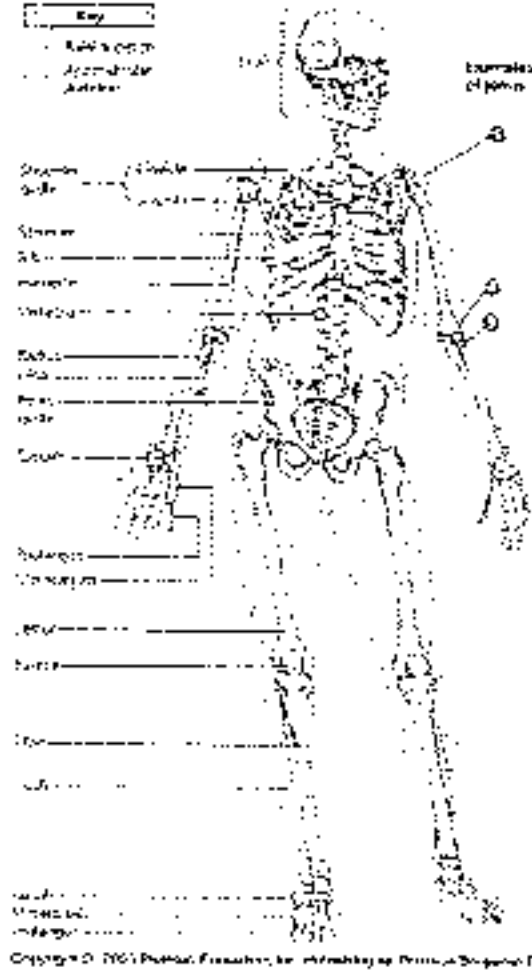


I. Skeletal System

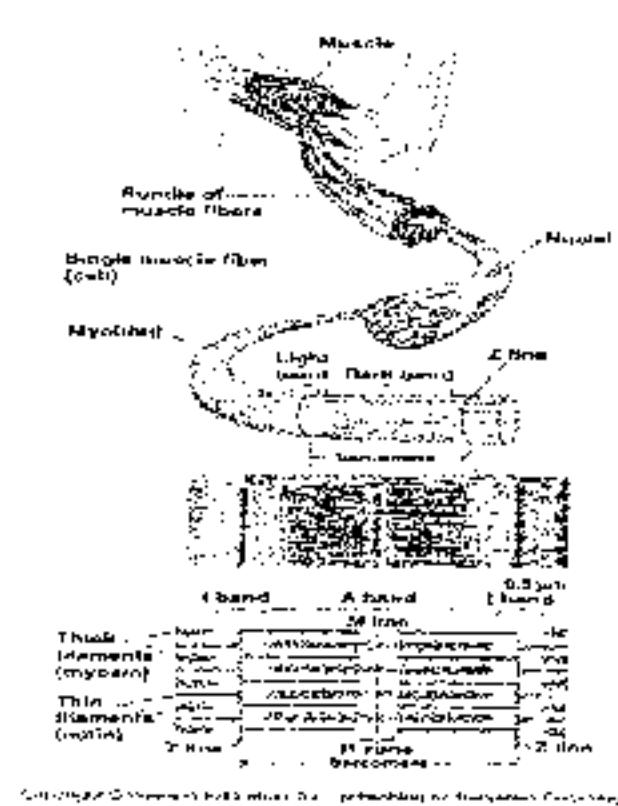


The skeletal system is the body's framework. It is made of bones, joints, and cartilage. An organism's skeleton stores minerals, makes blood cells, and protects organs.

There are three types of skeletons:

- The hydrostatic skeleton, found in earthworms, is a support system consisting of a body compartment filled with fluid under pressure. There are no bones. Either contractile cells or muscles surround the fluid-filled compartment. When contraction occurs, the compartment elongates and the animal moves forward.
- An exoskeleton is a hard covering on the outside of the body composed of molecules called chitin. Arthropods such as crabs and spiders have exoskeletons. To grow larger, the arthropod must shed its exoskeleton and then replace it with a larger one.
- An endoskeleton, found in vertebrates such as mammals, fishes, and birds, is made of bone and cartilage located inside the body. This hard internal skeleton facilitates movement, provides support, and stores minerals such as calcium. You have 206 bones in your body. Feel the back of your neck. Did you know that nearly all mammals have seven vertebrae in their necks? Necks vary in length, shape, and flexibility because the alignment of bones and cartilage, are different in different mammals. These variations enable a giraffe to nibble treetops and a person to look out a window.

