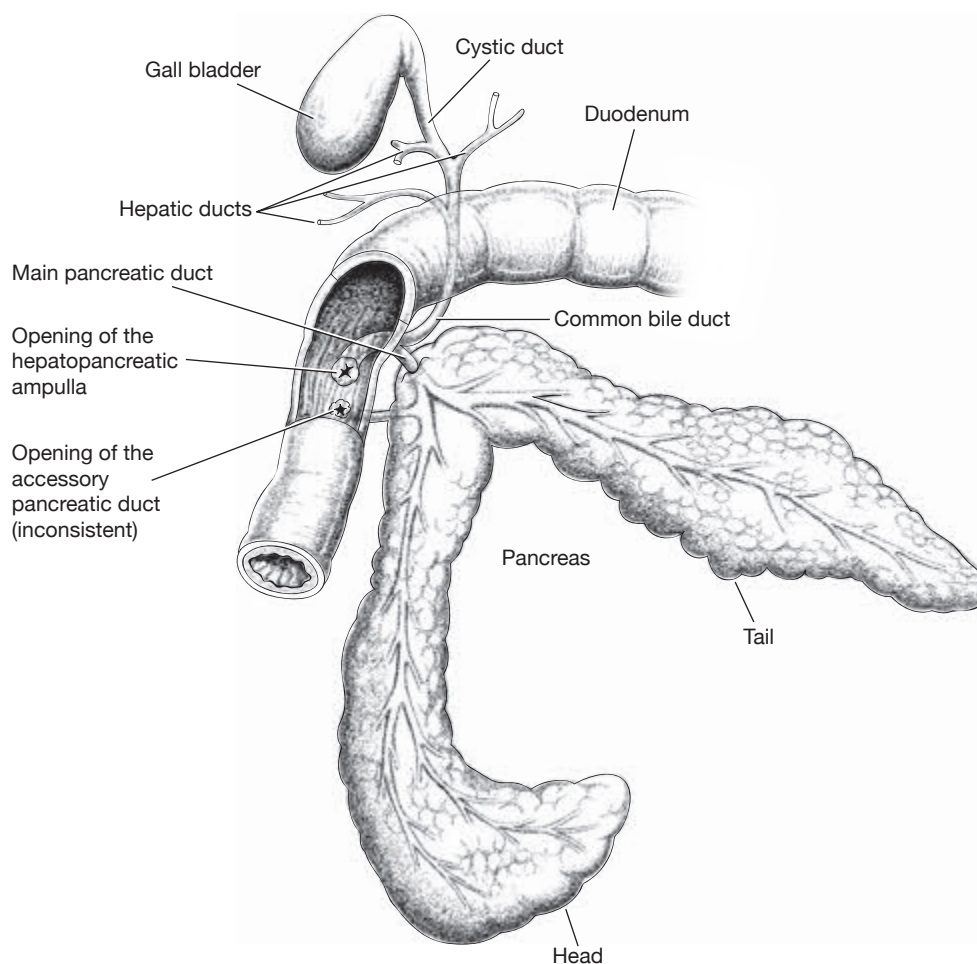


Figure 4.6 – Gallbladder, biliary ducts, and pancreas.

and contains fat deposits, lymph nodes, and lymphatic vessels.

Liver

The **liver** is the prominent, dark-brown organ lying immediately deep to the diaphragm, with most of its bulk on the right side (Figure 4.5). Its functions include management of sugar and fat levels in the blood, storage of toxins, and production of a yellow-green fluid that breaks down fats, called bile. In the cat, the liver is divided into six lobes. Identify the falciform ligament once again, which divides the liver into right and left portions. The left side of the liver includes a **left medial lobe** and a **left lateral lobe**. The right side of the liver includes a **quadrate lobe** adjacent to the falciform ligament, which is partially united with the **right medial lobe**. Between these two lobes is a depression that contains the greenish sac known as the gallbladder. Dorsolateral to the right medial lobe is the **right lateral lobe**, and dorsal to it is the smaller **caudate lobe**. *The human liver is also a prominent organ, but contains only four lobes: a large right lobe separated from the smaller left lobe by the falciform ligament, a quadrate lobe, and a caudate lobe.*

Gallbladder

Elevate the right medial lobe and quadrate lobe of the liver to observe the **gallbladder**, located in a depression between the two lobes, known as the cystic fossa (Figures 4.5 and 4.6). The gallbladder is a thin-walled sac that receives newly manufactured bile from the liver for temporary storage. When a meal is consumed, the gallbladder contracts to push bile into the **cystic duct**. The cystic duct combines with numerous **hepatic ducts** arising from the left lobes and right lateral lobe of the liver to form the **common bile duct**. The common bile duct extends caudally to unite with the duodenum of the small intestine at the hepatopancreatic ampulla. Once in the small intestine, bile assists in the digestion of fats.

Stomach

The stomach is a J-shaped enlargement of the GI tract, located directly beneath the diaphragm on the left side of the abdominal cavity (Figure 4.5). It functions as a temporary reservoir for swallowed food, and its inner lining contains **gastric glands** that secrete hydrochloric acid and the enzyme pepsinogen to begin the process of protein digestion. The lateral border of the stomach forms a rounded, convex surface called the **greater curvature**, and its medial border forms a concave angle known as the **lesser curvature**. Note the peritoneal fold called the greater omentum, which originates from the greater curvature to hang downward. Also note the flat, elongate, dark-reddish **spleen** near the left dorsolateral surface of the greater curvature. The spleen is part of the lymphatic system. Similar to the human stomach, the stomach of the cat is divided into the following parts:

CARDIA: the part of the stomach that receives the esophagus. It surrounds the **lower esophageal sphincter**, the ring of muscle that separates the stomach from the esophagus.

FUNDUS: a sac-like, rounded portion that extends laterally to the cardia and slightly cranial.

BODY: the large, central portion of the stomach, which is located caudal to the fundus.

PYLORUS: the narrow, caudal part that communicates with the duodenum of the small intestine via a sphincter muscle called the **pyloric valve**.

Once you've identified the parts of the stomach, make an incision along the greater curvature from the fundus to the pylorus, taking great care to avoid damaging the greater omentum. Notice the folds in the wall of the stomach, which are called **rugae**. They allow the organ to expand with incoming food.

Small Intestine

The small intestine is a long, winding tube that extends from the pyloric valve of the stomach to its junction with the large intestine (Figure 4.5). The small intestine finalizes chemical digestion

and is the only site for nutrient absorption. Its inner lining is characterized by the presence of tiny, fingerlike **villi**, which increase its absorptive surface area. Similar to the human small intestine, the small intestine of the cat is divided into three segments:

DUODENUM: the largest of the three segments in diameter, but the shortest in length, it extends from the pyloric valve to its union with the jejunum. In the cat, it ranges in length from 12-18 cm (5-7 inches). The duodenum receives the common bile duct from the liver and gallbladder and the pancreatic duct from the pancreas.

JEJUNUM: the middle segment of the small intestine, it is the longest, with an average length of about 50 cm (20 inches) in the cat.

ILEUM: the caudal segment, it extends from its union with the jejunum to the large intestine about 35 cm (14 inches) in the cat. A doughnut-shaped muscle called the **ileocecal valve** surrounds the junction of the ileum and large intestine. Similar to the pyloric valve, it regulates the movement of materials from one organ (the small intestine) to the next (the large intestine), and prevents the reflux of contents in the opposite direction.

Large Intestine

The caudal portion of the GI tract, the large intestine extends from the ileocecal valve to the anus (Figure 4.5). It gets its name from being larger in diameter along its entire length than the small intestine, although it is roughly one-third the length. The large intestine absorbs water from the contents that arrive from the small intestine, and prepares and forms the feces. Smooth muscles in the wall of the large intestine contract to move the feces and release it during defecation. The large intestine contains the following segments:

CECUM: the cranial segment, which communicates with the ileum via the ileocecal valve. It is a short, blind diverticulum in the right caudal aspect of the abdominal cavity. *The human cecum includes a fingerlike tube extend-*

ing from it, known as the appendix, which is lacking in the cat.

COLON: a long, wide segment extending from the cecum to the rectum. The colon is divided into an **ascending colon**, which ascends from its union with the cecum to the area occupied by the liver; a **transverse colon** that travels transversely from the right side near the liver to the left side of the cranial abdominal cavity; and a **descending colon**, which curves caudally to descend to the pelvic cavity.

RECTUM: the terminal segment of the large intestine. The short rectum opens to the exterior via the **anus**, which is surrounded by sphincter muscles. A pair of scent glands, known as **anal glands**, open into the rectum near the anus. Secretions from the anal glands are important for marking territorial boundaries. *The large intestine of the human is similar to that of the cat, except the human includes a sigmoid colon between the descending colon and rectum, which is an S-shaped curvature. Also, humans lack anal glands.*

Pancreas

The **pancreas** is a diffuse mass of soft glandular tissue located within the mesentery proper of the small intestine (Figures 4.5 and 4.6). It is located just below the greater curvature of the stomach, and slightly dorsal to it, and includes a caudal head portion and a cranial tail portion. The pancreas functions in the secretion of hormones that regulate blood sugar levels, and also in the secretion of digestive enzymes and sodium bicarbonate. The digestive enzymes and sodium bicarbonate form the pancreatic juice, which is channeled out of the pancreas by the main **pancreatic duct**. This duct unites with the common bile duct to be delivered into the duodenum. At the union of the common bile duct and duodenum is a small elevation known as the ampulla of Vater, or **hepatopancreatic ampulla**. An accessory duct may also be present.

CHAPTER REVIEW

A. Answer the following multiple-choice questions by circling the most correct answer.

1. Which of the following organs forms part of the GI tract?
 - a. stomach
 - b. peritoneum
 - c. tongue
 - d. liver
2. The digestive organ that is the site of nutrient absorption is the
 - a. liver
 - b. stomach
 - c. small intestine
 - d. esophagus
3. The membrane that lines the thoracic wall is the
 - a. pericardium
 - b. parietal peritoneum
 - c. parietal pleura
 - d. greater omentum
4. The structure that separates the thoracic and abdominopelvic cavities is called the
 - a. diaphragm
 - b. pericardial sac
 - c. falciform ligament
 - d. lesser omentum
5. The abdominopelvic cavity contains
 - a. the abdominal cavity
 - b. the stomach
 - c. the large intestine
 - d. all of the above
6. The largest of the salivary glands are
 - a. the maxillary glands
 - b. located on the tongue
 - c. the parotid glands
 - d. do not produce saliva
7. The prominent, brown organ beneath the diaphragm on the right side is the
 - a. pancreas
 - b. liver
 - c. duodenum
 - d. gallbladder
8. The soft, glandular organ that provides digestive enzymes to the duodenum is the
 - a. liver
 - b. pancreas
 - c. stomach
 - d. gallbladder
9. The segments of the large intestine are the
 - a. cecum, colon, and rectum
 - b. duodenum, jejunum, and ileum
 - c. cardia, body, and pylorus
 - d. none of the above
10. The first abdominopelvic structure receiving food is the
 - a. duodenum
 - b. stomach
 - c. cecum
 - d. pharynx

B. Complete the sentences below by providing the missing terms from the chapter material.

1. The liver, pancreas, and salivary glands are _____ of the digestive system.
2. The membrane attached to the inner wall of the abdominopelvic cavity is the _____.
3. The larger, cranial portion of the abdominopelvic cavity is known as the _____.
4. The paired glands located immediately ventral to the parotid gland and posterior to the angle of the mandible are the _____.
5. The rostral portion of the roof of the oral cavity is called the _____.
6. The _____ is attached to the floor of the mouth by a ventral fold of tissue called the lingual frenulum.
7. The part of the cat's throat that contains the palatine tonsils is the _____.
8. A double layer of peritoneum that extends from the visceral peritoneum of the small and large intestines to the dorsal abdominal wall is known as the _____.
9. Bile is channeled into the duodenum from the _____ by way of the common bile duct.
10. The union of the small and large intestines is marked by a valve called the _____ valve.

C. Answer the following descriptive and critical-thinking questions with a brief explanation in the spaces provided.

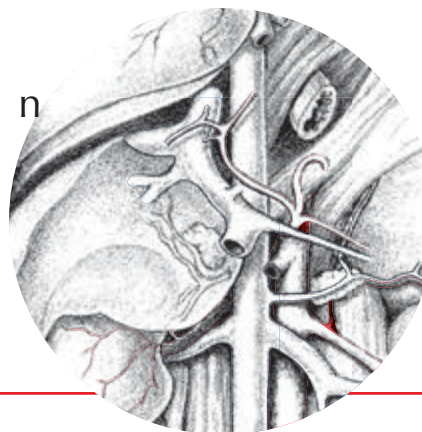
1. Describe the process of digestion by including contributions by the oral cavity, salivary glands, stomach, and small intestine.

2. Describe the contributions to the function of digestion by the liver, gallbladder, and pancreas.

3. Based on the anatomical similarities between cats and humans, suggest the type of diet that humans are adapted for and explain why.

c h a p t e r s e v e n

THE UROGENITAL SYSTEM



The urogenital system combines two systems, the urinary system and the reproductive system. The two systems are combined in this chapter because of the close anatomical relationship between them, which is common among mammals. As you will soon discover, several urinary organs lie in direct contact with reproductive organs, and in some cases, the functions of both systems take place within a common organ. The overall functions of the two systems are quite distinct, however.

The primary function of the urinary system is the formation of urine, which achieves several roles: the removal of nitrogen-containing materials that result from metabolic activities; the management of the water and salt balance of body fluids; and the regulation of blood pressure. Urine formation occurs in the kidneys, at the site of functional subunits called **nephrons**. Within the nephrons, blood is filtered, water is reabsorbed back into the bloodstream, and unwanted ions are secreted, resulting in a waste fluid known as urine. The remaining organs of the urinary system channel urine to the body's exterior. They are the ureters, urinary bladder, and urethra.

In contrast to urinary functions, the reproductive system performs the role of procreation. The system is unique in that the male and female structures are very different from each other, and are therefore said to exhibit **sexual dimorphism**. In the female, the reproductive organs are highly adapted for the production of the female gametes (**ova**) and for the internal fertilization process, the internal incubation of the developing embryo and fetus, and the birth process. In the male, reproductive organs are adapted for the production of the male gametes (**spermatozoa**) and for the internal semination process.

In this chapter, you will examine the urogenital system of the cat through dissection. The chapter begins with a study of the urinary system. Then, you will study the reproductive systems, including that of both sexes.

THE URINARY SYSTEM

With your cat specimen lying on its dorsal side, locate the following organs and features of the urinary system. The urinary organs include the kidneys, ureters, urinary bladder, and urethra.

Kidneys

The kidneys are bean-shaped organs that lie partially embedded in fat against the dorsal body wall (Figures 7.1, 7.2, and 7.3). To observe them, you must first push the visceral digestive organs completely to one side. If you are dissecting on a wax tray, pin these organs to the tray for the

remainder of your study of the urogenital system. Note that the kidneys are not suspended within the abdominal cavity, as are the visceral digestive organs, but lie outside the parietal peritoneum. This positioning is called **retroperitoneal**. Also note the position of the **adrenal glands**, which lie slightly cranial and medial to each kidney.

Carefully remove the fat from one of the kidneys, section it along the frontal plane, and identify the following features (Figure 7.1).

RENAL FASCIA: the outer layer of connective tissue that anchors each kidney to the dorsal abdominal wall.

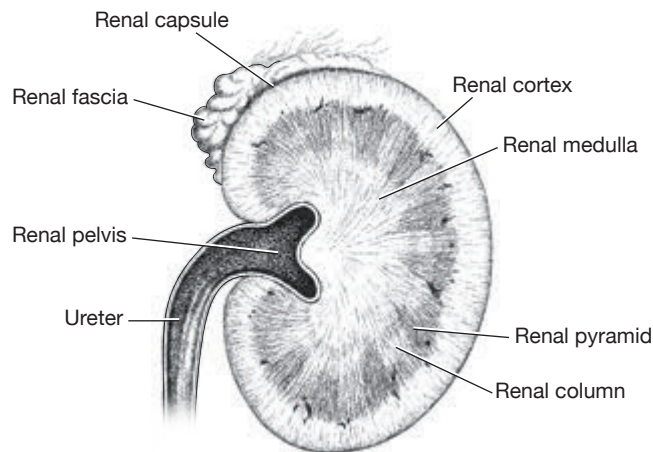


Figure 7.1 – Kidney (sectioned along the frontal plane).

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RENAL CAPSULE: a thin layer of transparent fibrous connective tissue that encloses each kidney and is deep to the renal fascia.

HILUM: a depression near the center of each kidney's concave medial border through which the renal artery, renal vein, lymphatic vessels, and nerves enter or exit.

RENAL PELVIS: a membrane-lined basin in the center of each kidney, which unites with the mucous membrane lining the ureter. Along its borders are cup-like extensions known as calyces, including major and minor. The calyces receive newly formed urine and channel it into the center of the renal pelvis.

RENAL CORTEX: the outermost region of the kidney. It is relatively smooth in texture, and outlines the internal periphery. The renal cortex extends from the renal capsule to the internal region of the kidney, the medulla (described next). The cortex is composed of blood vessels and renal corpuscles (ball-shaped components of nephrons that contain the filtration apparatus).

RENAL MEDULLA: the inner region of the kidney parenchyma. It includes from six to eighteen triangular, striated structures called **renal pyramids**. The bases of the pyramids face the

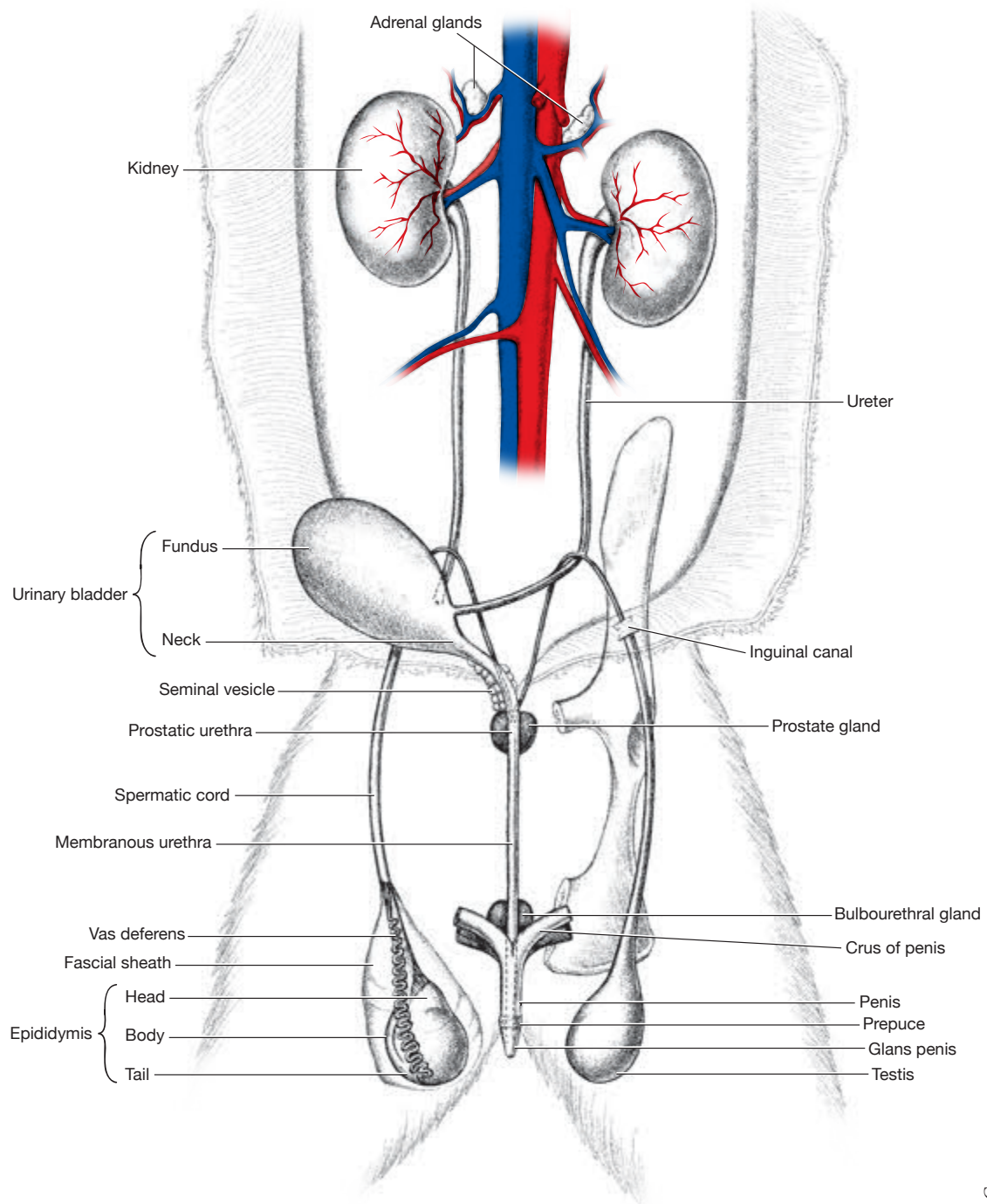
renal cortex, and the apices, or renal papillae, point to the renal pelvis. The areas between adjacent renal pyramids are called **renal columns**. The renal medulla is composed of blood vessels and renal tubules (lengths of tubes that form part of the nephron).

Ureters

The paired ureters are narrow tubes that transport urine from the hili of the kidneys to the urinary bladder at the base of the pelvic cavity (Figures 7.2 and 7.3). Each ureter arises from the renal pelvis of a kidney, and courses caudally in a retroperitoneal pathway until it unites with the dorsal wall of the bladder. Along the surface of each ureter is a thin layer of fibrous connective tissue that is continuous with the renal capsule of a kidney. Carefully pick away any remaining connective tissue and fat covering one of the ureters to expose it. In males, another small tube, the vas deferens, coils around the ureter near the base of the urinary bladder; avoid damaging the vas deferens for later study.

Urinary Bladder

Follow the path of the ureters to their caudal extremities. Here they unite with the sac-like urinary bladder (Figures 7.2 and 7.3). The urinary



THE UROGENITAL SYSTEM

Figure 7.2 – Urogenital system of the male cat.

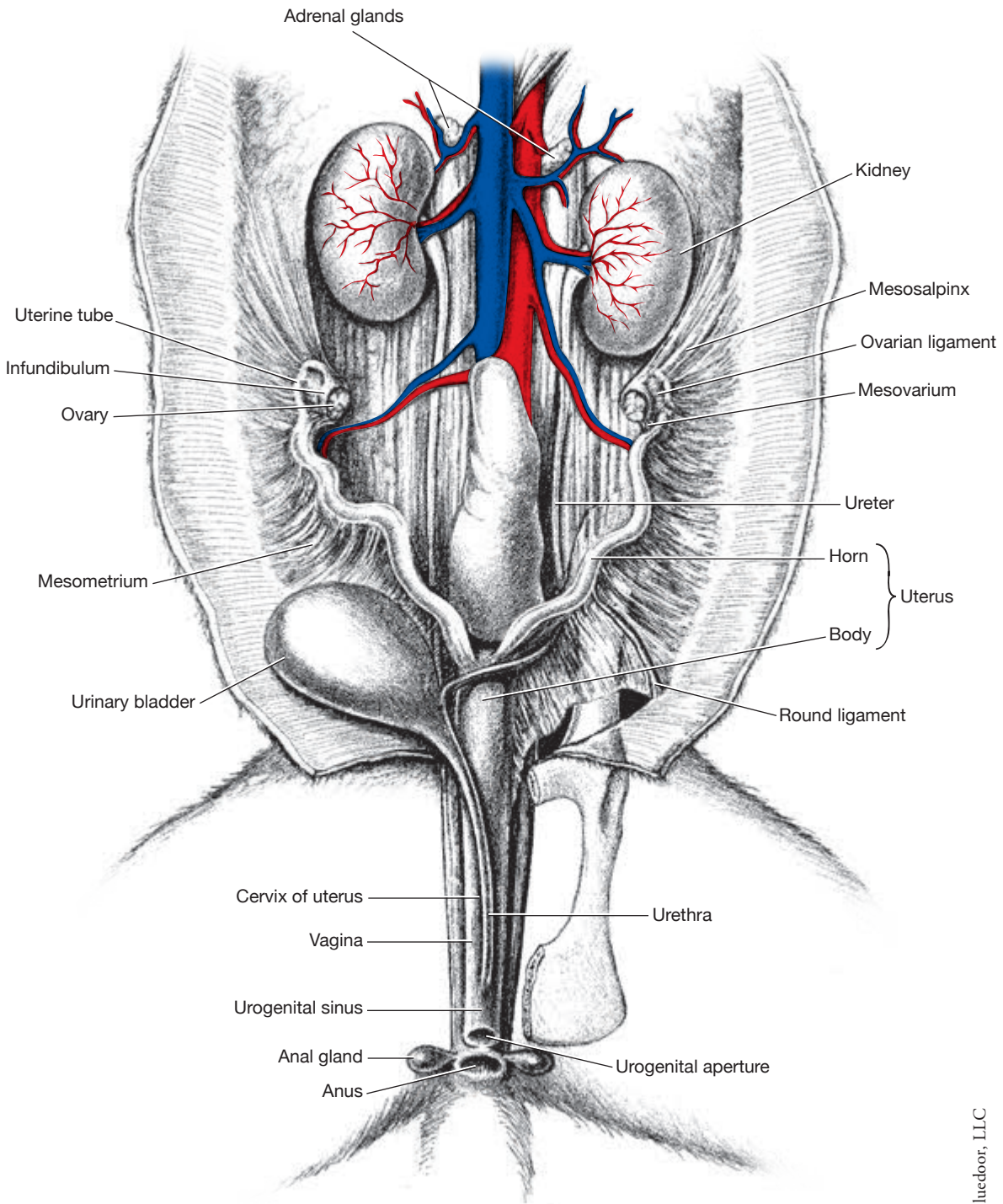


Figure 7.3 – Urogenital system of the female cat.

bladder is a reservoir for urine. In the preserved state, it is empty and reduced in size, but when it fills with urine, it expands about 5-fold. The expanded cranial portion is the **fundus**, and the narrow caudal portion is the **neck**. Section the bladder along the frontal plane and note the wrinkled texture of the internal surface. These “wrinkles” are called **rugae**. Also note the points of entry of the two ureters at the dorsal wall and the exit opening to the urethra. These three openings form an internal triangle known as the **trigone**. The bladder is held in position ventrally by a median ligament and on each side by lateral ligaments, and is protected by pads of fat.

Urethra

The urethra is the duct that transports urine from the urinary bladder to the exterior of the body. Because the urethra lies mainly in the pelvic canal, you will observe it during dissection of the reproductive system (Figures 7.2 and 7.3). The urethra exhibits sexual dimorphism because its length varies between males and females. In the female, it is a short duct that empties to the exterior by way of the **urogenital orifice**. The caudal portion of the female urethra is also the caudal portion of the vagina, and is called the **vaginal vestibule** (or **urogenital sinus**). The male urethra is much longer, extending from the urinary bladder to the tip of the penis, where it opens as the **urogenital orifice**. The male urethra is associated with both urinary and reproductive functions, since it transports urine and semen. It is divided into three portions: the proximal portion is the **prostatic urethra**, the middle portion is the **membranous urethra**, and the distal portion extending through the penis is the **spongy urethra**. *The human urethra is very similar, except it opens to the exterior as the urinary meatus.*

THE REPRODUCTIVE SYSTEM

Your study of the reproductive system is divided into the male and female systems. On the basis of the descriptions that follow, determine the sex of your specimen, if you have not yet done so, and follow the appropriate dissection protocol. Then locate a specimen of the opposite sex within your lab, and examine it also.

Male Reproductive Structures

The organs of the male reproductive system include the male gonads, known as the testes, which are located within the scrotum. They also include the penis, a series of tubes that carry spermatozoa and fluids collectively called semen, and the glands that produce the fluid. The tubes include the epididymus, vas deferens, and urethra, and the glands are the seminal vesicles, prostate gland, and bulbourethral gland. Locate the following components of the male reproductive system in your male specimen (Figure 7.2).

Scrotum

The scrotum lies hidden beneath the fur of the region caudal to the penis and ventral to the pelvis. It is an integumentary sac that hangs below the pelvic wall and contains the male **gonads** (sex organs), the **testes**. Carefully make a cut through the dorsal wall of one side of the scrotum and, using scissors, cut the skin to the ventral margin. Repeat this cut on the opposite side. Now, peel the skin away to expose the two testes. Note the median septum that divides the scrotum internally in half, providing a separate chamber for each testis, known as the **cremasteric pouch**. Notice that the pouch narrows into a tubular structure at its ventral end. This structure is the **spermatic cord**, which contains the vas deferens, the spermatic artery and vein, and nerves.

Testes

The paired testes are the organs that produce the male **gametes**, or sex cells, and the male sex hormone, **testosterone**. Their outer coat, called the **tunica albuginea**, gives the testes a white, marbled appearance. With a sharp scalpel, cut one testis in half and notice the coiled tubules within. These are the **seminiferous tubules** and are the site where the male gametes, called **spermatozoa**, are produced.

Epididymus

On the dorsal part of each testis is an arrangement of tightly coiled tubules known as the **epididymus**. Locate the epididymus of your cat on the unsectioned testis. It is a comma-shaped organ that curves around the dorsal margin of the testis. From ventral to dorsal, it is divided into a **head**, a **body**, and a **tail**. The coiled tubule that forms the main part of the epididymus is called the **ductus epididymus**, which extends from the head region to the tail region, where it continues as the **vas deferens**.

Vas Deferens

The **vas deferens**, which may also be called the **ductus deferens**, extends from the epididymus to the urethra. From each testis, it begins as a coiled tube at its union with the ductus epididymus and continues in a cranial direction into the ventral body wall along with the spermatic artery, vein, and nerves as the **spermatic cord**. Follow the vas deferens to its point of entry into the body wall. Note that it passes through an opening called the **inguinal canal**. Once within the body cavity, it passes ventrally toward the ureter and turns medially until it reaches the dorsal wall of the urinary bladder. Do not attempt to trace the vas deferens further at this point in the dissection; you will need to open the pelvic cavity, which will be done soon. At the base of the bladder is a membranous, elongate sac called the **seminal vesicle**, which empties its secretions into the vas deferens via a small duct. Near the neck of the bladder, the vas deferens passes with its counterpart from the opposite side to the **prostate gland**, which is a glandular thickening of the dorsal wall of the seminal vesicle. The seminal vesicle and the prostate contribute fluids to form the semen. The vas deferens then passes through the prostatic tissue to unite with the urethra near its origin from the bladder.

