

The Main Systems of the Human Body

Circulatory system:

The circulatory system also called the cardiovascular system or the vascular system, is an organ system that permits blood to circulate and transport nutrients (such as amino acids and electrolytes), oxygen, carbon dioxide, hormones, and blood cells to and from the cells in the body to provide nourishment and help in fighting diseases, stabilize temperature and pH, and maintain homeostasis.

Blood is a fluid consisting of plasma, red blood cells, white blood cells, and platelets that is circulated by the heart through the vertebrate vascular system, carrying oxygen and nutrients to and waste materials away from all body tissues.

Structure of the Cardiovascular system

The essential components of the human cardiovascular system are the heart, blood and blood vessels.

Blood consists of plasma, red blood cells, white blood cells, and platelets. Also, the digestive system works with the circulatory system to provide the nutrients the system needs to keep the heart pumping.

Heart

The heart pumps oxygenated blood to the body and deoxygenated blood to the lungs.

Lungs

The circulatory system of the lungs is the portion of the cardiovascular system in which oxygen-depleted blood is pumped away from the heart, via the pulmonary artery, to the

lungs and returned, oxygenated, to the heart via the pulmonary vein.

Lymphatic system

The lymphatic system is part of the circulatory system. It is a network of lymphatic vessels and lymph capillaries, lymph nodes and organs, and lymphatic tissues and circulating lymph.

One of its major functions is to carry the lymph, draining and returning interstitial fluid back towards the heart for return to the cardiovascular system, by emptying into the lymphatic ducts.

Digestive system:

The human digestive system consists of the gastrointestinal tract plus the accessory organs of digestion (the tongue, salivary glands, pancreas, liver, and gallbladder).

Digestion involves the breakdown of food into smaller and smaller components until they can be absorbed and assimilated into the body.

Most of the digestion of food takes place in the small intestine.

There are several organs and other components involved in the digestion of food. The organs known as the accessory digestive glands are the liver, gallbladder, and pancreas.

Other components include the mouth, salivary glands, tongue, teeth, and epiglottis.

The largest structure of the digestive system is the gastrointestinal tract (GI tract).

The largest part of the GI tract is the colon or large intestine.

Esophagus

The esophagus commonly known as the food pipe or gullet is an organ through which food passes, aided by peristaltic contractions, from the pharynx to the stomach.

Diaphragm

The diaphragm is an important part of the body's digestive system. The muscular diaphragm separates the thoracic cavity from the abdominal cavity where most of the digestive organs are located.

Stomach

The stomach is a major organ of the gastrointestinal tract and digestive system.

Spleen

The spleen breaks down both red and white blood cells that are spent. This is why it is sometimes known as the 'graveyard of red blood cells'.

Liver

The liver can detoxify various metabolites; synthesize proteins and produce biochemicals needed for digestion. It regulates the storage of glycogen which can form from glucose (glycogenesis).

The liver can also synthesize glucose from certain amino acids.

Its digestive functions are largely involved with the breaking down of carbohydrates. It also maintains protein metabolism in its synthesis and degradation.

The main purpose of the gallbladder is to store and release bile.

Pancreas

The pancreas is a major organ functioning as an accessory digestive gland in the digestive system.

The endocrine part secretes insulin when the blood sugar becomes high; insulin moves glucose from the blood into the muscles and other tissues for use as energy.

The endocrine part releases glucagon when the blood sugar is low; glucagon allows stored sugar to be broken down into glucose by the liver in order to re-balance the sugar levels.

The pancreas produces and releases important digestive enzymes in the pancreatic juice that it delivers to the duodenum.

The pancreas is also the main source of enzymes for the digestion of fats and proteins.

Lower gastrointestinal tract

The lower gastrointestinal tract (GI), includes the small intestine and all of the large intestine.

The small intestine is subdivided into the duodenum, the jejunum, and the ileum.

Most food digestion takes place in the small intestine.

Cecum

The cecum is a pouch marking the division between the small intestine and the large intestine.

Large intestine

In the large intestine, the passage of the digesting food in the colon is a lot slower, taking from 12 to 50 hours until it is removed from the body.