II. Muscular System

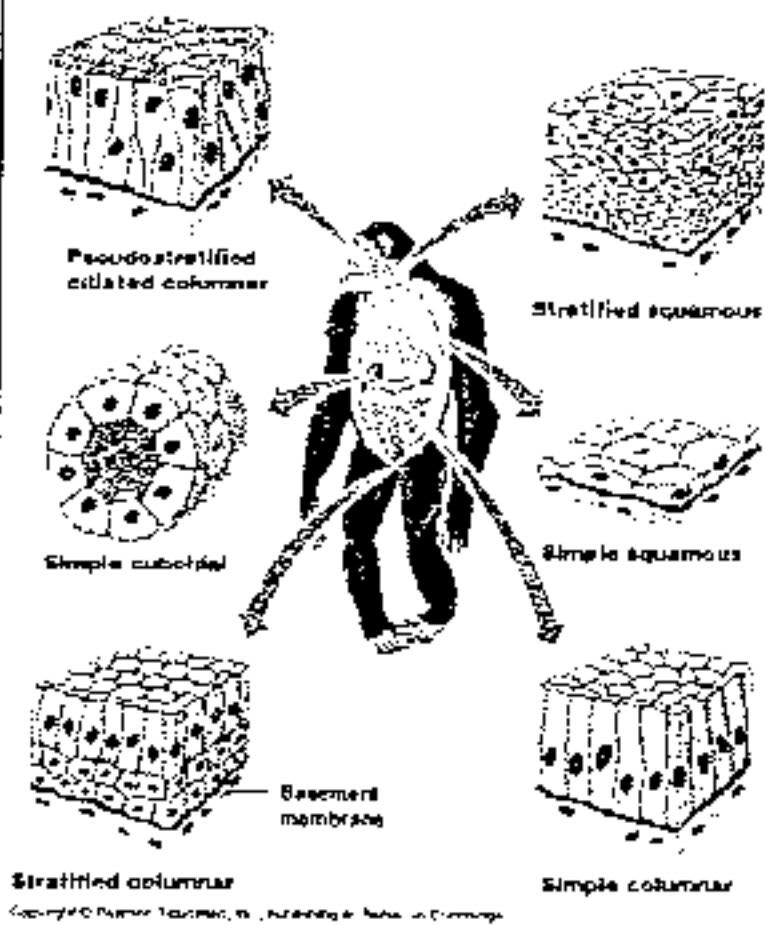


When muscles work with bones, they move parts of the body including hands, fingers, legs, neck, and head. Muscles in internal organs move substances in the organs.

All muscles can contract to shorten and relax to lengthen. They are in locations where a contraction can cause movement. Movement takes place because muscles are attached to parts of the skeleton. When the attached muscles shorten, they move the corresponding body part. As muscles contract, they use energy to do work and generate heat. Because of this, you may feel warm when you run, stamp your feet, or shiver. Muscle contraction is the main source of heat to maintain body temperature and homeostasis.

- The type of muscles in your legs and other parts of your body are called skeletal muscle. They are sometimes called voluntary muscles because they are under your conscious control. Skeletal muscle is composed of cells that create a striated (striped) pattern when viewed under a microscope.
- Many of your internal organs contain smooth muscles. These are called involuntary muscles because they are not under conscious control. They regulate the width of blood vessels and the contractions of your digestive system. Smooth muscle is not striated.
- Cardiac muscle is found only in your heart. It is striated is under involuntary control. Cardiac muscle contracts and relaxes throughout your life to pump blood through your vessels.