Urethra

To observe the urethra and the male glands that contribute to semen, it is necessary to cut through the symphysis pubis. To do this, carefully make a 2.5-cm-long (1-inch) incision through the abdominal wall along the margin of the pelvis. With your fingers, find a slight depression in the midline between the pubic bones and with

a sharp scalpel, cut into the depression and adjacent muscles. Plunge the scalpel deeply as you cut. Now separate the pelvic bones by grasping the hind limbs and push them laterally, completing the separation of the pelvis. Clean up the area by removing connective tissue and fat. With good technique, you should now be observing the organs of the pelvic wall, including the seminal vesicles at the base of the bladder and the whitish prostate gland immediately ventral to it. The tube extending from the urinary bladder to the prostate gland, emerging to extend through the penis, is the urethra. As described previously, it consists of a **prostatic urethra**, a **membranous urethra**, and a **spongy urethra**. The prostatic urethra is the proximal portion, extending from the urinary bladder through the prostate gland. The membranous urethra and spongy urethra are also known as the urogenital urethra. The membranous urethra extends a short distance to the base of the penis. It receives secretions from a small gland known as the **bulbourethral gland**, which contributes to semen. The spongy urethra extends through the penis. It opens to the exterior at the **urogenital orifice**, *which is called the urinary meatus in humans*.

Penis

The penis of the cat is obscured by a sheath of skin, which surrounds it. To observe the penis, grasp the opening of the sheath with a pair of forceps and make a cut through its ventral wall with scissors. Continue this cut along the ventral wall of the sheath, cutting through connective tissue to expose the penis completely. Of course, be careful to avoid cutting the penis at this point. The penis encloses the spongy urethra, which lies outside the pelvic canal. The free end of the penis, called the **glans penis**, lies within a pocket of skin called the **prepuce**. Cut open the prepuce to reveal completely the glans and the opening of the spongy urethra. Then cut through the penis along the longitudinal plane. Notice the columns of erectile tissue, which contain blood sinuses that fill with blood to produce erection. The columns are called **corpora cavernosa**. Their proximal ends are attached to the ischia by tough bands of connective tissue, known as **crura** (crus in the

singular form). *The human penis is not contained within a sheath as in the cat, but hangs freely from its attachments to the pubic symphysis by way of the crura.*

The reproductive system of the cat includes **anal glands**, which are located near the anus. In male cats, contraction of the glands and nearby muscles causes fluid to spray outward, marking the cat's territory.

Female Reproductive Structures

The female gonads are the ovaries. Other female organs include the uterine tubes, uterus, vagina, and vulva. Locate and identify the following components of the female reproductive system in a female cat (Figure 7.3):

Ovaries

The ovaries are paired, oval organs that lie slightly caudolateral to the kidneys in the abdominopelvic cavity. They are anchored to the ventral body wall by the **suspensory ovarian ligament** and to the dorsal body wall by the larger **ovarian ligament**. The ovarian ligament connects each ovary to the cranial end of the uterus. A third ligament, the **mesovarium**, provides an additional connection between each ovary and the corresponding uterine horn. As the female gonads, the ovaries produce the female gametes, the **ova**, and the female sex hormones, estrogen and progesterone. During ovulation, or release of an ovum from an ovary, the ovum bursts through the ovarian wall to enter the abdominal cavity. Ideally, the ovum is then swept into the nearby opening to the uterine tube by ciliary currents.

Uterine tubes

Also known as oviducts, or fallopian tubes, the paired uterine tubes transport ova that have been released during ovulation from the ovaries. If fertilization is to occur, it usually occurs within the upper one-third of a uterine tube. The fertilized ovum, called a zygote, is then transported by ciliary currents within the tube to the uterus for implantation. Carefully reflect the ovary and uterine tubes to the side, and notice that the cranial extremity of each uterine tube curves laterally over each ovary to form a hood-like expansion

called the **infundibulum** and opens medially by way of the **ostium tubae**. The outer margins of the infundibulum contain finger-like projections, called **fimbriae**. Each uterine tube is attached to the dorsal body wall by a broad ligament known as the **mesosalpinx**. The distal end of each uterine tube merges with a uterine horn, which is larger in diameter. *The uterine tubes of the human female are comparatively much greater in length, extending from the infundibulum surrounding an ovary to the pelvic cavity to unite with the uterus.*

Uterus

The uterus of the cat includes two **uterine horns**, right and left, that begin as continuations of the uterine tubes. They descend into the pelvic cavity, where they unite to form the **body** of the uterus. The combination of the uterine horns and body form the Y-shaped uterus. The mesentery supporting the uterus is known as the **mesometrium**, and an additional structure, called the **round ligament**, adds strength to the mesometrium as it extends diagonally across it. The distal end of the uterus is slightly tapered, forming the **cervix**, which unites with the vagina. *The uterus of the human female is not Y-shaped, but resembles the shape of a pear, instead. It receives the right and left uterine tubes at its superior border, which is a rounded area known as the fundus. The constricted part of the uterus is known as the cervix, and its internal channel is the cervical canal. Also, the junction of the uterus and vagina is a distinct separation between the two organs.*

Vagina

To view the vagina and other caudal parts of the reproductive system, you will need to expose the pelvic cavity. Begin by making a 2.5-cm-long (1-inch) incision horizontally along the pelvic rim, cutting through muscles and fat. Insert a finger to find the symphysis pubis, which will feel like a shallow groove near the midventral line. Once you've located it, cut through it with a pair of scissors or bone cutters, but be careful to avoid plunging the instrument too deeply. You will be cutting through deep muscles and the cartilage of the symphysis pubis, if you are cut-

ting correctly. After cutting, grasp the hindlimbs and separate the pelvic bones to expose the pelvic wall. Carefully clean away connective tissue and fat, and find the body of the uterus once again. Trace it to its narrowed distal part, the cervix, which protrudes into the vagina. The vagina extends from its origin near the cervix to its opening to the **urogenital sinus** at the **vaginal orifice**. Because the urogenital sinus also receives the opening of the urethra, the **urethral orifice**, it is a common channel for the urinary and reproductive fluids.

Vulva

The vulva is the female external structure that includes the urogenital aperture, labia, and clitoris. The **urogenital aperture** is the exterior opening from the urogenital sinus, which is common to the urinary and reproductive systems. Bordering

the urogenital aperture on both sides are the small **labia**, which are very small in the cat and, therefore, difficult to observe. However, you should be able to identify the **clitoris**, represented as a small projection at the cranial union of the labia. It rests in a shallow, midventral depression. The clitoris is the homologous structure to the penis, although in most mammals, the urethra does not pass through it. Similar to the male, **anal glands** are present on either side of the anus. *The human vulva contains two pairs of labia, majora and minora, rather than a single pair, as seen in the cat. Also, the human clitoris is a more prominent structure. Finally, the urethra and vagina enter the vulva as separate openings in human females: as the urethral orifice and the vaginal orifice.*

CHAPTER REVIEW

A. Answer the following multiple-choice questions by circling the most correct answer.

1. The urogenital organs that function in the formation of urine are the
 - a. urethra
 - b. kidneys
 - c. spleen and thymus
 - d. ureters and urinary bladder
2. Organs that have a different structure between males and females are
 - a. called sexually dimorphic
 - b. the ureters
 - c. the kidneys
 - d. the urinary bladder
3. The blood becomes filtered, water is reabsorbed, and excess ions are secreted within
 - a. the gonads
 - b. nephrons
 - c. the renal pelvis
 - d. ureters
4. Renal pyramids may be found within the
 - a. renal capsule
 - b. renal medulla
 - c. renal cortex
 - d. renal pelvis
5. From the ureters, urine flows into the
 - a. urinary bladder
 - b. renal pelvis
 - c. urethra
 - d. kidneys
6. In the female cat, the urethra opens to the exterior as the
 - a. vagina
 - b. urogenital orifice
 - c. urinary meatus
 - d. urethral orifice
7. The dorsal part of each testis is an arrangement of tightly coiled tubules known as the
 - a. vas deferens
 - b. seminal vesicles
 - c. epididymus
 - d. spermatic cord
8. Near the neck of the bladder, the vas deferens passes with its counterpart from the opposite side to the
 - a. epididymis
 - b. prostate gland
 - c. seminal vesicles
 - d. ureter
9. As the female gonads, the _____ produce the female gametes called ova.
 - a. testes
 - b. uterus
 - c. ovaries
 - d. fallopian tubes
10. The distal end of the uterus is slightly tapered, forming the _____, which unites with the vagina.
 - a. vas deferens
 - b. cervix
 - c. uterine cavity
 - d. vestibule

B. Complete the sentences below by providing the missing terms from the chapter material.

1. Urine formation occurs in the kidneys, at the site of functional subunits called _____.
2. The _____ is a membrane-lined basin in the center of each kidney, which unites with the mucous membrane lining the ureter.
3. The three openings into the urinary bladder form an internal triangle known as the _____.
4. The _____ is the duct that transports urine from the urinary bladder to the exterior of the body.
5. The integumentary sac that hangs below the pelvic wall and contains the testes is called the _____.
6. The coiled tubules within the testes, where spermatozoa are produced, are called _____.
7. The ductus epididymus continues as a tube of larger diameter known as the _____.
8. Each ovary is supported to the dorsal body wall by the _____.
9. The uterus of the cat includes two _____, right and left, that begin as continuations of the uterine tubes.
10. The _____ is the exterior opening from the urogenital sinus in the female cat, which is common to the urinary and reproductive systems.

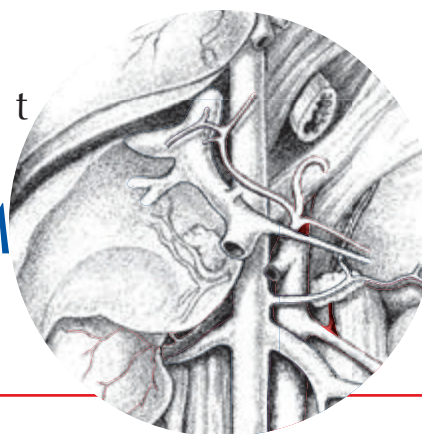
C. Answer the following descriptive and critical-thinking questions with a brief explanation in the spaces provided.

1. Describe the functional importance of nephrons and where they are located. _____

2. Trace the pathway of spermatozoa during an ejaculation. _____

3. Compare and contrast the vulva of a cat and a human. _____

c h a p t e r e i g h t

THE NERVOUS SYSTEM
AND SPECIAL SENSES

The nervous system provides a system of communication between its primary organ, the **brain**, and the distant parts of the body. Its goal is to monitor changes in the environment inside and outside the body, interpret the changes, and initiate a response in an effort to maintain homeostasis. It does all of this by way of electrochemical messages called **nerve impulses**. Nerve impulses race through the body every moment, traveling along special routes, or **nerves**, at high speeds.

As a whole, the nervous system is a complex series of organs and structures that extend throughout the body. In addition to the brain, its organs include the spinal cord, nerves, ganglia, and sensory receptors. The nervous system is divided into two main categories: the **central nervous system (CNS)**, which includes the brain and spinal cord, and the **peripheral nervous system (PNS)**, which includes the nerves, ganglia, and sensory receptors. The PNS is further divided in an **afferent (sensory) system**, which carries impulses from receptors to the CNS, and an **efferent (motor) system**, which carries impulses from the CNS to effectors, such as muscles and glands. The efferent system is itself divided into a **somatic system**, in which impulses are carried to skeletal muscles, and an **autonomic system**, which carries impulses to glands and smooth muscles. Finally, the autonomic system is divided into a **sympathetic division** and a **parasympathetic division**.

This chapter enables you to explore the structures of the nervous system of the cat. You will remove the brain from the cranial cavity to examine it, observe the spinal cord, and trace the major nerves throughout the body. You will also examine the **special sensory organs**, which are associated with the nervous system. They include the eyes, ears, taste organs of the tongue, and smelling centers in the nasal epithelium.

CENTRAL NERVOUS SYSTEM

The central nervous system, which includes the brain and spinal cord, represents the center of nervous system structure and function. You will study the brain of the cat first, which requires removal of the brain from the cranial cavity. In some labs, the cat brain may be substituted for a sheep brain. Because both are typical of a mammalian brain, either is suitable for this study.

To remove the brain from the cranium of your cat, follow the protocol outlined below. As you progress through this procedure, identify the three membrane layers that surround the brain and spinal cord. Collectively known as the

meninges, they are the outer **dura mater**, the middle **arachnoid**, and the innermost **pia mater**.

1. Clean the dorsal skull and neck regions completely of skin, muscle, and connective tissue.
2. Using a pair of sharp bone shears, cut the 3rd, 2nd, and 1st cervical vertebrae, and remove the bone fragments with forceps. Sever the spinal cord with a clean cut as far caudally as possible.
3. Very carefully insert the pointed half of your bone shears slightly through the

foramen magnum at the base of the skull, but don't go too deep! Close the shears and apply pressure. This should crack the thick occipital bone.

4. From the cracked occipital bone, cut around the skullcap above the eye orbits with bone shears, but again be very careful to avoid cutting too deeply. Once you've cut a complete circle, carefully lift the skullcap off. Note the tough dura mater that covers the brain. The outermost of the meninges, it is composed of tough, fibrous connective tissue. In some areas, it is connected to the inner surface of the skull, and, thus, may have been damaged as you cut through the cranium. Carefully pull the dura mater away from the brain to expose the underlying meningeal layers, and make a cut through it with a scalpel from rostral to caudal. As you do so, note the extension of the dura mater between the two cerebral hemispheres, which is called the **falx cerebri**, and the extension between the cerebrum and the cerebellum, known as the **tentorium**. These membranes help anchor the brain within the cranial cavity.
5. Using a pair of forceps, carefully remove the remaining pieces of bone. In the caudal section of the cranial cavity, cut out and remove the small bone segments protecting the delicate cerebellum. Continue to remove bone pieces until the brain is well exposed. With the dura mater removed, note the meningeal layer beneath it, known as the **arachnoid**. It is composed of loose connective tissue arranged in a cobweb-like arrangement. The arachnoid passes over the shallow grooves, or **sulci**, of the brain's surface. The upfolds of the brain are called **gyri**. With your forceps, pick away the thin membrane adhering to the surface of the brain. This is the deepest meningeal layer, the **pia mater**. The pia mater

is separated from the arachnoid by a fluid-filled space called the **subarachnoid space**, which is continuous around the brain and spinal cord. A slightly yellowish fluid circulates within this space to provide a liquid cushion for the CNS, and is known as **cerebrospinal fluid (CSF)**.

6. To remove the brain from the cranial cavity, begin by lifting the severed spinal cord from the floor of the vertebral canal. Then lift the brain from the floor of the cranial cavity by working caudally and very cautiously. As you do so, sever the cranial nerves from the brain with a sharp scalpel (this is a good job for a partner if one is available). Make your cuts as far from the brain as possible to facilitate their identification later.

Brain

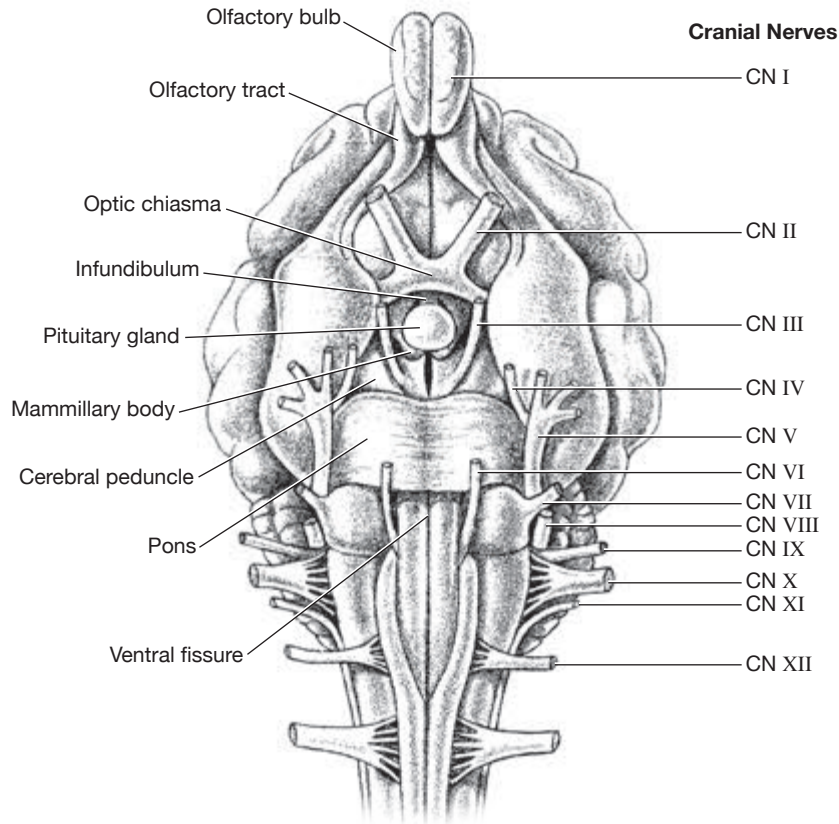
The mammalian brain contains three primary divisions: the forebrain, the midbrain, and the hindbrain. Before identifying the structures of the brain, many of which require sectioning of the brain in half to observe, turn the brain on its dorsal side to expose the ventral surface. Using Table 8.1 as a reference, identify the **cranial nerves**, whose cut ends should be visible as shown in Figure 8.1. Following this exercise, observe the parts of the brain as described.

FOREBRAIN (prosencephalon): the largest division of the brain. Occupying the cranial and middle regions, it consists of the large telencephalon and the much smaller diencephalon (Figures 8.1 - 8.3).

Telencephalon: consists of the largest single structure of the brain, the **cerebrum**. The cerebrum is convoluted in the cat, although much more so in the human. Note the downfolds, or **sulci**, and the upfolds, or **gyri**. The cerebrum consists of two halves, the right and left **cerebral hemispheres**, which are separated by a deep furrow called the **longitudinal fissure**.

Cranial Nerve	Union with Brain	Innervations	Sensation or Action
Olfactory (I)	olfactory lobe	sensory endings in nasal epithelium	sense of olfaction (smell)
Optic (II)	rostral colliculi and thalamus	sensory cells in the retina of each eye	sense of vision (sight)
Oculomotor (III)	cerebral peduncles of midbrain	intrinsic and extrinsic eye muscles	movement of eye, control of light entering eye
Trochlear (IV)	roof of midbrain	superior oblique muscle of eye	movement of eye
Trigeminal (V): 1. Ophthalmic 2. Maxillary 3. Mandibular	lateral portions of pons	external eyeball, skin of skull vibrissae and upper teeth jaw, skin of lower face, teeth of lower jaw, mouth, tongue	sensations of face region sensations of rostrum movement of jaw; sensations of lower face and mouth
Abducens (VI)	rostral end of medulla	rectus externus muscle of eye	movement of eye
Facial (VII)	medulla caudal to CN VI	jaw and face muscles	mastication and facial expression
Auditory (VIII)	lateral medulla	sensory cells within cochlea of inner ear	sense of audition (hearing)
Glossopharyngeal (IX)	lateral medulla	pharynx, parotid gland, caudal portion of tongue	sense of gustation (taste), sensations of throat region
Vagus (X)	lateral medulla	muscles of the pharynx, larynx, thoracic viscera, abdominal visceral; sensory of larynx, and thoracic and abdominal viscera	contraction of innervated muscles; sensation of innervated regions
Spinal accessory (XI)	lateral medulla	muscles of the neck and pharyngeal region	movement of the neck and pharynx
Hypoglossal (XII)	ventral medulla	tongue and hyoid muscles	movement of the tongue

Table 8.1 – The cranial nerves.



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Figure 8.1 – Cranial nerves (ventral aspect of the brain).

Separate the hemispheres by spreading them apart with your fingers, and you will see a thick, transverse band of white matter that connects the hemispheres. This bridge is the **corpus callosum**. Now make a mid-sagittal section through the brain by cutting deeply through the longitudinal fissure. Use a long, sharp knife for this procedure to make a single, clean cut through the brain. The corpus callosum includes an expanded rostral end, called the **genu**, a thinner middle section known as the **trunk**, and an expanded caudal end known as the **splenium**. The ventral continuation of the splenium is called the **fornix**. Immediately inferior to the corpus callosum is a cavity, called the **lateral ventricle**, which is one of four ventricles in

the brain (two lateral ventricles, one **third ventricle**, and one **fourth ventricle**; you will identify the third and fourth ventricles a bit later). They contain clusters of capillaries and ventricular cells. The cell clusters are known as **choroid plexi**, which serve as the source of cerebrospinal fluid (CSF). The **septum pellucidum** may be visible, which is a thin membrane separating the two lateral ventricles. At the rostral end of the cerebrum is located a pair of swellings, called the **olfactory lobes**. They represent the terminal points of olfactory nerves originating from the nasal epithelium. The Olfactory Nerves (CN I) extend from the olfactory lobes to the cerebrum. A second deep furrow, called the **transverse fissure**, separates the cerebrum from the smaller

cerebellum located on the caudal side of the brain. The cerebrum is the integrative center of the brain. It receives sensory information, processes it with memory connections, and initiates motor responses. Its primary functional zone is the outer fringe of gray matter, known as the **cerebral cortex**. White matter is found deep to the cortex, which serves as communication pathways. Embedded within the white matter of both hemispheres are islands of gray matter called the **basal ganglia**.

Diencephalon: the region of the brain located ventral to the cerebrum and immediately below the lateral ventricles. Its most prominent structure is the bilobed **thalamus**, which forms the central portion and lateral walls of the diencephalon. The thalamus is a switchboard for impulses traveling to and from the cerebrum. At its ventral border is the much smaller **hypothalamus**, which serves as a cen-

ter for autonomic functions and triggers the **pituitary gland** (hypophysis) that is attached to it via a narrow stalk. A second endocrine gland, the **pineal gland**, is the small, round structure that projects from the roof of the diencephalon. Ventral to the pineal gland is the **third ventricle**. It receives CSF from the two lateral ventricles via a small channel called the **foramen of Monro**. Turn the brain over to expose the ventral surface, and find the X-shaped **optic chiasma**. It is the crossing of the two Optic Nerves (CN II).

MIDBRAIN (mesencephalon): a small part of the brain, which is located ventral to the fore-brain (Figure 8.3). Its major portions are the tectum and the cerebral peduncles.

Tectum: forms the roof of the mid-brain, and can be observed as the swellings in the center of the brain rostral to the cerebellum. The swellings are the **corpora quadrigemina**. The larger rostral

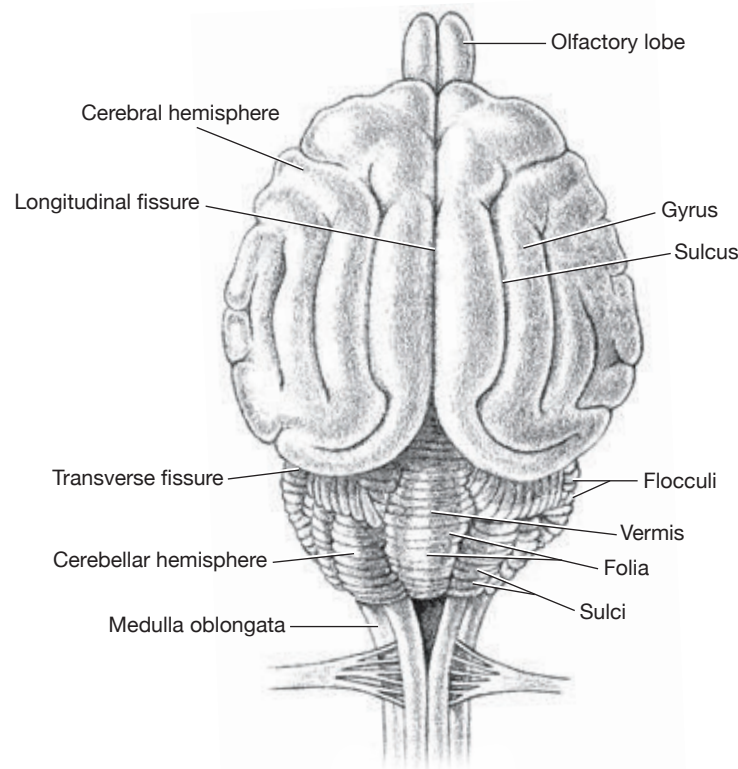
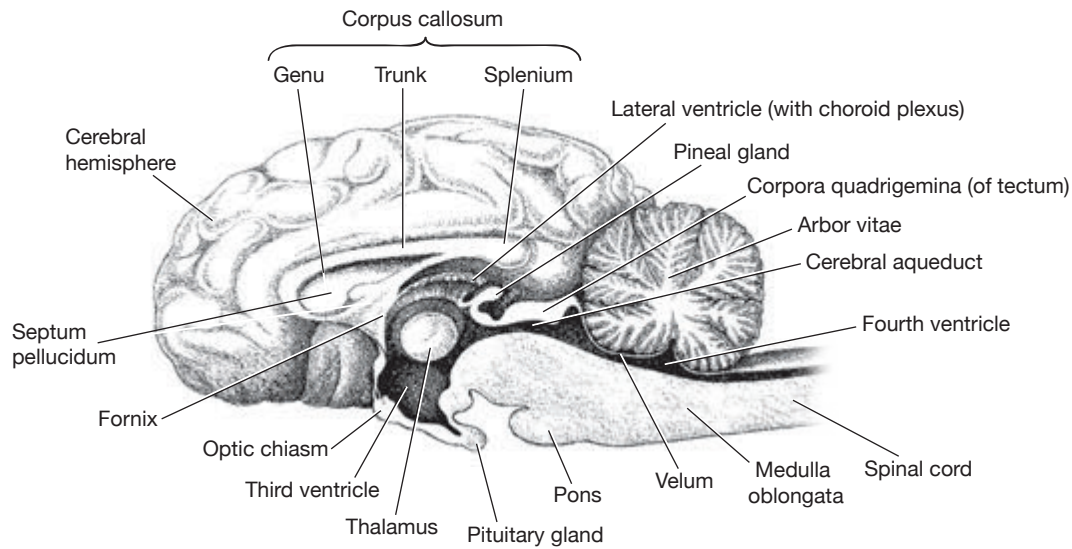


Figure 8.2 – Brain (dorsal aspect).



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Figure 8.3 – Brain, midsagittal section (lateral view).

pair is called the **rostral colliculi**, and the smaller caudal pair is the **caudal colliculi**.

Cerebral peduncles: a pair of fiber bundles that form the ventrolateral surface of the midbrain.

HINDBRAIN (rhombencephalon): the caudal part of the brain, it consists of the metencephalon and the myelencephalon (Figures 8.2 - 8.3).

Metencephalon: the cranial part of the hindbrain. The **cerebellum** dominates most of the metencephalon, forming the dorsal component. Its surface area is increased by numerous folds, known as **folia**, which are separated from each other by shallow grooves, or **sulci**. The central portion of the cerebellum, the **vermis**, is composed by white matter, as you can observe in the sectioned brain. Numerous branches of gray matter extend from it to the outer surface. This branching arrangement is called the **arbor vitae** (tree of life). Lateral to the vermis are the right and left **cerebellar hemispheres** and their lateral extensions, the **floc-**

culi. The outer surface, which is composed of gray matter, is called the **cerebellar cortex**. The ventral component of the metencephalon is formed by a rounded swelling at the cranial end of the brain stem, called the **pons varolii**. The pons is connected to the cerebellum by transverse fibers.

Myelencephalon: the caudal part of the midbrain, which is also the caudal extremity of the brain. The myelencephalon includes the **medulla oblongata**, which is the transitional region between the brain and the spinal cord. Together with the pons varolii and midbrain, the three brain structures form the **brain stem**. The **fourth ventricle** is located between the cerebellum and the medulla. It receives CSF by way of the narrow **cerebral aqueduct** (aqueduct of Sylvius), which runs through the midbrain.

Spinal Cord

The spinal cord is a semicylindrical mass of gray and white matter enveloped by the meninges

(Figure 8.4). Beginning at its cranial end as a caudal continuation of the medulla oblongata, it passes through the vertebral canal and tapers at the 7th lumbar segment to a bundle of nerves called the **cauda equina**. The spinal cord terminates as a slender filament, the **filum terminale**, in the base of the tail. In the cervical and lumbosacral regions, the spinal cord contains swellings that give rise to the nerves that innervate the front and hind limbs, respectively.

A pair of **spinal nerves** arise from each segment and exit the vertebral column via intervertebral foramina. The spinal nerves are named according to the region of the vertebral column where they arise. A spinal nerve is formed by the union of a **ventral root** and a **dorsal root**. After exiting the vertebral column, the spinal nerve divides into a **dorsal ramus**, which supplies the muscles of the back, and a thicker **ventral ramus**, which supplies the remaining somatic muscles of the body.

You should not attempt to remove the entire spinal cord of your cat at this time, because of the damage this dissection would cause to spinal and peripheral nerves. Instead, obtain a cross section of the cord by cutting off the caudal tip of the region below the brain stem of the brain. Using this section, locate the following components of the spinal cord (Figure 8.5):

MENINGES: continuous with the meninges of the brain, the three membranes are the outermost **dura mater**, which continues to the 2nd sacral vertebral

segment where it fuses with the pia mater; the **middle arachnoid**; and the deep **pia mater**, which adheres to the surface of the spinal cord. Similar to the brain meninges, the arachnoid and pia mater are separated by the **subarachnoid space**, in which CSF circulates.

SPINAL CORD GRAY MATTER: the H-shaped mass of nerve tissue at the center of the spinal cord. The gray matter of the cord consists of the **gray commissure**, which is the central bridge connecting the left and right sides of the H; the **anterior (ventral) gray horns**, located on the ventral side of the spinal cord and which form the larger of the two horn segments of the H; the **posterior (dorsal) gray horns**, located on the dorsal side of the spinal cord; and the **lateral gray horns**, located between the anterior and posterior gray horns. Note also the small hole in the center of the gray commissure. This is the **central canal**, which runs the entire length of the cord and carries CSF.

SPINAL CORD WHITE MATTER: the white nerve tissue surrounding the gray matter horns. The white matter consists of ascending tracts of sensory fibers and descending tracts of motor nerve fibers.

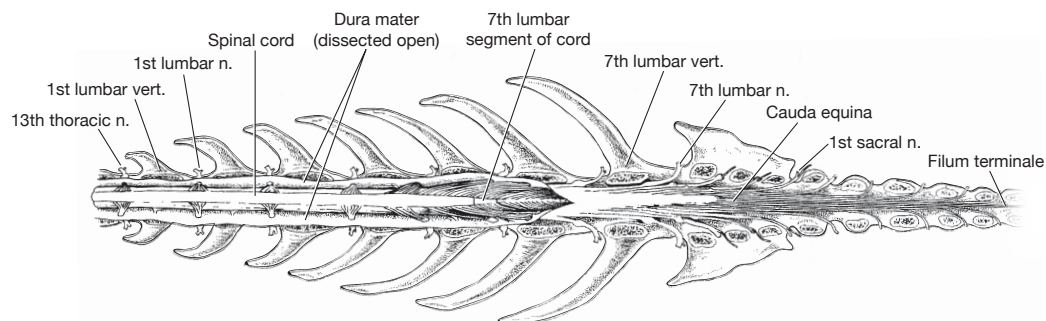


Figure 8.4 – Spinal cord (dorsal view of dissected cord within vertebral column).

