Sialolith
Stone in the salivary gland.
Sigmoidoscopy
Examination of the lower colon using a sigmoidoscope, inserted into the rectum.
Steatorrhea
Condition characterized by chronic fatty diarrhea.
Stoma
A surgically-created opening from an area inside the body to the outside.
Stomatitis
Inflammation or irritation of the mucous membranes in the mouth.
Stratified squamous epithelium
Cells arranged in layers upon a basal membrane.

Test Yourself

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://pressbooks.uwf.edu/medicalterminology/?p=142#h5p-85

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Image Descriptions

Figure 13.1 image description: This diagram shows the digestive system of a human being, with the major organs labeled. Labels read (clockwise, from top): salivary glands: parotid gland, sublingual gland, submandibular gland; pharynx, stomach, spleen, pancreas, large intestine: transverse colon, ascending colon, descending colon, cecum, sigmoid colon, appendix, rectum, anal canal, anus; small intestine: duodenum, jejunum, ileum, gallbladder, liver, esophagus, tongue, mouth. [Return to Figure 13.1].

Figure 13.2 image description: This diagram shows an anterior view of the structure of the mouth. The teeth, lips, tongue, gums, and many other parts are labeled. Labels read (clockwise from top): superior lip, superior labial frenulum, gingivae, palatoglossal arch, fauces, palatopharyngeal arch, palatine tonsil, tongue, lingual frenulum, opening duct of the

submandibular gland, gingivae, inferior labial frenulum, inferior lip, oral vestibule, incisors, cuspid, premolars, molars, cheek, uvula, soft palate, hard palate. [Return to Figure 13.2].

Figure 13.3 image description: This diagram shows the structures of the tongue and lingual papillae. Labels read (from top): epiglottis, palatopharyngeal arch, palatine tonsil, lingual tonsil, palatoglossal arch, terminal sulcus, foliate papillae, circumvallate papillae, dorsum of the tongue, fungiform papilla, filiform papillae. [Return to Figure 13.3].

Figure 13.4 image description: This diagram shows the esophagus, going from the mouth to the stomach. The upper and the lower esophageal sphincter are labeled. Labels read (from top): upper esophageal sphincter, trachea, esophagus, lower esophageal sphincter, stomach. [Return to Figure 13.4].

Figure 13.5 image description: This image shows a cross-section of the stomach, and the major parts: the cardia, fundus, body, and pylorus are labeled. Labels read (from top of the stomach): esophagus, muscularis externa (longitudinal layer, circular layer, oblique layer), cardia, fundus, serosa, lesser and greater curvatures, lumen, rugae of mucosa, pyloric antrum, pyloric canal, pyloric sphincter valve at the pylorus, duodenum. [Return to Figure 13.5].

Figure 13.6 image description: This diagram shows the small intestine. The different parts of the small intestine are labeled. Labels read (from top of the small intestine): duodenum, jejunum, ileum, large intestine, rectum. [Return to Figure 13.6].

Figure 13.7 image description: This image shows the large intestine; the major parts of the large intestine are labeled. Labels read (from the start of the large intestinal tract): vermiform complex, cecum, ileum, ascending colon, transverse colon, right colic hepatic flexure, left colic splenic flexure, descending colon, sigmoid colon, rectum, anal canal. [Return to Figure 13.7].

Figure 13.8 image description: This diagram shows the accessory organs of the digestive system. The liver, spleen, pancreas, gallbladder, and their major parts are shown. Labels read: liver (right lobe, quadrate lobe, left lobe, caudate lobe), spleen, pancreas, pancreatic duct, gallbladder right hepatic duct, cystic duct, common hepatic duct, common bile duct, left hepatic duct. [Return to Figure 13.8].

Figure 13.9 image description: This figure shows the pancreas and its major parts Labels read (from left to right): common bile duct, head of the pancreas, pancreatic duct, lobules, tail of the pancreas. A magnified view of a small region of the pancreas shows the pancreatic islet cells, the acinar cells, exocrine cells, and the pancreatic duct. [Return to Figure 13.9].

Figure 13.10 image description: This figure shows the gallbladder and its major parts are labeled. Labels read (starting in the gallbladder): body, fundus, neck, cystic duct, common hepatic duct, common bile duct, left and right hepatic ducts, liver. [Return to Figure 13.10].

Figure 13.11 image description: This image shows the peristaltic movement of food. In the left image, the food bolus is towards the top of the esophagus and arrows pointing downward show the direction of movement of the peristaltic wave. In the center image, the food bolus and the wave movement are closer to the center of the esophagus and in the right image, the bolus and the wave are close to the bottom end of the esophagus. [Return to Figure 13.11].

Figure 13.12 image description: This image shows the different processes involved in digestion. The image shows how food travels from the mouth through the major organs. Associated textboxes list the various digestive processes: Absorption (nutrients and water to blood vessels and lymph vessels (small intestine), water to blood vessels (large intestine)), propulsion (swallowing (oropharynx), peristalsis (esophagus, stomach, small intestine, large intestine), chemical digestion, mechanical digestion (chewing (mouth), churning (stomach), segmentation (small intestine)). Parts of the digestive tract are labeled: ingestion of food, pharynx, esophagus, stomach, small intestine, large intestine, feces, anus, defecation. [Return to Figure 13.12].

14. Endocrine System

Learning Objectives

- Examine the anatomy of the endocrine system
- Determine the main functions of the endocrine system
- Differentiate the medical terms of the endocrine system and common abbreviations
- Recognize the medical specialties associated with the endocrine system
- Discover common diseases, disorders, and procedures related to the endocrine system

Endocrine System Word Parts

Click on prefixes, combining forms, and suffixes to reveal a list of word parts to memorize for the Endocrine System.

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https://pressbooks.uwf.edu/medicalterminology/?p=198#h5p-116

Introduction to the Endocrine System

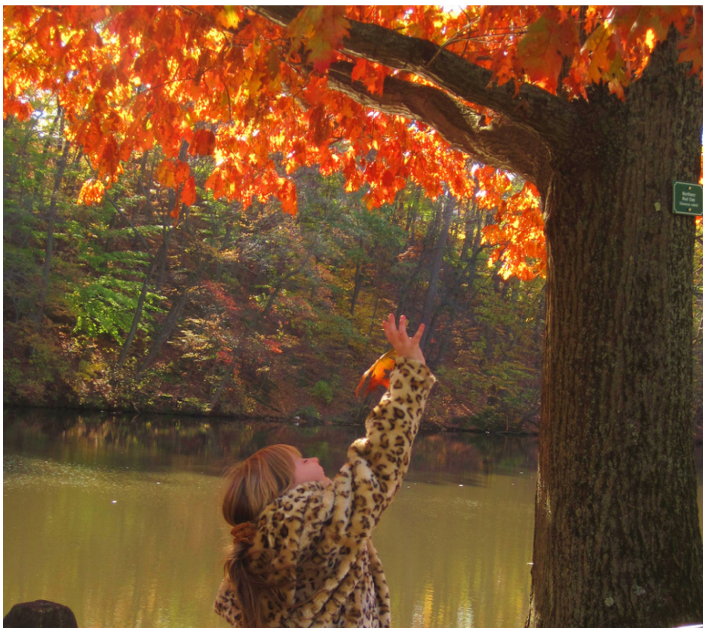

Figure 14.1 A Child Catches a Falling Leaf. Hormones of the endocrine system coordinate and control growth, metabolism, temperature regulation, the stress response, reproduction, and many other functions. (credit: "seenthroughmylense"/flickr.com). From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

You may never have thought of it this way, but when you send a text message to two friends to meet you at the dining hall at six, you're sending digital signals that (you hope) will affect their behavior—even though they are some distance away. Similarly, certain cells send chemical signals to other cells in the body that influence their behavior. This long-distance intercellular communication, coordination, and control are critical to maintaining equilibrium (homeostasis). This intercellular activity is the fundamental function of the endocrine system.

Watch this video:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.uwf.edu/medicalterminology/?p=198#oembed-1

Media 14.1 *Endocrine System, Part 1 – Glands & Hormones: Crash Course A&P #23 [Online video]. Copyright 2015 by CrashCourse.*

Practice Medical Terms Related to the Endocrine System

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Anatomy (Structures) of the Endocrine System

The endocrine system consists of cells, tissues, and organs that secrete hormones as a primary or secondary function. The **endocrine gland** is the major player in this system. The primary function of the endocrine gland is to secrete hormones directly into the surrounding fluid. The surrounding fluid (interstitial fluid) and the blood vessels then transport the hormones throughout the body. The endocrine system includes the pituitary, thyroid, parathyroid, adrenal, and pineal glands (see Figure 14.2). Some of these glands have both endocrine and nonendocrine functions. For example, the pancreas contains cells that function in digestion as well as cells that secrete the endocrine hormones like insulin and glucagon, which regulate blood glucose levels. The hypothalamus, thymus, heart, kidneys, stomach, small intestine, liver, skin, female ovaries, and male testes are other organs that contain cells with endocrine function. Moreover, fat (adipose) tissue has long been known to produce hormones, and recent research has revealed that even bone tissue has endocrine functions.

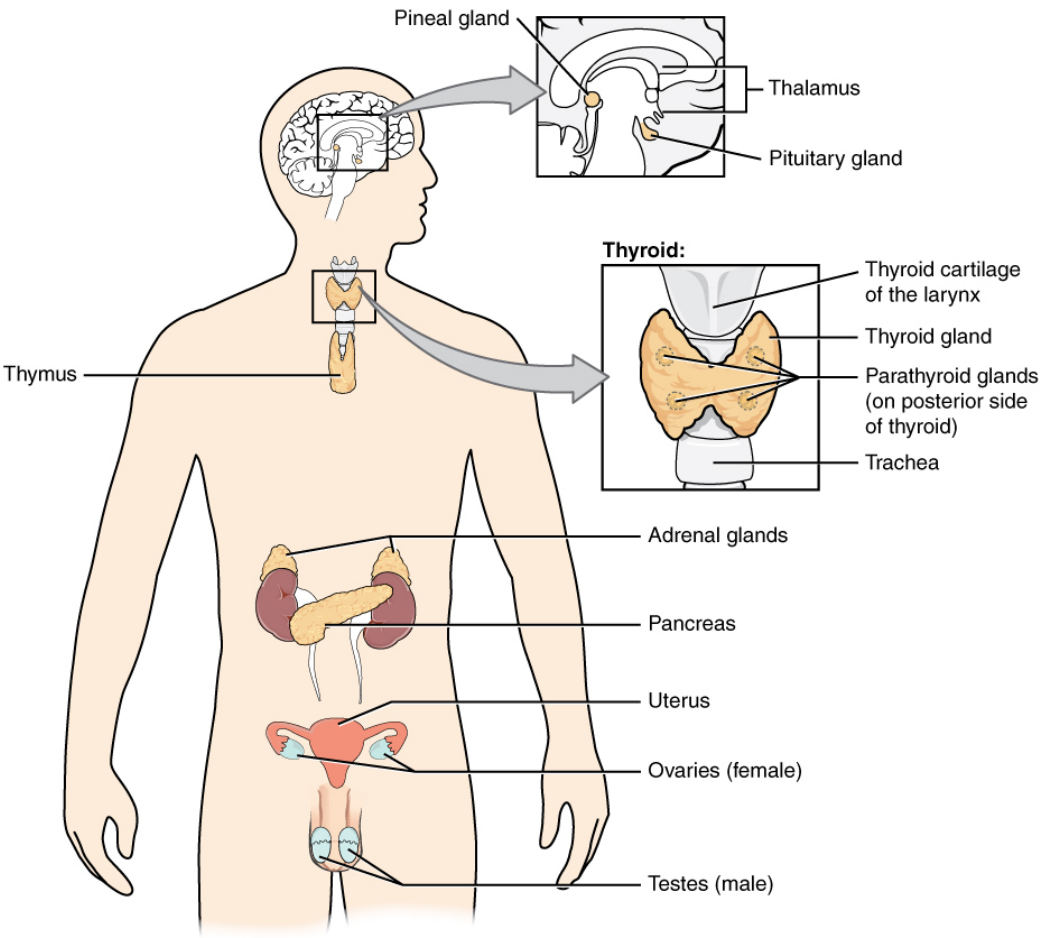

Figure 14.2 Endocrine System. Endocrine glands and cells are located throughout the body and play an important role in maintaining equilibrium (homeostasis). From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

The ductless endocrine glands are not to be confused with the body's **exocrine system**, whose glands release their secretions through ducts. Examples of exocrine glands include the sebaceous and sweat glands of the skin. As just noted, the pancreas also has an exocrine function: most of its cells secrete pancreatic juice through the pancreatic and accessory ducts to the lumen of the small intestine.

Did you know?

The pancreas acts as an endocrine and exocrine gland.

Anatomy Labeling Activity

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Physiology (Function) of the Endocrine System

Endocrine Signaling

The **endocrine system** uses one method of communication called chemical signaling. These chemical signals are sent by the endocrine organs. The endocrine organs secrete chemicals—called **hormones**—into the fluid outside of the tissue cells (extracellular fluid). Hormones are then transported primarily via the bloodstream throughout the body, where they bind to receptors on target cells, creating a particular response. For example, when you are presented with a dangerous or a frightening situation, the fight-or-flight response prompts the release of hormones from the adrenal gland—**epinephrine** and **norepinephrine**—within seconds. In contrast, it may take up to 48 hours for target cells to respond to certain reproductive hormones.

In addition, endocrine signaling is typically less specific than neural (nerve) signaling. The same hormone may also play a role in a variety of different physiological processes depending on the target cells involved. For example, the hormone oxytocin generates uterine contractions in women who are in labor. This hormone is also important in generating the milk release reflex during breastfeeding and may be involved in the sexual response and feelings of emotional attachment in both males and females.

Generally, the nervous system involves quick responses to rapid changes in the external environment, and the endocrine system is usually slower acting—taking care of the internal environment of the body, maintaining equilibrium (homeostasis), and controlling reproduction (see Table 14.1). So how does the fight-or-flight response, that was mentioned earlier, happen so quickly if hormones are usually slower acting? It is because the two systems are connected. It is the fast action of the nervous system in response to the danger in the environment that stimulates the adrenal glands to secrete their hormones, epinephrine, and norepinephrine. As a result, the nervous system can cause rapid endocrine responses to keep up with sudden changes in both the external and internal environments, when necessary.

Table 14.1: Endocrine and Nervous Systems. From Betts et al., 2013. Licensed under CC BY 4.0.

Characteristic	Endocrine System	Nervous System
Signaling mechanism(s)	Chemical	Chemical/electrical
Primary chemical signal	Hormones	Neurotransmitters
Distance traveled	Long or short	Always short
Response time	Fast or slow	Always fast
Environment targeted	Internal	Internal and external

Other Types of Chemical Signaling

There are four different types of chemical signaling occurring in multicellular organisms: endocrine signaling, **autocrine** signaling, **paracrine** signaling, and direct signaling.

In **endocrine signaling**, hormones secreted into the extracellular fluid spreads into the blood or lymphatic system, and can, therefore, travel great distances throughout the body.

In contrast, **autocrine signaling** occurs within the same cell. An **autocrine** (auto- = "self") is a chemical that triggers a response in the same cell that secreted the chemical. For example, Interleukin-1 (or IL-1), is a chemical signaling molecule that plays a role in inflammation. The cells that release IL-1 also have receptors on their surface that bind IL-1, resulting in autocrine signaling.

Paracrine signaling occurs amongst neighboring cells. A **paracrine** (para- = "near") is a chemical that triggers a response in neighboring cells. Although paracrines may enter the bloodstream, their concentration is generally too low to elicit a response from distant tissues. A familiar example for those with asthma is **histamine**, a paracrine that is released by immune cells. Histamine causes the smooth muscle cells of the lungs to constrict, narrowing the airways.

Direct signaling occurs between neighboring cells across gap junctions. Gap junctions are channels that connect neighboring cells, that allow small molecules to move between the neighboring cells.

Concept Check

- Describe the communication methods used by the endocrine system.
- Compare and contrast endocrine and exocrine glands.
- True or false: Neurotransmitters are a special class of paracrines? Explain your answer.

Hormones

Although a given hormone may travel throughout the body in the bloodstream, it will affect the activity only of its target cells; that is, cells with receptors for that particular hormone. Once the hormone binds to the receptor, a chain of events is initiated that leads to the target cell's response. Hormones play a critical role in the regulation of physiological processes because of the target cell responses they regulate. These responses contribute to human reproduction, growth and development of body tissues, metabolism, fluid, and electrolyte balance, sleep, and many other body functions. The major hormones of the human body and their effects are identified in Table 14.2.

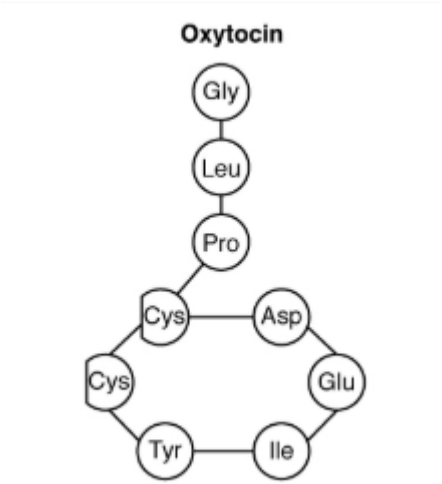
Table 14.2: Endocrine Glands and Their Major Hormones. From Betts et al., 2013. Licensed under CC BY 4.0.

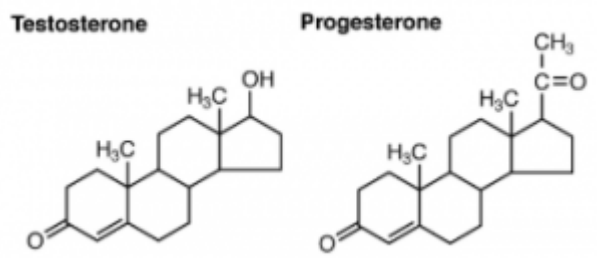
Endocrine Gland	Associated Hormones	Chemical Class	Effect
Pituitary (anterior)	Growth hormone (GH)	Protein	Promotes growth of body tissues
Pituitary (anterior)	Prolactin (PRL)	Peptide	Promotes milk production
Pituitary (anterior)	Thyroid-stimulating hormone (TSH)	Glycoprotein	Stimulates thyroid hormone release
Pituitary (anterior)	Adrenocorticotropic hormone (ACTH)	Peptide	Stimulates hormone released by the adrenal cortex
Pituitary (anterior)	Follicle-stimulating hormone (FSH)	Glycoprotein	Stimulates gamete production
Pituitary (anterior)	Luteinizing hormone (LH)	Glycoprotein	Stimulates androgen production by gonads
Pituitary (posterior)	Antidiuretic hormone (ADH)	Peptide	Stimulates water reabsorption by kidneys
Pituitary (posterior)	Oxytocin	Peptide	Stimulates uterine contractions during childbirth
Thyroid	Thyroxine (T_4), triiodothyronine (T_3)	Amine	Stimulate basal metabolic rate
Thyroid	Calcitonin	Peptide	Reduces blood Ca^{2+} levels
Parathyroid	Parathyroid hormone (PTH)	Peptide	Increases blood Ca^{2+} levels
Adrenal (cortex)	Aldosterone	Steroid	Increases blood Na^{+} levels
Adrenal (cortex)	Cortisol, corticosterone, cortisone	Steroid	Increase blood glucose levels
Adrenal (medulla)	Epinephrine, norepinephrine	Amine	Stimulate fight-or-flight response
Pineal	Melatonin	Amine	Regulates sleep cycles
Pancreas	Insulin	Protein	Reduces blood glucose levels
Pancreas	Glucagon	Protein	Increases blood glucose levels
Testes	Testosterone	Steroid	Stimulates development of male secondary sex characteristics and sperm production
Ovaries	Estrogens and progesterone	Steroid	Stimulate the development of female secondary sex characteristics and prepare the body for childbirth

Types of Hormones

The hormones of the human body can be divided into two major groups on the basis of their chemical structure. Hormones derived from amino acids include amines, peptides, and proteins. Those derived from lipids include steroids (see Table 14.3). These chemical groups affect a hormone's distribution, the type of receptors it binds to, and other aspects of its function.

Table 14.3 Amine, Peptide, Protein, and Steroid Hormone Structure. Adapted from Betts et al., 2013. Licensed under CC BY 4.0.

HORMONE CLASS	COMPONENTS	EXAMPLES
Amine Hormone	Amino acids with modified groups (e.g. norepinephrine's carboxyl group is replaced with a benzene ring)	 *Norepinephrine cellular structure.*
Peptide Hormone	Short chains of linked amino acids	 *Oxytocin cellular structure.*

HORMONE CLASS	COMPONENTS	EXAMPLES
Protein Hormone	Long chains of linked amino acids	 *Human growth hormone illustration.*
Steroid Hormones	Derived from lipid cholesterol	 *Testosterone and progesterone cellular structure.*

Amine Hormones

Hormones derived from the modification of amino acids are referred to as amine hormones. Amine hormones are synthesized from the amino acids tryptophan or tyrosine. An example of a hormone derived from tryptophan is melatonin, which is secreted by the pineal gland and helps regulate circadian rhythm.

Peptide and Protein Hormones

Whereas the amine hormones are derived from a single amino acid, peptide and protein hormones consist of multiple amino acids that link to form an amino acid chain. Examples of peptide hormones include antidiuretic hormone (ADH), a pituitary hormone important in fluid balance. Some examples of protein hormones include growth hormone, which is produced by the pituitary gland, and follicle-stimulating hormone (FSH). FSH helps stimulate the maturation of eggs in the ovaries and sperm in the testes.

Steroid Hormones

The primary hormones derived from lipids are steroids. Steroid hormones are derived from lipid cholesterol. For example, the reproductive hormones testosterone and estrogens—which are produced by the gonads (testes and ovaries)—are steroid hormones. The adrenal glands produce the steroid hormone aldosterone, which is involved in osmoregulation, and cortisol, which plays a role in metabolism.

Like cholesterol, steroid hormones are not soluble in water (they are hydrophobic). Because blood is water-based, lipid-derived hormones must travel to their target cell bound to a transport protein.

Pathways of Hormone Action

The message a hormone sends is received by a **hormone receptor**, a protein located either inside the cell or within the cell membrane. The receptor will process the message by initiating other signaling events or cellular mechanisms that result in the target cell's response. Hormone receptors recognize molecules with specific shapes and side groups and respond only to those hormones that are recognized. The same type of receptor may be located on cells in different body tissues, and trigger somewhat different responses. Thus, the response triggered by a hormone depends not only on the hormone but also on the target cell.

Once the target cell receives the hormone signal, it can respond in a variety of ways. The response may include the stimulation of protein **synthesis**, activation or deactivation of enzymes, alteration in the **permeability** of the cell membrane, altered rates of mitosis and cell growth, and stimulation of the secretion of products. Moreover, a single hormone may be capable of inducing different responses in a given cell.

Did you know?

Researchers say that one week of camping without electronics resets our biological body clock and synchronizes our melatonin hormones with sunrise and sunset (Wright et al., 2013).

Factors Affecting Target Cell Response

You will recall that target cells must have receptors specific to a given hormone if that hormone is to trigger a response, but several other factors influence the target cell response. For example, the presence of a significant level of a hormone circulating in the bloodstream can cause its target cells to decrease their number of receptors for that hormone. This process is called **downregulation**, and it allows cells to become less reactive to excessive hormone levels. When the level of a hormone is chronically reduced, target cells engage in **upregulation** to increase their number of receptors. This process allows cells to be more sensitive to the hormone that is present. Cells can also alter the sensitivity of the receptors themselves to various hormones.

Two or more hormones can interact to affect the response of cells in a variety of ways. The three most common types of interaction are as follows:

- The **permissive effect**, in which the presence of one hormone enables another hormone to act. For example, thyroid hormones have complex permissive relationships with certain reproductive hormones. A dietary deficiency of iodine, a component of thyroid hormones, can therefore affect reproductive system development and functioning.
- The **synergistic effect**, in which two hormones with similar effects produce an amplified response. In some cases, two hormones are required for an adequate response. For example, two different reproductive hormones—FSH from the pituitary gland and estrogens from the ovaries—are required for the maturation of female ova (egg cells).
- The **antagonistic effect**, in which two hormones have opposing effects. A familiar example is the effect of two pancreatic hormones, insulin and glucagon. Insulin increases the liver's storage of glucose as glycogen, decreasing blood glucose, whereas glucagon stimulates the breakdown of glycogen stores, increasing blood glucose.

Concept Check

- Describe how a hormone receptor functions and reacts to messages received.

- Contrast upregulation and downregulation. Are both of these processes necessary? Why or why not?

Regulation of Hormone Secretion

To prevent abnormal hormone levels and a potential disease state, hormone levels must be tightly controlled. The body maintains this control by balancing hormone production and degradation. Feedback loops govern the initiation and maintenance of most hormone secretion in response to various stimuli.

Role of Feedback Loops

The contribution of feedback loops to homeostasis will only be briefly reviewed here. Positive feedback loops are characterized by the release of additional hormones in response to an original hormone release. The release of oxytocin during childbirth is a positive feedback loop. The initial release of oxytocin begins to signal the uterine muscles to contract, which pushes the fetus toward the cervix, causing it to stretch. This, in turn, signals the pituitary gland to release more oxytocin, causing labor contractions to intensify. The release of oxytocin decreases after the birth of the child.

The more common method of hormone regulation is the negative feedback loop. Negative feedback is characterized by the inhibition of further secretion of a hormone in response to adequate levels of that hormone. This allows blood levels of the hormone to be regulated within a narrow range. An example of a negative feedback loop is the release of glucocorticoid hormones from the adrenal glands, as directed by the hypothalamus and pituitary gland. As glucocorticoid concentrations in the blood rise, the hypothalamus and pituitary gland reduce their signaling to the adrenal glands to prevent additional glucocorticoid secretion (see Figure 14.3).

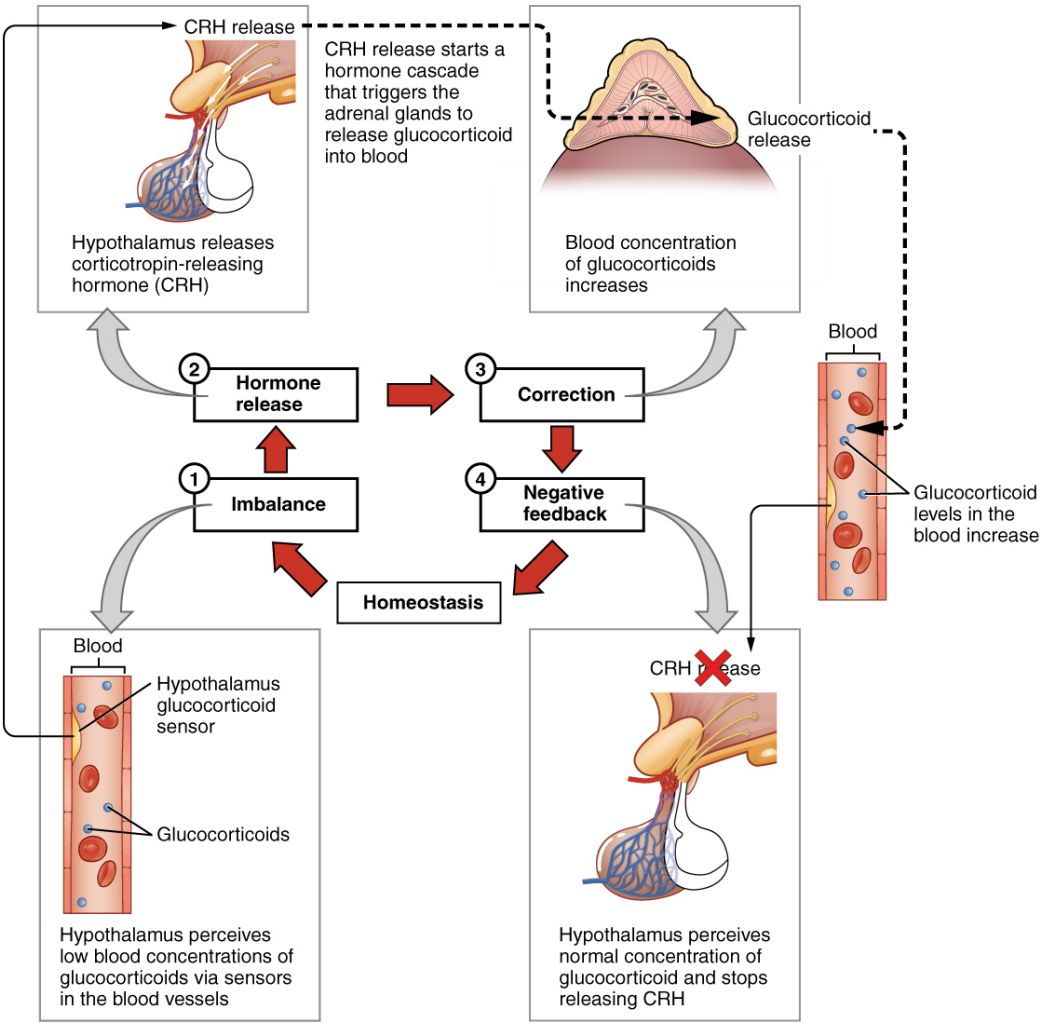


Figure 14.3 Negative Feedback Loop. The release of adrenal glucocorticoids is stimulated by the release of hormones from the hypothalamus and pituitary gland. This signaling is inhibited when glucocorticoid levels become elevated by causing negative signals to the pituitary gland and hypothalamus. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Anterior Pituitary Gland

The anterior pituitary originates from the digestive tract in the embryo and migrates toward the brain during fetal development. There are three regions: the pars distalis is the most anterior, the pars intermedia is adjacent to the posterior pituitary, and the pars tuberalis is a slender "tube" that wraps the infundibulum.

Recall that the posterior pituitary does not synthesize hormones, but merely stores them. In contrast, the anterior pituitary does manufacture hormones. However, the secretion of hormones from the anterior pituitary is regulated by two classes of hormones. These hormones—secreted by the hypothalamus—are the releasing hormones that stimulate the secretion of hormones from the anterior pituitary and the inhibiting hormones that inhibit secretion.

Hypothalamic hormones are secreted by neurons but enter the anterior pituitary through blood vessels. Within the infundibulum is a bridge of capillaries that connects the hypothalamus to the anterior pituitary. This network, called the **hypophyseal portal system**, allows hypothalamic hormones to be transported to the anterior pituitary without first entering the systemic circulation. The system originates from the superior hypophyseal artery, which branches off the carotid arteries and transports blood to the hypothalamus. The branches of the superior hypophyseal artery

form the hypophyseal portal system (see Figure 14.4). Hypothalamic releasing and inhibiting hormones travel through a primary capillary plexus to the portal veins, which carry them into the anterior pituitary. Hormones produced by the anterior pituitary (in response to releasing hormones) enter a secondary capillary plexus, and from there drain into the circulation.

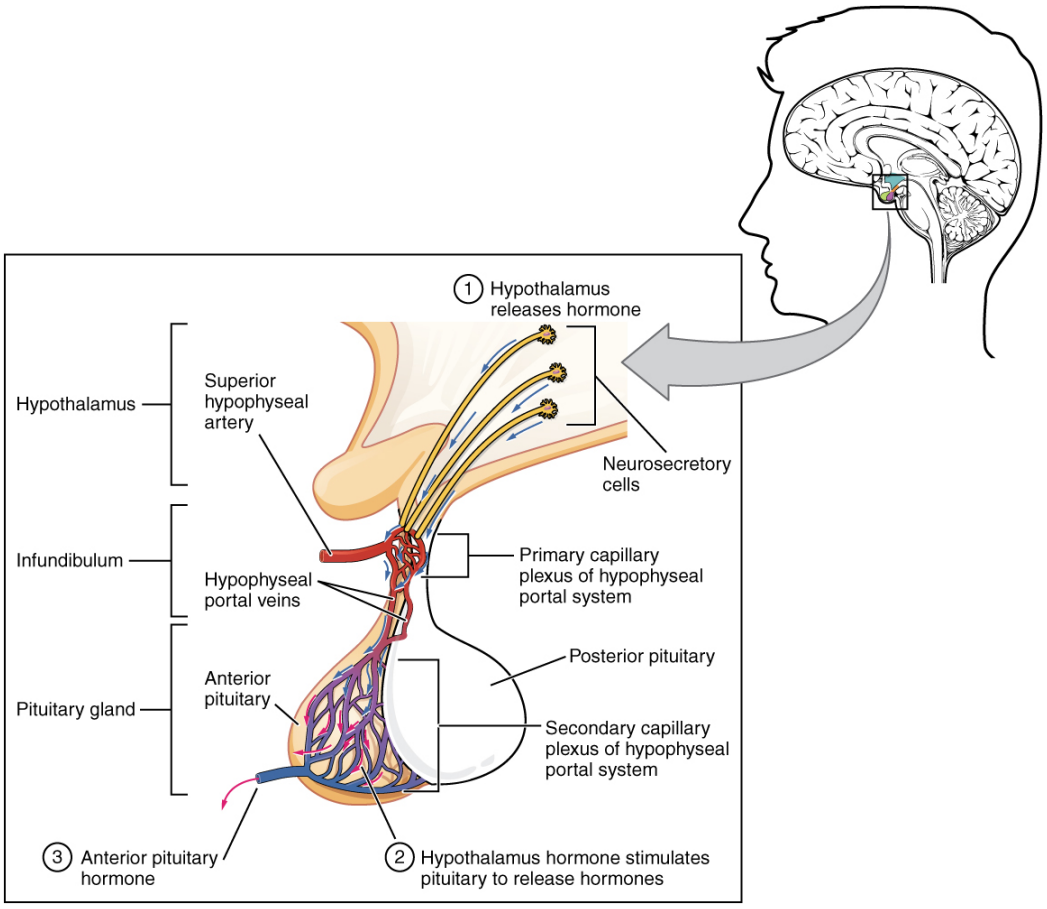


Figure 14.4 Anterior Pituitary. The anterior pituitary manufactures seven hormones. The hypothalamus produces separate hormones that stimulate or inhibit hormone production in the anterior pituitary. Hormones from the hypothalamus reach the anterior pituitary via the hypophyseal portal system. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

The anterior pituitary produces seven hormones. These are the growth hormone (GH), thyroid-stimulating hormone (TSH), adrenocorticotropic hormone (ACTH), follicle-stimulating hormone (FSH), luteinizing hormone (LH), beta-endorphin, and prolactin. Of the hormones of the anterior pituitary, TSH, ACTH, FSH, and LH are collectively referred to as tropic hormones (trope- = "turning") because they turn on or off the function of other endocrine glands.

Growth Hormone

The endocrine system regulates the growth of the human body, protein synthesis, and cellular replication. A major hormone involved in this process is **growth hormone (GH)**, also called somatotropin—a protein hormone produced and secreted by the anterior pituitary gland. Its primary function is anabolic; it promotes protein synthesis and tissue building through direct and indirect mechanisms (see Figure 14.5). GH levels are controlled by the release of GHRH and GHIH (also known as somatostatin) from the hypothalamus.

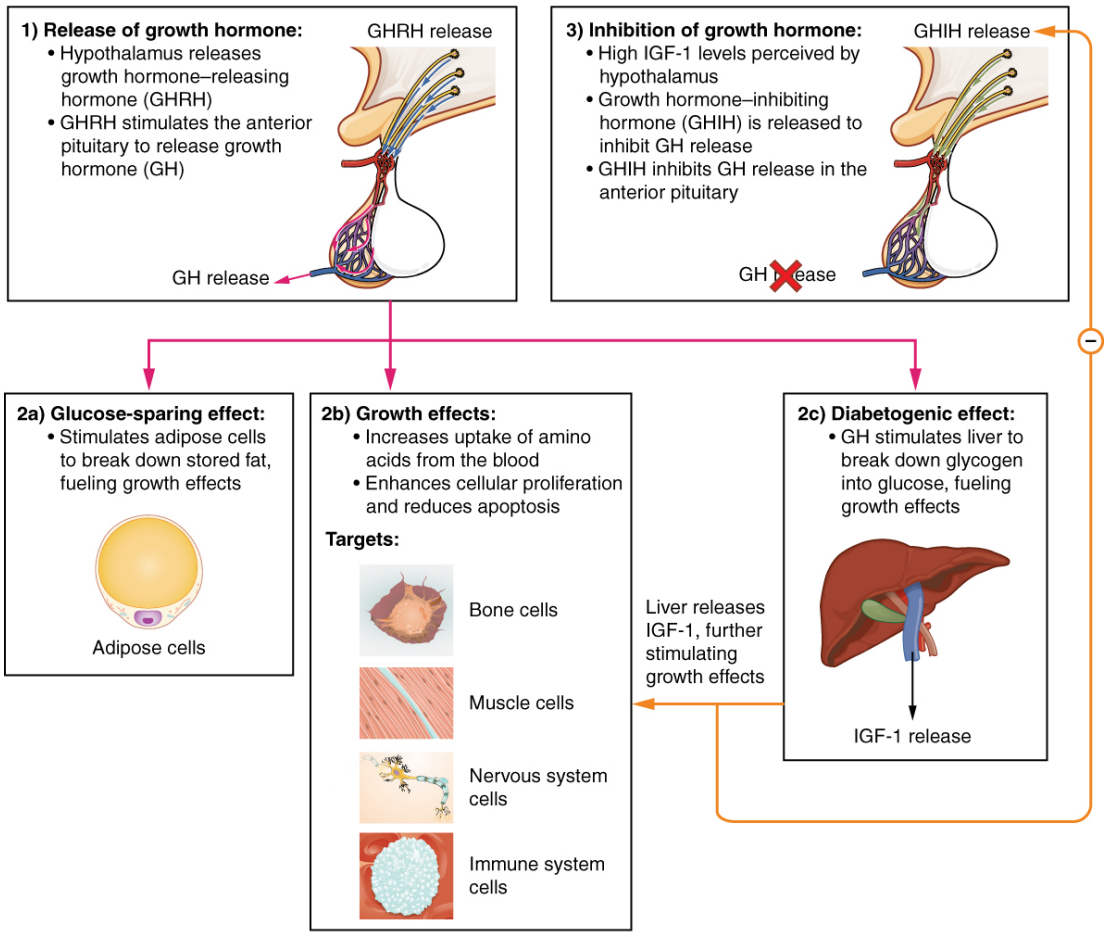


Figure 14.5 Hormonal Regulation of Growth. Growth hormone (GH) directly accelerates the rate of protein synthesis in skeletal muscle and bones. Insulin-like growth factor 1 (IGF-1) is activated by growth hormone and indirectly supports the formation of new proteins in muscle cells and bone. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

A glucose-sparing effect occurs when GH stimulates lipolysis, or the breakdown of adipose tissue, releasing fatty acids into the blood. As a result, many tissues switch from glucose to fatty acids as their main energy source, which means that less glucose is taken up from the bloodstream.

GH also initiates the diabetogenic effect in which GH stimulates the liver to break down glycogen to glucose, which is then deposited into the blood. The name "diabetogenic" is derived from the similarity in elevated blood glucose levels observed between individuals with untreated diabetes mellitus and individuals experiencing GH excess. Blood glucose levels rise as the result of a combination of glucose-sparing and diabetogenic effects.

GH indirectly mediates growth and protein synthesis by triggering the liver and other tissues to produce a group of proteins called **insulin-like growth factors (IGFs)**. These proteins enhance cellular **proliferation** and inhibit apoptosis, or programmed cell death. IGFs stimulate cells to increase their uptake of amino acids from the blood for protein synthesis. Skeletal muscle and cartilage cells are particularly sensitive to stimulation from IGFs.

Dysfunction of the endocrine system's control of growth can result in several disorders. For example, **gigantism** is a disorder in children that is caused by the secretion of abnormally large amounts of GH, resulting in excessive growth. A similar condition in adults is **acromegaly**, a disorder that results in the growth of bones in the face, hands, and feet in response to excessive levels of GH in individuals who have stopped growing. Abnormally low levels of GH in children can cause growth impairment—a disorder called **pituitary dwarfism** (also known as growth hormone deficiency).

Posterior Pituitary Gland

The posterior pituitary is actually an extension of the neurons of the nuclei of the hypothalamus. The cell bodies of these regions rest in the hypothalamus, but their axons descend as the hypothalamic–hypophyseal tract within the infundibulum and end in axon terminals that comprise the posterior pituitary (see Figure 14.6).

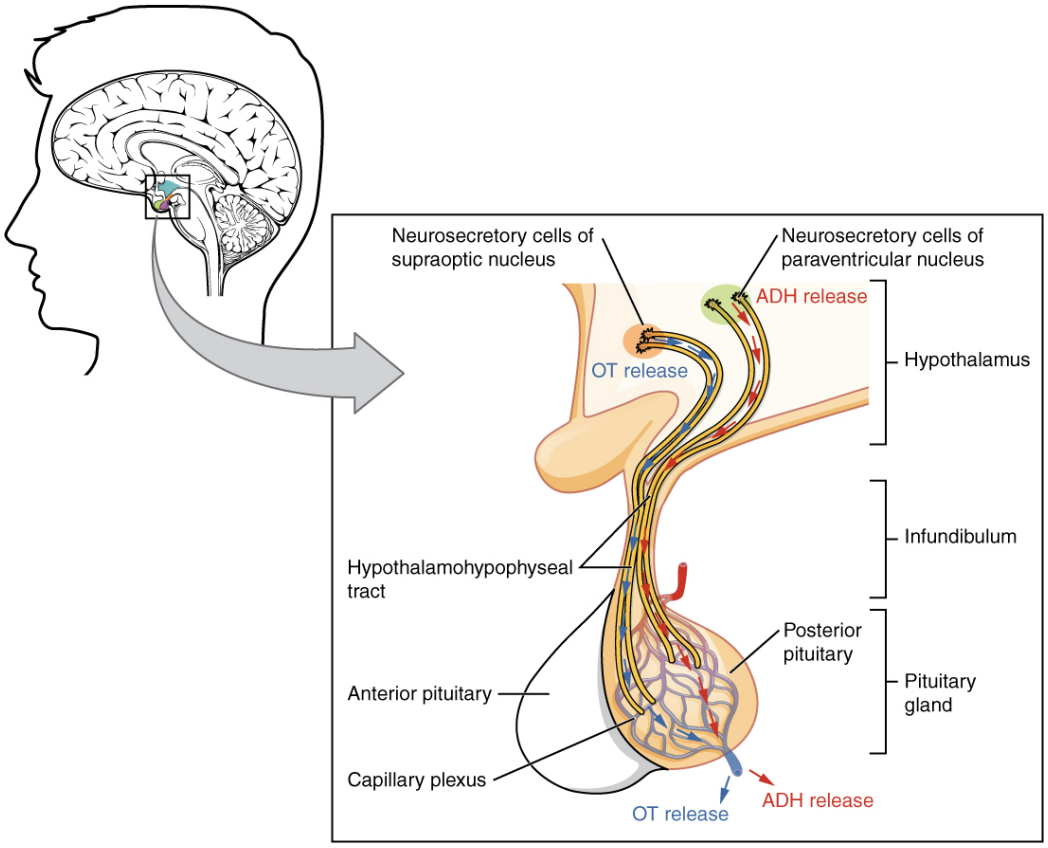


Figure 14.6 Posterior Pituitary. Neurosecretory cells in the hypothalamus release oxytocin (OT) or ADH into the posterior lobe of the pituitary gland. These hormones are stored or released into the blood via the capillary plexus. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

The posterior pituitary gland does not produce hormones, but rather stores and secretes hormones produced by the hypothalamus. The paraventricular nuclei produce the hormone oxytocin, whereas the supraoptic nuclei produce ADH. These hormones travel along the axons into storage sites in the axon terminals of the posterior pituitary. In response to signals from the same hypothalamic neurons, the hormones are released from the axon terminals into the bloodstream.

