

HUMAN ANATOMY FOR THE CERTIFIED NURSING ASSISTANT

A primary duty of healthcare workers is to monitor and assess the basic wellness of patients. They need to understand how the human body would normally function in order to detect changes that may indicate a serious alteration in health. Patients may have a chronic medical problem, such as diabetes, heart disease, or hypertension. Healthcare workers are expected to understand these disease processes, to understand how they affect health, and to know when these medical conditions have worsened. That level of knowledge requires a basic understanding of human anatomy.

Objective:

1. Define the term "anatomy".
2. Identify how the bones, connective tissue, joints, muscles and skin form organ systems.
3. Identify the three distinct parts of the nervous system.
4. Identify the primary function of the circulatory and pulmonary systems.
5. Identify the basic functions of the digestive system.
6. Identify the primary functions of the renal system.
7. Define the term "gland".

Introduction

Anatomy is the study of the structure of the organs and tissues of the human body. The human body is made up of tiny, microscopic building blocks called cells. The cells in turn are organized into tissues and organs, and the tissues and organs have a unique structure and a specific function. Certified Nursing Assistants (CNAs) must have a basic knowledge and understanding of human anatomy.

Anatomy As A Science

The medical dictionary defines anatomy as "*the science of the structure of the body and the relation of its parts.*" Anatomy can be studied at a very basic level and it can also be quite complex but for most healthcare workers, understanding anatomy does not have to be difficult. Much of the learning of the science of human anatomy is memorization and the simplest way to understand it is to divide the body into organ systems. Each organ system, and the organ or organs that make up that particular system, can be categorized by its functions, and the task of learning anatomy using this method of study becomes very manageable.

The Musculoskeletal System

Anatomy textbooks consider the bones, connective tissue, joints, muscles and skin to be separate organ systems. This is technically correct but as they do share some characteristics, and they function very closely together, they will all be discussed here as the musculoskeletal system.

Skeletal System

The skeletal system has six different functions consists of 206 bones.

Support

The skeletal system provides the supporting framework for the body, which is its primary function. The human skeleton is an endo-skeleton; the bones are inside the body. Other animals such as insects have an exo-skeleton. Their skeleton is a hard shell that surrounds and protects the body.

Movement

The bones of the skeletal system, in conjunction with the muscles and joints, allow for movement. The muscles themselves are very powerful, but if they were not attached to the bones movement would not be possible.

Protection

The bones surround and protect vital organs such as the brain, heart, and lungs.

Blood Cells

The marrow of the bones is where red blood cells and precursors to white blood cells are produced. The red blood cells carry oxygen in the blood and the white blood cells fight infection and provide immunity against disease.

Storage

The bones store much of the calcium in the human body and there is some storage of iron in bone marrow.

Endocrine Function

The term endocrine refers to a gland or organ that secretes a hormone directly into the bloodstream. The bones secrete a hormone called *osteocalcin* that helps to regulate blood sugar levels and fat deposition.

Bones

Each bone of the skeletal system has a specific shape and function. However, their basic anatomy is essentially the same and bones are comprised of several distinct layers. The anatomy of a bone, moving from the outside to the core, is described in the Table below.

Anatomy of a Bone

Periosteum: The outside of almost every bone is covered by a thin membrane called the periosteum that is similar to a sheet of plastic that has been shrink wrapped around an object. The periosteum carries the arteries and veins that supply the bones with blood; it has nerve endings for pain and sensation, and; it is also involved in growing new bone tissue.



Compact bone: Compact bone is what we think of when we think of bones. It is hard and dense, white and shiny, and this part of a bone is what gives the skeleton strength and helps it withstand stress.



Bone Cavity: The bone cavity is the hollow space inside many long bones that contains cancellous bone and bone marrow.



Cancellous bone: This is also called spongy bone. Cancellous bone is a soft, network of tissue that contains many blood vessels and holds the bone marrow. The cancellous bone is where most new bone cells are formed.



Bone marrow: Bone marrow is where red blood cells are formed and where precursors to white blood cells are formed.

Bones are dense and hard. They must be able to withstand a lot of stress. Given these characteristics, it is easy to forget that they are living tissue and that bones are metabolically active. Bones produce

red blood cells and precursors to white blood cells. Old bone tissue is regularly broken down and new bone tissue formed. Bones must be constantly supplied with blood and nutrients - especially calcium - in order to remain healthy.