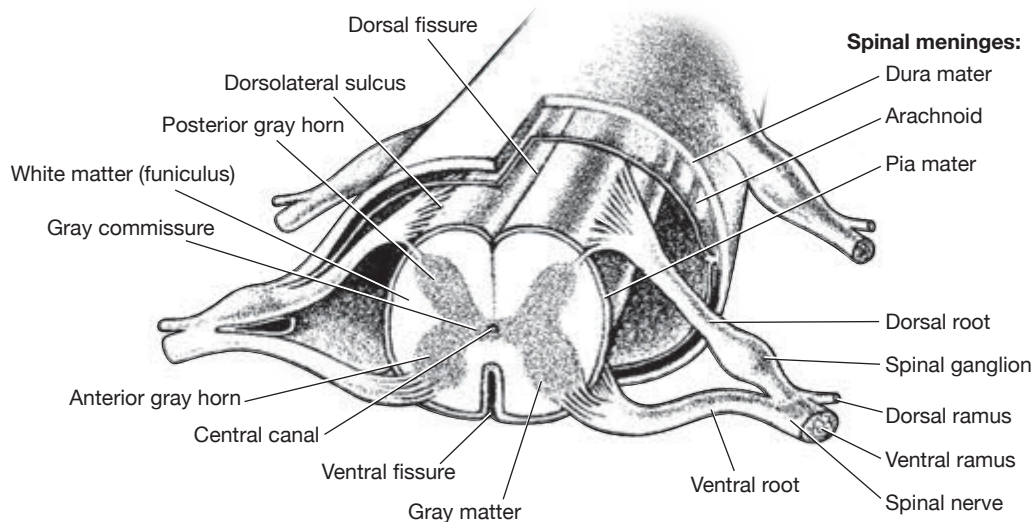


Figure 8.5 – Spinal cord (cross section).

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PERIPHERAL NERVOUS SYSTEM

The peripheral nervous system (PNS) consists of the **motor** (efferent) **nerves** that carry impulses from the CNS to PNS effectors, and the **sensory** (afferent) **nerves** that carry impulses in the opposite direction. The following study of the PNS includes the somatic division of the PNS, which contains the networks of nerves arising from the ventral rami that innervate skeletal muscles and a brief description of the autonomic division of the PNS.

Somatic Division

The somatic division of the PNS includes branching networks of nerves known as plexi, and the various peripheral nerves extending from the plexi to skeletal muscles. In the musculature of your cat, locate the following plexi and major peripheral nerves (Figure 8.6):

CERVICAL PLEXUS: the least extensive of the three major plexi, it is formed by the ventral rami of the cervical region. The nerves associated with the cervical plexus supply the musculature and skin of the neck region. It can be located by tracing the ventral rami of

the neck from the dorsal side as they emerge from the vertebral column.

BRACHIAL PLEXUS: located medial to the shoulder and cranial to the 1st rib, it can be observed from the ventral side deep to the pectoral muscles. The brachial plexus is formed by the union of the ventral rami of the 5th to 8th cervical and 1st thoracic nerves. From the brachial plexus arise the following nerves:

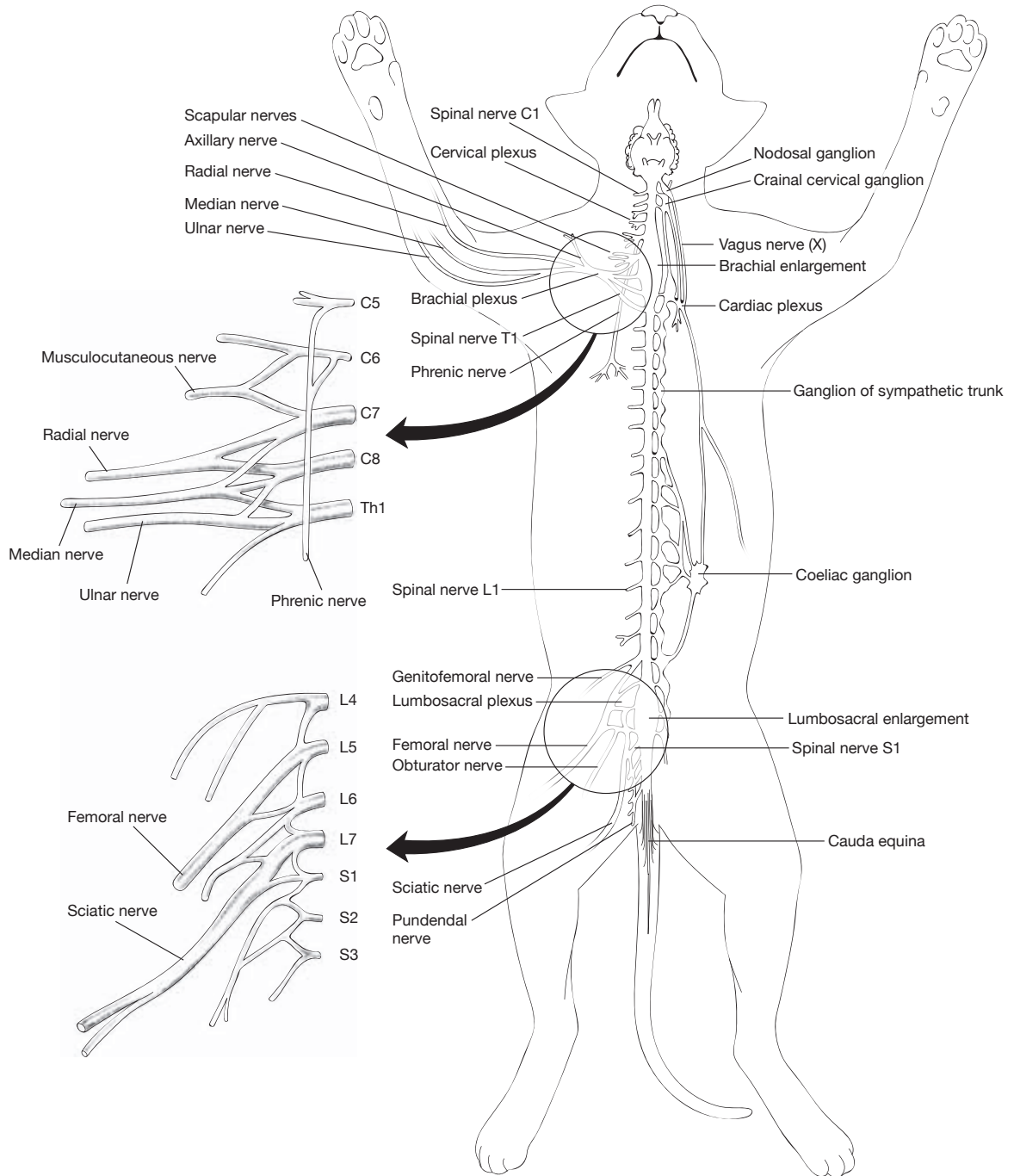
Pectoral nerves: several small nerves that arise from the ventral divisions of the plexus.

Scapular nerves: two nerves, a scapular and a suprascapular nerve, both of which arise mostly from the 6th cervical root.

Axillary nerve: a large nerve located caudal to the scapular nerves. It passes through the brachium ventral to the long head of the triceps.

Subscapular nerve: two small nerves that arise from the plexus near the origin of the axillary and continue dorsal to it.

Radial nerve: a large, deep nerve located caudal to the axillary. It is formed by



THE NERVOUS SYSTEM AND SPECIAL SENSES

Figure 8.6 – Nervous system of the cat.

the union of the 7th and 8th cervical and 1st thoracic nerves.

Musculocutaneous nerve: arising from the 6th and 7th cervical nerves, it passes superficial to the radial nerve into the brachium.

Median nerve: a prominent nerve that runs down the medial side of the brachium. It is a ventral division of the 7th and 8th cervical and 1st thoracic nerves.

Ulnar nerve: arising caudal to the median nerve, the ulnar is similar to the median nerve in its pathway.

LUMBOSACRAL PLEXUS: formed by the ventral rami of seven spinal nerves (4th lumbar to 3rd sacral), it supplies the skin and muscles of the pelvis and hind limbs. Because it lies deep within the abdominal and pelvic cavities, you will not observe it in your specimen. However, identify the following peripheral nerves that originate from this plexus in the hip and thigh musculature of your cat.

Genitofemoral nerve: a division of the 4th lumbar nerve, it passes caudally through the pelvic wall.

Femoral nerve: a large nerve that arises primarily from the 5th and 6th lumbar nerves. It passes through the pelvic wall on the ventral side along with the femoral artery and vein.

Obturator nerve: arising from the unification of a second division of the 6th lumbar nerve and a second division of the 5th lumbar nerve, it extends caudolaterally through the obturator internus muscle and the obturator foramen.

Sciatic nerve: a continuation of the **lumbosacral trunk**, which receives the 6th and 7th lumbar nerves and the 1st and 2nd sacral nerves. The sciatic nerve continues down the lateral side of the thigh to divide into the **tibial** and **fibular** (common peroneal) nerves.

Autonomic Division

The autonomic division of the PNS innervates smooth muscles and glands. Its major components include the following ganglia, rami, and nerves, some of which are diagrammed in Figure 8.6. Autonomic components are divided into two distinct groups: the **sympathetic division**, which carries impulses that activate body responses to emergency situations, and the **parasympathetic division**, which carries impulses that dominate when the body is at rest.

SYMPATHETIC TRUNK GANGLIA: a vertical row of ganglia, which are clusters of neuron cell bodies, extending along both sides of the vertebral column from the base of the skull to the tail. These ganglia receive sympathetic fibers originating from the spinal cord. Collectively, the sympathetic trunk ganglia are referred to as the **sympathetic chain**.

PREVERTEBRAL GANGLIA: also known as collateral ganglia, they are located ventral to the vertebral column and close to large abdominal arteries. Prevertebral ganglia receive sympathetic fibers originating from the spinal cord.

TERMINAL GANGLIA: also known as intramural ganglia, they are located at the end of visceral efferent pathways near or on the walls of visceral effectors, such as smooth muscle and glands. The terminal ganglia receive parasympathetic fibers that originate from the spinal cord.

COMMUNICATING RAMI: spinal nerve branches that carry impulses to or from sympathetic trunk ganglia. In the thoracic and upper lumbar segments, they contain myelinated fibers to form the **white communicating rami**, or nonmyelinated fibers to form the **gray communicating rami**. In the remaining vertebral segments all of the communicating rami are gray.

VAGUS NERVE (X): a large cranial nerve that was described previously. It contains sympathetic and parasympathetic fibers that supply major thoracic and abdominal visceral organs.

PHRENIC NERVE: a large nerve that arises from the ventral rami of the 5th and 6th cervical nerves and passes caudally through the thoracic cavity to innervate the diaphragm.

ORGANS OF SPECIAL SENSE

The special senses are specialized parts of the body that provide the brain with information about the outside environment. There are four special senses: olfaction (smell), gustation (taste), vision (sight), and audation (hearing). The four special senses are perceived with the help of highly specialized organs. They are sensory patches within the nasal epithelium (olfaction), taste organs on the tongue (gustation), the eyes (vision), and the ears (audation). In each case, the special sensory organ contains sensory receptors. The sensory receptors are sensitive to a particular stimulus, and generate a nerve impulse when the stimulus is sufficiently strong. The nerve impulse then travels to the brain for interpretation.

Olfaction

The sense organs responsible for smell reception may be found within a patch of the mucosa lining the nasal cavity. Located in the dorsocaudal part of each nasal chamber, it is called the **olfactory mucosa**. The receptors in the olfactory mucosa are olfactory hair cells. The hair cells include dendrites, which appear under the microscope like tiny hairs that project into the mucosal lining. When the hair cells make contact with dissolved chemicals in the mucosa, they generate a nerve impulse. The impulse passes to adjacent sensory neurons that form olfactory nerves, which extend to the olfactory lobe. At the olfactory lobe, the olfactory nerves synapse at sensory neurons, which transmit the impulse to the cerebral cortex for interpretation.

Gustation

The taste receptors are organized into specialized groups of cells, known as the **taste buds**. Most taste buds are located on the fungiform and circumvallate papillae of the tongue. Taste buds

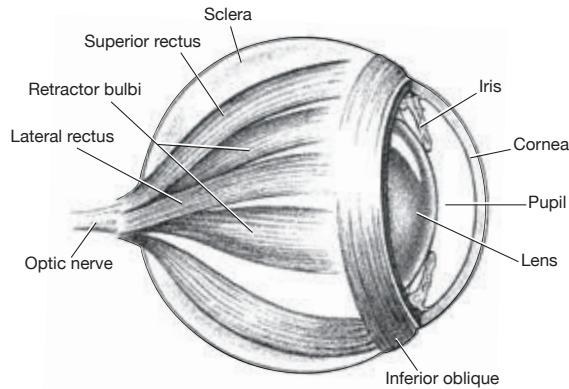
contain neurons with dendrites that project onto the surface of the papillae, and are sensitive to dissolved chemicals. From the front, or oral, part of the tongue, impulses generated by the sensory neurons in the taste buds are transmitted via a branch of the facial nerve (CN VII). From the back, or pharyngeal, part of the tongue, impulses are transmitted via the glossopharyngeal nerve (CN IX).

Vision

The eye lies within its protective bony orbit. During your earlier observation of the cat's surface anatomy, you identified the palpebrae (eyelids) and the nictitating membrane. At this time, identify also the **conjunctiva**, which is a thin transparent membrane covering the underside of each eyelid and the surface of the eyeball. Also, find the **harderian gland**, which is a small gland on the medial surface of the nictitating membrane. Now, free the eyeball from the orbit rim and push it forward to observe the **lacrimal gland**, which produces tears. Now push the eyeball dorsally until it can be extracted from the orbit completely, and sever the optic nerve. Some of the **extrinsic eye muscles** will also require cutting.

From Figure 8.7, identify the extrinsic eye muscles, which move the eyeball. There are seven muscles: four recti originate on the bone around the optic foramen and insert on the sclera (white exterior covering of the eyeball) just behind the midline, or equator, of the eyeball. They are known as the **superior, inferior, lateral, and medial recti** muscles according to their position. A **retractor** muscle also originates from the optic foramen, and inserts on the sclera around the entrance to the optic nerve. The two oblique muscles, the **superior oblique** and **inferior oblique**, are evident only if the lateral and dorsal walls of the orbit are removed.

With one eye from your cat removed, observe its external features. Then, using a sharp scalpel, cut it into two equal parts along the equatorial plane. Since the internal structures of the eye are difficult to observe in a cat, you may be asked to study a preserved or fresh cow eye instead, which is anatomically similar. The eye includes the



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Figure 8.7 – External eye with extrinsic muscles (lateral view).

following major structures, some of which are illustrated in Figure 8.7:

SCLERA: the white outer layer of the eyeball, which is composed of fibrous connective tissue. The sclera provides support for the eyeball.

CORNEA: a rostral continuation of the sclera that is transparent. The conjunctiva meets the cornea along its outer edge. The **anterior chamber** is located immediately behind the cornea.

IRIS: the pigmented ring of smooth muscle, which surrounds the black central hole. Involuntary impulses regulate contraction of the iris, which serves as a diaphragm to regulate the amount of light that enters the interior of the eye.

PUPIL: the black hole in the center of the iris, through which light enters the eye.

CHOROID: a vascular, black pigmented layer internal to the sclera. It helps to nourish the retina, and the pigments reduce the scattering of light rays to improve visual efficiency.

CILIARY BODY: a series of folds, forming a thickened ring within the eyeball between the choroid and iris junction.

LENS: the large oval or spherical structure that is suspended by **suspensory ligaments** extend-

ing from the ciliary body, located behind the pupil. Normally transparent, it is composed of dense protein formations. Immediately behind the lens is the **posterior chamber**, which contains a gelatinous **vitreous humor**.

RETINA: the innermost layer of the eyeball lining the posterior wall. It contains specialized sensory receptors, known as rod cells and cone cells, which generate a nerve impulse when they become activated by light. From the rods and cones, the nerve impulse is passed to two additional layers of neurons, the last of which converge at the **optic disc** to form the optic nerve (CN I). The optic nerve carries the impulse to the thalamus, and relays it to the occipital lobe of the cerebral cortex, where the impulses are interpreted into the sense of vision.

Audation

The ear contains the sense organs for both hearing and equilibrium. It consists of three parts: the external ear, the middle ear, and the internal ear.

EXTERNAL EAR: the part of the ear exposed to the external environment. It includes the following components:

Pinna: also known as the **auricle**, it is the external appendage on each side of the head of mammals. The pinna funnel mechanical vibrations (sound waves) into the head. Each consists of cartilage that is covered with skin, and is connected to extrinsic auricular muscles whose contraction moves the pinna in the direction of sound.

External auditory meatus: a skin-lined canal extending from the pinna to the tympanic membrane. It includes ceruminous glands, which secrete a waxy substance that lubricates the meatus and traps foreign particles.

Tympanic membrane: a thin membrane that separates the interior end of the external auditory meatus and the middle ear. It vibrates in response to sound waves, and transmits the vibration to the middle ear ossicles.

MIDDLE EAR: the cavity within the tympanic bulla of the skull, which is also known as the **tympanic cavity**. Dissection of the middle ear is extremely difficult, and is not recommended unless time and advanced dissection skills are available. If you wish to attempt it, you will remove the tympanic bulla from the cranium. To do this, first prepare the area by removing all soft tissues around the tympanic bulla. Using bone shears, cut through the bulla and medial (petrous) portion of the temporal bone from the skull. Next, remove the medial wall of the tympanic bulla by cutting with bone shears. Notice that the cavity within the bulla is separated into a larger lateral and a smaller medial chamber by a vertical wall of bone. Carefully break away this vertical plate of bone to expose the lateral chamber, which reveals the inner surface of the tympanic membrane and its attached middle ear ossicle (the malleus). Then, with your bone shears, fracture the thick bony connection between the caudal end of the petrous bone and the caudal part of the bony ring surrounding the external auditory meatus. Using Figure 8.8 as a guide, identify the following parts of the middle ear:

Malleus: the first and largest ossicle, it connects the inner surface of the tympanic membrane to the second ossicle.

Incus: the middle ossicle, which contacts the malleus to transmit vibrations from it to the third ossicle.

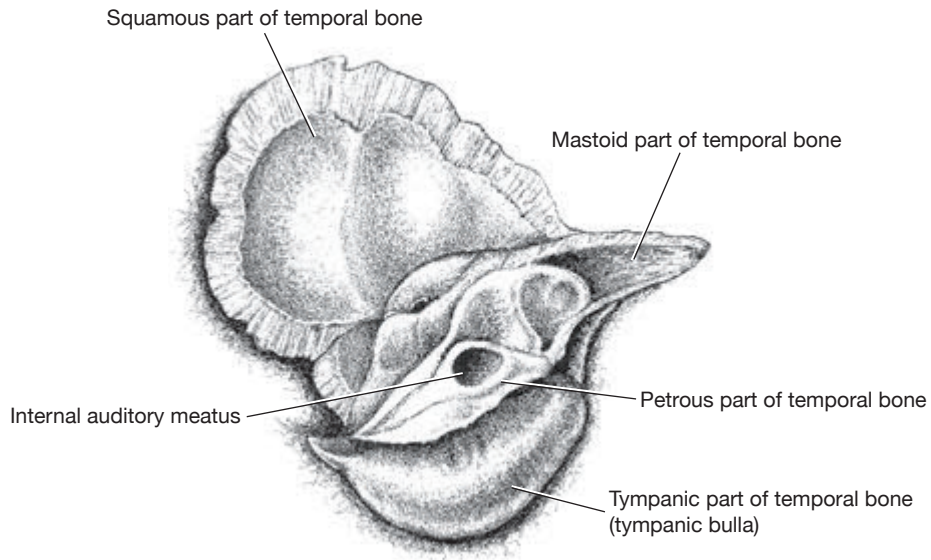
Stapes: the third ossicle, which articulates with the incus. Its distal end forms a flattened disc, which fits over an oval opening in the lateral wall of the tympanic cavity called the **fenestra vestibuli** (oval window). A round opening, called the **fenestra cochlea** (round window), is located slightly below the oval window.

INNER EAR: a series of winding canals surrounded by bone within the mastoid portion of the temporal bone, it is also called the **labyrinth**. It consists of an outer series of canals within walls of bone, known as the **bony labyrinth**, and an inner series of canals lined with membrane, called the **membranous labyrinth**. In life, fluid is present in each canal. Because of its very small size, the inner ear is extremely difficult to dissect. But if you wish to attempt it, it can be done by carefully chipping away the temporal bone medial to the tympanic cavity. With patience applied, you will gradually find the bony labyrinth embedded within the bone of this region. Using Figure 8.8 as a guide, identify the following parts of the inner ear:

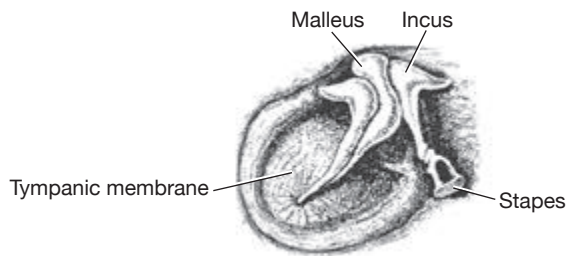
Cochlea: a coiled, snail-shell-like part of the labyrinth that contains hair cells, which are the sensory receptors for audition. The hair cells are sensory neurons with dendrites, which generate a nerve impulse when the fluid surrounding them moves in response to mechanical vibrations.

Semicircular canals: three loops of bony labyrinth that contain sensory receptors, which are activated by body movement. They transmit nerve impulses to the brain for the interpretation of equilibrium. The receptors are located within expanded areas at the base of the loops known as **ampullae**.

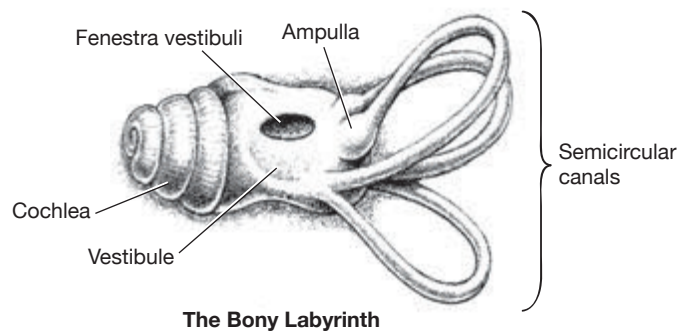
Vestibule: a small chamber between the cochlea and semicircular canals. It contains the **utricle** and **sacule**, which house receptors sensitive to movements of the head.



Dissection of Temporal Bone



The Middle Ear



The Bony Labyrinth

Figure 8.8 – Ear structures.

CHAPTER REVIEW

A. Answer the following multiple-choice questions by circling the most correct answer.

1. The brain and spinal cord are organs within the
 - a. cranial cavity
 - b. peripheral nervous system
 - c. central nervous system
 - d. csf
2. The dura mater is the outermost of the
 - a. layers of the brain
 - b. meninges
 - c. spinal cord regions
 - d. cerebrum
3. The convoluted mass that forms most of the forebrain is the
 - a. cerebrum
 - b. cerebellum
 - c. thalamus
 - d. hypothalamus
4. The small component of the diencephalon that manages involuntary actions is the
 - a. thalamus
 - b. hypothalamus
 - c. pons
 - d. cerebral cortex
5. A thick, transverse band of white matter connecting the two cerebral hemispheres is called the
 - a. corpus callosum
 - b. longitudinal fissure
 - c. central sulcus
 - d. cerebellum
6. The tectum and cerebral peduncles are parts of the
 - a. forebrain
 - b. hindbrain
 - c. midbrain
 - d. cerebrum
7. The vermis, folia, and arbor vitae may be found within the
 - a. cerebellum
 - b. cerebrum
 - c. forebrain
 - d. midbrain
8. The H-shaped mass of tissue in the center of the spinal cord is
 - a. white matter
 - b. gray matter
 - c. covered by meninges
 - d. continuous with the cerebral cortex
9. The femoral nerve arises from the:
 - a. lumbosacral plexus
 - b. cervical plexus
 - c. dorsal rami
 - d. brachial plexus
10. Photoreceptors, called rods and cones, may be found within the
 - a. labyrinth
 - b. retina
 - c. anterior chamber of the eye
 - d. tympanic cavity

B. Complete the sentences below by providing the missing terms from the chapter material.

1. The efferent nervous system includes the _____, which routes impulses to smooth muscles and glands.
2. In order to remove the brain from the cranial cavity, you severed the _____, which were attached to the brain stem at 12 different sites on each side of the brain.
3. The primary functional zone of the cerebrum is the outer fringe of gray matter, known as the _____.
4. The midbrain, pons varolii, and medulla oblongata together form the _____.
5. The spinal cord terminates as a slender filament, called the _____, in the base of the tail.
6. The plexus that is located medial to the shoulder and cranial to the 1st rib, and can be observed from the ventral side deep to the pectoral muscles, is the _____.
7. A vertical row of autonomic ganglia extending along both sides of the vertebral column from the base of the skull to the tail describes the _____.
8. Taste receptors are organized into specialized groups of cells, known as the _____.
9. The large oval or spherical structure that is suspended by suspensory ligaments extending from the ciliary body and located behind the pupil is called the _____.
10. The _____ is a coiled, snail-shell-like part of the labyrinth that contains the receptors responsible for audition, known as hair cells.

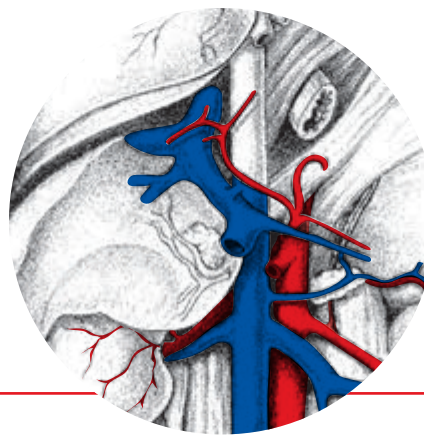
C. Answer the following descriptive and critical-thinking questions with a brief explanation in the spaces provided.

1. Describe the role of the cerebrum in achieving the functions of the nervous system. _____

2. Identify the structures that light must pass through in order to stimulate photoreceptors.

3. Describe the pathway of vibrations that result in audition. _____

c h a p t e r n i n e

THE ENDOCRINE
SYSTEM

The endocrine system works hand in hand with the nervous system to regulate body functions. Like the nervous system, it provides a method of control in order to keep the body functioning, despite changing conditions in the environment. Thus, the primary role of the endocrine system is to achieve homeostasis, a state in which the body's equilibrium is maintained.

The endocrine system communicates to the body by secreting chemicals into the bloodstream. The chemicals are called **hormones**, which are produced by special organs known as endocrine glands. The organs are also called glands because their primary function is the secretion of a product.

Endocrine glands secrete hormones directly into the watery environment surrounding each cell. From there, the hormones enter the bloodstream, which carries them throughout the body's circulation until they reach the part of the body they are to affect. Because blood flows much more slowly than the conduction of a nerve impulse, a hormone takes longer to reach its destination. As a result, the control provided by the endocrine system occurs more slowly, and also lasts longer, when compared to the nervous system.

Structurally, the endocrine system consists of the organs of the body that secrete hormones, which are scattered throughout the body. They include seven primary organs: pituitary gland, pineal gland, thyroid gland, parathyroid glands, adrenal glands, pancreas, and gonads. Several other organs also secrete hormones, although as a secondary function. You have studied them in previous chapters so they will not be considered here; they include the stomach, kidneys, thymus, and heart.

PITUITARY GLAND

The pituitary gland, which is also called the hypophysis, is connected to the hypothalamus at the base of the brain (Figure 9.1). The narrow bridge between the pituitary gland and the hypothalamus is known as the infundibulum. You have identified the pituitary gland during your study of the nervous system (Chapter 8), so you need not observe it again in your cat. The pituitary gland is a small oval gland composed of two parts: the **anterior pituitary** (adenohypophysis) and the **posterior pituitary** (neurohypophysis). It secretes a number of hormones, which are listed in Table 9.1.

PINEAL GLAND

Similar to the pituitary, the pineal gland is located within the cranial cavity. It forms part of the diencephalon, which you identified in Chapter 8 (Figure 9.1). It is a small gland, which produces a hormone (melatonin) that regulates biological cycles. If the brain of your cat is still available to observe, identify the pineal gland as the small caudal projection between the cerebral hemispheres.

THYROID GLAND

The thyroid gland is located caudal to the larynx in the ventral neck region (Figure 9.1). It consists of two **lobes**, right and left, that are often connected near the ventral midline by a thin bridge of fragile tissue called the **isthmus**. The thyroid gland secretes thyroxin, a hormone that regulates the rate of cellular metabolism in all body cells. It also secretes calcitonin, which reduces calcium levels in the bloodstream. Identify the thyroid gland in the neck of your specimen.

PARATHYROID GLANDS

The parathyroid glands are four, or sometimes five, small bodies embedded within the dorsal side of the thyroid gland (Figure 9.1). Because of their small size, they are not evident during routine dissection. The parathyroid glands secrete parathyroid hormone, which increases calcium levels in the bloodstream and is an antagonist to calcitonin.

ADRENAL GLANDS

The adrenal glands are a pair of oval organs, each located ventromedial to a kidney (Figure 9.1). Also known as the suprarenal glands, each consists of an outer **adrenal cortex** that secretes steroid hormones and an inner **adrenal medulla** that secretes epinephrine and norepinephrine. The steroid hormones of the adrenal cortex regulate water balance, reduce inflammation, participate in carbohydrate metabolism, and stimulate sex characteristics and sex cell development. The medullary products supplement the effect of the sympathetic division of the autonomic nervous system. Identify the adrenal glands in your specimen. *The human adrenals actually cap the superior border of the kidneys.*

PANCREAS

You have observed the pancreas in Chapter 4, because it performs digestive functions. Recall that it is an oblong, glandular structure located dorsal to the stomach in the abdominal cavity (Figure 9.1). The endocrine functions of the pancreas are isolated within small clusters of cells surrounded by digestive enzyme-secreting cells. The clusters are known as **islets of Langerhans**. The cells of the islets secrete insulin and glucagon, which regulate glucose (sugar) levels in the bloodstream. Identify the pancreas once again where it lies within the abdominal cavity.

GONADS

The gonads are the testes in the male and the ovaries in the female. You have identified these sexual organs in your study of Chapter 7. They are organs of the endocrine system because their primary function is the secretion of hormones. Recall that the male testes secrete testosterone, and the female ovaries secrete estrogen and progesterone. Identify these endocrine glands in a male and a female cat once again (Figure 9.1).