Oxytocin

When fetal development is complete, the peptide-derived hormone **oxytocin** (tocia- = "childbirth") stimulates uterine contractions and dilation of the cervix. Throughout most of pregnancy, oxytocin hormone receptors are not expressed at high levels in the uterus. Toward the end of pregnancy, the synthesis of oxytocin receptors in the uterus increases, and the smooth muscle cells of the uterus become more sensitive to its effects. Oxytocin is continually released throughout childbirth through a positive feedback mechanism. As noted earlier, oxytocin prompts the uterine contractions that push the fetal head toward the cervix. In response, cervical stretching stimulates additional oxytocin

to be synthesized by the hypothalamus and released from the pituitary. This increases the intensity and effectiveness of uterine contractions and prompts additional dilation of the cervix. The feedback loop continues until birth.

Although the mother's high blood levels of oxytocin begin to decrease immediately following birth, oxytocin continues to play a role in maternal and newborn health. First, oxytocin is necessary for the milk ejection reflex (commonly referred to as "let-down") in breastfeeding women. As the newborn begins suckling, sensory receptors in the nipples transmit signals to the hypothalamus. In response, oxytocin is secreted and released into the bloodstream. Within seconds, cells in the mother's milk ducts contract, ejecting milk into the infant's mouth. Secondly, in both males and females, oxytocin is thought to contribute to parent–newborn bonding, known as attachment. Oxytocin is also thought to be involved in feelings of love and closeness, as well as in the sexual response.

Did you know?

Oxytocin is used not only during childbirth but also during breastfeeding.

Antidiuretic Hormone (ADH)

The solute concentration of the blood, or blood osmolarity, may change in response to the consumption of certain foods and fluids, as well as in response to disease, injury, medications, or other factors. Blood osmolarity is constantly monitored by **osmoreceptors**—specialized cells within the hypothalamus that are particularly sensitive to the concentration of sodium ions and other solutes. In response to high blood osmolarity, which can occur during dehydration or following a very salty meal, the osmoreceptors signal the posterior pituitary to release **antidiuretic hormone (ADH)**. The target cells of ADH are located in the tubular cells of the kidneys. Its effect is to increase epithelial permeability to water, allowing increased water reabsorption. The more water reabsorbed from the filtrate, the greater the amount of water that is returned to the blood and the less that is excreted in the urine. A greater concentration of water results in a reduced concentration of solutes. ADH is also known as vasopressin because, in very high concentrations, it causes constriction of blood vessels, which increases blood pressure by increasing peripheral resistance.

The release of ADH is controlled by a negative feedback loop. As blood osmolarity decreases, the hypothalamic osmoreceptors sense the change and prompt a corresponding decrease in the secretion of ADH. As a result, less water is reabsorbed from the urine filtrate. Interestingly, drugs can affect the secretion of ADH. For example, alcohol consumption inhibits the release of ADH, resulting in increased urine production that can eventually lead to dehydration and a hangover. A disease called diabetes insipidus is characterized by chronic underproduction of ADH that causes chronic dehydration. Because little ADH is produced and secreted, not enough water is reabsorbed by the kidneys. Although patients feel thirsty and increase their fluid consumption, this doesn't effectively decrease the solute concentration in their blood because ADH levels are not high enough to trigger water reabsorption in the kidneys. Electrolyte imbalances can occur in severe cases of diabetes insipidus.

Thyroid-Stimulating Hormone

The activity of the thyroid gland is regulated by **thyroid-stimulating hormone (TSH)**, also called thyrotropin. TSH is released from the anterior pituitary in response to thyrotropin-releasing hormone (TRH) from the hypothalamus. As discussed shortly, it triggers the secretion of thyroid hormones by the thyroid gland. In a classic negative feedback loop, elevated levels of thyroid hormones in the bloodstream then trigger a drop in production of TRH and subsequently TSH.

Adrenocorticotropic Hormone

The **adrenocorticotropic hormone (ACTH)**, also called corticotropin, stimulates the adrenal cortex (the more superficial "bark" of the adrenal glands) to secrete corticosteroid hormones such as cortisol. ACTH comes from a precursor molecule known as proopiomelanocortin (POMC) which produces several biologically active molecules when cleaved, including ACTH, melanocyte-stimulating hormone, and the brain opioid peptides known as endorphins. The release of ACTH is regulated by the corticotropin-releasing hormone (CRH) from the hypothalamus in response to normal physiologic rhythms. A variety of stressors can also influence its release, and the role of ACTH in the stress response is discussed later in this chapter.

Follicle-Stimulating Hormone and Luteinizing Hormone

The endocrine glands secrete a variety of hormones that control the development and regulation of the reproductive system (these glands include the anterior pituitary, the adrenal cortex, and the gonads—the testes in males and the ovaries in females). Much of the development of the reproductive system occurs during puberty and is marked by the development of sex-specific characteristics in both male and female adolescents. Puberty is initiated by gonadotropin-releasing hormone (GnRH), a hormone produced and secreted by the hypothalamus. GnRH stimulates the anterior pituitary to secrete **gonadotropins**—hormones that regulate the function of the gonads. The levels of GnRH are regulated through a negative feedback loop; high levels of reproductive hormones inhibit the release of GnRH. Throughout life, gonadotropins regulate reproductive function and, in the case of women, the onset and cessation of reproductive capacity.

The gonadotropins include two glycoprotein hormones: **follicle-stimulating hormone (FSH)** stimulates the production and maturation of sex cells, or gametes, including ova in women and sperm in men. FSH also promotes follicular growth; these follicles then release estrogens in the female ovaries. **Luteinizing hormone (LH)** triggers ovulation in women, as well as the production of estrogens and progesterone by the ovaries. LH stimulates production of testosterone by the male testes.

Prolactin

As its name implies, **prolactin (PRL)** promotes lactation (milk production) in women. During pregnancy, it contributes to the development of the mammary glands, and after birth, it stimulates the mammary glands to produce breast milk. However, the effects of prolactin depend heavily upon the permissive effects of estrogens, progesterone, and other hormones. And as noted earlier, the let-down of milk occurs in response to stimulation from oxytocin.

In a non-pregnant woman, prolactin secretion is inhibited by prolactin-inhibiting hormone (PIH), which is actually the

neurotransmitter dopamine, and is released from neurons in the hypothalamus. Only during pregnancy do prolactin levels rise in response to prolactin-releasing hormone (PRH) from the hypothalamus.

Intermediate Pituitary: Melanocyte-Stimulating Hormone

The cells in the zone between the pituitary lobes secrete a hormone known as melanocyte-stimulating hormone (MSH) that is formed by cleavage of the proopiomelanocortin (POMC) precursor protein. Local production of MSH in the skin is responsible for melanin production in response to UV light exposure. The role of MSH made by the pituitary is more complicated. For instance, people with lighter skin generally have the same amount of MSH as people with darker skin. Nevertheless, this hormone is capable of darkening the skin by inducing melanin production in the skin's melanocytes. Women also show increased MSH production during pregnancy; in combination with estrogens, it can lead to darker skin pigmentation, especially the skin of the areolas and labia minora. Table 14.4 is a summary of the pituitary hormones and their principal effects.

Table 14.4 Major Pituitary Hormones. Major pituitary hormones and their target organs. Adapted from Betts et al., 2013. Licensed under CC BY 4.0.

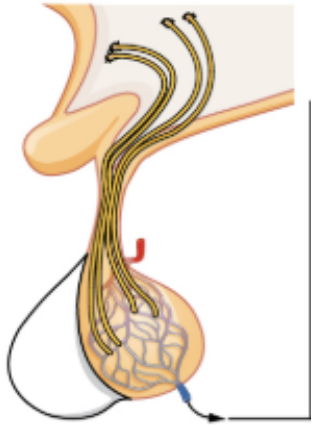
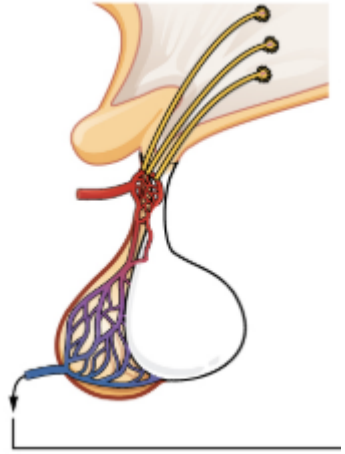
IMAGE OF GLANDS	HORMONES			
 *An image displaying the posterior pituitary gland*	**Posterior Pituitary Hormones**			
	Releasing hormone (hypothalamus)	**Pituitary Hormone**	**Target**	**Effects**
	ADH	Stores ADH	Kidneys, sweat glands, circulatory system	Water balance
	–	OT	Female reproductive system	Triggers uterine contractions during childbirth

IMAGE OF GLANDS	HORMONES			
 *An image displaying the Anterior Pituitary Gland*	**Anterior Pituitary Hormones**			
	Releasing hormone (hypothalamus)	**Pituitary Hormone**	**Target**	**Effects**
	GnRH	LH	Reproductive system	Stimulates production of sex hormones by gonads
	GnRH	FSH	Reproductive system	Stimulates production of sperm and eggs
	TRH	TSH	Thyroid gland	Stimulates the release of thyroid hormone (TH), TH regulates metabolism
	PRH (inhibited by PIH)	PRL	Mammary glands	Promotes milk production
	GHRH (inhibited by GHIH)	GH	Liver, bone, muscles	Induces targets to produce insulin-like growth factors (IGF). IGFs stimulate body growth and higher metabolic rate.
	CRH	ACTH	Adrenal glands	Induces targets to produce glucocorticoids, which regulate metabolism and stress response

Pineal Gland

The pineal gland is a tiny endocrine gland whose functions are not entirely clear. The **pinealocyte** cells that make up the pineal gland are known to produce and secrete the amine hormone **melatonin**, which is derived from serotonin. The secretion of melatonin varies according to the level of light received from the environment. When photons of light stimulate the retinas of the eyes, a nerve impulse is sent to a region of the hypothalamus which is important in regulating biological rhythms. When blood levels of melatonin fall they promote wakefulness. In contrast, as light levels decline—such as during the evening—melatonin production increases, boosting blood levels and causing drowsiness.

Melatonin

The secretion of melatonin may influence the body's circadian rhythms, the dark-light fluctuations that affect not only sleepiness and wakefulness but also appetite and body temperature. Interestingly, children have higher melatonin levels than adults, which may prevent the release of gonadotropins from the anterior pituitary, thereby inhibiting the onset of puberty. Finally, the antioxidant role of melatonin is the subject of current research. Jet lag occurs when a person travels across several time zones and feels sleepy during the day or wakeful at night. Traveling across multiple time zones significantly disturbs the light-dark cycle regulated by melatonin. It can take up to several days for melatonin synthesis to adjust to the light-dark patterns in the new environment, resulting in jet lag. Some air travelers take melatonin supplements to induce sleep.

Thyroid Gland

A butterfly-shaped organ, the **thyroid gland** is located anterior to the trachea, just inferior to the larynx (see Figure 14.7). The medial region, called the isthmus, is flanked by wing-shaped left and right lobes. Each of the thyroid lobes is embedded with parathyroid glands, primarily on their posterior surfaces. The tissue of the thyroid gland is composed mostly of thyroid follicles. The follicles are made up of a central cavity filled with a sticky fluid called **colloid**. Surrounded by a wall of epithelial follicle cells, the colloid is the center of thyroid hormone production, and that production is dependent on the hormones' essential and unique component: iodine.

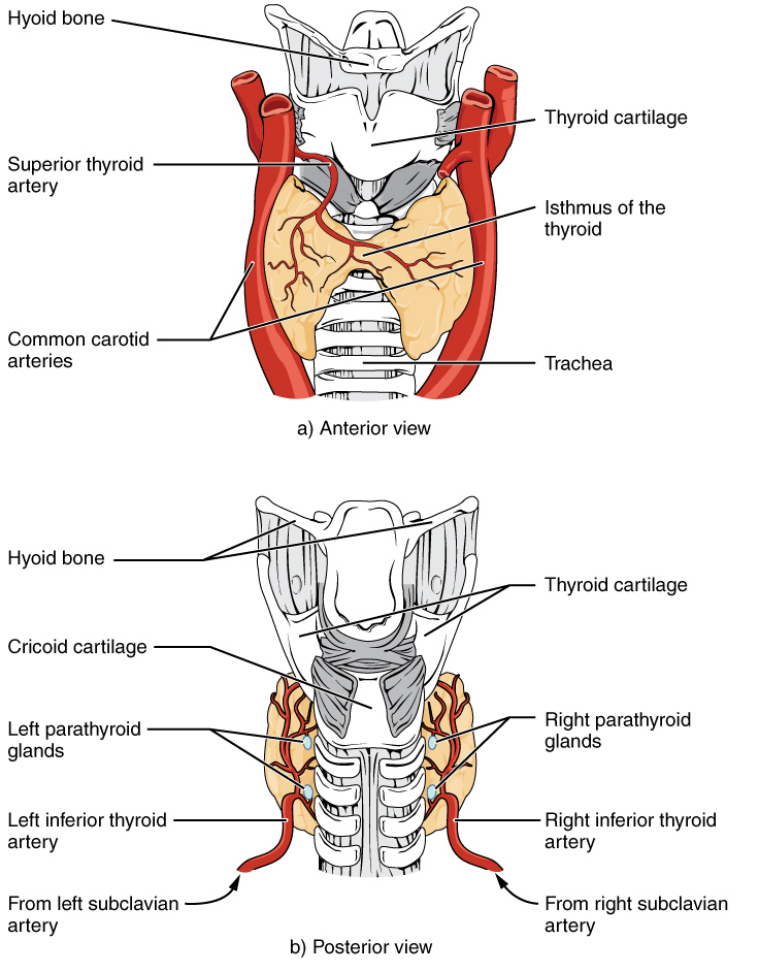


Figure 14.7 Thyroid Gland. The thyroid gland is located in the neck where it wraps around the trachea. (a) Anterior view of the thyroid gland. (b) Posterior view of the thyroid gland. (c) The glandular tissue is composed primarily of thyroid follicles. The larger parafollicular cells often appear within the matrix of follicle cells. LM × 1332. (Micrograph provided by the Regents of University of Michigan Medical School © 2012). From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Regulation of TH Synthesis

The release of T_3 and T_4 from the thyroid gland is regulated by thyroid-stimulating hormone (TSH). Low blood levels of T_3 and T_4 stimulate the release of thyrotropin-releasing hormone (TRH) from the hypothalamus, which triggers the secretion of TSH from the anterior pituitary. In turn, TSH stimulates the thyroid gland to secrete T_3 and T_4. The levels of TRH, TSH, T_3, and T_4 are regulated by a negative feedback system in which increasing levels of T_3 and T_4 decrease the production and secretion of TSH. The thyroid hormones, T_3 and T_4, are often referred to as metabolic hormones because their levels influence the body's basal metabolic rate, the amount of energy used by the body at rest.

The thyroid gland also secretes a hormone called **calcitonin** that is produced by the parafollicular cells (also called C cells) that stud the tissue between distinct follicles. Calcitonin is released in response to a rise in blood calcium levels.

Parathyroid Gland

The **parathyroid glands** are tiny, round structures usually found embedded in the posterior surface of the thyroid gland. A thick connective tissue capsule separates the glands from the thyroid tissue. Most people have four parathyroid glands, but occasionally there are more in tissues of the neck or chest. The function of one type of parathyroid cells, the oxyphil cells, is not clear. The primary functional cells of the parathyroid glands are the chief cells. These epithelial cells produce and secrete the **parathyroid hormone (PTH)**, the major hormone involved in the regulation of blood calcium levels.

Adrenal Gland

The **adrenal glands** are wedges of glandular and neuroendocrine tissue adhering to the top of the kidneys by a fibrous capsule (see Figure 14.8). The adrenal glands have a rich blood supply and experience one of the highest rates of blood flow in the body. They are served by several arteries branching off the aorta, including the suprarenal and renal arteries. Blood flows to each adrenal gland at the adrenal cortex and then drains into the adrenal medulla. Adrenal hormones are released into the circulation via the left and right suprarenal veins.

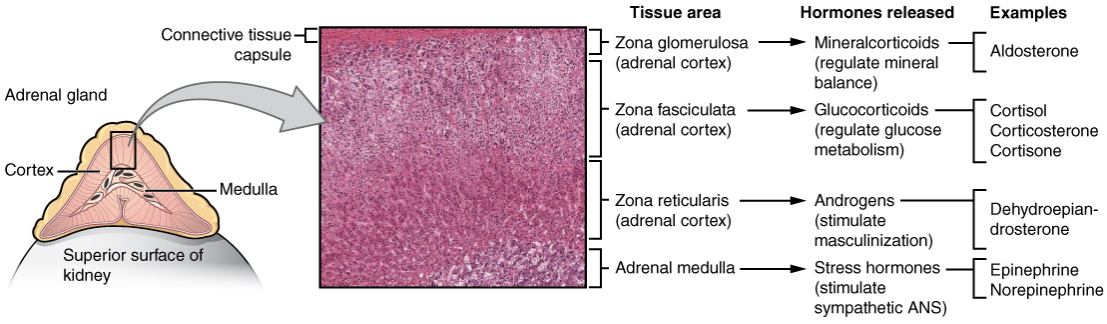


Figure 14.8 Adrenal Glands. Both adrenal glands sit atop the kidneys and are composed of an outer cortex and an inner medulla, all surrounded by a connective tissue capsule. The cortex can be subdivided into additional zones, all of which produce different types of hormones. LM × 204. (Micrograph provided by the Regents of University of Michigan Medical School © 2012). From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

The **adrenal cortex** consists of multiple layers of lipid-storing cells that occur in three structurally distinct regions, each of which produces different hormones. As a component of the hypothalamic-pituitary-adrenal (HPA) axis, it secretes

steroid hormones important for the regulation of the long-term stress response, blood pressure and blood volume, nutrient uptake and storage, fluid and electrolyte balance, and inflammation. The HPA axis involves the stimulation of hormone release of adrenocorticotropic hormone (ACTH) from the pituitary by the hypothalamus. ACTH then stimulates the adrenal cortex to produce the hormone cortisol. This pathway will be discussed in more detail below.

The **adrenal medulla** is neuroendocrine tissue composed of postganglionic sympathetic nervous system (SNS) neurons. It is really an extension of the autonomic nervous system, which regulates homeostasis in the body. The sympathomedullary (SAM) pathway involves the stimulation of the medulla by impulses from the hypothalamus via neurons from the thoracic spinal cord. The medulla is stimulated to secrete the amine hormones epinephrine and norepinephrine.

One of the major functions of the adrenal gland is to respond to stress. Stress can be either physical or psychological or both. Physical stresses include exposing the body to injury, walking outside in cold and wet conditions without a coat on, or malnutrition. Psychological stresses include the perception of a physical threat, a fight with a loved one, or just a bad day at school.

The body responds in different ways to short-term stress and long-term stress following a pattern known as the **general adaptation syndrome (GAS)**. Stage one of GAS is called the **alarm reaction**. This is short-term stress, the fight-or-flight response, mediated by the hormones epinephrine and norepinephrine from the adrenal medulla via the SAM pathway. Their function is to prepare the body for extreme physical exertion. Once this stress is relieved, the body quickly returns to normal. The section on the adrenal medulla covers this response in more detail.

If the stress is not soon relieved, the body adapts to the stress in the second stage called the **stage of resistance**. If a person is starving, for example, the body may send signals to the gastrointestinal tract to maximize the absorption of nutrients from food.

If the stress continues for a longer term, however, the body responds with symptoms quite different than the fight-or-flight response. During the **stage of exhaustion**, individuals may begin to suffer depression, the suppression of their immune response, severe fatigue, or even a fatal heart attack. These symptoms are mediated by the hormones of the adrenal cortex, especially cortisol, released as a result of signals from the HPA axis.

Adrenal hormones also have several non–stress-related functions, including the increase of blood sodium and glucose levels, which will be described in detail below.

Watch this video:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.uwf.edu/medicalterminology/?p=198#oembed-2

Media 14.2 Endocrine System, Part 2 – Hormone Cascades: Crash Course A&P #24 [Online video]. Copyright 2015 by CrashCourse.

Practice Terms Related to the Endocrine System

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://pressbooks.uwf.edu/medicalterminology/?p=198#h5p-127

Concept Check

Which hormone produced by the adrenal glands is responsible for the mobilization of energy stores?

Hormones of the Zona Glomerulosa

The most superficial region of the adrenal cortex is the zona glomerulosa, which produces a group of hormones collectively referred to as **mineralocorticoids** because of their effect on body minerals, especially sodium and potassium. These hormones are essential for fluid and electrolyte balance.

Aldosterone is the major mineralocorticoid. It is important in the regulation of the concentration of sodium and potassium ions in urine, sweat, and saliva. For example, it is released in response to elevated blood K^+, low blood Na^+, low blood pressure, or low blood volume. In response, aldosterone increases the excretion of K^+ and the retention of Na^+, which in turn increases blood volume and blood pressure. Its secretion is prompted when CRH from the hypothalamus triggers ACTH release from the anterior pituitary.

Aldosterone is also a key component of the renin-angiotensin-aldosterone system (RAAS) in which specialized cells of the kidneys secrete the enzyme renin in response to low blood volume or low blood pressure. Renin then catalyzes the conversion of the blood protein angiotensinogen, produced by the liver, to the hormone angiotensin I. Angiotensin I is converted in the lungs to angiotensin II by **angiotensin-converting enzyme** (ACE). Angiotensin II has three major functions:

1. Initiating vasoconstriction of the arterioles, decreasing blood flow
2. Stimulating kidney tubules to reabsorb NaCl and water, increasing blood volume
3. Signaling the adrenal cortex to secrete aldosterone, the effects of which further contribute to fluid retention, restoring blood pressure and blood volume

For individuals with hypertension, or high blood pressure, drugs are available that block the production of angiotensin II. These drugs, known as ACE inhibitors, block the ACE enzyme from converting angiotensin I to angiotensin II, thus mitigating the latter's ability to increase blood pressure.

Hormones of the Zona Fasciculata

The intermediate region of the adrenal cortex is the zona fasciculata, named as such because the cells form small fascicles (bundles) separated by tiny blood vessels. The cells of the zona fasciculata produce hormones called **glucocorticoids** because of their role in glucose metabolism. The most important of these is **cortisol**, some of which the liver converts to cortisone. A glucocorticoid produced in much smaller amounts is corticosterone. In response to long-term stressors, the hypothalamus secretes CRH, which in turn triggers the release of ACTH by the anterior pituitary. ACTH triggers the release of glucocorticoids. Their overall effect is to inhibit tissue building while stimulating the breakdown of stored nutrients to maintain adequate fuel supplies. In conditions of long-term stress, for example, cortisol promotes the catabolism of glycogen to glucose, the catabolism of stored triglycerides into fatty acids and glycerol, and the catabolism of muscle proteins into amino acids. These raw materials can then be used to synthesize additional glucose and ketones for use as body fuels. The hippocampus, which is part of the temporal lobe of the cerebral cortices and important in memory formation, is highly sensitive to stress levels because of its many glucocorticoid receptors.

You are probably familiar with prescription and over-the-counter medications containing glucocorticoids, such as cortisone injections into inflamed joints, prednisone tablets, and steroid-based inhalers used to manage severe asthma, and hydrocortisone creams applied to relieve itchy skin rashes. These drugs reflect another role of cortisol—the downregulation of the immune system, which inhibits the inflammatory response.

Hormones of the Zona Reticularis

The deepest region of the adrenal cortex is the zona reticularis, which produces small amounts of a class of steroid sex hormones called **androgens**. During puberty and most of adulthood, androgens are produced in the gonads. The androgens produced in the zona reticularis supplement the gonadal androgens. They are produced in response to ACTH from the anterior pituitary and are converted in the tissues to testosterone or estrogens. In adult women, they may contribute to the sex drive, but their function in adult men is not well understood. In post-menopausal women, as the functions of the ovaries decline, the main source of estrogens becomes the androgens produced by the zona reticularis.

Adrenal Medulla

As noted earlier, the adrenal cortex releases glucocorticoids in response to long-term stress such as severe illness. In contrast, the adrenal medulla releases its hormones in response to acute, short-term stress mediated by the sympathetic nervous system (SNS).

The medullary tissue is composed of unique postganglionic SNS neurons called **chromaffin** cells, which are large and irregularly shaped, and produce the neurotransmitters **epinephrine** (also called adrenaline) and **norepinephrine** (or noradrenaline). Epinephrine is produced in greater quantities—approximately a 4 to 1 ratio with norepinephrine—and is the more powerful hormone. Because the chromaffin cells release epinephrine and norepinephrine into the systemic circulation, where they travel widely and exert effects on distant cells, they are considered hormones. Derived from the amino acid tyrosine, they are chemically classified as catecholamines.

The secretion of medullary epinephrine and norepinephrine is controlled by a neural pathway that originates from the hypothalamus in response to danger or stress (the SAM pathway). Both epinephrine and norepinephrine signal the liver and skeletal muscle cells to convert glycogen into glucose, resulting in increased blood glucose levels. These hormones increase the heart rate, pulse, and blood pressure to prepare the body to fight the perceived threat or flee from it. In addition, the pathway dilates the airways, raising blood oxygen levels. It also prompts vasodilation, further increasing

the oxygenation of important organs such as the lungs, brain, heart, and skeletal muscle. At the same time, it triggers vasoconstriction to blood vessels serving less essential organs such as the gastrointestinal tract, kidneys, and skin, and downregulates some components of the immune system. Other effects include a dry mouth, loss of appetite, pupil dilation, and a loss of peripheral vision.

Pancreas

The **pancreas** is a long, slender organ, most of which is located posterior to the bottom half of the stomach (see Figure 14.9). Although it is primarily an exocrine gland, secreting a variety of digestive enzymes, the pancreas has an endocrine function. Its **pancreatic islets**—clusters of cells formerly known as the islets of Langerhans—secrete the hormones glucagon, insulin, somatostatin, and pancreatic polypeptide (PP).

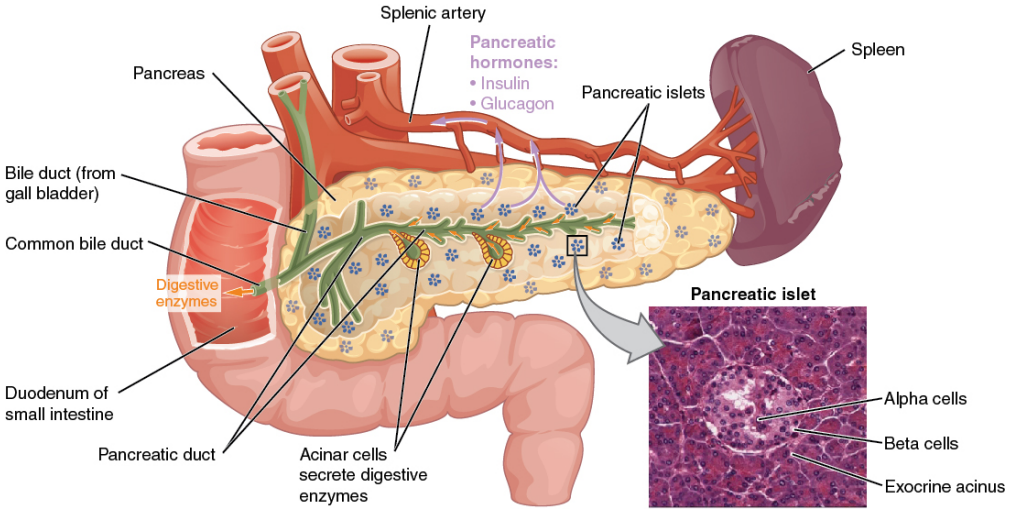


Figure 14.9 Pancreas. The pancreatic exocrine function involves the acinar cells secreting digestive enzymes that are transported into the small intestine by the pancreatic duct. Its endocrine function involves the secretion of insulin (produced by beta cells) and glucagon (produced by alpha cells) within the pancreatic islets. These two hormones regulate the rate of glucose metabolism in the body. The micrograph reveals pancreatic islets. LM × 760. (Micrograph provided by the Regents of University of Michigan Medical School © 2012). From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Cells and Secretions of the Pancreatic Islets

The pancreatic islets each contain four varieties of cells:

- The **alpha cell** produces the hormone glucagon and makes up approximately 20% of each islet. Glucagon plays an important role in blood glucose regulation; low blood glucose levels stimulate its release.
- The **beta cell** produces the hormone insulin and makes up approximately 75% of each islet. Elevated blood glucose levels stimulate the release of insulin.
- The **delta cell** accounts for 4% of the islet cells and secretes the peptide hormone somatostatin. Recall that somatostatin is also released by the hypothalamus (as GHIH), and the stomach and intestines also secrete it. An inhibiting hormone, pancreatic somatostatin inhibits the release of both glucagon and insulin.
- The **PP cell** accounts for about 1% of islet cells and secretes the pancreatic polypeptide hormone. It is thought to

play a role in appetite, as well as in the regulation of pancreatic exocrine and endocrine secretions. Pancreatic polypeptide released following a meal may reduce further food consumption; however, it is also released in response to fasting.

Regulation of Blood Glucose Levels by Insulin and Glucagon

Glucose is required for cellular respiration and is the preferred fuel for all body cells. The body derives glucose from the breakdown of the carbohydrate-containing foods and drinks we consume. Glucose not immediately taken up by cells for fuel can be stored by the liver and muscles as glycogen, or converted to triglycerides and stored in the adipose tissue. Hormones regulate both the storage and the utilization of glucose as required. Receptors located in the pancreas sense blood glucose levels, and subsequently the pancreatic cells secrete glucagon or insulin to maintain normal levels.

Gonadal Glands

The male testes and female ovaries—which produce the sex cells (sperm and ova) and secrete the gonadal hormones. The roles of the gonadotropins released from the anterior pituitary (FSH and LH) were discussed earlier.

The primary hormone produced by the male testes is **testosterone**, a steroid hormone important in the development of the male reproductive system, the maturation of sperm cells, and the development of male secondary sex characteristics such as a deepened voice, body hair, and increased muscle mass. Interestingly, testosterone is also produced in the female ovaries but at a much reduced level. In addition, the testes produce the peptide hormone **inhibin**, which inhibits the secretion of FSH from the anterior pituitary gland. FSH stimulates spermatogenesis.

The primary hormones produced by the ovaries are **estrogens**, which include estradiol, estriol, and estrone. Estrogens play an important role in a larger number of physiological processes, including the development of the female reproductive system, regulation of the menstrual cycle, the development of female secondary sex characteristics such as increased adipose tissue, and the development of breast tissue, and the maintenance of pregnancy. Another significant ovarian hormone is **progesterone**, which contributes to regulation of the menstrual cycle and is important in preparing the body for pregnancy as well as maintaining pregnancy. In addition, the granulosa cells of the ovarian follicles produce inhibin, which—as in males—inhibits the secretion of FSH. During the initial stages of pregnancy, an organ called the placenta develops within the uterus. The placenta supplies oxygen and nutrients to the fetus, excretes waste products, and produces and secretes estrogens and progesterone. The placenta produces human chorionic gonadotropin (hCG) as well. The hCG hormone promotes progesterone synthesis and reduces the mother's immune function to protect the fetus from immune rejection. It also secretes human placental lactogen (hPL), which plays a role in preparing the breasts for lactation and relaxin, which is thought to help soften and widen the pubic symphysis in preparation for childbirth.

Concept Check

- Do you recall the term which describes high levels of glucose in the blood?
- Do you recall the neurotransmitter responsible for assisting the response to danger or stress?
- Suggest what may happen if the adrenal cortex fails to secrete its hormones.

Common Abbreviations for the Endocrine System

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Diseases and Disorders of the Endocrine System

Acromegaly

Acromegaly is a rare disorder caused when abnormally high levels of GH trigger the growth of bones, cartilage, and body tissues. It is usually caused by a tumor in the pituitary gland. The condition is often characterized by enlarged ears, hands, and feet (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-a). For more information, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on acromegaly.

Addison's Disease

Addison's disease is a rare disorder that causes low blood glucose levels and low blood sodium levels. The signs and symptoms of Addison's disease are vague and are typical of other disorders as well, making diagnosis difficult. They may include general weakness, abdominal pain, weight loss, nausea, vomiting, sweating, and cravings for salty food. For more information, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on adrenal insufficiency and Addison's disease.

Cushing's Syndrome

Cushing's syndrome is characterized by high blood glucose levels and the accumulation of lipid deposits on the face and neck. It is caused by the hypersecretion of cortisol. The most common source of Cushing's disease is a pituitary tumor that secretes cortisol or ACTH in abnormally high amounts. For more information, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on Cushing's syndrome.

Gigantism

Gigantism is a disorder in children caused when abnormally high levels of GH prompt excessive growth in the body. It is most often caused by a benign tumor of the pituitary gland. If the condition lasts into adulthood, it is referred to as acromegaly (Genetic and Rare Diseases Information Center, 2017). For more information, visit the Genetic and Rare Diseases Information Center's web page on gigantism.

Hirsutism

Hirsutism is a symptom of excessive production of **androgens**, causing hair growth in women where they typically do not have hair growth. It is usually caused by polycystic ovary syndrome (PCOS), although certain medications and tumors of the ovary or adrenal gland can cause hirsutism (Hafsi & Badri, 2021). For more information, visit the Mayo Clinic's web page on hirsutism.

Hyperthyroidism

Hyperthyroidism is a condition marked by excessively high levels of thyroid hormones. Signs and symptoms include weight loss, heat sensitivity, and an increased or irregular heart rate. It may be caused by Graves' disease (an autoimmune disorder), thyroiditis, or a diet high in iodine (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-b). For more information, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on hyperthyroidism.

Hypothyroidism

Hypothyroidism is a condition marked by low levels of thyroid hormones. Signs and symptoms include weight gain, cold sensitivity, and a slowed heart rate. It may be caused by Hashimoto's disease (an autoimmune disorder), thyroiditis, or surgical removal of some or all of the thyroid. Although rare in the United States, a diet low in iodine can also lead to hypothyroidism (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-c). For more information, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on hypothyroidism.

Graves' Disease

Graves' disease is a disorder of the thyroid gland, resulting in hyperthyroidism. The immune system attacks the thyroid, resulting in excessive production of thyroid hormone. Researchers continue to investigate why some people develop Graves' disease (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-c). For more information, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on Graves' disease.

Diabetes Insipidus

Diabetes insipidus is a condition caused by a lack of or hyposecretion of the antidiuretic hormone (ADH). The condition can also be caused by the failure of the kidneys to respond to ADH. Signs and symptoms include **polyuria** and excessive thirst (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-d). For more information, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on diabetes insipidus.

Diabetes (Mellitus)

Diabetes mellitus is a condition marked by a disorder of the pancreas, resulting in high levels of glucose in the blood. There are three common types of diabetes mellitus:

- **Type 1 diabetes** occurs when the body mounts an autoimmune response against the pancreas cells that produce insulin. People with type 1 diabetes must take insulin every day.
- **Type 2 diabetes** occurs when the body does not utilize the insulin the body produces, causing unstable blood sugar levels. People at risk of type 2 diabetes can prevent or delay onset by making lifestyle changes.
- **Gestational diabetes** occurs in pregnant women who do not have a history of diabetes. Although it generally goes away after the child is born, both the child and mother are at an increased risk of developing type 2 diabetes (Centers for Disease Control and Prevention, n.d.).

Medical Terms in Context

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Medical Specialties and Procedures Related to the Endocrine System

Endocrinology is a specialization in the field of medicine that focuses on the treatment of endocrine system disorders. Endocrinologists—medical doctors who specialize in this field—are experts in treating diseases associated with hormonal systems, ranging from thyroid disease to diabetes. Endocrine surgeons treat endocrine disease through the removal of the affected endocrine gland or tissue. Some patients experience health problems as a result of the normal decline in hormones that can accompany aging. These patients can consult with an endocrinologist to weigh the risks and benefits of hormone replacement therapy intended to boost their natural levels of reproductive hormones. In addition to treating patients, endocrinologists may be involved in research to improve the understanding of endocrine system disorders and develop new treatments for these diseases.

- A **thyroid specialist** is an endocrinologist whose sub-specialty is focused on the treatment and disorders of the thyroid gland such as hypothyroidism (too low secretion) and hyperthyroidism (too high secretion).
- A **diabetes specialist** is an endocrinologist whose sub-specialty is focused on the treatment of diabetic conditions.

Thyroid Scan

The thyroid scan is a procedure used to check the size, shape, and position of the thyroid. Before the procedure, a small amount of radioactive iodine is administered intravenously or by oral capsule. A special camera then takes images of the thyroid, allowing the technician to determine the cause of hyperthyroidism or identify thyroid nodules (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-e). To learn more, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on thyroid tests.

Radioactive Iodine Uptake Test

Radioactive iodine uptake is a procedure used to check the function of the thyroid. Before the procedure, a small amount of radioactive iodine is administered in liquid or capsule form. The technician then uses a gamma probe to measure how much radioactive iodine the thyroid takes up from the blood, which can be an indication of Graves' disease or one or more thyroid nodules. The radioactive iodine uptake test can be performed at the same time as a thyroid scan (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-e). To learn more, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on thyroid tests.

Blood Serum Testing

Blood serum tests are used to determine the concentration and presence of various endocrine hormones in the blood, including TSH, T_4, and T_3. Blood serum tests can also detect the presence of thyroid antibodies which can indicate an autoimmune thyroid disorder (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-e). To learn more, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on thyroid tests.

Endocrine Surgical Procedures

Most of the surgeries and procedures performed with the endocrine system involve the removal of a gland or an incision into the gland. Once an endocrine gland is surgically removed, due to a tumor or enlargement, hormone replacement treatment is required. Medication is required to artificially or synthetically replace the hormone produced by the gland and the function it regulates.

Endocrine System Vocabulary

Acromegaly

A disorder that results in the growth of bones in the face, hands, and feet in response to excessive levels of growth hormone in individuals who have stopped growing.

Adenosis

A disease or abnormal change in a gland.

Adrenalectomy

Excision of one or both adrenal glands.

Autocrine

A chemical that elicits a response in the same cell that secreted it.

Endocrine gland

A ductless gland that releases secretions directly into surrounding tissues and fluids.

Endocrine system

Cells, tissues, and organs that secrete hormones as a primary or secondary function and play an integral role in normal bodily processes.

Endocrinologist

A doctor who has special training in diagnosing and treating disorders of the endocrine system.

Endocrinology

A specialty in the field of medicine that focuses on the treatment of endocrine system disorders.

Epinephrine

A hormone that causes the breakdown of glycogen into glucose; also known as adrenaline.

Exocrine system

Cells, tissues, and organs that secrete substances directly to target tissues via glandular ducts.

Glycemia

Sugar in the blood.

Histamine

A vasodilator involved in the inflammatory response.

Hormone

Secretion of an endocrine organ that travels via the bloodstream or lymphatics to induce a response in target cells or tissues in another part of the body.

Hypercalcemia

Excessive calcium in the blood.

Hyperglycemia

Abnormally high blood glucose levels.

Hyperkalemia

Higher-than-normal blood potassium levels.

Hyperthyroidism

The disease state caused by excessive production of hormones by the thyroid.

Hypocalcemia

Abnormally low blood levels of calcium.

Hypoglycemia

Low blood glucose levels.

Hypokalemia

Abnormally decreased blood levels of potassium.

Hyponatremia

Lower-than-normal levels of sodium in the blood.

Hypopituitarism

State of deficient pituitary gland activity.

Hypothyroidism

The disease state caused by insufficient production of thyroid hormone by the thyroid gland.

Neurotransmitters

Chemicals that are made by nerve cells and used to communicate with other cells, including other nerve cells and muscle cells.

Norepinephrine

A chemical in the body that can act as a neurotransmitter and a hormone. It is released from the adrenal gland in response to stress and low blood pressure and is also known as noradrenaline.

Panhypopituitarism

A rare condition in which the pituitary gland stops making most or all hormones.

Paracrine

Cellular signaling in which a factor secreted by a cell affects other cells in the local environment.

Parathyroidectomy

Surgery to remove one or more parathyroid glands.

Permeability

Property of membranes and other structures to permit passage of light, heat, gases, liquids, metabolites, and mineral ions.

Polydipsia

Condition of excessive thirst.

Proliferation

The multiplication or increase in number.

Syndrome

A set of symptoms or conditions that occur together and suggest the presence of a certain disease or an increased chance of developing the disease.

Synthesis

A chemical reaction that results in the synthesis (joining) of components that were formerly separate.

Thyroidectomy

Excision of all or part of the thyroid gland.

Thyroiditis

Inflammation of the thyroid gland.

Test Yourself

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://pressbooks.uwf.edu/medicalterminology/?p=198#h5p-122

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Image Descriptions

Figure 14.1 image description: This photo shows a young girl reaching for an orange leaf on an oak tree. She is on a

walkway near a creek. The opposite shore is a deep slope covered with more trees in autumn colors. [Return to Figure 14.1].

Figure 14.2 image description: This diagram shows the endocrine glands and cells that are located throughout the body. The endocrine system organs include the pineal gland and pituitary gland in the brain. The pituitary is located on the anterior side of the thalamus while the pineal gland is located on the posterior side of the thalamus. The thyroid gland is a butterfly-shaped gland that wraps around the trachea within the neck. Four small, disc-shaped parathyroid glands are embedded into the posterior side of the thyroid. The adrenal glands are located on top of the kidneys. The pancreas is located at the center of the abdomen. In females, the two ovaries are connected to the uterus by two long, curved, tubes in the pelvic region. In males, the two testes are located in the scrotum below the penis. [Return to Figure 14.2].

Figure 14.3 image description: This diagram shows a negative feedback loop using the example of glucocorticoid regulation in the blood. Step 1 in the cycle is when an imbalance occurs. The hypothalamus perceives low blood concentrations of glucocorticoids in the blood. This is illustrated by there being only 5 glucocorticoids floating in a cross-section of an artery. Step 2 in the cycle is hormone release, where the hypothalamus releases corticotropin-releasing hormone (CRH). Step 3 is labeled correction. Here, the CRH release starts a hormone cascade that triggers the adrenal gland to release glucocorticoid into the blood. This allows the blood concentration of glucocorticoid to increase, as illustrated by 8 glucocorticoid molecules now being present in the cross-section of the artery. Step 4 is labeled negative feedback. Here, the hypothalamus perceives normal concentrations of glucocorticoids in the blood and stops releasing CRH. This brings blood glucocorticoid levels back to homeostasis. [Return to Figure 14.3].

Figure 14.4 image description: This illustration zooms in on the hypothalamus and the attached pituitary gland. The anterior pituitary is highlighted. Three neurosecretory cells are secreting hormones into a web-like network of arteries within the infundibulum. The artery net is labeled the primary capillary plexus of the hypophyseal portal system. The superior hypophyseal artery enters the primary capillary plexus from outside of the infundibulum. The hypophyseal portal vein runs down from the primary capillary plexus, through the infundibulum, and connects to the secondary capillary plexus of the hypophyseal portal system. The secondary capillary plexus is located within the anterior pituitary. The hormones released from the neurosecretory cells of the hypothalamus travel through the primary capillary plexus, down the hypophyseal portal vein, and into the secondary capillary plexus. There, the hypothalamus hormones stimulate the anterior pituitary to release its hormones. The anterior pituitary hormones leave the primary capillary plexus from a single vein at the bottom of the anterior lobe. [Return to Figure 14.4].