Calcium is a mineral and it is the primary structural component of bone. Our bodies cannot produce calcium so we depend on calcium-containing foods for a daily supply. You may have noticed that milk, which is a good source of calcium, is often fortified with vitamin D. This is because calcium cannot be absorbed and used for bone growth without vitamin D.

Connective Tissue

Connective tissue is the term for a varied group of structures that are an important part of the musculoskeletal system: cartilage, ligaments, and tendons. As you have probably guessed, the connective tissues play an important part in connecting the different parts of the musculoskeletal system.

Cartilage

Cartilage is a tough, fibrous material that is found on the ends of bones, in the bronchial tubes, the trachea, and other areas of the body. The function of cartilage depends on its location. Cartilage that is found on the ends of bones acts like a shock absorber. It also provides a relatively friction-free surface so that bones that contact each other in a joint can move easily and do so without pain or excessive wear on the ends of the bones. For example, there is cartilage on the ends of the upper leg bone (the femur) and the lower

legs bones (tibia and fibula). In the trachea and the bronchial tubes, rings of cartilage act as structural supports and prevent these structures from closing with the passage of air.

Ligaments

Ligaments are bands of tissue that connect one bone to another and maintain the structural integrity of the joints.

Tendons

Tendons are very much like ligaments in their structure but they have a different function. Tendons attach the muscles to the bones. This attachment transfers muscular force, *i.e.*, muscular contractions, to the bones and thus allows movement.

The blood is technically considered to be a connective tissue because it connects organ systems together. Blood will be discussed here as being part of the cardiovascular system.

Joints

The junction where bones meet is called a joint. The technical term for a joint is an *articulation*. There are three types of joints: fibrous, synovial, and syndesmosis. Joints such as the elbows, wrist, hips, and knees are synovial joints, and synovial joints are constructed to allow for movement. Fibrous and syndesmosis joints are connections between bones that do *not* allow movement, or only a very slight amount of movement. For example, the skull is made up of multiple bones that are attached to one another by connective tissue but these joints are fixed and do not move.

Muscles

There are more than 700 muscles in the human body. The muscles provide voluntary and involuntary movement. The movements of a muscle are called contractions (the muscle gets shorter) and relaxation (the muscle relaxes and returns to its original length). Muscles are considered to be one of three types - skeletal, smooth and cardiac.

Skeletal Muscles

Skeletal muscles, such as the biceps in your upper arm, are muscles that we can consciously control.

Smooth Muscles

Smooth muscles are muscles that cannot be consciously controlled. For example, we have muscles in the small bowel of the digestive tract. These muscles contract and relax to allow for the passage and absorption of food and liquid. We also have muscles in some of the blood vessels and these help with the circulation of the blood and maintaining blood pressure. In both of these instances, the smooth muscle contraction and/or relaxation cannot be consciously started or controlled; it is automatic.

Cardiac Muscle

Cardiac muscle is the muscle found in the heart. It is somewhat like smooth muscle in that it is not under conscious control; however, it has several unique properties. Cardiac muscle has the ability to automatically and rhythmically contract and relax, and it does so continuously and for the most part it does so without external control.

Smooth muscle can also do this but it contracts and relaxes intermittently in response to internal and external stimuli.

The heartbeat, the contraction and relaxation of the cardiac muscle, occurs constantly, regularly, and it does not usually rely on external stimuli.

Skin

The skin covers the entire surface of the body. The skin's main function is to act as a barrier to protect the body from heat, cold, and contamination from infectious agents such as bacteria and viruses. The skin is often considered to be the body's first line of defense against infection because it forms a mechanical barrier between the internal and external environments.

There are three layers of skin. The *epidermis* is on the outside layer, and underneath that is the *dermis*. Underneath the dermis is a layer of fat called the *subcutaneous* layer. The skin is where many of the blood vessels, nerve receptors, temperature receptors, sweat glands, and oil glands are located. The skin also has the pigment cells that give the tissues their distinctive color.

Summary

The musculoskeletal system is made up of the bones, connective tissues, joints, muscles, and skin. The primary functions of the bones are to give the body form and support, and to produce blood cells. The connective tissues include cartilage, ligaments, and tendons. The primary functions of the connective tissues are to maintain the stability

of the joints, connect the muscles to the bones, and to protect the bone-to-bone connections. Joints are the junctions where bones meet and connect. Muscles allow for movement, and there are three types of muscle: 1) Skeletal muscle, which is under conscious control, 2) Smooth muscle, which is not under conscious control, and, 3) Cardiac muscle, the muscle tissue of the heart.