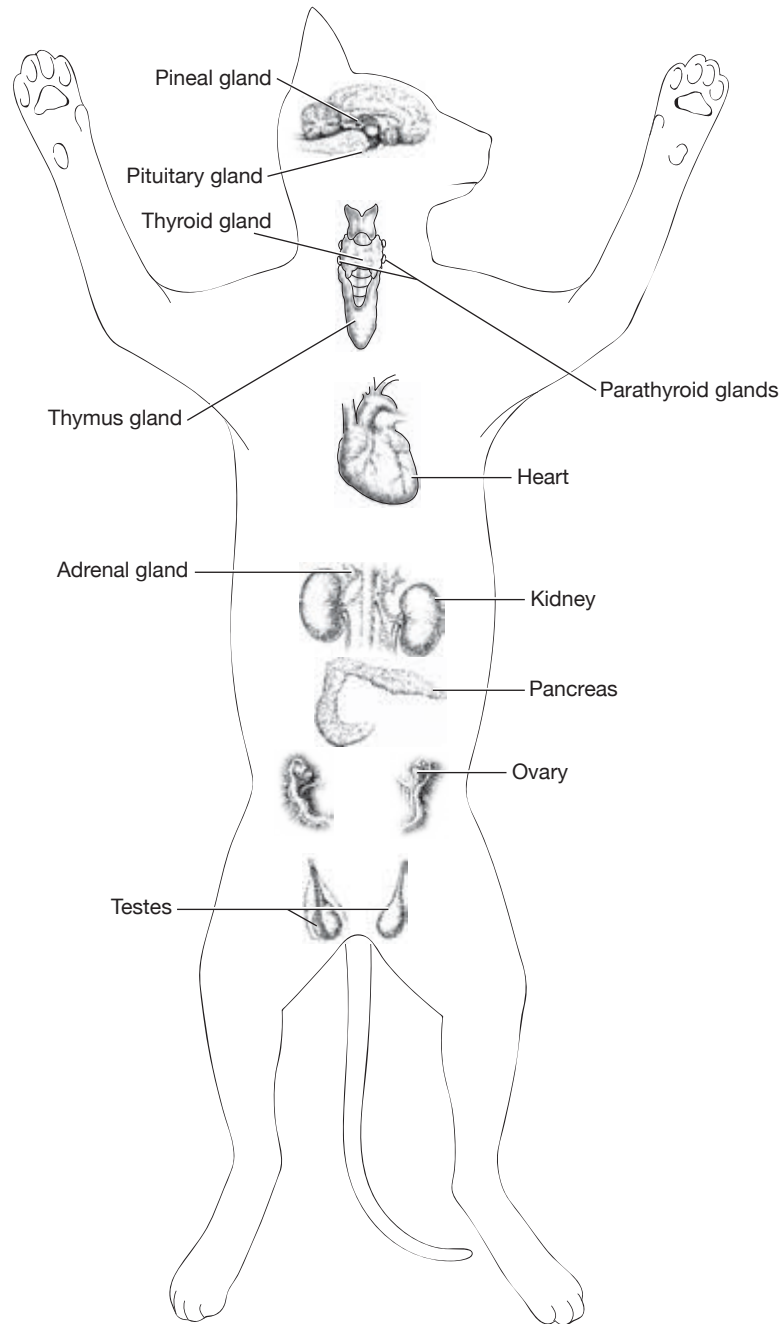


Figure 9.1 – Endocrine glands of the cat.

GLAND	HORMONE SECRETED	PRIMARY EFFECT
Pituitary Gland: Anterior Lobe	Growth hormone (GH) Melanocyte-stimulating hormone (MSH) Prolactin (PRL) Adrenocorticotrophic hormone (ACTH) Thyroid-stimulating hormone (TSH) Follicle-stimulating hormone (FSH) Luteinizing hormone (LH)	Controls growth and development Stimulates melanocytes to increase skin pigmentation Stimulates milk secretion by the mammary glands Stimulates the cortex of the adrenal glands Stimulates the thyroid gland Stimulates development of ova, sperm Stimulates the secretion of sex hormones by the gonads
Posterior Lobe	Oxytocin (OT) Antidiuretic hormone (ADH)	Stimulates contractions of the uterus and the release of milk by mammary glands Stimulates water reabsorption in the kidneys
Pineal Gland	Melatonin	Regulates body rhythms
Thyroid Gland	Thyroxin (T4) and Triiodothyronin (T3) Calcitonin (CT)	Controls catabolic metabolism and protein synthesis in most body cells Reduces calcium levels in the blood
Adrenal Glands: Medulla	Epinephrine & Norepinephrine	Prolongs the conditions responsible for the “flight or fight” response
Cortex	Mineralocorticoids (aldosterone) Glucocorticoids (cortisol, corticosterone, cortisone) Sex hormones (androgens & estrogens)	Maintains fluid balance by stimulating the retention of sodium and excreting potassium; helps regulate blood pressure Stimulates glycogen formation and storage, increases body resistance to stress, and reduces inflammation Stimulates sex characteristics; stimulates sex cell development
Pancreas (Islets of Langerhans)	Glucagon Insulin	Stimulates the conversion of glycogen to glucose Stimulates the conversion of glucose to glycogen
Gonads: Ovaries	Estrogens	Stimulates development of female sex characteristics, ovarian cycle, and menstrual cycle
Testes	Testosterone	Stimulates development of male sex characteristics, and sperm production

Table 9.1 – Endocrine glands and their hormones

CHAPTER REVIEW

- A. Answer the following multiple-choice questions by circling the most correct answer.
- The chemical messengers of the endocrine system are known as
 - proteins
 - electrolytes
 - hormones
 - endoglastins
 - The pituitary gland has a direct connection to the
 - cerebral cortex
 - hypothalamus
 - thalamus
 - pineal gland
 - The pineal gland is located within the
 - cranial cavity
 - diencephalon
 - brain
 - all of the above
 - The endocrine gland that is located below the larynx in the ventral neck region is the
 - thalamus
 - adrenal gland
 - thyroid gland
 - pituitary gland
 - The four or five tiny glands that are embedded within the thyroid gland are known as
 - lymph nodes
 - parathyroid glands
 - tumors
 - pineal glands
 - The glands that may be found ventromedial to each kidney are the
 - adrenal glands
 - gastric glands
 - islets of Langerhans
 - parathyroid glands
 - The islets of Langerhans are clusters of endocrine cells located within the
 - hypothalamus
 - ventral neck region
 - pancreas
 - gonads
 - The gonads are endocrine glands because they
 - produce the gametes
 - serve reproductive functions
 - secrete hormones
 - none of the above
 - Calcium levels in the blood are regulated by the thyroid and
 - metabolic activity
 - parathyroid glands
 - bone cells
 - adrenal glands
 - Insulin and glucagon are hormones that regulate sugar levels in the blood. They are secreted by endocrine cells within the
 - pancreas
 - adrenal cortex
 - thyroid gland
 - anterior pituitary gland

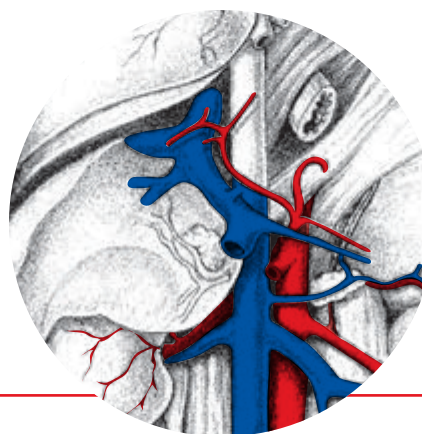
B. Complete the sentences below by providing the missing terms from the chapter material.

1. Structurally, the endocrine system consists of the organs of the body that secrete _____.
2. The _____ is connected to the hypothalamus at the base of the brain.
3. The _____ is part of the diencephalon of the brain.
4. The _____ is located on the ventral aspect of the neck.
5. The _____ are tiny glands that are embedded within the thyroid gland.
6. The _____ are located ventromedial to each kidney.
7. The _____ contains clusters of endocrine cells known as islets of Langerhans.
8. The glands that secrete testosterone are the _____.
9. Estrogens are secreted by the _____.
10. The anterior _____ regulates several other endocrine glands.

C. Answer the following descriptive and critical-thinking questions with a brief explanation in the spaces provided.

1. Contrast the primary functional role of the nervous system with that of the endocrine system.

A p p e n d i x

ANSWERS TO
CHAPTER REVIEWS

CHAPTER ONE

- A. 1. d; 2. a; 3. a; 4. c; 5. b; 6. b; 7. d; 8. c; 9. c; 10. a
- B. 1. mastoid process; 2. occipital; 3. sphenoid; 4. palatine; 5. maxillary; 6. coronal suture; 7. thoracic; 8. humerus; 9. ilium, ischium; 10. talus
- C. 1. The talus is very large, the calcaneus is elongate, the metatarsals are elongate, and the phalanges are angled to support weight.
2. Overall, the human cranium is much larger to accommodate the larger brain. More subtle differences include no distinct presphenoid in the human, and the temporal bone has less distinctive divisions in the human.
3. The innominate bones of the human differ from the cat due to the posture differences of bipedal gait. The innominate bones are in a more upright position in the human, and the ilium has a greater width relative to overall size. Also, the innominate bones are sexually dimorphic in humans; that is, the female ilium flares laterally, while the male ilium is more upright, and the angle between the opposing pubic bones is more obtuse in the female to form the birth canal.

CHAPTER TWO

- A. 1. c; 2. d; 3. c; 4. d; 5. d; 6. c; 7. b; 8. b; 9. c; 10. a
- B. 1. blunt probe; 2. needle probes; 3. eyelids; 4. pectoral; 5. urogenital; 6. axilla; 7. breasts; 8. cutaneus maximus; 9. platysma; 10. single piece
- C. 1. The skin should be retained so that it may be used as a wrap between dissections to reduce dehydration of tissues.
2. Over-use of a scalpel can lead to unnecessary cuts and a greater chance of personal injury during a dissection.
3. Dissection provides experience with touching and seeing real structures, which enhances learning and recall. It also serves to teach dissection skills.

CHAPTER THREE

- A. 1. a; 2. b; 3. b; 4. b; 5. c; 6. c; 7. b; 8. a; 9. b; 10. a
- B. 1. aponeurosis; 2. fascia; 3. adduction; 4. pectoantibrachialis; 5. trapezius; 6. brachialis; 7. brachioradialis; 8. fascia lata; 9. biceps femoris; 10. serratus ventralis
- C. 1. The quadriceps femoris group primarily extends the shank at the knee joint. The four muscles provide great force to enable the quadruped to run and leap by the push downward force that is exerted onto the ground. This force must be even greater in bipeds, because there is no assistance in the action by the forelimbs.

2. In humans, the gluteus maximus is a much more extensive muscle than the gluteus maximus of quadrupeds due to the stepping motion required of the bipedal gait. The g. medius is larger than the g. maximus in the cat and other quadrupeds, but smaller than the g. maximus in humans.
3. The human biceps brachii includes two heads of origin, from which its name is derived: a short head at the glenoid fossa and a long head at the coracoid process. The biceps brachii of the cat has only one origin: the glenoid fossa. In both organisms, the action is the same.

CHAPTER FOUR

- A. 1. a; 2. c; 3. c; 4. a; 5. d; 6. c; 7. b; 8. b; 9. a; 10. b
- B. 1. accessory organs; 2. parietal peritoneum; 3. abdominal cavity; 4. mandibular glands; 5. hard palate; 6. tongue; 7. oropharynx; 8. mesentery; 9. gallbladder; 10. ileocecal
- C. 1. The oral cavity tears and chews food (mastication); salivary glands secrete saliva, which begins carbohydrate digestion and lubricates food for swallowing; stomach begins protein digestion; and small intestine finalizes chemical digestion and performs nutrient absorption.
2. The liver secretes bile to assist in fat digestion within the small intestine; the gallbladder provides temporary storage of bile; pancreas secretes a collection of enzymes that participate in chemical digestion within the small intestine.
3. Based on the strict carnivorous diet of cats and the close similarity of GI tract anatomy between cats and humans, it may be suggested that humans are primarily carnivores. The dentition of humans, however, indicates an adaptation to chewing and grinding plant material, suggesting that meat consumption is supplemented with plants, providing evidence that human adaptations point to an omnivorous diet.

CHAPTER FIVE

- A. 1. a; 2. b; 3. b; 4. c; 5. b; 6. d; 7. c; 8. b; 9. c; 10. b
- B. 1. external respiration; 2. diaphragm; 3. thoracic; 4. primary bronchi; 5. nasal chambers; 6. thyroid cartilage; 7. glottis; 8. alveoli; 9. pleural; 10. apex
- C. 1. Respiration includes ventilation, which is composed of inspiration (inhaling) and expiration (exhaling). Inspiration is initiated when respiratory muscles contract, and expiration results when the muscles relax. External respiration is gas exchange between alveoli and capillaries due to pressure differences, resulting in oxygen moving into the bloodstream. Internal respiration is the movement of oxygen molecules from the bloodstream to body tissues.
2. The lungs are composed of tiny air sacs (alveoli), their surrounding capillaries, larger blood vessels, and the bronchial tree. The bronchial tree begins when the primary bronchi divide into secondary bronchi within each lung, then divide again into tertiary bronchi. The tertiary bronchi eventually divide to form bronchioles, which end in alveolar ducts that contain alveoli.

CHAPTER SIX

- A. 1. a; 2. b; 3. c; 4. c; 5. b; 6. b; 7. b; 8. c; 9. b; 10. c
- B. 1. capillaries; 2. left ventricle; 3. right atrium; 4. brachiocephalic artery; 5. caudal vena cava; 6. ventricles; 7. external jugular veins; 8. radial artery; 9. celiac trunk; 10. hepatic portal circulation
- C. 1. Right atrium through tricuspid valve to right ventricle, through pulmonary valve to pulmonary trunk and pulmonary circuit, pulmonary veins to left atrium, through bicuspid valve to left ventricle, through aortic valve to aorta.
2. A portal system shunts blood from one capillary network to another, whereas a

normal venous system carries blood from a capillary network toward the heart. The hepatic portal circuit shunts blood from the digestive tract to the liver for processing before it enters the general circulation.

3. The aortic branches are, from proximal to distal, the brachiocephalic artery, left subclavian artery, celiac trunk, superior mesenteric artery, adrenolumbar arteries, renal arteries, gonadal arteries, caudal mesenteric artery, lumbar arteries, deep circumflex iliac arteries, external iliac artery, internal iliac artery

CHAPTER SEVEN

- A. 1. b; 2. a; 3. b; 4. b; 5. a; 6. b; 7. c; 8. b; 9. c; 10. b
- B. 1. nephrons; 2. renal pelvis; 3. trigone; 4. urethra; 5. scrotum; 6. seminiferous tubules; 7. vas deferens; 8. ovarian ligament; 9. uterine horns; 10. urogenital aperture
- C. 1. The nephrons are located in the renal cortex and extend into the renal medulla of a kidney. They filter blood, reabsorb water from the filtrate, and secrete excess ions in the formation of urine. Urine formation helps manage blood pressure, fluid and salt balance in body fluids, and eliminates metabolic waste materials.
2. Spermatozoa are produced within seminiferous tubules of the testes, then pass into the ductus epididymus, then into the vas deferens, then into the ejaculatory duct of the urethra. The urethra opens to the exterior via the urogenital orifice.
3. The human vulva contains two pairs of labia, majora and minora, rather than a single pair as seen in the cat. Also, the human clitoris is a more prominent structure. Finally, the urethra and vagina enter the vulva as separate openings in human females: as the urethral orifice and the vaginal orifice.

CHAPTER EIGHT

- A. 1. c; 2. b; 3. a; 4. b; 5. a; 6. c; 7. a; 8. b; 9. a; 10. b
- B. 1. autonomic system; 2. cranial nerves; 3. cerebral cortex; 4. brain stem; 5. filum terminale; 6. brachial plexus; 7. sympathetic trunk ganglia; 8. taste buds; 9. lens; 10. cochlea
- C. 1. The cerebrum consists of the cerebral cortex, which receives sensory information, processes it by interpretation and correlation with memory, and initiates motor responses in order to maintain homeostasis. It also manages consciousness.
2. Light passes through the conjunctiva, then the anterior cavity with aqueous humor, then the pupil, then the lens, then the posterior cavity with aqueous humor, then the choroid, then the retina to stimulate rod and cone cells embedded within the retina.
3. A mechanical vibration is collected by the pinna (auricle) and directed into the external auditory meatus to contact the tympanic membrane, which vibrates in response. This vibration is transmitted to the ossicles: malleus, incus, and stapes, then to the oval window and into the cochlea. The vibration forms waves in fluid, which passes over hair cells to stimulate the impulse.

CHAPTER NINE

- A. 1. c; 2. b; 3. d; 4. c; 5. b; 6. a; 7. c; 8. c; 9. b; 10. a
- B. 1. hormones; 2. pituitary gland; 3. pineal gland; 4. thyroid gland; 5. parathyroid glands; 6. adrenal glands; 7. pancreas; 8. testes; 9. ovaries; 10. pituitary gland

- C. The nervous system relies upon nerve impulses to convey information from one part of the body to another. The nerve impulses move very rapidly, bringing about change in an instant. In contrast, the endocrine system relies upon the secretion of hormones, their movement into the bloodstream, and the delivery of hormones by way of blood flow. Consequently, hormone action to maintain homeostasis is much slower, and tends to last longer, than nervous action.

A p p e n d i x

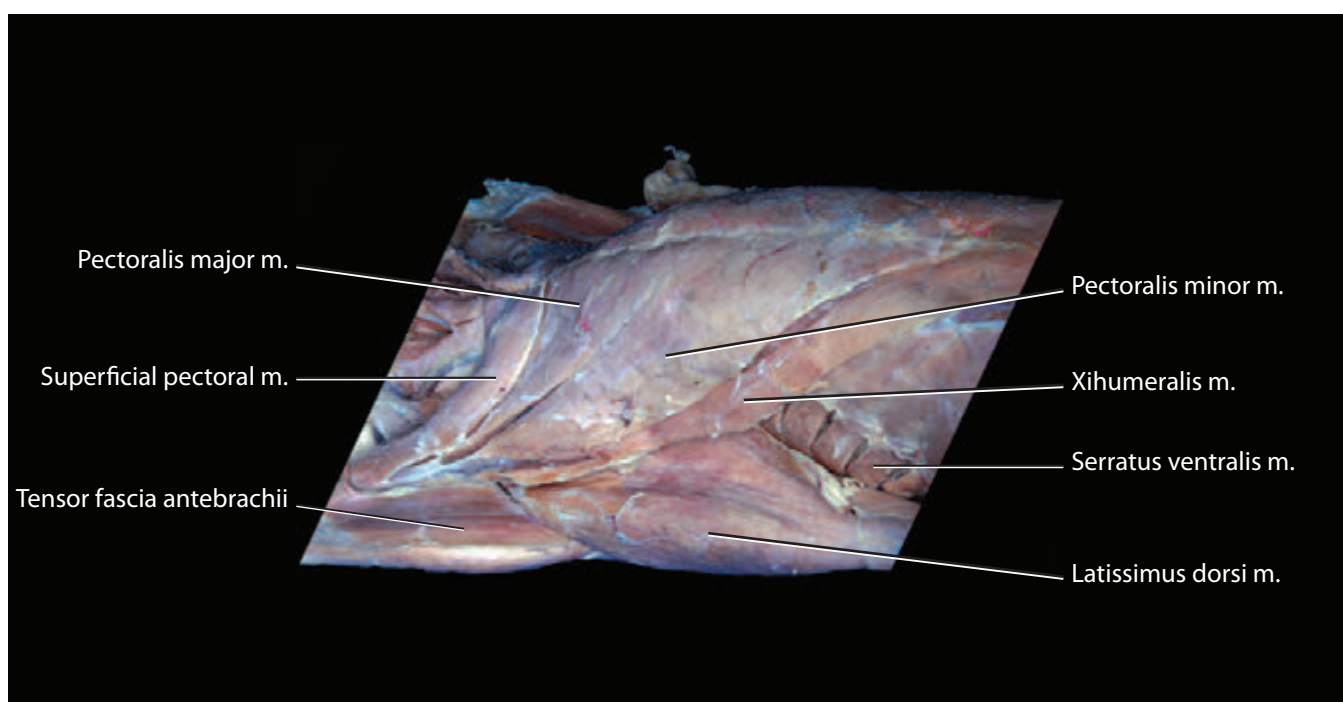
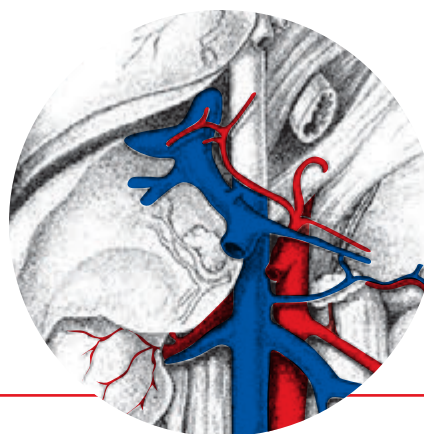
DISSECTION
PHOTOS