Endocrine system:

The endocrine system is a chemical messenger system consisting of hormones, the group of glands of an organism that carry those hormones directly into the circulatory system to be carried towards distant target organs, and the feedback loops of homeostasis that the hormones drive.

In humans, the major endocrine glands are the thyroid gland and the adrenal glands. The hypothalamus is the neural control center for all endocrine systems.

In addition to the specialized endocrine organs mentioned above, many other organs that are part of other body systems, such as bone, kidney, liver, heart, and gonads, have secondary endocrine functions.

The major glands of the endocrine system include the pineal gland, pituitary gland, pancreas, ovaries, testes, thyroid gland, parathyroid gland, hypothalamus, and adrenal glands.

The hypothalamus and pituitary gland are neuroendocrine organs.

Hormones

A hormone is a class of signaling molecules produced by glands in multicellular organisms that are transported by the circulatory system to target distant organs to regulate physiology and behavior.

Hormones are used to communicate between organs and tissues for physiological regulation and behavioral activities, such as

digestion, metabolism, respiration, tissue function, sensory perception, sleep, excretion, lactation, stress, growth and development, movement, reproduction, and mood.

Endocrine diseases

Diseases of the endocrine system are common, including conditions such as diabetes mellitus, thyroid disease, and obesity.

Other common diseases that result from endocrine dysfunction include Addison's disease, Cushing's disease, and Graves's disease.

Cushing's disease and Addison's disease are pathologies involving the dysfunction of the adrenal gland.

Integumentary system:

The integumentary system is the organ system that protects the body from damage, comprising the skin and its appendages (including hair, scales, and nails).

The integumentary system has a variety of functions; it may serve to waterproof, cushion and protect the deeper tissues, excrete wastes, regulate temperature and is the attachment site for sensory receptors to detect pain, sensation, pressure, and temperature.

The integumentary system is the largest organ system. The skin is the largest organ in the body: 12-15% of body weight, with a surface area of 1-2 meters.

The skin covers the entire outer surface of the body.

Epidermis: This is the top layer of skin made up of epithelial cells. It does not contain blood vessels. Its main job is protection, absorption of nutrients, and homeostasis.

Dermis: The dermis is the mid-layer of skin, composing of loose collective tissues such as collagen with elastin arranged in a diffusely bundled and woven pattern.

These layers serve to give elasticity to the integument, not allowing stretching and conferring flexibility, while also resisting distortions, wrinkling, and sagging.

Subdermal (Hypodermis): The sub-dermis is the layer of tissue directly underneath the dermis. It is mainly composed of connective and adipose tissue. Its physiological functions include insulation, the storage of energy, and aiding in the anchoring of the skin.

Functions of the integumentary system:

The skin has an important job of protecting the body and acts as the body's first line of defense against infection, temperature change, and other challenges to homeostasis. Functions include:

- Protect the body's internal living tissues and organs, against invasion by infectious organisms, the body from dehydration, the body against abrupt changes in temperature and protect the body against sunburns
- Help excrete waste materials through perspiration
- Act as a receptor for touch, pressure, pain, heat, and cold
- Generate vitamin D through exposure to ultraviolet light
- Store water, fat, glucose, and vitamin D
- Participate in temperature regulation

Lymphatic system / Immune system:

The immune system is a host defense system comprising many biological structures and processes within an organism that protects against disease.

To function properly, an immune system must detect a wide variety of agents, known as pathogens, from viruses to parasitic

worms, and distinguish them from the organism's own healthy tissue.

Pathogens can rapidly evolve and adapt, and thereby avoid detection and neutralization by the immune system; however, multiple defense mechanisms have also evolved to recognize and neutralize pathogens.

Adaptive (or acquired) immunity creates immunological memory after an initial response to a specific pathogen, leading to an enhanced response to subsequent encounters with that same pathogen. This process of acquired immunity is the basis of vaccination.

Disorders of the immune system can result in autoimmune diseases, inflammatory diseases, and cancer.

The immune system protects organisms from infection with layered defenses of increasing specificity. In simple terms, physical barriers prevent pathogens such as bacteria and viruses from entering the organism.

Tumor Immunology

Another important role of the immune system is to identify and eliminate tumors.

Muscular system:

The muscular system is an organ system consisting of skeletal, smooth and cardiac muscles.