III. Integumentary System

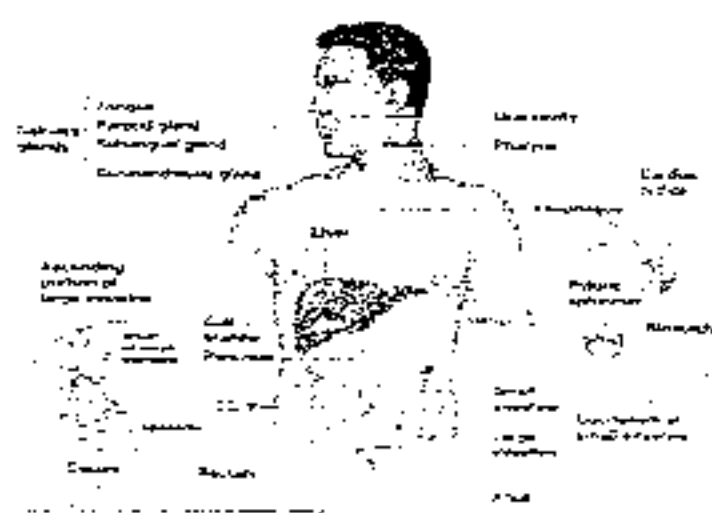


The integumentary system includes skin, hair, nails, and the glands in the skin. This system forms a waterproof protective barrier separating the body's internal environment from the external environment.

- The epidermis is the skin's outer layer. This skin layer is 10 to 30 cells thick—about as thick as this page. The epidermis is covered is covered with tiny openings called pores. Sweat and oils secreted by the skin leave the body through pores.
- The thick layer of the skin is the dermis. The cells of the dermis make collagen, a protein that makes skin flexible and strong. Collagen forms the ridges on your fingertips that make your fingerprints. It also forms ridges on the palms of your hands. Your toes, and the soles of your feet. The ridges act as nonskid treads for your hands and feet.

Skin cancer is a disease that results from the abnormal growth of skin cells. It is often associated with exposure to the sun and may appear as lumps, sores that do not heal, or unusual moles. Frequent baths or showers help to keep skin healthy and eating a healthful diet with adequate B vitamins. Most importantly, you should protect your skin from overexposure to the sun by avoiding strong sunlight and wearing protective clothing and a sunscreen with a sun protection factor (SPF) of at least 15. Inspect your skin on a regular basis and report any changes to your doctor. In the year 1935 the risk of melanoma (skin cancer) in the United States was 1 in 1,500 and in 2000 it was 1 in 75.

IV. Digestive System



The digestive system obtains food, breaks it down, and absorbs nutrients. Any unused food molecules get eliminated from the body. The digestive system includes the mouth, esophagus, stomach, intestines, liver, gallbladder, and pancreas.

During digestion three activities take place to extract nutrients from foods:

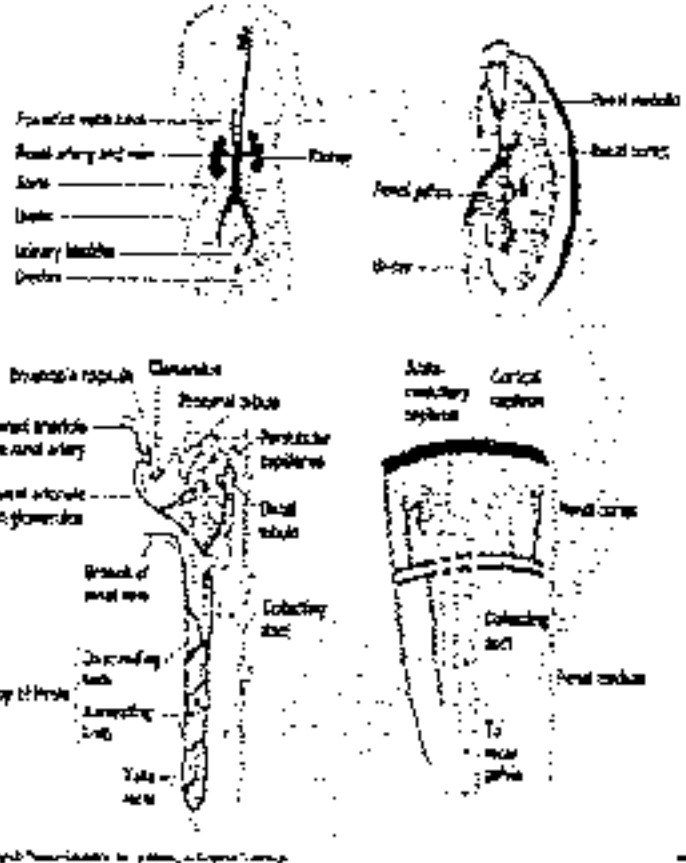
- mechanical digestion that breaks food into tiny pieces without changing its chemical structure,
- chemical digestion which breaks food down into smaller, simpler molecules—nutrients
- absorption which occurs when these nutrients are taken into the body's cells.