Figure 14.5 image description: This flow chart illustrates the hormone cascade that stimulates human growth. In step 1, the hypothalamus releases growth hormone-releasing hormone (GHRH). GHRH travels into the primary capillary plexus of the anterior pituitary, where it stimulates the anterior pituitary to release growth hormone (GH). The release of growth hormone causes three types of effects. In the glucose-sparing effect, GH stimulates adipose cells to break down stored fat, fueling the growth effects (discussed next). The target cells for the glucose-sparing effects are adipose cells. In the growth effects, GH increases the uptake of amino acids from the blood and enhances cellular proliferation while also reducing apoptosis. The target cells for the growth effects are bone cells, muscle cells, nervous system cells, and immune system cells. In the diabetogenic effect, GH stimulates the liver to break down glycogen into glucose, fueling the growth effects. The liver also releases IGF in response to GH. The IGF further stimulates the growth effects but also negatively feeds back to the hypothalamus. When high IGF one levels are perceived by the hypothalamus, it releases growth hormone inhibiting hormone (GHIH). GHIH inhibits GH release by the anterior pituitary. [Return to Figure 14.5].

Figure 14.6 image description: This illustration zooms in on the hypothalamus and the attached pituitary gland. The posterior pituitary is highlighted. Two nuclei in the hypothalamus contain neurosecretory cells that release different hormones. The neurosecretory cells of the paraventricular nucleus release oxytocin (OT) while the neurosecretory cells of the supraoptic nucleus release antidiuretic hormone (ADH). The neurosecretory cells stretch down the infundibulum into the posterior pituitary. The tube-like extensions of the neurosecretory cells within the infundibulum are labeled the hypothalamohypophysial tracts. These tracts connect with a web-like network of blood vessels in the posterior pituitary called the capillary plexus. From the capillary plexus, the posterior pituitary secretes the OT or ADH into a single vein that exits the pituitary. [Return to Figure 14.6].

Figure 14.7 image description: Part A of this figure is a diagram of the anterior view of the thyroid gland. The thyroid gland is a butterfly-shaped gland wrapping around the trachea. It narrows at its center, just under the thyroid cartilage of the larynx. This narrow area is called the isthmus of the thyroid. Two large arteries, the common carotid arteries, run parallel to the trachea on the outer border of the thyroid. A small artery enters the superior edge of the thyroid, near the isthmus, and branches throughout the two "wings" of the thyroid. Part B of this figure is a posterior view of the thyroid. The posterior view shows that the thyroid does not completely wrap around the posterior of the trachea. The posterior sides of the thyroid wings can be seen protruding from under the cricoid cartilage of the larynx. The posterior sides of the thyroid "wings" each contain two small, disc-shaped parathyroid glands embedded in the thyroid tissue. Within each wing, one disc is located superior to the other. These are labeled the left and right parathyroid glands. Just under the inferior parathyroid glands are two arteries that bring blood to the thyroid from the left and right subclavian arteries. Part C of this figure is a micrograph of thyroid tissue. The thyroid follicle cells are cuboidal epithelial cells. These cells form a ring around irregular-shaped cavities called follicles. The follicles contain light-colored colloids. A larger parafollicular cell is embedded between two of the follicular cells near the edge of a follicle. [Return to Figure 14.7].

Figure 14.8 image description: This diagram shows the left adrenal gland located atop the left kidney. The gland is composed of an outer cortex and an inner medulla all surrounded by a connective tissue capsule. The cortex can be subdivided into additional zones, all of which produce different types of hormones. The outermost layer is the zona glomerulosa, which releases mineralocorticoids, such as aldosterone, that regulate mineral balance. Underneath this layer is the zona fasciculata, which releases glucocorticoids, such as cortisol, corticosterone, and cortisone, that regulate glucose metabolism. Underneath this layer is the zona reticularis, which releases androgens, such as dehydroepiandrosterone, that stimulate masculinization. Below this layer is the adrenal medulla, which releases stress hormones, such as epinephrine and norepinephrine, that stimulate the sympathetic ANS. [Return to Figure 14.8].

Figure 14.9 image description: This diagram shows the anatomy of the pancreas. The left, larger side of the pancreas is seated within the curve of the duodenum of the small intestine. The smaller, rightmost tip of the pancreas is located near the spleen. The splenic artery is seen traveling to the spleen, however, it has several branches connecting to the pancreas. An interior view of the pancreas shows that the pancreatic duct is a large tube running through the center of the pancreas. It branches throughout its length into several horseshoe-shaped pockets of acinar cells. These cells secrete digestive enzymes, which travel down the bile duct and into the small intestine. There are also small pancreatic islets scattered throughout the pancreas. The pancreatic islets secrete the pancreatic hormones insulin and glucagon into the splenic artery. An inset micrograph shows that the pancreatic islets are small discs of tissue consisting of a thin, outer ring called the exocrine acinus, a thicker, inner ring of beta cells, and a central circle of alpha cells. [Return to Figure 14.9].

15. Urinary System

Learning Objectives

- Examine the anatomy of the urinary system
- Determine the main functions of the urinary system
- Differentiate urinary system medical terms and common abbreviations
- Recognize the medical specialties associated with the urinary system
- Discover common diseases, disorders, and procedures related to the urinary system

Urinary System Word Parts

Click on prefixes, combining forms, and suffixes to reveal a list of word parts to memorize for the urinary system.

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Introduction to the Urinary System

The urinary system has roles you may be well aware of on a daily basis. Cleansing the blood and ridding the body of wastes probably come to mind. However, there are additional, equally important functions, played by the system. Take, for example, regulation of **pH**, a function shared with the lungs and the buffers in the blood. Additionally, the regulation of blood pressure is a role shared with the heart and blood vessels. What about regulating the concentration of **solutes** in the blood? Did you know that the kidney is important in determining the concentration of red blood cells? Eighty-five percent of the erythropoietin (EPO) produced to stimulate red blood cell production is produced in the kidneys. The kidneys also perform the final synthesis step of vitamin D production, converting calcidiol to calcitriol, the active form of vitamin D. If the kidneys fail, these functions are compromised or lost altogether, with devastating effects on **homeostasis**.

Watch this video:

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Media 15.1. Urinary System, Part 1: Crash Course A&P #38 [Online video]. Copyright 2015 by CrashCourse.

Practice Medical Terms Related to the Urinary System

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Anatomy (Structures) of the Urinary System

Kidneys

The kidneys lie on either side of the spine in the retroperitoneal space between the parietal peritoneum and the posterior abdominal wall, well protected by muscle, fat, and ribs. They are roughly the size of your fist. The male kidney is typically a bit larger than the female kidney. The kidneys are well vascularized, receiving about 25% of the cardiac output at rest. Figure 15.1 displays the location of the kidneys.

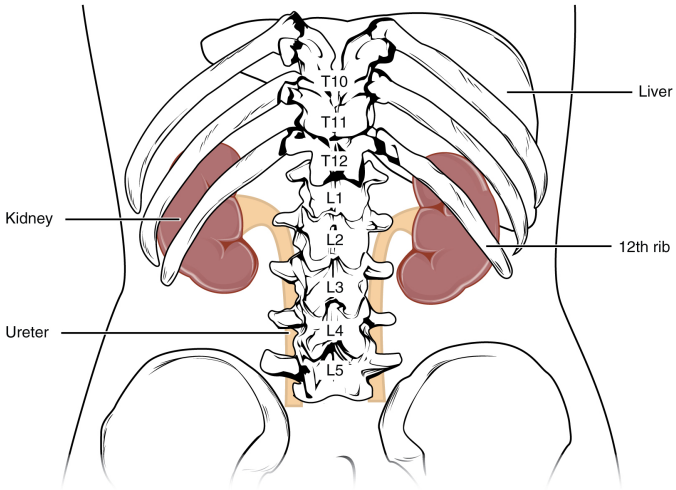

Figure 15.1 Kidneys. The kidneys are slightly protected by the ribs and are surrounded by fat for protection (not shown). From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Kidneys' Internal Structure

A frontal section through the kidney reveals an outer region called the **renal cortex** and an inner region called the **medulla** (see Figure 15.2). The **renal columns** are connective tissue extensions that radiate downward from the cortex through the medulla to separate the most characteristic features of the medulla, the **renal pyramids** and **renal papillae**. The papillae are bundles of collecting ducts that transport urine made by nephrons to the **calyces** of the kidney for **excretion**. The renal columns also serve to divide the kidney into 6 to 8 lobes and provide a supportive framework for vessels that enter and exit the cortex. The pyramids and renal columns taken together constitute the kidney lobes.

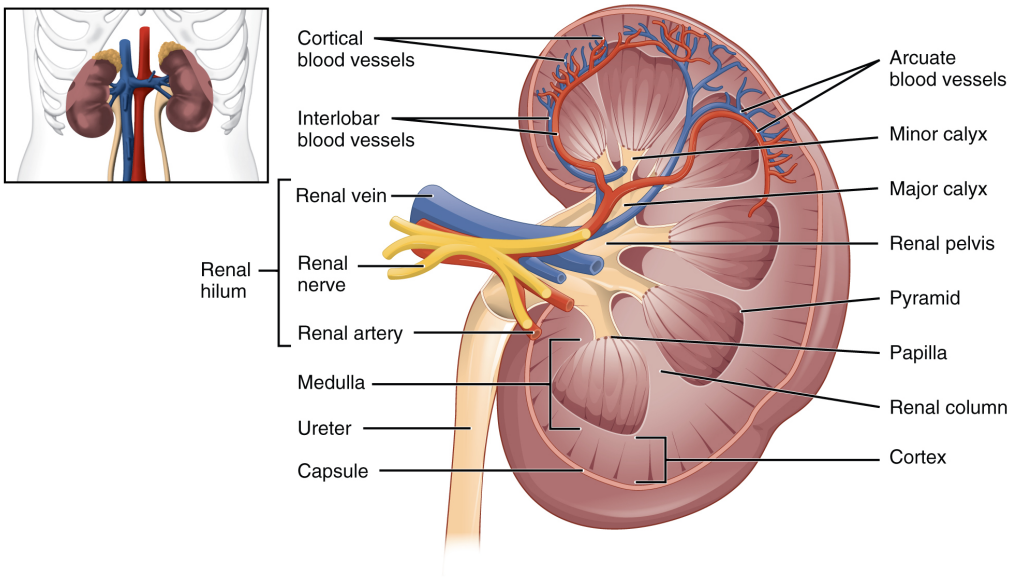

Figure 15.2 Left Kidney. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Did you know?

The right kidney is smaller than the left. It also sits slightly lower to make room for the liver located on the right side of your body.

Renal Hilum

The **renal hilum** is the entry and exit site for structures servicing the kidneys: vessels, nerves, lymphatics, and ureters. The medial-facing hila are tucked into the sweeping convex outline of the cortex. Emerging from the hilum is the renal pelvis, which is formed from the major and minor **calyces** in the kidney. The smooth muscle in the renal pelvis funnels urine via **peristalsis** into the ureter. The renal arteries form directly from the descending aorta, whereas the renal veins return cleansed blood directly to the inferior vena cava. The artery, vein, and renal pelvis are arranged in an anterior-to-posterior order.

Nephrons and Vessels

The renal artery first divides into segmental arteries, followed by further branching to form interlobar arteries that pass through the renal columns to reach the cortex (see Figure 15.3). The **interlobar** arteries, in turn, branch into **arcuate** arteries, cortical **radiate** arteries, and then into afferent arterioles. The afferent arterioles service about 1.3 million nephrons in each kidney.

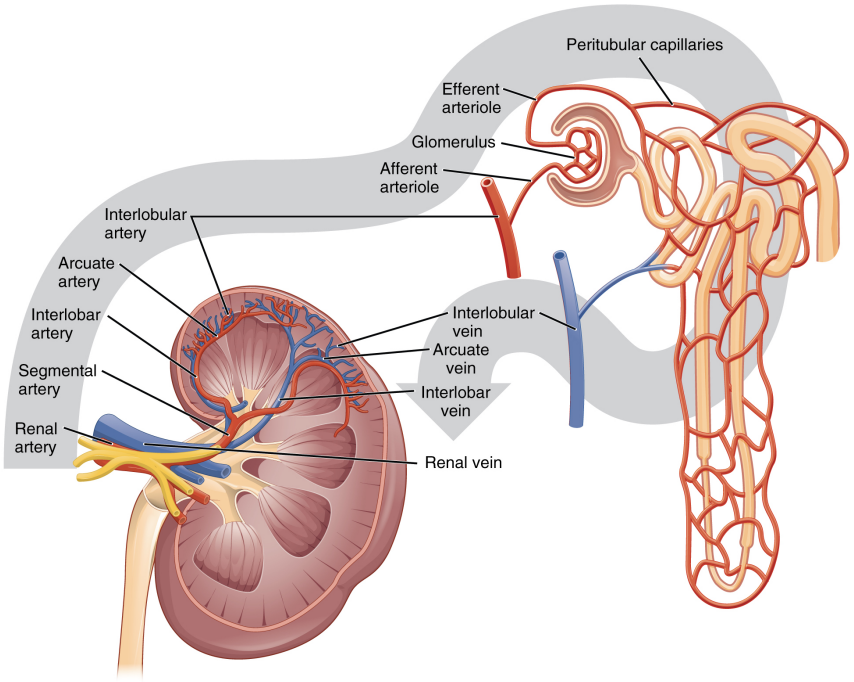

Figure 15.3 Blood Flow in the Kidney. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Nephrons are the "functional units" of the kidney; they cleanse the blood and balance the constituents of the circulation. The afferent arterioles form a tuft of high-pressure capillaries about 200 μm in diameter, the **glomerulus**. The rest of the nephron consists of a continuous sophisticated tubule whose proximal end surrounds the glomerulus in an intimate embrace—this is **Bowman's capsule**. The glomerulus and Bowman's capsule together form the **renal corpuscle**. As mentioned earlier, these glomerular capillaries filter the blood based on particle size. After passing through the renal corpuscle, the capillaries form a second arteriole, the **efferent arteriole** (see Figure 15.4). These will next form a capillary network around the more distal portions of the nephron tubule, the **peritubular capillaries** and **vasa recta**, before returning to the venous system. As the glomerular filtrate progresses through the nephron, these capillary networks recover most of the solutes and water, and return them to the circulation. Since a capillary bed (the glomerulus) drains into a vessel that in turn forms a second capillary bed, the definition of a portal system is met. This is the only portal system in which an arteriole is found between the first and second capillary beds. Portal systems also link the hypothalamus to the anterior pituitary, and the blood vessels of the digestive viscera to the liver.

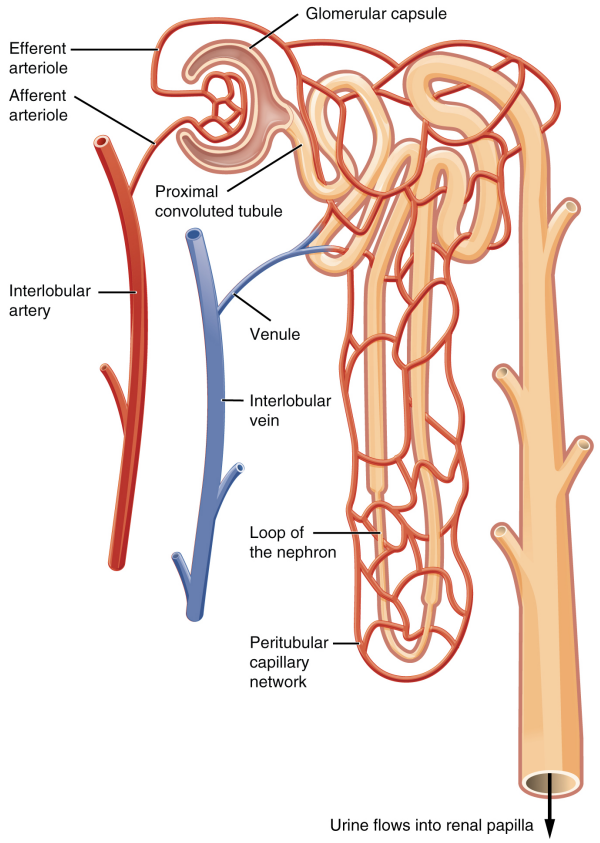

Figure 15.4. Blood Flow in the Nephron. The two capillary beds are clearly shown in this figure. The efferent arteriole is the connecting vessel between the glomerulus and the peritubular capillaries and vasa recta. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Ureters

The kidneys and ureters are completely **retroperitoneal**, and the bladder has a **peritoneal** covering only over the dome. As urine is formed, it drains into the calyces of the kidney, which merge to form the funnel-shaped renal pelvis in the hilum of each kidney. The hilum narrows to become the **ureter** of each kidney. As urine passes through the ureter, it does not passively drain into the bladder but rather is propelled by waves of **peristalsis**. The ureters are approximately 30 cm long. The inner mucosa is lined with transitional epithelium and scattered **goblet** cells that secrete protective mucus. The muscular layer of the ureter consists of longitudinal and circular smooth muscles that create the peristaltic contractions to move the urine into the bladder without the aid of gravity. Finally, a loose **adventitial** layer composed of **collagen** and fat anchors the ureters between the parietal peritoneum and the posterior abdominal wall.

Bladder

The urinary bladder collects urine from both ureters (see Figure 15.5). The bladder lies anterior to the uterus in females, posterior to the pubic bone and anterior to the rectum. During late pregnancy, its capacity is reduced due to compression by the enlarging uterus, resulting in increased frequency of urination. In males, the anatomy is similar,

minus the uterus, and with the addition of the prostate inferior to the bladder. The bladder is partially retroperitoneal (outside the peritoneal cavity) with its peritoneal-covered "dome" projecting into the abdomen when the bladder is distended with urine.

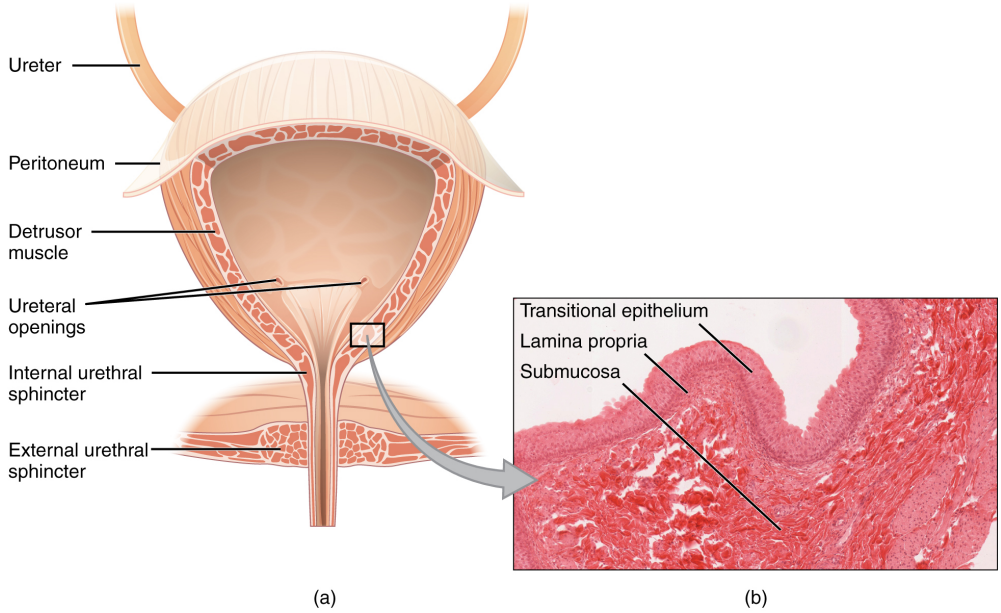

Figure 15.5 Bladder. (a) Anterior cross section of the bladder. (b) The detrusor muscle of the bladder (source: monkey tissue) LM × 448. (Micrograph provided by the Regents of the University of Michigan Medical School © 2012). From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Urethra

The urethra transports urine from the bladder to the outside of the body for disposal. The urethra is the only urologic organ that shows any significant anatomic difference between males and females; all other urine transport structures are identical (see Figure 15.6).

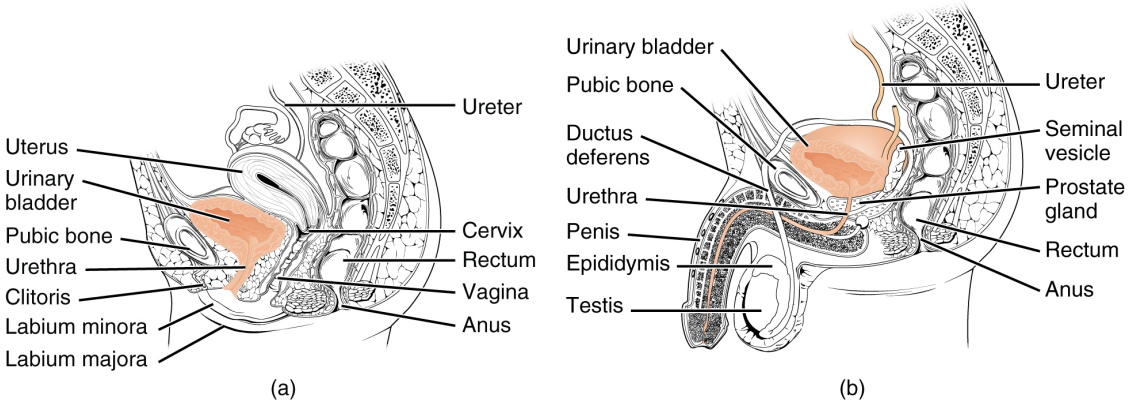

Figure 15.6. Female and Male Urethras. The urethra transports urine from the bladder to the outside of the body. This image shows (a) a female urethra and (b) a male urethra. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

The urethra in both males and females begins inferior and central to the two ureteral openings forming the three points of a triangular-shaped area at the base of the bladder called the trigone (Greek tri- = "triangle" and the root of the word "trigonometry"). The urethra tracks posterior and inferior to the pubic symphysis (see Figure 15.6). In both males and females, the proximal urethra is lined by transitional epithelium, whereas the terminal portion is a nonkeratinized, stratified squamous epithelium. In the male, **pseudostratified** columnar epithelium lines the urethra between these two cell types. **Voiding** is regulated by an involuntary **autonomic** nervous system-controlled internal urinary sphincter, consisting of smooth muscle and voluntary skeletal muscle that forms the external urinary sphincter below it.

Micturition Reflex

Micturition is a less-often used, but proper term for **urination** or **voiding**. It results from an interplay of involuntary and voluntary actions by the internal and external urethral sphincters. When bladder volume reaches about 150 mL, an urge to void is sensed but is easily overridden. Voluntary control of urination relies on consciously preventing relaxation of the external urethral sphincter to maintain urinary continence. As the bladder fills, subsequent urges become harder to ignore. Ultimately, voluntary constraint fails with resulting incontinence, which will occur as bladder volume approaches 300 to 400 ml.

- Normal micturition is a result of stretch **receptors** in the bladder wall that transmit nerve impulses to the sacral region of the spinal cord to generate a spinal reflex. The resulting parasympathetic neural outflow causes contraction of the **detrusor** muscle and relaxation of the involuntary internal urethral sphincter.
- At the same time, the spinal cord inhibits somatic motor neurons, resulting in the relaxation of the skeletal muscle of the external urethral **sphincter**.
- The micturition reflex is active in infants but with maturity, children learn to override the reflex by asserting external sphincter control, thereby delaying voiding (potty training). This reflex may be preserved even in the face of spinal cord injury that results in paraplegia or quadriplegia. However, relaxation of the external sphincter may not be possible in all cases, and therefore, periodic catheterization may be necessary for bladder emptying.

Nerves involved in the control of urination include the hypogastric, pelvic, and pudendal. Voluntary micturition requires an intact spinal cord and functional pudendal nerve arising from the sacral micturition center. Since the external urinary sphincter is voluntary skeletal muscle, actions by cholinergic neurons maintain contraction (and thereby continence) during filling of the bladder. At the same time, sympathetic nervous activity via the hypogastric nerves suppresses contraction of the detrusor muscle. With further bladder stretch, afferent signals traveling over sacral pelvic nerves activate parasympathetic neurons. This activates efferent neurons to release acetylcholine at the neuromuscular junctions, producing detrusor contraction and bladder emptying.

Did you know?

A healthy adult bladder can store up to 455 millilitres of urine for between two to five hours.

Concept Check

- Describe two organs or structures essential to the urinary system.
- Identify the structure within the kidneys which filters blood.
- Name a commonly used term for the **micturition reflex.**

Anatomy Labeling Activity

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://pressbooks.uwf.edu/medicalterminology/?p=80#h5p-26

Physiology (Function) of the Urinary System

- Remove waste products and medicines from the body
- Balance the body's fluids
- Balance a variety of electrolytes
- Release hormones to control blood pressure
- Release a hormone to control red blood cell production
- Help with bone health by controlling calcium and phosphorus

Having reviewed the anatomy of the urinary system now is the time to focus on physiology. You will discover that different parts of the **nephron** utilize specific processes to produce urine: **filtration**, **reabsorption**, and **secretion**. You will learn how each of these processes works and where they occur along the nephron and collecting ducts. The physiologic goal is to modify the composition of the plasma and, in doing so, produce the waste product urine.

Nephrons: The Functional Unit

Nephrons take a simple filtrate of the blood and modify it into urine. Many changes take place in the different parts of the nephron before urine is created for disposal. The term "forming urine" will be used hereafter to describe the **filtrate** as it is modified into true urine. The principal task of the nephron population is to balance the **plasma** to homeostatic

set points and excrete potential toxins in the urine. They do this by accomplishing three principle functions—filtration, reabsorption, and secretion. They also have additional secondary functions that exert control in three areas: blood pressure (via the production of renin), red blood cell production (via the hormone EPO), and calcium absorption (via the conversion of calcidiol to calcitriol, the active form of vitamin D).

Loop of Henle

The descending and ascending portions of the loop of Henle (sometimes referred to as the **nephron loop**) are, of course, just continuations of the same tubule. They run adjacent and parallel to each other after having made a hairpin turn at the deepest point of their descent. The descending loop of Henle consists of an initial short, thick portion and long, thin portion, whereas the ascending loop consists of an initial short, thin portion followed by a long, thick portion. The descending and ascending thin portions consist of simple squamous epithelium. Different portions of the loop have different **permeabilities** for solutes and water.

Collecting Ducts

The collecting ducts are continuous with the nephron but are not technically part of it. In fact, each duct collects filtrate from several nephrons for final modification. Collecting ducts merge as they descend deeper in the medulla to form about 30 terminal ducts, which empty at a papilla.

Glomerular Filtration Rate (GFR)

The volume of filtrate formed by both kidneys per minute is termed the **glomerular filtration rate** (GFR). The heart pumps about 5 L blood per min under resting conditions. Approximately 20% or one liter enters the kidneys to be filtered. On average, this liter results in the production of about 125 mL/min filtrate produced in men (range of 90 to 140 mL/min) and 105 mL/min filtrate produced in women (range of 80 to 125 mL/min). This amount equates to a volume of about 180 L/day in men and 150 L/day in women. Ninety-nine percent of this filtrate is returned to the circulation by reabsorption so that only about 1 to 2 liters of urine are produced per day.

GFR is influenced by the hydrostatic pressure and colloid osmotic pressure on either side of the capillary membrane of the glomerulus. Recall that filtration occurs as pressure forces fluid and solutes through a **semipermeable** barrier with the solute movement constrained by particle size. **Hydrostatic** pressure is the pressure produced by a fluid against a surface. If you have fluid on both sides of a barrier, both fluids exert pressure in opposing directions. The net fluid movement will be in the direction of the lower pressure. **Osmosis** is the movement of solvent (water) across a membrane that is **impermeable** to a solute in the solution. This creates osmotic pressure which will exist until the solute concentration is the same on both sides of a semipermeable membrane. As long as the concentration differs, water will move. Glomerular filtration occurs when glomerular hydrostatic pressure exceeds the luminal **hydrostatic** pressure of Bowman's capsule. There is also an opposing force, the osmotic pressure, which is typically higher in the glomerular capillary. To understand why this is so, look more closely at the microenvironment on either side of the filtration membrane.

You will find osmotic pressure exerted by the solutes inside the lumen of the capillary as well as inside of Bowman's capsule. Since the filtration membrane limits the size of particles crossing the membrane, the osmotic pressure inside the glomerular **capillary** is higher than the osmotic pressure in Bowman's capsule. Recall that cells and the medium-

to-large proteins cannot pass between the podocyte processes or through the fenestrations of the capillary endothelial cells. This means that red and white blood cells, platelets, **albumins**, and other proteins too large to pass through the filter remain in the capillary, creating an average **colloid** osmotic pressure of 30 mm Hg within the capillary. The absence of proteins in Bowman's space (the lumen within Bowman's capsule) results in an osmotic pressure near zero. Thus, the only pressure moving fluid across the capillary wall into the lumen of Bowman's space is hydrostatic pressure. Hydrostatic (fluid) pressure is sufficient to push water through the membrane despite the osmotic pressure working against it. The sum of all of the influences, both osmotic and hydrostatic, results in a net filtration pressure (NFP) of about 10 mm Hg (see Figure 15.7).

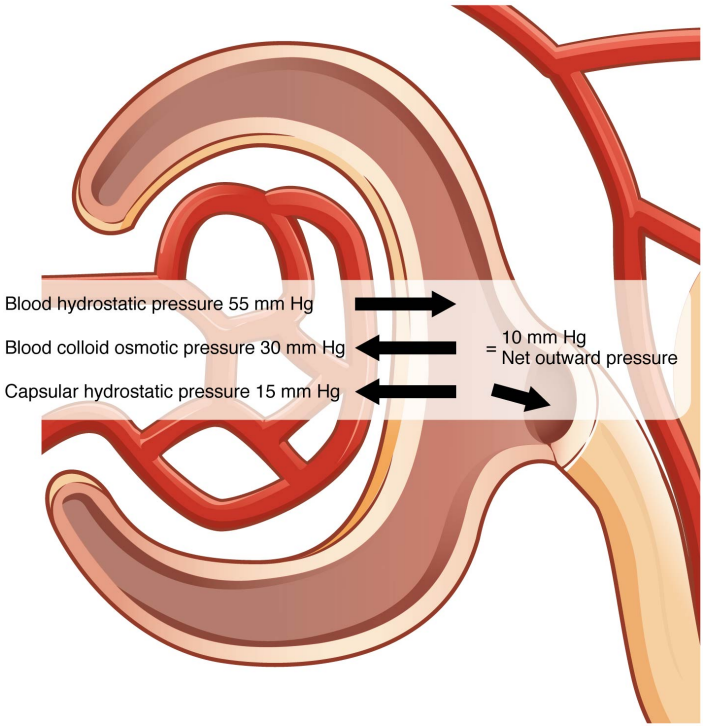

Figure 15.7 Net Filtration Pressure. The NFP is the sum of osmotic and hydrostatic pressures. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

A proper concentration of solutes in the blood is important in maintaining osmotic pressure both in the glomerulus and systemically. There are disorders in which too much protein passes through the filtration slits into the kidney filtrate. This excess protein in the filtrate leads to a deficiency of circulating **plasma** proteins. In turn, the presence of protein in the urine increases its osmolarity; this holds more water in the filtrate and results in an increase in urine volume. Because there is less circulating protein, principally albumin, the osmotic pressure of the blood falls. Less osmotic pressure pulling water into the capillaries tips the balance towards hydrostatic pressure, which tends to push it out of the capillaries. The net effect is that water is lost from the circulation to interstitial tissues and cells. This "plumps up" the tissues and cells, a condition termed **systemic edema**.

Reabsorption and Secretion

The renal corpuscle filters the blood to create a filtrate that differs from blood mainly in the absence of cells and large proteins. From this point to the ends of the collecting ducts, the filtrate or forming urine is undergoing modification

through **secretion** and **reabsorption** before true urine is produced. Here, some substances are reabsorbed, whereas others are secreted. Note the use of the term "reabsorbed." All of these substances were "absorbed" in the digestive tract—99% of the water and most of the solutes filtered by the nephron must be reabsorbed. Water and substances that are reabsorbed are returned to the circulation by the peritubular and vasa recta capillaries.

It is vital that the flow of blood through the kidney is at a suitable rate to allow for filtration. This rate determines how much solute is retained or discarded, how much water is retained or discarded, and ultimately, the **osmolarity** of blood and the blood pressure of the body.

Urinalysis

Urinalysis (urine analysis) often provides clues to renal disease. Normally, only traces of protein are found in urine, and when higher amounts are found, damage to the glomeruli is the likely basis. Unusually large quantities of urine may point to diseases like diabetes mellitus or hypothalamic tumors that cause diabetes insipidus. The color of urine is determined mostly by the breakdown products of red blood cell destruction (see Figure 15.8). The "heme" of **hemoglobin** is converted by the liver into water-soluble forms that can be excreted into the **bile** and indirectly into the urine. This yellow pigment is urochrome. Urine color may also be affected by certain foods like beets, berries, and fava beans. A kidney stone or a cancer of the urinary system may produce sufficient bleeding to manifest as pink or even bright red urine. Diseases of the liver or obstructions of bile drainage from the liver impart a dark "tea" or "cola" hue to the urine. **Dehydration** produces darker, concentrated urine that may also possess the slight odor of **ammonia**. Most of the ammonia produced from protein breakdown is converted into **urea** by the liver, so ammonia is rarely detected in fresh urine. The strong ammonia odor you may detect in bathrooms or alleys is due to the breakdown of urea into ammonia by bacteria in the environment. About one in five people detect a distinctive odor in their urine after consuming asparagus; other foods such as onions, garlic, and fish can impart their own aromas. These food-caused odors are harmless.

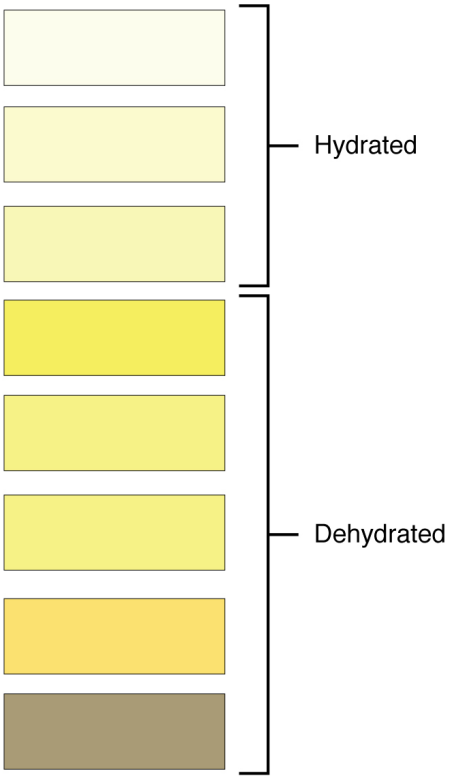

Figure 15.8 Urine Color. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Urine volume varies considerably. The normal range is one to two liters per day. The kidneys must produce a minimum urine volume of about 500 mL/day to rid the body of wastes. Output below this level may be caused by severe dehydration or renal disease and is termed **oliguria**. The virtual absence of urine production is termed **anuria**. Excessive urine production is **polyuria**, which may be due to diabetes mellitus or diabetes insipidus. In diabetes mellitus, blood glucose levels exceed the number of available sodium-glucose transporters in the kidney, and glucose appears in the urine. The osmotic nature of glucose attracts water, leading to its loss in the urine. In the case of diabetes insipidus, insufficient pituitary antidiuretic hormone (ADH) release or insufficient numbers of ADH receptors in the collecting ducts means that too few water channels are inserted into the cell membranes that line the collecting ducts of the kidney. Insufficient numbers of water channels (aquaporins) reduce water absorption, resulting in high volumes of very dilute urine.

Concept Check

- Contrast the following terms: **oliguria**, **anuria** and **polyuria**. What are the differences between these terms as they describe urinary output?
- Explain how urine **color** varies based on food consumed and/or **hydration** levels.

Endocrine Urinary Function

Several hormones have specific, important roles in regulating kidney function. They act to stimulate or inhibit blood flow. Some of these are endocrine, acting from a distance, whereas others are paracrine, acting locally.

Renin–Angiotensin–Aldosterone

Renin is an **enzyme** that is produced by the granular cells of the afferent arteriole. It enzymatically converts angiotensinogen (made by the liver, freely circulating) into angiotensin I. Its release is stimulated by **prostaglandins** to decrease extracellular fluid volume.

Angiotensin II is a potent vasoconstrictor that plays an immediate role in the regulation of blood pressure. It acts systemically to cause vasoconstriction as well as constriction of both the **afferent** and **efferent** arterioles of the glomerulus. In instances of blood loss or dehydration, it reduces both GFR and renal blood flow, thereby limiting fluid loss and preserving blood volume. Its release is usually stimulated by decreases in blood pressure, and so the preservation of adequate blood pressure is its primary role.

Aldosterone, often called the "salt-retaining hormone," is released from the **adrenal cortex** in response to angiotensin II or directly in response to increased plasma potassium. It promotes sodium reabsorption by the nephron, promoting the retention of water.

Antidiuretic Hormone (ADH)

Diuretics are drugs that can increase water loss by interfering with the recapture of solutes and water from the forming urine. They are often prescribed to lower blood pressure. Coffee, tea, and alcoholic beverages are familiar diuretics. ADH, released by the posterior pituitary, works to do the exact opposite. It promotes the recovery of water, decreases urine volume, and maintains plasma osmolarity and blood pressure. It does so by stimulating the movement of **aquaporin** proteins into the apical cell membrane of principal cells of the collecting ducts to form water channels, allowing the transcellular movement of water from the lumen of the collecting duct into the interstitial space in the medulla of the kidney by osmosis. From there, it enters the vasa recta capillaries to return to the circulation. Water is attracted by the high osmotic environment of the deep kidney **medulla.**

Parathyroid Hormone

Parathyroid hormone (PTH) is produced by the **parathyroid** glands in response to decreased circulating calcium levels.

Maintaining Homeostasis

Homeostasis requires that volume and **osmolarity** be preserved. Blood volume is important in maintaining sufficient blood pressure, and there are **nonrenal** mechanisms involved in its preservation, including vasoconstriction, which can act within seconds of a drop in pressure. Thirst mechanisms are also activated to promote the consumption of water lost through respiration, evaporation, or urination. Hormonal mechanisms are activated to recover volume while maintaining a normal osmotic environment. These mechanisms act principally on the kidney.

Diuretics and Fluid Volume

A diuretic is a compound that increases urine volume. Three familiar drinks contain diuretic compounds: coffee, tea, and alcohol. The caffeine in coffee and tea works by promoting vasodilation in the nephron, which increases GFR. Alcohol increases GFR by inhibiting ADH release from the posterior pituitary, resulting in less water recovery by the collecting duct. In cases of high blood pressure, diuretics may be prescribed to reduce blood volume and, thereby, reduce blood pressure. The most frequently prescribed anti-hypertensive diuretic is **hydrochlorothiazide.**

Regulation of Nitrogen Wastes

Nitrogen wastes are produced by the breakdown of proteins during normal **metabolism**. Proteins are broken down into amino acids, which in turn are deaminated by having their nitrogen groups removed. **Deamination** converts the amino (NH_2) groups into ammonia (NH_3), ammonium ion (NH_4^+), urea, or uric acid (Figure 15.9). Ammonia is extremely toxic, so most of it is very rapidly converted into urea in the liver. Human urinary wastes typically contain primarily urea with small amounts of ammonium and very little uric acid.

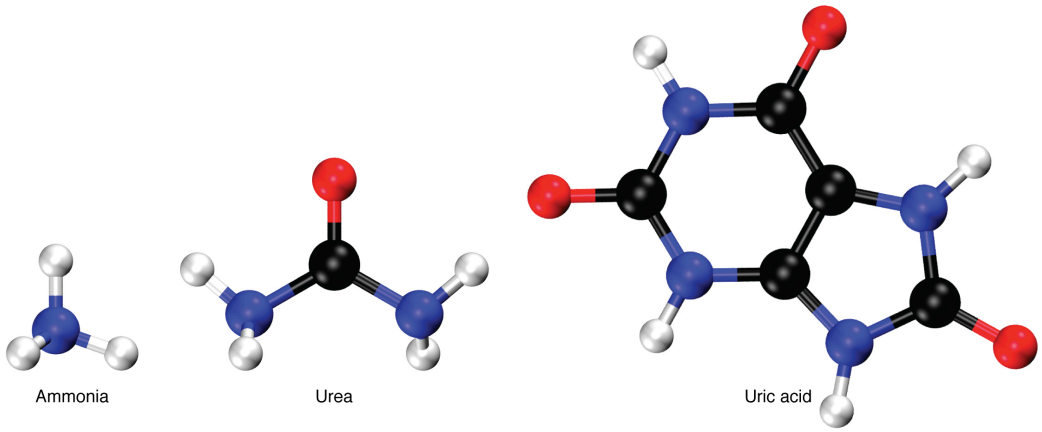

Figure 15.9 Nitrogen Wastes. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Elimination of Drugs and Hormones

Water-soluble drugs may be excreted in the urine and are influenced by one or all of the following processes: glomerular filtration, tubular secretion, or tubular reabsorption. Drugs that are structurally small can be filtered by the glomerulus with the filtrate. Large drug molecules such as **heparin** or those that are bound to plasma proteins cannot be filtered and are not readily eliminated. Some drugs can be eliminated by carrier proteins that enable secretion of the drug into the tubule lumen. There are specific carriers that eliminate basic (such as dopamine or histamine) or acidic drugs (such as penicillin or indomethacin). As is the case with other substances, drugs may be both filtered and reabsorbed passively along a concentration gradient.

Watch this video:

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Media 15.2. Urinary System, Part 2: Crash Course A&P #39 [Online video]. Copyright 2015 by CrashCourse.

Practice Terms Related to the Urinary System

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Common Abbreviations for the Urinary System

Many terms and phrases related to the urinary system are abbreviated. Learn these common abbreviations by expanding the list below.

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Diseases and Disorders of the Urinary System

Diabetic Nephropathy

Diabetic nephropathy impacts the kidneys as a result of having diabetes mellitus type 1 or 2. Higher levels of blood sugar can lead to high blood pressure and this additional pressure exerted on the kidneys causes destruction of the small filtering structures within the kidney (Varghese & Jialal, 2021). To learn more, visit the Mayo Clinic's web page on diabetic nephropathy.

Glomerulonephritis

Glomerulonephritis refers to acute or chronic nephritis that involves inflammation of the capillaries of the renal glomeruli. It is characterized by blood or protein in the urine and edema. If untreated, it could lead to kidney failure. Glomerulonephritis may be caused by a variety of infections and immune conditions, as a result of genetic defects, or by unknown causes (Genetic and Rare Diseases Information Center, 2012). For more information, visit the Genetic and Rare Diseases Information Center's web page on glomerulonephritis.

Hydronephrosis

Hydronephrosis is a condition whereby the kidneys begin to swell because of the retention of urine. Several conditions can cause hydronephrosis, such as a kidney stone or pregnancy. Treatment will vary, depending on the cause (Thotakura & Anjum, 2021). To learn more, visit the Cleveland Clinic's web page on hydronephrosis.

Polycystic Kidney Disease

Polycystic kidney disease (PKD) is a genetic disorder whereby cysts grow inside the kidneys. The kidneys enlarge from the cystic collections, and damage to the filtering structures of the kidneys can occur. As the disease progresses, it may lead to kidney failure (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-a). To learn more, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on polycystic kidney disease.