Figure 1 – Muscles of chest and shoulder, superficial lateral view, cat

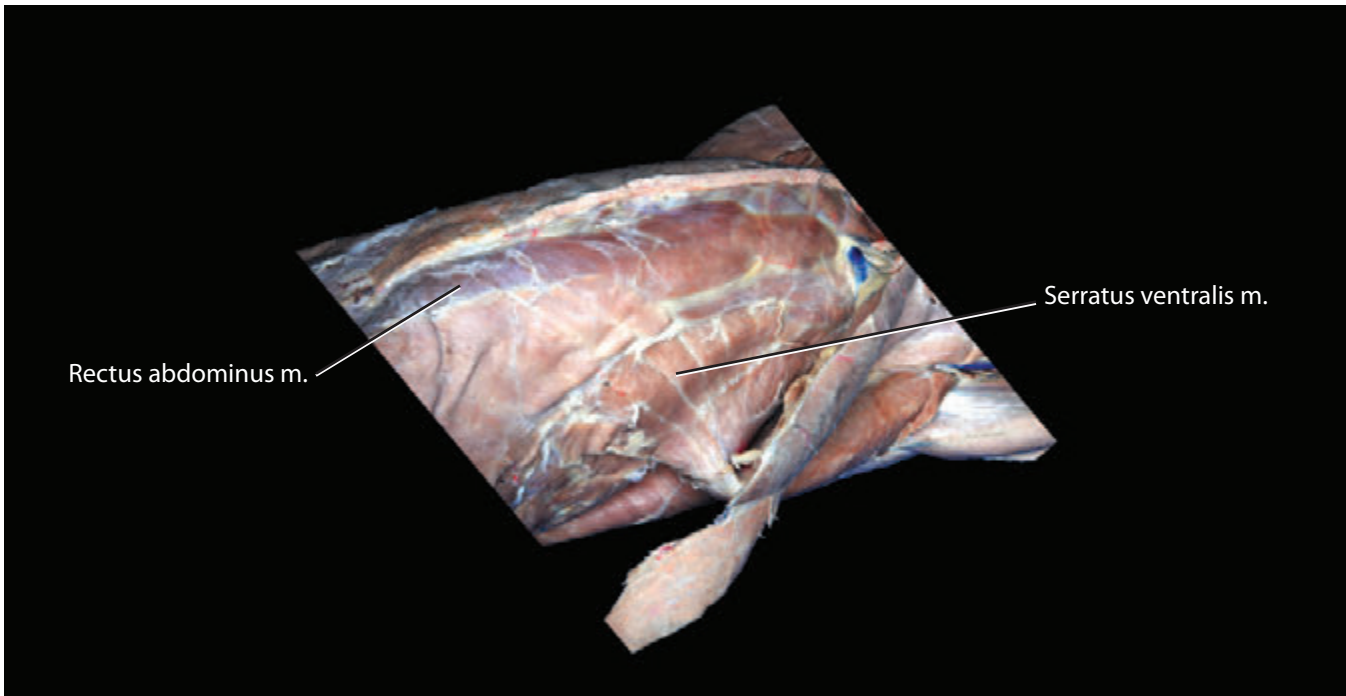


Figure 2 – Muscles of thorax, deep, ventral view, cat

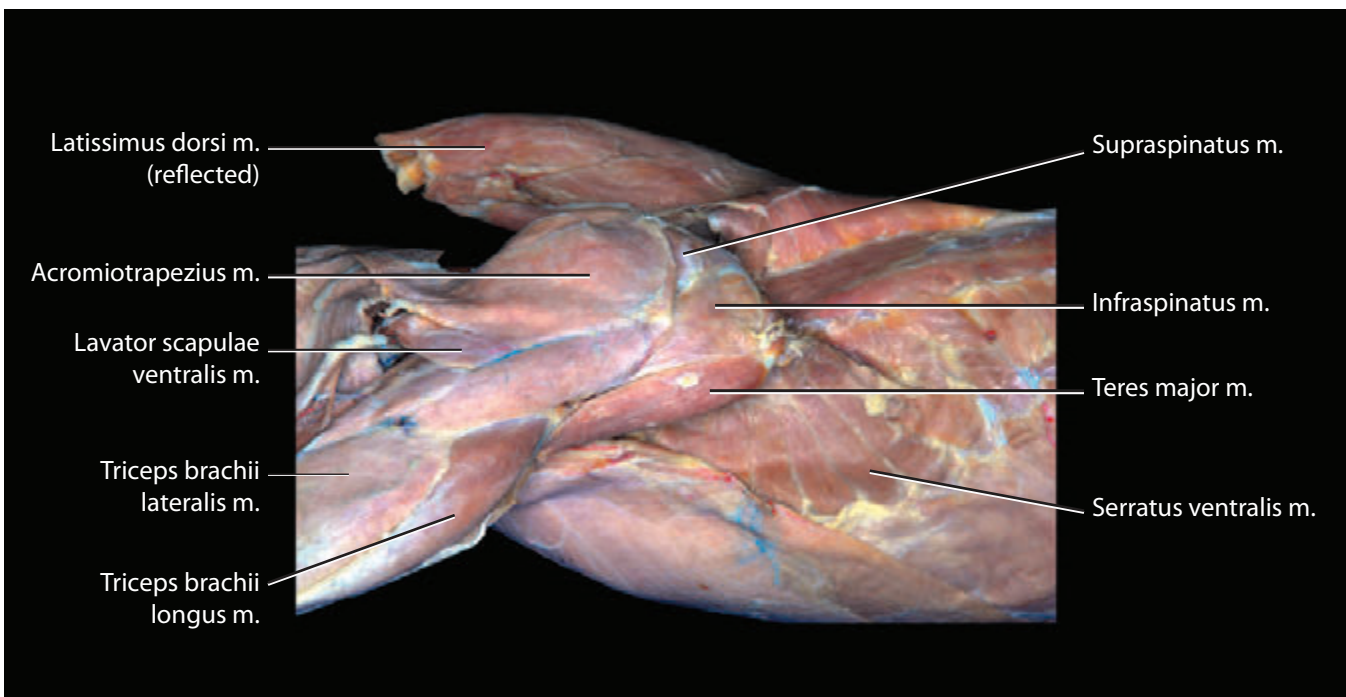


Figure 3 – Muscles of upper back, shoulder, and thorax, lateral view, cat



Figure 4 – Muscles of thorax, lateral view, cat

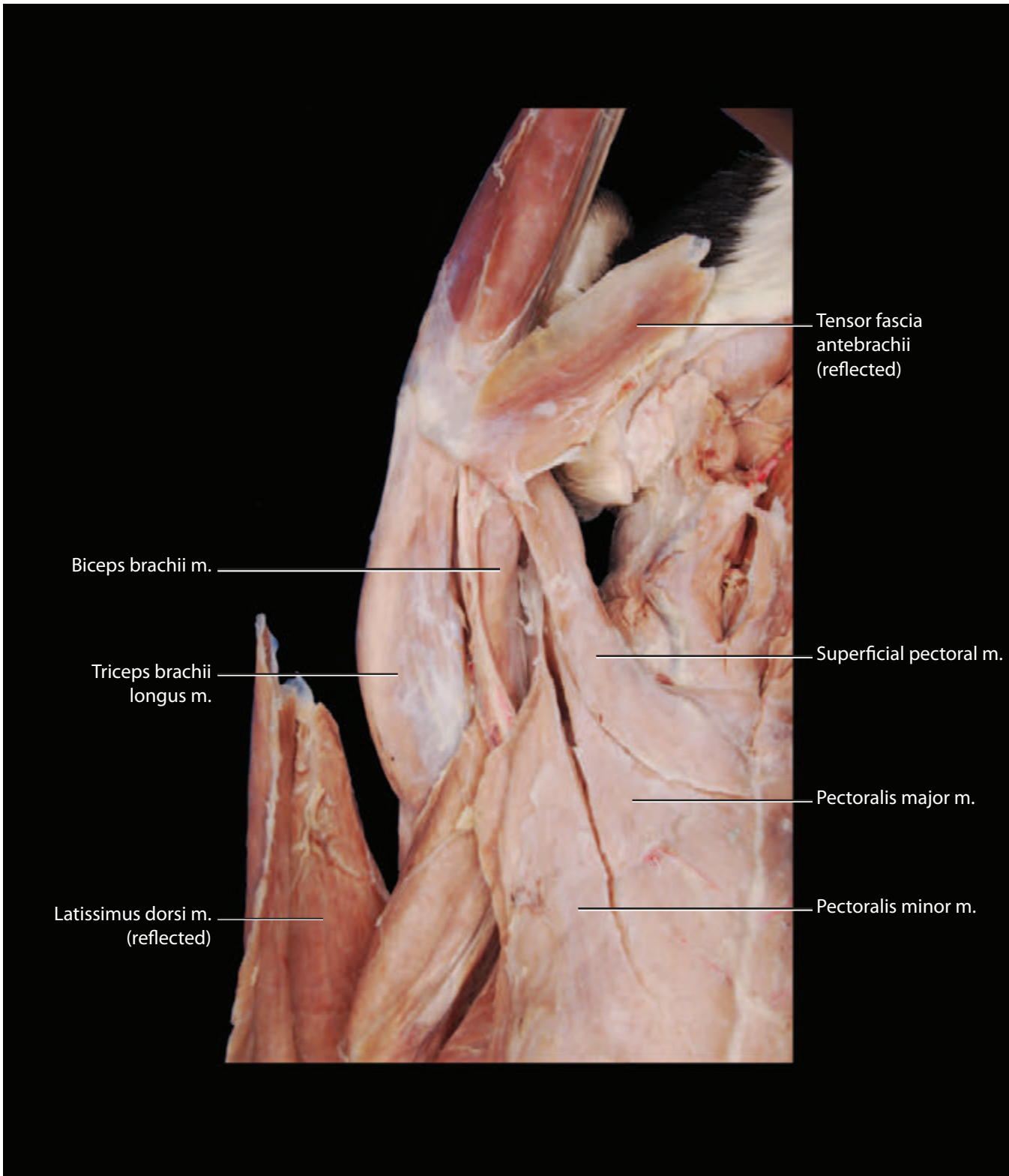


Figure 5 – Muscles of shoulder and brachium, deep, ventral view, cat

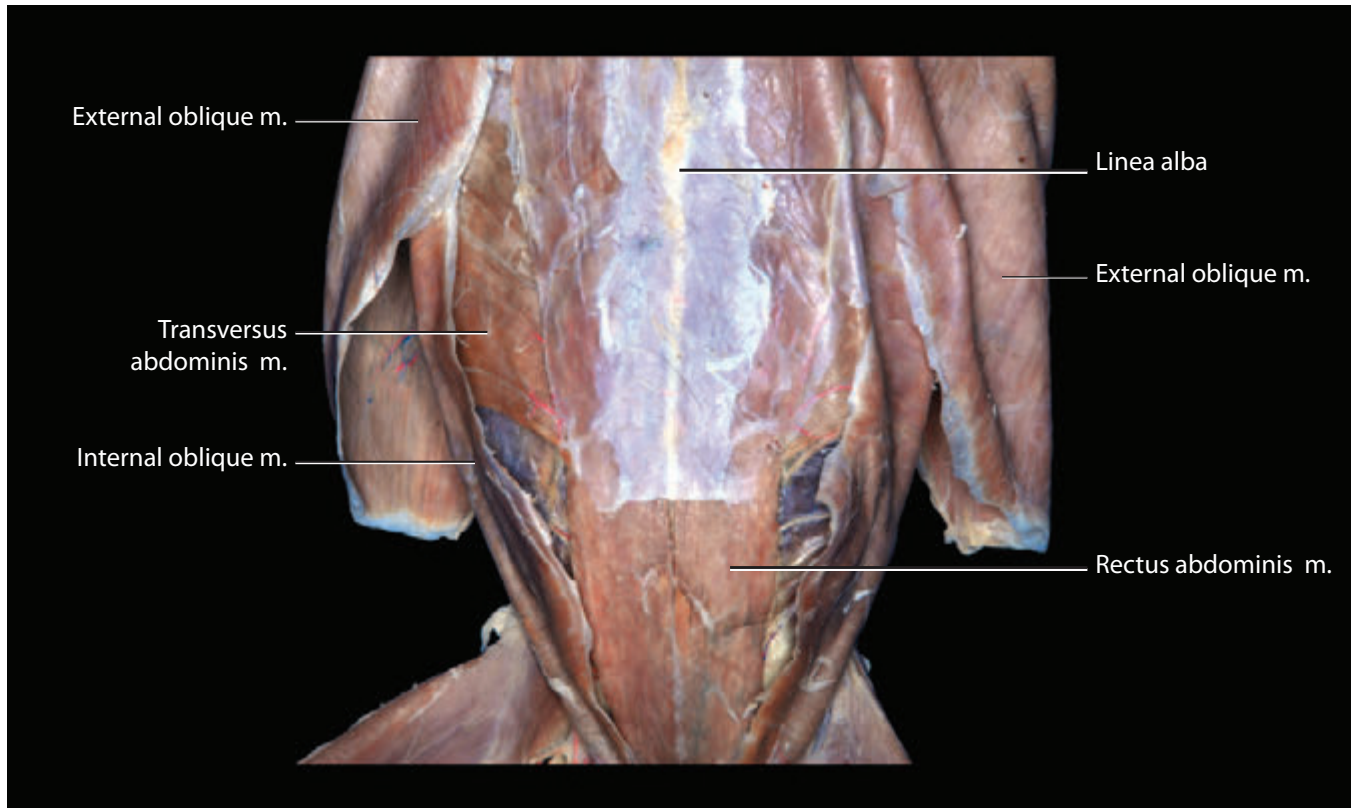


Figure 6 – Muscles of abdominal wall, ventral view, cat



Figure 7 – Muscles of abdomen, ventrolateral view, cat

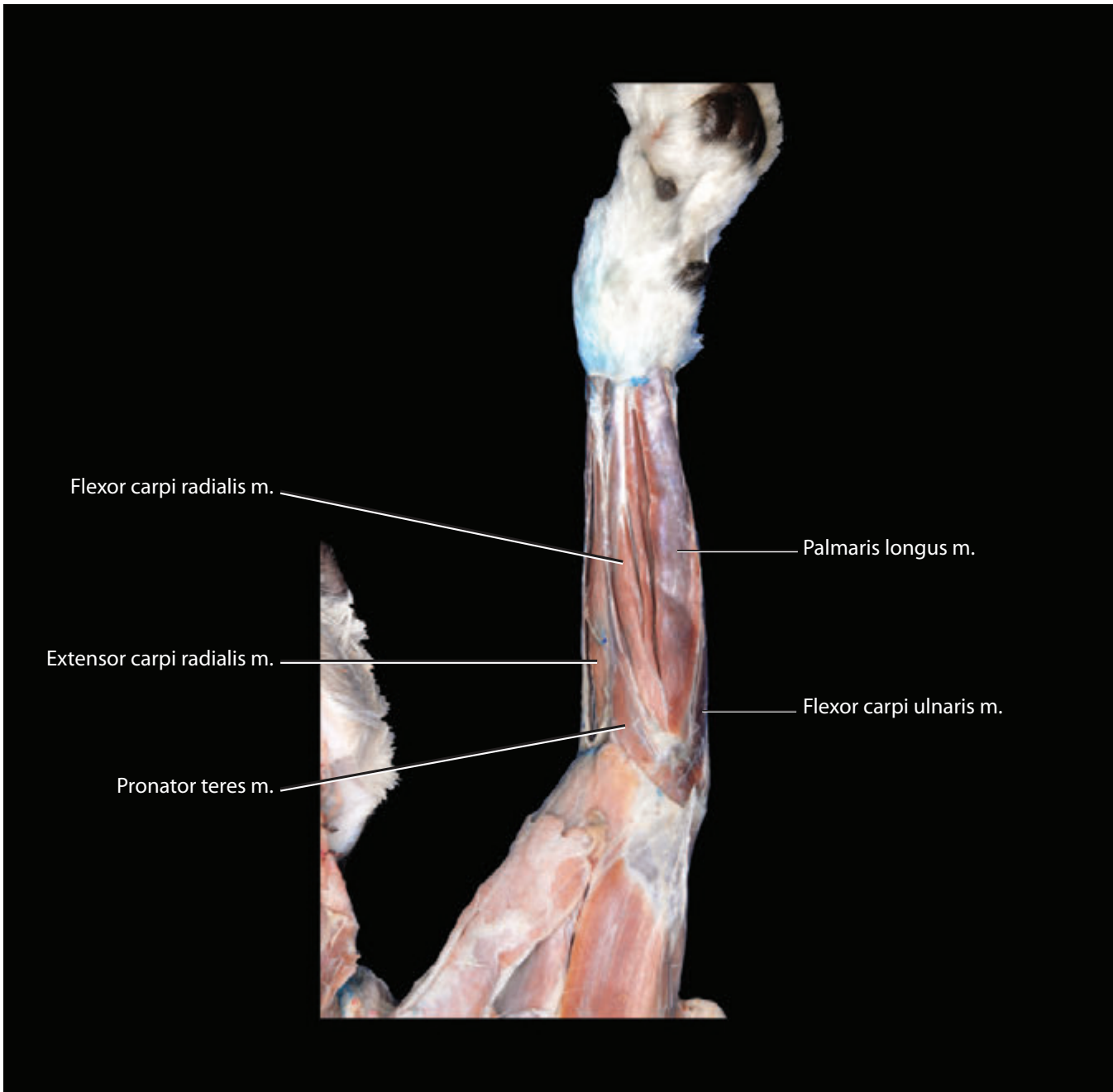


Figure 8 – Forelimbs muscles, medial view, cat

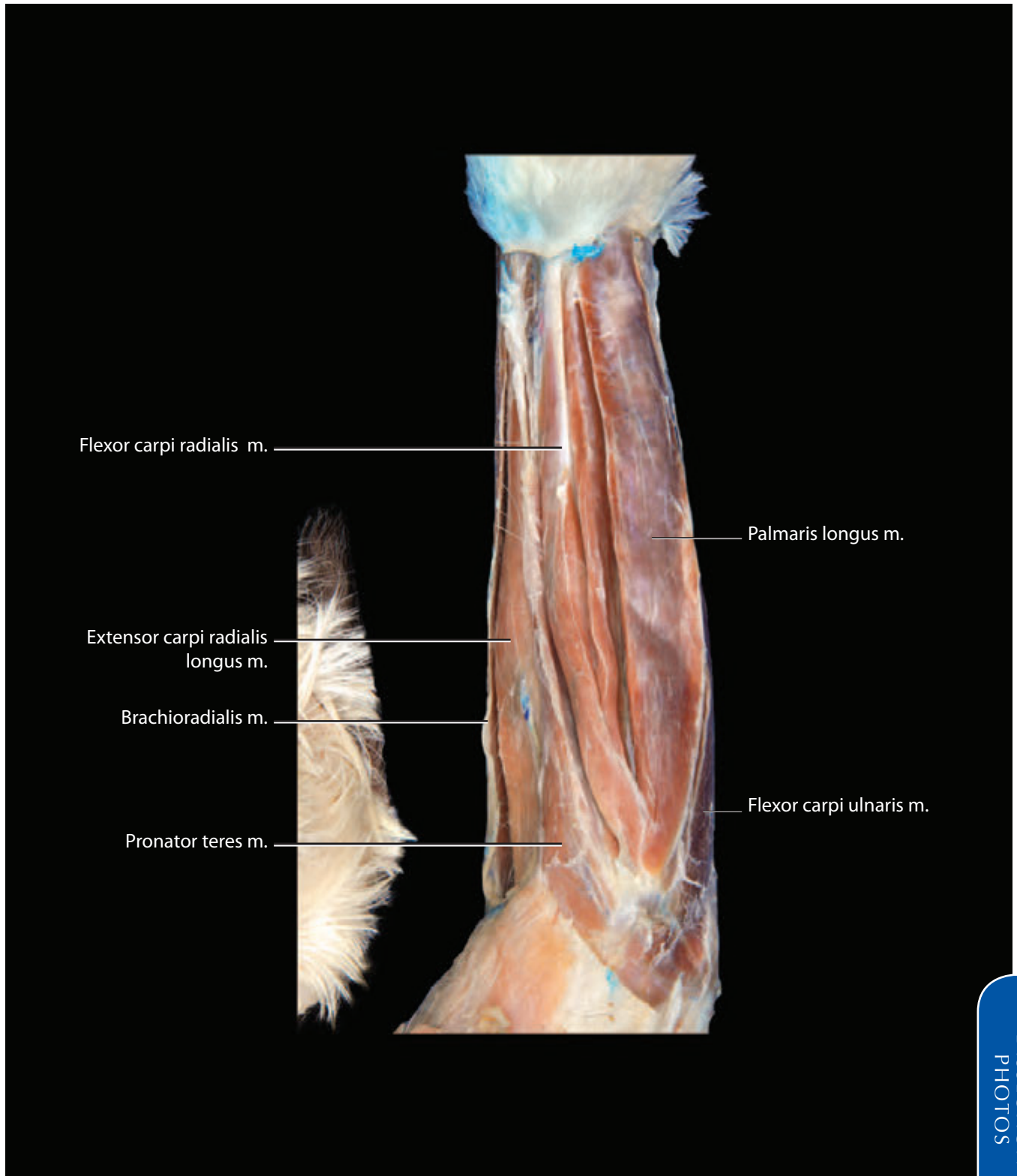


Figure 9 – Muscles of antebrachium, medial view, cat

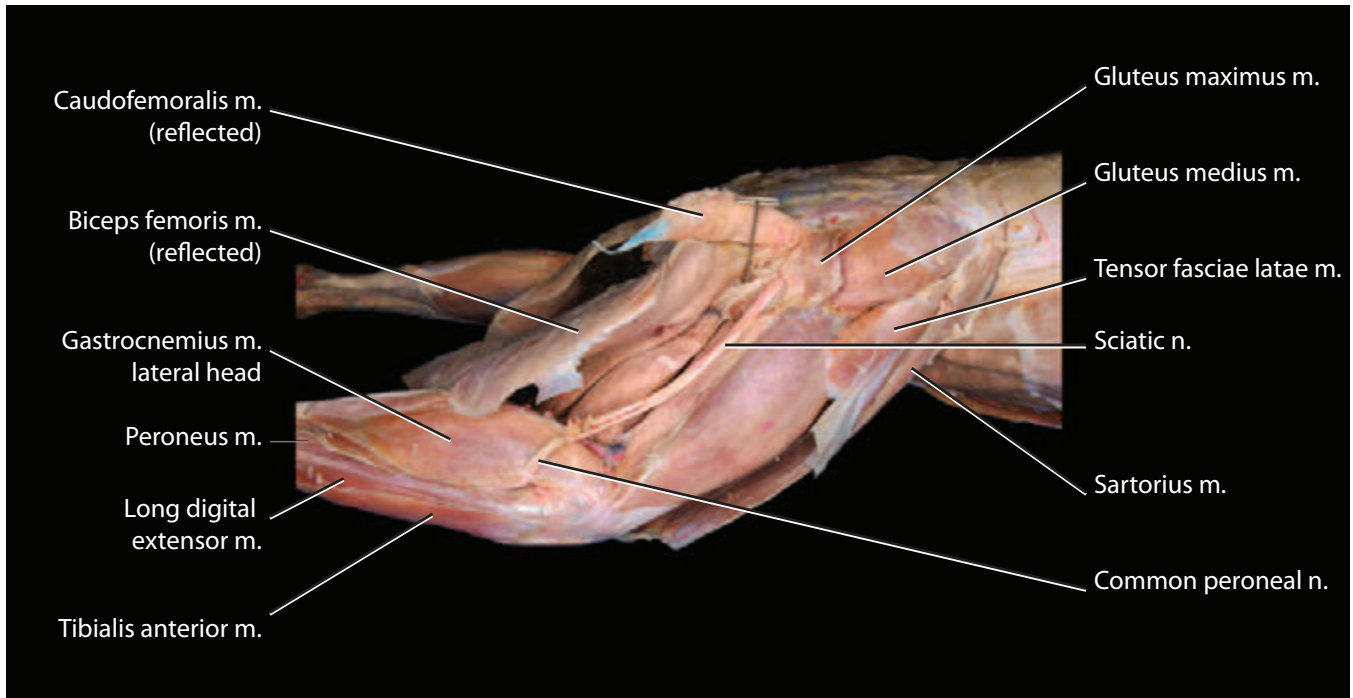


Figure 10 – Muscles of hindlimb, lateral view, cat

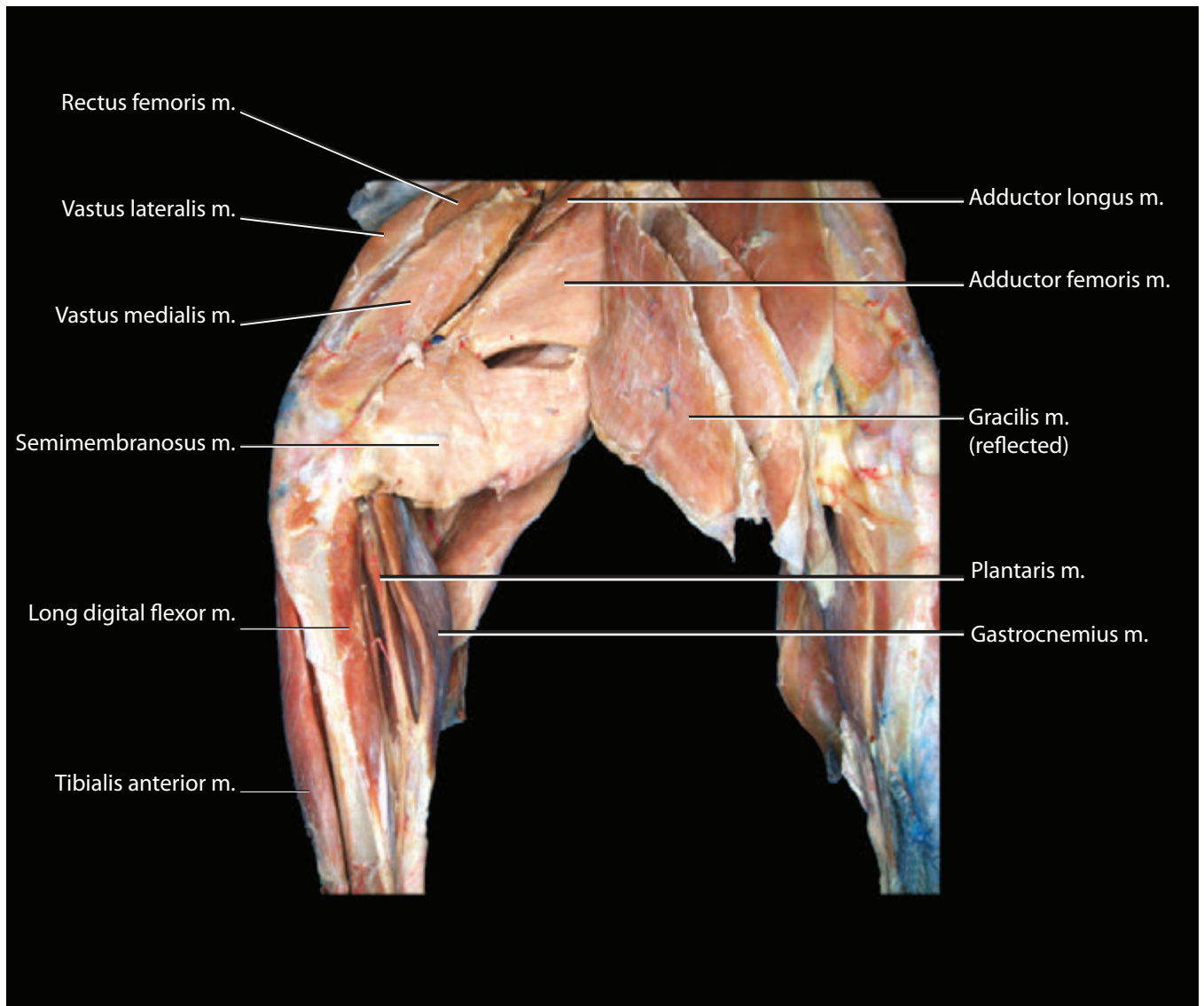


Figure 11 – Muscles of hindlimb, medial view, cat

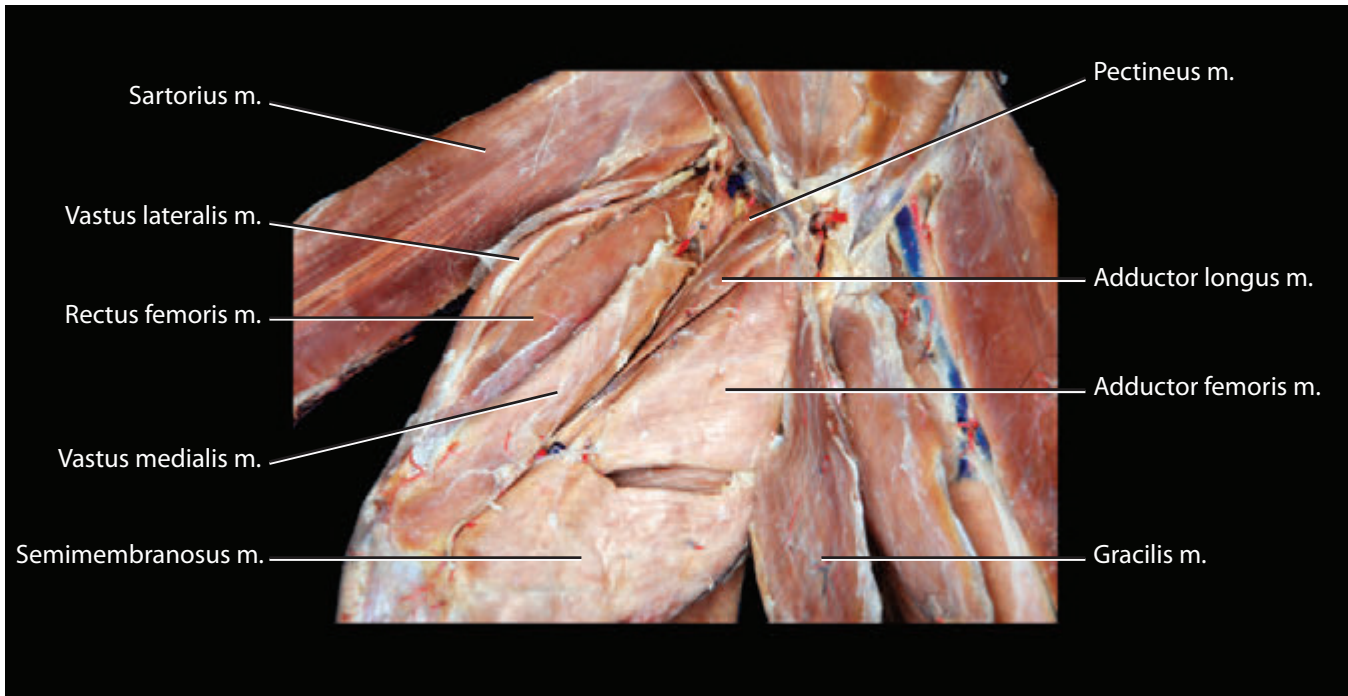


Figure 12 – Muscles of thigh, deep, medial view, cat

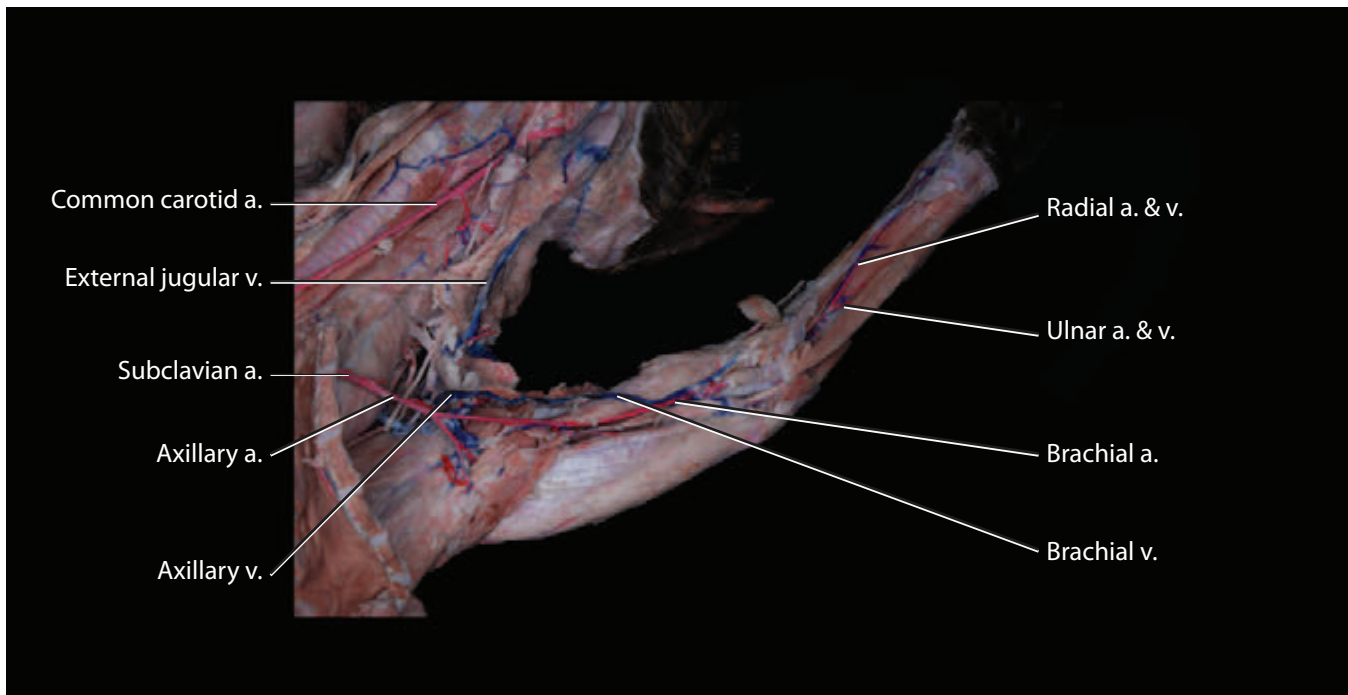


Figure 13 – Blood vessels of forelimb, cat

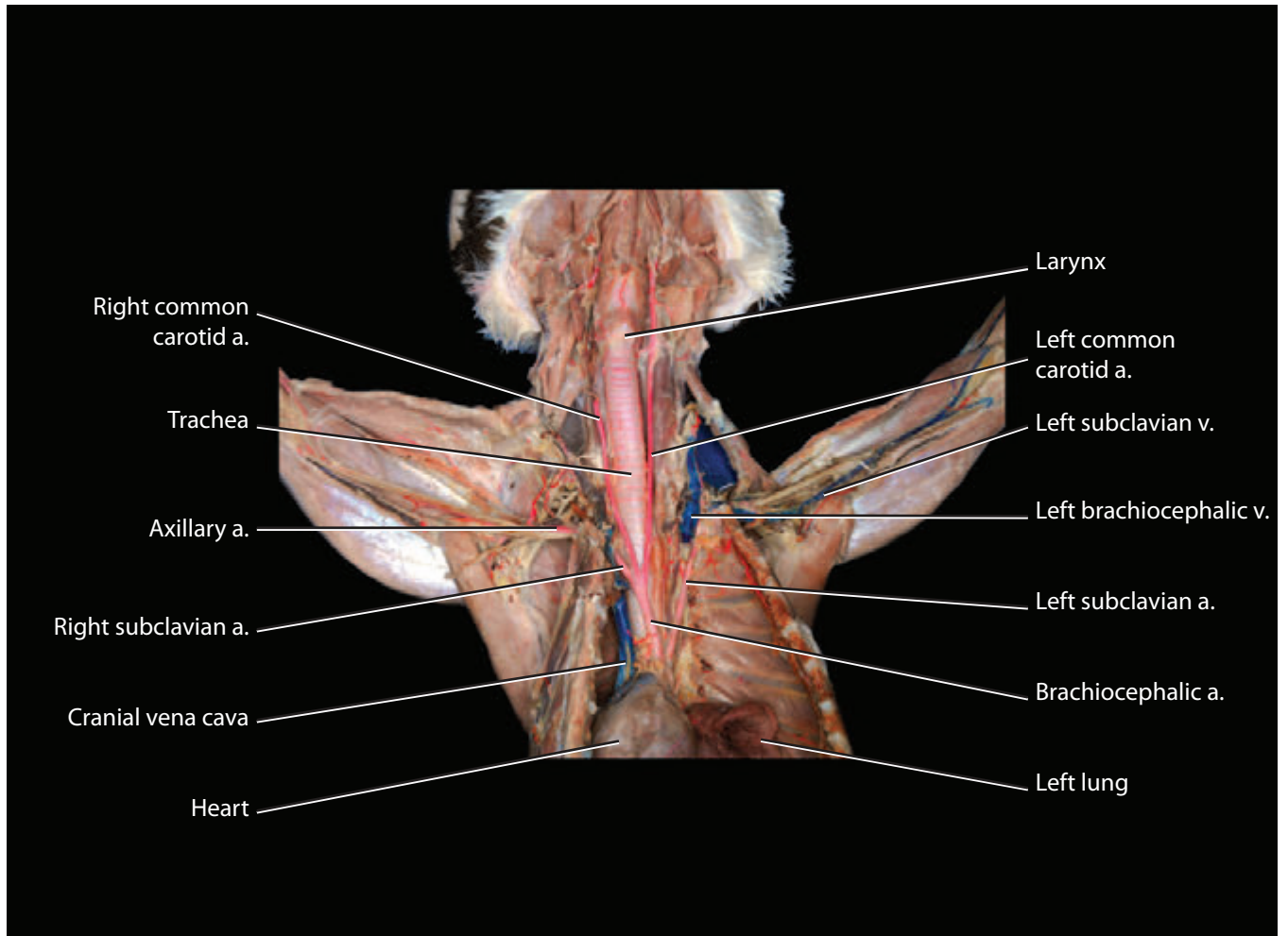


Figure 14 – Blood vessels cranial to heart, cat

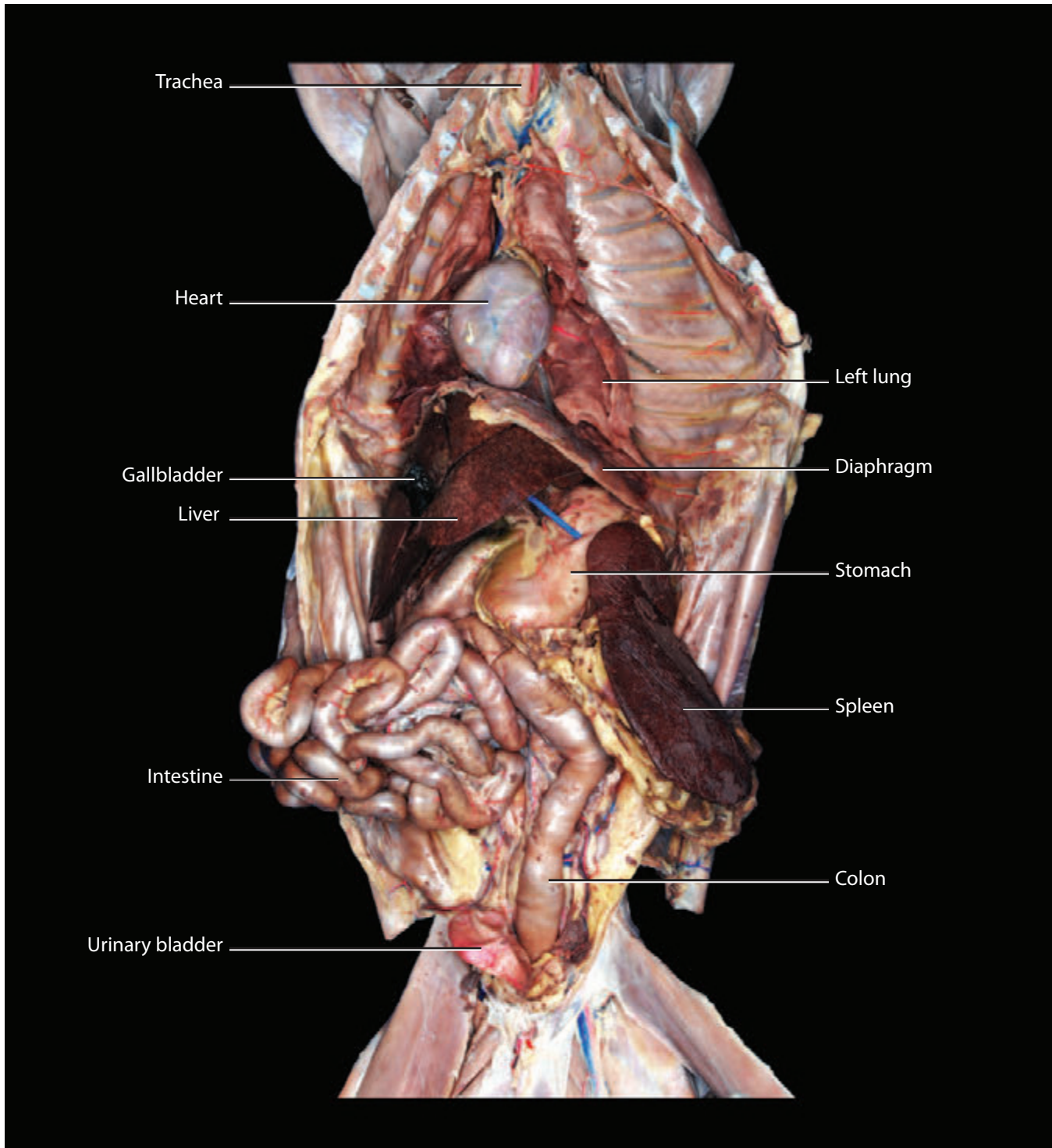


Figure 15 – Internal organs of cat

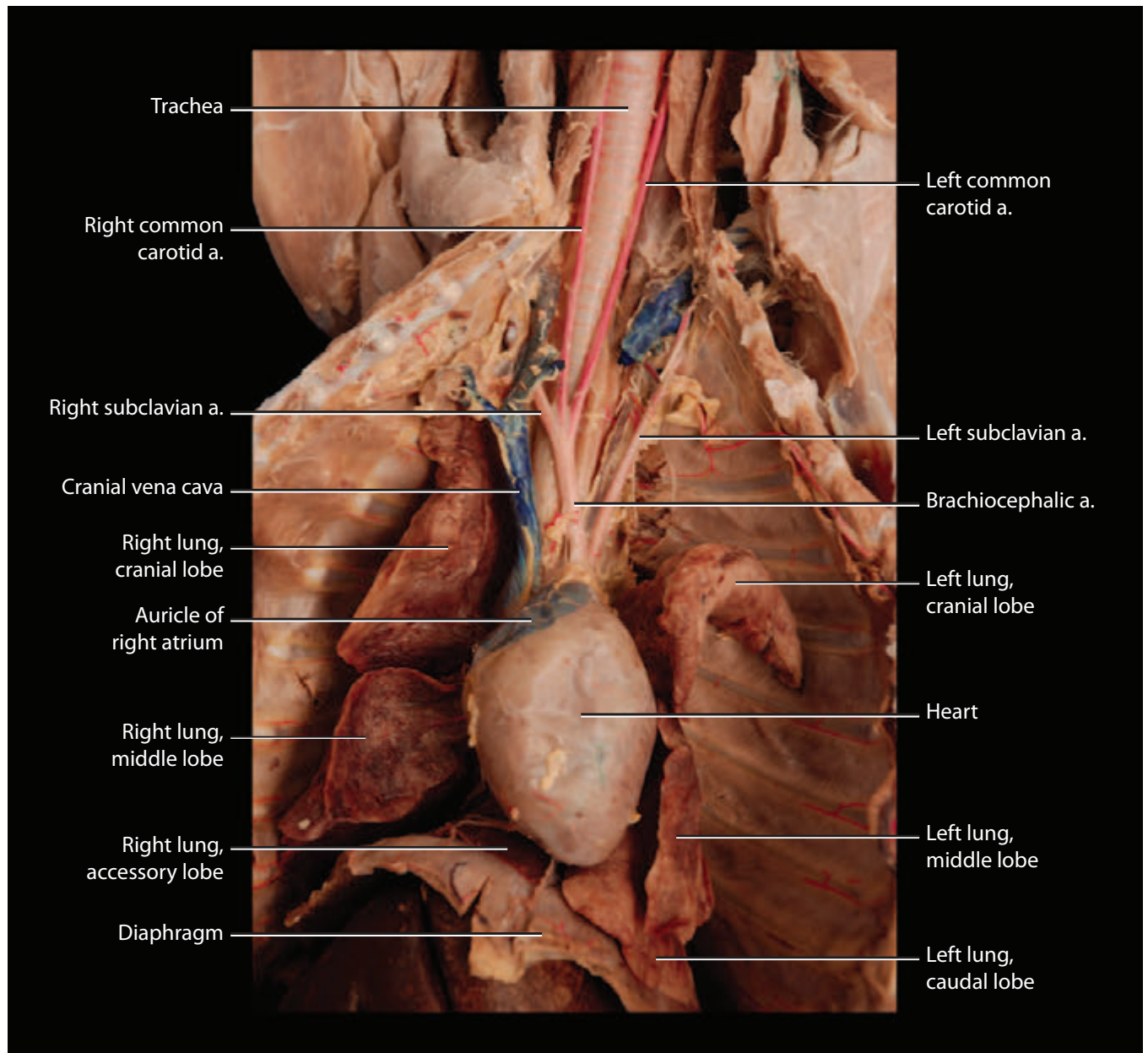


Figure 16 – Organs of thoracic cavity, cat

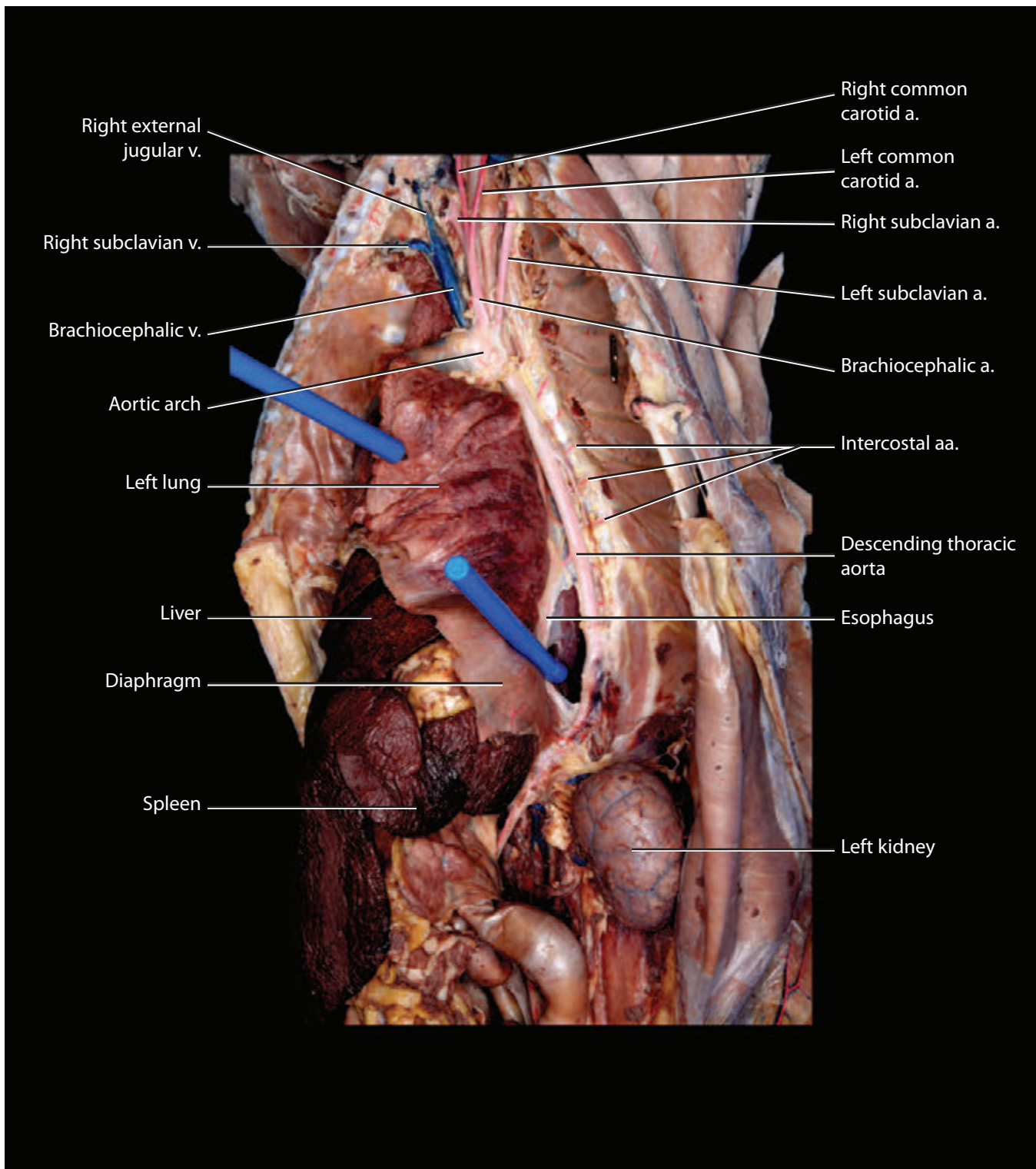


Figure 17 – Descending thoracic aorta, lateral view, cat

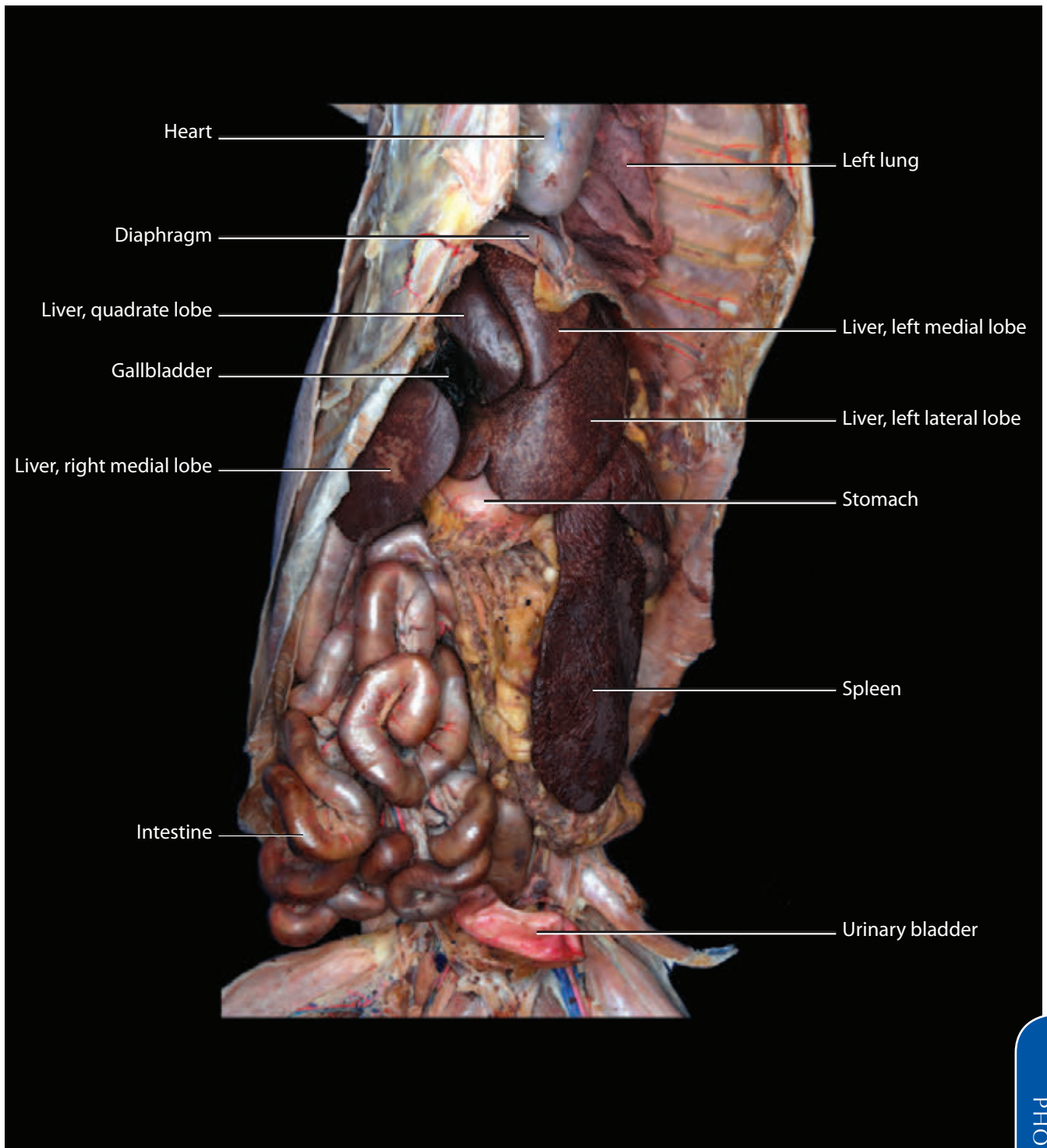


Figure 18 – Abdominopelvic cavity, superficial structures, cat

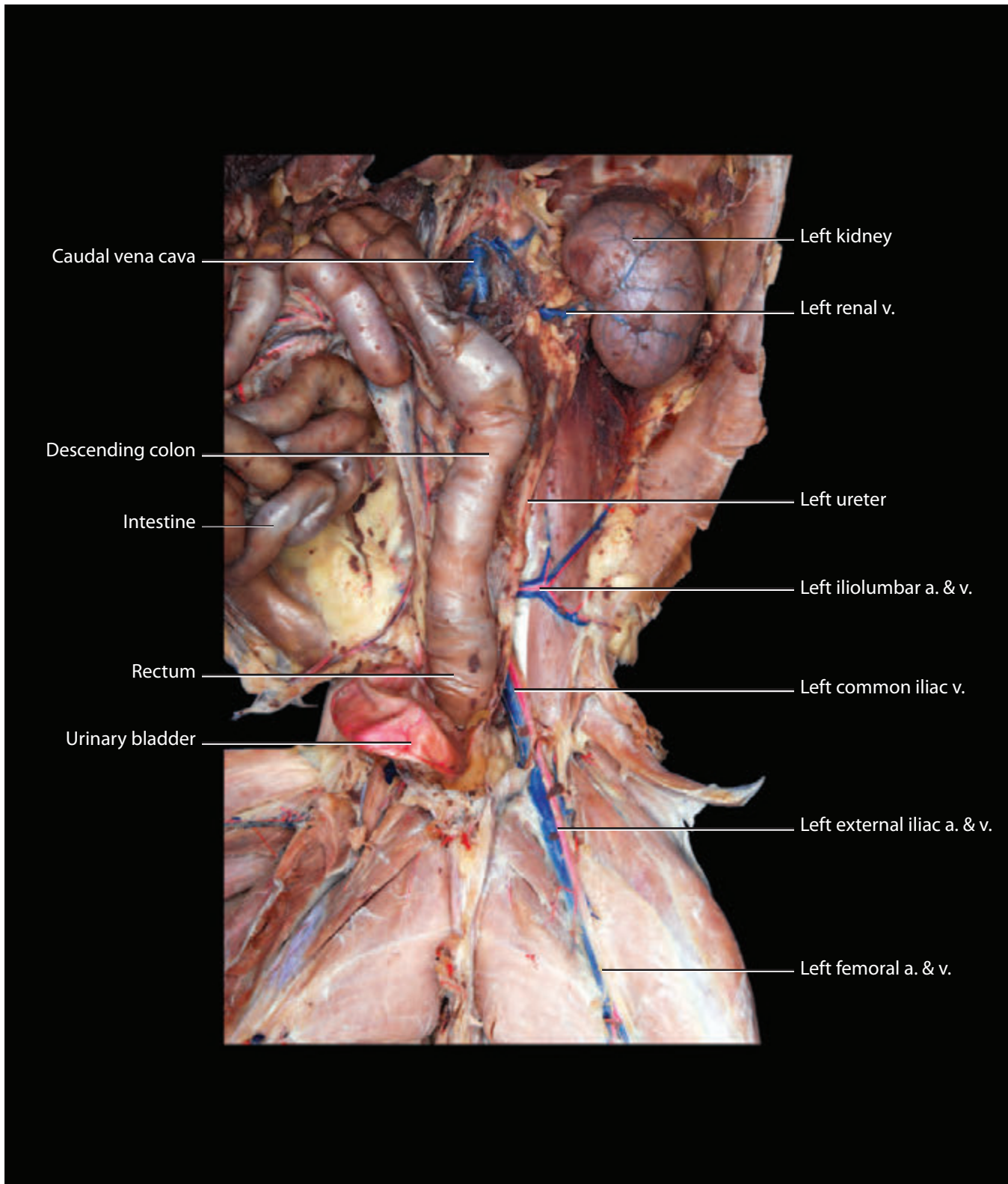


Figure 19 – Abdominopelvic cavity, deep structures, cat

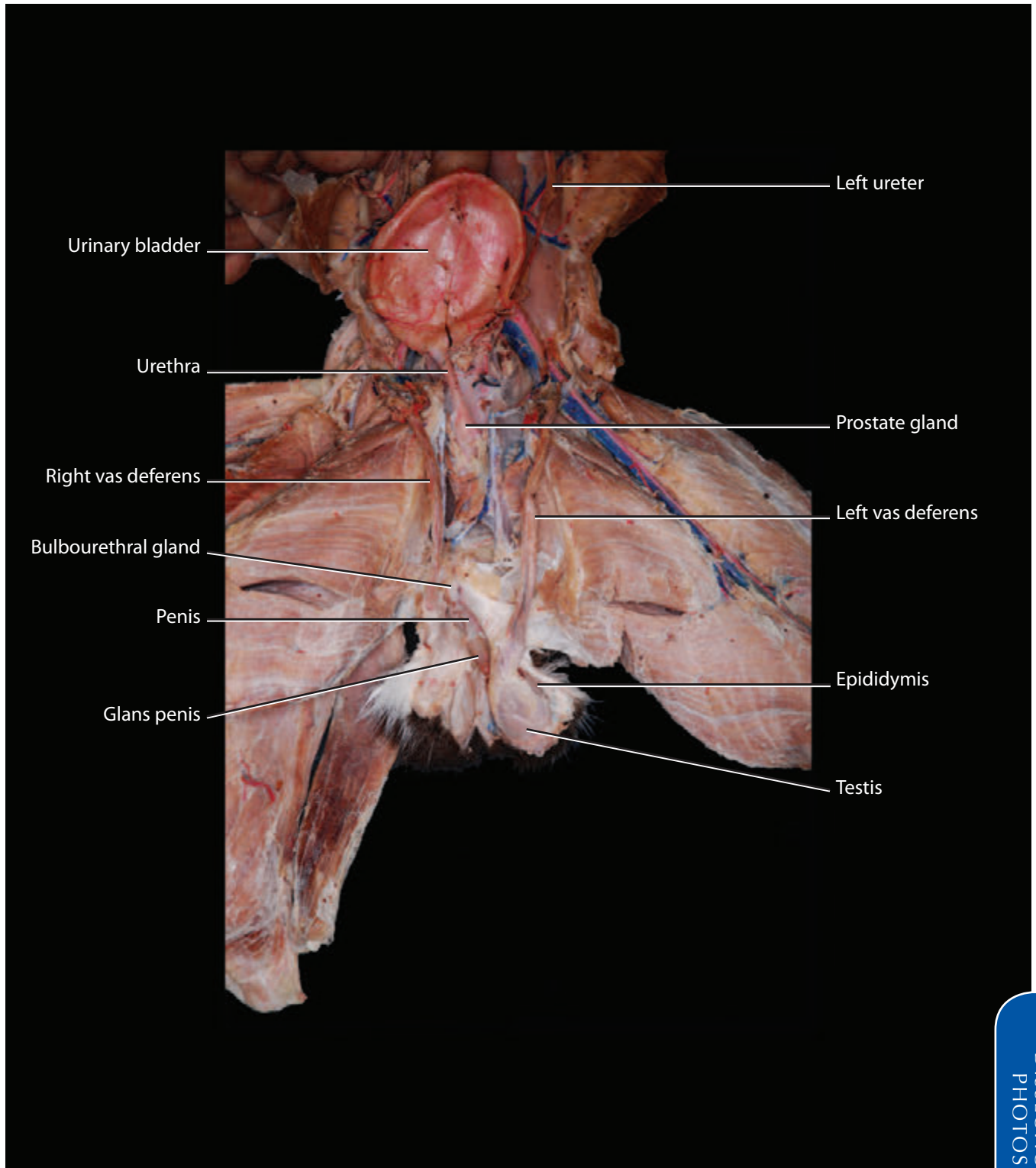
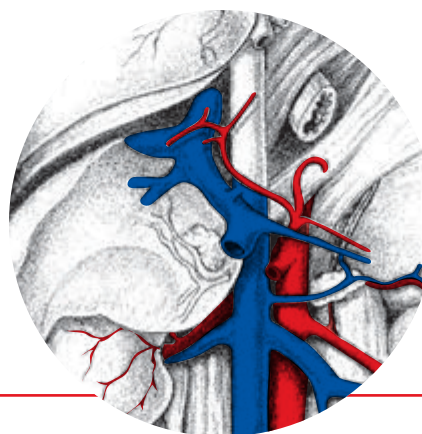


Figure 20 – Male reproductive system, cat

A p p e n d i x

GLOSSARY



A

- Abdomen** (AB-do-men): The regional area between the diaphragm and pelvis.
- Abdominal cavity:** The membrane-bound space between the diaphragm, abdominal wall, and pelvis.
- Abdominopelvic** (ab-do'-mi-no-PEL-vik) **cavity:** The membrane-bound space that includes the abdominal cavity and pelvic cavity.
- Abduction** (ab-DUK-shun): Movement away from the midline.
- Absorption** (ab-SORB-shun): The passage of digested foods from the digestive tract and into the bloodstream.
- Acetabulum** (a'-se-TAB-yoo-lum): A cup-shaped depression on the lateral surface of the coxal (hip) bone. It receives the head of the femur to form the hip joint.
- Achilles** (a-KIL-es) **tendon:** Also called the calcaneus tendon, it is the common tendon of the calf muscles that originates from the calcaneus (heel).
- Adduction** (ad-DUK-shun): Movement toward the midline.
- Adipose** (AD-i-pos): A type of loose connective tissue containing adipocytes, or fat cells.
- Adrenal cortex** (a-DRE-nal KOR-teks): The outer region of the adrenal glands, located superior to each kidney. It secretes steroid hormones, including glucocorticoids and mineralocorticoids.
- Adrenal glands:** Two endocrine glands, each situated superior to a kidney. Also called suprarenal glands.
- Adrenal medulla:** The inner region of the adrenal glands, which secretes epinephrine and norepinephrine.
- Adventitia** (ad'-ven-TISH-ya): The outermost covering of an organ or tissue.
- Alimentary canal** (a'-li-MEN-ta-re ca-NAL): The tube of the digestive system that includes the mouth, esophagus, stomach, small intestine, and large intestine. Also called the digestive tract, and gastrointestinal (GI) tract.
- Alveolar** (al-VE-o-lar) **duct:** A branch of a respiratory bronchiole within the lungs that leads to alveoli and alveolar sacs.
- Alveolar sac:** Two or more alveoli that share a common opening from an alveolar duct.
- Alveolus** (al-VE-o-lus): alveoli plural form: A microscopic air sac within the lungs.
- Amylase** (AM-i-las): An enzyme produced by the salivary glands and pancreas that cleaves starch, glycogen, and other polysaccharides during chemical digestion.
- Anatomical** (a-na-TOM-ik-al) **position:** The reference position, in which the bipedal subject is standing erect with the feet facing forward, arms are at the sides, and the palms of the hands are facing forward (the thumbs are to the outside).
- Anatomy** (a-NA-to-me): The study of the structure of the body.
- Anterior** (an-TER-e-or): Toward the belly or front of the body. In humans, it is also called ventral.
- Anterior horn:** A region of the spinal cord gray matter containing the cell bodies of motor neurons. It is also called the ventral horn.

- Anterior root:** The structure emerging from the spinal cord on its anterior aspect that contains axons of motor neurons. It is also called the ventral root.
- Anterior pituitary gland:** The portion of the pituitary gland at the base of the brain composed of glandular epithelium.
- Anus (A-nus):** The distal end and outlet of the rectum.
- Aorta (a-OR-ta):** The main trunk of the systemic circulatory circuit. It originates from the left ventricle of the heart.
- Aortic semilunar valve:** One of four heart valves, it consists of three cusps that are attached to the wall of the aorta near its origin from the left ventricle. It is also called the aortic valve.
- Apex (A-peks):** The extremity of a conical or pyramidal structure. The apex of the heart is the rounded, inferior-most tip that points to the left side.
- Aponeurosis (ap^o-o-noo-RO-sis):** A broad, sheet-like tendon joining one muscle with another or with a bone.
- Appendicular (ap^o-en-DIK-yoo-lar):** Pertaining to the major appendages, the forelimbs and hindlimbs.
- Aqueous humor (AK-we-us HYOO-mor):** The watery fluid that fills the anterior compartment of the eye.
- Arachnoid (a-RAK-noyd):** The middle of three connective tissue coverings (meninges) of the brain and spinal cord.