The skin covers the entire surface of the body. It has three layers, many blood vessels, different types of receptors, and glands. The primary function of the skin is to act as a barrier to protect the body from heat, cold, and contamination from infectious agents such as bacteria and viruses. It is also the place where many blood vessels, glands, and receptors are located.

Nervous System

The nervous system controls conscious and unconscious behavior. It gives individuals the ability to think, to speak, and to perform higher intellectual functions. The anatomy of the nervous system is very complex but it can best be understood by considering it to be three distinct parts of 1) the brain, 2) the spinal cord, and 3) the peripheral nerves.

The Brain

The brain is divided into specific and anatomically distinct regions that control basic body functions such as breathing, heart rate, digestion, pain, sight, smell, and taste, and regions that control higher functions (speech, memory, complex thinking, and sexual behavior) and emotions.

The Spinal Cord

The spinal cord is a long tube-like structure of nerve tissue that extends inside the spine, also known as the backbone. It is attached to the base of the brain and ends at the bottom of the spine near the beginning of the buttocks. The basic function of the spinal cord is to connect the brain to the peripheral nerves and the organs and tissues in which the peripheral nerves are located.

The brain and the spinal cord are often classified together as the central nervous system.

The Peripheral Nerves

The peripheral nerves are long, thin fibers that leave the spinal cord and travel to the organs and tissues in the body. The peripheral nerves terminate in structures called nerve endings, and it is the nerve endings that sense pain, heat and cold, and receive information from the organs about the body's internal environment.

There are literally millions of peripheral nerves and there are no organs and very few parts of the body that are not supplied with peripheral nerves. The peripheral nerves pick up information from the environment and from the body and send it back to the brain. In turn, the brain sends out signals and information to the organs and tissues by way of the peripheral nerves. The peripheral nerves are involved in touch, the sensations of heat and cold, and pain. The peripheral nerves also help the brain control various organ functions.

The brain can be thought of as the “command center” of the nervous system, and the spinal cord and the peripheral nerves transmit nerve impulses that help maintain the optimal internal environment.

Example:

There are peripheral nerves in the arteries that can sense when a person’s blood pressure has increased past a point that is safe. If this occurs, the peripheral nerves send a message to the brain that blood pressure is too high. The brain in turn will send out nerve transmissions that cause blood vessels to dilate, increase urine flow and decrease the volume of body fluid.

The brain will transmit nerve impulses to decrease the heart rate and the force of cardiac contraction. All of these will help lower blood pressure, and when the brain receives feedback from the peripheral nerves that blood pressure has returned to normal, these compensatory mechanisms are stopped. The nervous system functions by processing information, transmitting nerve impulses, receiving feedback, and controlling systems.

Summary

The nervous system is comprised of the brain, the spinal cord, and the peripheral nerves. The nervous system controls all conscious and unconscious behavior and body functions. The brain can be thought of as the “command center” of the nervous system, and the spinal cord and the peripheral nerves transmit nerve impulses that help maintain the optimal internal environment.

Cardiovascular System

The cardiovascular system is comprised of the heart, the blood vessels, and the blood. The cardiovascular system is also called the circulatory system and as this name implies, the primary function of the circulatory system is to circulate the blood.

The Heart

The heart is located on the left side of the chest between the waist and the shoulder. It is surrounded and enclosed by a thin-walled membrane called the *pericardium* or the pericardial sac. The pericardial sac is filled with pericardial fluid and this arrangement allows the heart to contract and relax in a relatively friction-free environment.

The heart is a complex organ, and there are four types of structures that are specific to the heart that will be discussed: 1) the cardiac chambers, 2) the cardiac valves, 3) the sino-atrial node, and 4) the cardiac conducting system.

The heart is divided into four cardiac chambers: the *left and right atriums* and the *left and right ventricles*. The atria sit on top of the ventricles and are separated from them by the cardiac valves. Each of the cardiac chambers has a specific role in the circulation, and these are outlined below.

The Atria, Ventricles, and Cardio-Pulmonary Circulation

Unxygenated venous blood from the peripheral circulation flows into the right atrium.