Renal Cell Carcinoma

Renal cell carcinoma is a cancer occurring in the kidney tubes where urine is produced or collected. Signs and symptoms may include blood in the urine and the presence of a lump in the abdomen. Risk factors include smoking and the long-term misuse of pain medicine (National Cancer Institute, 2020). For more information, visit the National Cancer Institute's web page on renal cell carcinoma.

Renal Failure

Renal failure occurs when kidneys become unable to filter waste products from blood. When kidneys stop filtering, high levels of waste may build. Renal failure may be acute (sudden onset) or chronic (gradual onset) (Bindroo et al., 2021). For more information, visit the Cleveland Clinic's web page on renal failure.

Cystitis

Cystitis is inflammation of the urinary bladder, often caused by an infection. A chronic form of this condition is known as interstitial cystitis. Signs and symptoms of cystitis include bladder pressure, voiding frequently, and abdominal pain (Centers for Disease Control and Prevention, n.d.; Li & Leslie, 2021). To learn more, visit the Mayo Clinic's web page on cystitis.

Urinary Tract Infection

A urinary tract infection (UTI) is an infection caused by bacteria. The exact type of bacterial growth is determined by conducting a urine culture. Signs and symptoms include a burning sensation during urination and voiding frequently

(National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-b). For more information, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on urinary tract infections.

Urinary Incontinence

Urinary incontinence is a loss of bladder control. Those afflicted with the condition will experience urine leakage from the bladder. Urinary incontinence may be related to another health issue, such as prostate problems, or it may be the result of weakened urinary tract muscles (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-c). For more information, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on bladder incontinence.

Medical Terms in Context

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Medical Specialties and Procedures Related to the Urinary System

Urology is a specialty that focuses on the diagnosis, treatment, and surgical repair of the urinary tract. To learn more about urology as a specialty, visit the American College of Surgeons' web page.

Urologist

A urologist is a medical specialist involved in the diagnosis and treatment of urinary and male genitourinary system conditions, disorders, and diseases (National Cancer Institute, n.d.-a). To learn more about what urologists do and how to become one, visit the Cleveland Clinic's web page about the specialty.

Procedures and Testing

Urinalysis

A urinalysis is the physical, chemical, and microscopic examination of urine. This test detects and measures several substances in the urine such as products of normal and abnormal metabolism and bacteria (Queremel Milani & Jialal, 2021). To learn more, visit the Mayo Clinic's web page on urinalysis.

Urine Culture and Sensitivity

A urine culture is a test that can detect and identify bacteria in the urine, which may be causing a urinary tract infection (UTI). If harmful bacteria is found, a sensitivity report is generated. A sensitivity test indicates which antibiotics will be effective in treating the infection (Sinawe & Casadesus, 2021; MedlinePlus, 2021). For more information, visit MedlinePlus' web page on urine cultures.

24-Hour Urinalysis

A 24-hour urinalysis is a test whereby all urinary output is collected over a 24-hour period of time. The analysis of urinary output over this extended period of time provides a greater indication of normal or abnormal kidney function (Corder et al., 2021). For more information, visit Johns Hopkins Medicine's web page on 24-hour urine collection.

CT Scan of Kidney

Computed tomography is a diagnostic imaging procedure that uses a combination of x-rays and computer technology to produce a variety of images (National Cancer Institute, n.d.-b). It provides detailed images of the kidney so that healthcare professionals can diagnose disease, obstructions, and other kidney conditions. To learn more, visit Johns Hopkins Medicine's page on computed tomography scan of the kidney.

Cystoscopy

A cystoscopy is a procedure allowing a physician to view the bladder and urethra. The procedure involves the use of a cystoscope, a long tube-like instrument that has a camera and light at the end. The camera's images are transmitted to a computer, where the urologist can determine whether the patient has bladder stones, cancer, or other urinary tract problems (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-d). For more information, view the National Institute of Diabetes and Digestive and Kidney Diseases' web page on cystoscopy.

Dialysis

Dialysis is a treatment that removes waste products from the blood when the kidneys are not fully functioning. This type of therapy is available at home, in a hospital, or clinic. There are two main types: peritoneal dialysis and hemodialysis (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-e). To learn more, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on kidney failure treatment options.

Intravenous Pyelogram

An intravenous pyelogram (IVP) is a specialized x-ray designed to produce views of the entire urinary tract. Contrast dye is used to produce clear x-ray images. The x-rays can show how well the urinary tract is functioning and identify any blockages (MedlinePlus, 2020). For more information, visit MedlinePlus' web page on intravenous pyelogram.

Kidney Scan

A kidney scan is an imaging test which views the kidneys. It is considered a nuclear imaging test as it uses radioactive tracers to evaluate kidney function. A kidney scan may be performed if the patient is allergic to the contrast material used with CT or MRI tests (Banker et al., 2021). For more information, visit MedlinePlus' web page on renal scans.

Kidney Transplant

When a patient experiences kidney failure, a healthy kidney can be surgically transplanted from a donor to the patient. The donor may be living or recently deceased. Patients may have to wait for many years before a kidney is available and may have to go on dialysis in the meantime (National Institute of Diabetes and Digestive and Kidney Diseases, n.d.-f). For more information, visit the National Institute of Diabetes and Digestive and Kidney Diseases' web page on kidney transplant.

Urinary System Vocabulary

Adventitial
The outermost layer of organs, blood vessels, and other structures in the body.
Albuminuria
Albumin in the urine.
Anuria
The absence of urine production.
Autonomic
Involuntary or unconscious.
Azotemia
Urea in the blood.
Cystectomy

Excision of all or part of the bladder to remove a cyst.

Cystitis

Inflammation of the lining of the bladder.

Cystocele

A condition in which weakened pelvic muscles cause the bladder to drop from its normal position.

Cystography

Radiographic imaging of the bladder.

Cystoscope

A thin, tube-like instrument used to look inside the bladder and urethra.

Cystoscopy

Examination of the bladder and urethra using a cystoscope, inserted into the urethra.

Cystostomy

Creation of an artificial opening into the bladder.

Cystotomy

Incision into the bladder.

Deamination

The removal of an amino group from a molecule.

Detrusor

A muscle which forms a layer of the wall of the bladder.

Diuresis

Excess production of urine.

Dysuria

Painful urination.

Enuresis

Involuntary urination.

Excretion

To get rid of waste material from the blood, tissues, or organs by a normal discharge (such as sweat, urine, or stool).

Glomerulonephritis

A condition in which the tissues in the kidney become inflamed and have problems filtering waste from the blood.

Glycosuria

Presence of glucose in the urine.

Hematuria

Blood in the urine.

Homeostasis

The state of steady internal conditions maintained by living things.

Hydronephrosis

Abnormal enlargement of a kidney, which may be caused by blockage of the ureter (such as by a kidney stone) or chronic kidney disease that prevents urine from draining into the bladder.

Hydrostatic

Relating to the equilibrium of liquids and the pressure exerted by liquid at rest.

Hypothalamus

A region of the forebrain below the thalamus; has function in both the autonomic and endocrine systems and regulates homeostasis.

Incontinence

Loss of ability to control micturition (urination).

Lethargy

A condition marked by drowsiness and an unusual lack of energy and mental alertness.

Micturition

Also called urination or voiding.

Lithotripsy

The destruction of a calculus (stone) of the kidney, ureter, bladder, or gallbladder by physical forces.

Mitochondria

A membranous, bean-shaped organelle that is the "energy transformer" of the cell.

Nephrectomy

Excision of all or part of the kidney.

Nephritis

A condition in which the tissues in the kidney become inflamed and have problems filtering waste from the blood.

Nephrolithiasis

Formation of stone(s) in the kidney.

Nephrolithotomy

Incision into the kidney to remove stone(s).

Nephrologist

A doctor who has special training in diagnosing and treating kidney disease.

Nephrology

A subspecialty of internal medicine concerned with the anatomy, physiology, and pathology of the kidney.

Nephrostomy

Surgery to make an opening from the outside of the body to the renal pelvis.

Nocturia

Frequent urination at night that interrupts sleep.

Oliguria

Below normal urine production of 400–500 mL/day.

Osmosis

A process by which molecules of a solvent tend to pass through a membrane from a less concentrated solution into a more concentrated one.

pH

A measure of how acidic or alkaline a substance is, as determined by the number of free hydrogen ions in the substance.

Polyuria

Excessive urine production.

Prostaglandins

Signaling molecules derived from unsaturated fatty acids with hormone-like effects.

Pseudostratified

Tissue with a single layer of irregularly shaped cells that give the appearance of more than one layer.

Pyelitis

Inflammation of the renal pelvis and kidney calices.

Pyelonephritis

Inflammation of the nephrons, renal pelvis, and kidney calices.

Pyuria

The presence of white blood cells in the urine.

Solutes

The minor component in a solution.

Stricture

Abnormal narrowing.

Ureterocele

A cystic dilatation of the end of a ureter.

Ureterolithiasis

Formation of stone(s) in the ureter.

Ureteroscopy

Examination of the inside of the kidney and ureter, using a ureteroscope.

Ureterostomy

Creation of an artificial opening into the ureter.

Urinal

Receptacle used for the collection of urine.

Urinary

Pertaining to urine or the organs of the body that produce and get rid of urine.

Urologist

A doctor who has special training in diagnosing and treating diseases of the urinary organs in females and the urinary and reproductive organs in males.

Urology

A surgical specialty concerned with the study, diagnosis, and treatment of diseases of the urinary tract in both sexes, and the genital tract in the male.

Voiding

Also known as urination or micturition.

Test Yourself

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https://pressbooks.uwf.edu/medicalterminology/?p=80#h5p-31

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Image Descriptions

Figure 15.1 image description: Diagram of a human torso showing the location of the kidneys within the torso. Callouts identify the liver, kidney, ureter, and 12th rib. [Return to Figure 15.1].

Figure 15.2 image description: The left panel of this figure shows the location of the kidneys in the abdomen. The right panel shows the cross-section of the kidney. [Return to Figure 15.2].

Figure 15.3 image description: This figure shows the network of blood vessels and the blood flow in the kidneys. Callouts identify the process as follows: renal artery, segmental artery, interlobar artery, arcuate artery, interlobular

artery, afferent arteriole, glomerulus, efferent arteriole, peritubular capillaries, interlobular vein, arcuate vein, interlobar vein, and renal vein. [Return to Figure 15.3].

Figure 15.4 image description: This image shows the blood vessels and the direction of blood flow in the nephron. Callouts identify the process as involving the following structures: interlobular artery, afferent arteriole, efferent arteriole, glomerular capsule, proximal convoluted tubule, venule, interlobular vein, loop of the nephron, and peritubular capillary network. Urine then flows into the renal papilla. [Return to Figure 15.4].

Figure 15.5 image description: The left panel of this figure shows the cross-section of the bladder and the major parts are labeled. The right panel shows a micrograph of the bladder. [Return to Figure 15.5].

Figure 15.6 image description: Diagrams of the (a) female and (b) male genitalia highlighting the respective urethras. [Return to Figure 15.6].

Figure 15.7 image description: This figure shows the different pressures acting across the glomerulus including blood hydrostatic pressure, blood colloid osmotic pressure, capsular hydrostatic pressure. [Return to Figure 15.7].

Figure 15.8 image description: This color chart shows 8 different shades of yellow and associates each shade with stages of hydration (lightest 3 shades) or dehydration (remaining 5 darker shades). [Return to Figure 15.8].

Figure 15.9 image description: This figure shows the chemical structure of ammonia, urea, and uric acid. [Return to Figure 15.9].

16. Male Reproductive System

Learning Objectives

- Examine the anatomy of the male reproductive system
- Determine the main functions of the male reproductive system
- Differentiate male reproductive system medical terms and common abbreviations
- Recognize the medical specialties associated with the male reproductive system
- Discover common diseases, disorders, and procedures related to the male reproductive system

Male Reproductive System Word Parts

Click on prefixes, combining forms, and suffixes to reveal a list of word parts to memorize for the Male Reproductive System.

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Introduction to the Male Reproductive System

Gametes are the reproductive cells that combine to form a fetus. Organs called **gonads** produce the gametes, along with the hormones that regulate human reproduction. The male gametes are called sperm. **Spermatogenesis** occurs within the **seminiferous tubules** that make up most of the testis. The **scrotum** is a sac that holds the testes outside of the body cavity.

Watch this video:

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Media 16.1. Reproductive System, Part 2 – Male Reproductive System: Crash Course A&P 41 [Online video]. Copyright 2015 by CrashCourse.

Practice Medical Terms Related to the Male Reproductive System

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Anatomy (Structures) of the Male Reproductive System

The structures of the male reproductive system include the **testes**, the epididymis, the penis, and the ducts and glands that produce and carry semen. Sperm exit the scrotum through the vas deferens. The spermatic cord is an enclosed sheath which includes the vas deferens, **arteries**, **veins** and **nerves**. The seminal vesicles and **prostate** add fluids to the **sperm** to create **semen**.

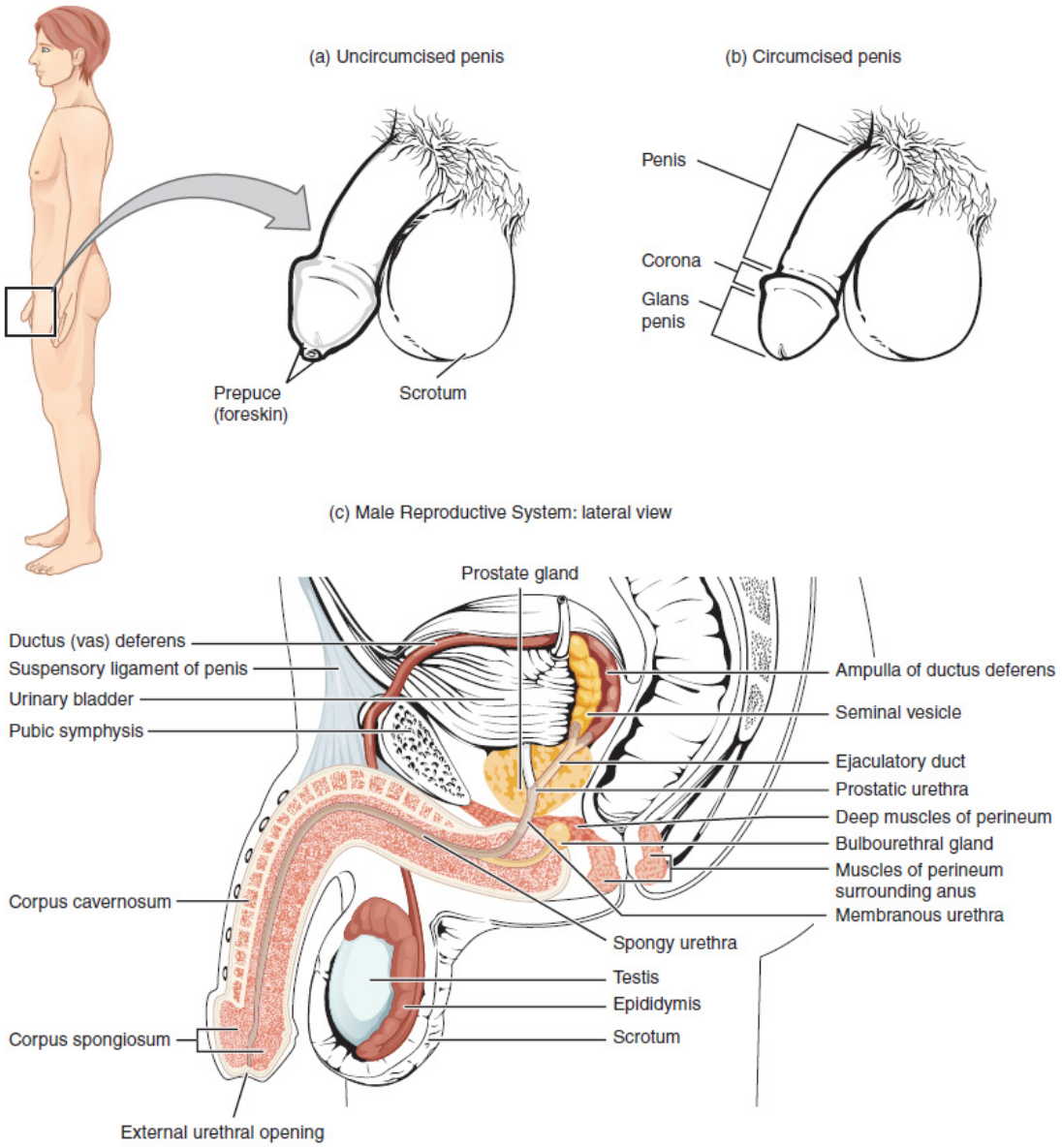

Figure 16.1. Male Reproductive System. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Physiology (Function) of the Male Reproductive System

Spermatogenesis

Spermatogenesis occurs in the **seminiferous tubules** that form the bulk of each testis. The process begins at puberty, after which time sperm is produced constantly throughout a man's life. One production cycle takes approximately 64 days. One production cycle is considered from **spermatogonia** through to formed sperm. A new cycle starts approximately every 16 days, although this timing is not synchronous across the **seminiferous tubules**.

Sperm

Sperm is smaller than most cells in the body; in fact, the volume of a sperm cell is 85,000 times less than that of the female gamete. Approximately 100 to 300 million sperm are produced each day, whereas women typically ovulate only one **oocyte** per month as is true for most cells in the body, the structure of sperm cells speaks to their function. Sperm have a distinctive head, mid-piece, and tail region (see Figure 16.2).

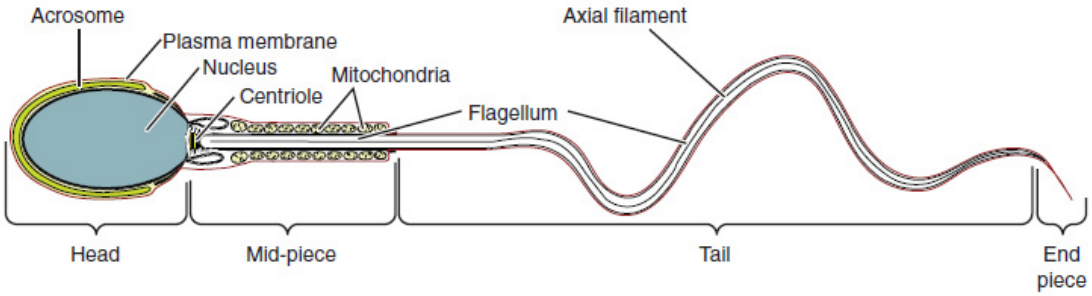

Figure 16.2. Structure of Sperm. Sperm cells are divided into a head, containing DNA; a mid-piece, containing mitochondria; and a tail, providing motility. The acrosome is oval and somewhat flattened. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Sperm Transport

To fertilize an egg, sperm must be moved from the **seminiferous tubules** in the testes, through the **epididymis**, and—later during ejaculation—along the length of the penis and out into the female reproductive tract. It takes an average of 12 days for sperm to move through the coils of the **epididymis**, with the shortest recorded transit time in humans being one day.

Did you know?

Sperm counts slowly decline after age 35, and some studies suggest that smoking can lower sperm counts irrespective of age.

Epididymis

Sperm enter the head of the epididymis and are moved by the contraction of smooth muscles lining the epididymal tubes. As the sperm mature they acquire the ability to move under their own power. Once inside the female reproductive

tract, they will use this ability to move independently toward the unfertilized egg. The more mature sperm are then stored in the tail of the epididymis until ejaculation occurs.

Ducts

During ejaculation, sperm exit the tail of the epididymis and are pushed by smooth muscle contraction to the **vas deferens** (also called the ductus deferens). The **vas deferens** is a thick, muscular tube that is bundled together inside the scrotum with connective tissue, blood vessels, and nerves into a structure called the **spermatic cord.** From each epididymis, each vas deferens extends through the inguinal canal in the abdominal wall and continues to a region called the ampulla. The sperm is mixed with fluid from the paired seminal vesicles and moves into its associated ejaculatory duct. The ejaculatory ducts transport the seminal fluid to the prostate gland.

Prostate Gland

The **prostate gland** secretes an alkaline, milky fluid to the passing seminal fluid (referred to as semen) to first coagulate and then decoagulate the semen following ejaculation. The temporary thickening of semen helps retain it within the female reproductive tract. Once decoagulated, the sperm can pass farther into the female reproductive tract.

Bulbourethral Glands

Bulbourethral glands release a thick, salty fluid that lubricates the end of the urethra and vagina, and helps to clean urine residues from the penile urethra.

Concept Check

- Write or draw out the components of the **pathway** that sperm takes from the beginning until the end.
- Consider fertility challenges that may be experienced if a large number of defective sperm are produced.

Anatomy Labeling Activity

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Practice Terms Related to the Male Reproductive System

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Common Abbreviations for the Male Reproductive System

Many terms and phrases related to the male reproductive system are abbreviated. Learn these common abbreviations by expanding the list below.

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Diseases and Disorders of the Male Reproductive System

Erectile Dysfunction Disorder (EDD)

Erectile dysfunction (ED) is a condition in which a male has difficulty either initiating or maintaining an erection. The combined prevalence of minimal, moderate, and complete ED is approximately 40% in men at age 40 and reaches nearly 70% by 70 years of age. In addition to aging, ED is associated with diabetes, vascular disease, psychiatric disorders, prostate disorders, the use of some drugs such as certain antidepressants, and problems with the testes resulting in low testosterone concentrations. These physical and emotional conditions can lead to disruptions in the vasodilation pathway and result in an inability to achieve an erection.

Cancer

Prostate Cancer

According to the Centers for Disease Control and Prevention (CDC), prostate cancer is the second most common cancer occurring in men. However, some forms of prostate cancer grow very slowly and may not require treatment. Aggressive forms of prostate cancer, in contrast, involve **metastasis** to organs like the lungs and brain. There is no link between Benign Prostatic Hyperplasia (BPH) and prostate cancer, but the symptoms are similar. Prostate cancer is detected by medical history, a blood test, and a digital rectal exam that allows physicians to palpate the prostate and check for unusual masses. If a mass is detected, the cancer diagnosis is confirmed by biopsy of the cells (Betts et al., 2013; Centers for Disease Control, n.d-a.).

Testicular Cancer

Testicular cancer begins in the **testicle** or testis. It is most often found in men aged 20 to 35 years old, although it can occur at any age. Common signs and symptoms include a painless lump in the testicle, swelling, and a build-up of fluid in the **scrotum**. Testicular cancer is treatable when diagnosed early. An **orchiectomy** may be required for diagnosing and treating testicular cancer (National Cancer Institute, 2021a). For more information, visit the Cleveland Clinic's web page on testicular cancer.

Did you know?

Family history is a common risk factor for testicular cancer.

Sexually Transmitted Infections and Diseases (STIs and STDs)

Although the terms sexually transmitted infections (STI) and sexually transmitted diseases (STD) are often used interchangeably, they have distinct meanings. STIs refer to infections caused by a virus, bacteria, fungus, or parasite via sexual contact. STDs refer to the disease state that develops as a result of infection (U.S. Department of Health and Human Services, 2020).

Chlamydia

Chlamydia is one of the most common sexually transmitted diseases. It is caused by the bacteria *Chlamydia trachomatis*, which infects the urethra and prostate in men. Chlamydia spreads through unprotected oral, anal, or vaginal sex with an infected person. Many people with chlamydia do not have any symptoms and unknowingly pass the infection to their sexual partner(s). If symptoms develop, they may not appear for several weeks after sexual contact with an infected person. Males may have penile discharge, itching around the urethra, and pain in or swelling of the testicles. Chlamydia is easy to treat with antibiotics and can be cured. However, until a patient finishes their treatment, they continue to have the infection and can continue to pass it to others (Centers for Disease Control and Prevention, n.d.-b).

Gonorrhea (Gonococcus)

Gonorrhea is a sexually transmitted disease caused by the bacterium *Neisseria gonorrhoeae*. It infects the mucous membranes of the reproductive tract, including the urethra in men. Infections can also infect the mouth, throat, eyes, and anus. Gonorrhea is spread through unprotected oral, vaginal or anal sex with an infected person. Many people infected with gonorrhea have no symptoms and can unknowingly pass the infection on to their sexual partner(s). Symptoms vary depending on which part of the body is infected. Males may have yellowish-white discharge from the penis or **dysuria**. Gonorrhea infection from oral sex may lead to a sore throat, whereas infection from anal sex may cause itchiness and discharge from the anus. Gonorrhea can be treated and cured with antibiotics in combination with an **intramuscular** (IM) injection. However, until the patient finishes their treatment, they continue to have the infection and can pass it to others (Centers for Disease Control and Prevention, n.d.-c).

Notifiable and Reportable Diseases

In every state in the United States, chlamydia and gonorrhea are notifiable and reportable diseases. This means that when a person tests positive for either of the STIs, public health departments and the CDC are informed so that they may monitor trends, identify outbreaks, and take the necessary steps to prevent further spread of the disease (Centers for Disease Control and Prevention, n.d.-d, n.d.-e).

Human Papillomavirus (HPV)

Human papillomavirus (HPV) is another common STI. Both males and females can be infected with HPV. There are over 200 strains of HPV. Some strains can cause visible genital warts, while others cause genital, anal, throat, and cervical cancers. HPV spreads through sexual activity and skin-to-skin contact in the genital area with an infected person. Since some people are **asymptomatic**, they don't know they have the virus and consequently pass the virus to their sexual partners. Treatments are available for genital warts, but there is no cure for HPV. However, in the United States, a vaccine called Gardasil® 9 is available, which prevents infection with HPV (MedlinePlus, 2021; National Cancer Institute, 2021b). For more information, visit the Centers for Disease Control and Prevention's web page on HPV.

Herpes Simplex Virus (HSV)

Genital herpes is a sexually transmitted disease that is caused by a virus called the herpes simplex virus (HSV). There are two types of herpes simplex viruses:

- Type 1- oral herpes or cold sores (HSV-1)
- Type 2- genital herpes (HSV-2)

Signs and symptoms might include **dysuria**, enlarged glands, **myalgia**, and fever. Once a patient is infected with HSV, the virus remains in their body even after the symptoms are gone and can cause recurring outbreaks. When the virus becomes active again, the symptoms return but are usually less painful and heal faster (Centers for Disease Control and Prevention, n.d.-f).

Herpes is spread through direct contact with the sores or blisters of an infected person. Contact (and transfer of the virus) can occur from genitals-to-genitals, mouth-to-genitals, or mouth-to-mouth. Herpes can also be passed to the anal area. Herpes spreads easily during sexual contact while symptoms are present or just before an outbreak of symptoms. An infected person may spread herpes even when they have no symptoms; this is called **asymptomatic** shedding. One can spread the herpes virus to other parts of their body after touching the sores. The fingers, eyes, and other body areas can accidentally become infected in this way. Hand washing after touching sores and blisters is recommended to prevent spreading the virus (Centers for Disease Control and Prevention, n.d.-f).

There is no cure for herpes. Antiviral pills help to reduce symptoms and speed the healing of blisters or sores and are prescribed by a doctor. All sexual partner(s) should be informed. The only way to reduce the risk of transmission of herpes is to avoid direct contact with the sores and to use condoms. Condoms will reduce but not eliminate risk, as the virus can be present and shed from the skin in the genital area (Centers for Disease Control and Prevention, n.d.-f).

Common Abbreviations for Reproductive Sexually Transmitted Infections (STIs)

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Medical Terms in Context

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Medical Specialties and Procedures Related to the Male Reproductive System

Urology

Urology is a specialty that focuses on the diagnosis, treatment, and surgical repair of the urinary tract. To learn more about urology as a specialty, visit the American College of Surgeons' web page.

Vasectomy

A vasectomy is a procedure in which a small section of the ductus (vas) deferens is removed from the scrotum. This cuts off the path taken by sperm through the ductus deferens. Although it can be reversed, clinicians consider it permanent and advise men to undergo it only if they are certain that they no longer wish to father children. For more information, view this video from MedlinePlus on vasectomies.

Male Reproductive Vocabulary

Ablation
The removal or destruction of a body part or tissue or its function. Ablation may be performed by surgery, hormones, drugs, radiofrequency, heat, or other methods.

Arthralgia
Joint pain.

Aspermia
Condition of the complete absence of sperm.

Balanitis
Inflammation of the glans penis.

Benign prostatic hyperplasia (BPH)
A benign condition in which an overgrowth of prostate tissue pushes against the urethra and the bladder, blocking the flow of urine.

Bulbourethral glands
Glands that secrete a lubricating mucus that cleans and lubricates the urethra prior to and during ejaculation; also called Cowper's glands.

Circumcision
The surgical removal of the prepuce.

Coitus
Sexual intercourse between a male and female.

Condom
A sheath that is worn over the penis during sexual behavior in order to prevent pregnancy or spread of sexually transmitted disease.

Corpus cavernosum
Either of two columns of erectile tissue in the penis that fill with blood during an erection.

Corpus spongiosum

Column of erectile tissue in the penis that fills with blood during an erection and surrounds the penile urethra on the ventral portion of the penis.

Cryptorchidism

The failure of one or both testes to descend into the scrotum prior to birth.

Ductus deferens

Duct that transports sperm from the epididymis through the spermatic cord and into the ejaculatory duct; also referred to as the vas deferens.

Dysuria

Painful urination.

Ejaculatory duct

Duct that connects the ampulla of the ductus deferens with the duct of the seminal vesicle at the prostatic urethra.

Enucleation

Excision of a whole organ or mass without cutting into it.

Epididymis

A coiled tubular structure in which sperm start to mature and are stored until ejaculation.

Epididymitis

Inflammation of the epididymis.

Gamete

A specialized sex cell carrying 23 chromosomes.

Glans penis

Bulbous end of the penis that contains a large number of nerve endings.

Gonadotropin-releasing hormone (GnRH)

Hormone released by the hypothalamus that regulates the production of follicle-stimulating hormone and luteinizing hormone from the pituitary gland.

Gonads

Reproductive organs (testes in men and ovaries in women) that produce gametes and reproductive hormones.

Hydrocele

Accumulation of serous fluid between the layers of membrane covering the testis.

Infertility

The inability to produce children.

Inguinal canal

Opening in the abdominal wall that connects the testes to the abdominal cavity.

Leydig cells

Cells between the seminiferous tubules of the testes that produce testosterone; a type of interstitial cell.

Myalgia

Pain in a muscle or group of muscles.

Oligospermia

Condition of a suboptimal concentration of spermatozoa in the ejaculated semen to ensure successful fertilization of an ovum.

Orchidectomy

Surgery to remove one or both testicles; also called orchiectomy.

Orchiectomy

Surgery to remove one or both testicles; also called orchidectomy.

Orchiopexy

Surgical fixation of the testicle.

Orchitis

Inflammation of a testis.

Penis

Male organ of copulation.

Polyuria

Excessive urine production.

Prepuce

Flap of skin that forms a collar around, and thus protects and lubricates, the glans penis; also referred to as the foreskin.

Prostate gland

A gland at the base of the bladder surrounding the urethra that contributes fluid to semen during ejaculation.

Prostatitis

Inflammation of the prostate gland.

Scrotum

An external pouch of skin and muscle that houses the testes.

Semen

Ejaculatory fluid composed of sperm and secretions from the seminal vesicles, prostate, and bulbourethral glands.

Seminal vesicle

Gland that produces seminal fluid, which contributes to semen.

Seminiferous tubules

Structures within the testes where spermatogenesis occurs.

Sertoli cells

Cells that support germ cells through the process of spermatogenesis; a type of sustentacular cell.

Sperm

Male gamete.

Spermatic cord

Bundle of nerves and blood vessels that supplies the testes; contains ductus deferens.

Spermatid

Immature sperm cells produced by meiosis II of secondary spermatocytes.

Spermatocyte

A male gametocyte from which a spermatozoon develops.

Spermatogenesis

The process of producing sperm.

Spermatogonia

The diploid precursor cells that become sperm.

Spermiogenesis

Transformation of spermatids to spermatozoa during spermatogenesis.

Sterility

A condition of being unable to produce children.

Testes

Male gonads.

Urethritis

Inflammation of the urethra.

Varicocele

Distended veins of the spermatic cord.

Vasectomy

A procedure in which a small section of the ductus deferens is cut and sealed to interrupt sperm delivery. It is an effective form of male birth control.

Vasovasostomy

Creation of an artificial opening between ducts to restore fertility to males who have had a vasectomy.

Test Yourself

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Image Descriptions

Figure 16.1 image description: This figure shows the different organs in the male reproductive system. The top panel shows the side view of a man and an uncircumcised and a circumcised penis. The bottom panel shows the lateral view of the male reproductive system and the major parts are labeled. [Return to Figure 16.1].

Figure 16.2 image description: This diagram shows the structure of sperm; the major parts are labeled (from left

to right): head section (acrosome, plasma membrane, nucleus), mid-piece (centriole, mitochondria, flagellum), tail (flagellum, axial filament), end piece (end piece). [Return to Figure 16.2].

17. Female Reproductive System

Learning Objectives

- Examine the anatomy of the female reproductive system
- Determine the main functions of the female reproductive system
- Differentiate the medical terms of the female reproductive system and common abbreviations
- Recognize the medical specialties associated with the female reproductive system
- Discover common diseases, disorders, and procedures related to the female reproductive system

Female Reproductive System Word Parts

Click on prefixes, combining forms, and suffixes to reveal a list of word parts to memorize for the female reproductive system.

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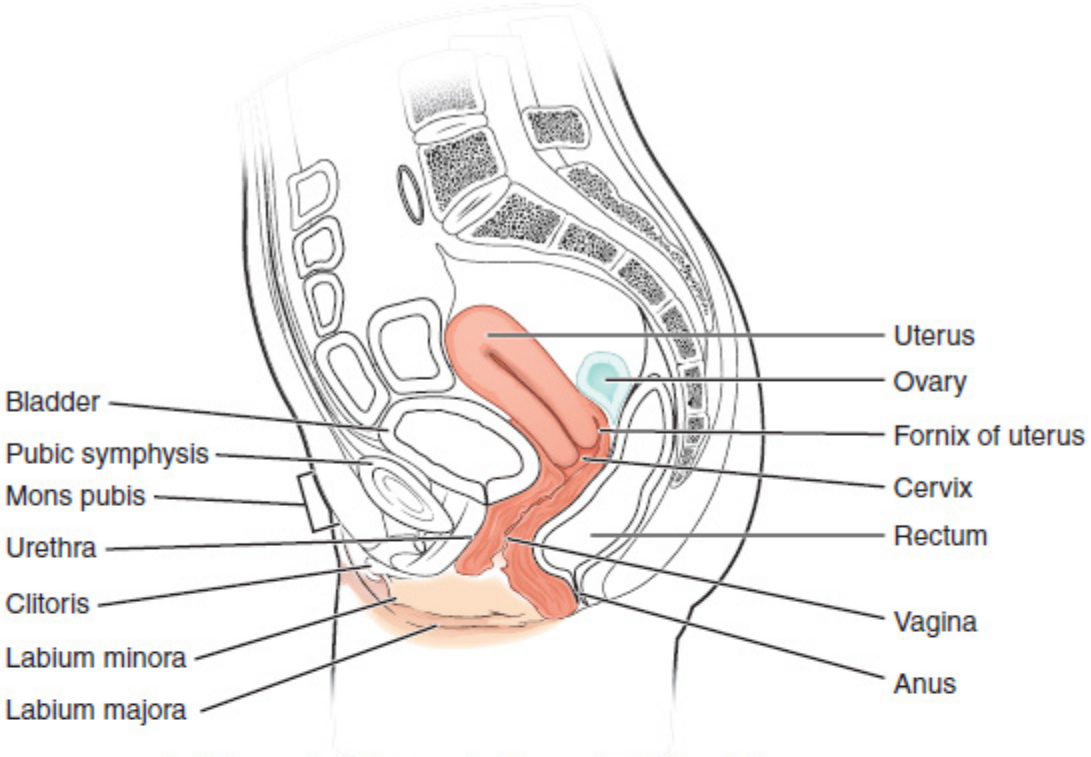
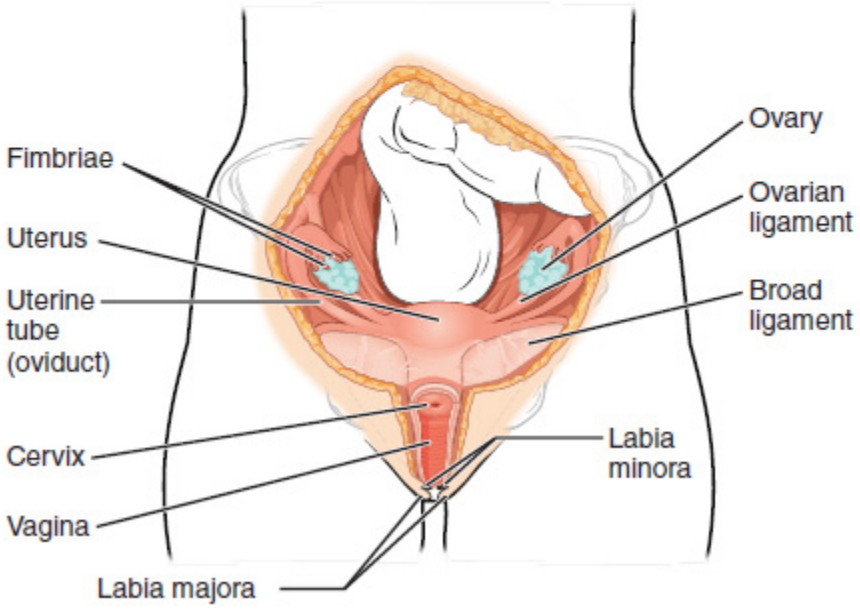
Introduction to the Female Reproductive System

The female reproductive system produces **gametes** and reproductive hormones. In addition, the female reproductive system supports the developing fetus and delivers it to the outside world. The female reproductive system is located primarily inside the pelvic cavity. The female gonads are called ovaries and the gamete they produce is called an oocyte.



(a) Human female reproductive system: lateral view



(b) Human female reproductive system: anterior view

Figure 17.1 Female Reproductive System. The major organs of the female reproductive system are located inside the pelvic cavity. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

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Media 17.1. Reproductive System, Part 1 – Female Reproductive System: Crash Course A&P #40 [Online video]. Copyright 2015 by CrashCourse.

Practice Medical Terms Related to the Female Reproductive System

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Anatomy (Structures) of the Female Reproductive System

External Female Genitals

The external female reproductive structures are referred to collectively as the **vulva** and they include:

- The **mons pubis,** a pad of fat that is located at the anterior, over the pubic bone. After puberty, it becomes covered in pubic hair.
- The **labia majora** (labia = "lips"; majora = "larger"), folds of hair-covered skin that begin just posterior to the mons pubis.
- The **labia minora** (labia = "lips"; minora = "smaller"), which is thinner and more pigmented and extends medially to the labia majora.
    - Although they naturally vary in shape and size from woman to woman, the labia minora serve to protect the female urethra and the entrance to the female reproductive tract.
    - The superior, anterior portions of the labia minora come together to encircle the **clitoris** (or glans clitoris), an organ that originates from the same cells as the glans penis and has abundant nerves that make it important in sexual sensation and orgasm. The **hymen** is a thin membrane that sometimes partially covers the entrance to the **vagina**.

- The vaginal opening is located between the opening of the urethra and the anus. It is flanked by outlets to the **Bartholin's glands**.

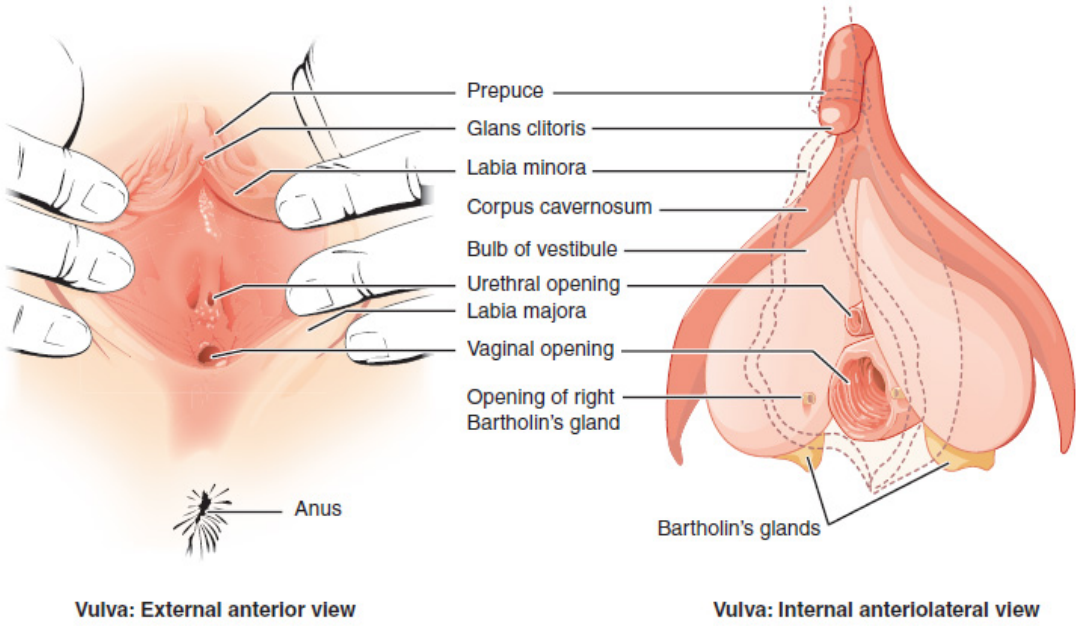

Figure 17.2. The Vulva. The external female genitalia is referred to collectively as the vulva. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Internal Female Reproductive Organs

Vagina

The **vagina** is a muscular canal (approximately 10 cm long) that is the entrance to the reproductive tract. It also serves as the exit from the uterus during menses and childbirth. The outer walls of the anterior and posterior vagina are columns with ridges. The superior **fornix** meets the uterine cervix. The cervix is the opening to the uterus.

The walls of the vagina are lined with:

- An outer, fibrous adventitia
- A middle layer of smooth muscle
- An inner mucous membrane with transverse folds called **rugae**.

Together, the middle and inner layers allow the expansion of the vagina to accommodate intercourse and childbirth. The thin, perforated hymen can partially surround the opening to the vaginal orifice. The **Bartholin's glands** and the lesser vestibular glands (located near the clitoris) secrete mucus, which keeps the vestibular area moist.

The vagina has a normal population of microorganisms that help to **protect** against infection. There are both pathogenic bacteria and yeast in the vagina. In a healthy woman, the most predominant type of vaginal bacteria is from the genus *Lactobacillus*, which secretes lactic acid. The lactic acid protects the vagina by maintaining an acidic **pH** (below 4.5).

Lactic acid, in combination with other vaginal secretions, makes the vagina a self-cleansing organ. However, **douching**

can disrupt the normal balance of healthy microorganisms, and increase a woman's risk for infections and irritation. It is recommended that women do not douche and that they allow the vagina to maintain its normal healthy population of protective microbial flora.

Ovaries

The **ovaries** are the female gonads. There are two, one at each entrance to the fallopian tube. They are each about 2 to 3 cm in length, about the size of an almond. The ovaries are located within the pelvic cavity. The ovary itself is attached to the uterus via the ovarian ligament. The ovarian stroma forms the bulk of the adult ovary. Oocytes develop within the outer layer of this stroma, each surrounded by supporting cells. This grouping of an oocyte and its supporting cells is called a **follicle.**

The Fallopian Tubes

The fallopian tubes, also known as uterine tubes, are the conduit of the **oocyte** from the ovary to the uterus. Each of the two fallopian tubes is close to, but not directly connected to, the ovary.