In the mouth chewing start mechanical digestion, and saliva begins the breakdown of starches to sugars. As you swallow, a small flap of tissue called the epiglottis closes the trachea and the entrance to your respiratory tract. This ensures that food enters the esophagus and moves towards the stomach where mechanical digestion continues as your food churns and chemical digestion continues with the breakdown of proteins by the enzyme pepsin.

After about three hours the food is reduced to a soft pulp called chyme made of acids, partially digested proteins and carbohydrates, and undigested fats. The stomach valve opens and sends the chyme to the small intestine where the digestion of carbohydrates and proteins is completed, fats are digested, and nutrients are absorbed. Tiny finger-like projections called villi line the internal surface of the small intestine increasing its surface area and making absorption more efficient. In the colon, or large intestine, water and water-soluble vitamins are absorbed from undigested material and redistributed to the rest of your body. When most of the water is removed, a solid waste matter, called feces moves through the rectum and out of the body through the anus.

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V. Excretory System



The excretory system removes wastes from the body. It includes the kidneys and the bladder. The skin, lungs and liver are sometimes considered part of the excretory system.

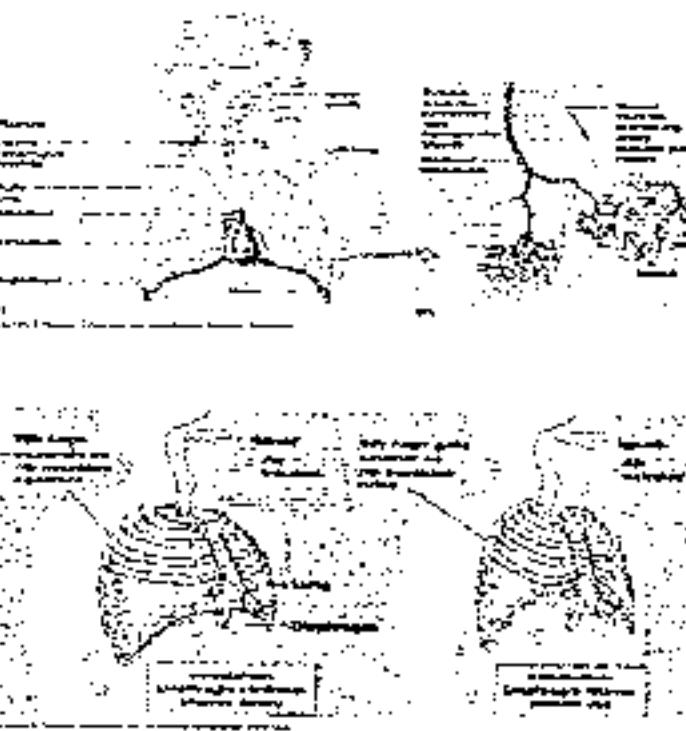
The kidneys are located at the bottom of the rib cage near the backside of the body. Blood enters the kidneys from vessels that branch from the aorta, the body's largest blood vessel. The kidneys remove wastes from the blood and process them into a yellow liquid called urine.

The kidneys control the amount of salts, water, and vitamins in the blood, and regulate the pH and volume of the blood in the body. At any given time, up to 25 percent of the body's blood may be in the kidneys.

The functional unit of the kidney is called the nephron.

- In the nephron, filtration causes water, salt, glucose, and amino acids to be filtered out of the blood and into urea to form a filtrate that can exit the body. Proteins and blood cells remain in the blood.
- Reabsorption allows water and nutrients to be reabsorbed into the blood and waste to remain.
- Secretion allows wastes, such as urea toxins, vitamins, and some medications, such as penicillin to be removed from the blood. Urine produced by each kidney flows into a long thin tube called a ureter to the bladder. The bladder has a tube, the urethra that opens to outside the body.