It permits movement of the body, maintains posture, and circulates blood throughout the body.

The muscular system in vertebrates is controlled through the nervous system, although some muscles (such as the cardiac muscle) can be completely autonomous.

Together with the skeletal system, it forms the musculoskeletal system, which is responsible for the movement of the human body.

Muscles

There are three distinct types of muscles: skeletal muscles, cardiac or heart muscles, and smooth (non-striated) muscles.

Muscles provide strength, balance, posture, movement, and heat for the body to keep warm.

Skeletal muscle

There are approximately 639 skeletal muscles in the human body.

Cardiac muscle

Heart muscles are distinct from skeletal muscles because the muscle fibers are laterally connected to each other.

Smooth muscles are controlled directly by the autonomic nervous system and are involuntary, meaning that they are incapable of being moved by conscious thought.

Nervous system:

The nervous system coordinates its actions by transmitting signals to and from different parts of its body.

The nervous system detects environmental changes that impact the body, then works in tandem with the endocrine system to respond to such events.

It consists of two main parts, the central nervous system (CNS) and the peripheral nervous system (PNS).

The CNS (central nervous system) consists of the brain and spinal cord.

The PNS (peripheral nervous system) consists mainly of nerves, which are enclosed bundles of the long fibers or axons, that connect the CNS to every other part of the body.

Nerves that transmit signals from the brain are called motor or efferent nerves, while those nerves that transmit information from the body to the CNS are called sensory or afferent.

Spinal nerves serve both functions and are called mixed nerves.

The PNS is divided into three separate subsystems, the somatic, autonomic, and enteric nervous systems.

Somatic nerves mediate voluntary movement.

The autonomic nervous system is further subdivided into the sympathetic and the parasympathetic nervous systems.

The sympathetic nervous system is activated in cases of emergencies to mobilize energy, while the parasympathetic nervous system is activated when organisms are in a relaxed state.

Nerves that exit from the cranium are called cranial nerves while those exiting from the spinal cord are called spinal nerves.

At the cellular level, the nervous system is defined by the presence of a special type of cell, called the neuron, also known as a "nerve cell".

Malfunction of the nervous system can occur as a result of genetic defects, physical damage due to trauma or toxicity, infection or simply of aging.

Reproductive system:

The reproductive system or genital system is a system of sex organs within an organism that works together for the purpose of sexual reproduction.

Unlike most organ systems, the sexes of differentiated species often have significant differences.

Diseases of the human reproductive system are very common and widespread, particularly communicable sexually transmitted diseases.

The female reproductive system has two functions: The first is to produce egg cells, and the second is to protect and nourish the offspring until birth.

The male reproductive system has one function, and it is to produce and deposit sperm.

Male reproductive system

The male reproductive system is a series of organs located outside of the body and around the pelvic region of a male that contributes towards the reproduction process.

The primary direct function of the male reproductive system is to provide the male sperm for fertilization of the ovum.

Female reproductive system

The human female reproductive system is a series of organs primarily located inside of the body and around the pelvic region of a female that contributes towards the reproductive process.

The human female reproductive system contains three main parts: the vulva, the vaginal opening, to the uterus; the uterus,

which holds the developing fetus; and the ovaries, which produce the female's ova.

Respiratory system:

The respiratory system is a biological system consisting of specific organs and structures used for gas exchange.

Gas exchange in the lungs occurs in millions of small air sacs called alveoli.

These microscopic air sacs have a very rich blood supply, thus bringing the air into close contact with the blood.

These air sacs communicate with the external environment via a system of airways, or hollow tubes, of which the largest is the trachea, which branches in the middle of the chest into the two main bronchi.

These enter the lungs where they branch into progressively narrower secondary and tertiary bronchi that branch into numerous smaller tubes, the bronchioles.

The respiratory tract is divided into an upper and a lower respiratory tract.

The upper tract includes the nose, nasal cavities, sinuses, pharynx and the part of the larynx above the vocal folds.

The lower tract includes the lower part of the larynx, the trachea, bronchi, bronchioles, and the alveoli.

The branching airways of the lower tract are often described as the respiratory tree or tracheobronchial tree.

Bronchioles are defined as small airways lacking any cartilaginous support.

The first bronchi to branch from the trachea are the right and left main bronchi.