The right atria contract and pump the unxygenated blood through the tricuspid valve into the right ventricle.



The right ventricle contracts and pumps the unxygenated blood through the pulmonary valve and into the pulmonary circulation.



Unxygenated blood flowing through the pulmonary circulation combines with oxygen and flows into the left atrium.



The left atrium contracts and pumps the oxygenated blood through the mitral valve and into the left ventricle.



The left ventricle contracts and pumps oxygenated blood through the aortic valve and out into the peripheral circulation where it can be used by the organs and tissues.

The movement of blood into the heart, through the heart, and out into the peripheral circulation is called the cardiac cycle. Each cardiac cycle is one heartbeat and the number of heartbeats in one minute is called the pulse. The number of times the heart beats in one minute and the force with which it contracts is controlled by a structure called the *sino-atrial node*, more commonly called the SA node.

The SA node is a small node of tissue located in the right atrium and it functions as the pacemaker of the heart. The SA node spontaneously, continually, and rhythmically sends out an electrical current that flows through specialized cardiac conducting system tissues. The conducting tissues end in the cardiac muscle, and when the electrical current from the SA node exits the conducting tissues it stimulates the heart to contract.

The SA node is an automatic pacemaker that produces an intrinsic heart rate but it has nerve fibers and these can stimulate the SA node

to increase or decrease the heart rate, depending on the circumstances and needs.

Blood Vessels

The blood vessels carry blood through the tissues and organs. Each of the major organs, *i.e.*, the brain, heart, lungs, liver, and kidneys has its own circulatory system. Although some of these have unique characteristics they will not be discussed here in detail. There are at least five different types of blood vessels but only three primary types, the arteries, capillaries, and veins, are discussed.

The Arteries

The arteries are blood vessels that carry oxygenated blood. The arteries are supplied with muscles and nerves and they can contract or dilate to raise or lower the blood pressure as needed. Arteries are typically located well below the skin and they cannot be seen. However, some arteries are relatively close to the surface of the skin and they can be palpated to check the heart rate; *i.e.*, the radial arteries in the wrist and the carotid arteries on the sides of the neck.

The arterial system begins at the left ventricle of the heart and it continues until it reaches the peripheral tissues and organs. At that point, the arteries end and they connect with the capillaries. Some arteries such as the aorta, which branches off from the left ventricle, are very large.

The Capillaries

The capillaries also carry oxygenated blood; however, the capillaries are microscopic in size and there are many more capillaries than arteries. In addition, the arteries transport oxygenated blood but the capillaries are where the oxygen leaves the blood and enters the tissues and organs *and* the capillaries are where carbon dioxide, one of the primary waste products of metabolism, leaves the tissues and organs and enters the bloodstream.

The Veins

The veins are thin-walled blood vessels that are connected to the capillaries. Unlike arteries veins are easily seen as they are often close to the skin, but an artery will have a pulse, a vein will not. The veins store blood and help to a slight degree to maintain blood pressure.

However, the most important function of the venous system is to carry the unoxygenated blood and carbon dioxide back to the heart. The heart pumps the unoxygenated blood, and the carbon dioxide it is carrying, to the pulmonary circulation in the lungs. At that point, the process of ventilation brings oxygen into contact with the blood and allows for carbon dioxide to be removed by exhaling.

Blood samples for testing can be obtained by needle puncture of an artery or a vein. Venipuncture is the preferred method because veins are often easily visible and unlike the arteries the veins do not have significant pain receptors.

Blood

Blood carries oxygen to the tissues and organs and carries waste products from metabolism that must be transported to the lungs and the kidneys for elimination. Blood is comprised of a liquid and a cellular component. The liquid component is comprised of plasma and serum. The cellular component is comprised of platelets, red blood cells, and white blood cells. Blood has other solid substances but these will not be covered here. The average blood volume for an adult is 5 liters/1.3 gallons.

Platelets

Platelets are small cells that prevent bleeding. When a blood vessel is injured or ruptured, platelets migrate to the area and form a plug. This process is called activation and adhesion, and it is the first step in blood clotting.

Red Blood Cells

The medical term for red blood cells is *erythrocytes*. Red blood cells have a protein called hemoglobin. Hemoglobin combines with oxygen. The primary function of red blood cells is to transport oxygen to the tissues and organs. Red blood cells also combine with carbon dioxide and bring this metabolic waste product to the heart and pulmonary circulation, as was previously explained.