VI. Respiratory System



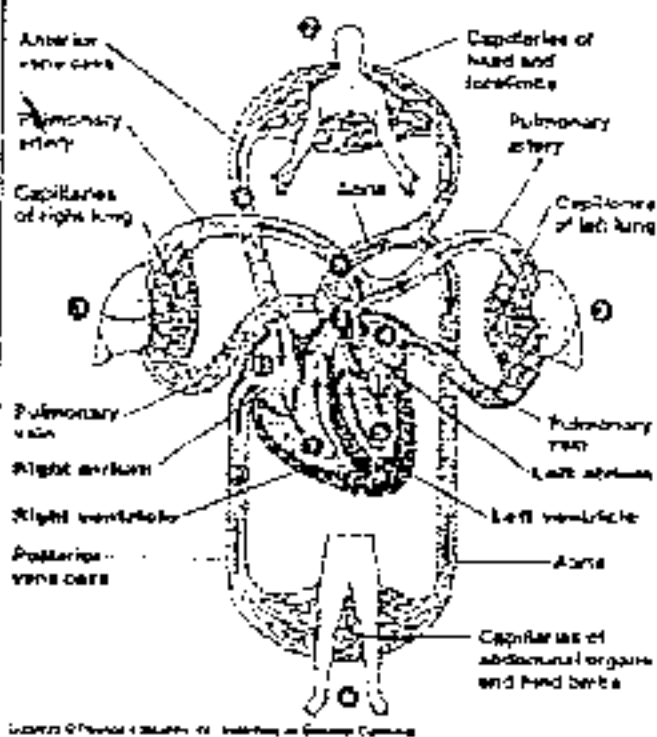
The respiratory system is made of a network of breathing passages and the lungs. These organs take in oxygen from the air for cellular respiration and release carbon dioxide.

All animals depend on cellular respiration for energy to survive. In cellular respiration food molecules are broken down to make ATP. The most efficient form of cellular respiration is aerobic and requires oxygen and produces carbon dioxide. Animals obtain oxygen from the environment and then expel carbon dioxide. This gas exchange takes place in the respiratory system.

The respiratory system provides surfaces where oxygen and carbon dioxide diffuse across cell membranes. These tissues are moist because oxygen and carbon dioxide must be dissolved in water before they can efficiently diffuse across cell membranes. First, air passes over the mucous membrane of the nasal cavity and is moistened, warmed, and filtered. Next air travels through the pharynx (throat) to the epiglottis, then down to the larynx (voice box), and then to the trachea (windpipe) leading to the lungs. The trachea divides into two tubes called bronchi that branch into bronchioles. At the end of the bronchioles are bunches of alveoli, or air sacs. Most of the gas exchange occurring between the circulatory and respiratory systems takes place at the alveoli.

Most of the oxygen needed by the body is bound to a protein in red blood cells called hemoglobin. Breathing is regulated by the amount of carbon dioxide in your blood. Carbon dioxide in the blood forms carbonic acid which changes the blood's pH. As the pH drops it signals your body to breathe more. During inhalation the diaphragm (a sheet of muscle below the lungs) contracts and moves down. During exhalation the diaphragm relaxes and moves up.

VII. Circulatory System



The circulatory system transports essential substances such as O_2 , CO_2 , nutrients, wastes, and hormones throughout the body. This system includes the heart, the network of blood vessels, and blood.

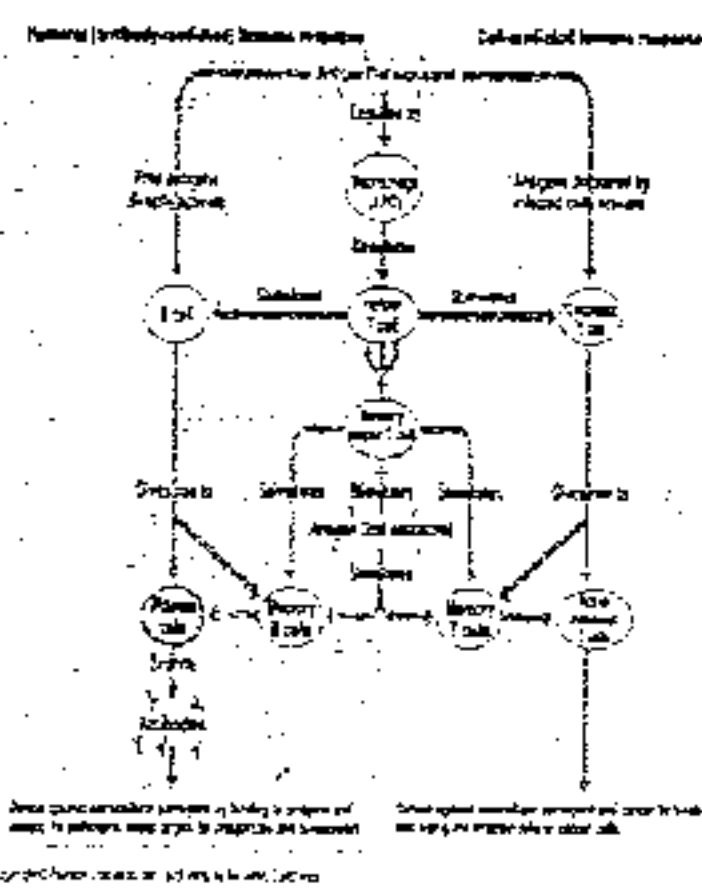
You have a closed circulatory system through which blood travels.