- Areolar (a-RE-o-lar):** A type of connective tissue with sparse protein fibers in the matrix (loose connective tissue).
- Arrector pili (a-REK-tor Pi-le):** Smooth muscle fibers attached to hair within the skin.
- Arteriole (ar-TE-re-ol):** A small tributary from a larger artery that delivers blood to a capillary.
- Artery (AR-ter-e):** A blood vessel that carries blood away from the heart.
- Articular cartilage (ar-TI-kyoo-lar KAR-ti-lej):** The cartilage that covers the end of a bone where it forms a joint with another bone.
- Articulation (ar-tik^o-yoo-LA-shun):** A synonym for joint, which is a point of contact between two opposing bones.
- Ascending colon (a-SEN-ding KO-lon):** A segment of the large intestine that extends from the cecum to the transverse colon.
- Atrioventricular (a-tre-o-ven-TRIK-yoo-lar) node:** A cluster of specialized cardiac (heart) cells in the right atrial wall that serve as part of the heart conduction system.
- Atrioventricular (AV) valve:** Two of four heart valves, each of which is located between an atrium and a ventricle. The right AV valve is also called the tricuspid valve, and the left AV valve is also called the bicuspid or mitral valve.
- Atrium (A-tre-um):** One of two superior chambers of the heart. Plural form is atria.
- Audation (ah-DA-shun):** The sense of hearing.
- Auditory ossicles (AH-di-tor-e OS-ik-elz):** The three small bones within the middle ear that transmit sound vibrations: the malleus, incus, and stapes.
- Autonomic ganglion (ah^o-to-NOM-ik GANG-le-on):** A cluster of neuron cell bodies that lie outside the central nervous system, serving either the sympathetic or parasympathetic divisions.
- Autonomic nervous system (ANS):** A division of the peripheral nervous system that serves body functions not requiring conscious control. It is divided into sympathetic and parasympathetic subdivisions.
- Axilla (ak-SIL-a):** The small depression beneath the arm where it joins the trunk of the body. It is also called the armpit.
- Axial (AK-se-al):** The body region along the midline, which includes the head, neck, and trunk.
- Axon (AK-son):** A long process of a neuron that carries a nerve impulse away from the cell body.
- ## B
- Basement membrane:** A thin layer of extracellular material that underlies epithelium.
- Basilar (BAS-i-lar) membrane:** One of two membranes in the inner ear that form the cochlear duct. It supports the organ of Corti.

Bicuspid (bi-KUS-pid) valve: The left atrioventricular (AV) valve of the heart. It is also called the mitral valve.

Bile: A fluid secreted by the liver and stored in the gallbladder. It assists in the digestion of fats within the small intestine.

Blind spot: A region of the retina where no photoreceptive cells are present, due to the exit point of the optic nerve.

Body cavity: A space in the body that is internally lined by a membrane, and contains structures including organs.

Bony labyrinth (BO-ne LAB-e-rinth): The portion of the inner ear that consists of cavities within the temporal bone, forming the vestibule, cochlea, and semicircular canals.

Brachial (BRA-ke-al): Pertaining to the upper arm.

Brachial plexus (BRA-ke-al PLEK-sus): A network of nerves from the anterior rami of spinal nerves C5, C6, C7, C8, and T1. The nerves of the brachial plexus supply the forelimbs.

Brain stem: The inferior portion of the brain that consists of the midbrain, pons, and medulla oblongata.

Bronchial tree (BRONG-ke-al): A portion of the respiratory conduction zone that consists of a series of tubes that branch from the trachea (the primary bronchi), and continue to branch after entering each lung (into secondary and tertiary bronchi).

Bronchiole (BRONG-ke-ol): A series of small tubes that arise as branches from tertiary bronchi within each lung.

Bronchus (BRONG-kus): Any one of the air passageways that carry air between the trachea and the bronchioles. Plural form is bronchi.

Buccal (BUK-al): Pertaining to the mouth or the cheeks.

Bulbourethral (bul'-bo-yoo-RE-thral) glands: A pair of small glands in the male reproductive system located inferior to the prostate gland. Its secretions contribute to semen. Also called Cowper's glands.

C

Calcaneus (kal-KA-ne-us): A large tarsal bone (of the foot), it forms the heel.

Calyx (KAL-iks): A cuplike extension of the renal pelvis (of the kidney). Plural form is calyces.

Canaliculus (kan'-a-LIK-yoo-lus): A small channel within compact bone tissue that connects lacunae. Plural form is canaliculi.

Capillary (KAP-i-lar'-e): A microscopic blood vessel that interconnects arterioles with venules. The capillary wall is a single cell layer in thickness, and is the only site of nutrient diffusion between the bloodstream and body cells.

Cardiac (KAR-de-ak) muscle: One of three types of muscle tissue. It is characterized by striations and involuntary contractions, and makes up the bulk of the heart wall.

Carpals (KAR-palz): The eight individual bones of the wrist. As a group, the bones of the wrist are referred to as the carpus.

Cartilage (KAR-ti-lej): A type of connective tissue characterized by the presence of a matrix containing a dense distribution of proteins and a thickened ground substance. The matrix is secreted by chondroblasts.

Cartilaginous (kar'-ti-LA'-jin-us) joint: One of three types of joints. It is characterized by the presence of cartilage that connects opposing bones.

Cauda equina (KAH-da e-KWI-na): The group of spinal nerves and roots at the inferior end of the spinal cord.

Cecum (SE-kum): The proximal end of the large intestine that receives the ileum of the small intestine.

Cell: The basic living unit of multicellular organisms.

Cell body: The portion of a neuron that contains the nucleus and much of the cytoplasm. Also called the soma.

Central fovea (FO-ve-a): A small depression in the center of the macula lutea of the retina. It contains cone cells (only), and is the area of optimal visual acuity (clearest vision).