- The **isthmus** is the narrow medial end of each fallopian tube that is connected to the uterus.
- The wide distal **infundibulum** flares out with slender, finger-like projections called **fimbriae**.
- The middle region of the tube, called the **ampulla**, is where fertilization often occurs.

The fallopian tubes have three layers:

- An outer serosa.
- A middle smooth muscle layer.
- An inner mucosal layer.
    - In addition to its mucus-secreting cells, the inner mucosa contains ciliated cells that beat in the direction of the uterus, producing a current that will be critical to moving the **oocyte**.

Did you know?

Fallopian tubes are not connected to the ovaries. Instead, fimbriae catch the oocyte like a baseball in a glove.

The Uterus and Cervix

The **uterus** is the muscular organ that nourishes and supports the growing embryo. Its average size is approximately 5 cm wide by 7 cm long, and it has three sections.

- The portion of the uterus **superior** to the opening of the uterine tubes is called the **fundus**.
- The middle section of the uterus is called the **body of the uterus** (or corpus).
- The **cervix** is the narrow **inferior** portion of the uterus that projects into the vagina.
    - The cervix produces mucus secretions that become thin and stringy under the influence of high systemic plasma estrogen concentrations, and these secretions can facilitate sperm movement through the reproductive tract.

The wall of the uterus is made up of three layers:

- **Perimetrium:** the most superficial layer and serous membrane.
- **Myometrium:** a thick layer of smooth muscle responsible for uterine contractions.
- **Endometrium:** the innermost layer containing a connective tissue lining covered by epithelial tissue that lines the lumen. It provides the site of implantation for a fertilized egg and sheds during menstruation if no egg is fertilized.

Concept Check

- Write or draw out the components of the pathway that an **oocyte** takes from beginning to end.
- Why do you think the **fallopian tubes** are not connected to the **ovaries**?

Physiology (Function) of the Female Reproductive System-Ovulation

Following ovulation, the Fallopian tube receives the oocyte. Oocytes lack flagella, and therefore cannot move on their own.

- High concentrations of estrogen that occur around the time of ovulation induce contractions of the smooth muscle along the length of the fallopian tube.
- These contractions occur every 4 to 8 seconds, causing the oocyte to flow towards the uterus, through the coordinated beating of the cilia that line the outside and lumen of the length of the fallopian tube which pulls the oocyte into the interior of the tube.
- Once inside, the muscular contractions and beating cilia move the oocyte slowly toward the uterus.
- When fertilization does occur, sperm typically meet the egg while it is still moving through the ampulla.

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Media 17.2. The ovarian cycle | Reproductive system physiology | NCLEX-RN | Khan Academy [Online video]. Copyright 2014 by Khan Academy Medicine.

The Menstrual Cycle

The three phases of the menstrual cycle are:

1. The **menses phase** of the menstrual cycle is the phase during which reproductive hormone levels are low, the woman menstruates, and the lining is shed. The menses phase lasts between 2 to 7 days with an average of 5 days.
2. The **proliferative phase** is when menstrual flow ceases and the endometrium begins to **proliferate**. During this phase reproductive hormones are working in **homeostasis** to trigger ovulation on approximately day 14 of a typical 28-day menstrual cycle. Ovulation marks the end of the proliferative phase.
3. The **secretory phase** is when the endometrial lining prepares for the implantation of a fertilized egg. If no pregnancy occurs within approximately 10 to 12 days the endometrium will grow thinner and shed starting the first day of the next cycle.

Menopause

Menopause is the cessation of the menstrual cycle that occurs as a result of the loss of ovarian follicles and the hormones that they produce, namely estrogen. The earliest changes occur during the menopausal transition, often referred to as **perimenopause**, when a woman's cycle becomes irregular but does not stop entirely. As estrogen levels change, other signs and symptoms that occur are hot flashes and night sweats, trouble sleeping, vaginal dryness, mood swings, difficulty focusing, and thinning of hair on the head along with the growth of more hair on the face. Depending on the individual, these symptoms can be entirely absent, moderate, or severe.

A woman is considered to have completed menopause if she has not menstruated in a full year. After that point, she is considered postmenopausal. The average age for this change is consistent worldwide at between 50 and 52 years of age, but it can normally occur in a woman's forties or later in her fifties. Poor health, including smoking, can lead to earlier loss of fertility and earlier menopause. After menopause, low levels of estrogen increase women's risks of high cholesterol, cardiovascular disease, and **osteoporosis**.

Anatomy Labeling Activity

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Practice Terms Related to the Female Reproductive System

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Common Abbreviations for the Female Reproductive System

Many terms and phrases related to the female reproductive system are abbreviated. Learn these common abbreviations by expanding the list below.

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Diseases and Disorders of the Female Reproductive System

Breast Cancer

Breast cancer is the second most common cancer among women in the United States. It starts in the cells that line the ducts or the lobule of the breast. Some warning signs include a new lump in the breast or **axilla**, thickening or swelling, dimpling of the breast skin, redness or flaky skin, discharge, and change in breast size. Risk factors include a familial or personal history of breast cancer, obesity, hormonal treatment, and mutations in breast cancer-related genes (BRCA1 or BRCA2) (Centers for Disease Control and Prevention, n.d.-a; National Cancer Institute, 2021a).

Treatment options include chemotherapy, hormone therapy, immunotherapy, radiation, and surgical interventions

such as **mastectomy**, and biopsy (National Cancer Institute, 2021a). To learn more about breast cancer, view the National Cancer Institute's web page on breast cancer.

Cervical Cancer

Cervical cancer is typically slow-growing cancer and is highly curable when found and treated early. Advanced cervical cancer may cause abnormal bleeding or discharge from the vagina such as bleeding after sex. It is diagnosed during a Papanicolaou test (or Pap smear), which looks for precancerous lesions on the cervix. The Pap test can find cervical cancer early when treatment is most effective. Almost all cervical cancers are caused by human papillomavirus (HPV). The HPV test looks for HPV strains which is the virus that can cause precancerous cell changes. In the United States, a vaccine called Gardasil® 9 is available, which prevents infection with HPV and significantly reduces the risk of cervical cancer (National Cancer Institute, 2021b, 2021c). To learn more, visit the National Cancer Institute's web page on cervical cancer.

Endometriosis

Endometriosis is an abnormal condition of the **endometrium**. Endometriosis occurs when this tissue grows and implants outside the uterus. The female hormone estrogen causes these implants to grow, bleed, and become inflamed. The inflammation causes scar tissue around nearby organs, which can interfere with their normal functioning and cause pain (Office on Women's Health, 2019a).

Endometriosis generally appears in women in their 30s and 40s. Signs and symptoms may include **dysmenorrhea**, **dyspareunia**, menstrual irregularity, and infertility. Diagnosis may include **laparoscopy** and endometrial biopsy. There is no cure for endometriosis. Treatment may include hormonal birth control, surgical interventions such as **hysterectomy** and **oophorectomy**. The cause of endometriosis is unknown (MedlinePlus, 2021; Office on Women's Health, 2019a). For more information, visit the Office on Women's Health web page on endometriosis.

Polycystic Ovary Syndrome (PCOS)

Polycystic ovary syndrome (PCOS) has no known etiology, but researchers have linked it to excessive production of insulin and **androgens**. Excessive insulin in the body can cause insulin resistance and lead to type 2 diabetes. High levels of androgens can prevent the ovaries from releasing an egg during the menstrual cycle. The most common signs and symptoms of PCOS include **oligomenorrhea**, **amenorrhea**, polymenorrhea, one or both ovaries with multiple small painless cysts, **acrochordons**, **acanthosis nigricans**, **hirsutism**, thinning hair, acne, weight gain, anxiety, depression, hyperglycemia, and infertility. Treatments like medications such as birth control pills or **antiandrogens** can help balance the hormones in your body and relieve some of the symptoms (Office on Women's Health, 2019b). To learn more, visit the Office on Women's Health's web page on endometriosis.

Sexually Transmitted Infections and Diseases (STIs and STDs)

Although the terms sexually transmitted infections (STI) and sexually transmitted diseases (STD) are often used

interchangeably, they have distinct meanings. STIs refer to infections caused by a virus, bacteria, fungus, or parasite via sexual contact. STDs refer to the disease state that develops as a result of infection (U.S. Department of Health and Human Services, 2020).

Chlamydia

Chlamydia is one of the most common sexually transmitted diseases. It is caused by the bacterium *Chlamydia trachomatis*, which infects the cervix and other organs of the reproductive tract in women. Chlamydia spreads through unprotected oral, anal, or vaginal sex with an infected person. Chlamydia can also spread from mother to child during childbirth. Many people with chlamydia do not have any symptoms and unknowingly pass the infection to their sexual partner(s). If symptoms develop, they may not appear for several weeks after sexual contact with an infected person. Women may have abnormal vaginal discharge, polyuria, and painful intercourse. Untreated chlamydia in women can cause pelvic inflammatory disease, which can cause permanent damage to the reproductive tract and infertility. Chlamydia is easy to treat with antibiotics and can be cured. However, until a patient finishes their treatment, they continue to have the infection and can continue to pass it to others. Patients should be re-tested three months after treatment, as re-infection is common (Centers for Disease Control and Prevention, n.d.-b).

Gonorrhea (Gonococcus)

Gonorrhea is a sexually transmitted disease caused by the bacterium *Neisseria gonorrhoeae*. It infects the mucous membranes of the reproductive tract, including the cervix, uterus, and fallopian tubes in women. Infections can also infect the mouth, throat, eyes, and anus. Gonorrhea is spread through unprotected oral, vaginal or anal sex with an infected person. It can also spread from mother to child during childbirth. Many people infected with gonorrhea have no symptoms and can unknowingly pass the infection on to their sexual partner(s). Signs and symptoms vary depending on which part of the body is infected. Women may have dysuria, increased vaginal discharge, or vaginal bleeding not related to their menstrual cycle. Gonorrhea infection from oral sex may lead to a sore throat, whereas infection from anal sex may cause itchiness and discharge from the anus. Untreated chlamydia can cause pelvic inflammatory disease. Gonorrhea can be treated and cured with antibiotics in combination with an **intramuscular** (IM) injection. However, until the patient finishes their treatment, they continue to have the infection and can pass it to others. Patients should be re-tested three months after treatment, as re-infection is common (Centers for Disease Control and Prevention, n.d.-c).

Notifiable and Reportable Diseases

In every state in the United States, chlamydia and gonorrhea are notifiable and reportable diseases. This means that when a person tests positive for either of the STIs, public health departments and the Centers for Disease Control and Prevention (CDC) are informed so that they may monitor trends, identify outbreaks, and take the necessary steps to prevent further spread of the disease (Centers for Disease Control and Prevention, n.d.-d, n.d.-e).

Human Papillomavirus (HPV)

Human papillomavirus (HPV) is another common sexually transmitted infection (STI). Both males and females can

be infected with HPV. There are over 200 strains of HPV. Some strains can cause visible genital warts, while others cause genital, anal, throat, and cervical cancers. HPV spreads through sexual activity and skin-to-skin contact in the genital area with an infected person. Since some people are **asymptomatic**, they don't know they have the virus and consequently pass the virus to their sexual partners. Treatments are available for genital warts but there is no cure for HPV (MedlinePlus, 2021). For more information, visit the CDC's web page on HPV.

Herpes Simplex Virus (HSV)

Genital herpes is a sexually transmitted disease that is caused by a virus called the herpes simplex virus (HSV). There are two types of herpes simplex viruses:

- Type 1- oral herpes or cold sores (HSV-1)
- Type 2- genital herpes (HSV-2).

Signs and symptoms might include **dysuria**, enlarged glands, **myalgia**, and fever. Once a patient is infected with HSV, the virus remains in their body even after the symptoms are gone and can cause recurring outbreaks. When the virus becomes active again, the symptoms return but are usually less painful and heal faster (Centers for Disease Control and Prevention, n.d.-f).

Herpes is spread through direct contact with the sores or blisters of an infected person. Contact (and transfer of the virus) can occur from genitals-to-genitals, mouth-to-genitals, or mouth-to-mouth. Herpes can also be passed to the anal area. Herpes spreads easily during sexual contact while symptoms are present or just before an outbreak of symptoms. An infected person may spread herpes even when they have no symptoms; this is called **asymptomatic** shedding. One can spread the herpes virus to other parts of their body after touching the sores. The fingers, eyes, and other body areas can accidentally become infected in this way. Hand washing after touching sores and blisters is recommended to prevent spreading the virus (Centers for Disease Control and Prevention, n.d.-f).

There is no cure for herpes. Antiviral pills help to reduce symptoms and speed the healing of blisters or sores and are prescribed by a doctor. All sexual partner(s) should be informed. The only way to reduce the risk of transmission of herpes is to avoid direct contact with the sores and to use condoms. Condoms will reduce but not eliminate risk, as the virus can be present and shed from the skin in the genital area (Centers for Disease Control and Prevention, n.d.-f).

Common Abbreviations for Reproductive Sexually Transmitted Infections (STIs)

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Medical Terms in Context

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Medical Specialties and Procedures Related to the Female Reproductive System

Obstetrics and Gynecology

Obstetrics and gynecology, also known as OB/GYN, is a branch of medicine focusing on the diagnosis, treatment, management, and prevention of diseases and disorders of the female reproductive system, as well as the care of women during pregnancy and childbirth. Subspecialties in women's health include contraception, reproductive **endocrinology**, and infertility (National Cancer Institute, n.d.-a). To learn more, visit the American College of Surgeons' web page on obstetrics and gynecology.

Hysterectomy

A **hysterectomy** is performed to stage or treat endometriosis, cancers, and precancers of the female reproductive tract, and some non-cancerous conditions that have not responded to other forms of treatment. There are three types of hysterectomy:

- A **total hysterectomy** removes both the uterus and the cervix.
- A **subtotal hysterectomy** removes the uterus only.
- A **radical hysterectomy** removes the uterus, cervix, part of the vagina, and ligaments (Office on Women's Health, 2019b).

Sometimes the ovaries and fallopian tubes are removed at the same time that a hysterectomy is done. A **bilateral** salpingo-oophorectomy (BSO) removes both ovaries and fallopian tubes. A **unilateral** salpingo-oophorectomy removes one ovary and one fallopian tube (National Cancer Institute, n.d.-b, n.d.-c). For more information, visit the Cleveland Clinic's web page on hysterectomy.

Female Reproductive System Vocabulary

Acanthosis nigricans
A disorder that causes darkening and thickening of the armpit and other body folds.

Acrochordons
Common benign skin growths that appear as small, raised, brown or skin-colored bumps; also called skin tags.

Amenorrhea
Absence of menstruation.

Androgens
Male sex hormones; for example, testosterone.

Antiandrogens
Substances that keep androgens (male sex hormones) from binding to proteins called androgen receptors. Preventing this binding blocks the effects of these hormones in the body.

Antibiotics
A drug used to treat infections caused by bacteria and other microorganisms.

Antiretrovirals
Drugs that inhibit the ability of the human immunodeficiency virus (HIV) or other types of retroviruses to multiply in the body.

Asymptomatic
Having no signs or symptoms of disease.

Axilla
The underarm or armpit.

Bartholin's glands
Glands that produce a thick mucus that maintains moisture in the vulva area; also referred to as the greater vestibular glands.

Bilateral
Affecting both the right and left sides of the body.

Cervicitis
Inflammation of the cervix.

Colposcope
A lighted magnifying instrument used to check the cervix, vagina, and vulva for signs of disease.

Colposcopy
A procedure in which a lighted, magnifying instrument called a colposcope is used to examine the cervix, vagina, and vulva.

Contraception
The use of drugs, devices, or surgery to prevent pregnancy.

Douching
Washing the vagina with fluid.

Dysmenorrhea
Painful menstruation.

Dyspareunia

Genital pain before, during, or after intercourse.

Dysuria

Painful urination.

Endocrinology

A specialty in the field of medicine that focuses on the treatment of endocrine system disorders.

Endometriosis

A disease characterized by the presence of endometrial-like tissue found outside the uterus.

Endometritis

Inflammation of the endometrium.

Endometrium

The innermost layer of the uterus. It provides the site of implantation for a fertilized egg and sheds during menstruation if no egg is fertilized.

Endoscopy

A procedure that uses an endoscope to examine the inside of the body.

Fistula

An abnormal opening or passage between two organs or between an organ and the surface of the body.

Fornix

The superior portion of the vagina.

Gamete

A specialized sex cell carrying 23 chromosomes.

Gynecologist

A doctor who has special training in diagnosing and treating diseases of the female reproductive organs.

Gynecology

A medical-surgical specialty concerned with the physiology and disorders primarily of the female genital tract, as well as female endocrinology and reproductive physiology.

Hirsutism

A condition in which women and children have excess coarse body hair of an adult male distribution pattern as a result of elevated androgen levels.

Homeostasis

The state of steady internal conditions maintained by living things.

Hysterectomy

Surgery to remove the uterus and, sometimes, the cervix.

Hysterosalpingogram

A radiographic image of the uterus and fallopian (uterine) tubes.

Hysteroscope

An endoscope used for examining the interior of the uterus.

Hysteroscopy

Endoscopic examination of the uterus.

Inferior

A position below or lower than another part of the body proper.

Intramuscular

Within or into muscle.

Laparoscopy

A procedure that uses a laparoscope, inserted through the abdominal wall, to examine the inside of the abdomen.

Leukorrhea

White discharge from the vagina.

Lumbago

Acute or chronic pain in the lumbar or sacral regions.

Mammography
The use of film or a computer to create a picture of the breast.
Mammogram
Radiographic image of the breast.
Mammoplasty
Surgical reconstruction of the breast, including both augmentation and reduction.
Mastalgia
Pain or discomfort in one or both breasts.
Mastectomy
The surgical procedure to remove all or part of a breast.
Mastitis
A condition in which breast tissue is inflamed.
Menarche
First menstruation in a pubertal female.
Menopause
The cessation of the menstrual cycle; is considered complete when a woman has not menstruated in a full year.
Menorrhagia
Excessive bleeding at menstruation.
Metrorrhagia
Excessive bleeding from the uterus not related to menstruation.
Oligomenorrhea
Abnormally infrequent menstruation.
Oocyte
Immature egg cell.
Oophorectomy
Surgery to remove one or both ovaries.
Oophoritis
Inflammation of the ovary.
Ovulation
Release of a secondary oocyte and associated granulosa cells from an ovary.
Papanicolaou smear (Pap test)
A procedure in which a small brush is used to gently remove cells from the surface of the cervix and the area around it so they can be checked under a microscope for cervical cancer or cell changes that may lead to cervical cancer.
Perimenopause
The transitional period before and after menopause wherein the menstrual cycle is irregular and hormone levels widely fluctuate.
Polyuria
Excessive urine production.
Prolapse
The protrusion of an organ or part of an organ into a natural or artificial orifice.
Proliferate
The ability to reproduce rapidly.
Puerperium
Time directly after childbirth.
Salpingectomy
Excision of one or both of the fallopian (uterine) tubes.
Salpingitis
Inflammation of a fallopian (uterine) tube.

Salpingo-oophorectomy
Surgical removal of the fallopian (uterine) tubes and ovaries.
Salpingostomy
Creation of an artificial opening in the fallopian (uterine) tube.
Speculum
An instrument used to widen an opening of the body to make it easier to look inside.
Superior
A position above or higher than another part of the body proper.
Trachelectomy
Excision of the cervix.
Tubal ligation
Surgical closure of the fallopian (uterine) tubes for sterilization.
Unilateral
Pertaining to one side.
Urethritis
Inflammation of the urethra.
Vaginal
Pertaining to the vagina.
Vaginosis
Abnormal condition of the vagina.
Vulvectomy
Excision of the vulva.
Vulvovaginitis
Inflammation of the vulva and vagina.

Test Yourself

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https://pressbooks.uwf.edu/medicalterminology/?p=88#h5p-48

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Image Descriptions

Figure 17.1 image description: This figure shows the structure and the different organs in the female reproductive system. The top panel shows the lateral view with labels (clockwise from top): uterus, ovary, fornix of uterus, cervix, rectum, vagina, anus, labia majora, labium minora, clitoris, urethra, mons pubis, pubic symphysis, bladder; and the bottom panel shows the anterior view with labels (clockwise from top): ovary, ovarian ligament, broad ligament, labia minora, labia majora, vagina, cervix, uterine tube, uterus, fimbriae. [Return to Figure 17.1].

Figure 17.2 image description: This figure shows the parts of the vulva. The right panel shows the external anterior view and the left panel shows the internal anterolateral view. The major parts are labeled (from top): prepuce, glans clitoris, labia minora, corpus cavernosum, bulb of vestibule, urethral opening, labia majora, vaginal opening, the opening of right Bartholin's gland, Bartholin's glands, anus. [Return to Figure 17.2].

18. Obstetrics

Learning Objectives

- Identify the processes involved in human reproduction and childbirth
- Evaluate the specialty of obstetrics
- Differentiate the medical terms used in obstetrics and use correct abbreviations
- Recognize the medical specialties associated with obstetrics
- Discover common complications and procedures related to obstetrics

Obstetrics Word Parts

Click on prefixes, combining forms, and suffixes to reveal a list of word parts to memorize related to obstetrics.

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Introduction to Obstetrics

Obstetrics is a specialty that is concerned with the mother and fetus during pregnancy, childbirth, and the immediate postpartum period. Obstetricians study obstetrics and gynecology and are referred to as OB/GYN, Obstetrics and Gynecology.

Watch this video:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.uwf.edu/medicalterminology/?p=90#oembed-1

Media 18.1. Reproductive System, Part 4 – Pregnancy & Development: Crash Course A&P #43 [Online video]. Copyright 2015 by CrashCourse.

Practice Medical Terms Related to Obstetrics

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Fertilization

Fertilization occurs when **sperm** and an **oocyte** combine. Because each of these reproductive cells is a haploid cell containing half of the genetic material needed to form a human being, their combination forms a diploid cell. This new single cell is called a **zygote**.

Most of the time, a woman releases a single egg during an ovulation cycle.

- In approximately 1% pof ovulation cycles, two eggs are released and both are fertilized.
  - Two zygotes form, implant, and develop, resulting in the birth of **dizygotic (or fraternal) twins**. Because dizygotic twins develop from two eggs fertilized by two sperm, they are no more identical than siblings born at different times.
- Less common, one zygote can divide into two separate offspring during early development. This results in the birth of **monozygotic (or identical) twins**.

A full-term pregnancy lasts approximately 270 days (approximately 38.5 weeks) from conception to birth. Because it is easier to remember the first day of the last menstrual period (LMP) than to estimate the date of conception, obstetricians set the due date as 284 days (approximately 40.5 weeks) from the LMP. This assumes that conception occurred on day 14 of the woman's cycle, which is usually a good approximation. The 40 weeks of an average pregnancy are usually discussed in terms of three trimesters, each approximately 13 weeks. During the second and third trimesters,

the pre-pregnancy uterus is about the size of a fist and grows dramatically to contain the fetus, causing a number of anatomical changes in the mother.

Stages of Childbirth

The process of childbirth can be divided into three stages (see Figure 18.1):

- cervical dilation
- expulsion of the newborn
- after birth

For vaginal birth to occur, the cervix must dilate fully to 10 cm in diameter, wide enough to deliver the newborn's head. The dilation stage is the longest stage of labor and typically takes 6 to 12 hours. However, it varies widely and may take minutes, hours, or days, depending in part on whether the mother has given birth before. In each subsequent labor, this stage tends to be shorter.

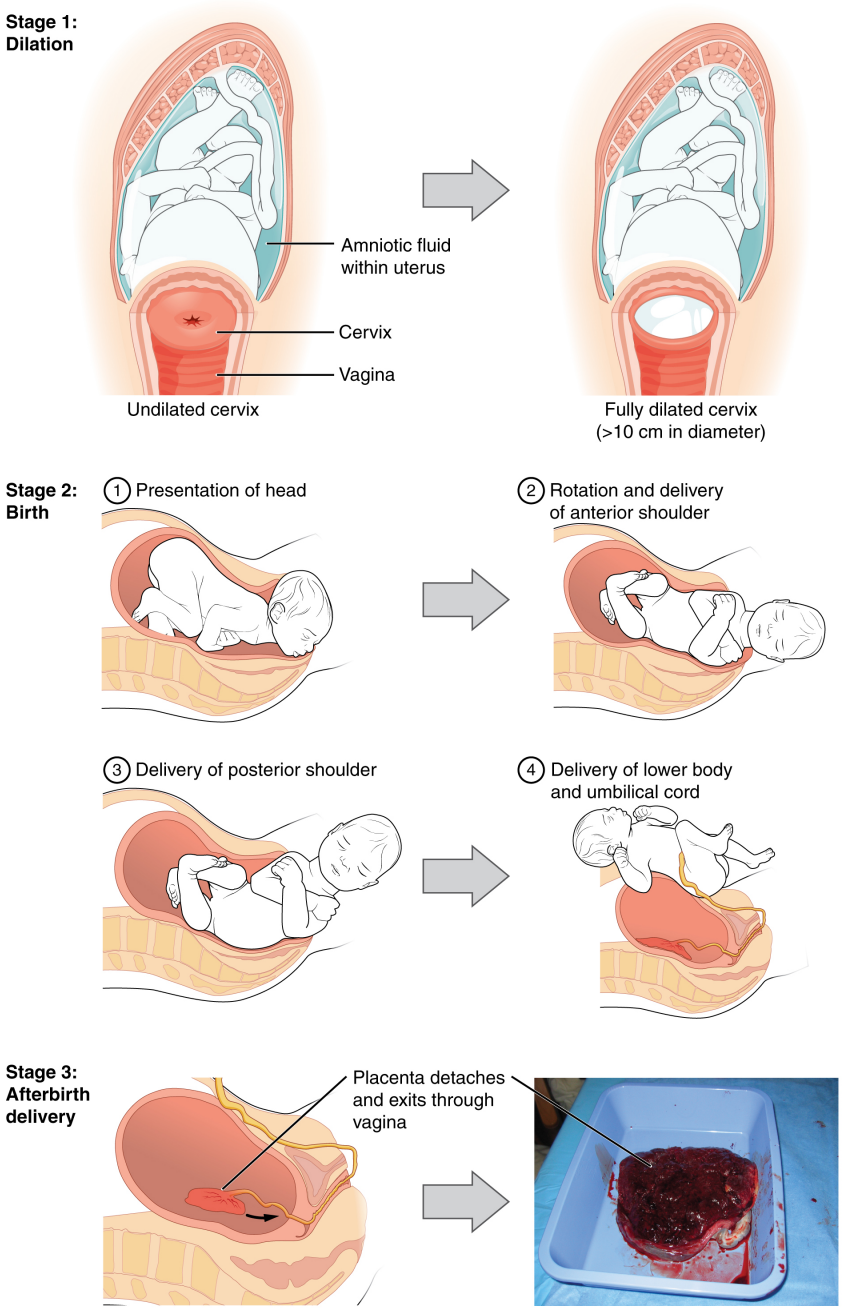

Figure 18.1 Stages of Childbirth. The stages of childbirth include Stage 1, early cervical dilation; Stage 2, full dilation and expulsion of the newborn; and Stage 3, delivery of the placenta and associated fetal membranes. (The position of the newborn's shoulder is described relative to the mother). From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Concept Check

- How is a **due date** determined?
- Explain the difference between a **monozygotic pregnancy** and a **dizygotic pregnancy**.

Homeostasis in the Newborn: Apgar Score

In the minutes following birth, a newborn must undergo dramatic systemic changes to be able to survive outside the womb. An obstetrician, midwife, or nurse can estimate how well a newborn is doing by obtaining an **Apgar score**. The Apgar score was introduced in 1952 by the anesthesiologist Dr. Virginia Apgar as a method to assess the effects on the newborn of anesthesia given to the laboring mother. Healthcare providers now use it to assess the general well-being of the newborn, whether or not analgesics or anesthetics were used.

The five criteria, skin color, heart rate, reflex, muscle tone, and respiration, are assessed and each criterion is assigned a score of 0, 1, or 2. Scores are taken one minute after birth and again five minutes after birth. Each time scores are taken, the five scores are added together. High scores (out of a possible 10) indicate the baby has made the transition from the womb well, whereas lower scores indicate that the baby may be in distress.

The technique for determining an Apgar score is quick and easy, painless for the newborn, and does not require any instruments except for a stethoscope. A convenient way to remember the five scoring criteria is to apply the mnemonic APGAR:

- **A**ppearance (skin color)
- **P**ulse (heart rate)
- **G**rimace (reflex)
- **A**ctivity (muscle tone)
- **R**espiration

Of the five Apgar criteria, heart rate and respiration are the most critical. Poor scores for either of these measurements may indicate the need for immediate medical attention to resuscitate or stabilize the newborn. In general, any score lower than 7 at the 5-minute mark indicates that medical assistance may be needed. A total score below 5 indicates an emergency. Normally, a newborn will get an intermediate score of 1 for some of the Apgar criteria and will progress to a 2 by the five-minute assessment. Scores of 8 or above are normal.

Did you know?

The Apgar score was introduced in 1952 by Dr. Virginia Apgar to assess the effect of anesthesia on newborns and mothers in labor.

Practice Terms Related to Obstetrics

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Common Abbreviations for Obstetrics

Many terms and phrases related to obstetrics are abbreviated. Learn these common abbreviations by expanding the list below.

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https://pressbooks.uwf.edu/medicalterminology/?p=90#h5p-52

Medical Terms in Context

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https://pressbooks.uwf.edu/medicalterminology/?p=90#h5p-53

Diseases and Disorders Related to Obstetrics

Preeclampsia and Eclampsia

Preeclampsia and eclampsia refer to hypertensive disorders that occur during pregnancy among women without a history of high blood pressure. Signs and symptoms of preeclampsia include blood pressure at or greater than 140/90 mmHg at or after 20 weeks of pregnancy, **edema**, and protein in the urine. Women with preeclampsia are at risk of preterm birth. If the condition is severe enough to cause seizures or a coma, it is referred to as eclampsia. If not treated, preeclampsia and eclampsia can be fatal (Office of Communications, n.d.).

Ectopic Pregnancy

An ectopic pregnancy occurs when a fertilized egg implants outside of the uterus, usually in the fallopian tube. Risk factors include older age, smoking, the use of an intrauterine device, in vitro fertilization, and prior pelvic infections, including chlamydia. Signs and symptoms include pain in the abdomen or shoulder, vaginal bleeding, and dizziness. Treatment may involve surgery or the use of medication to stop the growth of ectopic tissue (Mummert & Gnugnoli, 2021; MedlinePlus, 2021a).

Miscarriage

Miscarriage, also known as spontaneous abortion, refers to the loss of pregnancy before the 20th week. It is the most common form of pregnancy loss. Risk factors include older maternal age, a history of miscarriages, disorders of the uterus or cervix, and chronic diseases such as polycystic ovary syndrome. Signs and symptoms include vaginal spotting, abdominal pain, and cramping. However, these symptoms can be confused with symptoms of an ectopic or normal pregnancy. Treatment is generally not required in women who miscarry early in their pregnancy. If tissue remains in the uterus after miscarriage, treatment includes the use of medication to aid expulsion or a surgical procedure called **dilation and curettage (D&C)** (Dugas & Slane, 2021; MedlinePlus, 2021b).

Medical Procedures Related to Obstetrics

In Vitro Fertilization (IVF)

IVF, which stands for **in vitro fertilization**, is an assisted reproductive technology. In vitro, which in Latin translates to in glass, refers to a procedure that takes place outside of the body. There are many different indications for IVF. For example, a woman may produce normal eggs, but the eggs cannot reach the uterus because the uterine tubes are blocked or otherwise compromised. A man may have a low sperm count, low sperm motility, sperm with an unusually high percentage of morphological abnormalities, or sperm that are incapable of penetrating the zona pellucida of an egg. Figure 18.2 illustrates the steps involved in IVF.

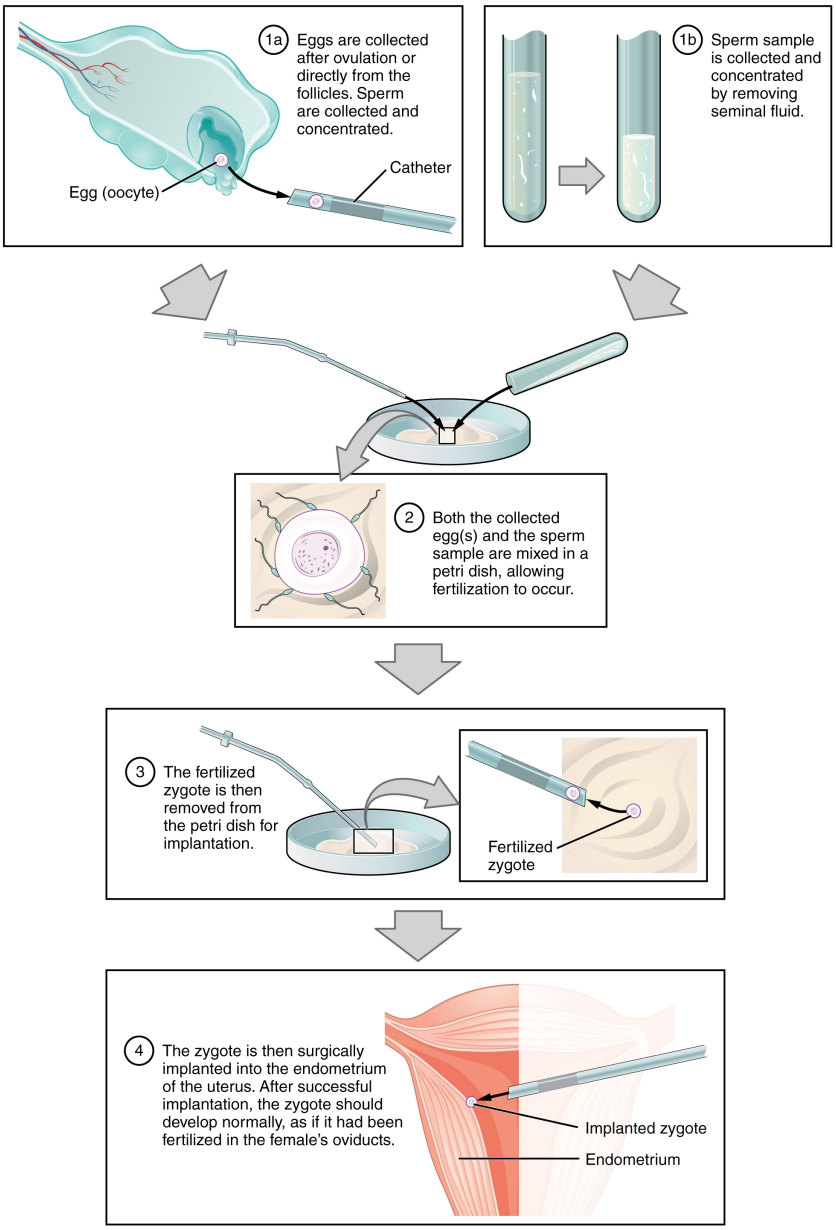

Figure 18.2 IVF. In vitro fertilization involves egg collection from the ovaries, fertilization in a petri dish, and the transfer of embryos into the uterus. From Betts et al., 2013. Licensed under CC BY 4.0. [Image description.]

Did you know?

According to the Centers for Disease Control and Prevention (n.d.-a), 6% of married women aged 15 to 44 years in the U.S. experience infertility.

Prenatal Screening and Diagnostic Testing

Approximately 3% of babies born in the United States are born with a congenital anomaly. The most common anomalies include structural heart defects, brain/spine defects, cleft lip/palate, or anomalies like Down syndrome. Prenatal testing may include blood work, ultrasound, **chorionic villus sampling** (CVS) and **amniocentesis** (Centers for Disease Control and Prevention, n.d.-b, n.d.-c).

Obstetrics Vocabulary

Abortion
Intentional removal of a fetus from the uterus.

Alpha-fetoprotein test
Alpha-fetoprotein (AFP) is a protein that is produced during fetal development. The AFP test is an analysis of the mother's blood serum to determine whether the level of AFP denotes a risk of a birth defect.

Amenorrhea
Absence of menstruation.

Amniocentesis
A procedure for obtaining amniotic fluid.

Amniotomy
Incision into the amnion to induce labor.

Apgar score
A technique used to assess the general wellbeing of a newborn. The newborn is assessed one minute after birth and again five minutes after birth.

Artificial insemination
A process where the semen is introduced into the vagina by mechanical means.

Breech
The position of the fetus is feet first. Ideally, the position of the fetus should be headfirst for a safer delivery.

Cesarean section
Delivery of the fetus through an abdominal incision.

Cephalopelvic disproportion
A condition where the infant's head is larger than the mother's pelvis.

Cerclage

A suture inserted into the cervix to prevent dilation and prevention miscarriage.

Chorioamnionitis

Inflammation of the chorion and amnion.

Choriocarcinoma

A malignant, fast-growing tumor that develops from trophoblastic cells (cells that help an embryo attach to the uterus and help form the placenta).

Chorionic villus sampling

A procedure in which tissue from the placenta is tested for fetal chromosomal disorders.

Colostrum

A thick, yellowish substance secreted from a mother's breasts in the first postpartum days.

Dilation and curettage (D&C)

A procedure to scrape and remove tissue from the inner lining of the uterus. The cervix is dilated (made larger) and a curette (spoon-shaped instrument) is inserted into the uterus to remove tissue. The procedure is used to test tissue for signs of disease, after a miscarriage, or to treat certain conditions.

Dystocia

Slow or difficult labor.

Eclampsia

A very serious condition in pregnant women with hypertension; patients are at high risk of coma, convulsions, and even death.

Ectopic pregnancy

A pregnancy in which the fertilized ovum is implanted in any tissue other than the uterine wall.

Episiotomy

Incision made in the posterior vaginal wall and perineum that facilitates vaginal birth.

Fetal

Pertaining to the fetus.

Gestation

The period required for embryonic and fetal development in utero; pregnancy.

Gestational diabetes

Diabetes mellitus that occurs during pregnancy but resolves by the end of pregnancy in women without a history of diabetes.

Gestational hypertension

Elevated systolic and diastolic blood pressure in pregnant women.

Gravidity

The number of pregnancies, complete or incomplete, experienced by a woman.

Hyperemesis gravidarum

Excessive vomiting during pregnancy. Hyperemesis can occur with any pregnant woman, even a woman who miscarried. Often these women may require hospitalization for fluid and electrolyte intake.

Induction

The process of bringing on or starting labor through artificial means.

In vitro fertilization

A process where the ova is fertilized outside the body and then implanted into the uterus.

Lactic acid

A substance produced by the body, such as during strenuous exercise, that aids in various chemical processes in the body.

Meconium

Fetal wastes consisting of ingested amniotic fluid, cellular debris, mucus, and bile.

Microcephaly

A congenital abnormality where the head is small.

Midwifery

Practice of assisting in childbirth.

Natal

Pertaining to being born or birth.

Neonatal

Pertaining to the newborn's first thirty days of life outside of the uterus.

Neonate

An infant during the first 28 days after birth.

Neonatologist

Physician who studies and treats disorders of the newborn.

Neonatology

A subspecialty of pediatric medicine concerned with the newborn.

Obstetrician

A doctor who specializes in caring for women during pregnancy and childbirth.

Obstetrics and gynecology

A branch of medicine that specializes in the care of women during pregnancy and childbirth and in the diagnosis and treatment of diseases of the female reproductive organs; also called OB/GYN.

Oligohydramnios

A condition of abnormally low amniotic fluid volume.

Oocyte

Immature egg cell.

Parturition

Childbirth.

Placenta abruptio

Occurs when the placenta prematurely becomes detached from the uterine wall, resulting in uterine bleeding, fetal distress, or fetal death; also known as abruptio placenta.

Placenta previa

Low placement of fetus within the uterus, which causes the placenta to partially or completely cover the opening of the cervix as it grows.

Polyhydramnios

A condition where there is excessive amniotic fluid in the placenta.

Postnatal

Pertaining to after birth.

Postpartum

The period of approximately 6 weeks immediately following childbirth.

Preeclampsia

The abnormal condition in pregnancy where the patient experiences hypertension, edema, and proteinuria.

Prenatal

Having to do with the time a female is pregnant, before birth occurs; also called antenatal.

Primigravida

First pregnancy.

Pseudocyesis

False pregnancy.

Puerperal

Pertaining to immediately after childbirth.

Puerperium

Time directly after childbirth (6 to 8 weeks after giving birth).

Sperm
Male gamete (spermatozoon).
Stillbirth
An infant who is born dead.
Teratogen
An agent capable of producing malformations in a developing embryo.
Teratology
A branch of embryology for the study of congenital malformations and developmental abnormalities.
Vaginal birth following a C-section
Delivery of an infant through the vagina in a female who has had a prior cesarean section.
Zygote
A single cell formed by the fusion of an egg and sperm; also called the fertilized egg.

Test Yourself

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https://pressbooks.uwf.edu/medicalterminology/?p=90#h5p-54

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Image Descriptions

Figure 18.1 image description: This multi-part figure shows the different stages of childbirth. The top panel shows dilation of the cervix (undilated vs fully dilated), the middle panel shows birth (presentation of the head, rotation and delivery of anterior shoulder, delivery of posterior shoulder, delivery of lower body, and umbilical cord), and the bottom panel shows afterbirth delivery. [Return to Figure 18.1].

Figure 18.2 image description: This multi-part figure shows the different steps in in vitro fertilization. The top panel shows how the oocytes and the sperm are collected and prepared (text reads: 1a) eggs are collected after ovulation or directly from the follicles. Sperm is collected and concentrated. 1b) Sperm sample is collected and concentrated by removing seminal fluid). The next panel shows the sperm and oocytes being mixed in a petri dish (text labels read: 2) both the collected eggs and the sperm sample are mixed in a petri dish, allowing fertilization to occur). The panel below shows the fertilized zygote being prepared for implantation (text labels read: 3a) the fertilized zygote is then removed from the petri dish for implantation. 3b) fertilized zygote). The last panel shows the fertilized zygote being implanted into the uterus (text label reads: 4) The zygote is then surgically implanted into the endometrium of the uterus. After successful implantation, the zygote should develop normally, as if it had been fertilized in the female's oviducts). [Return to Figure 18.2].

Glossary

Abdominal
Pertaining to the abdomen (National Cancer Institute, n.d.)

Abdominoplasty
Surgical repair of the abdomen (National Library of Medicine, 2021)

Abduction
Moving the limb or hand laterally away from the body, or spreading the fingers or toes (Betts et al., 2013)

Abductor
Moves the bone away from the midline (Betts et al., 2013)

Ablation
The removal or destruction of a body part or tissue or its function. Ablation may be performed by surgery, hormones, drugs, radiofrequency, heat, or other methods (National Cancer Institute, n.d.)

Abortion
Intentional removal of a fetus from the uterus (National Library of Medicine, 2021)

Acanthosis nigricans
A disorder that causes darkening and thickening of the armpit and other body folds (National Library of Medicine, 2021)

Acoustic meatus
The opening that provides for passage of the nerve from the hearing and equilibrium organs of the inner ear (Betts et al., 2013)

Acoustic neuroma
A benign tumor of the vestibular nerve in the internal auditory canal (National Library of Medicine, 2021)

Acrochordons
Common benign skin growths that appear as small, raised, brown or skin-colored bumps; also called skin tags (National Cancer Institute, n.d.)