- Arteries carry oxygenated blood away from the heart
- Veins return oxygen deficient blood to the heart
- Capillaries are thin blood vessels where gases, nutrients, and wastes are exchanged by cells via diffusion

The circulatory system is divided into two parts based on whether blood is being transported between your heart and the lungs or the heart and the rest of your body. Blood is carried to and from your lungs by the pulmonary circuit. The systemic circuit takes blood from the heart to the body's capillaries and back.

Smoking increases the risk of lung cancer and cardiovascular disease. Nicotine in tobacco raises the heart rate and narrows arteries. Smoking lowers the efficiency of the respiratory organs. Consequently, the heart must pump faster to deliver oxygen to the body's cells.

VIII. Immune System



The immune system defends the body against infectious agents and mutant cells. This system includes bone marrow and white blood cells, and organs such as lymph nodes.

The body's first line of defense against pathogens is nonspecific and includes the skin and mucus membranes. The second line of defense is the inflammatory response. The third defense is a specific response that targets specific pathogens (a virus or organism that causes an infectious disease) and can be either humoral, creating antibodies that target infected cells for death, or cell-mediated, creating cytotoxic T-cells that rupture infected cells.

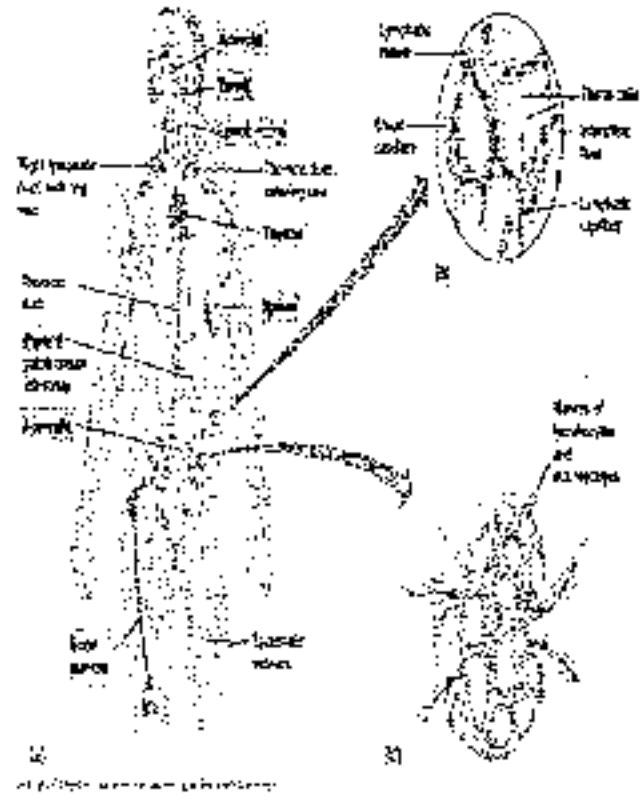
White blood cells or leukocytes are cells of the immune system that originate in the bone marrow. Some mature in the bone marrow while others migrate and develop in the thymus. Most white blood cells circulate in the blood, while others are stored in the lymphatic system. When an invasion is detected, leukocytes gather at the infection site.

Different types of white blood cells are involved in nonspecific and specific responses.

- Phagocytes engulf and digest unwanted cells and pathogens in a nonspecific manner.
- Macrophages are the largest phagocytes; each one can engulf hundreds of bacterial cells.
- Lymphocytes are involved in the body's specific defense as some secrete antibodies that are specific to different pathogens and others recognize and destroy body cells that have been infected by specific pathogens.

Autoimmune diseases result when the body's immune system fails to differentiate between pathogens and its own cells, attacking the body's own tissues. Allergies occur when your immune system mounts a response to a normally harmless substance such as pollen.