- Central nervous system (CNS):** A major division of the nervous system that contains the brain and spinal cord.
- Cephalic** (se-FAL-ik): Pertaining to the head region.
- Cerebellum** (ser'-e-BEL-um): A functional region of the hindbrain located inferior to the cerebrum. It coordinates muscle movement.
- Cerebral aqueduct** (SER-e-bral AK-we-dukt): A channel through the midbrain containing cerebrospinal fluid. It connects the third and fourth ventricles of the brain.
- Cerebral cortex:** The outer layer of the cerebrum, which is composed of gray matter.
- Cerebrospinal fluid** (se-re'-bro-SPI-nal FLOO-id) (CSF): A clear fluid produced as a filtrate from blood in the choroid plexuses of the brain. It circulates through the ventricles of the brain, the central canal of the spinal cord, and the subarachnoid space of the brain and spinal cord.
- Cerebrum** (SER-e-brum): The largest functional region of the brain, it is the convoluted mass that lies superior to all other parts of the brain. It is the main site of integration of sensory and motor impulses.
- Cervical** (SER-vi-kal): Pertaining to the neck region.
- Cervical plexus** (PLEK-sus): A branching network of nerves originating from the anterior rami of the first four cervical nerves.
- Cervix** (SER-viks): The narrow, constricted part of the uterus that lies between the vagina and the body of the uterus.
- Chondrocyte** (KON-dro-sit): A mature cartilage cell.
- Chordae tendineae** (KOR-de TEN-din-e-e): Strands of connective tissue in the heart that anchor atrioventricular valves to papillary muscles.
- Choroid** (KO-royd): Part of the vascular tunic of the eyeball. It lines most of the internal surface of the sclera, thereby forming the middle layer of the wall of the eye.
- Choroid plexus** (KO-royd PLEK-sus): A mass of specialized capillaries in the ventricles of the brain, from which cerebrospinal fluid is produced.
- Chromosome** (KRO-mo-som): One of the structures (46 in human cells) within the cell nucleus that contains genetic material. Chromosomes become visible during cell division.
- Ciliary body** (SIL-e-ar-e BOD-e): Part of the vascular tunic of the eyeball, along with the choroid and iris. It suspends the lens, and consists of the ciliary muscle and ligaments.
- Cilia** (SIL-e-a): A hair-like process associated with a cell that is a modification of the plasma membrane. Its movement generates a flow of fluid (usually mucus) in the extracellular environment. Singular form is cilium.
- Circumduction** (ser'-kum-DUK-shun): A movement at a synovial joint such that the distal end of the bone draws a circular path.
- Clavicle** (KLA-vik-el): One of two bones connecting the sternum and the forelimb. Also called the collarbone.
- Clitoris** (KLI-tor-is): The female erectile organ located at the anterior junction of the labia minora.
- Coccyx** (KOK-siks): The fused bones at the end of the vertebral column of the human.
- Cochlea** (KOK-le-a): The portion of the inner ear that contains the receptors of hearing (the organ of Corti).
- Collagen** (KOL-a-jen): A protein that is an abundant component of connective tissue.
- Colon** (KO-lon): The division of the large intestine containing the ascending, transverse, descending, and sigmoid sections.
- Common bile duct:** A tube extending from the union of the common hepatic duct and the cystic duct to the duodenum (of the small intestine) that transports bile.
- Compact bone:** One of two types of bone tissue, it is characterized by a dense matrix filled with mineral salts and collagen arranged in lamellae that surround a central osteonic (Haversian) canal. Also called dense bone.
- Conchae** (KONG-ke): Scroll-like bones in the facial skeleton forming the superior, middle, and inferior shelves and meati of the nasal cavity.
- Condyle** (KON-dil): A rounded process of a bone.

- Cone:** A photoreceptor in the retina of the eye that is involved in color vision and high visual acuity.
- Conjunctiva** (kon'-junk-TE-va): A thin, transparent membrane lining the outer surface of the cornea of the eye and inner surface of the eyelids.
- Connective tissue:** One of the four basic types of tissue in the body. It is characterized by an abundance of extracellular material with relatively few cells, and functions in the support and binding of body structures.
- Conus medullaris** (KO-nus med'-yoo-LAR-is): The tapered terminal end of the spinal cord.
- Cornea** (KOR-ne-a): The transparent, anterior portion of the fibrous tunic covering the eye.
- Coronal (ko-RO-nal) plane:** A plane that extends vertically to divide the body into anterior and posterior portions. Also called the frontal plane.
- Coronary circulation** (KO-ro-nar-e ser'-kyoo-LA-shun): The circulatory pathway of blood to the heart wall from the aorta (by way of coronary arteries) and its return to the right atrium (by way of coronary veins).
- Coronary sinus:** An expanded venous channel on the posterior surface of the heart into which coronary veins empty.
- Corpus callosum** (KOR-pus ka-LO-sum): A bundle of nerve fibers forming a band of white matter that interconnects the two cerebral hemispheres of the brain.
- Corpus luteum** (LOO-te-um): A structure within the ovary that forms from a ruptured Graafian follicle and functions as an endocrine gland by secreting female hormones.
- Cortex** (KOR-teks): The outer portion of an organ.
- Costal cartilage** (KOS-tel CAR-ti-lej): A band of hyaline cartilage that connects a true rib with the sternum.
- Coxal bones** (KOK-sal bonz): The two bones that form the pelvis. Also called os coxae, or innominate bones.
- Cranial cavity** (KRA-ne-al CAV-i-te): The cavity within the skull that contains the brain.
- Cranial nerve:** One of twelve pairs of nerves that originate from the brain.
- Cranium** (KRA-ne-um): The skeletal portion of the skull that forms the cranial cavity.
- Cystic duct** (SIS-tik dukt): A tube that transports bile from the gallbladder to the common bile duct.
- Cytoplasm** (SI-to-plazm): The material of a cell located within the plasma membrane and outside the nuclear membrane, and containing the cellular organelles.
- Cytosol** (SI-to-sol): The thickened fluid of the cytoplasm that lies outside the cellular organelle membranes.
- Cytoskeleton** (ci'-to-SKEL-e-ton): A complex supportive network of microtubules and microfilaments within the cytoplasm of a cell.

D

- Deep:** A directional term meaning away from the surface of the body.
- Deep fascia** (FASH-e-a): A sheet of connective tissue covering the external surface of a muscle. Also called the epimysium.
- Defecation** (def-e-CA-shun): The discharge of feces from the rectum through the anus. Also called elimination.
- Dendrite** (DEN-drit): A cytoplasmic extension from the cell body of a neuron that carries a nerve impulse toward the cell body.
- Deoxyribonucleic acid** (de-ok'-se-ri-bo-nyoo-KLE-ik A-sid) (DNA): A nucleic acid in the shape of a double helix that contains the genetic information necessary for protein synthesis.
- Depression** (de-PRE-shun): Movement of a body part downward.
- Dermis** (DER-mis): The layer of the skin lying deep to the epidermis and composed of dense, irregular connective tissue.
- Descending colon** (de-SEN-ding KO-lon): The segment of the large intestine between the transverse colon and the sigmoid colon.
- Diaphragm** (DI-a-fram): An internal, circular muscle dividing the thoracic cavity from the abdominopelvic cavity.

Diaphysis (di-A-fi-sis): The shaft of a long bone.

Diastole (di-AS-to-le): A part of the cardiac cycle characterized by relaxation of the heart chambers, during which they fill with blood.

Diencephalon (di-en-CEF-a-lon): A region of the brain located inferior to the cerebrum. It is part of the forebrain, and contains the thalamus, hypothalamus, and pineal gland.

Digestion (di-JES-chun): The breakdown of food particles into units small enough to be absorbed.

Digestive tract: (see Alimentary canal).

Dilate (DI-lat): To enlarge in size or expand.

Distal (DIS-tal): A directional term identifying a body part located further from the origin or point of attachment to the trunk relative to another.

Distal convoluted tubule: A segment of the renal tubule (of the kidney nephron) that extends from the loop of Henle to the collecting duct.

Dorsal (DOR-sal): A directional term indicating toward the back side, or posterior.

Dorsal cavity: A major body cavity containing the cranial cavity and the vertebral canal.

Dorsal root: The sensory branch of a spinal nerve that connects with the spinal cord.

Dorsiflexion (dor'-se-FLEK-shun): Movement of the foot toward the dorsal side.

Ductus deferens (DUK-tus DEF-er-enz): The tube that conducts sperm from the epididymis in the testes to the ejaculatory duct. Also called vas deferens and seminal duct.

Duodenum (doo-o-DE-num): The first segment of the small intestine that extends from the pyloric valve to the jejunum.

Dura mater (DYOO-ra MA-ter): The outer of the three meninges that surround the brain and spinal cord.

E

Effector (e-FEK-tor): Any muscle or gland that responds to a stimulus from a motor neuron.

Efferent arteriole (EF-er-ent ar-TE-re-ol): An arteriole that transports blood away from the glomerulus of a nephron (in the kidney).

Efferent ductules (DUK-tyoo-elz): Small coiled tubes that transport sperm from the rete testis to the epididymis.

Efferent neuron (NOO-ron): A neuron that carries impulses away from the central nervous system. Also called motor neuron.

Ejaculation (e-jak'-yoo-LA-shun): The expulsion of semen from the penis, which is accomplished by reflexive muscle contractions.

Ejaculatory duct (e-JAK-yoo-la-to-re dukt): A short tube that carries sperm from the ductus deferens to the urethra.

Electrolyte (e-LEK-tro-lit): A chemical that can separate into ions and conduct an electric current when in a water solution.

Elevation (el-e-VA-shun): Movement of a body part upward.

Embryo (EM-bre-o): In the human, it is the developing organism during its first eight weeks of life following fertilization.

Endocardium (en-do-KAR-de-um): The inner layer of the heart wall that forms a thin, smooth lining covering the chambers and valves.

Endochondral ossification (en-do-KON-dral os'-i-fi-KA-shun): The development of bone such that bone tissue forms in replacement of hyaline cartilage.

Endocrine gland (EN-do-krin gland): One of two main categories of glands, in which the products are secreted into the extracellular space and transported by the bloodstream. Also called ductless glands.

Endocytosis (en'-do-si-TO-sis): The active process of bulk transport of material into a cell. It includes phagocytosis and pinocytosis.

Endolymph (EN-do-lymf): The fluid within the membranous labyrinth of the inner ear.

Endometrium (en'-do-ME-tre-um): The inner, vascular layer of the uterus.

Endomysium (en'-do-MI-se-um): The deepest layer of connective tissue associated with a muscle. It surrounds individual muscle fibers.

Endoneurium (en'-do-NYOO-re-um): The deepest layer of connective tissue associated with a nerve. It surrounds individual nerve fibers (myelinated axons of neurons).

- Endoplasmic reticulum** (en³-do-PLAZ-mik re-TIK-yoo-lum) (ER): A cytoplasmic organelle that consists of a series of tubules with a hollow center. It functions in the transport of cellular products (smooth ER), and as a site for protein synthesis (if ribosomes are attached, called rough ER).
- Endosteum** (en-DO-ste-um): A membrane lining the medullary cavity within a bone and containing osteoblasts and osteoclasts.
- Endothelium** (en³-do-THE-le-um): A layer of simple squamous epithelium lining the inside of blood vessels and the heart chambers.
- Enzyme** (EN-zim): A protein that performs the role of catalyst in a chemical reaction.
- Eosinophil** (e³-o-SIN-o-fil): A type of granulated white blood cell characterized by a cytoplasm that accepts the eosin stain.
- Ependymal** (e-pen-DI-mal) **cells**: A type of neuroglial cell in the brain that lines the ventricles. Also called ependymocytes.
- Epicardium** (ep³-i-KAR-de-um): The thin outer layer of the heart wall. Also called the visceral pericardium.
- Epidermis** (ep³-i-DERM-is): The superficial layer of skin composed of stratified squamous epithelium.
- Epididymis** (ep³-i-DID-i-mis): An organ in the male reproductive system that consists of a coiled tube located within the scrotum.
- Epiglottis** (ep³-i-GLOT-is): A part of the larynx that consists of a leaf-shaped piece of hyaline cartilage that forms a movable lid over the opening into the trachea, called the glottis.
- Epimysium** (ep³-i-MI-ze-um): The outer layer of connective tissue associated with muscle, it surrounds the whole muscle. Also called deep fascia.
- Epineurium** (ep³-i-NYOO-re-um): The outermost layer of connective tissue associated with a nerve. It surrounds the whole nerve.
- Epiphyseal** (ep³-i-FIZ-e-al) **line**: A line of calcified bone visible in a section through bone that is the remnant of the epiphyseal plate.
- Epiphyseal plate**: A region of cartilage between the epiphysis and diaphysis that produces lengthwise growth of a bone.
- Epiphysis** (e-PIF-i-sis): The end of a long bone that contains spongy bone tissue.
- Epithelial** (ep³-i-THE-le-al) **tissue**: One of four primary tissue types, it is characterized by a close arrangement of cells with little intercellular material. Also called epithelium.
- Eponychium** (ep³-o-NIK-e-um): A narrow region of stratum corneum at the proximal end of a nail. Also called cuticle.
- Erythrocyte** (e-RITH-ro-sit): A synonym for red blood cell.
- Erythropoiesis** (e-rith³-ro-poy-E-sis): The process by which erythrocytes are formed.
- Esophagus** (e-SOF-a-gus): A tubular segment of the alimentary canal between the pharynx and the stomach.
- Eustachian** (yoo-STA-she-an) **tube**: See auditory tube.
- Eversion** (e-VER-zhun): Movement of the sole of the foot in an outward direction.
- Exocrine** (EK-so-krin) **gland**: One of two main categories of glands, in which the products are released into ducts that transport them to the body surface or into body cavities.
- Exocytosis** (ek³-so-si-TO-sis): The active cellular process by which materials are transported out of a cell and into the extracellular environment.
- Expiration** (ek³-spi-RA-shun): The process of expelling air from the lungs to the external environment, or breathing out. Also called exhalation.
- Extension** (ek-STEN-shun): Movement of a body part such that the angle between opposing bones is increased; returning to original position after flexion.
- External auditory canal**: The epidermal-lined tube of the external ear extending from the auricle to the tympanic membrane. It passes through the hole in the temporal bone called the external auditory meatus.
- External ear**: The outer part of the ear, which consists of the appendage known as the auricle, the external auditory canal, and the tympanic membrane.
- External nares** (NAR-ez): The openings of the nose between the external environment and the nasal cavity. Also called nostrils.

External respiration: The exchange of respiratory gases between the lungs and the bloodstream.

Extracellular environment (ek'-stra-CEL-yoo-lar-en-VI-ron-ment): The body space outside the plasma membrane of cells.

Extracellular fluid (ECF): The fluid outside the plasma membrane of cells, including interstitial fluid and blood plasma.

F

Facet (FA-set): A smooth articular surface on a bone.

Falciform ligament (FAL-si-form LIG-a-ment): A part of the parietal peritoneum that is located between the right and left lobes of the liver.

Fallopian tube (see Uterine tube).

Fascia (FASH-e-a): A sheet or band of dense connective tissue that structurally supports organs and tissues. Deep fascia surrounds muscle, and superficial fascia separates the skin and muscle layers.

Fascicle (FAS-i-kul): A bundle of skeletal muscle fibers (cells) that forms a part of a muscle.

Fat: A lipid compound formed from one molecule of glycerol and three molecules of fatty acids. It is the body's most concentrated form of energy, and also serves to insulate from external temperature changes. It is stored within cells comprising adipose tissue.

Fauces (FAW-ses): The opening into the pharynx from the oral cavity (mouth).

Feces (FE-sez): Waste material discharged from the large intestine during defecation.

Fertilization (fer'-ti-li-ZA-shun): The union of a sperm cell with a secondary oocyte.

Fetus (FE-tus): The early developmental stage from eight weeks after fertilization to the time of birth.

Fibroblast (FI-bro-blast): A large cell in connective tissue that manufactures much of the intercellular material.

Fibrous (FI-brus) **joint:** One of three general types of joints in the body. Fibrous joints are characterized by the presence of dense connective tissue between opposing bones. They

allow little or no movement between bones.

Fibrous tunic: The outer wall of the eyeball that is composed of dense connective tissue, it contains the sclera and the cornea.

Filum terminale (FI-lum ter-mi-NAL-e): Connective tissue that extends beyond the conus medullaris of the spinal cord inferiorly into the coccyx.

Fimbriae (FIM-bre-e): The fingerlike extensions of the uterine tube at its proximal end (near the ovary).

Fissure (FISH-er): A cleft or groove separating two parts, such as the cerebral hemispheres of the brain; a deep sulcus of the brain.

Flagellum (fla-JEL-um): A single, long extension of a cell composed of protein filaments to provide mobility. In human cells, it is found only in sperm cells.

Flexion (FLEK-shun): Movement of a body part such that the angle between bones is decreased.

Foramen (fo-RA-men): An opening or passage through bone. Plural form is foramina.

Foramen magnum (MAG-num): The large opening at the base of the skull through which passes the spinal cord.

Fossa (FOS-a): A shallow depression or groove in a bone.

Fourth ventricle (forth VEN-tri-kul): The cavity in the brain located between the cerebellum and the midbrain and pons.

Fovea centralis (FO-ve-a cen-TRAL-is): The region of the retina that consists of cone cells, but no rod cells; it is the area of highest visual acuity (sharpness of vision).

Frontal plane: A plane that extends in a vertical direction dividing the human body into front (anterior) and back (posterior) portions. Also called the coronal plane.

G

Gallbladder (GAWL-blad-er): A small saclike organ located beneath the liver that stores bile.

Gamete (ga-MET): A sex cell. It may be male (sperm cell) or female (oocyte).

- Ganglion** (GANG-le-on): A cluster of neuron cell bodies located outside the central nervous system.
- Gastric** (GAS-trik) **gland**: Any one of several types of glands in the stomach mucosa that contributes to the gastric juice.
- Gene**: A segment of a DNA molecule that contains the information needed to synthesize one complete polypeptide chain.
- Genitalia** (jen'-i-TAL-ya): The reproductive organs.
- Germinal** (JER-mi-nal) **epithelium**: A layer of epithelial cells covering the ovaries.
- Gestation** (jes-TA-shun): The period of development prior to birth.
- Gingivae** (jin-JI-ve): The mucous membrane covering the alveolar processes of the maxillary bones and mandible. Also called the gums.
- Gland**: A specialization of epithelial tissue to secrete substances. It may consist of a single cell or a multicellular arrangement.
- Glans penis** (glanz PE-nis): The slightly enlarged, distal end of the penis.
- Glomerulus** (glo-MER-yoo-lus): One of many specialized capillary networks located in the kidney cortex, each of which is encapsulated by a Bowman's capsule. It is part of the kidney nephron, and is the site of kidney filtration.
- Glottis** (GLOT-is): The opening into the larynx from the pharynx.
- Glucose** (GLOO-kos): A monosaccharide that serves as the preferred energy source by the body.
- Glycogen** (GLI-ko-jen): A polysaccharide composed of glucose subunits that is manufactured by the liver to serve as a storage form of energy.
- Goblet cell**: A unicellular gland, often in the shape of a goblet, that secretes mucus. Also called a mucus cell.
- Golgi apparatus** (GOL-je ap'-a-RAT-us): A cellular organelle characterized by a series of flattened, hollow cisternae. It serves as a site of anabolic activities.
- Gonad** (GO-nad): An organ that produces gametes and sex hormones. In the male it is the testes, and in the female it is the ovaries.
- Gray matter**: Nerve tissue in the brain and spinal cord that contains neuron cell bodies, dendrites, and nonmyelinated axons, and therefore appears gray or non-white in color.
- Greater omentum** (GRA-ter o-MEN-tum): A large fold of the serosa of the stomach (or visceral peritoneum) that covers over the abdominal cavity.
- Groin** (groyn): The region of the body located between the thigh and the trunk.
- Gustation** (gus-TA-shun): The sense of taste.
- Gyrus** (JI-rus): An upfolding convolution on the cerebral surface of the brain. Plural is gyri.

H

- Hair**: A threadlike outgrowth of the skin that is composed of columns of keratinized cells.
- Hair follicle**: A cluster of epithelial tissue surrounding the root of a hair where the hair originates.
- Hard palate** (PAL-at): The anterior portion of the roof of the mouth. It is formed by the maxillary and palatine bones and is lined with mucous membrane.
- Haustra** (HAWS-tra): The pouches in the large intestine that form when the taenia coli muscle contracts.
- Haversian system** (see Osteon).
- Head**: The region of the body superior to the neck. The rounded, proximal end of a long bone. The proximal attachment of a muscle to a bone.
- Heart**: The hollow muscular organ within the thoracic cavity that propels blood through the circulatory network.
- Hematopoiesis** (hem'-a-to-poy-E-sis): The production of blood cells in the red bone marrow. Also called hemopoiesis.
- Hemoglobin** (he'-mo-GLO-bin): A complex protein in red blood cells involved in the transport of oxygen and carbon dioxide.
- Hepatic** (he-PAT-ic): Pertaining to the liver.

- Hepatic portal circulation:** A circulatory network within the systemic system that involves the transport of blood from the alimentary canal to the liver. Its main vessel is the hepatic portal vein.
- Hilum** (HI-lum): An area of an organ, usually a depression, where blood vessels and nerves enter or exit. Also called a hilus.
- Histology** (HIS-to-lo-je): The microscopic study of tissues.
- Homeostasis** (ho'-me-o-STA-sis): A condition of equilibrium, or physiological stability, of body systems, in which the internal environment of the body remains relatively constant.
- Homologous** (ho-MOL-o-gus): Two organs that correspond in structure, position, and origin.
- Horizontal plane:** A plane that extends perpendicular to the length of the body, dividing it into superior and inferior portions. Also called transverse plane.
- Hormone** (HOR-mon): A substance secreted by endocrine tissue that changes the physiological activity of the target cell.
- Hypodermis** (hi'-po-DERM-is): The area of the body between the dermis of the skin and skeletal muscle.
- Hypothalamus** (hi'-po-THAL-a-mus): The small, inferior portion of the diencephalon in the brain. It functions mainly in the control of involuntary activities, including endocrine gland regulation, sleep, thirst, and hunger.
- Ileocecal valve** (il'-e-o-SE-kal valv): A fold of mucous membrane between the ileum (of the small intestine) and the cecum (of the large intestine). Also called the ileocecal sphincter.
- Ileum** (IL-e-um): The distal segment of the small intestine.
- Inferior** (in-FER-e-or): A directional term describing a location further from the head than something else.
- Infundibulum** (in'-fun-DIB-yoo-lum): The narrow connection between the hypothalamus of the brain and the pituitary gland. Also, the funnel-shaped distal end of the uterine tube that opens near an ovary.
- Ingestion** (in-GES-chun): The intake of food or liquid by the mouth.
- Inguinal** (IN-gwi-nal): Pertaining to the groin region (between the hip and thigh).
- Insertion** (in-SER-shun): The attachment of a muscle by its tendon to a movable bone.
- Inspiration** (in-spi-RA-shun): The act of drawing air into the lungs. Also called inhalation.
- Integumentary** (in-teg'-yoo-MEN-tar-e): Pertaining to the skin and its accessory organs.
- Intercalated disk** (in-ter'-ka-LA-ted disk): A transverse thickening of a cardiac muscle cell's sarcolemma at its boundary with an adjacent cell. It aids in the conduction of an impulse from one cardiac cell to another.
- Intercellular** (in'-ter-SEL-yoo-lar) **environment:** The area between cells.
- Internal** (in-TER-nal): A directional term describing a location deep to the surface of the skin relative to something else.
- Internal nares** (NAR-ez): The paired openings between the nasal cavity and the nasopharynx through which air passes. Also called choanae.
- Internal respiration:** The exchange of respiratory gases between the blood and body cells.
- Interstitial cells** (in'-ter-STI-shul): Cells in the testes located between seminiferous tubules that secrete testosterone. Also called cells of Leydig.
- Interstitial fluid** (in'-ter-STI-shul FLOO-id): The portion of extracellular fluid that fills the tissue spaces between cells. Also called tissue fluid and intercellular fluid.
- Intervertebral disk** (in'-ter-VER-te-bral disk): A cartilaginous joint that consists of a pad of fibrocartilage located between two adjacent vertebrae.
- Intestinal gland** (in-TES-tin-al gland): A tubular gland in the mucosa of the small intestine that secretes digestive enzymes. Also called crypt of Leiberkuhn.

Intracellular (in'-tra-SEL-yoo-lar) **environment:**

The space within a cell.

Intracellular fluid (ICF): The fluid within cells.**Intramembranous ossification** (in'-tra-MEM-bra-nus os'-i-fi-KA-shun): The development of bone from fetal connective tissue membranes.**Invagination** (in-vaj'-in-A-shun): A folding inward of a body cavity wall into the body cavity.**Inversion** (in-VER-zhun): Movement of the foot inward such that the sole of the foot faces medially.**In vitro** (in VE-tro): Outside the body, such as in a culture bottle.**In vivo** (in VE-vo): Inside the living body.**Iris** (I-ris): A part of the vascular tunic of the eye. It is located on the anterior side of the eyeball and is composed of smooth muscle fibers that regulate the amount of light entering the eye. The iris is the colored part of the eye surrounding the pupil.**Islet of Langerhans** (I-let of LANG-er-hanz): One of numerous clusters of endocrine cells within the pancreas.**J****Jejunum** (je-JOO-num): The middle segment of the small intestine.**Joint** (joynt): A point of contact between two opposing bones. Also called articulation.**Juxtaglomerular apparatus** (juks'-ta-glo-MER-yoo-lar ap'-a-RAT-us): A structure located in a kidney nephron that is composed of cells from the distal convoluted tubule and the afferent arteriole. It secretes renin in response to a decrease in blood pressure.**K****Keratin** (KER-a-tin): A waterproofing protein present in the epidermis, nails, and hair.**L****Labium** (LA-be-um): A synonym for lip. Plural form is labia.**Labyrinth** (LAB-i-rinth): The system of interconnecting tubes of the inner ear.**Lacrimal** (LAK-ri-mal): Pertaining to the production or release of tears.**Lactation** (lak-TA-shun): The production of milk by the mammary glands.**Lacteal** (lak-TE-al): A small lymphatic vessel located within a villus of the small intestine that transports fat.**Lacuna** (la-KOO-na): A chamber within bone or cartilage matrix that houses a cell (an osteocyte or chondrocyte). Plural form is lacunae.**Lamellae** (la-MEL-e): Concentric rings of hardened bone matrix found in compact bone.**Large intestine:** The final segment of the alimentary canal consisting of a large tube that forms the feces, which is expelled by the process of defecation.**Laryngopharynx** (la-ring'-o-FAR-inks): The inferior part of the pharynx, which opens to the esophagus (posteriorly) and to the larynx (anteriorly).**Larynx** (LAR-inks): A box-like cartilaginous organ in the respiratory tract located between the pharynx and the trachea.**Lateral** (LA-ter-al): A directional term describing a structure that is located further from the vertical midline of the body relative to another.**Lens:** An oval, transparent structure located between the posterior iris and the vitreous humor of the eyeball. It is connected to the vascular tunic by suspensory ligaments.**Lesser omentum** (LES-er o-MEN-tum): A fold of the peritoneum that extends between the liver and the medial margin of the stomach.**Leukocyte** (LOO-ko-sit): A white blood cell. Also called leucocyte.**Ligament** (LIG-a-ment): A band or cord of dense connective tissue that extends from one bone to another to provide a joint with structural stability.

Lingual (LIN-gwal): Pertaining to the tongue; for example, the lingual frenulum that connects the tongue to the floor of the mouth.

Lipid (LI-pid): An organic compound that is usually insoluble in water, but soluble in alcohol, ether, and chloroform. It includes fats, phospholipids, and steroids.

Liver: A large digestive organ in the superior right corner of the abdominopelvic cavity that functions mainly in the interconversion of energy-storage molecules, detoxification of blood, and production of bile.

Lumbar (LUM-bar): The region of the back between the ribs and pelvis. Also called loins.

Lumen (LOO-men): The potential space within a tubular structure.

Lung: One of two large organs in the thoracic cavity that functions in the exchange of respiratory gases.

Lymph (limf): The slow-moving fluid within lymphatic vessels of the lymphatic system.

Lymph node: A small, oval organ located within the lymphatic vessel network.

Lymphatic tissue: A specialized type of connective tissue that contains an abundance of lymphocytes. Also called lymphoid tissue.

Lymphatic vessel: A hollow tubular structure similar to a vein that transports lymph in a direction leading toward the heart.

Lymphocyte (LIM-fo-cit): A type of white blood cell lacking large granules in the cytoplasm that plays a central role in immunity.

Lysosome (LI-so-som): A cellular organelle that contains digestive enzymes.

M

Macrophage (MAK-ro-faj): A large phagocytic cell that originated from a monocyte.

Macula (MAK-yoo-la): One of the sensory structures in the vestibule of the inner ear. It serves as a receptor for static equilibrium.

Macula lutea (MAK-yoo-la LOO-te-a): A yellow-colored depression in the retina of the eye.

Malleus (MAL-e-us): The lateral ear bone that contacts the tympanic membrane; the hammer.

Mammary (MAM-a-re) **gland:** A modified sweat gland in the breast that serves as the gland of milk secretion for nourishment of the young.

Matrix (MA-triks): The intercellular material in connective tissue.

Mastication (mas'-ti-KA-shun): A synonym for the muscular act of chewing.

Medial (ME-de-al): A directional term describing a part lying nearer to the vertical midline of the body relative to another part.

Mediastinum (me'-de-as-TI-num): A partition between the two pleural cavities in the chest that consists of the heart, part of the esophagus, part of the trachea, and the major vessels of the heart.

Medulla (me-DUL-a): An inner, or deeper, part of an organ. For example, the medulla of the kidneys and the medulla of the adrenal gland.

Medulla oblongata (me-DUL-a ob'-long-GA-ta): The inferior part of the brain stem.

Medullary cavity (med-YOO-lar-e KAV-i-te): The potential space within the shaft of a long bone that contains yellow marrow.

Membrane (MEM-bran): A thin sheet of tissue that lines or covers body structures. It may contain a thin layer of epithelial tissue and connective tissue, or only connective tissue.

Membranous labyrinth (MEM-bra-nus LAB-i-rinth): The portion of the inner ear located inside the bony labyrinth that contains perilymph fluid. It consists of the membranous semicircular canals, the saccule and utricle, and the cochlear duct.

Meninges (me-NIN-jez): The three membranes covering the brain and spinal cord.

Mesentery (MES-en-ter'-e): A fold of the peritoneum that attaches the small intestine to the posterior abdominal wall.

Metabolism (me-TAB-o-lizm): The sum of all chemical reactions occurring in the body, including anabolic (synthetic) and catabolic (decomposition) reactions.

Metacarpus (met'-a-KAR-pus): A collective term for the five bones (each of which is called a metacarpal) of the palm of the hand.

Metatarsus (MET-a-tar-sus): A collective term for the five bones (each of which is called a metatarsal) of the foot.