Acromegaly
A disorder that results in the growth of bones in the face, hands, and feet in response to excessive levels of growth hormone in individuals who have stopped growing (Betts et al., 2013)

Active immunity
Immunity developed from an individual's own immune system (Betts et al., 2013)

Acute inflammation
Inflammation occurring for a limited time period; rapidly developing (Betts et al., 2013)

Adaptive immune response
A relatively slow but very specific and effective immune response controlled by lymphocytes (Betts et al., 2013)

Adduction
Movement that brings the limb or hand toward or across the midline of the body, or brings the fingers or toes together (Betts et al., 2013)

Adductor
Moves the bone toward the midline (Betts et al., 2013)

Adenoid
Pharyngeal tonsil (Betts et al., 2013)

Adenoidectomy
Excision of the adenoids (National Library of Medicine, 2021)

Adenosis
A disease or abnormal change in a gland (National Cancer Institute, n.d.)

Adipocyte

Fat cell (Betts et al., 2013)

Adipose tissue

Fat tissue (Betts et al., 2013)

Adrenal cortex

The outer region of the adrenal gland; secretes steroid hormones (Betts et al., 2013)

Adrenalectomy

Excision of one or both adrenal glands (National Cancer Institute, n.d.)

Adventitial

The outermost layer of organs, blood vessels, and other structures in the body (National Library of Medicine, 2021)

Afferent lymphatic vessels

Vessels that lead into a lymph node (Betts et al., 2013)

Afferent nerves

Nerves that carry sensory signals (nerve impulses) toward the central nervous from the periphery (Betts et al., 2013)

Agranulocytosis

A serious condition that occurs when there is an extremely low number of granulocytes (a type of white blood cell) in the blood (National Cancer Institute, n.d.)

Acquired immunodeficiency syndrome (AIDS)

A disease caused by the human immunodeficiency virus (HIV). People with acquired immunodeficiency syndrome are at an increased risk for developing certain cancers and for infections that usually occur only in individuals with a weak immune system (National Cancer Institute, n.d.)

Albumin

A type of protein found in blood, egg white, milk, and other substances (National Cancer Institute, n.d.)

Albuminuria

Albumin in the urine (National Library of Medicine, 2021)

Allergens

Antigens that evoke type 1 hypersensitivity (allergy) responses (Betts et al., 2013)

Allergist

Specialist who specializes in treating individuals with a hypersensitivity to allergens (National Library of Medicine, 2021)

Allergy

Inflammatory response due to a hypersensitivity to a substance that normally is harmless or would not cause an immune response in most people (National Cancer Institute, n.d.)

Alpha-fetoprotein test

Alpha-fetoprotein (AFP) is a protein that is produced during fetal development. The AFP test is an analysis of the mother's blood serum to determine whether the level of AFP denotes a risk of a birth defect (National Library of Medicine, 2021)

Alveolar duct

Small tube that leads from the terminal bronchiole to the respiratory bronchiole and is the point of attachment for alveoli (Betts. et al., 2013)

Alveolitis

Inflammation of the alveoli (National Library of Science, 2021)

Amenorrhea

Absence of menstruation (National Library of Medicine, 2021)

Amniocentesis

A procedure for obtaining amniotic fluid (National Library of Medicine, 2021)

Amniotomy

Incision into the amnion to induce labor (National Library of Medicine, 2021)

Amphiarthrosis

A slightly mobile joint (Betts et al., 2013)

Ampulla

A sac-like enlargement of a canal or duct (National Cancer Institute, n.d.)

Anal

Pertaining to the anus (National Cancer Institute, n.d.)

Anaphylactic shock

A severe and sometimes life-threatening immune system reaction to an antigen that a person has been previously exposed to. The reaction may include itchy skin, edema, collapsed blood vessels, fainting, difficulty in breathing, and death (National Cancer Institute, n.d.)

Anaphylaxis

An acute hypersensitivity reaction due to exposure to a previously encountered antigen (National Library of Medicine, 2021)

Anatomical position

That of the body standing upright, with the feet at shoulder width and parallel, toes forward. The upper limbs are held out to each side, and the palms of the hands face forward (Betts, et al 2013)

Androgens

Male sex hormones; for example, testosterone (Betts et al., 2013)

Anemia

A condition in which the number of red blood cells or hemoglobin is deficient (Betts et al., 2013)

Anesthesia

A loss of feeling or awareness caused by drugs or other substances (National Cancer Institute, n.d.)

Aneurysm

Weakening of the wall of a blood vessel, causing it to thin and balloon out, and possibly eventually burst, resulting in internal bleeding (Betts et al., 2013)

Angina pectoris

Chest pain. It may be a symptom of coronary artery disease and myocardial infarction (Betts et al., 2013)

Angiogram

An x-ray or computer image (CT scan or MRI) of the blood vessels and blood flow in the body. A dye may be injected through a catheter (small tube) into an artery or vein to make the blood vessels easier to see (National Cancer Institute, n.d.)

Angiography

A procedure to x-ray blood vessels (National Cancer Institute, n.d.)

Angioplasty

A procedure in which an occlusion is mechanically widened with a balloon (Betts et al., 2013)

Angiosarcoma

A type of cancer that begins in the cells that line blood vessels or lymph vessels (National Cancer Institute, n.d.)

Angioscope

Instrument used for visual examination of blood vessels (National Library of Medicine, 2021)

Angioscopy

Endoscopic examination of blood vessels (National Library of Medicine, 2021)

Anisocoria

Condition of unequal pupil size (National Library of Medicine, 2021)

Ankylosis

Fixation and immobility of a joint (National Library of Medicine, 2021)

Antagonistic

In opposition to each other (Betts et al., 2013)

Antenatal

Having to do with the time a female is pregnant, before birth occurs; also called prenatal (National Cancer Institute, n.d.)

Anterior

Describes the front or direction toward the front of the body (Betts et al., 2013)

Anti-B antibodies

Proteins that will mount an immune response against B antigens (Betts et al., 2013)

Antibodies

Proteins made by plasma cells (a type of white blood cell) in response to an antigen (a substance that causes the body to make a specific immune response). Each antibody can bind to only one specific antigen. The purpose of this binding is to help destroy the antigen (National Cancer Institute, n.d.)

Antiandrogens

Substances that keep androgens (male sex hormones) from binding to proteins called androgen receptors. Preventing this binding blocks the effects of these hormones in the body (National Cancer Institute, n.d.)

Antibiotic

A drug used to treat infections caused by bacteria and other microorganisms (National Cancer Institute, n.d.)

Antibody

A protein made by plasma cells (a type of white blood cell) in response to an antigen (a substance that causes the body to make a specific immune response). Each antibody can bind to only one specific antigen. The purpose of this binding is to help destroy the antigen (National Cancer Institute, n.d.)

Anticholinergic drugs

Drugs that inhibit the release of acetylcholine (ACh) (Betts et al., 2013)

Antigens

Substances that provokes an immune response. This happens because the immune system sees the antigen as foreign, or 'non-self" (does not belong in that body) (Betts et al., 2013)

Antihypertensives

A class of medications used to treat high blood pressure (National Cancer Institute, n.d.)

Antiretrovirals

Drugs that inhibit the ability of the human immunodeficiency virus (HIV) or other types of retroviruses to multiply in the body (National Cancer Institute, n.d.)

Anuria

The absence of urine production (Betts et al., 2013)

Aortic stenosis

A condition in which the aortic valve becomes rigid and may calcify over time (Betts et al., 2013)

Apgar score

A technique used to assess the general wellbeing of a newborn. The newborn is assessed one minute after birth and again five minutes after birth (Betts et al., 2013)

Aphakia

Condition of no lens (National Library of Medicine, 2021)

Aphasia

A loss of speech (Betts et al., 2013)

Aphonia

Condition of the absence of one's voice (National Library of Medicine, 2021)

Apnea

A temporary absence of respiration (National Library of Medicine, 2021)

Apoptosis

Programmed cell death (Betts et al., 2013)

Appendectomy

Excision of the appendix (National Cancer Institute, n.d.)

Appendicitis
Acute inflammation of the appendix (National Library of Medicine, 2021)

Appendicular skeleton
All bones of the upper and lower limbs, plus the girdle bones that attach each limb to the axial skeleton (Betts et al., 2013)

Aqueous
Having to do with water (National Cancer Institute, n.d.)

Arachnoid mater
Middle layer of the meninges named for the spider-web–like trabeculae that extend between it and the pia mater (Betts et al., 2013)

Arachnoid trabeculae
A membrane layer of the CNS that resembles a spider web (Betts et al., 2013)

Arrhythmia
A deviation from the normal pattern of impulse conduction and contraction of the heart (Betts et al., 2013)

Arteriogram
An x-ray of arteries (National Cancer Institute, n.d.)

Arteriole
A very small artery that leads to a capillary (Betts et al., 2013)

Arteriosclerosis
The generalized loss of compliance; "hardening of the arteries" (Betts et al., 2013)

Artery
A blood vessel that transports blood away from the heart (Betts et al., 2013)

Arthralgia
Joint pain (National Cancer Institute, n.d.)

Arthritis
Chronic inflammation of the synovial joints (Betts et al., 2013)

Arthrocentesis
Surgical puncture to aspirate fluid from a joint (National Library of Medicine, 2021)

Arthrography
Process of recording a joint (National Library of Medicine, 2021)

Arthroplasty
Joint replacement surgery (Betts et al., 2013)

Arthroscopy
Process of viewing a joint using an endoscope (National Library of Medicine, 2021)

Articulations
Where two bone surfaces meet (Betts et al., 2013)

Artificial insemination
A process where the semen is introduced into the vagina by mechanical means (National Library of Medicine, 2021)

Ascites
Abnormal buildup of fluid in the abdomen that may cause swelling (National Cancer Institute, n.d.)

Aspermia
Condition of the complete absence of sperm (National Library of Medicine, 2021)

Asphyxia
Condition caused by a lack of oxygen that leads to impending or actual death (National Library of Medicine, 2021)

Aspirate
To withdraw fluid, tissue, or other substances from a body cavity, cyst, or tumor (National Cancer Institute, n.d.)

Astrocyte
Glial cell type of the central nervous system that provides support for neurons and maintains the blood-brain barrier (Betts et al., 2013)

Asymptomatic
Having no signs or symptoms of disease (National Cancer Institute, n.d.)

Atelectasis
Failure of the lung to expand (inflate) completely (National Cancer Institute, n.d.)

Atherectomy
Excision of fatty plaque (National Library of Medicine, 2021)

Atherosclerosis
A hardening of the arteries that involves the accumulation of plaque (Betts et al., 2013)

Atrioventricular (AV)
The area of the heart where the atria and ventricles meet (Betts et al., 2013)

Atrioventricular (AV) valves
Mitral (bicuspid) valve that allows blood to flow from left atrium to left ventricle and tricuspid valve that allows blood to flow from right atrium to right ventricle (Betts et al., 2013)

Audiologist
Specialist who studies, diagnoses, and treats hearing-related issues (National Library of Medicine, 2021)

Audiology
Medical specialty that studies hearing and hearing impairment (National Library of Medicine, 2021)

Audiometry
The testing of the acuity of the sense of hearing (National Library of Medicine, 2021)

Auscultation
Listening to the heart using a stethoscope (Betts et al., 2013)

Autocrine
A chemical that elicits a response in the same cell that secreted it (Betts et al., 2013)

Autoimmune diseases/disorders
Disorders in which the immune system overreacts and begins to attack itself (Betts et al., 2013)

Autonomic
Involuntary or unconscious (Betts et al., 2013)

Autonomic nervous system (ANS)
Functional division of the nervous system that is responsible for homeostatic reflexes that coordinate control of cardiac and smooth muscle, as well as glandular tissue (Betts et al., 2013)

Avascular
Without blood vessels (Betts et al., 2013)

Axial skeleton
The central, vertical axis of the body, including the skull, vertebral column, and thoracic cage (Betts et al., 2013)

Axilla
The underarm or armpit (National Cancer Institute, n.d.)

Axon hillock
Tapering of the neuron cell body that gives rise to the axon (Betts et al., 2013)

Axon segment
Single stretch of the axon insulated by myelin and bounded by nodes of Ranvier at either end (except for the first, which is after the initial segment, and the last, which is followed by the axon terminal) (Betts et al., 2013)

Axon terminal
End of the axon, where there are usually several branches extending toward the target cell (Betts et al., 2013)

Axons
Single process of the neuron that carries an electrical signal (action potential) away from the cell body toward a target cell (Betts et al., 2013)

Axoplasm
Cytoplasm of an axon, which is different in composition than the cytoplasm of the neuronal cell body (Betts et al., 2013)

Azotemia

Urea in the blood (National Library of Medicine, 2021)

B cells

Lymphocytes that act by differentiating into an antibody-secreting plasma cell (Betts et al., 2013)

Babinski sign

Dorsiflexion of the foot with extension and splaying of the toes in response to the plantar reflex, normally suppressed by corticospinal input (Betts et al., 2013)

Bacteria

Single-cell microorganisms that reproduce by cell division and may cause infection by invading body tissue (Betts et al., 2013)

Balanitis

Inflammation of the glans penis (National Library of Medicine, 2021)

Barrier defenses

Antipathogen defenses deriving from a barrier that physically prevents pathogens from entering the body to establish an infection (Betts et al., 2013)

Bartholin's glands

Glands that produce a thick mucus that maintains moisture in the vulva area; also referred to as the greater vestibular glands (Betts et al., 2013)

Basal cell carcinoma

A form of cancer that affects the stratum basale of the epidermis (Betts et al., 2013)

Benign

Non-cancerous (Betts et al., 2013)

Benign prostatic hyperplasia (BPH)

A benign condition in which an overgrowth of prostate tissue pushes against the urethra and the bladder, blocking the flow of urine (National Cancer Institute, n.d.)

Bicarbonate

A by-product of the body's metabolism (Betts et al., 2013)

Biceps

Muscles with two origins (Betts et al., 2013)

Bilateral

Affecting both the right and left sides of the body (National Cancer Institute, n.d.)

Binocular

Pertaining to two or both eyes (Betts et al., 2013)

Biology

A science concerned with the origin, structure, development, growth, function, genetics, and reproduction of animals, plants, and microorganisms (National Library of Medicine, 2021)

Biopsy

The removal of cells or tissues for examination by a pathologist (National Cancer Institute, n.d.)

Bipolar

Shape of a neuron with two processes extending from the neuron cell body—the axon and one dendrite (Betts et al., 2013)

Blepharitis

Inflammation of eyelids (National Library of Medicine, 2021)

Blepharoplasty

Surgical repair of the eyelid (National Library of Medicine, 2021)

Blepharoptosis

Drooping of the upper eyelid (National Library of Medicine, 2021)

Blood-brain barrier (BBB)

Physiological barrier between the circulatory system and the central nervous system that establishes a privileged blood supply, restricting the flow of substances into the central nervous system (Betts et al., 2013)

Bone marrow

Tissue found inside bones; the site of all blood cell differentiation and maturation of B lymphocytes (Betts et al., 2013)

Brachial artery

The large artery in the upper arm near the biceps muscle (Betts et al., 2013)

Bradycardia

A condition in which the heart beats slower than 50 beats per minute (Betts et al., 2013)

Bradykinesia

Condition of slow movement (National Library of Medicine, 2021)

Brain

The large organ of the central nervous system composed of white and gray matter, contained within the cranium and continuous with the spinal cord (Betts et al., 2013)

Brain stem

Region of the adult brain that includes the midbrain, pons, and medulla oblongata and develops from the mesencephalon, metencephalon, and myelencephalon of the embryonic brain (Betts et al., 2013)

Breech

The position of the fetus is feet first. Ideally, the position of the fetus should be headfirst for a safer delivery (Betts et al., 2013)

Broca's area

Region of the frontal lobe associated with the motor commands necessary for speech production (Betts et al., 2013)

Brodmann's areas

Mapping of regions of the cerebral cortex based on microscopic anatomy that relates specific areas to functional differences, as described by Brodmann in the early 1900s (Betts et al., 2013)

Bronchiectasis

Inflammation of the bronchus (National Library of Medicine, 2021)

Bronchioles

Branches of the bronchi (Betts et al., 2013)

Bronchodilators

A type of drug that causes small airways in the lungs to open up (National Cancer Institute, n.d.)

Bronchogenic carcinoma

Cancer that begins in the tissue that lines or covers the airways of the lungs, including small cell and non-small cell lung cancer (National Cancer Institute, n.d.)

Bronchopneumonia

Inflammation of the lung, particularly the bronchioles and alveoli, that is associated with bronchitis (National Library of Medicine, 2021)

Bronchoscope

A thin, tube-like instrument used to examine the inside of the trachea, bronchi, and lungs (National Cancer Institute, n.d.)

Bronchoscopy

A procedure involving a bronchoscope to examine the inside of the trachea, bronchi, and lungs (National Cancer Institute, n.d.)

Bronchospasm

Spasmodic contraction of the smooth muscle of the bronchi (National Library of Medicine, 2021)

Bronchus

Large airway that leads from the trachea (windpipe) to a lung (Betts et al., 2013)

Bronchus-associated lymphoid tissue (BALT)

Lymphoid nodule associated with the respiratory tract (Betts et al., 2013)

Buccal cavity

The cheeks, tongue, and palate (Betts et al., 2013)

Bulbourethral glands

Glands that secrete a lubricating mucus that cleans and lubricates the urethra prior to and during ejaculation; also called Cowper's glands (Betts et al., 2013)

Bursa

A thin connective tissue sac filled with lubricating liquid (Betts et al., 2013)

Bursitis

Inflammation of a bursa near a joint (Betts et al., 2013)

Cancer

Abnormal cells in the body that divide uncontrollably (Betts et al., 2013)

Capillaries

The smallest type of blood vessel. A capillary connects an arteriole (small artery) to a venule (small vein) to form a network of blood vessels in almost all parts of the body (National Cancer Institute, n.d.)

Carbohydrates

Molecules composed of carbon, hydrogen, and oxygen. Carbohydrates are found in plant-based foods and dairy products and are an important fuel source (Betts et al., 2013)

Carcinogen

Any substance that causes cancer (National Cancer Institute, n.d.)

Cardiac

Having to do with the heart (National Cancer Institute, n.d.)

Cardiac cycle

The period of time that begins with contraction of the atria and ends with ventricular relaxation (Betts et al., 2013)

Cardiac muscle

Involuntary and found only in the heart. Highly coordinated contractions pump blood into the vessels of the circulatory system (Betts et al., 2013)

Cardiac notch

An indentation on the surface of the left lung (Betts et al., 2013)

Cardiac output

The measurement of blood flow from the heart through the ventricles and is usually measured in liters per minute. Any factor that causes cardiac output to increase, by elevating heart rate or stroke volume or both, will elevate blood pressure and promote blood flow (Betts et al., 2013)

Cardiac tamponade

A potentially fatal condition in which excess fluid builds within the pericardial space, preventing the heart from beating effectively (Betts et al., 2013)

Cardiac troponin

The regulatory protein for muscle contraction (Betts et al., 2013)

Cardiogenic

Originating from the heart (Betts et al., 2013)

Cardiologist

A doctor who has special training to diagnose and treat diseases of the heart and blood vessels (National Cancer Institute, n.d.)

Cardiology

The study of the heart (Betts et al., 2013)

Cardiomegaly

Enlarged heart (National Library of Medicine, 2021)

Cardiomyopathy

Disease of the heart muscle (National Library of Medicine, 2021)

Carina

A ridge at the base of the trachea (windpipe) that separates the openings of the right and left main bronchi (the large air passages that lead from the trachea to the lungs) (National Cancer Institute, n.d.)

Carotid artery

Located in the neck, it is one of the three major branches of the aortic arch (Betts et al., 2013)

Cauda equina

Bundle of spinal nerve roots that descend from the lower spinal cord below the first lumbar vertebra and lie within the vertebral cavity; has the appearance of a horse's tail (Betts et al., 2013)

Caudate

Nucleus deep in the cerebrum that is part of the basal nuclei; along with the putamen, it is part of the striatum (Betts et al., 2013)

Cauterize

To destroy tissue using a hot or cold instrument, an electrical current, or a chemical that burns or dissolves the tissue to kill tumors or stop bleeding (National Cancer Institute, n.d.)

CD4 T cells

CD4 is the receptor that HIV uses to get inside T cells and reproduce. CD4+ helper T cells play an important role in T cell immune responses and antibody responses. (Betts et al., 2013)

Celiac

Pertaining to the abdomen (Betts et al., 2013)

Cellulitis

An infection of the skin and subcutaneous tissue, characterized by tenderness, fever, and blisters (National Cancer Institute, n.d.)

Central nervous system (CNS)

Anatomical division of the nervous system located within the cranial and vertebral cavities, namely the brain and spinal cord (Betts et al., 2013)

Central sulcus

Surface landmark of the cerebral cortex that marks the boundary between the frontal and parietal lobes (Betts et al., 2013)

Centrifugation

Process of using a rotating machine to generate centrifugal force to separate substances of different densities, remove moisture, or simulate gravitational effects (National Library of Medicine, 2021)

Cephalgia

Pain in the head (National Library of Medicine, 2021)

Cephalic flexure

The curve between the brain stem and forebrain (Betts et al., 2013)

Cephalic version

Turning the fetus's head to facilitate birth (National Library of Medicine, 2021)

Cephalopelvic disproportion

A condition where the infant's head is larger than the mother's pelvis (National Library of Medicine, 2021)

Cerclage

A suture inserted into the cervix to prevent dilation and prevention miscarriage (National Library of Medicine, 2021)

Cerebellum

Region of the adult brain connected primarily to the pons that developed from the metencephalon (along with the pons) and is largely responsible for comparing information from the cerebrum with sensory feedback from the periphery through the spinal cord (Betts et al., 2013)

Cerebral angiography

Process of recording the blood vessels of the cerebrum (National Library of Medicine, 2021)

Cerebral cortex

Outer gray matter covering the forebrain, marked by wrinkles and folds known as gyri and sulci (Betts et al., 2013)

Cerebral hemisphere

One half of the bilaterally symmetrical cerebrum (Betts et al., 2013)

Cerebral thrombosis

Formation of a blood clot in a blood vessel within the skull (National Library of Medicine, 2021)

Cerebrospinal fluid (CSF)

A colorless fluid produced by the brain that cushions the brain and spinal cord within the posterior (dorsal) cavity (Betts et al., 2013)

Cerebrum

Region of the adult brain that develops from the telencephalon and is responsible for higher neurological functions such as memory, emotion, and consciousness (Betts et al., 2013)

Cervicitis

Inflammation of the cervix (National Library of Medicine, 2021)

Cervix

The narrow inferior portion of the uterus that projects into the vagina (Betts et al., 2013)

Cesarean section

Delivery of the fetus through an abdominal incision (National Library of Medicine, 2021)

Chemokine

Soluble, long-range, cell-to-cell communication molecule (Betts et al., 2013)

Chemoreceptors

Cells that sense changes in chemical levels (Betts et al., 2013)

Chemotaxis

Movement in response to chemicals; a phenomenon in which injured or infected cells and nearby leukocytes emit the equivalent of a chemical "911" call, attracting more leukocytes to the site (Betts et al., 2013)

Chemotherapy

Treatment that uses drugs to stop the growth of cancer cells, either by killing the cells or by stopping them from dividing (National Cancer Institute, n.d.)

Chlorophyll

A green pigment that captures the energy of sunlight for photosynthesis (National Library of Medicine, 2021)

Cholangiography

Radiographic imaging of the bile duct (National Library of Medicine, 2021)

Cholangioma

Tumor of the bile duct (National Library of Medicine, 2021)

Cholecystectomy

Excision of the gallbladder (National Library of Medicine, 2021)

Cholecystitis

Inflammation of the gallbladder (National Library of Medicine, 2021)

Choledocholithiasis

Condition of gallstones in the common bile duct (National Library of Medicine, 2021)

Cholelithiasis

Condition of gallstones (National Library of Medicine, 2021)

Cholesterol

An important component of bile acids; a building block of many hormones (Betts et al., 2013)

Chondromalacia

Degeneration of cartilage (National Library of Medicine, 2021)

Chondrosarcoma

A type of cancer that forms in bone cartilage (National Cancer Institute, n.d.)

Chorioamnionitis

Inflammation of the chorion and amnion (National Library of Medicine, 2021)

Choriocarcinoma

A malignant, fast-growing tumor that develops from trophoblastic cells (cells that help an embryo attach to the uterus and help form the placenta) (National Cancer Institute, n.d.)

Chorionic villus sampling

A procedure in which tissue from the placenta is tested for fetal chromosomal disorders (Betts et al., 2013)

Choroid plexus

Specialized structure containing ependymal cells that line blood capillaries and filter blood to produce cerebrospinal fluid in the four ventricles of the brain (Betts et al., 2013)

Chromosome

Composed of DNA and proteins; the condensed form of chromatin (Betts et al., 2013)

Chronic

A condition that lasts a long time with periods of remission and exacerbation (Betts et al., 2013)

Chronic inflammation

Ongoing inflammation that can be caused by foreign bodies, persistent pathogens, and autoimmune diseases such as rheumatoid arthritis (Betts et al., 2013)

Chyle

Lipid-rich lymph inside the lymphatic capillaries of the small intestine (Betts et al., 2013)

Circumcision

The surgical removal of the prepuce (Betts et al., 2013)

Cirrhosis

A type of chronic, progressive liver disease in which liver cells are replaced by scar tissue (National Cancer Institute, n.d.)

Cisterna chyli

A sac-like chamber that receives lymph from the lower abdomen, pelvis, and lower limbs by way of the left and right lumbar trunks and the intestinal trunk (Betts et al, 2013)

Coelomic

Cavities that do not open to the outside (Betts et al., 2013)

Coitus

Sexual intercourse between a male and female (National Library of Medicine, 2021)

Colectomy

Excision of the colon (Betts et al., 2013)

Colitis

Inflammation of the colon (National Cancer Institute, n.d.)

Colonoscope

A thin, tube-like instrument used to examine the inside of the colon (National Cancer Institute, n.d.)

Colonoscopy

Examination of the inside of the colon using a colonoscope, inserted into the rectum (National Cancer Institute, n.d.)

Colorectal

Pertaining to the colon or rectum (National Cancer Institute, n.d.)

Colostomy

An opening into the colon from the outside of the body (National Cancer Institute, n.d.)

Colostrum

A thick, yellowish substance secreted from a mother's breasts in the first postpartum days (Betts et al., 2013)

Colposcope

A lighted magnifying instrument used to check the cervix, vagina, and vulva for signs of disease (Betts et al., 2013)

Colposcopy

A procedure in which a lighted, magnifying instrument called a colposcope is used to examine the cervix, vagina, and vulva (National Cancer Institute, n.d.)

Combining form

A word root with a combining form vowel.

Combining form vowel

The combining form vowel is used to join word parts and to ease pronunciation. The most common combining form vowel is an "o," but sometimes it is an "i" or an "e".

Complement

Enzymatic cascade of constitutive blood proteins that have antipathogen effects, including the direct killing of bacteria (Betts et al., 2013)

Compliance

The ability of the blood vessels to dilate and constrict as needed (Betts et al., 2013)

Computerized tomography (CT)

A noninvasive imaging technique that uses computers to analyze several cross-sectional X-rays in order to reveal minute details about structures in the body (Betts et al., 2013)

Condom

A sheath that is worn over the penis during sexual behavior in order to prevent pregnancy or spread of sexually transmitted disease (National Library of Medicine, 2021)

Conducting zone

The major functions of the conducting zone are to provide a route for incoming and outgoing air, remove debris and pathogens from the incoming air, and warm and humidify the incoming air (Betts, et al., 2013).

Congenital

Present at birth (Betts et al., 2013)

Conjunctivitis

Inflammation or infection of the conjunctiva; also called pinkeye (National Cancer Institute, n.d.)

Connective tissue

Type of tissue that serves to hold in place, connect, and integrate the body's organs and systems (Betts et al., 2013)

Contraception

The use of drugs, devices, or surgery to prevent pregnancy (National Cancer Institute, n.d.)

Contusion

Injury resulting in a bruise (National Library of Medicine, 2021)

Coronary arteries

Supply blood to the myocardium and other components of the heart (Betts et al., 2013)

Coronary artery bypass graft (CABG)

Surgery in which a healthy blood vessel taken from another part of the body is used to make a new path for blood around a blocked artery leading to the heart. This restores the flow of oxygen and nutrients to the heart (Betts et al., 2013)

Coronary heart disease

A disease in which there is a narrowing or blockage of the coronary arteries (National Cancer Institute, n.d.)

Corpus callosum

Large white matter structure that connects the right and left cerebral hemispheres (Betts et al., 2013)

Corpus cavernosum

Either of two columns of erectile tissue in the penis that fill with blood during an erection (Betts et al., 2013)

Corpus spongiosum

Column of erectile tissue in the penis that fills with blood during an erection and surrounds the penile urethra on the ventral portion of the penis (Betts et al., 2013)

Costal cartilage

Made of hyaline cartilage and located at the end of each rib (Betts et al., 2013)

Craniotomy

An operation in which a piece of the skull is removed (National Cancer Institute, n.d.)

Cranium

Completely surrounds and protects the brain from non-traumatic injury (Betts et al., 2013)

Creatine kinase MB

An enzyme that catalyzes the conversion of creatine to phosphocreatine, consuming ATP (Betts et al., 2013)

Crohn's disease

A condition in which the gastrointestinal tract is inflamed over a long period of time (National Cancer Institute, n.d.)

Cryotherapy

A procedure in which an extremely cold liquid or an instrument called a cryoprobe is used to freeze and destroy abnormal tissue (National Cancer Institute, n.d.)

Cryptorchidism

The failure of one or both testes to descend into the scrotum prior to birth (Betts et al., 2013)

CT colonography

A method to examine the inside of the colon by taking a series of x-rays (National Cancer Institute, n.d.)

Cutaneous

Skin (Betts et al., 2013)

Cutaneous membrane

Epithelial tissue made up of stratified squamous epithelial cells that cover the outside of the body; skin (Betts et al., 2013)

Cyanosis

A condition in which the oxygen supply is restricted, causing the skin to look blue (Betts et al., 2013)

Cyanotic

Pertaining to abnormal discolouration of blue (bluish colour, lips and nail beds) caused by deoxygenation (National Cancer Institute, n.d.)

Cyclic neutropenia

A condition in which the number of neutrophils in the blood goes in cycles from normal to low and back to normal again (National Cancer Institute, n.d.)

Cyst

Closed sac containing fluid or semisolid material.

Cystectomy

Excision of all or part of the bladder to remove a cyst (National Cancer Institute, n.d.)

Cystitis

Inflammation of the lining of the bladder (National Cancer Institute, n.d.)

Cystocele

A condition in which weakened pelvic muscles cause the bladder to drop from its normal position (National Library of Medicine, 2021)

Cystography

Radiographic imaging of the bladder (National Library of Medicine, 2021)

Cystoscope

A thin, tube-like instrument used to look inside the bladder and urethra (National Cancer Institute, n.d.)

Cystoscopy

Examination of the bladder and urethra using a cystoscope, inserted into the urethra (National Cancer Institute, n.d.)

Cystostomy

Creation of an artificial opening into the bladder (National Library of Medicine, 2021)

Cystotomy

Incision into the bladder (National Library of Medicine, 2021)

Cytokine

A signaling molecule that allows cells to communicate with each other over short distances (Betts et al., 2013)

Cytoplasm

A water-based cellular fluid (Betts et al., 2013)

Dacryocystitis

Inflammation of the tear (lacrimal) sac (National Library of Medicine, 2021)

Dacryocystorhinostomy

Creation of an artificial opening between the lacrimal sac and the nose (to restore drainage) (National Library of Medicine, 2021)

Deamination

The removal of an amino group from a molecule (National Library of Medicine, 2021)

Debridement

Excision of damaged tissues and cell debris from a wound or burn to prevent infection and promote healing (Betts et al., 2013)

Deep

Describes a position farther from the surface of the body (Betts et al., 2013)

Deep lymphatic vessels

Lymphatic vessels of the organs (Betts et al., 2013)

Defensins

The lysozyme enzyme and proteins which have antibacterial properties (Betts, et al., 2013)

Dehydration

A net loss of water that results in insufficient water in blood and other tissues (Betts et al., 2013)

Dendrite

One of many branchlike processes that extends from the neuron cell body and functions as a contact for incoming signals (synapses) from other neurons or sensory cells (Betts et al., 2013)

Dermabrasion

A procedure to remove superficial scars using sandpaper or revolving wire brushes (National Cancer Institute, n.d.)

Dermatitis

Inflammation of the skin (National Cancer Institute, n.d.)

Dermatofibroma

Fibrous tumor of the skin (National Library of Medicine, 2021)

Dermatologist

Medical doctor who specializes in diagnosing and treating skin disorders (Betts et al., 2013)

Dermatology

Study of disorders of the skin (Betts et al., 2013)

Dermis

The layer that is made of dense, irregular connective tissue that houses blood vessels, hair follicles, sweat glands, and other structures (Betts et al., 2013)

Descending tract

Central nervous system fibers carrying motor commands from the brain to the spinal cord or periphery (Betts et al., 2013)

Detrusor

A muscle which forms a layer of the wall of the bladder (Betts et al., 2013)

Diabetes mellitus

A disease in which the body does not control the amount of glucose (a type of sugar) in the blood and the kidneys make a large amount of urine. This disease occurs when the body does not make enough insulin or does not use it the way it should (Betts et al., 2013)

Diagnosis

The process of identifying a disease, condition, or injury from its signs and symptoms (National Cancer Institute, n.d.)

Dialysis

The process of filtering the blood when the kidneys are not able to cleanse it (National Cancer Institute, n.d.)

Diapedesis

The migration of blood cells through the intact walls of blood vessels into the surrounding tissue (Betts et al., 2013)

Diaphoresis

Sweating (Betts et al., 2013)

Diaphragm

A sheet of skeletal muscle separating the thoracic and abdominal cavities that has to contract and relax for you to breathe (Betts et al., 2013)

Diarrhea

Frequent and watery bowel movements (National Cancer Institute, n.d.)

Diastole

Period of time when the heart muscle is relaxed and the chambers fill with blood (Betts et al., 2013)

Diastolic pressure

The arterial pressure of blood during ventricular relaxation, or diastole (Betts et al., 2013)

Diencephalon

Region of the adult brain that retains its name from embryonic development and includes the thalamus and hypothalamus (Betts et al., 2013)

Digit

Finger or toe (Betts et al., 2013)

Dilation and curettage

A procedure to scrape and remove tissue from the inner lining of the uterus. The cervix is dilated (made larger) and a curette (spoon-shaped instrument) is inserted into the uterus to remove tissue. The procedure is used to test tissue for signs of disease, after a miscarriage, or to treat certain conditions (National Cancer Institute, n.d.)

Diploid

A cell containing two matched sets of chromosomes (Betts et al., 2013)

Diplopia

Double vision (Betts et al., 2013)

Direct pathway

Connections within the basal nuclei from the striatum to the globus pallidus internal segment and substantia nigra pars reticulata that disinhibit the thalamus to increase cortical control of movement (Betts et al., 2013)

Discitis

Inflammation of the intervertebral disk (National Library of Medicine, 2021)

Diskectomy

Excision of the intervertebral disk (National Library of Medicine, 2021)

Dissection

When a body is dissected, its structures are cut apart in order to observe their physical attributes and relationships to one another (Betts et al., 2013)

Distal

A position in a limb that is farther from the point of attachment or the trunk of the body (Betts et al., 2013)

Diuresis

Excess production of urine (Betts et al., 2013)

Diverticulitis

Inflammation of one or more pouches or sacs that bulge out from the wall of a hollow organ, such as the colon (National Cancer Institute, n.d.)

Diverticulosis

A condition marked by small sacs or pouches in the walls of a hollow organ, such as the colon (National Cancer Institute, n.d.)

Dorsal (posterior) nerve root

Axons entering the posterior horn of the spinal cord (Betts et al., 2013)

Douching

Washing the vagina with fluid (Betts et al., 2013)

Ductus arteriosus

A temporary connection between pulmonary trunk and aorta in the fetal heart (Betts et al., 2013)

Ductus deferens

Duct that transports sperm from the epididymis through the spermatic cord and into the ejaculatory duct; also referred as the vas deferens (Betts et al., 2013)

Duodenitis

Inflammation of the duodenum (National Cancer Institute, n.d.)

Duodenum

The first portion of the small intestine (Betts et al., 2013)

Dura mater

Tough, fibrous, outer layer of the meninges that is attached to the inner surface of the cranium and vertebral column and surrounds the entire central nervous system (Betts et al., 2013)

Dysentery

Acute inflammation of the intestine presenting with abdominal pain and bloody diarrhea (National Library of Medicine, 2021)

Dyskinesia

Abnormal involuntary movements of the extremities, trunk, or jaw (National Library of Medicine, 2021)

Dysmenorrhea

Painful menstruation (National Library of Medicine, 2021)

Dyspareunia

Genital pain before, during, or after intercourse (National LIbrary of Medicine, 2021)

Dyspepsia

Upset stomach (National Cancer Institute, n.d.)

Dysphagia

Difficulty swallowing (National Cancer Institute, n.d.)

Dysphonia

Condition of difficult speaking, including hoarseness and change in pitch or quality of the voice (National Cancer Institute, n.d.)

Dyspnea

Difficulty breathing (Betts et al., 2013)

Dystocia

Slow or difficult labor (National Library of Medicine, 2021)

Dysuria

Painful urination (National Library of Medicine, 2021)

Echocardiogram

A computer picture of the heart created by bouncing high-energy sound waves (ultrasound) off internal tissues or organs of the chest (National Cancer Institute, n.d.)

Echocardiography

A procedure that uses high-energy sound waves (ultrasound) to look at tissues and organs inside the chest (National Cancer Institute, n.d.)

Eclampsia

A very serious condition in pregnant women with hypertension; patients are at high risk of coma, convulsions, and even death (National Library of Medicine, 2021)

Ectopic pregnancy

A pregnancy in which the fertilized ovum is implanted in any tissue other than the uterine wall (Betts et al., 2013)

Eczema

Non-infectious, inflammatory disease presenting as redness, blisters, scabs, and itching (Betts et al., 2013)

Edema

Swelling due to excessive liquid in the tissues (Betts et al., 2013)

Efferent lymphatic vessels

Vessels that lead out of a lymph node (Betts et al., 2013)

Efferent nerves

Nerve tissue that carries impulses away from the CNS towards the peripheral that result in motor response (movement) (Betts et al., 2013)

Ejaculatory duct

Duct that connects the ampulla of the ductus deferens with the duct of the seminal vesicle at the prostatic urethra (Betts et al., 2013)

Electrocardiogram (ECG/EKG)

The record of the heart's function produced by the electrocardiograph (Betts et al., 2013)

Electrocardiograph

The instrument that generates an electrocardiogram (ECG); 10 electrodes are placed in standard locations on the patient's skin to record heart function (Betts et al., 2013)

Electrocardiography

The science of recording the electrical activity of the heart (National Library of Medicine, 2021)

Electroencephalogram

The record of electrical activity of the brain (National Cancer Institute, n.d.)

Electroencephalography

Process of recording the electrical activity of the brain (National Library of Medicine, 2021)

Electromyogram

Record of the electricity of the muscle (National Library of Medicine, 2021)

Electromyography

Recording of muscle electrical activity in response to a nerve's stimulation of the muscle (National Library of Medicine, 2021)

Electrophysiology

The study of electrical properties of cells and tissues (National Library of Medicine, 2021)

Embolus

An obstruction such as a blood clot or plaque that blocks the flow of blood in an artery or vein (Betts et al., 2013)

Emesis

Vomiting (Betts et al., 2013)

Emulsification

The process of breaking down the fat into smaller blood cells, which makes it easy for enzymes to function and digest food (Betts et al., 2013)

Encephalitis

Inflammation of the tissues of the brain (National Cancer Institute, n.d.)

Encephalomalacia

Softening of the tissues of the brain (National Library of Medicine, 2021)

Endarterectomy

Excision of plaque from within the artery (National Library of Medicine, 2021)

Endocarditis

A condition in which the tissues lining the inside of the heart and the heart valves become inflamed (National Cancer Institute, n.d.)

Endocardium

The innermost layer of the heart (Betts et al., 2013)

Endocrine gland

A ductless gland that releases secretions directly into surrounding tissues and fluids (Betts et al., 2013)

Endocrine system

Cells, tissues, and organs that secrete hormones as a primary or secondary function and play an integral role in normal bodily processes (Betts et al., 2013)

Endocrinologist

A doctor who has special training in diagnosing and treating disorders of the endocrine system (National Cancer Institute, n.d.)

Endocrinology

A specialty in the field of medicine that focuses on the treatment of endocrine system disorders (Betts et al., 2013)

Endometriosis

A disease characterized by the presence of endometrial-like tissue found outside the uterus (Betts et al., 2013)

Endometritis

Inflammation of the endometrium (National Library of Medicine, 2021)

Endometrium

The innermost layer of the uterus. It provides the site of implantation for a fertilized egg and sheds during menstruation if no egg is fertilized (Betts et al., 2013)

Endophthalmitis

Inflammation within the eye (National Library of Medicine, 2021)

Endoscope

A thin, tube-like instrument used to look at tissues inside the body (National Cancer Institute, n.d.)

Endoscopy

A procedure that uses an endoscope to examine the inside of the body (National Cancer Institute, n.d.)

Endothelium

Epithelium that lines vessels in the lymphatic and cardiovascular systems (Betts et al., 2013)

Enteric nervous system (ENS)

Neural tissue associated with the digestive system that is responsible for nervous control through autonomic connections (Betts et al., 2013)

Enucleation

Excision of a whole organ or mass without cutting into it (National Cancer Institute, n.d.)

Enuresis

Involuntary urination (National Library of Medicine, 2021)

Ependymal cell

Glial cell type in the central nervous system responsible for producing cerebrospinal fluid (Betts et al., 2013)

Epidermis

The outer, protective layer of the skin (Betts et al., 2013)

Epididymis

A coiled tubular structure in which sperm start to mature and are stored until ejaculation (Betts et al., 2013)

Epididymitis

Inflammation of the epididymis (National Library of Medicine, 2021)

Epiglottis

Leaf-shaped piece of elastic cartilage that is a portion of the larynx that swings to close the trachea during swallowing (Betts et al., 2013)

Epiglottitis

Inflammation of the epiglottis (National Library of Medicine, 2021)

Epinephrine

A hormone that causes the breakdown of glycogen into glucose; also known as adrenaline (Betts et al., 2013)

Epiphyses

The wider section at the end of long bones (Betts et al., 2013)

Episiotomy

Incision made in the posterior vaginal wall and perineum that facilitates vaginal birth (Betts et al., 2013)

Epistaxis

Nosebleed (National Library of Medicine, 2021)

Epithalamus

Region of the diencephalon containing the pineal gland (Betts et al., 2013)

Epithelial membrane

Epithelium attached to a layer of connective tissue (Betts et al., 2013)

Epithelium

Sheets of cells that cover the exterior surfaces of the body, line internal cavities and passageways, and form certain glands; also known as epithelial tissue (Betts et al., 2013)

Equilibrium

The sense of balance (Betts et al., 2013)

Erythroblastosis fetalis

An immune reaction between maternal and fetal blood due to the Rh antigen; also known as hemolytic disease of the newborn (HDN) (Betts et al., 2013)

Erythrocyte

A red blood cell (Betts et al., 2013)

Erythrocytes

Red blood cells (Betts et al., 2013)

Erythropoietin (EPO)

A hormone produced by the kidneys that triggers the production of red blood cells (Betts et al., 2013)

Esophagitis

Inflammation of the esophagus (National Cancer Institute, n.d.)