White Blood Cells

The medical term for white blood cells is *leukocytes*. There are many different types of leukocytes but they all play a role in the immune system and the body's defense against infection.

Summary

The cardiovascular system is comprised of the heart, the blood vessels, and the blood. The heart pumps blood through the blood vessels, the arteries, capillaries, and veins, and the blood carries oxygen to the tissues and organs and helps eliminate carbon dioxide.

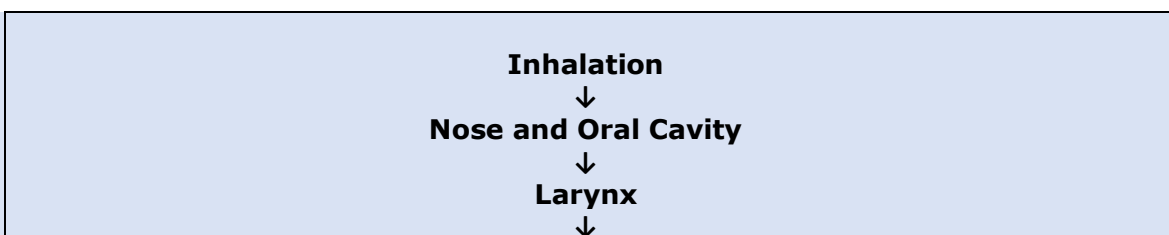
Respiratory System

The primary function of the respiratory function is to deliver oxygen to the blood and to eliminate carbon dioxide from the body. This process is referred to as *gas exchange*. Gas exchange also occurs in the tissues and organs when oxygen leaves the blood and carbon dioxide leaves the cells and moves the blood.

The respiratory system, which can also be referred to as the pulmonary system, begins with the nose and oral cavity and ends with the alveoli in the lungs. The respiratory system is comprised of many different structures, each with its functions and purpose.

This section will divide the structures of the pulmonary system into two categories: 1) air transporting structures and 2) gas exchange structures. The lungs and the pulmonary circulation will be discussed separately.

Movement of Air in the Pulmonary System





Air Transporting Structures

The respiratory system begins with air transporting structures and the first of these are the nose and the oral cavity (mouth). The intake of air is initiated with these structures and the nose and the oral cavity play an important role in filtering, humidifying, and warming inhaled air before it reaches the deep structures of the bronchial tree and the lungs.

All of the structures discussed in this section are lined with *mucous membranes*. The mucous membrane secretions help to humidify and warm inhaled air. They also trap and eliminate foreign particles and bacteria, preventing them from reaching the deep parts of the lungs.

The Larynx

The oral cavity ends at the back of the mouth at the beginning of the larynx. The larynx contains the vocal cords and it connects the oral cavity to the next structure of the respiratory system, the trachea.

The Trachea

The trachea (commonly called the windpipe) is a semi-flexible tube supported by rings of cartilage. It can be seen beginning under the chin and extending down to the level of the clavicles (collar bones). The trachea warms and humidifies inhaled air and serves as a connection to the next air transporting structure, the bronchial tree.

The Bronchial Tree

The bronchial tree begins at the end of the trachea with left and right main stem bronchial tubes; these extend into the left and right lungs, respectively. Branching off from the terminal ends of the left and right main stem bronchial tubes are the *segmental bronchii*, each of which corresponds to a specific segment of the lungs.

The bronchial segments divide into smaller bronchial passages called *bronchioles*. The bronchioles are where the bronchial tree ends and they are the last air transporting structures of the pulmonary system, which began in the nose and the oral cavity.

Gas Exchange Structures

At the end of the bronchioles are the alveolar ducts. The alveolar ducts are short, narrow tubes that connect the bronchial tree with the primary gas exchange structures the alveoli.

The Alveoli

The alveoli are small clusters of air sacs. An accurate image of the alveoli would be a grouped cluster of grapes. The walls of the alveoli are microscopically thin and oxygen and carbon dioxide can easily pass

through the alveolar walls and into and out of the blood. There is some gas exchange in the alveolar ducts but the majority of the oxygen and carbon dioxide exchange occurs in the alveoli.

The Pulmonary Circulation

The pulmonary circulation deserves special mention. It is an extensive, essentially closed system, where gas exchange occurs. It is separate from the peripheral circulation.