These bronchi enter the lungs at each hilum, where they branch into narrower secondary bronchi known as lobar bronchi, and these branch into narrower tertiary bronchi known as segmental bronchi.

Further divisions of the segmental bronchi are grouped together as subsegmental bronchi.

The alveoli are the dead-end terminals of the "tree", meaning that any air that enters them has to exit via the same route.

Local defenses

Irritation of nerve endings within the nasal passages or airways can induce a cough reflex and sneezing.

Disorders of the respiratory system can be classified into several general groups:

Airway obstructive conditions (e.g., emphysema, bronchitis, asthma)

Pulmonary restrictive conditions (e.g., fibrosis, sarcoidosis, alveolar damage, pleural effusion)

Vascular diseases (e.g., pulmonary edema, pulmonary embolism, pulmonary hypertension)

Infectious, environmental and other "diseases" (e.g., pneumonia, tuberculosis, asbestosis, particulate pollutants)

Primary cancers (e.g. bronchial carcinoma, mesothelioma)

Secondary cancers (e.g. cancers that originated elsewhere in the body, but have seeded themselves in the lungs)

Insufficient surfactant
(e.g. respiratory distress syndrome in premature babies).

Skeletal system:

The skeleton is the body part that forms the supporting structure of an organism.

The human skeleton consists of both fused and individual bones supported and supplemented by ligaments, tendons, muscles, and cartilage.

It serves as a scaffold that supports organs, anchors muscles, and protects organs such as the brain, lungs, heart, and spinal cord.

The biggest bone in the body is the femur in the upper leg, and the smallest is the stapes bone in the middle ear.

There are 206 bones in the adult human skeleton.

The human skeleton takes 20 years before it is fully developed.

There exist several general differences between male and female skeletons.

Bones and cartilage

Bones are rigid organs that function to move, support, and protect the various organs of the body, produce red and white blood cells and store minerals.

Bone tissue is a type of dense connective tissue. Bones have a variety of shapes with a complex internal and external structure they are also lightweight, yet strong and hard.

Cartilage

Cartilage is a stiff and inflexible connective tissue found in many areas in the body, including the joints between bones, the rib cage, the ear, the nose, the elbow, the knee, the ankle, the bronchial tubes, and the intervertebral discs.

It is not as hard and rigid as a bone but is stiffer and less flexible than muscle.

Cartilage is composed of specialized cells.

Cartilage is classified into three types, elastic cartilage, hyaline cartilage, and fibrocartilage.

Urinary system:

The urinary system, also known as the renal system or urinary tract, consists of the kidneys, ureters, bladder, and the urethra.

The purpose of the urinary system is to eliminate waste from the body, regulate blood volume and blood pressure, control levels of electrolytes and metabolites, and regulate blood pH.

The urinary tract is the body's drainage system for the eventual removal of urine. The kidneys have an extensive blood supply via the renal arteries which leave the kidneys via the renal vein.

Urine is formed in the kidneys through the filtration of blood. The urine is then passed through the ureters to the bladder, where it is stored. During urination, the urine is passed from the bladder through the urethra to the outside of the body.

These collecting ducts then join together to form the minor calyces, followed by the major calyces that ultimately join the renal pelvis.

The main functions of the urinary are to:

Regulate blood volume and composition (e.g. sodium, potassium, and calcium)
Regulate blood pressure.
Regulate pH homeostasis of the blood.
Contributes to the production of red blood cells by the kidney.
It helps synthesize calcitriol (the active form of Vitamin D).
Stores waste product (mainly urea and uric acid) before it and other products are removed from the body.

Urologic disease

A Urological disease can involve congenital or acquired dysfunction of the urinary system. A urinary tract obstruction is a urologic disease that can cause urinary retention.

Diseases of other bodily systems also have a direct effect on urogenital function.

Diabetes also can have a direct effect in urination due to peripheral neuropathies which occur in some individuals with poorly controlled diabetes.

Urinary incontinence can result from a weakening of the pelvic floor muscles caused by factors such as pregnancy, childbirth, aging and being overweight.

Some cancers also target the urinary system, including bladder cancer, kidney cancer, ureteral cancer, and urethral cancer. Due to the role and location of these organs, treatment is often complicated.