Esophagoscopy

Examination of the esophagus using an esophagoscope (National Cancer Institute, n.d.)

Esophagus

Pertaining to the esophagus (National Cancer Institute, n.d.)

Eupnea

A mode of breathing that occurs at rest and does not require the cognitive thought of the individual; also known as quiet breathing (Betts et al., 2013)

Eversion

Foot movement in which the bottom of the foot is turned laterally, away from the midline (Betts et al., 2013)

Exacerbation

A transient worsening of disease symptoms (National Library of Medicine, 2021)

Excisional skin surgery

A surgical procedure used to remove moles, cysts, skin cancer, and other skin growths using local anesthesia (National Cancer Institute, n.d.)

Excretion

To get rid of waste material from the blood, tissues, or organs by a normal discharge (such as sweat, urine, or stool) (National Cancer Institute, n.d.)

Exocrine gland

A gland whose secretions leave through a duct that opens directly, or indirectly, to the external environment (Betts et al., 2013)

Exocrine system

Cells, tissues, and organs that secrete substances directly to target tissues via glandular ducts (Betts et al., 2013)

Exocytosis

A form of active transport in which a cell exports material using vesicular transport (Betts et al., 2013)

Expiration

Exhalation, or the process of causing air to leave the lungs (Betts et al., 2013)

Extension

Movement in the sagittal plane that increases the angle of a joint (straightens the joint) (Betts et al., 2013)

External nose

The surface and skeletal structures that result in the outward appearance of the nose and contribute to its numerous functions (Betts et al., 2013)

Extramedullary hematopoiesis

Hematopoiesis outside the medullary cavity of adult bones (National Library of Medicine, 2021)

Fascia

Fibrous tissue (Betts et al., 2013)

Fauces

The opening of the oral cavity into the pharynx (Betts et al., 2013)

Feces

Semisolid waste product of digestion (Betts et al., 2013)

Fetal

Pertaining to the fetus (National Cancer Institute, n.d.)

Fibroelastic membrane

A flexible membrane that closes the posterior surface of the trachea, connecting the C-shaped cartilages (Betts et al., 2013)

Fibromyalgia

A common nonarticular rheumatic syndrome characterized by muscle pain (National Library of Medicine, 2021)

Fibrosis

A process in which muscle fibers are replaced by scar tissue (Betts et al., 2013)

Fistula

An abnormal opening or passage between two organs or between an organ and the surface of the body (National Cancer Institute, n.d.)

Flares

A transient exacerbation of symptoms of an existing disease or condition (National Library of Medicine, 2021)

Flatus

Gas in the intestine (Betts et al., 2013)

Flexion

Movement in the sagittal plane that decreases the angle of a joint (bends the joint) (Betts et al., 2013)

Foramen magnum

Large opening in the occipital bone of the skull through which the spinal cord emerges and the vertebral arteries enter the cranium (Betts et al., 2013)

Foramen ovale

An opening between right and left atria, which is normal in the fetal heart (Betts et al., 2013)

Fornix

The superior portion of the vagina (Betts et al., 2013)

Frontal lobe

Region of the cerebral cortex directly beneath the frontal bone of the cranium (Betts et al., 2013)

Frontal plane

Two-dimensional, vertical plane that divides the body or organ into anterior and posterior portions (Betts et al., 2013)

Frostbite

A condition in which conservation of the body core heat results in the skin freezing (Betts et al., 2013)

Fundus

The part of a hollow organ that is across from, or farthest away from, the organ's opening (National Cancer Institute, n.d.)

Gamete

A specialized sex cell carrying 23 chromosomes (Betts et al., 2013)

Ganglion

Localized collection of neuron cell bodies in the peripheral nervous system (Betts et al., 2013)

Ganglionectomy

Excision of a ganglion (National Library of Medicine, 2021)

Gangrene

Death of tissue due to blood supply loss (National Library of Medicine, 2021)

Gastrectomy

Stomach removal (Betts et al., 2013)

Gastric

Pertaining to the stomach (National Cancer Institute, n.d.)

Gastritis

Inflammation of the lining of the stomach (National Cancer Institute, n.d.)

Gastroenteritis

Inflammation of the lining of the stomach and the intestines (National Cancer Institute, n.d.)

Gastroenterologist

A doctor who has special training in diagnosing and treating disorders of the digestive system (National Cancer Institute, n.d.)

Gastroenterology

A subspecialty of internal medicine concerned with the study of the physiology and diseases of the digestive system and related structures (National Library of Medicine, 2021)

Gastrojejunostomy

A surgical procedure that connects part of the stomach to the jejunum (National Cancer Institute, n.d.)

Gastroplasty

Surgical repair of the stomach (National Library of Medicine, 2021)

Gastroscope

A thin, tube-like instrument used to examine the inside of the stomach (National Cancer Institute, n.d.)

Gastroscopy

Examination of the inside of the stomach using a gastroscope passed through the mouth and esophagus (National Cancer Institute. n.d.)

Gastrostomy

Creation of an artificial opening in the stomach (National Library of Medicine. 2021)

Genetic recombination

The combining of gene segments from two different pathogens (Betts et al., 2013)

Gestation

The period required for embryonic and fetal development in utero; pregnancy (Betts et al., 2013)

Gestational diabetes

Diabetes mellitus that occurs during pregnancy but resolves by the end of pregnancy in women without a history of diabetes (National Library of Medicine, 2021)

Gestational hypertension

Elevated systolic and diastolic blood pressure in pregnant women (National Library of Medicine, 2021)

Gingivectomy

Excision of the gums (National Library of Medicine, 2021)

Gingivitis

Inflammation of the gums (National Library of Medicine, 2021)

Glans penis

Bulbous end of the penis that contains a large number of nerve endings (Betts et al., 2013)

Glial cell

One of the various types of neural tissue cells responsible for maintenance of the tissue, and largely responsible for supporting neurons (Betts et al., 2013)

Glioblastoma

A central nervous system tumor composed of developing glial tissue (National Cancer Institute, n.d.)

Glioma

A tumor that begins in the glial tissue (National Cancer Institute, n.d.)

Glomerulonephritis

A condition in which the tissues in the kidney become inflamed and have problems filtering waste from the blood (National Cancer Institute, n.d.)

Glossectomy

Surgical removal of all or part of the tongue (National Cancer Institute, n.d.)

Glossitis

Inflammation of the tongue (National Library of Medicine, 2021)

Glottis

The glottis is composed of the vestibular folds, the true vocal cords, and the space between these folds (Betts et al., 2013)

Glycemia

Sugar in the blood (National Cancer Institute, n.d.)

Glycogen

A polysaccharide that is converted to glucose (Betts et al., 2013)

Glycosuria

Presence of glucose in the urine (Betts et al., 2013).

Gonadotropin-releasing hormone (GnRH)

Hormone released by the hypothalamus that regulates the production of follicle-stimulating hormone and luteinizing hormone from the pituitary gland (Betts et al., 2013)

Gonads

Reproductive organs (testes in men and ovaries in women) that produce gametes and reproductive hormones (Betts et al., 2013)

Graft-versus-host disease (GVHD)

A condition that can occur in bone marrow transplant recipients; occurs when the transplanted cells mount an immune response against the recipient's tissue (Betts et al., 2013)

Gravidity

The number of pregnancies, complete or incomplete, experienced by a woman (National Library of Medicine, 2021)

Gray matter

Regions of the nervous system containing cell bodies of neurons with few or no myelinated axons; actually may be more pink or tan in color, but called gray in contrast to white matter (Betts et al., 2013)

Great vessels

Include the superior vena cava, inferior vena cava, aorta and pulmonary trunk (Betts et al., 2013)

Gynecologist

A doctor who has special training in diagnosing and treating diseases of the female reproductive organs (National Cancer Institute, n.d.)

Gynecology

A medical-surgical specialty concerned with the physiology and disorders primarily of the female genital tract, as well as female endocrinology and reproductive physiology (National Library of Medicine, 2021)

Gyrus

Ridge formed by convolutions on the surface of the cerebrum or cerebellum (Betts et al., 2013)

Hard palate

Located at the anterior region of the nasal cavity and is composed of bone (Betts et al., 2013)

Heart murmur

An abnormal heart sound (Betts et al., 2013)

Heart rate

The number of times the heart beats within a certain time period, usually a minute (National Cancer Institute, n.d.)

Hematocrit

A lab test which measures the percentage red blood cells in a sample of whole blood (Betts et al., 2013)

Hematologist

A doctor who has special training in diagnosing and treating blood disorders (National Cancer Institute, n.d.)

Hematology

The study of blood and blood-forming issues (National Library of Medicine, 2021)

Hematoma

A pool of mostly clotted blood that forms in an organ, tissue, or body space (National Cancer Institute, n.d.)

Hematopoiesis

The production of blood cells (Betts et al., 2013)

Hematuria

Blood in the urine (National Cancer Institute, n.d.)

Hemihypertrophy

A condition in which one side of the body or a part of one side is larger than the other (National Cancer Institute, n.d.)

Hemiplegia

Paralysis on one side of the body (Betts et al., 2013)

Hemocytoblast

A hematopoietic stem cell (Betts et al., 2013)

Hemolysis

The breakdown of red blood cells (Betts et al., 2013)

Hemolytic disease of the newborn

A condition in which the mother's Rh antibodies cross the placenta into the fetal bloodstream and destroy the fetal RBCs (Betts et al., 2013)

Hemophilia

A group of related disorders in which there is the inadequate production of functional amounts of one or more clotting factors (Betts et al., 2013)

Hemopoiesis

The process by which the body produces blood (Betts et al., 2013)

Hemopoietic growth factors

Chemical messengers which promote the proliferation and differentiation of formed elements and include erythropoietin, thrombopoietin, colony-stimulating factors, and interleukins (Betts et al., 2013)

Hemorrhage

Excessive bleeding (Betts et al., 2013)

Hemorrhagic stroke

Disruption of blood flow to the brain caused by bleeding within the cranial vault (Betts et al., 2013)

Hemorrhoid

An enlarged or swollen blood vessel, usually located near the anus or the rectum (National Cancer Institute, n.d.)

Hemostasis

The process by which the body seals a ruptured blood vessel to prevent further blood loss (Betts et al., 2013)

Hemothorax

Hemorrhage within the pleural cavity (National Library of Medicine, 2021)

Hepatic portal system

Carriers blood to the liver for processing before it enters circulation (Betts et al., 2013)

Hepatitis

Disease of the liver causing inflammation (National Cancer Institute, n.d.)

Hepatoma

Tumor of the liver (National Cancer Institute, n.d.)

Hepatomegaly

Enlarged liver (National Cancer Institute, n.d.)

Herniorrhaphy

Suturing of a hernia (National Library of Medicine, 2021)

Heterogeneous

Made up of elements or ingredients that are not alike (National Cancer Institute, n.d.)

Hidradenitis

Inflammation of a sweat gland (National Library of Medicine, 2021)

High-density lipoprotein (HDL)

Often referred to as "good" cholesterol (Betts et al., 2013)

Hilum of the lung

A concave region where blood vessels, lymphatic vessels, and nerves also enter the lungs (Betts et al., 2013)

Hirsutism

A condition in which women and children have excess coarse body hair of an adult male distribution pattern as a result of elevated androgen levels (National Library of Medicine, 2021)

Histamine

A vasodilator involved in the inflammatory response (Betts et al., 2013)

Histology

The study of tissues (Betts et al., 2013)

Homeostasis

The state of steady internal conditions maintained by living things (Betts et al., 2013)

Homozygous genotype

A term that describes having two identical versions of the same gene (Betts et al., 2013)

Hormone

Secretion of an endocrine organ that travels via the bloodstream or lymphatics to induce a response in target cells or tissues in another part of the body (Betts et al., 2013)

Human immunodeficiency virus (HIV)

An infectious disease transmitted through semen, vaginal fluids, and blood that suppresses the immune system. HIV infection may be managed with antiviral drugs or may progress to acquired immune deficiency syndrome (AIDS) (Betts et al., 2013)

Hydrocele

Accumulation of serous fluid between the layers of membrane covering the testis (National Library of Medicine, 2021)

Hydrocephalus

The abnormal buildup of cerebrospinal fluid in the ventricles of the brain (National Cancer Institute, n.d.)

Hydronephrosis

Abnormal enlargement of a kidney, which may be caused by blockage of the ureter (such as by a kidney stone) or chronic kidney disease that prevents urine from draining into the bladder (National Cancer Institute, n.d.)

Hydrostatic

Relating to the equilibrium of liquids and the pressure exerted by liquid at rest (Betts et al., 2013)

Hypercalcemia

Excessive calcium in the blood (National Cancer Institute, n.d.)

Hypercapnia
Abnormally elevated blood levels of CO2 (carbon dioxide) (Betts et al., 2013)
Hypercholesterolemia
Higher than normal levels of cholesterol in the blood (National Library of Medicine, 2021)
Hyperemesis gravidarum
Excessive vomiting during pregnancy (National Library of Medicine, 2021)
Hyperesthesia
Increased sensitivity to stimuli (National Library of Medicine, 2021)
Hyperglycemia
Abnormally high blood glucose levels (Betts et al., 2013)
Hyperkalemia
Higher-than-normal blood potassium levels (Betts et al., 2013)
Hyperkinesia
Excessive movement of muscles of the body as a whole (National Library of Medicine, 2021)
Hyperlipidemia
Excessive fat in the blood (National Library of Medicine, 2021)
Hyperopia
Farsightedness (National Library of Medicine, 2021)
Hyperplasia
Abnormal growth due to the production of cells (Betts et al., 2013)
Hyperpnea
Forced breathing or breathing that is excessive (Betts et al., 2013)
Hypersensitivities
Reacting to something that would not normally evoke a reaction (Betts et al., 2013)
Hypertension
Abnormally high blood pressure (Betts et al., 2013)
Hyperthyroidism
The disease state caused by excessive production of hormones by the thyroid (Betts et al., 2013)
Hypertrophy
The enlargement of muscles (Betts et al., 2013)
Hypocalcemia
Abnormally low blood levels of calcium (Betts et al., 2013)
Hypocapnia
Abnormally low blood levels of CO2 (carbon dioxide) (Betts et al., 2013)
Hypodermis
The layer of the skin below the dermis that is composed mainly of loose connective and fatty tissues (Betts et al., 2013)
Hypoglycemia
Low blood glucose levels (Betts et al., 2013)
Hypokalemia
Abnormally decreased blood levels of potassium (Betts et al., 2013)
Hyponatremia
Lower-than-normal levels of sodium in the blood (Betts et al., 2013)
Hypopituitarism
State of deficient pituitary gland activity (National Library of Medicine, 2021)
Hypotension
Blood pressure goes below the homeostatic set point when standing (Betts et al., 2013)
Hypothalamus

A region of the forebrain below the thalamus; has function in both the autonomic and endocrine systems and regulates homeostasis (Betts et al., 2013)

Hypothermia

Abnormally low body temperature (Betts et al., 2013)

Hypothyroidism

The disease state caused by insufficient production of thyroid hormone by the thyroid gland (Betts et al., 2013)

Hypovolemic

An abnormally low volume of blood circulating through the body (National Library of Medicine, 2021)

Hypoxemia

Below-normal level of oxygen saturation of blood (typically <95 percent) (Betts et al., 2013)

Hypoxia

Lack of oxygen supply to the tissues (Betts et al., 2013)

Hysterectomy

Surgery to remove the uterus and, sometimes, the cervix (National Cancer Institute, n.d.)

Hysterosalpingogram

A radiographic image of the uterus and uterine/fallopian tubes (National Library of Medicine, 2021)

Hysteroscope

An endoscope used for examining the interior of the uterus (National Library of Medicine, 2021)

Hysteroscopy

Endoscopic examination of the uterus (National Library of Medicine, 2021)

Idiopathic

Something that is unknown (Betts et al., 2013)

Ileostomy

A procedure in which the ileum is brought through the abdominal wall (Betts et al., 2013)

Ileum

The longest part of the small intestine (Betts et al., 2013)

Immune system

Series of barriers, cells, and soluble mediators that combine to response to infections of the body with pathogenic organisms (Betts et al., 2013)

Immunity

Pertaining to the body's ability to mount an overwhelming immune response against a pathogen so that it cannot produce disease (Betts et al., 2013)

Immunodeficiency

The decreased ability of the body to fight infections and other diseases (National Cancer Institute, n.d.)

Immunological memory

Ability of the adaptive immune response to mount a stronger and faster immune response upon re-exposure to a pathogen (Betts et al., 2013)

Immunology

The study of the body's immune system (National Cancer Institute, n.d.)

Implantable cardioverter defibrillators (ICD)

A small device placed by surgery in the chest or abdomen that is used to correct a heartbeat that is abnormal. Wires are passed through a vein to connect the device to the heart. When it detects abnormal heartbeats, it sends an electrical shock to the heart to restore the heartbeat to normal (National Cancer Institute, n.d.)

In vitro fertilization

A process where the ova is fertilized outside the body and then implanted into the uterus (Betts et al., 2013)

Incision

A cut made in the body to perform surgery (National Cancer Institute, n.d.)

Incontinence

Loss of ability to control micturition (urination) (Betts et al., 2013)

Induction

The process of bringing on or starting labor through artificial means (National Library of Medicine, 2021)

Induration

A firm, raised reddened patch of skin (Betts et al., 2013)

Infarct

cells and tissues that have died, often due to a complete disruption in the blood and oxygen supply (National Library of Medicine, 2021)

Infection

The invasion and growth of bacteria, viruses, yeast, fungi, or other microorganisms in the body (National Cancer Institute, n.d.)

Inferior

A position below or lower than another part of the body proper (Betts et al., 2013)

Inferior vena cava

One of the two largest veins in the body. It carries deoxygenated blood from the torso and legs back to the heart (Betts et al., 2013)

Infertility

The inability to produce children (National Cancer Institute, n.d.)

Inflammation

Basic innate immune response characterized by heat, redness, pain, and swelling (Betts et al., 2013)

Influenza (flu)

An acute viral infection involving the respiratory tract (National Library of Medicine, 2021)

Infratemporal fossa

Located below the zygomatic arch and deep to the ramus of the mandible (Betts et al., 2013)

Inguinal canal

Opening in the abdominal wall that connects the testes to the abdominal cavity (Betts et al., 2013)

Initial segment

First part of the axon as it emerges from the axon hillock, where the electrical signals known as action potentials are generated (Betts et al., 2013)

Innate immune response

Fast-acting non-specific immune mechanisms that are present from birth (Betts et al., 2013)

Inspiration

Inhalation, or process of breathing air into the lungs (Betts et al., 2013)

Integration

Nervous system function that combines sensory perceptions and higher cognitive functions (memories, learning, emotion, etc.) to produce a response (Betts et al., 2013)

Interatrial septum

The wall separating the right and left atria (Betts et al., 2013)

Intercellular

Between cells (Betts et al., 2013)

Interferons

Early induced proteins made in virally infected cells that cause nearby cells to make antiviral proteins (Betts et al., 2013)

Internal nose

The nasal cavity (Betts et al., 2013)

Interstitial fluid

Extracellular fluid not contained within blood vessels (Betts et al., 2013)

Interstitial space

Spaces between individual cells in the tissues (Betts et al., 2013)

Interventricular septum

The wall of myocardium that separates the right and left ventricles (Betts et al., 2013)

Intracellular

Inside the cell membrane or within the cell (Betts et al., 2013)

Intracellular fluid

The fluid interior of the cell (Betts et al., 2013)

Intradermal

Within the skin (National Cancer Institute, n.d.)

Intramuscular

Within or into muscle (National Cancer Institute, n.d.)

Intravenous

Into or within the vein (National Cancer Institute, n.d.)

Inversion

Foot movement in which the bottom of the foot is turned toward the midline (Betts et al., 2013)

Iridectomy

Excision of part of the iris (National Library of Medicine, 2021)

Iritis

Inflammation of the iris (National Library of Medicine, 2021)

Ischemia

Lack of blood flow to body tissues (Betts et al., 2013)

Ischemic stroke

Disruption of blood flow to the brain because blood cannot flow through blood vessels as a result of a blockage or narrowing of the vessel (Betts et al., 2013)

Ischium

The lower and back part of the hip bone (Betts et al., 2013)

Isointense

Having the same intensity as another object (National Cancer Institute, n.d.)

Jaundice

A condition in which the skin and the whites of the eyes become yellow, urine darkens, and the color of stool becomes lighter than normal (National Cancer Institute, n.d.)

Jaundiced

Yellow-colored. Jaundice is a condition in which the skin and the whites of the eyes become yellow, urine darkens, and the color of stool becomes lighter than normal (National Cancer Institute, n.d.)

Juvenile rheumatoid arthritis

Chronic arthritis in children; also referred to as juvenile idiopathic arthritis (National Library of Medicine, 2021)

Keloid

A raised or hypertrophic scar (Betts et al., 2013)

Keratin

An intracellular fibrous protein that gives hair, nails, and skin their hardness and water-resistant properties (Betts et al., 2013)

Keratinocytes

Cells that manufacture and store the protein keratin (Betts et al., 2013)

Keratitis

Inflammation of the cornea (National Library of Medicine, 2021)

Keratomalacia

Degeneration of the cornea (National Library of Medicine, 2021)

Keratoplasty

Surgical replacement of the cornea (National Library of Medicine, 2021)

Keratosis

Any growth of horny tissue (National Library of Medicine, 2021)

Kinesthesia

Sense of body movement based on sensation in the skeletal muscles, tendons, joints, and the skin (Betts et al., 2013)

Kinetic energy

The energy matter possesses because of its motion (Betts et al., 2013)

Kyphosis

An excessive posterior curvature of the thoracic region (Betts et al., 2013)

Labia

Lips; can refer to the lips of the mouth or the folds of hair-covered skin that begin just posterior to the mons pubis (Betts et al., 2013)

Labyrinthitis

Inflammation of the inner ear (labyrinth) (National Library of Medicine, 2021)

Laceration

Torn, ragged-edged wound (National Library of Medicine, 2021)

Lacrimal fluid

Tears of the eye (Betts et al., 2013)

Lacteals

The lymphatic vessels of the small intestine which absorb digested fats (Betts et al., 2013)

Lactic acid

A substance produced by the body, such as during strenuous exercise, that aids in various chemical processes in the body (Betts et al., 2013)

Lactose

Milk sugar (Betts et al., 2013)

Laparoscope

A thin, tube-like instrument used to look at tissues and organs inside the abdomen (National Cancer Institute, n.d.)

Laparoscopy

A procedure that uses a laparoscope, inserted through the abdominal wall, to examine the inside of the abdomen (National Cancer Institute, n.d.)

Laparotomy

A surgical incision made in the wall of the abdomen (National Cancer Institute, n.d.)

Laryngeal

Pertaining to the larynx (National Cancer Institute, n.d.)

Laryngitis

Inflammation of the larynx (National Cancer Institute, n.d.)

Laryngopharynx

One of the three regions of the pharynx; inferior to the oropharynx and posterior to the larynx (Betts et al., 2013)

Laryngoplasty

Surgical repair of the larynx (National Library of Medicine, 2021)

Laryngoscope

A thin, tube-like instrument used to examine the larynx (National Cancer Institute, n.d.)

Laryngoscopy

Examination of the larynx with a mirror or laryngoscope (National Cancer Institute, n.d.)

Larynx

A cartilaginous structure inferior to the laryngopharynx that connects the pharynx to the trachea and helps regulate the volume of air that enters and leaves the lungs; also known as the voice box (Betts et al., 2013)

Lateral

Describes the side or direction toward the side of the body (Betts et al., 2013)

Lesion

An area of abnormal tissue (National Cancer Institute, n.d.)

Lethargy

A condition marked by drowsiness and an unusual lack of energy and mental alertness (National Cancer Institute, n.d.)

Leukemia

A cancer involving an abundance of leukocytes (Betts, et al., 2013)

Leukocyte

White blood cell(s) (Betts et al., 2013)

Leukocytopenia

An abnormal decrease in the number of leukocytes (National Library of Medicine, 2021)

Leukorrhea

White discharge from the vagina (National Library of Medicine, 2021)

Leydig cells

Cells between the seminiferous tubules of the testes that produce testosterone; a type of interstitial cell (Betts et al., 2013)

Lingual tonsil

Lymphoid tissue located at the base of the tongue (Betts et al., 2013)

Lipolysis

The breakdown of adipose tissue (Betts et al., 2013)

Lipoprotein

Compounds in which the hydrophobic triglycerides are packaged in protein envelopes for transport in body fluids (Betts et al., 2013)

Lithotripsy

The destruction of a calculus (stone) of the kidney, ureter, bladder, or gallbladder by physical forces (National Library of Medicine, 2021)

Lobectomy

Excision of the lobe(s) of an organ (National Cancer Institute, n.d.)

Longitudinal fissure

A large separation along the midline between the two cerebral hemispheres (Betts et al., 2013)

Lordosis

Excessive anterior curvature of the lumbar vertebral column region; also called swayback (Betts et al., 2013)

Low-density lipoprotein (LDL)

Often referred to as 'bad' cholesterol (Betts et al., 2013)

Lumbago

Acute or chronic pain in the lumbar or sacral regions (National Library of Medicine, 2021)

Lumbar

Pertaining to the lumbar region of the spine (L1 to L5) (Betts et al., 2013)

Lumbar puncture

Procedure used to withdraw cerebrospinal fluid from the lower lumbar region of the vertebral column (Betts et al., 2013)

Lumbosacral

Pertaining to the region of the back that includes the lumbar vertebrae, sacrum, and nearby structures (National Library of Medicine, 2021)

Lumen

A hollow passageway through which blood flows (Betts et al., 2013)

Lupus

A chronic, inflammatory, connective tissue disease that can affect the joints and many organs (National Cancer Institute, n.d.)

Lymph

The term used to describe interstitial fluid once it has entered the lymphatic system (Betts et al., 2013)

Lymph node

One of the bean-shaped organs found associated with the lymphatic vessels (Betts et al., 2013)

Lymphadenitis

Inflammation of lymph nodes (National Library of Medicine, 2021)

Lymphadenopathy

Disease or swelling of the lymph nodes (National Cancer Institute, n.d.)

Lymphatic capillaries

Smallest of the lymphatic vessels and the origin of lymph flow (Betts et al., 2013)

Lymphatic system

Network of lymphatic vessels, lymph nodes, and ducts that carries lymph from the tissues and back to the bloodstream (Betts et al., 2013)

Lymphatic trunks

Large lymphatic vessels that collect lymph from smaller lymphatic vessels and empty it into the blood via lymphatic ducts (Betts et al., 2013)

Lymphocytes

The second most common type of leukocyte and are essential for the immune response (Betts et al., 2013)

Lymphoid

Referring to lymphocytes or tissue in which lymphocytes develop (National Cancer Institute, n.d.)

Lymphoid nodules

Unencapsulated patches of lymphoid tissue found throughout the body (Betts et al., 2013)

Lymphoma

A form of cancer in which masses of malignant T and/or B lymphocytes collect in lymph nodes, the spleen, the liver, and other tissues. These leukocytes do not function properly, and the patient is vulnerable to infection (Betts. et al., 2013)

Lysosome

An organelle that contains enzymes that break down and digest unneeded cellular components (Betts et al., 2013)

Macrophage

A large cell derived from a monocyte; they participate in innate immune responses (Betts et al., 2013)

Magnetic Resonance Imaging (MRI)

A procedure in which radio waves and a powerful magnet linked to a computer are used to create detailed pictures of areas inside the body (National Cancer Institute, n.d.)

Major histocompatibility complex (MHC)

Protein structures found on the outside of cells that help the immune system recognize non-self antigens (Betts et al., 2013)

Malignant

Cancerous (Betts et al., 2013)

Mammary glands

Modified sweat glands that produce breast milk (Betts et al., 2013)

Mammogram

Radiographic image of the breast (National Cancer Institute, n.d.)

Mammography

The use of film or a computer to create a picture of the breast (National Cancer Institute, n.d.)

Mammoplasty

Surgical reconstruction of the breast, including both augmentation and reduction (National Library of Medicine, 2021)

Mast cell

Cell found in the skin and the lining of body cells that contains cytoplasmic granules with vasoactive mediators such as histamine (Betts et al., 2013)

Mastalgia

Pain or discomfort in one or both breasts (National Cancer Institute, n.d.)

Mastectomy

The surgical procedure to remove all or part of a breast (National Cancer Institute, n.d.)

Mastitis

A condition in which breast tissue is inflamed (National Cancer Institute, n.d.)

Mastoidectomy

Excision of the mastoid bone (National Library of Medicine, 2021)

Mastoiditis

Inflammation of the mastoid bone (National Library of Medicine, 2021)

Mechanoreceptors

A sensory neuron that responds to mechanical pressure (Betts et al., 2013)

Meconium

Fetal wastes consisting of ingested amniotic fluid, cellular debris, mucus, and bile (Betts et al., 2013)

Medial

Describes the middle or direction toward the middle of the body (Betts et al., 2013)

Medulla oblongata

A part of the brain stem responsible for control of heart rate and breathing (Betts et al., 2013)

Meissner corpuscle

A specialized sensory nerve structures that responds to light touch (Betts et al., 2013)

Melanin

Pigment that gives the hair and skin its color (Betts et al., 2013)

Melanocyte

A cell that produces the pigment melanin (Betts et al., 2013)

Melanoma

A cancer characterized by the uncontrolled growth of melanocytes, the pigment-producing cells in the epidermis (Betts et al., 2013)

Melena

Black, tarry feces containing blood (National Library of Medicine, 2021)

Memory T cells

Long-lived immune cells reserved for future exposure to a pathogen (Betts et al., 2013)

Menarche

First menstruation in a pubertal female (Betts et al., 2013)

Meninges

The membranes that surround the central nervous system (Betts et al., 2013)

Meningioma

A tumor of the meninges (National Cancer Institute, n.d.)

Meningitis

Inflammation of the meninges, the tough membranes that surround the central nervous system (Betts et al., 2013)

Meningocele

Protrusion of the meninges (Betts et al., 2013)

Meningomyelocele

Protrusion of the meninges and spinal cord (National Library of Medicine, 2021)

Menopause

The cessation of the menstrual cycle; is considered complete when a woman has not menstruated in a full year (Betts et al., 2013)

Menorrhagia

Excessive bleeding at menstruation (National Cancer Institute, n.d.)

Mesoderm

The middle germ layer in the embryo (Betts et al., 2013)

Metabolism

The sum of all anabolic and catabolic reactions that take place in the body (Betts et al., 2013)

Metacarpal bones

The bones that form the palm of the hand (Betts et al., 2013)

Metastasis

The process in which cancer spreads from one part of the body to another (Betts et al., 2013)

Metrorrhagia

Excessive bleeding from the uterus not related to menstruation (National Library of Medicine, 2021)

Microcephaly

A congenital abnormality where the head is small (National Library of Medicine, 2021)

Microglia

Smaller than most of the other glial cells; they ingest and digest cells or pathogens that cause disease (Betts et al., 2013)

Microscope

An instrument that is used to look at cells and other small objects that cannot be seen with the eye alone (National Cancer Institute, n.d.)

Micturition

Also called urination or voiding (Betts et al., 2013)

Midbrain

A portion of the brainstem, positioned above the pons, also called mesencephalon, that assists in motor reflexes associated with visual, auditory, and somatosensory stimuli (Betts et al., 2013)

Midwifery

Practice of assisting in childbirth (National Library of Medicine, 2021)

Mitochondria

A membranous, bean-shaped organelle that is the "energy transformer" of the cell (Betts et al., 2013)

Mitral valve

Located at the opening between the left atrium and left ventricle; also known as the bicuspid valve (Betts et al., 2013)

Monocyte

A type of immune cell that is made in the bone marrow (National Cancer Institute, n.d.)

Mononeuropathy

Disease affecting a single peripheral nerve (National LIbrary of Medicine, 2021)

Motor nerves

Peripheral, efferent, myelinated nerve tissue that stimulates muscle contraction (Betts et al., 2013)

Mucosa-associated lymphoid tissue (MALT)

Lymphoid nodule associated with the mucosa (Betts et al., 2013)

Mucous membranes

Epithelial membranes that line the body cavities and hollow passageways that open to the external environment (Betts et al., 2013)

Mucus

A thick, slippery fluid made by the membranes that line certain organs of the body (National Cancer Institute, n.d.)

Multipolar

Shape of a neuron that has multiple processes—the axon and two or more dendrites (Betts et al., 2013)

Muscular dystrophy

A general term for the group of inherited myopathies that are characterized by wasting and weakness of the skeletal muscle (National Library of Medicine, 2021)

Musculoskeletal

Refers to both the muscular system and skeletal system (Betts et al., 2013)

Myalgia

Pain in a muscle or group of muscles (National Cancer Institute, n.d.)

Myasthenia gravis

A disease in which antibodies made by a person's immune system prevent certain nerve-muscle interactions, causing weakness in the arms and legs, vision problems, and drooping eyelids or head (National Cancer Institute, n.d.)

Mycetoma

A chronic subcutaneous infection (National Library of Medicine, 2021)

Myelin sheath

Lipid-rich layer of insulation that surrounds an axon, formed by oligodendrocytes in the central nervous system and Schwann cells in the peripheral nervous system; facilitates the transmission of electrical signals (Betts et al., 2013)

Myeloblast

A type of immature white blood cell that forms in the bone marrow (National Cancer Institute, n.d.)

Myeloma

Cancer that arises in plasma cells (National Cancer Institute, n.d.)

Myelopoiesis

Formation of bone marrow (National Library of Medicine, 2021)

Myocardial infarction (MI)

Heart attack, caused by lack of blood flow and oxygen to the heart (Betts et al., 2013)

Myocarditis

A rare condition in which the heart muscle becomes thick and inflamed and may also become weak (National Cancer Institute, n.d.)

Myocardium

The middle and thickest muscle layer of the heard (Betts et al., 2013)

Myopia

Nearsightedness (National Library of Medicine, 2021)

Myringoplasty

Surgical repair of the tympanic membrane.

Naïve lymphocyte

Mature B or T cell that has not yet encountered antigen for the first time (Betts et al., 2013)

Nasal cavity

The inside of your nose (Betts et al., 2013)

Nasogastric

Describes the passage from the nose to the stomach (National Cancer Institute, n.d.)

Nasopharyngeal

Pertaining to the nose and pharynx (throat) (National Library of Medicine, 2021)

Nasopharyngitis

Inflammation of the nose and pharynx (National Library of Medicine, 2021)

Nasopharynx

The upper part of the throat behind the nose. An opening on each side of the nasopharynx leads into the ear (National Cancer Institute, n.d.)

Natal

Pertaining to being born or birth (Betts et al., 2013)

Natural killer cell (NK)

Cytotoxic lymphocyte of innate immune response (Betts et al., 2013)

Nausea

A feeling of sickness or discomfort in the stomach that may come with an urge to vomit (National Cancer Institute, n.d.)

Nebuilizer

A device used to turn liquid into a fine spray (National Cancer Institute, n.d.)

Necrosis

Accidental cell death (Betts et al., 2013)

Neonatal

Pertaining to the newborn's first thirty days of life outside of the uterus (Betts et al., 2013)

Neonate

An infant during the first 28 days after birth (National Library of Medicine, 2021)

Neonatologist

Physician who studies and treats disorders of the newborn (National Library of Medicine, 2021)

Neonatology

A subspecialty of pediatric medicine concerned with the newborn (National Library of Medicine, 2021)

Nephrectomy

Excision of all or part of the kidney (National Cancer Institute, n.d.)

Nephritis

A condition in which the tissues in the kidney become inflamed and have problems filtering waste from the blood (National Cancer Institute, n.d.)

Nephrolithiasis

Formation of stone(s) in the kidney (National Library of Medicine, 2021)

Nephrolithotomy

Incision into the kidney to remove stone(s) (National Library of Medicine, 2021)

Nephrologist

A doctor who has special training in diagnosing and treating kidney disease (National Cancer Institute, n.d.)

Nephrology

A subspecialty of internal medicine concerned with the anatomy, physiology, and pathology of the kidney (National Library of Medicine, 2021)

Nephron

A highly specialized tubular structure responsible for creating the final urine composition (Betts et al., 2013)

Nephrostomy

Surgery to make an opening from the outside of the body to the renal pelvis (National Cancer Institute, n.d.)

Nerve

Bundle of fibers that receives and sends messages between the body and the brain (National Cancer Institute, n.d.)

Nervous

Nervous system function that causes a target tissue (muscle or gland) to produce an event as a consequence to stimuli (Betts et al., 2013)

Neuralgia

Pain of the peripheral or cranial nerves (National Library of Medicine, 2021)

Neuritis

Inflammation of a peripheral or cranial nerve (National Library of Medicine, 2021)

Neuroglia

Supportive tissue of the nervous system, including the network of branched cells in the central nervous system (astrocytes, microglia, and oligodendrocytes) and the supporting cells of the peripheral nervous system (Schwann cells and satellite cells), also called glia (Betts et al., 2013)

Neurologist

A doctor who has special training in diagnosing and treating disorders of the nervous system (National Cancer Institute, n.d.)

Neurology

A medical specialty concerned with the study of the structures, functions, and diseases of the nervous system (National Cancer Institute, n.d.)

Neuroma

Tumor made up of nerve cells (National Cancer Institute, n.d.)

Neuron

Cells that propagate information via electrochemical impulses (Betts et al., 2013)

Neuropathy

A nerve problem that causes pain, numbness, tingling, swelling, or muscle weakness in different parts of the body (National Cancer Institute, n.d.)

Neurotransmitters

Chemicals that are made by nerve cells and used to communicate with other cells, including other nerve cells and muscle cells (National Cancer Institute, n.d.)

Neutrophil

Phagocytic white blood cell recruited from the bloodstream to the site of infection via the bloodstream.

Nevus

A benign growth on the skin that is formed by a cluster of melanocytes (National Cancer Institute, n.d.)

Nociceptors

Sensory neurons that respond to pain (Betts et al., 2013)

Nocturia

Frequent urination at night that interrupts sleep (National Library of Medicine, 2021)

Node of Ranvier

Gap between two myelinated regions of an axon, allowing for strengthening of the electrical signal as it propagates down the axon (Betts et al., 2013)

Nodule

A growth or lump that may be malignant or benign (National Cancer Institute, n.d.)

Norepinephrine

A chemical in the body that can act as a neurotransmitter and a hormone. It is released from the adrenal gland in response to stress and low blood pressure and is also known as noradrenaline (National Cancer Institute, n.d.)

Nosocomial infection

Any infection which a patient contracts in a health-care institution (National Library of Medicine, 2021)

Nucleus

The cell's central organelle, which contains the cell's DNA (Betts et al., 2013)

Obesity

A common, chronic disease marked by an abnormally high, unhealthy amount of body fat (National Cancer Institute, n.d.)

Obstetrician

A doctor who specializes in caring for women during pregnancy and childbirth (National Cancer Institute, n.d.)

Obstetrics and gynecology

A branch of medicine that specializes in the care of women during pregnancy and childbirth and in the diagnosis and treatment of diseases of the female reproductive organs; also called OB/GYN (National Cancer Institute, n.d.)

Occipital lobe

Region of the cerebral cortex directly beneath the occipital bone of the cranium (Betts et al., 2013)

Occlusion

A blockage (Betts et al., 2013)

Oculomotor nerve

Responsible for eye movements (Betts et al., 2013)

Olfaction

The sense of smell (Betts et al., 2013)

Oligodendrocyte

Glial cell type in the central nervous system that provides the myelin insulation for axons in tracts (Betts et al., 2013)

Oligohydramnios

A condition of abnormally low amniotic fluid volume (National Library of Medicine, 2021)

Oligomenorrhea

Abnormally infrequent menstruation (National Library of Medicine, 2021)

Oligospermia

Condition of a suboptimal concentration of spermatozoa in the ejaculated semen to ensure successful fertilization of an ovum (National Library of Medicine, 2021)

Oliguria

Below normal urine production of 400–500 mL/day (Betts et al., 2013)

Omentum

A fold of the peritoneum (the thin tissue that lines the abdomen) that surrounds the stomach and other organs in the abdomen (National Cancer Institute, n.d.)

Oncogene

A gene that is a mutated form of a gene involved in normal cell growth and may cause the growth of cancer cells (National Cancer Institute, n.d.)

Oncologist

A doctor who has special training in diagnosing and treating cancer (National Cancer Institute, 2021)

Oncology

A branch of medicine that specializes in the diagnosis and treatment of cancer (National Cancer Institute, 2021)

Onychocryptosis

An ingrown nail (National Library of Medicine, 2021)

Onychodystrophy

Abnormal changes in the shape, color, texture, and growth of the fingernails or toenails (National Cancer Institute, n.d.)

Onychomycosis

A fungal infection of the nail (National Library of Medicine, 2021)

Onychophagia

Nail-biting (National Library of Medicine, 2021)

Oocyte

Immature egg cell (Betts et al., 2013)

Oophorectomy

Surgery to remove one or both ovaries (National Cancer Institute, n.d.)

Oophoritis

Inflammation of the ovary (National Library of Medicine, 2021)

Oophoropexy

A procedure in which one or both ovaries and fallopian tubes are separated from the uterus and attached to the wall of the abdomen (National Cancer Institute, n.d.)

Ophthalmia neonatorum

Conjunctivitis in newborns (severe) (National Library of Medicine, 2021)

Ophthalmic artery

Provides blood to the eyes (Betts et al., 2013)

Ophthalmologist

A doctor who has special training in diagnosing and treating eye problems (National Cancer Institute, n.d.)

Ophthalmology

A surgical specialty focused on the structure, function, and surgery of the eye (National Library of Medicine, 2021)

Ophthalmopathy

Disease of the eye (National Library of Medicine, 2021)

Ophthalmoplegia

Paralysis of one or more eye muscles (National Library of Medicine, 2021)

Ophthalmoscope

Instrument used to view the inside of the eye (National Cancer Institute, n.d.)

Ophthalmoscopy

An exam of the fundus of the eye using a magnifying lens and light (National Cancer Institute, n.d.)

Opsonization

A process by which an antibody or an antimicrobial protein binds to a pathogen, thereby marking it as a target for phagocytes (Betts et al., 2013)

Optic nerve

Carriers signals from the retina to the brain (Betts et al., 2013)

Optometry

The professional practice of eye and vision care that involves measuring vision (National Library of Medicine, 2021)

Oral

By or pertaining to the mouth (National Cancer Institute, n.d.)

Orchidectomy

Surgery to remove one or both testicles; also called orchiectomy (National Cancer Institute, n.d.)

Orchiectomy

Surgery to remove one or both testicles; also called orchidectomy (National Cancer Institute, n.d.)