- Microvilli** (mi'-kro-VIL-i): Microscopic extensions of the cell membrane filled with cytoplasm that serve to increase the absorptive surface area of the cell.
- Micturition** (mik'-too-RISH-un): The act of discharging urine from the urinary bladder to the exterior. Also called urination.
- Midbrain** (MID-bran): The superior part of the brain stem, located between the diencephalon and the pons. It serves as a relay center for impulses. Also called the mesencephalon.
- Middle ear:** The area of the ear between the tympanic membrane of the outer ear and the bony labyrinth of the inner ear. It is an epithelial-lined space that houses the three ear ossicles. Also called the tympanic cavity.
- Midsagittal** (MID-sag-i-tal): A plane that extends vertically through the body, dividing it into unequal right and left portions.
- Mitochondrion** (mit'-o'-KON-dre-on): A cellular organelle that consists of a double layer of plasma membrane where many of the catabolic activities of the cell take place.
- Mitosis** (mi-TO-sis): The division of a cell's nucleus into two daughter nuclei, each of which contain the same genetic composition as the original parent. When mitosis is followed by cytokinesis, equal division of the whole cell results.
- Mitral valve** (MI-tral valv): A synonym for the left atrioventricular valve. Also called the bicuspid valve.
- Mons pubis** (monz PYOO-bis): The elevated, hair-covered body surface area over the symphysis pubis in females.
- Mucosa** (myoo-KO-sa): An epithelial membrane that lines a body cavity or organ and contains cells that secrete mucus. Also called mucous membrane.
- Mucus** (MYOO-kus): A thick fluid secretion from mucous cells.
- Muscle:** An organ composed of skeletal muscle tissue and its associated connective tissue that functions mainly in the production of movement of the skeleton.
- Muscle fiber:** A synonym for muscle cell.
- Muscle tissue:** One of the four primary types of tissue in the body, characterized by its specialization to contract.
- Muscularis** (mus'-kyoo-LAR-is): A layer of smooth muscle tissue within the wall of an organ.
- Myelin sheath** (MI-e-lin sheth): A white, segmented insulative cover over the axons of many peripheral neurons that is produced by Schwann cells. A neuron axon that is covered by the myelin sheath is said to be myelinated.
- Myocardium** (mi'-o-KAR-de-um): The primary layer of the heart wall, which is composed of cardiac muscle tissue.
- Myofibril** (mi'-o-FI-bril): A rod-shaped component of a muscle fiber, which extends the length of the fiber and is composed of thin and thick filaments of protein.
- Myometrium** (mi'-o-ME-tre-um): The smooth muscle layer in the wall of the uterus.

N

Nail: A thin, hard plate of mostly keratin that is derived from the epidermis and develops at the distal end of the fingers and toes.

Nasal cavity: The space within the nose that is lined with mucous membrane and divided by the nasal septum into right and left chambers.

Nasal septum: A vertical partition dividing the nasal cavity into right and left chambers that is composed of bone and cartilage covered with mucous membrane.

Nasopharynx (na'-so-FAR-inks): The superior portion of the pharynx, which transports air between the internal nares and the oropharynx.

Nephron (NE-fron): One of many microscopic, tubular structures within each kidney where the functions of filtration, reabsorption, and secretion occur.

Nerve: An organ of the nervous system composed of a bundle of neuron axons invested and surrounded by connective tissue and blood vessels, which functions in the conduction of an impulse from one area of the body to another.

Nerve impulse: A wave of negative charges (depolarization) that propagates along the outer surface of the plasma membrane of a conductive cell, such as a neuron. Also called an action potential.

Neurilemma (noo'-ri-LEM-a): The outer layer of a myelin sheath associated with a nerve fiber that contains the nucleus and much of the cytoplasm of a Schwann cell.

Neuroglia (noo'-ROG-le-a): Supportive cells of the nervous system that are most prevalent in the brain and spinal cord.

Neuromuscular junction (noo'-ro-MUS-kyoo-lar JUNK-shun): The area of contact between the terminal end of a motor neuron and the sarcolemma of a skeletal muscle fiber.

Neuron (NOO-ron): A cell of nerve tissue characterized by its specialization to conduct impulses (conductivity).

Neurotransmitter (noo'-ro-TRANS-mit-er): A molecule that transmits or inhibits the transmission of a nerve impulse from one neuron to another across a synapse.

Neutrophil (NOO-tro-fil): A type of granular, phagocytic white blood cell characterized by a cytoplasm that stains pink in a neutral stain.

Node of Ranvier (ran'-ve-A): A gap in the myelin sheath covering a nerve fiber, which accelerates the rate of impulse conduction.

Nucleolus (noo-KLE-o-lus): A spherical body within the nucleus of a cell that is not bound by a plasma membrane, which functions in the storage of ribosomal RNA.

Nucleus (NOO-kle-us): The largest structure in a cell, it contains the genetic material to determine protein structure and function, the DNA, and is enveloped by a double-layered plasma membrane.

O

Occipital (ok-SIP-i-tal): Pertaining to the lower back portion of the head.

Olfactory (ol-FAK-tor-e): Pertaining to the sense of smell.

Oocyte (O-o-sit): A gamete produced within an ovary. Also called ovum or egg.

Optic (OP-tik): Pertaining to the sense of vision or to the eye.

Optic chiasma (OP-tik ki-AZ-ma): The point at which the two optic nerves cross on the ventral aspect of the brain.

Optic disk: The area on the retina where the optic nerve exits the eye and contains no rod or cone cells. Also called the blind spot.

Orbit (OR-bit): One of two large depressions in the skull that is bordered by seven bones and houses the eyeball and associated structures. Also called the eye socket.

Organ (OR-gan): An organized combination of two or more different types of tissues that performs a general function.

Organ of Corti (KOR-ti): The structure within the inner ear that contains receptor cells sensitive to sound vibrations.

Organelle (or-gan-EL): A component of a cell that has a consistent, similar structure in other cells and performs a particular function.

Organic (or-GAN-ik): A chemical substance whose structure is based on a carbon skeleton.

Organism (OR-gan-izm): A complete living being; a whole individual.

Orifice (OR-i-fis): An opening into the body or into a structure.

Origin (OR-i-jin): The point of attachment of a muscle's tendon to a stationary bone.

Oropharynx (or'-o-FAR-inks): The middle portion of the pharynx, located between the nasopharynx and the laryngopharynx. The oral cavity opens into it (by way of the fauces).

Osseous (OS-e-us): Pertaining to bone.

Ossification (os'-i-fi-KA-shun): Bone formation. Also called osteogenesis.

Osteoblast (OS-te-o-blast'): A type of bone cell characterized by its mobility and by its ability to produce bone matrix.

Osteoclast (OS-te-o-klast'): A type of bone cell characterized by its ability to dissolve bone matrix.

Osteocyte (OS-te-o-sit'): A type of bone cell characterized by its immobile location within a lacunus and by a reduced ability to produce bone matrix.

Osteon (OS-te-on): An organized arrangement of bone tissue in adult compact bone such that the bone matrix concentrically surrounds a central canal containing a blood vessel. Also called a Haversian system.

Otic (O-tik): Pertaining to the ear.

Oval window: The membrane-covered opening between the stapes and the inner ear.

Ovary (O-var-e): The female gonad, or primary reproductive organ that produces gametes and female sex hormones.

Ovulation (ov-yoo-LA-shun): The release of a secondary oocyte from a Graafian follicle in an ovary.

P

Pacinian corpuscle (pa-SIN-e-an KOR-pus-el): A receptor located in the dermis that responds to touch (pressure).

Palate (PAL-at): The mucous membrane-lined structure forming the roof of the mouth. The anterior end is the hard palate, and the posterior end is the soft palate.

Pancreas (PAN-kre-as): A soft, oblong organ located posterior to the stomach in the abdominal cavity. The pancreas secretes digestive enzymes and hormones that regulate blood sugar.

Papilla (pa-PIL-a): A small finger-shaped projection.

Parasagittal (par'-a-SAJ-i-tal): A plane that extends vertically through the body dividing it into unequal right and left portions.

Parasympathetic division (par'-a-simp-a-THE-tik di-VI-zhun): The component of the autonomic nervous system that stimulates activities that conserve body energy.

Parathyroid (par'-a-THI-royd) **gland**: One of four or five pea-shaped glands embedded into the posterior side of the thyroid gland.

Parietal (pa-RI-e-tal): Pertaining to the outer wall of a cavity or organ.

Parietal cell: A cell in the stomach mucosa that secretes hydrochloric acid and intrinsic factor

Parietal pericardium (par'-i-KAR-de-um): The outer serous membrane covering the heart. Also called the pericardial sac.

Parietal peritoneum (par'-i-to-NE-um): The outer serous membrane covering attached to the walls of the abdominopelvic cavity.

Parietal pleura (PLOO-ra): The outer serous membrane associated with each lung. It is attached to the inner thoracic wall.

Parotid (pa-ROT-id) **glands**: A pair of salivary glands, each of which is located between the skin of the cheek and the masseter muscle on a side of the face.

Pectoral (PEK-tor-al): Pertaining to the ventral thorax, or chest.

Pelvic (PEL-vik): Pertaining to the base of the trunk region, or pelvis.

Pelvic cavity: The inferior portion of the abdominopelvic cavity bordered by the pelvis.

Pelvis: The bowl-like base axial skeleton formed by the two pelvic (innominate) bones and the sacrum.

Penis (PE-nis): The external reproductive organ of the male through which most of the urethra extends.

Pepsin (PEP-sin): An enzyme initially secreted by zymogenic (chief) cells in the stomach mucosa in the inactive form of pepsinogen that, when activated by the presence of hydrochloric acid into pepsin, can digest protein.

Pericardial (par'-i-KAR-de-al) **cavity**: A narrow space between the outer wall of the heart (the visceral pericardium) and the parietal pericardium that contains pericardial fluid.

Pericardium (par'-i-KAR-de-um): The serous membrane associated with the heart that is composed of two layers, an inner visceral pericardium and an outer parietal pericardium.

Perichondrium (par'-i-KON-dre-um): A layer of dense connective tissue that envelopes cartilage.

Perilymph (PAR-i-limf): The fluid within the membranous labyrinth of the inner ear.

Perimysium (par'-i-MI-se-um): An extension of the epimysium of muscle that invaginates inward to divide a muscle into bundles.

- Perineum** (par'-i-NE-um): The area between the anus and the posterior border of the external genitalia.
- Perineurium** (par'-i-NYOO-re-um): An extension of the epineurium of a nerve that invaginates inward to wrap around bundles of nerve fibers.
- Periosteum** (par'-e-OS-te-um): The connective tissue covering around a bone that is important in bone growth, nutrition, and repair.
- Peripheral** (per-I-fer-al) **nervous system (PNS)**: The division of the nervous system consisting of nerves and ganglia located between the central nervous system and the body surfaces.
- Peritoneum** (par'-i-to-NE-um): The extensive serous membrane associated with the abdominopelvic cavity.
- Peritoneal** (par'-i-to-NE-al) **cavity**: The space between the parietal peritoneum and the visceral peritoneum that contains a small amount of fluid.
- Peyer's patches**: Clusters of lymphatic tissue containing numerous white blood cells that are located in the wall of the small intestine.
- Phalanx** (FA-lanks): A bone of a digit (finger or toe). Plural form is phalanges.
- Pharynx** (FAR-inks): A tube that extends from the level of the internal nares to its union with the larynx, which transports air, food, and liquid.
- Pia mater** (PE-a MA-ter): The innermost of the three meninges surrounding the brain and spinal cord.
- Pineal** (pi-NE-al) **gland**: A small endocrine gland located at the posterior end of the diencephalon, forming a part of the roof of the third ventricle.
- Pituitary** (pi-TOO-i-tar-e) **gland**: A small, functionally important endocrine gland located inferior to the hypothalamus and attached to it by way of a short stalk. Also called the hypophysis.
- Placenta** (pla-SEN-ta): A structure whose origin is shared by embryonic cells and the uterine lining that provides a means of material transport between the mother and developing unborn child.
- Plasma** (PLAZ-ma): The extracellular fluid that forms a portion of blood.
- Plasma cell**: A differentiated white blood cell that secretes antibodies.
- Plasma membrane**: A microscopic barrier associated with cells composed mainly of a phospholipid bilayer and protein. The outer plasma membrane of a cell is also called the cell membrane.
- Platelet** (PLA-te-let): A formed element of blood that is active in blood clot formation.
- Pleura** (PLOOR-a): The serous membrane associated with the lungs. It consists of an inner visceral pleural and an outer parietal pleura. Plural form is pleurae.
- Pleural cavity**: A narrow space between the visceral and parietal pleurae that contains pleural fluid.
- Plexus** (PLEKS-us): A network of interconnecting nerves, veins, or lymphatic vessels.
- Pons** (ponz): A part of the brain located between the midbrain and the medulla oblongata.
- Popliteal** (pop'-li-TE-al): Pertaining to the area posterior to the knee joint.
- Posterior** (po-STER-e-or): A directional term describing the location of a part being toward the back or rear side relative to another part. In humans it is also known as dorsal.
- Posterior horn**: A region of the spinal cord gray matter containing sensory neuron cell bodies. Also called the ventral horn.
- Posterior root**: The structure merging with the spinal cord on its posterior aspect that contains sensory nerves. Also called the dorsal root.
- Prepuce** (PRE-poos): The skin that partially covers the glans of the penis (in the male) or clitoris (in the female).
- Process** (PRO-ses): A prominent projection on a bone.
- Pronation** (pro-NA-shun): Movement of the hand such that the palm is turned downward (inferiorly) or backward (posteriorly).
- Prostate** (PRO-stat) **gland**: A walnut-shaped gland surrounding the urethra as it emerges from the urinary bladder in males. Its secretions contribute to semen.

- Protein** (PRO-ten): An organic compound composed of amino acid subunits.
- Proximal** (PROKS-i-mal): A directional term indicating a body part that is located nearer to the origin or point of attachment to the trunk than another; opposite of distal.
- Pulmonary circulation:** The circuit of blood flow to the lungs, through lung capillaries, and back to the left atrium of the heart.
- Pupil** (PYOO-pil): The small hole through the center of the iris in the eye through which light passes.
- Pyloric sphincter** (pi-LOR-ik SFINC-ter): A circular band of smooth muscle at the union of the stomach and small intestine that controls the movement of material between them. Also called the pyloric valve.

R

- Receptor** (re-SEP-tor): A structure that is capable of responding to a stimulus by initiating a nerve impulse.
- Rectum** (REK-tum): The distal portion of the large intestine.
- Renal** (RE-nal): Pertaining to the kidneys.
- Renal corpuscle** (KOR-pus-el): The portion of a kidney nephron consisting of the Bowman's capsule and glomerulus.
- Renal pelvis** (PEL-vis): A membrane-lined basin within the renal sinus of each kidney.
- Renal pyramid** (PIR-a-mid): One of about eight to ten cone-shaped structures in each kidney extending from the medulla to the cortex, which contain the renal tubules.
- Renal sinus** (SI-nus): A potential space within each kidney extending from the hilum to the medulla, which contains the renal pelvis.
- Renal tubule** (TOO-byool): A part of a nephron of the kidney consisting of a microscopic tube extending from Bowman's capsule to a collecting duct. The functions of reabsorption and secretion occur across its walls.

- Respiratory membrane:** The barrier in the lungs that must be crossed by gas molecules during gas exchange. It consists of the alveolar epithelium, a basement membrane, and the endothelium of a capillary.
- Retina** (RET-i-na): The light-sensitive inner layer of the eye that contains rod and cone cells.
- Retroperitoneal** (re'tro-par'i-to-NE-al): Pertaining to a structure lying external to the peritoneum.
- Ribosome** (RI-bo-som): A microscopic, spherical structure within the cytoplasm of a cell composed of RNA and protein that serves as an attachment site for messenger RNA during protein synthesis.
- Rod cell:** A photoreceptor cell in the retina of the eye that detects very low levels of light.
- Rotator cuff:** A group of four muscles that attach the humerus to the scapula.
- Rotation** (ro-TA-shun): The movement of a bone around its own (longitudinal) axis.
- Round window:** The membrane-covered opening between the middle ear and the inner ear that is not in contact with the auditory ossicles.
- Rugae** (ROO-je): Folds or ridges in the mucosa of an organ with a large lumen, such as the stomach or vagina.

S

- Sacculae** (SAK-yool): One of two sacs within the vestibule of the inner ear that houses the receptors of static equilibrium.
- Sagittal** (SAJ-i-tal): A vertical plane that divides the body into right and left portions, and includes the midsagittal plane (dividing into equal halves) and the parasagittal plane (dividing into unequal portions).
- Saliva** (sa-LI-va): A fluid secretion by the salivary glands deposited into the mouth to lubricate and begin digestion of food before swallowing.
- Salivary** (SAL-i-var-e) **gland:** One of several exocrine glands in the facial region that secrete saliva into the mouth to initiate the digestive process.

- Sarcolemma** (sar'-ko-LEM-a): The plasma membrane covering the outer surface of a muscle fiber.
- Sarcomere** (SAR-ko-mer): A contractile microscopic subunit of striated muscle (skeletal and cardiac muscle tissue).
- Sarcoplasm** (SAR-ko-plazm): The cytoplasm of a muscle fiber.
- Schwann cell**: A type of neuroglial cell that forms myelin sheaths around axons of peripheral nerves.
- Sclera** (SKLE-ra): The posterior part of the outer, fibrous tunic covering the eyeball; the white of the eye.
- Scrotum** (SKRO-tum): An external genital organ of the male consisting of a skin-covered sack that contains the testes.
- Sebaceous gland** (se-BA-shus gland): An exocrine gland located in the dermis that secretes an oily substance called sebum. It is usually associated with a hair follicle.
- Sebum** (SE-bum): An oily secretion of a sebaceous gland.
- Secretion** (se-KRE-shun): A substance produced and released by a cell that serves a useful benefit.
- Semen** (SE-men): A reproductive fluid discharged by a male during ejaculation that contains sperm cells and secretions from the seminal vesicles, prostate gland, and bulbourethral glands.
- Semicircular canal** (se'-mi-SER-kyoo-lar canal): One of three looping canals in each temporal bone that form a part of the inner ear. It contains perilymph fluid and the receptors for equilibrium.
- Semilunar valve** (sem-i-LOO-nar valv): One of two heart valves located between a ventricle and a major artery. The aortic valve is located between the left ventricle and aorta, and the pulmonary valve is located between the right ventricle and pulmonary trunk.
- Seminal vesicle** (SEM-i-nal VES-i-kel): One of a pair of convoluted glands of the male reproductive system located posterior to the urinary bladder that secretes part of the semen.
- Seminiferous tubule** (sem'-i-NIF-er-us TOO-byool): A microscopic, tightly packed tube within each testis where sperm cells develop.
- Septum** (SEP-tum): A barrier between two spaces, such as the interventricular septum of the heart and the nasal septum.
- Serosa** (ser-O-sa): Any serous membrane. Also, the outer serous membrane layer of a visceral organ.
- Serous membrane** (SER-us MEM-bran): An epithelial membrane that lines a body cavity or covers an organ, and secretes small amounts of fluid.
- Sesamoid bones** (SES-a-moyd bones): Small bones formed and located within major tendons or ligaments. For example, the patella (kneecap) is a sesamoid bone.
- Sigmoid colon** (SIG-moyd KO-lon): The distal segment of the colon located between the descending colon and the rectum.
- Sinoatrial node** (sin'-o-A-tre-al nod) (SA node): A cluster of specialized cardiac muscle cells in the wall of the right atrium that initiate each cardiac cycle.
- Sinus** (SI-nus): A space within a bone lined with mucous membrane, such as the frontal and maxillary sinuses in the head. Also, a modified vein with an enlarged lumen for blood storage.
- Skeletal muscle tissue**: One of three types of muscle tissue in the body characterized by the presence of visible striations and conscious control over its contraction. It attaches to bones to form the muscles of the body.
- Skull**: The group of bones that make up the supporting framework and body of the head.
- Small intestine**: The organ of the alimentary canal located between the stomach and the large intestine that functions in the final digestion and absorption of nutrients.
- Smooth muscle**: One of three types of muscle tissue in the body characterized by the lack of visible striations and unconscious control over its contraction. It forms part of the walls of hollow organs and blood vessels.

- Soft palate:** The posterior portion of the bridge forming the roof of the mouth, consisting of skeletal muscle covered with mucous membrane.
- Somatic (so-MA-tik):** Pertaining to the body. For example, a somatic cell is any body cell other than a sex cell.
- Somatic nervous system:** The component of the peripheral nervous system that conveys impulses associated with conscious sensory and motor activities.
- Spermatic cord (sper-MA-tik kord):** A narrow bundle of tissue in the male reproductive system extending from the epididymis to the inguinal canal, consisting of the ductus deferens, cremaster muscle, blood vessels, lymphatics, nerves, and connective tissue.
- Spermatozoa (sper-ma'-to-ZO-a):** The male gametes, or reproductive cells. Also called sperm cells. Singular form is spermatozoon.
- Sphincter (SFENK-ter):** A circular band of smooth muscle surrounding an opening, which serves to control the movement of materials through.
- Spinal cord:** A long, narrow organ of the central nervous system that extends through the vertebral canal and connects the peripheral nervous system with the brain.
- Spinal nerve:** One of 31 pairs of nerves that extend between the spinal cord and another part of the body.
- Spleen:** An soft, glandular organ that is part of the lymphatic system and is located in the upper left region of the abdomen behind the stomach.
- Spongy bone:** One of two types of bone tissue, characterized by the presence of spaces filled with red marrow between thin bone spicules called trabeculae.
- Stomach (STO-muk):** A large, hollow organ in the alimentary canal located between the esophagus and small intestine that plays a prominent role in digestion.
- Subarachnoid space (sub-a-RAK-noyd spas):** The narrow space between the arachnoid and pia mater surrounding the brain and spinal cord, which contains circulating cerebrospinal fluid.
- Subcutaneous layer (sub'-kyoo-TA-ne-us LA-yer):** The layer of loose connective tissue and adipose tissue deep to the dermis of the skin. Also called hypodermis, and superficial fascia.
- Sublingual (sub-LING-wal) glands:** A pair of salivary glands located in the floor of the mouth deep to the mucous membrane.
- Submandibular (sub'-man-DIB-yoo-lar) glands:** A pair of salivary glands located along the inner surface of the jaw in the floor of the mouth. Also called submaxillary glands.
- Submucosa (sub'-myoo-KO-sa):** A layer of connective tissue located external to a mucous membrane.
- Sudoriferous (soo'-dor-I-fer-us) gland:** An exocrine gland located in the skin that secretes sweat. Also called sweat gland.
- Sulcus (SUL-kus):** A shallow groove or depression.
- Superficial (soo'-per-FISH-al):** A directional term indicating the location of a part that is toward or nearer to the body surface relative to another.
- Superior (soo-PER-e-or):** A directional term indicating the location of a part that is nearer to the head region than another. Also called cranial or cephalad.
- Supination (soo'-pi-NA-shun):** The rotation of the forearm such that the palm of the hand is turned anteriorly or superiorly.
- Suture (SOO-cher):** A type of tight-fitting fibrous joint that permits little or no movement between opposing bones.
- Sweat gland:** An exocrine gland located in the skin that secretes sweat. Also called sudoriferous gland.
- Sympathetic division (simp'-a-THE-tik di-VI-zhun):** A division of the autonomic nervous system that functions mainly in stimulating emergency responses (fight or flight).
- Synapse (sin-APS):** The junction between the axon of one neuron and the dendrite or cell body of another neuron.
- Synergist (SIN-er-jist):** A muscle in a group action that assists the prime mover by keeping other structures stable.

Synovial joint (sin-O-ve-al joynt): A type of joint characterized by the presence of a membrane-lined cavity, called the synovial cavity, between opposing bones.

Synovial fluid: The liquid secretion of epithelial cells in the synovial membrane lining a synovial joint, which serves as a lubricant and shock absorber.

System (SIS-tem): An organized combination of organs and associated structures that share a common function.

Systemic circulation: The major circulatory network of the body that carries oxygenated blood from the left ventricle throughout the body (except the lungs), and returns deoxygenated blood to the right atrium.

T

Tarsus (TAR-sus): The seven bones of the ankle as a collective unit.

Tectorial membrane (tek-TOR-e-al MEM-bran): A thin membrane in the inner ear that projects over the receptor hair cells of the organ of Corti.

Tendon (TEN-don): A band of dense connective tissue that extends from the muscle to attach to a bone.

Testis (TES-tis): One of a pair of male gonads (sex glands) located within the scrotum that produces sperm cells and testosterone. Plural form is testes.

Thalamus (THAL-a-mus): A bilobed endocrine gland located in the anterior neck region that produces hormones influencing growth and metabolism, and maintains calcium levels in the blood.

Thoracic cavity (tho-RAS-ik CAV-i-te): The part of the anterior (ventral) body cavity located superior to the diaphragm.

Thoracic duct: The main collecting trunk of the lymphatic circulation, which extends along the back of the chest to the right subclavian vein. It drains lymph from all areas of the body but the right side of the head, neck, chest, and right arm.

Thorax (THOR-aks): The region of the trunk located superior to the diaphragm. Also called the chest.

Thrombocyte (THROM-bo-sit): The formed elements in blood that play a prominent role in blood clotting. Also called platelets.

Thymus (THI-mus) **gland:** A glandular lymphatic organ located superior to the heart that produces T lymphocytes during early childhood, and degenerates by adulthood.

Thyroid cartilage (THI-royd CAR-ti-lij): The largest piece of hyaline cartilage of the larynx. Also called Adam's apple.

Thyroid gland: An endocrine gland located on the anterior side of the neck that secretes hormones involved in growth and metabolism, and maintains calcium levels in the blood.

Tissue (TI-shoo): A group of similar cells that combine to form a common function.

Tongue (tung): The muscular organ of the digestive system that is anchored to the floor of the mouth and wall of the pharynx, and which plays a role in swallowing and speech formation.

Tonsil (TON-sil): A small organ of the lymphatic system that consists of an aggregation of fixed lymphocytes and connective tissue embedded in a mucous membrane. There are three pairs (pharyngeal, palatine, and lingual), all of which play a role in the immune response.

Trabecula (tra-BEK-yoo-la): A thin plate of bone within spongy bone tissue. Also, a band of supportive connective tissue extending to the interior of an organ from its outer wall.

Trachea (TRA-ke-a): An organ of the respiratory system that consists of a long tube supported by rings of cartilage extending from the pharynx to the bronchi.

Transverse colon (TRANS-vers KO-lon): The segment of the colon that extends from its union with the ascending colon to its union with the descending colon.

Tricuspid valve (tri-KUS-pid valv): The heart valve located between the right atrium and right ventricle. Also called the right atrioventricular (AV) valve.

Trunk: The region of the body to which the appendages are attached, and includes the chest, abdomen, and back.

Tubercle (TOO-ber-kul): A small, rounded process on the surface of a bone.

Tympanic membrane (tim-PAN-ik MEM-bran): A thin membrane between the external auditory canal and the tympanic cavity, separating the external ear from the middle ear. Also called the eardrum.

U

Umbilical cord (um-BIL-i-kal kord): The rope-like structure containing the umbilical arteries and umbilical vein that connects a fetus with the placenta.

Ureter (YOO-re-ter): A long, narrow tube that extends from a kidney to the urinary bladder and transports urine.

Urethra (yoo-RE-thra): A tube extending from the urinary bladder to the exterior that carries urine in females and urine and semen in males.

Urinary bladder (yoo'-ri-NAR-e BLAD-der): A hollow muscular organ located at the floor of the pelvic cavity that temporarily stores urine.

Urine (YOO-rin): The fluid produced by the kidneys that is expelled out the urethra and contains water, metabolic waste materials, and excess salts.

Uterine tube (YOO-ter-in toob): One of two tubes that transport ova from the ovaries to the uterus in the female reproductive system. Also called fallopian tubes or oviducts.

Uterus (YOO-ter-us): A hollow muscular organ in the female reproductive system that serves as a site of embryo implantation and development, and menstruation.

Uvula (YOO-vyoo-la): A fingerlike projection of skeletal muscle covered with mucous membrane at the posterior end of the soft palate.

V

Vagina (va-JI-na): A tubular, muscular organ of the female reproductive system extending between the vulva and the uterus.

Vascular (VAS-kyoo-lar): Pertaining to or containing blood vessels.

Vein (van): A blood vessel that transports blood from body tissues to the heart.

Ventral (VEN-tral): A directional term describing the location of a part nearer to the anterior, or front side, of the body relative to another. Also called anterior.

Ventral cavity: The body cavity located on the anterior side of the trunk containing the thoracic and abdominopelvic cavities.

Ventral root: The motor branch of a spinal nerve that connects with the spinal cord.

Ventricle (VEN-tri-kul): One of the two inferior, highly muscular chambers of the heart that push blood into major arteries during their contraction.

Venule (VEN-yool): A small vein that collects deoxygenated blood from a capillary network and conveys it to a larger vein.

Vermiform appendix (VER-mi-form a-PEN-diks): A small, closed-end tube extending from the cecum of the large intestine.

Vermis (VER-mis): The central constricted part of the cerebellum that separates the two cerebellar hemispheres.

Vertebral canal (VER-te-bral ka-NAL): A cavity extending through the vertebral column that is formed by the vertebral foramina of each vertebra, through which extends the spinal cord.

Vertebral column: The skeleton of the back that is composed of 26 vertebrae and associated tissues. Also called the backbone, spine, or spinal column.

Vesicle (VES-i-kul): A small sac containing a fluid. In the cell, it is a membranous sac within the cytoplasm that contains cellular products or waste materials.

Vestibule (VES-ti-byool): A small space that opens into a larger cavity or canal. A vestibule is found in the inner ear, mouth, nose, and vagina.

Villus (VIL-lus): A small, fingerlike projection of the small intestinal wall that contains connective tissue, blood vessels, and a lymphatic vessel, and which functions in the absorption of nutrients. Plural form is villi.

Visceral (VIS-er-al): Pertaining to the internal components (mainly the organs) of a body cavity; pertaining to the outer surface of an internal organ.

Visceral peritoneum (par'-i-to-NE-um): A serous membrane that covers the surfaces of abdominal organs.

Visceral pleura (PLOO-ra): A serous membrane that covers the outer surface of each lung.

Vitreous humor (VI-tre-us HYOO-mer): A mass of gelatinous material located within the eyeball in the posterior cavity located between the lens and the retina. Also called vitreous body.

Vocal cords (VO-kal kordz): Folds of mucous membrane within the larynx that produce sound when they vibrate.

Vulva (VUL-va): The external genitalia of the female reproductive system. Also called pudendum.

W

White matter: A type of nerve tissue composed mainly of the myelinated axons of neurons.

Y

Yellow marrow: A collection of fat storage (adipose) and other tissues found within the medullary cavities of bones.

Z

Zygote (ZI-got): The single, fertilized cell resulting from the union of an oocyte with a sperm cell.

Zymogenic (zi'-mo-GEN-ik) **cell**: A cell within a gastric gland of the stomach mucosa that secretes a precursor protein, pepsinogen.