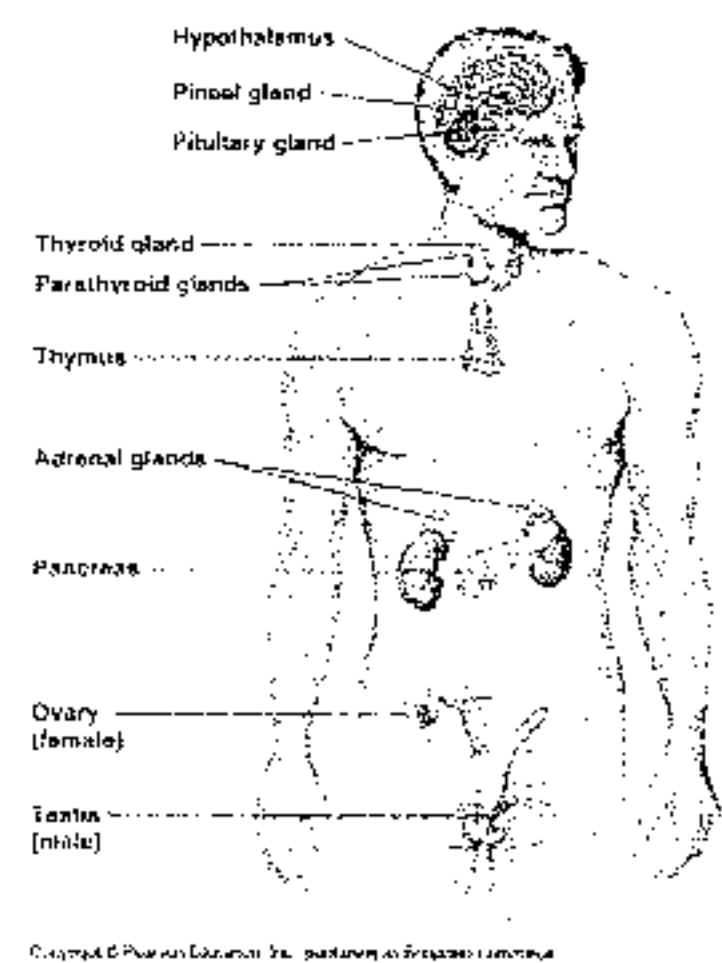
IX. Lymphatic System



The lymphatic system returns fluid from spaces between cells to the circulatory system. It also filters bacteria and particles out of the fluid. This system is made of a network of vessels and lymph nodes, as well as organs such as the spleen, tonsils, and appendix.

Lymph capillaries entwine with blood capillaries, absorbing intercellular fluid, called lymph, that leaks from blood capillaries. The fluid is then moved into larger lymph vessels and is filtered through densely packed areas called lymph nodes. Eventually lymph is put back into the blood. The lymphatic system plays a critical role in the immune system by producing and circulating white blood cells. White blood cells are stored in lymph nodes and can attack pathogens. Your lymph nodes swell and become sore when you are sick because of the large number of white blood cells your body is producing. The tonsils, located in the back of your mouth, filter and destroy bacteria. The thymus produces hormones that play a role in white blood cell maturation. The spleen removes worn-out red blood cells, platelets, bacteria, and other particles from the blood. The spleen also stores some of the components of red blood cells, such as iron. Finally, the lymphatic system returns fluid to the circulatory system helping keep the cells moist.

X. Endocrine System



The endocrine system secretes chemicals called hormones. Hormones control body process that take place over longer periods of time such as growth. This system includes the thyroid, the pituitary, and the adrenal glands.

The endocrine system controls the body by the means of chemical messengers called hormones. Hormones are typically produced in one part of the body and control activities in another part of the body, including growth, development, metabolism, behavior, and reproduction.

- The hypothalamus makes hormones such as ADH (anti-diuretic hormone) that increases water uptake by the kidneys, and oxytocin which stimulates uterine contractions during labor, and controls the pituitary gland which secretes hormones to other endocrine glands.
- The pineal gland secretes melatonin, which controls the response to daylight and seasonal changes.
- The parathyroid gland regulates blood calcium levels and the thyroid gland secretes thyroxine which speeds up metabolism and helps manage growth and development.
- The thymus secretes thymosin which stimulates the development of T cells.
- The pancreas has patches of tissue called the Islets of Langerhans, which have cells that make the hormones insulin and glucagon. Insulin keeps blood sugar levels from rising too high and glucagon stimulates the release of glycogen from the liver to help keep blood sugar levels from falling too low.
- The adrenal glands make epinephrine and norepinephrine, two hormones which cause the "fight or flight" response. They also secrete aldosterone, which affects the body's osmotic balance, and cortisol, which promotes glucose synthesis.
- Ovaries produce estrogen and progesterone that help maintain the female reproductive system.
- Testes make testosterone that helps maintain the male reproductive system.