Orchiopexy

Surgical fixation of the testicle (National Library of Medicine, 2021)

Orchitis

Inflammation of a testis (National Library of Medicine, 2021)

Oropharynx

The oropharynx is a passageway for both air and food and borders the nasopharynx and the oral cavity (Betts, et al., 2013)

Orthostatic

Standing up (Betts et al., 2013)

Osmolarity

The concentration of solutes in the blood plasma (Betts et al., 2013)

Osmosis

A process by which molecules of a solvent tend to pass through a membrane from a less concentrated solution into a more concentrated one (Betts et al., 2013)

Osseous tissue

Bone tissue (Betts et al., 2013)

Ossicles

Three small bones located in the middle ear (Betts et al., 2013)

Osteitis

Inflammation of bone (National LIbrary of Medicine, 2021)

Osteoarthritis

The most common type of arthritis; associated with aging and “wear and tear” of the articular cartilage (Betts et al., 2013)

Osteoblast

The cell responsible for forming new bone (Betts et al., 2013)

Osteochondritis
Inflammation of bone and cartilage (National Library of Medicine, 2021)
Osteocyte
Bone cell (Betts et al., 2013)
Osteolytic
Causing the breakdown of bone (National Cancer Institute, n.d.)
Osteomalacia
A softening of adult bones due to Vitamin D deficiency (Betts et al., 2013)
Osteomyelitis
Inflammation of bone and bone marrow (National Cancer Institute, n.d.)
Osteonecrosis
Abnormal condition of bone death (lack of blood supply) (National Cancer Institute, n.d.)
Osteopenia
Abnormally low bone mass or bone mineral density (National Cancer Institute, n.d.)
Osteopetrosis
Abnormal condition of porous bones (National Library of Medicine, 2021)
Osteoporosis
A disease characterized by a decrease in bone mass that occurs when the rate of bone resorption exceeds the rate of bone formation (Betts et al., 2013)
Osteosarcoma
Malignant tumor of bone (National Cancer Institute, n.d.)
Otalgia
Pain in the ear (National Library of Medicine, 2021)
Otitis externa
Inflammation of the outer ear (National Library of Medicine, 2021)
Otitis media
inflammation of the middle ear (National Library of Medicine, 2021)
Otolaryngologist
A doctor who has special training in diagnosing and treating diseases of the ear, nose, and throat; also called ENT doctor (National Cancer Institute, n.d.)
Otomycosis
Fungal infection of the external ear (National Library of Medicine, 2021)
Otosclerosis
Formation of spongy bone in the labyrinth capsule that can lead to hearing loss (National Library of Medicine, 2021)
Otoscope
Instrument used to view the ear (National Library of Medicine, 2021)
Otoscopy
Process of viewing the ear canal and eardrum (National Library of Medicine, 2021)
Ovarian follicle
The oocyte and its supporting cells (Betts et al., 2013)
Ovarian ligament
A fibrous ligament that connects the ovary to the lateral surface of the uterus (Betts et al., 2013)
Ovaries
Female gonads (Betts et al., 2013)
Ovulation
Release of a secondary oocyte and associated granulosa cells from an ovary (Betts et al., 2013)
Oximeter
Instrument used to measure the oxygenation of tissues (National Cancer Institute, n.d.)

Oxytocin

Hypothalamic hormone stored in the posterior pituitary gland and important in stimulating uterine contractions in labor, milk ejection during breastfeeding, and feelings of attachment (also produced in males) (Betts et al., 2013)

Pacemaker

An electronic device that is implanted in the body to monitor heart rate and rhythm. It gives the heart electrical stimulation when it does not beat normally (National Cancer Institute, n.d.)

Pacinian corpuscle

A specialized sensory nerve structure that responds to vibration (Betts et al., 2013)

Palatine tonsils

A pair of soft tissue masses located at the rear of the throat (pharynx) (Betts et al., 2013)

Pallor

Unnatural paleness of the skin (National Library of Medicine, 2021)

Palpation

Examination by pressing on the surface of the body to feel the organs or tissues underneath (National Cancer Institute, n.d.)

Palpitations

A rapid or irregular heartbeat that a person can feel (National Cancer Institute, n.d.)

Pancreating

Pertaining to the pancreas (National Cancer Institute, n.d.)

Pancreatitis

Inflammation of the pancreas (National Cancer Institute, n.d.)

Pancytopenia

A condition in which there is a lower-than-normal number of red and white blood cells and platelets in the blood (National Cancer Institute, n.d.)

Panhypopituitarism

A rare condition in which the pituitary gland stops making most or all hormones (National Cancer Institute, n.d.)

Papanicolaou smear (Pap test)

A procedure in which a small brush is used to gently remove cells from the surface of the cervix and the area around it so they can be checked under a microscope for cervical cancer or cell changes that may lead to cervical cancer (National Cancer Institute, n.d.)

Papillary layer

The superficial layer of the dermis made of loose, areolar connective tissue (Betts et al., 2013)

Paracrine

Cellular signaling in which a factor secreted by a cell affects other cells in the local environment (National Library of Medicine, 2021)

Paraplegia

Paralysis that affects both legs and lower part of the body (Betts et al., 2013)

Parasympathetic

Activity that is referred to by the epithet of rest and digest (Betts et al., 2013)

Parathyroid glands

Small structures located on the posterior thyroid gland that produce parathyroid hormone (PTH) (Betts et al., 2013)

Parathyroidectomy

Surgery to remove one or more parathyroid glands (National Cancer Institute, n.d.)

Paresis

Partial paralysis wherein there is still some control of the muscles (Betts et al., 2013)

Paresthesia

Abnormal sensation in the extremities (National Cancer Institute, n.d.)

Parietal layer

Outermost layer of the pleura that connects to the thoracic wall, mediastinum, and diaphragm (Betts et al., 2013)

Parietal lobe

Region of the cerebral cortex directly beneath the parietal bone of the cranium (Betts et al., 2013)

Paronychia

Infection of the skin around the nail (National Library of Medicine, 2021)

Parturition

Childbirth (Betts et al., 2013)

Passive immunity

Transfer of immunity to a pathogen to an individual that lacks immunity to this pathogen usually by the injection of antibodies (Betts et al., 2013)

Pathogen

An organism that causes a disease (Betts et al., 2013)

Pathologist

A doctor who has special training in identifying diseases by studying cells and tissues under a microscope (National Cancer Institute, n.d.)

Pelvic

Pertaining to the pelvis (National Cancer Institute, n.d.)

Penis

Male organ of copulation (Betts et al., 2013)

Percutaneous

Passing through the skin, as an injection or a topical medicine (National Cancer Institute, n.d.)

Perfusion

Penetration of blood (Betts et al., 2013)

Pericardial fluid

Watery fluid produced in the serous and visceral pericardium surrounding the surface of the heart (National Library of Medicine, 2021)

Pericardiocentesis

Surgical puncture to aspirate fluid from the (sac) surrounding the heart (National Library of Medicine, 2021)

Pericarditis

Inflammation of the (sac) surrounding the heart (National Cancer Institute, n.d.)

Pericardium

Membrane that separates the heart from other mediastinal structures; consists of two distinct, fused sublayers: the fibrous pericardium and the parietal pericardium (Betts et al., 2013)

Perimenopause

The transitional period before and after menopause wherein the menstrual cycle is irregular and hormone levels widely fluctuate (National Library of Medicine, 2021)

Peripheral arterial disease

Obstruction of vessels in peripheral regions of the body (Betts et al., 2013)

Peripheral nervous system (PNS)

All nervous tissue that is outside of the brain and spinal cord (Betts et al., 2013)

Peripheral vision

The outer sides of the field of vision (Betts et al., 2013)

Peritoneal

Having to do with the parietal peritoneum (the tissue that lines the abdominal wall and pelvic cavity) and visceral peritoneum (the tissue that covers most of the organs in the abdomen, including the intestines) (National Cancer Institute, n.d.)

Peritoneum

Serous membrane that lines the abdominopelvic cavity and covers the organs found there (Betts et al., 2013)

Peritonitis

Inflammation of the peritoneum (Betts et al., 2013)

Permeability

Property of membranes and other structures to permit passage of light, heat, gases, liquids, metabolites, and mineral ions (National Library of Medicine, 2021)

pH

A measure of how acidic or alkaline a substance is, as determined by the number of free hydrogen ions in the substance (Betts et al., 2013)

Phagocytes

Cells that engulf and absorb bacteria and cell particles (Betts et al., 2013)

Phagocytized

The process by which certain cells are able to "eat" other cells or substances by engulfing them (Betts et al., 2013)

Phagocytosis

Movement of material from the outside to the inside of the cells via vesicles made from invaginations of the plasma membrane; process where some white blood cells engulf invading microorganisms (Betts et al., 2013)

Phalanges

Finger and toe bones (Betts et al., 2013)

Phalanx

Any bone in the fingers or toes (Betts et al., 2013)

Pharmacist

A health professional who has special training in preparing and dispensing (giving out) prescription drugs (National Cancer Institute, n.d.)

Pharyngeal tonsil

The tonsil located at the back of the throat; also known as the adenoid when swollen (Betts et al., 2013)

Pharyngitis

Inflammation of the pharynx (National Library of Medicine, 2021)

Pharynx

A tube formed by skeletal muscle and lined by mucous membrane that is continuous with that of the nasal cavities; also known as the throat (Betts, et al., 2013)

Phlebitis

Inflammation of a vein (National Cancer Institute, n.d.)

Phlebotomist

A medical professional trained to draw blood, typically by performing a venipuncture of a surface vein of the arm (Betts et al., 2013)

Phlebotomy

A procedure in which a needle is used to take blood from a vein, usually for laboratory testing (National Cancer Institute, n.d.)

Photophobia

A condition in which the eyes are more sensitive than normal to light (National Cancer Institute, n.d.)

Photoreceptor

A specialized receptor in the eye that responds to light stimuli (Betts et al., 2013)

Phrenic nerve

The nerve connected to the spinal cord at cervical levels 3 to 5; it is responsible for the muscle contractions that drive ventilation (Betts et al., 2013)

Pia mater

Thin, innermost membrane of the meninges that directly covers the surface of the central nervous system (Betts et al., 2013)

Placenta

The organ that supplies oxygen and nutrients to the fetus, excretes waste products, and produces and secretes estrogens and progesterone (Betts et al., 2013)

Placenta abruptio

Occurs when the placenta prematurely becomes detached from the uterine wall, resulting in uterine bleeding, fetal distress, or fetal death; also known as abruptio placenta (National Library of Medicine, 2021)

Placenta previa

Low placement of fetus within the uterus, which causes the placenta to partially or completely cover the opening of the cervix as it grows (Betts et al., 2013)

Plaque

A fatty material including cholesterol, connective tissue, white blood cells, and some smooth muscle cells (Betts et al., 2013)

Plasma cells

A type of B lymphocyte that produces antibodies, which bind to specific foreign or abnormal antigens in order to destroy them (Betts et al., 2013)

Plasmapheresis

A procedure in which a machine is used to separate the plasma from the blood cells (National Cancer Institute, n.d.)

Platelets

Cell fragments involved in blood clotting; also called thrombocytes (Betts et al., 2013)

Pleura

The membrane that wraps around the outside of your lungs and lines the inside of your chest cavity (Betts et al., 2013)

Pleural cavity

The space between the lung's visceral and parietal layers (Betts et al., 2013)

Pleural effusion

An abnormal collection of fluid between the thin layers of tissue (pleura) lining the lung and the wall of the chest cavity (National Cancer Institute, n.d.)

Pleurisy

Inflammation of the pleura (National Library of Medicine, 2021)

Pleurodesis

A medical procedure that uses chemicals or drugs to cause inflammation and adhesion between the layers of the pleura to prevent buildup of fluid (National Cancer Institute, n.d.)

Pneumoconiosis

A condition caused by the inhalation of dust (National Library of Medicine, 2021)

Pneumonectomy

Excision of the lung (National Cancer Institute, n.d.)

Pneumonia

A severe inflammation of the lungs in which the alveoli (tiny air sacs) are filled with fluid (National Cancer Institute, n.d.).

Pneumothorax

An abnormal collection of air in the space between the thin layer of tissue that covers the lungs and the chest cavity that can cause all or part of the lung to collapse (National Cancer Institute, n.d.)

Poliomyelitis

Acute infection by the poliovirus, especially of the motor neurons in the spinal cord and brainstem (National Library of Medicine, 2021)

Polycythemia

A rare disorder in which the bone marrow produces an abnormally large amount of blood cells (Betts et al., 2013)

Polycythemia vera

A disease in which there are too many red blood cells in the bone marrow and blood, causing the blood to thicken (National Cancer Institute, n.d.)

Polydipsia

Condition of excessive thirst (Betts et al., 2013)

Polyhydramnios

A condition where there is excessive amniotic fluid in the placenta (National Library of Medicine, 2021)

Polymyositis

An inflammatory disease of the muscles closest to the center of the body (National Cancer Institute, n.d.)

Polyneuritis

Inflammation of several peripheral nerves at the same time (National Cancer Institute, n.d.)

Polyneuropathy

Disease of multiple peripheral nerves at the same time (National Library of Medicine, 2021)

Polyp

A growth that protrudes from a mucous membrane (National Cancer Institute, n.d.)

Polypectomy

Excision of polyps (National Cancer Institute, n.d.)

Polyposis

The development of numerous polyps (National Cancer Institute, n.d.)

Polysomnography (PSG)

Simultaneous and continuous monitoring of several parameters during sleep to study normal and abnormal sleep (National Library of Medicine, 2021)

Polyuria

Excessive urine production (Betts et al., 2013)

Pons

The main connection between the cerebellum and the brain stem. It is responsible for regulating several crucial functions, including the cardiovascular and respiratory systems (Betts et al., 2013)

Posterior

Describes the back or direction toward the back of the body (Betts et al., 2013)

Postnatal

Pertaining to after birth (National Library of Medicine, 2021)

Postpartum

The period of approximately 6 weeks immediately following childbirth (Betts et al., 2013)

Precancerous

A term used to describe a condition that may (or is likely to) become cancer (Betts et al., 2013)

Preeclampsia

The abnormal condition in pregnancy where the patient experiences hypertension, edema and proteinuria (National Library of Medicine, 2021)

Prefix

Word part at the beginning of a medical term that changes the meaning of the word root.

Premature

Occurring before expected; for example, premature birth or premature death (National Library of Medicine, 2021)

Prenatal

Having to do with the time a female is pregnant, before birth occurs; also called antenatal (National Cancer Institute, n.d.)

Prepuce

Flap of skin that forms a collar around, and thus protects and lubricates, the glans penis; also referred to as the foreskin (Betts et al., 2013)

Primary adaptive response

Immune system's response to the first exposure to a pathogen (Betts et al., 2013)

Primary lymphoid organs

Site where lymphocytes mature and proliferate; for example, red bone marrow and the thymus gland (Betts et al., 2013)

Primigravida

First pregnancy (National Library of Medicine, 2021)

Process

In cells, an extension of a cell body; in the case of neurons, this includes the axon and dendrites (Betts et al., 2013)

Proctoscope

A thin, tube-like instrument used to look inside the anus and rectum (National Cancer Institute, n.d.)

Proctoscopy

A procedure that uses a proctoscope to look inside the anus and rectum (National Cancer Institute, n.d.)

Prolapse

The protrusion of an organ or part of an organ into a natural or artificial orifice (National Library of Medicine, 2021)

Proliferate

The ability to reproduce rapidly (Betts et al., 2013)

Pronation

Forearm motion that moves the palm of the hand from the palm forward to the palm backward position (Betts et al., 2013)

Prone

A face-down orientation (Betts et al., 2013)

Proprioception

Sense of position and movement of the body (Betts et al., 2013)

Prostaglandins

Signaling molecules derived from unsaturated fatty acids with hormone-like effects (Betts et al., 2013)

Prostate gland

A gland at the base of the bladder surrounding the urethra that contributes fluid to semen during ejaculation (Betts et al., 2013)

Prostatectomy

Surgery to remove part or all of the prostate and some of the tissue around it (National Cancer Institute, n.d.)

Prostatitis

Inflammation of the prostate gland (National Cancer Institute, n.d.)

Proximal

A position in a limb that is nearer to the point of attachment or the trunk of the body (Betts et al., 2013)

Pruritus

Itching (National Cancer Institute, n.d.)

Pseudocyesis

False pregnancy (National Library of Medicine, 2021)

Pseudostratified

Tissue with a single layer of irregularly shaped cells that give the appearance of more than one layer (Betts et al., 2013)

Psoriasis

A chronic disease of the skin marked by red patches covered with white scales (National Cancer Institute, n.d.)

Psychiatrist

A medical doctor who specializes in neuroscience and diagnoses and treats mental disorders (Betts et al., 2013)

Psychiatry

The medical science that deals with the origin, diagnosis, prevention, and treatment of mental disorders (National Library of Medicine, 2021)

Psychologist

A specialist who can talk with patients and their families about emotional and personal matters (National Cancer Institute, n.d.)

Psychology

The study of how the mind works and how thoughts and feelings affect behavior (National Cancer Institute, n.d.)

Psychosis

A severe mental disorder in which a person loses the ability to recognize reality or relate to others (National Cancer Institute, n.d.)

Puerperal

Pertaining to immediately after childbirth (National Library of Medicine, 2021)

Puerperium

Time directly after childbirth (6 to 8 weeks after giving birth) (National Library of Medicine, 2021)

Pulmonary artery

Artery that arises from the pulmonary trunk (Betts et al., 2013)

Pulmonary edema

Fluid accumulation in alveoli and bronchioles (related to heart failure) (Betts et al., 2013)

Pulmonary embolism

A blood clot within the lung (Betts et al., 2013)

Pulmonary trunk

The very large artery referred to as a trunk, a term indicating that the vessel gives rise to several smaller arteries (Betts et al., 2013)

Pyelitis

Inflammation of the renal pelvis and kidney calices (National Library of Medicine, 2021)

Pyelonephritis

Inflammation of the nephrons, renal pelvis, and kidney calices (National Library of Medicine, 2021)

Pyloric sphincter

A band of smooth muscle at the junction between the pylorus of the stomach and the duodenum of the small intestine (Betts et al., 2013)

Pyloric stenosis

Narrowing of the pylorus or pyloric sphincter (National Library of Medicine, 2021)

Pyloromyotomy

Incision into the pyloric muscle (used to correct pyloric stenosis) (National Library of Medicine, 2021)

Pyuria

The presence of white blood cells in the urine (National Library of Medicine, 2021)

Quadriceps

A group of four muscles located on the anterior (front) thigh (Betts et al., 2013)

Quadriplegia

Paralysis of all four limbs (National Library of Medicine, 2021)

Radiculopathy

Disease of the nerve roots (National Library of Medicine, n.d.)

Radiography

A procedure that uses x-rays to take pictures of areas inside the body (National Cancer Institute, n.d.)

Radioisotopes

Radioactive isotopes (Betts et al., 2013)

Radiologist

A doctor who has special training in creating and interpreting pictures of areas inside the body (National Cancer Institute, n.d.)

Radiology

The use of radiation or other imaging technologies to diagnose or treat disease (National Cancer Institute, n.d.)

Rectal

By or pertaining to the rectum (National Cancer Institute, n.d.)

Rectocele

Herniation of the rectum into the vagina (National Library of Medicine, 2021)

Reflux

The backward flow of liquid from the stomach into the esophagus (National Cancer Institute, n.d.)

Rejuvenation

The phenomenon of youthfulness, vitality, and freshness being restored (National Library of Medicine, 2021)

Remission

A decrease in or disappearance of signs and symptoms (Betts et al., 2013)

Renal cortex

The outer region of the kidney, between the renal capsule and the renal medulla (Betts et al., 2013)

Respiratory zone

The respiratory zone includes structures that are directly involved in gas exchange (Betts, et al., 2013)

Reticulated

Net-like (Betts et al., 2013)

Reticulocytes

Immature erythrocytes (Betts et al., 2013)

Retinitis pigmentosa

A disease that causes deterioration of the retinas of the eyes (Betts et al., 2013)

Retinoblastoma

Cancer that forms in the tissues of the retina (National Cancer Institute, n.d.)

Retinopathy

Disease of the retina (National Library of Medicine, 2021)

Retinoscopy

Process of viewing the retina (National Library of Medicine, 2021)

Retroperitoneal

Located behind the peritoneum (Betts et al., 2013)

Rhabdomyolysis

Necrosis or disintegration of skeletal muscle (National Library of Medicine, 2021)

Rhabdomyosarcoma

Cancer that forms in the soft tissues in a type of muscle called striated muscle (National Cancer Institute, n.d.)

Rheumatoid arthritis

An autoimmune disorder in which the body mounts an immune response against its own joint tissues, causing inflammation and damage to the joints (Betts et al., 2013)

Rhinitis

Inflammation of the mucous membranes of the nose (National Library of Medicine, 2021)

Rhinoplasty

A plastic surgical operation on the nose, either reconstructive, restorative, or cosmetic (National LIbrary of Medicine, 2021)

Rhinorrhea

Excess nasal drainage; also called a “runny nose” (Betts et al., 2013)

Rhinoscope

A thin, tube-like instrument used to examine the inside of the nose (National Cancer Institute, n.d.)

Rhizotomy

Incision into a nerve root (National Library of Medicine, 2021)

Rhytidoplasty

Excision of wrinkles of the skin (National Library of Medicine, 2021)

Rickets

A painful condition in children where bones are misshapen due to a lack of calcium, causing bow-sleggedness (Betts et al., 2013)

Right lymphatic duct

Drains lymph fluid from the upper right side of the body into the right subclavian vein (Betts et al., 2013)

Roots of the great vessels

The part of each great vessel (aorta, pulmonary trunk, inferior vena cava, superior vena cava) that connects to the base of the heart (Betts et al., 2013)

Rotation

Movement of a bone around a central axis or around its long axis (Betts et al., 2013)

Sagittal plane

Two-dimensional, vertical plane that divides the body or organ into right and left sides (Betts et al., 2013)

Salpingectomy

Excision of one or both of the uterine/fallopian tubes (National Library of Medicine, 2021)

Salpingitis

Inflammation of a fallopian/uterine tube (National Library of Medicine, 2021)

Salpingo-oophorectomy

Surgical removal of the fallopian tubes and ovaries (National Cancer Institute, n.d.)

Salpingostomy

Creation of an artificial opening in the uterine/fallopian tube (National Library of Medicine, 2021)

Sarcomere

The functional unit of a skeletal muscle fiber (Betts et al., 2013)

Sarcopenia

Age-related muscle atrophy (Betts et al., 2013)

Satellite cell

Glial cell type in the peripheral nervous system that provides support for neurons in the ganglia (Betts et al., 2013)

Scar

A collagen-rich skin formed after the process of wound healing that differs from normal skin (Betts et al., 2013)

Schizophrenia

A group of severe mental disorders in which a person has trouble telling the difference between real and unreal experiences, thinking logically, having normal emotional responses to others, and behaving normally in social situations (National Cancer Institute, n.d.)

Schwann cell

Glial cell type in the peripheral nervous system that provides the myelin insulation for axons in nerves (Betts et al., 2013)

Sclera

The white of the eye (Betts et al., 2013)

Sclerosis

Hardening of tissue (Betts et al., 2013)

Scoliosis

Lateral curvature of the spine (Betts et al., 2013)

Scrotum

An external pouch of skin and muscle that houses the testes (Betts et al., 2013)

Secondary adaptive response

Immune response observed upon re-exposure to a pathogen, which is stronger and faster than a primary response (Betts et al., 2013)

Secondary lymphoid organs

Sites where lymphocytes mount adaptive immune responses; examples include lymph nodes and spleen (Betts et al., 2013)

Semen

Ejaculatory fluid composed of sperm and secretions from the seminal vesicles, prostate, and bulbourethral glands (Betts et al., 2013)

Semilunar valves

The generic name for the the openings that lead to the pulmonary trunk and aorta (Betts et al., 2013)

Seminal vesicle

Gland that produces seminal fluid, which contributes to semen (Betts et al., 2013)

Seminiferous tubules

Structures within the testes where spermatogenesis occurs (Betts et al., 2013)

Sensation

Nervous system function that receives information from the environment and translates it into the electrical signals of nervous tissue (Betts et al., 2013)

Sepsis

Organismal-level inflammatory response to a massive infection (Betts et al., 2013)

Septal cartilage

The flexible hyaline cartilage connected to the nasal bone (Betts, et al., 2013)

Seroconversion

The reciprocal relationship between virus levels in the blood and antibody levels (Betts et al., 2013)

Serous membrane

One of the thin membranes that cover the walls and organs in the thoracic and abdominopelvic cavities (Betts et al., 2013)

Serous space

The very thin, fluid-filled space between the parietal and visceral layers (Betts et al., 2013)

Sertoli cells

Cells that support germ cells through the process of spermatogenesis; a type of sustentacular cell (Betts et al., 2013)

Severe combined immunodeficiency disease (SCID)

A rare, inherited disease that is marked by a lack of B and T lymphocytes (National Cancer Institute, n.d.)

Sialolith

Stone in the salivary gland (National Library of Medicine, 2021)

Sickle cell disease

An inherited disease in which the red blood cells have an abnormal crescent shape, block small blood vessels, and do not last as long as normal red blood cells; also called sickle cell anemia (National Cancer Institute, n.d.)

Sigmoidoscopy

Examination of the lower colon using a sigmoidoscope, inserted into the rectum (National Cancer Institute, n.d.)

Sinus rhythm

The normal electrical pattern followed by contraction of the heart (Betts et al., 2013)

Sinusitis

Inflammation of the sinuses (National Cancer Institute, n.d.)

Skeletal muscle

The muscles responsible for voluntary muscle movement; also called striated muscle (Betts et al., 2013)

Sleep apnea

A chronic disorder characterized by the cessation of breathing during sleep (Betts et al., 2013)

Smooth muscle

The muscles responsible for involuntary muscle movement; also called striated muscle (Betts et al., 2013)

Soft palate

Located at the posterior portion of the nasal cavity and consists of muscle tissue (Betts et al., 2013)

Solutes

The minor component in a solution (Betts et al., 2013)

Soma

In neurons, that portion of the cell that contains the nucleus; the cell body, as opposed to the cell processes (axons and dendrites) (Betts et al., 2013)

Somatic cell

General term for a body cell (Betts et al., 2013)

Somatic nervous system (SNS)

Functional division of the nervous system that is concerned with conscious perception, voluntary movement, and skeletal muscle reflexes (Betts et al., 2013)

Sonogram

A computer picture of areas inside the body created by high-energy sound waves (National Cancer Institute, n.d.)

Speculum

An instrument used to widen an opening of the body to make it easier to look inside (National Cancer Institute, n.d.)

Sperm

Male gamete (spermatozoon) (Betts et al., 2013)

Spermatic cord

Bundle of nerves and blood vessels that supplies the testes; contains ductus deferens (Betts et al., 2013)

Spermatid

Immature sperm cells produced by meiosis II of secondary spermatocytes (Betts et al., 2013)

Spermatocyte

A male gametocyte from which a spermatozoon develops (Betts et al., 2013)

Spermatogenesis

The process of producing sperm (Betts et al., 2013)

Spermatogonia

The diploid precursor cells that become sperm (Betts et al., 2013)

Spermiogenesis

Transformation of spermatids to spermatozoa during spermatogenesis (Betts et al., 2013)

Sphygmomanometer

A blood pressure cuff attached to a measuring device (Betts et al., 2013)

Spinal cord

Organ of the central nervous system found within the vertebral cavity and connected with the periphery through spinal nerves; mediates reflex behaviors (Betts et al., 2013)

Spirometry

The measurement of volume of air inhaled or exhaled by the lung (National Library of Medicine, 2021)

Spleen

Secondary lymphoid organ that filters pathogens from the blood (white pulp) and removes degenerating or damaged blood cells (red pulp) (Betts et al., 2013)

Splenectomy

Excision of the spleen (National Cancer Institute, n.d.)

Splenomegaly

Enlarged spleen (National Cancer Institute, n.d.)

Spondyloarthritis

Inflammation of the joints of the spine (National Library of Medicine, 2021)

Spondylosis

A degenerative spinal disease that can involve any part of the vertebra, intervertebral disk, and surrounding soft tissue (National Library of Medicine, 2021)

Sprain

The stretching or tearing of the supporting ligaments (Betts et al., 2013)

Sputum

Mucus and other matter brought up from the lungs by coughing (National Cancer Institute, n.d.)

Stapedectomy

Excision of the stapes (National Library of Medicine, 2021)

Staphylococcus aureus

A bacteria that is commonly found in minor skin infections, as well as in the nose of some healthy people (Betts et al., 2013)

Steatorrhea

Condition characterized by chronic fatty diarrhea (National Library of Medicine, 2021)

Stenosis

A condition in which the heart valves become rigid and may calcify over time (Betts et al., 2013)

Sterility

A condition of being unable to produce children. In other contexts, it means free from germs (National Cancer Institute, n.d.)

Sternoclavicular joint

The only bony articulation between the pectoral girdle of the upper limb and the axial skeleton (Betts et al., 2013)

Sternum

Breastbone (Betts et al., 2013)

Stethoscope

An instrument used to hear sounds produced by the heart, lungs, or other parts of the body (National Library of Medicine, 2021)

Stillbirth

An infant who is born dead (National Library of Medicine, 2021)

Stimulus

An event in the external or internal environment that registers as activity in a sensory neuron (Betts et al., 2013)

Stoma

A surgically created opening from an area inside the body to the outside (National Cancer Institute, n.d.)

Stomatitis

Inflammation or irritation of the mucous membranes in the mouth (National Cancer Institute, n.d.)

Strain

An overstretching or overexertion of a muscle (National Library of Medicine, 2021)

Stratified squamous epithelium

Cells arranged in layers upon a basal membrane (Betts et al., 2013)

Stratum basale

The deepest layer of the epidermis (Betts et al., 2013)

Stratum lucidum

The smooth, seemingly translucent layer of the epidermis located just above the stratum granulosum and below the stratum corneum (Betts et al., 2013)

Streptococcus

The bacteria that causes strep throat (Betts et al., 2013)

Stricture

Abnormal narrowing (National Library of Medicine, 2021)

Stroke

Loss of neurological function caused by an interruption of blood flow to a region of the central nervous system, also called cerebrovascular accident (CVA) (Betts et al., 2013)

Stye

Infection of an oil gland of the eyelid (hordeolum) (National Library of Medicine, 2021)

Subarachnoid space

Space between the arachnoid mater and pia mater that contains CSF and the fibrous connections of the arachnoid trabeculae (Betts et al., 2013)

Subcutaneous

Beneath the skin (National Cancer Institute, n.d.)

Subcutaneous layer

The layer of skin directly below the dermis (Betts et al., 2013)

Subdural hematoma

Accumulation of blood in the subdural space (National Library of Medicine, 2021)

Sulcus

Groove formed by convolutions in the surface of the cerebral cortex (Betts et al., 2013)

Superficial

Describes a position nearer to the surface of the body (Betts et al., 2013)

Superficial lymphatics

Lymphatic vessels of the subcutaneous tissues of the skin (Betts et al., 2013)

Superior

A position above or higher than another part of the body proper (Betts et al., 2013)

Superior vena cava

One of two large veins in the body, which carries deoxygenated blood from the head and upper extremities back to the heart (Betts et al., 2013)

Supination

Forearm motion that moves the palm of the hand from the palm backward to the palm forward position (Betts et al., 2013)

Supine

A face-up orientation (Betts et al., 2013)

Supraglottis

The upper part of the larynx (voice box), including the epiglottis (National Cancer Institute, n.d.)

Sympathetic nervous system (SNS)

The division of the nervous system involved in our fight-or-flight responses. It continuously monitors body temperature and initiates appropriate motor responses (Betts et al., 2013)

Synaptic end bulb

Swelling at the end of an axon where neurotransmitter molecules are released onto a target cell across a synapse (Betts et al., 2013)

Synarthrosis

An immobile or nearly immobile joint (Betts et al., 2013)

Synovial membrane

Thin layer that lines the inner surface of the joint cavity at a synovial joint; produces the synovial fluid (Betts et al., 2013)

Syncope

Fainting (Betts et al., 2013)

Syndrome

A set of symptoms or conditions that occur together and suggest the presence of a certain disease or an increased chance of developing the disease (National Cancer Institute, n.d.)

Synovectomy

Excision of the synovial membrane (National Library of Medicine, 2021)

Synovial sarcoma

Malignant tumor of the synovial membrane (National Library of Medicine, 2021)

Synthesis

A chemical reaction that results in the synthesis (joining) of components that were formerly separate (Betts et al., 2013)

Systemic lupus erythematosus (SLE)

A chronic, inflammatory, connective tissue disease that can affect the joints and many organs; also called lupus (National Cancer Institute, n.d.)

Systole

Period of time when the heart muscle is contracting (Betts et al., 2013)

Systolic pressure

The arterial pressure resulting from the ejection of blood during ventricular contraction, or systole (Betts et al., 2013)

T cell

Lymphocyte that acts by secreting molecules that regulate the immune system or by causing the destruction of foreign cells, viruses, and cancer cells (Betts et al., 2013)

Tachycardia

A condition in which the resting rate is above 100 bpm (Betts et al., 2013)

Tachypnea

Rapid breathing (National Cancer Institute, n.d.)

Temporal lobe

Region of the cerebral cortex directly beneath the temporal bone of the cranium (Betts et al., 2013)

Tendinitis

Inflammation of the tendon (Betts et al., 2013)

Tenosynovitis

Inflammation of the synovial membrane of a tendon (National Library of Medicine, 2021)

Teratogen

An agent capable of producing malformations in a developing embryo (National Library of Medicine, 2021)

Teratology

A branch of embryology for the study of congenital malformations and developmental abnormalities (National Library of Medicine, 2021)

Testes

Male gonads (Betts et al., 2013)

Testicle

Male gonad (Betts et al., 2013)

Tetralogy of Fallot

A congenital heart condition comprised of four defects (Betts et al., 2013)

Thalamus

Major region of the diencephalon that is responsible for relaying information between the cerebrum and the hindbrain, spinal cord, and periphery (Betts et al., 2013)

Thalassemia

A genetic disorder characterized by abnormal synthesis of globin proteins and excessive destruction of erythrocytes (Betts et al., 2013)

Thermoreceptors

Specialized neurons that respond to changes in temperature (Betts et al., 2013)

Thermotherapy

Treatment of disease using heat (National Cancer Institute, n.d.)

Thoracalgia

Pain in the chest (National Cancer Institute, n.d.)

Thoracentesis

Removal of fluid from the pleural cavity through a needle inserted between the ribs (National Cancer Institute, n.d.)

Thoracic

Pertaining to the chest (National Cancer Institute, n.d.)

Thoracic cavity

A chamber located within the upper human torso which contains the heart and lungs (Betts et al., 2013)

Thoracic duct

Large duct that drains lymph from the lower limbs, left thorax, left upper limb, and the left side of the head (Betts et al., 2013)

Thoracodynia

Chest pain (National Cancer Institute, n.d.)

Thoracoscope

A thin tube-like instrument used to examine the inside of the chest (National Cancer Institute, n.d.)

Thoracoscopy

Examination of the inside of the chest, using a thoracoscope (National Cancer Institute, n.d.)

Thoracotomy

An operation to open the chest (National Cancer Institute, n.d.)

Thrombocyte

Platelets (Betts et al., 2013)

Thrombocytopenia

A condition in which there is an insufficient number of platelets (Betts et al., 2013)

Thrombocytosis

A condition in which there are too many platelets (Betts et al., 2013)

Thrombolysis

The process of breaking up a thrombus that is blocking blood flow (National Cancer Institute, n.d.)

Thrombolytic

A class of drugs that can help speed up the degradation of an abnormal clot (Betts et al., 2013)

Thrombophlebitis

Inflammation of a vein that occurs when a blood clot forms (National Cancer Institute, n.d.)

Thrombosis

The formation of unwanted blood clots (Betts et al., 2013)

Thrombus

Aggregation of fibrin, platelets, and erythrocytes in an intact artery or vein (Betts et al., 2013)

Thymectomy

Excision of the thymus gland (National Library of Medicine, 2021)

Thymic involution

The shrinking of the thymus due to age (Betts et al., 2013)

Thymocytes

A type of white blood cell that is part of the immune system and develops from stem cells in the bone marrow; also called T cells and T lymphocytes (National Cancer Institute, n.d.)

Thymoma

Tumor of the thymus gland (National Cancer Institute. n.d.)

Thymus

Primary lymphoid organ, where t lymphocytes proliferate and mature (Betts et al., 2013)

Thyroidectomy

Excision of all or part of the thyroid gland (National Cancer Institute, n.d.)

Thyroiditis

Inflammation of the thyroid gland (National Cancer Institute, n.d.)

Tinea

A group of fungal skin diseases of the hair, skin, and nail tissues (National Library of Medicine, 2021)

Tissue membrane

Thin layer or sheet of cells that covers the outside of the body, organs, and internal cavities (Betts et al., 2013)

Tissue rejection

The recipient's immune system recognizes the transplanted tissue as non-self and mounts an immune response against it, ultimately destroying it (Betts et al., 2013)

Tissue typing

The determination of major histocompatibility complex (MHC) molecules in the tissue to be transplanted to better match the donor to the recipient (Betts et al., 2013)

Tonometer

Instrument used to measure pressure (within the eye) (National Library of Medicine, 2021)

Tonometry

Process of measuring pressure (within the eye) (National Library of Medicine, 2021)

Tonsillectomy

Excision of the tonsils (National Library of Medicine, 2021)

Tonsillitis

Inflammation of the tonsils (National Library of Medicine, 2021)

Tonsils

Lymphoid nodules associated with the nasopharynx (Betts et al., 2013)

Trachea

The windpipe (Betts et al., 2013)

Trachealis

A smooth muscle that bridges the gap between the free ends of C-shaped cartilages at the posterior border of the trachea (Betts et al., 2013)

Tracheitis

Inflammation of the trachea (National Library of Medicine, 2021)

Trachelectomy

Excision of the cervix (National Cancer Institute, n.d.)

Tracheostomy

Surgery to create an opening into the trachea (National Cancer Institute, n.d.)

Tracheotomy

Surgical incision of the trachea (National Library of Medicine, 2021)

Tract

Bundle of axons in the central nervous system having the same function and point of origin (Betts et al., 2013)

Transdermal

Absorbed through the unbroken skin (National Cancer Institute, n.d.)

Transient ischemic attack (TIA)

Temporary disruption of blood flow to the brain in which symptoms occur rapidly but last only a short time (Betts et al., 2013)

Triceps

The extensor muscles of the arms (Betts et al., 2013)

Tubal ligation

Surgical closure of the fallopian tubes for sterilization (National Cancer Institute, n.d.)

Tympanic membrane

Ear drum (Betts et al., 2013)

Tympanoplasty

Surgical repair of the tympanic membrane (National Library of Medicine, 2021)

Umami

A Japanese word that means "delicious taste" and is often translated to mean savory (Betts et al., 2013)

Unicellular

Single-celled (Betts et al., 2013)

Unilateral

Pertaining to one side (Betts et al., 2013)

Unipolar

Shape of a neuron which has only one process that includes both the axon and dendrite (Betts et al., 2013)

Upper respiratory infection

Infection of the nasal cavity, pharynx and larynx cause by a virus (Betts et al., 2013)

Ureterocele

A cystic dilatation of the end of a ureter (National Library of Medicine, 2021)

Ureterolithiasis

Formation of stone(s) in the ureter (National Library of Medicine, 2021)

Ureteroscopy

Examination of the inside of the kidney and ureter, using a ureteroscope (National Cancer Institute, n.d.)

Ureterostomy

Creation of an artificial opening into the ureter (National Library of Medicine, 2021)

Urethritis

Inflammation of the urethra (Betts et al., 2013)

Urinal

Receptacle used for the collection of urine (National Library of Medicine, 2021)

Urinary

Pertaining to urine or the organs of the body that produce and get rid of urine (National Cancer Institute, n.d.)

Urologist

A doctor who has special training in diagnosing and treating diseases of the urinary organs in females and the urinary and reproductive organs in males (National Cancer Institute, n.d.)

Urology

A surgical specialty concerned with the study, diagnosis, and treatment of diseases of the urinary tract in both sexes, and the genital tract in the male (National Library of Medicine, 2021)

Uvula

A small bulbous, teardrop-shaped structure located at the apex of the soft palate (Betts, et al., 2013)

Vaccine

A killed or weakened pathogen or its components that, when administered to a healthy individual, leads to the development of immunological memory (a weakened primary immune response) without causing much in the way of symptoms (Betts et al., 2013)

Vaginal birth following a C-section

Delivery of an infant through the vagina in a female who has had a prior cesarean section (National Library of Medicine, 2021)

Vaginitis

Inflammation of the vagina characterized by pain and a purulent discharge (National Library of Medicine, 2021)

Vaginosis

Abnormal condition of the vagina (National Library of Medicine, 2021)

Valve

A specialized structure that ensures one-way flow of blood (Betts et al., 2013)

Valvuloplasty

The widening of a stenosed heart valve using a balloon catheter (National Library of Medicine. 2021)

Varicocele

Distended veins of the spermatic cord (National Library of Medicine, 2021)

Varicose veins

Distended, twisted veins (Betts et al., 2013)

Vas deferen

The duct that transports sperm from the epididymis through the spermatic cord and into the ejaculatory duct; also referred as the vas deferens (Betts et al., 2013)

Vasa vasorum

Small blood vessels within the walls of larger arteries and veins; literally means "vessels of vessels" (Betts et al., 2013)

Vascularization

The development of blood vessels (Betts et al., 2013)

Vascularized

Tissue that has numerous blood vessels (Betts et al., 2013)

Vasculitis

Inflammation of blood vessels (Betts et al., 2013)

Vasectomy

A procedure in which a small section of the ductus deferens is cut and sealed to interrupt sperm delivery. It is an effective form of male birth control (Betts et al., 2013)

Vasoconstriction

The physiological narrowing of blood vessels by contraction of the vascular smooth muscle (National Library of Medicine, 2021)

Vasodilation

The physiological widening of blood vessels by relaxing the vascular smooth muscle (National Library of Medicine, 2021)

Vasovasostomy

Creation of an artificial opening between ducts to restore fertility to males who have had a vasectomy (National Library of Medicine, 2021)

Veins

Blood vessels that conduct blood toward the heart (Betts et al., 2013)

Venae cavae

The two major systemic veins (Betts et al., 2013)

Ventilator

A machine used to help a patient breathe (National Cancer Institute, n.d.)

Ventricle

Central cavity within the brain where cerebrospinal fluid is produced and circulates (Betts et al., 2013)

Venules

Small blood vessels that carry blood to a vein (Betts et al., 2013)

Vertebral column

The spine (Betts et al., 2013)

Vertebroplasty

A procedure used to repair a bone in the spine that has a break caused by cancer, osteoporosis, or trauma (National Cancer Institute, n.d.)

Vesicle

A membranous sac (Betts et al., 2013)

Virus

A simple microorganism that may cause infection by invading body tissue (National Cancer Institute, n.d.)

Viscera

Internal organs (Betts et al., 2013)

Visceral

Pertaining to internal organs (National Cancer Institute, n.d.)

Visceral (sense)

Sense associated with the internal organs (Betts et al., 2013)

Visceral layer
Innermost layer of the pleura that is superficial to the lungs and extends into the lung fissures (Betts et al., 2013)
Viscosity
A measure of a fluid's thickness or resistance to flow (Betts et al., 2013)
Visual acuity
Sharpness of vision (Betts et al., 2013)
Voiding
Also known as urination or micturition (Betts et al., 2013)
Vulvectomy
Excision of the vulva (National Library of Medicine, 2021)
Vulvovaginitis
Inflammation of the vulva and vagina (National Library of Medicine, 2021)
Wernicke's area
Region at the posterior end of the lateral sulcus in which speech comprehension is localized (Betts et al., 2013)
Wheal and flare response
A soft, pale swelling at the site surrounded by a red zone (Betts et al., 2013)
White matter
Regions of the nervous system containing mostly myelinated axons, making the tissue appear white because of the high lipid content of myelin (Betts et al., 2013)
Xerophthalmia
Condition of dry eye (National Library of Medicine, 2021)
Zygote
A single cell formed by the fusion of an egg and sperm; also called the fertilized egg (Betts et al., 2013)

References

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