The pulmonary capillaries are immediately adjacent to the alveoli and the separation between them is extremely thin. Because of that and because there are so many pulmonary capillaries, oxygen and carbon dioxide can easily move between the alveoli and the blood. This structural arrangement also explains why inhaled drugs act so quickly.

The Lungs

The lungs are located in the chest cavity, starting just below the shoulders and ending near the bottom level of the rib cage. The lungs are large, flexible organs that contain the structures of the bronchial tree, the alveolar ducts, and the alveoli and they are divided into distinct anatomical sections called lobes and segments.

The lungs themselves are surrounded and enclosed by a thin wall of tissue called the pleura. The space between the pleura and the outside of the lung is called the pleural cavity and it contains pleural fluid. The pleural cavity and the pleural fluid allow the lungs to expand and contract in a relatively friction-free environment.

Lung tissue is very elastic and this property of elasticity is very important. Exhaling may seem as if it is done by the muscles of the chest pushing air out of the lungs, and the contraction of the chest muscles does contribute to the process of exhaling. However, at the end of inhaling the lung tissues have been significantly stretched and when inhaling stops the elastic “recoil” of the lung contributes significantly to air being exhaled from the lungs.

Summary

The primary function of the pulmonary system is gas exchange; transferring oxygen from the inhaled air to the blood and removing carbon dioxide from the blood during exhalation. The pulmonary system is comprised of: 1) The gas transporting structures - nose, oral cavity, larynx, trachea, main stem bronchial tubes, segmental bronchii, and the bronchioles, 2) The gas exchanging structures - alveolar ducts and alveoli, 3) The pulmonary circulation, and 4) The lungs, the lung lobes and segments, and the pleura.

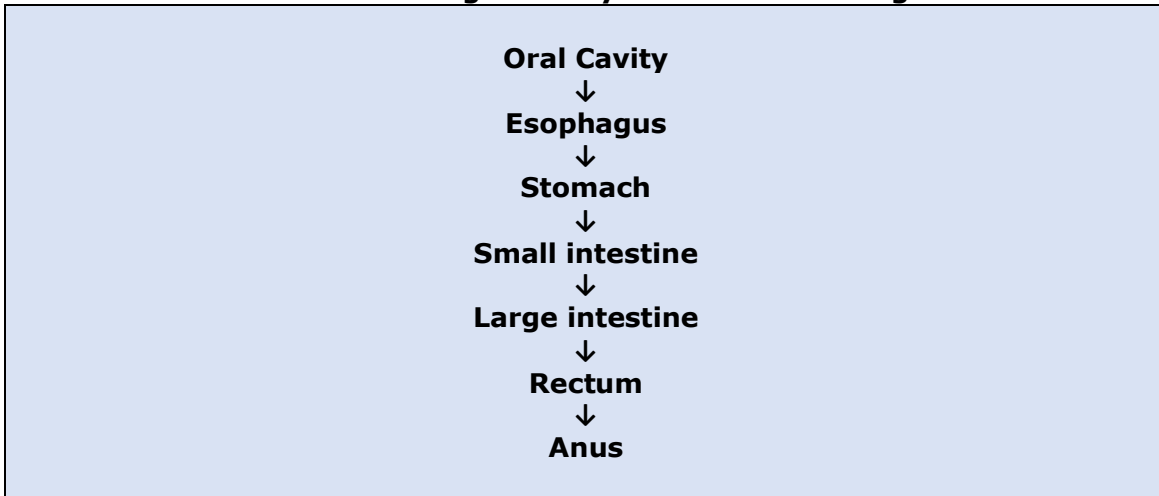
Digestive System

The primary functions of the digestive system are the absorption of nutrients and fluids, and the elimination of wastes. Food, fluids, and medications enter the digestive tract, and nutrients, drugs, and water are absorbed. Undigested food, metabolized drugs, and waste products are passed along through the digestive tract and are eliminated in the form of stool, which is also known as feces.

The digestive system can be usefully pictured as a long tube that begins with the mouth and ends with the anus. The digestive system

also includes the gall bladder, liver, and the pancreas. These organs play essential roles in digestion and they have other functions, as well.

Structures of the Digestive System in Descending Order



Oral Cavity

The oral cavity produces saliva that lubricates food and makes it easier to swallow. The saliva also contains several digestive enzymes that help to break down food so it can be absorbed.