People take steroids to "boost" their development by abusing drugs affect their endocrine system. Anabolic steroids stimulate growth of muscles and increase strength and performance. But they eventually cause liver and heart disease. In males testes shrink and female sex characteristics develop. Females stop menstruating and develop male sex characteristics. All of this can lead to an early death.

XI. Reproductive System

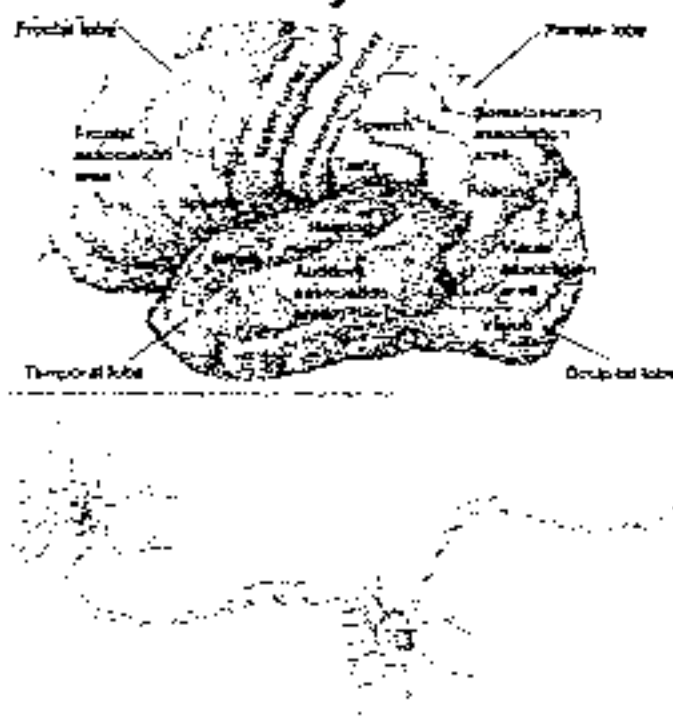


The reproductive system enables the body to produce offspring. This system includes some endocrine glands as well as the reproductive organs.

Male reproductive organs include the testes which produce sperm and the hormone testosterone. The testes are inside a protective sac called the scrotum. They are located outside the body to keep the sperm slightly cooler than body temperature. Matured sperm are stored in the epididymis. They travel through the vas deferens to the urethra in the penis. Semen consists of sperm cells, fluids made by the seminal vesicles and the prostate gland, and fructose as an energy source for the rapidly moving sperm cells.

Female reproductive organs include the ovary that releases eggs and produces the hormones estrogen and progesterone. The egg will travel from the ovaries through the fallopian tube, where the egg is fertilized by the sperm, and then to the uterus, where the fetus will develop. The cervix, a muscle located at the base of the uterus, connects the uterus to the vagina.

XII. Nervous System



The nervous system detects changes in the environment and signals rapid responses. It is also responsible for higher order functions such as memory and emotions. It includes the brain, the spinal cord, and the nerves that transmit the information throughout the body.

The nervous system is divided into two main parts.

- The central nervous system (CNS) is the body's main control center and consists of the brain and the spinal cord. This part processes information and sends instructions to other parts of the body.
- The peripheral nervous system (PNS) is a network of nerves that extend throughout the body. It gathers information from the environment and delivers it to the CNS and it sends messages from the CNS back out to the body.

The nervous system consists of two types of cells, neurons that carry nerve impulses, and glial cells that protect, support and assist the neurons.

The nervous system performs four functions that enable an animal to respond quickly. First, it uses sensors to gather information from inside and outside the body. Then, the PNS transmits the information over a network of specialized nerve cells to processing areas such as the brain in the CNS. Next, the information is processed into possible responses. Finally, information to direct responses is sent back through the network of nerve cells of the PNS to the appropriate part of the animal to affect the response.