Esophagus

The esophagus (commonly called the gullet) is a large flexible tube that is located behind the trachea. The esophagus connects the oral cavity with the stomach.

Stomach

The stomach contains many digestive enzymes. These enzymes, along with the churning movements of the stomach, break food down so that it can be more easily absorbed. The stomach connects to the

duodenum section of the small intestine by way of a valve, the pyloric sphincter.

Small Intestine

The small intestine (commonly called the small bowel) is a long (approximately 23 feet) narrow tube that connects the stomach with the large intestine. The small intestine has many powerful digestive enzymes, and the small intestine is where the majority of carbohydrates, fats, proteins, minerals and vitamins are absorbed. It is also the area of the digestive tract where most of fluid intake is absorbed.

The small intestine is divided into three sections: the duodenum, the jejunum, and the ileum.

Large Intestine

The large intestine (commonly called the large bowel or the colon) begins at the end of the ileum of the small intestine and it ends with the rectum. The large intestine absorbs some of the nutrients that passed through the small intestine, it removes water from food boluses, and it forms stool.

The large intestine is divided into three sections: the ascending colon, the transverse colon, and the descending colon.

Rectum

The rectum connects with the large intestine at the descending colon and it ends at a connection with the anus. The primary function of the rectum is to store formed stool.

Anus

The anus is the terminal end of the digestive tract and it is the opening through which stool is expelled.

Gall Bladder, Liver, and Pancreas

The Gall Bladder

The gall bladder is a small, pouch-like structure that is located on the bottom of the liver. The gall bladder is connected to the liver by the hepatic duct and it is connected to the duodenum by the common bile duct.

The gall bladder stores the bile that has been produced by the liver. When bile is needed, the gall bladder contracts and pumps bile through the bile duct into the small intestine.

The Liver

The liver is located in the right upper quadrant of the abdomen, beginning slightly above the rib cage and ending slightly above the level of the umbilicus. The liver has many critically important functions. It produces bile, a liquid that is needed for the absorption of fat-soluble vitamins and fats. It produces clotting factors that are needed for normal blood coagulation, and the liver is the primary site at which drugs are metabolized.

The Pancreas

The pancreas is located in mid-section of the abdomen and behind the stomach. The pancreas is connected to the duodenum by the pancreatic ducts. The pancreas produces the hormones insulin, glucagon, and somatostatin and it produces digestive enzymes such as amylase.

Summary

The basic functions of the digestive system are to allow for intake of food, fluids, and drugs, and for the elimination of wastes. The digestive system is comprised of the oral cavity, the esophagus, the stomach, the small and large intestines, the rectum, and the anus. The gall bladder, the liver, and the pancreas are organs that have important digestive functions.

Renal System

The primary functions of the renal system are maintaining proper fluid balance, maintaining a normal acid-base balance, forming urine, and elimination of waste products of metabolism. A large part of the blood that circulates through the body is directed to the kidneys. As the blood passes through the kidneys, some water and waste products from the metabolism are filtered out and concentrated as urine and some fluids and solutes are reabsorbed.

The urine collects in the bladder and is periodically eliminated. The renal system is comprised of the kidneys, the ureters, the bladder, and the urethra.

The Kidneys

The kidneys are located on the left and right sides of the abdomen, below the level of the rib cage and close to the back. The functional

unit of the kidneys is called the nephron, and the nephron is where blood from the peripheral circulation is filtered and urine is formed.

The nephrons are connected to and drain into the renal pelvis. This is a cavity inside the kidney that collects and stores urine before it passes into the bladder.

The Ureters

The ureters are 10 to 12-inch long tubes made of smooth muscle that connect the kidneys to the bladder. The bladder is located between the umbilicus and the pelvic bone. The bladder stores urine prior to urination. The urethra connects the bladder to the external opening of the urinary tract, the meatus, and the urethra is the passage through which urine is expelled from the bladder. In males, the urethra also allows for the passage of semen. The female urethra is approximately 2 inches long; the male urethra is approximately 8 inches long.

Summary

The renal system forms urine, eliminates waste products of metabolism, and helps to maintain a normal acid-base balance and fluid balance. The renal system is comprised of the kidneys, two ureters, the bladder, and the urethra.

Endocrine System

The endocrine system is comprised of glands. The definition of a gland is an organ that secretes a specific substance that is needed for normal functioning. Most of the substances that glands produce are hormones. A hormone is defined as a substance produced by a gland

that has a regulatory effect on another organ or organ system. Insulin is a well-known hormone that helps control glucose metabolism.

Thyroid Gland

The thyroid is a gland that produces thyroid hormones that are released into the blood stream and influence the metabolic rate and the growth of tissues. The adrenal glands produce a hormone called adrenaline that acts as a stimulant and helps dilate blood vessels and the bronchial tree. The thyroid gland also produces calcitonin, a hormone that helps regulate the homeostasis of calcium.

Glands are classified as *endocrine* or *exocrine*. Endocrine glands secrete their hormones directly into the bloodstream. After entering the bloodstream, the endocrine hormones travel to the target organ and initiate the desired effect.

Exocrine glands release their hormones through a duct and then reach the target organ or tissue. Sweat glands are exocrine glands and they release sweat directly onto the surface of the skin.

Endocrine Glands and Their Hormones

Adrenal glands: Located on the top of the kidneys. The adrenal glands produce adrenaline, aldosterone, cortisol, noradrenaline, and the male hormone DHEA

Ovaries: There are two ovaries, located in left and right side of the abdomen adjacent to the uterus. The ovaries produce the female sex hormones estrogen and progesterone. They also secrete testosterone and they are where egg cells are produced.

Pancreas: The pancreas secretes glucagon, insulin, and somatostatin. The pancreas also functions as an exocrine gland.

Pineal gland: The pineal gland is located in the brain. It produces the hormone melatonin.

Pituitary gland: The pituitary gland is located at the base of the brain. The pituitary gland produces adrenocorticotropic hormone, anti-diuretic hormone, human growth hormone, the follicle stimulating hormone, luteinizing hormone, melanocyte-stimulating hormone, oxytocin, prolactin, and thyroid stimulating hormone.

Testis: The testis is a gland that is located in the testicles. The testis produces testosterone. The testis also produces sperm cells.

Thyroid gland: The thyroid gland is located in the neck immediately below the laryngeal prominence cartilage (commonly known as the Adam's apple). The thyroid hormones are calcitonin, thyroxine (T₄) and triiodothyronine (T₃).

Exocrine Glands

Lacrimal glands, aka tear glands

Liver

Mammary glands

Pancreas

Prostate gland: the prostate gland produces some of the components of semen

Sebaceous glands: The sebaceous glands secrete skin oils.

Salivary glands

Sweat glands

Summary

The endocrine system is comprised of glands. The definition of a gland is an organ that secretes a specific substance that is needed for normal functioning. Most of the substances that glands produce are hormones, and a hormone is defined as a substance produced by a gland that has a regulatory effect on another organ or organ system. Glands are classified as endocrine (they release their hormones

directly into the bloodstream) or exocrine (they release their hormones through a duct).

These organs help control body functions and metabolism by the hormones they produce. Hormones are chemical substances that are involved in many body processes. One important example is the hormone insulin. Insulin is produced by the pancreas. It helps control blood sugar levels and assists in the storage of blood sugar.

Reproductive System

The reproductive system consists of the organs and body structures that are involved in reproduction and sexual activity. The female reproductive system is comprised of the vagina, the uterus, the fallopian tubes, the ovaries, and the breasts. The ovaries produce eggs that may be fertilized by sperm to produce a fetus. The eggs are carried from the ovaries by the fallopian tube to the uterus.

Fertilization of the eggs and growth of the fetus occurs in the uterus. The vagina provides access for the sperm to the eggs in the uterus. It also functions as the birth canal and as a center of sexual stimulation and pleasure. The breasts (also known as mammary glands) produce milk after childbirth.

The male reproductive system is comprised of the penis and the testicles. The testicles produce sperm and the sperm is delivered to the vagina through the penis.

Summary

The reproductive system is involved in reproduction and sexual activity. In females, it is comprised of the vagina, uterus, fallopian tubes, ovaries, and breasts. In males, it is comprised of the penis and the testicles.

Summary

Healthcare workers need to understand how the human body would normally function in order to detect changes that may indicate a serious alteration in health. Patients may have a chronic medical problem, such as diabetes, heart disease, or hypertension. Healthcare workers are expected to understand these disease processes, to understand how they affect health, and to know when these medical conditions have worsened.

Each organ system, and the organ or organs that make up that particular system, can be categorized by its functions, and the task of learning anatomy using this method of study becomes very manageable.